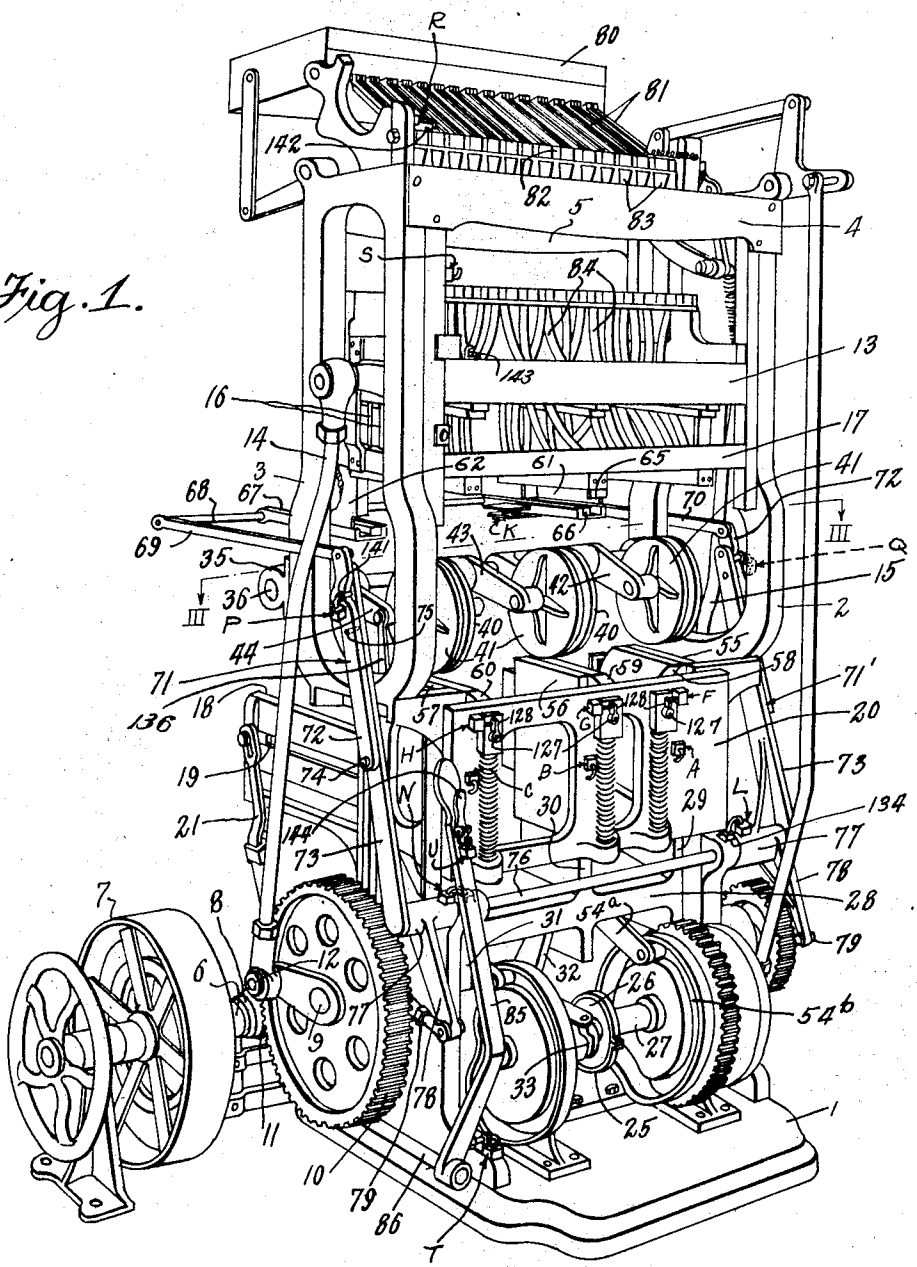
April 5, 1938. J. B. TATE 2,113,360

SAFETY SYSTEM FOR BOX MAKING MACHINES

Filed Oct. 25, 1935 5 Sheets-Sheet 1

Fig. 1.



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SAFETY SYSTEM FOR BOX MAKING MACHINES

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Fig. 2.

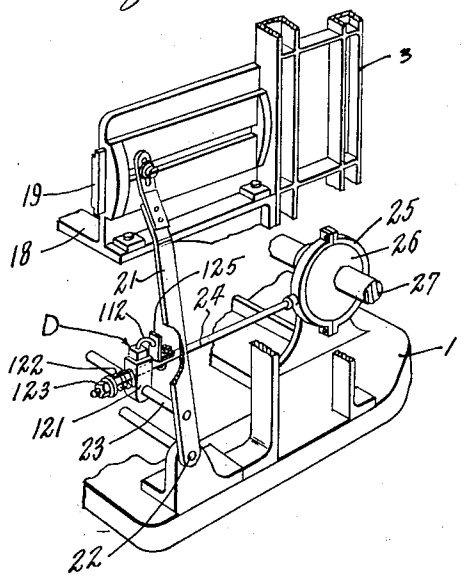


Fig. 4.

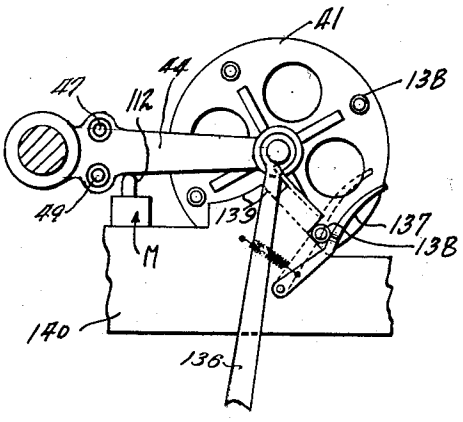
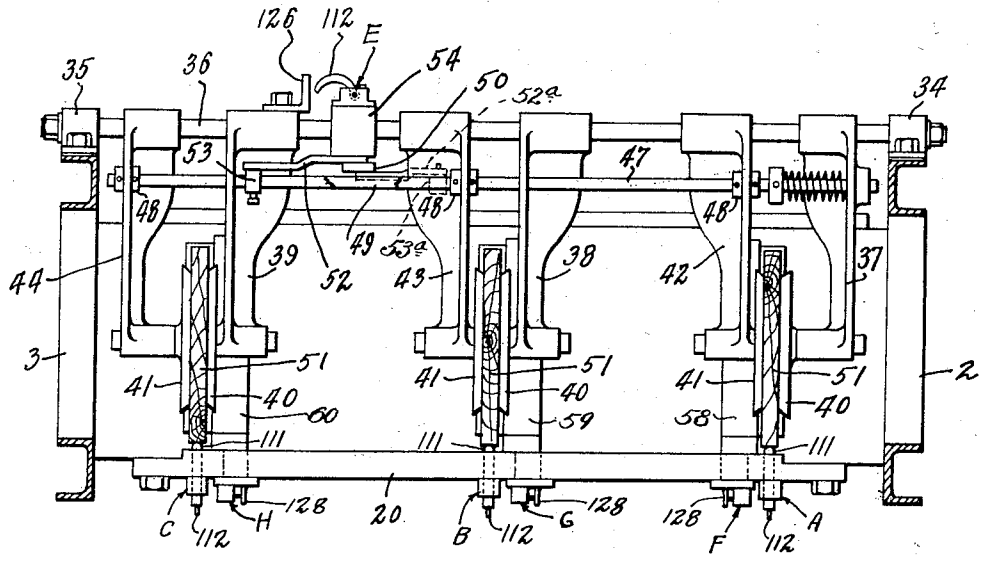


Fig. 3.



