

March 25, 1958

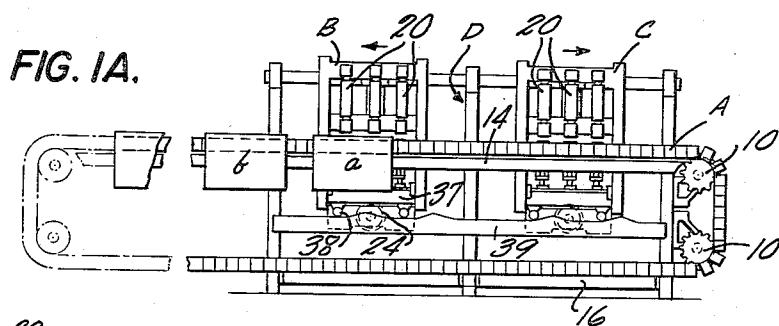
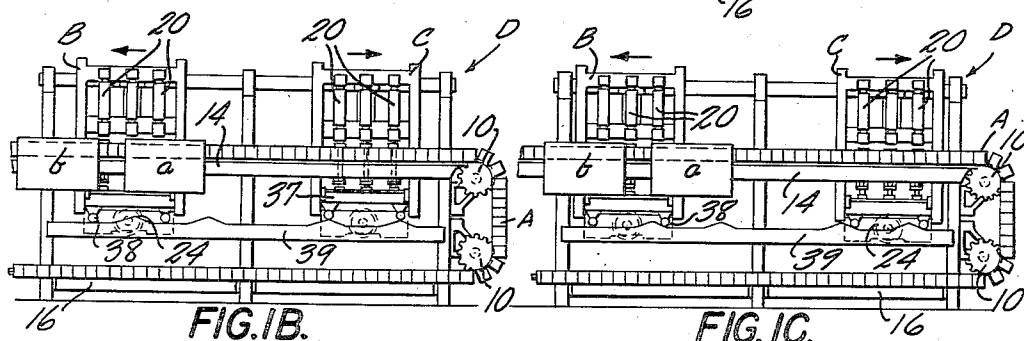
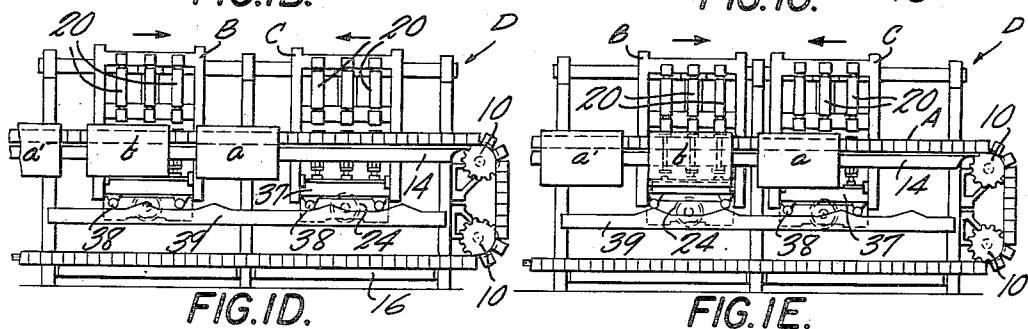
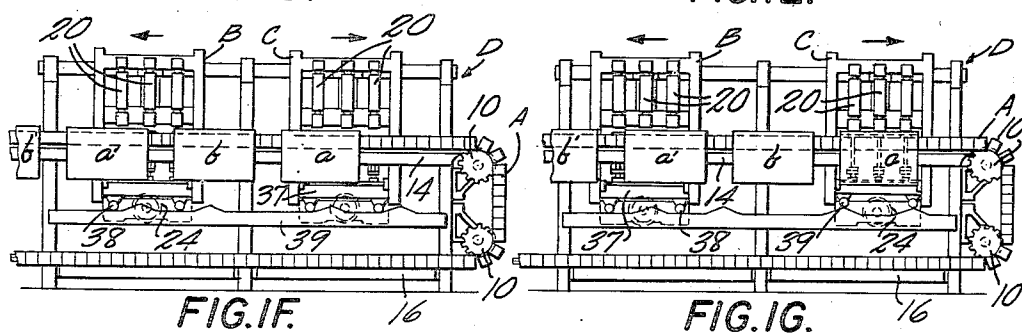
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2,827,632