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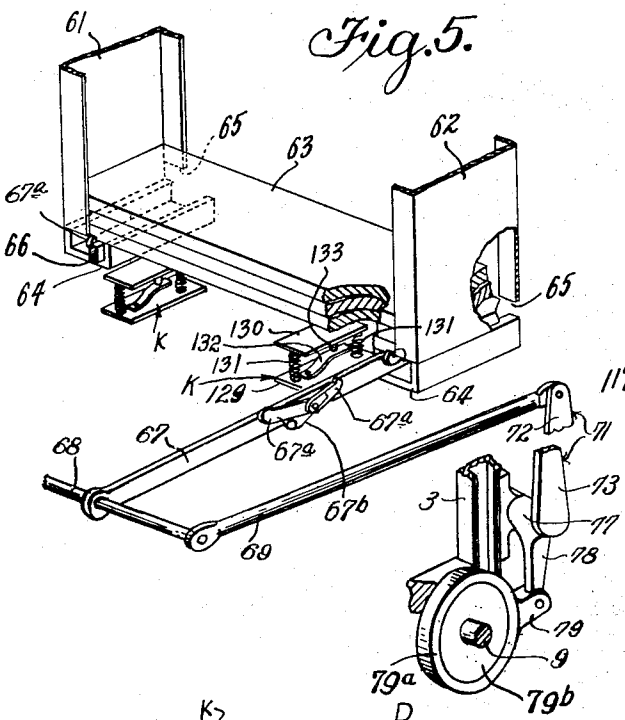
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SAFETY SYSTEM FOR BOX MAKING MACHINES

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Fig. 5.



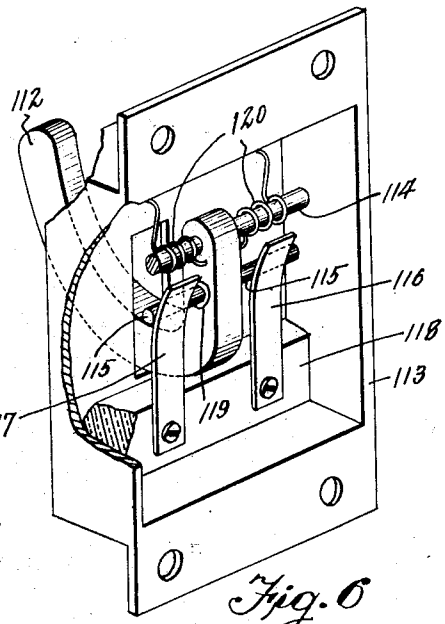


Fig. 6

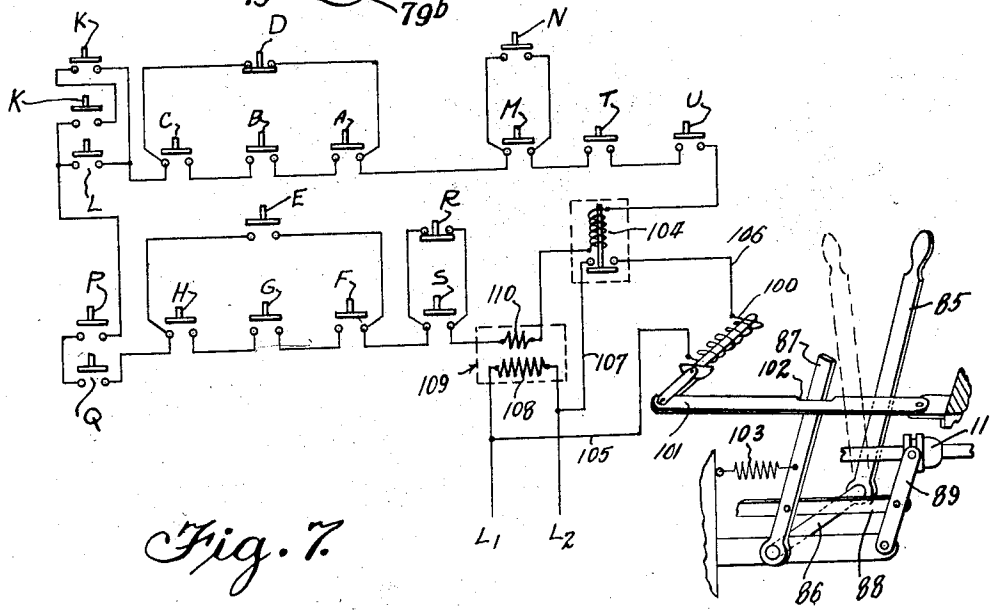


Fig. 7.

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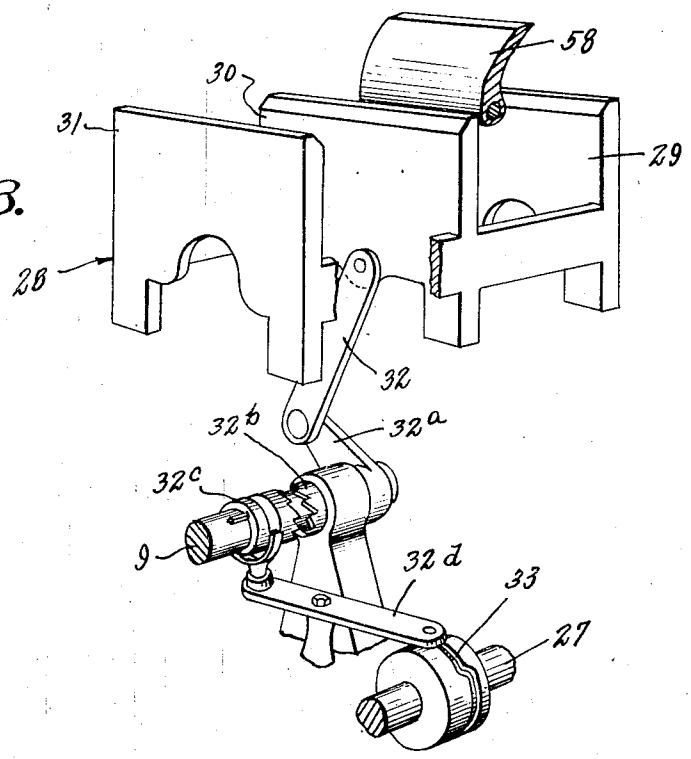
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SAFETY SYSTEM FOR BOX MAKING MACHINES

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Fig. 8.



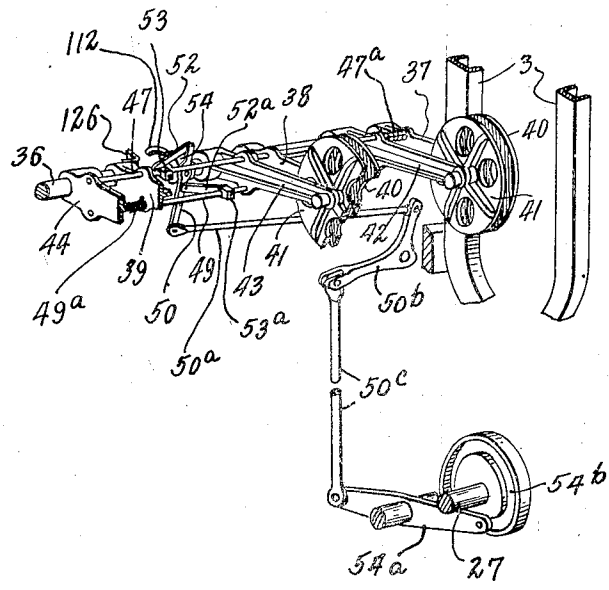


Fig. 9.

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SAFETY SYSTEM FOR BOX MAKING MACHINES

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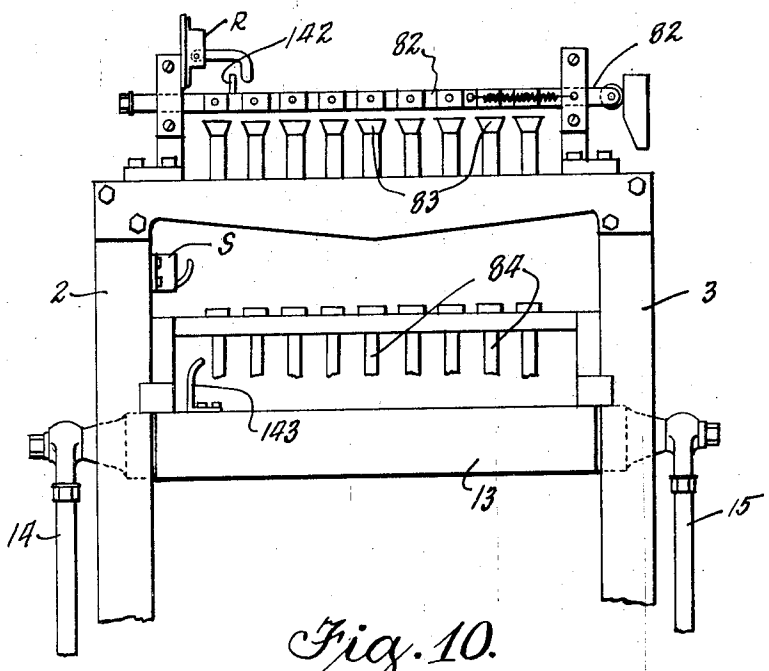


Fig. 10.

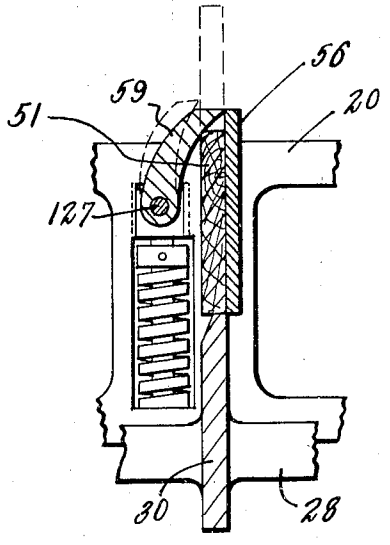


Fig. 11.

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Patented Apr. 5, 1938 2,113,360

UNITED STATES PATENT OFFICE

2,113,360

SAFETY SYSTEM FOR BOX MAKING MACHINES

John B. Tate, Riverside, Calif., assignor, by mesne assignments, to Food Machinery Corporation, a corporation of Delaware

Application October 25, 1935, Serial No. 46,685

16 Claims. (Cl. 1—14)

My invention relates to box making machines of the character employed in the manufacture of boxes or crates for the packaging of fruits and vegetables, and similar articles, and has particular reference to a safety system which may be provided upon such machines to stop the machine in the event any operation performed by the machine is interrupted or prevented from its successful performance to thereby prevent the machine from breaking boards or parts of the machine. In the box making industry, particularly that of making boxes for fruits, vegetables and similar articles, it is the common practice to employ an automatic machine which will feed end boards, side boards and bottom boards automatically into a nailing machine so arranged as to engage and hold the end boards in proper position relative to side boards and bottom boards during the nailing operations necessary to secure the side boards and end boards to the box ends, such machine having been developed sufficiently as to be substantially automatic in its operation from the time at which the boards start to feed into the nailing position into the machine and the time at which the finished box is ejected from the machine.

Typical examples of machines of this character are illustrated and described in United States Letters Patents No. 980,431, granted to George D. Parker on January 3, 1911; and No. 928,439, granted to George D. Parker on January 24, 1911, in which a machine for manufacturing boxes for the shipment of citrus fruits, such as oranges, lemons and grapefruit is described and shown, these machines being substantially automatic in operation and including the successive operations of drawing a plurality of box ends and partitions from a stack or supply into position in three spaced clamps which hold these ends and partitions in vertical position, thence side boards are fed into place immediately above the ends and partitions and are nailed thereto by nailing mechanism which reciprocates in a vertical direction. Then the clamping mechanism is rotated to turn the ends and partitions through an angle of 90°, during which time the bottom boards are fed into position above the ends and partitions and are then nailed thereto, the clamps being rotated through another angle of 90°, and the side boards fed into position and nailed to the opposite side of the ends and partitions, forming a completed box which is then ejected from the machine.

In the operations of such machines as are described in the above mentioned patents, it is necessary that an operator be constantly supervising the machine to insure that the box parts are properly fed into the machine, and to insure that the various operations take place only after the box parts are in the positions required. It frequently occurs that due to inaccuracies in the boards employed in the manufacture of the box, such as warping, cracking, or other defects in the boards, they do not feed into proper position by the automatic feeding mechanism of the machine and thus when the nailing mechanism operates the boards are either not properly secured together or the boards are injured or crushed by the nailing mechanism or by subsequent operations of the board feeding device.

It is an object of my invention to provide a safety system upon a machine of the character described in the above mentioned patents, which will automatically stop the machine at any point in its cycle of operations at which either the boards do not feed into the machine in proper position or if for any reason it is impossible to complete the nailing operations necessary to properly nail the box parts together.

Another object of the invention is to provide a safety system on the board feeding mechanism which will automatically stop the further operations of the machine in the event that one or more of the boards fails to move into its proper nailing position.

Another object of the invention is to provide a safety system for machines of the character set forth, in which the machine will be automatically stopped in the event any part of the machine fails to perform its functions.

A further object of the invention is to provide a safety system for machines of the character set forth in which the machine will be automatically stopped whenever any part of the box is endangered by the machine.

Other objects and advantages will be apparent from a description of the following specifications, read in connection with the accompanying drawings, wherein

Figure 1 is a perspective view of a box making machine similar to that illustrated in the Parker Patents 980,431 and 982,439, referred to above, and illustrating the manner in which my safety system may be applied to such feeding mechanism;

Fig. 2 is a detail view of a portion of the box end or partition feeding mechanism, illustrating the application of my safety system to such feeding mechanism;

Fig. 3 is a sectional view, taken along the plane indicated by the line III—III on Fig. 1, illustrating in detail the box end and partition clamping mechanism and the manner in which my safety devices may be applied thereto and to the box end and partition feeding mechanisms;

Fig. 4 is an end view of the box end and partition clamping mechanism, illustrating the position and operation of a portion of my safety system actuated when the clamping devices are to be rotated;

Fig. 5 is a detail perspective view of the side and

bottom board or slat supply holder illustrating the portion of my safety system employed to stop the machine if the side and bottom boards fail to feed properly therethrough;

Fig. 6 is a detail view of a switch which may be employed in the practice of my invention;

Fig. 7 is a diagrammatic view illustrating the wiring and switches employed in the practice of my invention;

Fig. 8 is a detail perspective view of the end and partition board elevating mechanism employed in such box making machine and illustrates the operation thereof;

Fig. 9 is a perspective view of the end and partition board clamping mechanism and illustrating the manner in which the clamping operation takes place;

Fig. 10 is a detail elevational view of the nail pick and feeding mechanism of such box making machine and illustrating the application of my safety system thereto; and

Fig. 11 is a detail sectional view of one of the end and partition board anvils illustrating the manner in which such anvil is constructed and moves.

I have illustrated my safety system as applied to a Parker box making machine, the construction and operation of which is fully described in the Parker patents hereinbefore referred to, such machines including, in brief, a suitable base 1 from which rises a pair of side frames 2 and 3 connected together near their upper ends by means of cross members 4 and 5. A power shaft 6 is journaled in the side frames 2 and 3, near the rear thereof, which shaft is adapted to be rotated by the application of any suitable rotary power thereto, illustrated herein as being applied by means of a pulley 7 which may be coupled by means of a belt to any motor or other prime mover. The power supplied to the pulley 7 may be transmitted to the shaft 6 by means of a cone clutch 8 which when engaged will cause the shaft 6 to be rotated.

A nail driving shaft 9 is also journaled in the side frames 2 and 3, and bears upon one of its ends a gear 10 meshed with a pinion 11 on the shaft 6, the gear 10 being provided with a crank pin 12 while a similar crank pin (not shown) is secured to the end of the shaft 9 at the opposite side of the machine. The upper portions of the side frames 2 and 3 constitute guides in which a nail driving head 13 is mounted for vertical reciprocation, the head 13 being connected to the crank pins 12 on opposite sides of the machine by means of connecting rods 14 and 15 so that upon one rotation of the shaft 9 the nailing head 13 will be moved downwardly from an elevated position, to a nail driving position and back to the elevated position. The nail driving head 13 carries a plurality of nail driving punches 16 operating through suitable nail chucks (not shown) carried by a chuck head 17 suspended from the nail driving head 13 so that when the nail driving head 13 is moved downwardly the chucks will be moved down until the chucks contact the boards, following which the nail driving head will continue downwardly to drive the nail punches through the nail chucks to press the nails into the boards to secure the boards together.