SIGNATURE STITCHING MECHANISM

Filed Jan. 17, 1955

5 Sheets-Sheet 1



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SIGNATURE STITCHING MECHANISM

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5 Sheets-Sheet 2

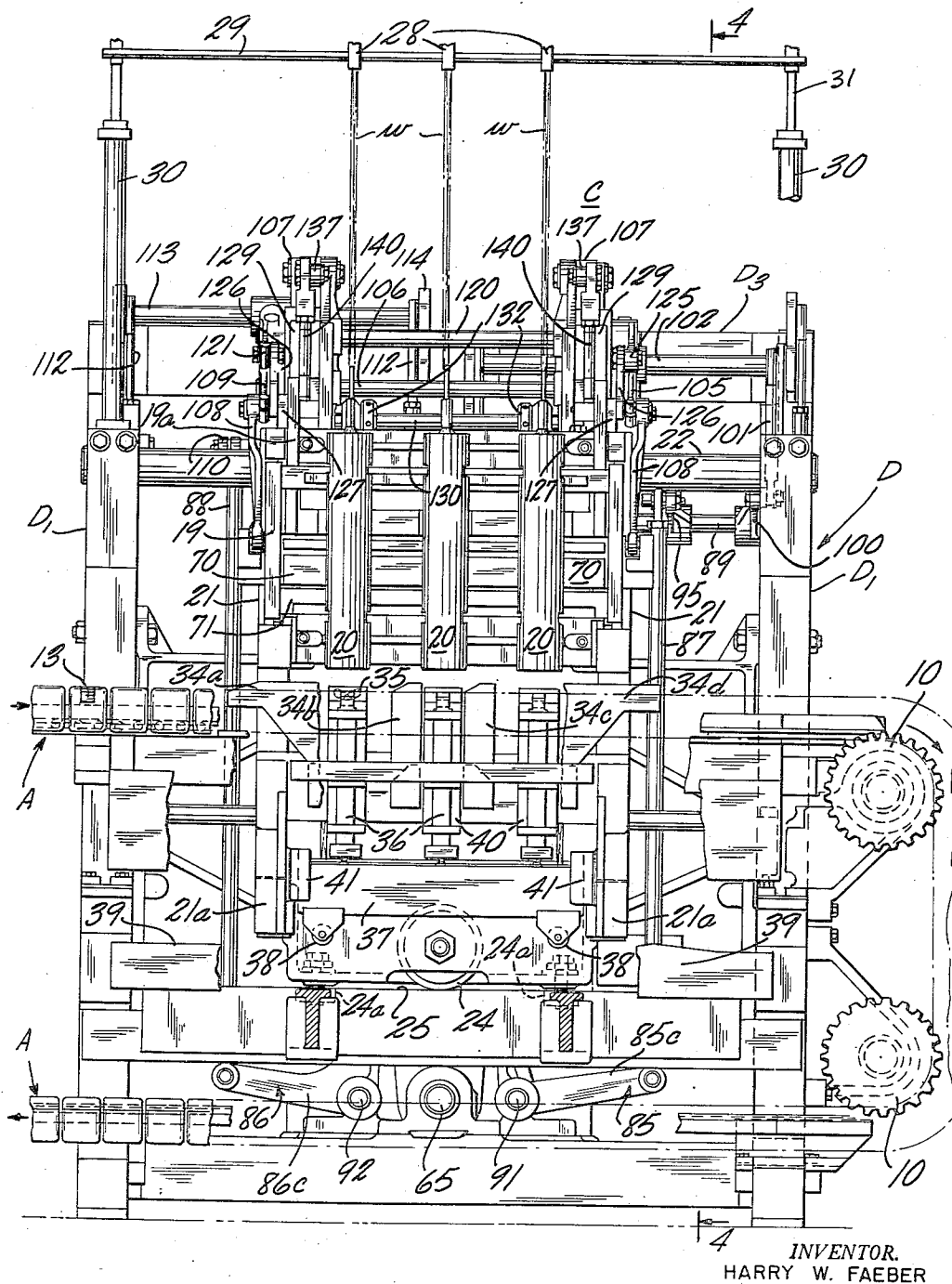


FIG. 2.