At the rear of the machine a plurality of hoppers 18 are provided for the reception of the relatively thick boards which are employed to form the ends and partitions of the boxes, there being ordinarily three of such hoppers provided, in each of which may be stacked a plurality of the end and partition boards and from which such boards may be fed by means of the box end feeding mechanism illustrated herein in Fig. 2 as including a horizontally mounted slide 19 provided with suitable board engaging or gripping mechanism (not shown) so that as the slide 19 is moved forwardly of the machine it will drag one of the end boards forwardly of the machine until the front edge of the board abuts a front plate 20 (Figs. 1 and 3) on the front of the machine.

It will be understood that there are three of the end board feeding slides 19, one for each end board for the box, and one for the partition of the box. The end board feeding slides 19 are arranged to be reciprocated from their rearmost position to their forwardmost position by means of a plurality of levers 21, one for each of the slides 19, said levers 21 being pivoted upon a shaft 22. The levers 21 are interconnected by a secondary shaft 23 spaced a considerable distance above the pivot shaft 22. Connected to the secondary shaft 23 is a connecting rod 24 which extends forwardly of the machine and terminates in an eccentric strap 25 surrounding an eccentric 26 mounted upon a jack shaft 27 so that when the jack shaft 27 is rotated through one complete revolution all of the slides 19 will be moved from their rearmost position to their forwardmost position and return, thus causing the two end boards and the one partition board to be moved forwardly of the machine into abutting relation with the front plate 20.

The machine is provided with an elevator 28 (Figs. 1, 8, and 11) which consists of a frame having a plurality of upstanding members 29, 30, and 31, the upper edges of which constitute guides along which the lower edges of the end and partition boards may slide as they are drawn forwardly by the feeding slides 19. The elevator 28 is arranged to be positioned normally in its lowermost position, as illustrated in Figs. 1 and 11, with the upper edges of the members 29, 30, 31 aligned with the lower edges of the boards as they are fed by the feeding mechanism 19. As is illustrated in the Parker Patent No. 982,439, hereinbefore referred to, the elevator 28 is adapted to be raised upwardly during certain portions of the cycle of operations of the machine to elevate the two end boards and the partition boards upwardly into nailing position. This operation is illustrated as being accomplished by connecting the elevator 28, through the agency of a link 32, to a crank 32*a* carried by a sleeve 32*b* rotatably mounted upon the main drive shaft 9. A clutch 32*c* splined to the shaft 9 is adapted to be thrown into clutching relation with the sleeve 32*b* by means of a clutch operating lever 32*d* actuated by a cam 33 mounted upon the jack-shaft 27. Thus during that portion of the cycle of operations of the box making machine at which a fresh supply of end and partition boards are to be moved into nailing position ready for the manufacture of the next box, the cam 33 will operate to throw the clutch 32*c*—32*b* into action, thus causing the next rotation of the drive shaft 9 to swing the crank 32*a* and raising the elevator 28. When the elevator has moved to its uppermost position, the cam 32 will have arrived at such position as will allow the lever 32*d* to move back to its normal position disengaging the clutch and allowing the elevator 28 to descend by gravity. All of this mechanism is illustrated particularly in Fig. 8 and is clearly illustrated and described in the beforementioned Parker patent,

further detailed description being deemed unnecessary herein.

Referring again to the parts described above, including the bar or slide 19, and the mechanism associated therewith, shown in Fig. 2, and the elevator and guides shown in Fig. 8 and numbered 28, 29, 30, and 31, it will be seen that a box part is given an initial feeding movement by the slides 19, and a secondary or final feeding movement by the elevator guides 29, 30, and 31 which operate to elevate the heads or box parts into nailing position.

Mounted upon the frame members 2 and 3 are a pair of bearing members 34 and 35, in which is journaled a cross shaft 36 upon which is slidably mounted a plurality of forwardly extending arms 37, 38, and 39, the outer ends of each of which have rotatably secured thereto a disc 40 forming one element of a box end clamp, the other element of which is formed by a complementary disc 41 rotatably mounted in the outer ends of each of the forwardly extending arms 42, 43, and 44 which are likewise slidably mounted upon the cross shaft 36.

The arms 42, 43, and 44 are coupled together by means of a rod 47, the arms being spaced along the rod by means of collars 48. The arms 37, 38, and 39 are similarly coupled together by means of a rod 49 (see Figs. 3 and 9). The arms 37, 38, and 39 supporting each of the discs 40, are normally urged away from the arms 42, 43, and 44 supporting the complementary discs 41 to normally separate the complementary discs 40, 41, a distance greater than the thickness of one of the end boards, by means of springs 47a—49a mounted upon the rods 47, 49 respectively. By this arrangement the complementary discs 40, 41 are normally spaced a sufficient distance apart to readily receive the end boards and partition boards between the discs as these boards are moved upwardly by the elevator 28. The arms 37, 38, and 39 are respectively adapted to move toward the arms 42, 43, 44 to bring the complementary discs 40, 41 into clamping relation upon the end and partition boards. This may be accomplished by means of a lever 50 pivoted upon the shaft 36, one end of the lever 50 being connected by a link 52 to a clamp 53 secured to the rod 47. A similar link 52a connects the lever 50 with a clamp 53a secured to the rod 49 so that a partial rotary movement of the lever 50 will urge the rod 47 in one direction and the rod 49 in the opposite direction to move the arms 37, 38, 39 toward the arms 42, 43, and 44. The lever 50 may be given a partial rotation at predetermined timed relation to the operation of other parts of the machine to cause the clamping action to take place immediately after the elevator 28 has elevated the end boards into position between the discs 40, 41, such mechanism being illustrated as including a link 50a connected to a bell-crank 50b which is in turn connected by means of a link 50c to a lever 54a actuated by a cam 54b on the jack-shaft 27.

Secured rigidly between the end frames 2 and 3 are three vertically extending guide plates 55, 56 and 57 which act as guides for one side of the end and partition boards as they are elevated by the upward movement of the elevator 28. The discs 40—41 are mounted immediately above the guide plates 55, 56 and 57, respectively, so that when these discs are moved to their expanded position the boards so elevated will readily pass between the associated discs. However, when the boards have been elevated to their uppermost positions and the clamping action of the discs 40—41 has taken place, the lower edges of the boards so clamped should rest upon nailing anvils 58, 59, and 60 upon which they will bear to resist the downward forces exerted by the nailing mechanism 13—16—17 as the nailing operations take place.

As is described in the Parker Patents 980,431 and 982,439 and illustrated in Figs. 1 and 11 herein the anvils 58—59—60 are pivoted so that they will yield out of the way of upwardly rising boards carried by the elevator 28, but when the boards have been moved upwardly to the position clearing the tops of the anvils 58—59—60 the anvils will swing back into position immediately below these boards, where they will remain until the next set of end and partition boards are moved upwardly into the clamping discs 40—41. The construction and operation of one of these nailing anvils 59 are illustrated in detail in Fig. 11.

Also the box making machine is equipped with a hopper or reservoir for receiving a plurality of slats employed to form the side boards and the bottom boards of the boxes made by the machine, this hopper being formed of a pair of end members 61 and 62 located at the rear of the upper portion of the machine, more clearly illustrated in Fig. 5 as comprising a pair of channel members in which a stack of end and side boards or slats 63 may be received. The lower ends of the end members 61, 62 extend inwardly, as indicated at 64, to form a rest upon which the outer ends of the boards or slats may lie. Immediately above the inwardly extending ends 64 the front web of the channels of which members 61—62 are formed is cut away to form a slot 65 through which the ends of the boards 63 may be moved horizontally by a slat feeding mechanism illustrated in complete detail in the Parker patents hereinbefore referred to, and the details of which need not be repeated here except to note that each of the bars 66, 67 carries a pair of sets of slat-engaging fingers 67a (only the foremost of which is shown in Fig. 5), the fingers of each set of which are urged into slat-engaging position by springs 67b, so that upon one forward movement of the feeding bars 66, 67 the fingers 67a will engage the lowermost board 63 and press it out through the slot 65 and then will engage the next lowermost board 63 and move it out through the slot 65, holding the two boards so fed in proper spaced relation until these boards have been moved out directly over the end boards which are now held clamped between the discs 40, 41. The feed bars 66, 67 may now be retracted to their rearmost position, as shown in Fig. 5, ready to select the next two slats or side boards upon the next forward movement of the bars 66, 67. The bars 66—67 are coupled to a cross rod 68, the outer ends of which are connected by means of links 69—70 to a pair of arms 71—71' at opposite sides of the machine. Each of the arms 71—71' is formed of two parts, an upper lever 72 and a lower lever 73 pivoted together at 74 and connected together by means of a small pin 75 (Fig. 1) extending through both levers 72—73. Thus, if for any reason one of the slats should become jammed in the machine and refuse to feed forward properly the pin 75 will be sheared off allowing the lever 73 to move without occasioning movement of the lever 72.

The lower end of the lever 73 is journaled upon a cross shaft 76 as by means of a hub 77

from which extends an arm 78 connected by means of a link 79 to an eccentric strap 79a (see Fig. 5), on an eccentric 79b mounted upon the shaft 9 which operates the nail driving head 13 so that upon each rotation of the shaft 9 to cause one nailing operation, the arms 71—71' will be moved forwardly and then rearwardly to feed the slats or side boards or bottom boards into place above the end and partition boards held by the clamping discs 40—41.

In order to feed nails into the nail chucks carried by the chuck carrier 17 in proper timed relation with the reciprocating motion of the nailing head 13, a nail pan 80 (see Figs. 1 and 10) is mounted at the upper end of the machine, from which nails are passed downwardly through nail slides 81 to a pick-bar 82 of the type generally employed upon nailing machines and arranged to reciprocate horizontally crosswise of the machine upon each lifting and lowering movement of the nailing head 13 to pick off a sufficient number of nails which are dropped through funnels 83 and into nailing tubes 84 from which they pass down through the chucks of the machine.

The preferred mode of operation of the machine is to permit the pulley 7 to continuously rotate and to control the operation of the machine by means of a hand lever 85 rigidly secured upon a shaft 86 which extends rearwardly of the machine and has an upstanding lever 87 connected thereto. The lever 87 is coupled by means of a link 88 to a lever 89 which engages the cone clutch 11 to move the same into and out of engagement as the lever 85 is moved from one of its positions to another. Thus whenever it is desired to cause the machine to manufacture boxes the hand lever 85 is moved to the left, as viewed in Fig. 1, to engage the clutch, thereby transmitting power continuously to the shaft 9 for operating the nail driving mechanism, the slat feeding mechanism, and for turning the discs 40—41 through their operations.

The jack shaft 27 is coupled to the shaft 9 by means of suitable reduction gearing which causes the shaft 27 to operate at one-third of the speed of the shaft 9, whereby the feeding mechanism 19—20—21 for feeding the ends and partitions into place and for operating the elevator 28 and for controlling the clamping action of the discs 40—41 will be operated only once for each three nailing operations,—namely after the side boards have been nailed to one side, the bottom boards have been nailed to another side, and the second set of side boards have been nailed to the third side of the box.

With the described operation of the box making machine, it will be apparent that in the event any of the feeding mechanism for feeding the box parts into position in the machine should become disarranged, jammed or otherwise disabled, the continuous operation of the machine will either cause breakage of the machine or breakage of the box parts, and I have devised a simple mechanism for preventing such injury to the machine or boxes by providing stopping devices so co-ordinated with the various operations of the machine as to stop the machine whenever any dangerous situation occurs.

By referring particularly to Figs. 1 and 3, it will be observed that at various positions on the machine I have provided an electrical switch so interconnected as to control a solenoid 100 (see Fig. 7) located on any suitable portion of the machine and arranged to operate a lever 101 to cause the same to bear against the clutch operating lever.

In the form illustrated herein, the lever 101 is formed with a notch 102 which engages the upper portion of the lever 87 when hand lever 85 is in the full line position, as shown in Fig. 7, at which position the clutch 11 is engaged. The lever 87 is provided with a spring 103 which normally urges this lever to the left, as viewed in Fig. 7, to cause the clutch 11 to become disengaged so that whenever the solenoid 100 is deenergized the spring 103 will move the lever 87 and the hand lever 85 to their inoperative positions, disengaging the clutch 11 and causing the machine to be stopped.

By referring particularly to Fig. 7, it will be observed that the solenoid 100 is supplied with electric current from a suitable source of electric supply, indicated by the line conductors line L—1 and line L—2, controlled by a relay 104, the circuit for the solenoid 100 extending from line L—1 through conductor 105, the coil of solenoid 100, conductor 106, the contacts *a* of relay 104, and conductor 107 to line conductor L—2. A primary winding 108 of a transformer 109 may be connected to the line conductors L—1 and L—2, the secondary winding 110 of which may be employed as a low voltage supply for the controlling relay 104 through the operation of the various control switches, thereby avoiding the employing of high voltage electric wiring throughout the machine parts.

A more ready understanding of the control devices and the operations thereof may be had with reference to a complete description of the operations of the machine for the manufacture of a single box.

With the machine parts in the position illustrated in Fig. 1, the machine is ready to start the manufacture of a single box. To do so the operator grasps the hand lever 85 and moves the same to the left, as viewed in this figure, to engage the clutch 11, starting the rotation of the shaft 9 and the stub shaft 27. The rotation of the jack shaft 27 will, by reason of the eccentric 20, draw the three end and partition feeding slides 19 forwardly of the machine to draw the two ends and the partition of a citrus box forwardly above the top edges of the upstanding members 29—30—31 of the elevator 28. If these three boards move properly into position with their front edges abutting the front plate 20 of the machine, the further operations of the machine may properly take place. However, should one or more of these boards fail to feed into the machine, for instance should the feeding slides 19 fail to grip the parts properly, or if the boards are cracked or split or warped so that they fail to move to their forwardmost positions, the subsequent operation of the elevator 28 would cause their breakage, or would cause breakage of the machine, and I therefore provide three switches A, B, and C on the front plate 20.

By referring particularly to Fig. 3, it will be observed that there are a plurality of pins 111 extending slidably through the front plate 20, the outer ends of these pins 111 bearing upon the operating levers 112 on each of the switches A, B, and C, respectively, so that if the end boards and partition boards move to their fullest forward position the front edges of these boards will engage and press the pins 111 outwardly, thereby moving the switch levers to their outermost or switch operating position.

In Fig. 6, I have illustrated a typical switch

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which may be employed as the switches A, B, and C, this switch including a suitable shell or housing 113 through which extends a shaft 114 upon which is rotatably mounted the switch operating lever 112, the switch lever 112 having a contact pin 115 extending therethrough in position to be brought into bridging engagement between a pair of electric contacts 116—117. The contacts 116—117 may be suitably mounted in the housing 113 upon a block of insulating material 118, the pin 115 preferably extending through an insulating bushing 119 in the switch operating lever 112 to prevent grounding of the electric circuits when the pin 115 is in contacting relation with the contacts 116—117. The switch illustrated in Fig. 6 is of the normally open type, that is, it is provided with a spring 120 which normally urges the switch lever 112 outwardly of the housing 113 to separate the pin 115 from the contacts 116—117.

It will therefore be observed that as each of the end and partition boards is moved into position against the front plate 20 it will engage its associated switch and move this switch to closed circuit position while when no boards are present in this position each of the switches A, B, and C will be in open circuit position.

If, however, one of the boards becomes jammed or fails to feed into proper abutting relation with the front plate 20, one or more of the switches A, B, and C will fail to close, thus preventing completion of the circuit for the relay 104, since these switches A, B, and C are in series circuit relation with the relay 104 as will be observed from an inspection of Fig. 7.

In order to prevent stopping of the machine prior to the feeding of the boards into abutting relation with the plate 20, and to prevent stoppage of the machine after the elevator 28 has been elevated out of its abutting relation with the plate 20, I provide a switch D in a circuit which bridges all three of the circuits A, B, and C to complete a shunt circuit around these switches until the boards have been moved into the desired position.

By referring particularly to Fig. 2, it will be observed that the rod 24, which draws the head and partition slides 19 forwardly, projects through a block 121 mounted upon the secondary shaft 23 and extends beyond the block 121, the engagement between the rod 24 and the block 121 being accomplished by a compression spring 122, abutting the rear surface of the block 121, and a suitable nut 123 so that as the rod 24 is pulled forwardly to feed the end and partition boards forwardly of the machine, the forces are exerted through the compression spring 122.

The switch D is mounted upon the block 121 with its operating lever 112 extending into abutting relation with an angle stop 125 mounted upon the rod 24 so that as long as the compression spring 122 is in its fully extended position the angle stop 125 will hold the switch lever 112 in such position as will cause it to bridge its contacts 116—117 (Fig. 6), while should the boards jam or otherwise fail to feed forwardly in the machine the forward pull on the rod 24 will cause the rod 24 to slide forwardly with reference to the block 121, separating the stop 125 from the switch lever 112 and permitting the switch D to open its contacts. Thus as the partition boards and end boards are moved forwardly of the machine the switches A, B, and C will be opened and in the event of a jamming of the boards, the switch D will be opened, thereby interrupting the circuit to the relay 104 and causing the machine to be stopped.

The normal adjustment of the spring 122 and the nut 123 is such that as the rod 24 is moved to its extreme forward position to cause the boards to abut the front plate 20 and spring 122 will be compressed slightly, separating the stop 125 from the switch lever 112, and opening the switch D. This will occur when any of the boards have been moved into abutting relation with the front plate 20 so that if all three of the boards have not moved into this position one or more of the switches A, B, and C will be opened at the time the switch D is opened and the machine will stop because one or more of the end and partition boards has failed to move into its proper position in the machine, thereby closing switches A and B and C. It is therefore apparent that the timing of the switches A, B, and C relative to D is such that during the normal functioning of the machine and the box head the switch D will always be closed when A, B, and C are open and A, B, and C will be closed when D is open.

The next operation of the machine is the elevation of the elevator 28 which causes all three of the boards, which have been moved into abutting relation with the front plate 20, to be elevated into the spaces between the now separated clamping discs 40—41. The upward movement of the elevator 28, in the operating cycle of the machine, is so timed that it will occur slightly after the boards have been moved into abutting relation with the front plate 20 and at a time when the rod 24 is on its backward movement to retract the feeding slides 19. This return movement of the rod 24 will result in reclosing the switch D. As the boards are further elevated they will clear the switches A, B, and C, allowing them to be opened. Ordinarily this would result in stopping the machine, but it is prevented due to the closed switch D which is shunted across the switches A, B, and C.

As the elevator 28 starts to rise and lift the end and partition boards upwardly toward the clamping discs 41, the clamping discs will be in their extended position ready to receive these boards. By referring particularly to Fig. 3, it will be observed that a switch E, corresponding in all respects to the switches A, B, C, and D previously described, is mounted upon the collar 54 which constitutes the pivot for the lever 50 employed to move the discs 40, 41 between their clamped and extended positions. This switch E is arranged in such manner that its operating lever 112 is adapted to be engaged by an angled stop member 126 secured upon and movable with the arm 39 so that whenever the discs 40, 41 are separated, ready to receive the upwardly moving boards from the elevator, the switch E will have its contacts closed, while, when the clamping discs 40, 41 are moved into clamping relation to clamp the boards therebetween, the switch E will be opened.

It will also be noted from an inspection of Figs. 1 and 11 that when the elevator 28 starts to rise and presses the end and partition boards 51 upwardly, the upper edges of these boards will engage the anvils 58, 59 and 60, and will cause these anvils to be moved out of alignment with the upwardly moving boards and will hold them out of such alignment until the elevator has completed its upward movement.

By referring particularly to Figs. 1, 3, 7, and 11 it will be observed that the anvils 58—59—60 are each mounted upon trunnions 127 so that as

these anvils are moved away by the upwardly moving end and partition boards, the trunnions 127 will be slightly rotated. I employ this slight rotation of the trunnions 127 for the purpose of operating a plurality of switches F, G and H mounted upon the front plate 20 of the machine, as by connecting a lever or crank 128 upon the trunnions 127 in position to engage the operating lever 112 of the switches. It will be observed that the rotation of the anvils 58, 59 and 60 will move the levers 128 away from the switch levers 112, allowing these switches to open their contacts during the upward movement of the elevator 28, while when the elevator arrives at its uppermost position and has delivered the boards between the clamping discs 40 and 41 the return movement of the elevator 28 will allow the anvils 58, 59, and 60 to swing under the lower edges of the boards back to their normal positions. At this time the levers 128 will engage and operate the switches F, G, and H to closed circuit position. The subsequent operation of the collar 54 to clamp the boards between the discs 40 and 41 will open switch E but this will occur only after the switches F, G, and H have been closed.

It will be observed that switch E is in shunt circuit relation to the three switches F, G, and H so that if for any reason the elevated boards do not move to their uppermost positions and the anvils do not move to proper nailing position below these boards, one or another of the switches F, G, and H will remain open. Thus when switch E has subsequently opened the circuit, relay 104 will be opened and cause the machine to stop. Failure of the boards to move into their elevated positions and failure of the anvils to move into their proper positions may be occasioned either by a broken board, boards which are not cut squarely, and other defects or inaccuracies in the boards. As was described with reference to the switch D on the horizontal feed mechanism for the end and partition boards, the switch E acts as a circuit-maintaining device during the operation of a portion of the machine so that if the operation of that portion of the machine is successfully performed that closes circuits controlled as a result of the successful performance of that operation, the subsequent opening of the switches D and E will not open the circuit and stop the machine. In other words, the switches D and E are actuated by parts of the machine which must coordinate with other parts of the machine to perform the successful sequential functions of the machine and failure of any of these parts to successfully perform its function will result in opening the circuit for the relay 104.

With the boards in their clamped relation between the discs 40—41, the slats forming one side of the box may now be fed into position above the end and partition boards, the gearing of the machine being so coordinated that this forward feeding of the slats occurs immediately after the end and partition boards have been placed in clamped relation in the clamping discs 40—41. At this time the shaft 9 will have rotated to such position as will swing the arms 70 and 71 forwardly, moving the slat feed slides 66 and 67 forwardly to engage two of the slats in the hopper formed by the channels 61 and 62 and to move them into proper relation above the end and partition boards, as is fully described in the Parker patents hereinbefore referred to.

It frequently occurs that either due to a warping or breaking of the slats one of the slats fails to move properly as, for example, the fingers on bar 66 may properly engage one end of the slat while the fingers on bar 67 fails to engage the opposite end of the slat. By referring particularly to Figs. 1, 5, and 7, it will be observed that one or more switches K is secured in any suitable manner to the lower ends 64 of the channels 61 and 62 so that whenever boards or slats 63 are within the channels 61 and 62, the switches K will be held in circuit-closing relation.

By referring particularly to Fig. 5, it will be observed that the switches K are each constructed of a pair of plates 129 and 130 preferably formed of insulating material spaced apart by means of springs 131. The plate 129 bears a spring contact 132 disposed immediately below a complementary contact 133 and engaging the contact 133 whenever the plate 130 is held depressed by boards or slats 63 in the channels 61 and 62. As the bottom board or slat is fed forwardly of the machine out of the channels 61 and 62, the switch contacts 132—133 will be momentarily opened until the next uppermost board 63 falls downwardly in the channels 61—62 and depresses the plate 130. Thus if one end of the slat 63 moves outwardly without the other end of the slat also moving outwardly of the channels 61—62, the next uppermost board will be prevented from moving down to again depress the plate 130 and the switch K associated with that end of the board will be left in open circuit relation and the relay 104 will be open to stop the machine.

However, since it is not desired to stop the machine due to the momentary opening of switches K when the slats feed properly, I provide a switch L on some part of the machine which is actuated at the same time the slat feed bars 66 and 67 move forwardly, to close contacts shunting switches K, which contacts will reopen upon the completion of the cycle of operations of the bars 66 and 67 when they have been returned to their rearmost position. For convenience, I have illustrated the location of the switch L on the hub 77 of the arms 71—71' (preferably arm 71'), the lever 112 of this switch engaging a cam 134 on the bearings of the side frame 3 near which the hub rotates. It will therefore be observed that whenever the arms 71—71' move forwardly, the switch lever 112 of the switch L will move off of the cam 134 and this switch will close its contact, it being understood by those skilled in the art that the arrangement of the switch lever 112 and contacts 115, 116 and 117 on switch L is such that release of the lever 112 will close or bridge the contacts 116—117 instead of opening the circuit between these contacts, as has been the case with the switches previously described.

Therefore, if the slats 63 feed properly, switches K will reclose their contacts prior to the restoration of the arms 71—71' to their rearmost position and hence prior to the opening of the contacts of switch L and the machine will continue to run, while if for any reason the slats fail to feed properly, the reopening of switch L with the switches K maintained open due to some defect or dearrangement will cause the immediate stopping of the machine.

As hereinbefore explained, after the operation of nailing the first side boards or slats to the end and partition has occurred, the clamping discs 40—41 must be rotated through 90° ready to receive the bottom boards, and after the

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nailing of the bottom boards the discs must be again rotated through 90° ready for the reception of the side board for the opposite side of the box. It frequently occurs that due to some inaccuracy or failure in the operation of the machine, the discs do not rotate to a complete 90°, thereby permitting the end and partition boards to rest upon their anvils in some position other than flat upon the anvils, so that a subsequent nailing operation by the nailing head 13 would cause breakage of the box.

The machine may be readily stopped in the event of such inaccurate rotation of the discs 40—41 by providing a switch M (Fig. 4) to be held closed only when the discs and their supporting arms 37—38—39—42—43—44 are in their lowermost position. As was described in the Parker patents hereinbefore referred to, the rotation of the discs 40—41 requires that these discs and their supporting arms be slightly elevated prior to the turning movement of the discs which is occasioned by a lifting motion upon a rod 136 actuated by a suitable cam (not shown) on the shaft 9. The switch M may have its operating lever 112 disposed immediately below one of the arms 37—44 so that whenever the arm is raised, the switch lever is released and the contacts of switch M are opened. The turning operation of the discs 41 is accomplished by a hook-like pawl 137 engaging any one of a plurality of pins 138 extending outwardly from the discs 41, so that as the arms 37—44 are lifted, the pawl 137 will drag the disc 41 through an angle of slightly less than 90°, the return downward movement of the arm 44 positioning that pin 138 which has just been moved by the pawl 137 immediately above a cam surface 139 on an arm or cross bar 140 extending forwardly and rearwardly of the machine. Further descent of the arm 44 will cause the pin 138 to roll or ride down the cam surface 139 until the disc has been rotated through a complete 90° angle.

Since the switch M is opened upon the elevation of the arm 44, a secondary switch must be employed coordinating with the operation of this arm to prevent opening of the circuit to relay 104 until the arm has again been moved downwardly to its new position. This switch is illustrated as switch N. Since the forward movement of the arms 71—71' is timed in proper relation with the rotational movement of the discs 40—41, I employ the switch N on the hub 77 of the arm 71 corresponding in all respects to the switch L previously described which, as was described with reference to the switch L, will close its contacts when the arm 71 moves forwardly and will open its contacts when the arm 71 has returned to its rearmost position.

As was hereinbefore described, the slat feeding arms 71—71' are formed in two parts, an upper link 72 and a lower link 73 pivoted together at 74, the pin 75 extending through both of the links to make the entire assembly one rigid lever but which will permit the shearing of the pin in the event the box parts become jammed in the machine and refuse to feed rather than to cause breakage of the levers or the box end feeding mechanism.

However, should the pin 75 shear off the machine should be stopped, and for this purpose I have provided a pair of switches P and Q, the switch P being mounted upon the link 72 of the arm 71, while the switch Q is mounted upon the link 72 of the arm 71'. The switch P has its operating arm normally engaged with the head of a bolt 141 which extends into threaded engagement with the link 73 and normally nests in a notched portion of the link 72. The adjustment of the bolt 130 is such that when the links are in their assembled relationship, as shown in Fig. 1, the switch lever resting upon the head of the bolt will hold its contacts closed. Switch Q is arranged in the same manner upon the head of the bolt, similarly arranged upon the head of the arm 71' so that in the event either of the pins 75 should shear and the links 72 and 73 collapse, the bolt will be moved out of engagement with the operating arm of the switch P or Q as the case may be and will open the circuit to the relay 104, stopping the machine and preventing any damage.

Due to the fact that occasionally the nail picking and distributing mechanism fails to function, due to a defective nail or to some other cause, it is desirable to stop the machine unless the nail pick mechanism operates in its proper timed relation to the movement of the nail driving head 13. To insure stoppage of the machine in the event the nails do not feed properly, I provide a switch R near the top of the machine, (see Figs. 1 and 10) preferably securing the same to any suitable upstanding stationary portion of the machine in such manner that the operating lever of the switch extends over the movable pick bar 82. The pick bar 82 is provided with an upstanding lug 142 which normally is out of engagement with the operating arm of the switch R but when the pick bar is moved to select nails for the next nailing operation the lug 142 engages and moves the switch arm for the switch R to open circuit position. To prevent the machine from being stopped upon each operation of the pick bar, I provide a holding circuit shunting the switch R arranged to be closed only when the nail driving head 13 is in its uppermost position, and the machine is therefore at such point in its cycle of operations as to be ready to receive the nails. This switch is illustrated as switch S mounted upon one of the upright members of the frame of the machine and having its operating lever extending over a suitable lug 143 projecting from some portion of the nail driving head 13. The location of the switch S is such that only when the nail driving head is in its uppermost position, that is, ready to receive nails, the switch S will close and will remain closed during the operation of the pick bar to select the nails. Thus, even though the circuit is opened at the switch R by the nail picking operation, the circuit to the relay 104 is maintained during this operation through the agency of the switch S. If, however, the nail driving head 13 starts downwardly and the nail pick bar has not returned to its normal position, representing a condition under which the nails have been picked off and fed to the nailing apparatus, the relay 104 will be opened and the machine stopped before any failure of the box parts to be nailed together can occur.

I also prefer to provide a safety switch T to be actuated by the clutch operating lever 85. As will be understood by those skilled in the art from a review of the foregoing description, any failure of any portion of the machine to perform its proper function will result in opening the circuit to the relay 104 which will cause the solenoid 100 to release the lever 87 and permit the clutch operating handle to be swung to clutch-out position by means of the spring 103.

However, it may occur that the condition which causes the opening of the circuit for the

relay 104 is but momentary and may correct itself, permitting the circuit to be recompleted. The recompletion of the circuit will cause the solenoid 100 to be energized even though the clutch handle 85 has not again been operated into clutch-in position. To prevent the re-energization of the solenoid 100 under these conditions, the switch T is arranged with its switch operating arm to be engaged by the clutch handle 85 to close the contacts of this switch T only when the handle 85 has been moved to clutch-in position.

Also, it will be observed that the solenoid 100, being energized to normally press against the lever 87, would render it difficult for the operator of the machine to manually move the clutch handle 85 out of clutch-engaging position if he desired to manually stop the machine. I therefore provide a switch U on the handle 85 having its operating arm engaged by a finger-piece 144 which may readily be grasped by the operator as he grasps the handle 85. The arrangement of the switch U and the finger-piece 144 is such that when the operator grasps the finger-piece 144 it will move the switch U to open circuit position, thereby breaking the circuit to the relay 104 and de-energizing the solenoid in advance of the operator's actually moving the handle 85 to clutch-out position.

While in the form of the device illustrated and described herein the motor or prime mover for operating the box making machine is assumed to be continuously operating, and the starting and stopping of the machine is illustrated as being controlled by the clutch 11, it will be understood by those skilled in the art that a motor may be individually connected to the machine and arranged to be started and stopped by actuation of the relay 104 directly rather than to have this relay control a clutch. In other words, the relay 104 may be arranged in the motor circuit to start and stop the motor whenever it is desired to start or stop the operation of the machine.

It will be observed, therefore, that I have provided interrelated switch mechanism which will maintain supervision over all portions of the operation of the box making machine, and will automatically stop the machine in the event of the failure of any part of the machine to perform its function correctly, irrespective of the cause of failure.

While I have shown and described the preferred form of my invention, it is to be understood that I do not wish to be limited to any of the details of construction shown herein, except as defined in the appended claims.

I claim:

1. In a box making machine having means for mechanically feeding box parts into operative relation in said machine, power means for driving said machine, means including a normally closed electric circuit for stopping the supply of power from said power means to said machine in response to opening of said circuit, including a switch for opening said circuit upon failure of box parts to move toward proper position and also in response to completion of movement of box parts into proper position, and switch means operable to close a shunt circuit around said first-named switch in response to completion of movement of box parts into proper position.

2. In a box making machine including means for holding box ends in position to receive box sides, means for feeding box ends into said holding means, anvil means upon which said box ends rest while box sides are nailed thereto, power means for supplying power to said machine to feed box ends into place and to secure the sides thereto operably responsive to failure of said box ends to move into proper position in said holding means for stopping the supply of power to said machine, including switch means on each of said anvil means opened during the movement of box ends into place in said holding means and closed when said anvil means engage beneath said box ends.

3. In a box making machine including means for holding box ends in position to receive box sides, means for feeding box ends into said holding means, anvils upon which said box ends rest while box sides are nailed thereto, power means for supplying power to said machine to feed box ends into place and to secure the sides thereto operably responsive to failure of said box ends to move into proper position in said holding means for stopping the supply of power to said machine, including switch means on each of said anvils opened during the movement of box ends into place in said holding means and closed when said anvils engage beneath said box ends, and switch means actuated by movement of said holding means to a position to receive said box ends for completing a circuit around said anvil actuated switches to prevent stopping of the machine while said box ends are fed into the machine.

4. In a box making machine including means for holding box ends in position to have sides nailed thereto, means for rotating said holding means to present various edges of said box ends for the reception of box sides, power means for supplying power to said machine, and means operably responsive to failure of said box to rotate through 90° upon each operation of said machine for stopping the supply of power to said machine.

5. In a box making machine including means for holding box ends in position to have sides nailed thereto, means for rotating said holding means to present various edges of said box ends for the reception of box sides, power means for supplying power to said machine, means operably responsive to failure of said box to rotate through 90° upon each operation of said machine for stopping the supply of power to said machine, means for feeding box sides into position upon said box ends, and means actuated by movement of said side feeding mechanism for completing a shunt circuit around said first-named switch to prevent stopping of said machine during the turning movement of said end holding means.

6. In a box making machine having means for feeding box side parts into position in said machine from a stack of box side parts, power means for operating said machine to feed said box side parts from said stack, means for stopping the supply of power from said power means upon failure of said box side parts to feed from said stack including switch means actuated by failure of the bottom part in said stack to feed from said stack.

7. In a box making machine having means for feeding box side parts into position in said machine from a stack of box side parts, power means for operating said machine to feed said box side parts from said stack, means for stopping the supply of power from said power means upon failure of said box side parts to feed from said stack including a pair of switch means, one en-

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gaged by each end of the bottom one of said box parts in said stack, whereby failure of both ends of said box parts to feed evenly from said stack will open one or the other of said switches.

8. In a box making machine having means for feeding box side parts into position in said machine from the bottom of a stack of box side parts, power means for operating said machine to feed said box side parts from said stack, means for stopping the supply of power from said power means upon failure of said box side parts to feed from said stack including switch means moved into closed condition by the bottom part in said stack when the latter is in normal position, and switch means actuated by movement of said box part feeding means for shunting said first-named switch to prevent stopping of said machine during normal removal of each bottom part from said stack.

9. In a box making machine having means for supporting box ends in spaced relation to each other to receive side and bottom boards, means for feeding box ends into said supporting means including means for moving box end parts into position below said supporting means, means for alining said box end parts below said supporting means and means for elevating said box end parts into said supporting means, power means for supplying power to said machine to feed said box ends and to nail said box parts together, means for stopping the supplying of power to said machine including a plurality of switches, one for each of said box ends, associated with said end aligning means, and operable when box ends are in aligned position to continue the supply of power to said machine and operable by the absence of any box end from said aligned position for interrupting the supply of power to said machine, and means for disabling said switches during the normal movement of said box ends toward said aligned position.

10. In a machine for making boxes having means for nailing box parts together, nail feeding means for feeding nails to said nailing machine, and power means for supplying power to said machine and means operably responsive to failure of said nail feeding means to feed nails to said nailing mechanism for stopping the supply of power to said machine.

11. In a box making machine including means for feeding box parts into said machine, and means for nailing said box parts together to form a box, power means for supplying power to said machine, means for controlling said power means to apply power from said means to said machine and to stop the supply of power to said machine, means normally urging said control means to a position to stop the supply of power to said machine, electromagnetic holding means for holding said control means in said power applying position, and a circuit for said electromagnetic means including a plurality of switches actuated by the normal movement of said box parts feeding mechanism and said box nailing mechanism for maintaining said circuit completed and for interrupting said circuit upon failure of any of said box parts feeding and box nailing mechanisms for stopping the supply of power to said machine.

12. In a box making machine including means for feeding box parts into position in said machine and means for nailing said box parts together to form a box, power means for supplying power to said machine, clutch means for connecting and disconnecting said power means with said machine, handle means for actuating said clutch, means normally urging said handle means to clutch-out position, electromagnetic means for holding said handle in clutch engaged position, a circuit for said electromagnetic means including a plurality of switches actuated by movement of the box parts feeding means, the box nailing means of said machine for maintaining said circuit completed during the normal operation of said box parts feeding means and said nailing means, and for interrupting said circuit upon failure of any of said box parts feeding means and said nailing means to perform its normal functions.

13. In a box making machine having means for mechanically feeding box parts into operative relation in said machine, power means for driving said machine, electric circuit means for stopping the supply of power from said power means to said machine upon failure of said box parts feeding means to properly feed box parts to said machine, including a switch for opening said circuit, and means coupling said feeding means to said switch to open said switch upon the exertion of a predetermined resistance to the movement of box parts by said feeding means.

14. In a box making machine having means for mechanically feeding box parts into operative relation in said machine, power means for driving said machine, electric circuit means for stopping the supply of power from said power means to said machine, including a switch, means mounting said switch on said box parts feeding means for operation to open circuit position upon the exertion of a predetermined resistance to the movement of box parts by said feeding means, means for contacting and normally limiting movement of said box parts by said feeding means just prior to completion of movement of said feeding means, whereby said switch is opened, and means actuated by said movement-limiting means for maintaining supply of power to said machine in response to pressure exerted by said box parts against said limiting means.

15. In a box making machine having means for mechanically feeding box parts into operative relation in said machine, including means for engaging box parts, means for moving said box part-engaging means to feed the box parts toward nailing position in said machine, power means for driving said machine, means yieldably connecting said power means to the moving means of said feeding means adapted to yield upon the exertion of a predetermined resistance to the movement of said box parts by said feeding means, electric circuit means for stopping the supply of power from said power means to said machine including a switch, and means mounting said switch relative to said yielding means to move said switch to open circuit position upon the yielding of said yielding means.

16. In a box nailing machine, the combination of: means for transmitting an initial feeding movement to a box part to start the feeding of said part into proper relation for assembly with the box parts; means for stopping the operation of said machine; and means actuated by a jamming of a box part being acted on by said means first recited, to actuate said means last previously recited to stop said machine.

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