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SIGNATURE STITCHING MECHANISM

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5 Sheets-Sheet 4



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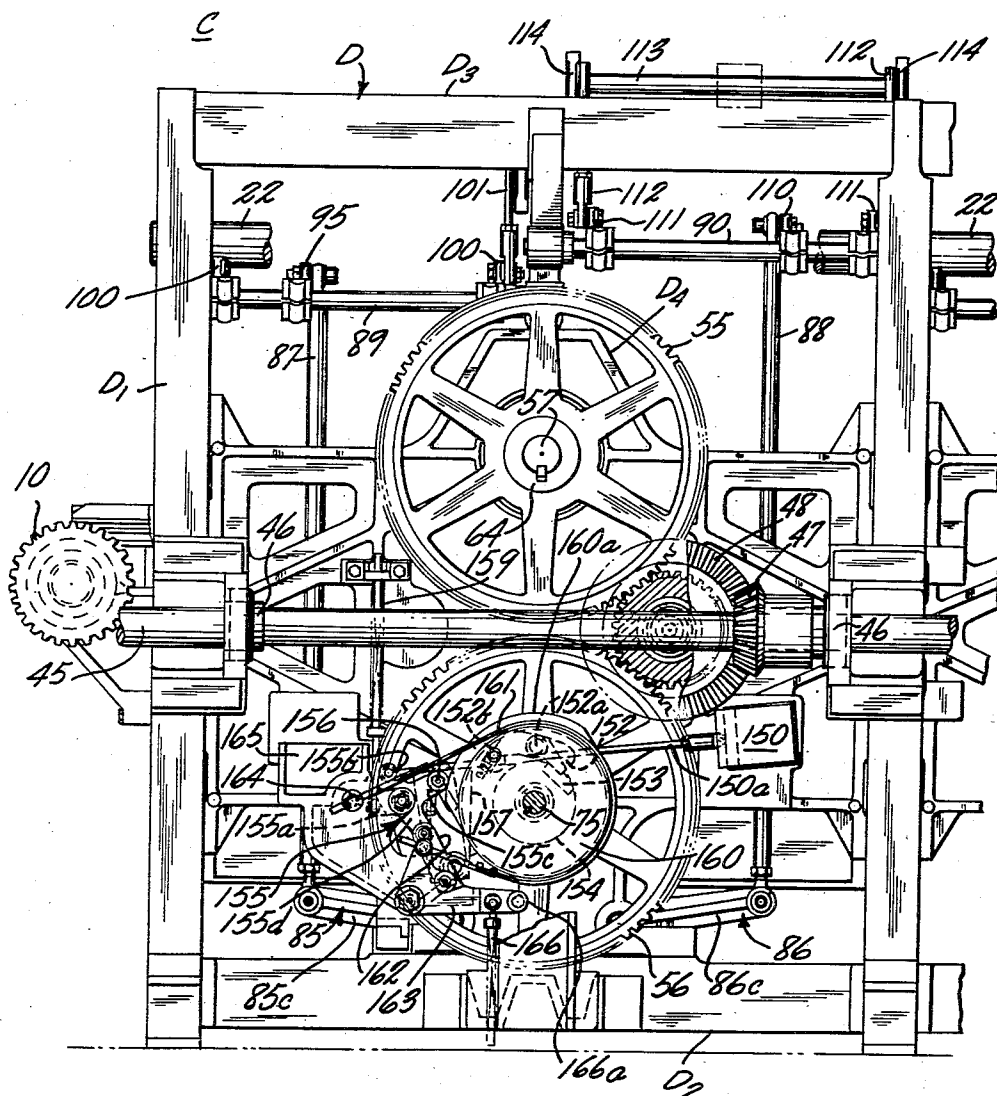
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SIGNATURE STITCHING MECHANISM

5 Sheets-Sheet 5

FIG. 5.



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2,827,632

SIGNATURE STITCHING MECHANISM

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Application January 17, 1955, Serial No. 482,255

5 Claims. (Cl. 1—7)

This invention relates to binding machines generally, and, in particular, to a machine of that general organization for stitching together a plurality of different folded sheets or "signatures" to form a book or booklet.

The binding machine of the present invention is especially applicable, although by no means limited, to a system for producing bound books or booklets in a continuous operation wherein a plurality of folded sheets or signatures are opened and received by a continuously moving conveyor, one on top of another in proper sequence to make up a book or booklet ready for binding, and the signatures transported by the conveyor to the binding apparatus of the present invention at spaced intervals. The compiled signatures comprising each book are received upon the conveyor with their folded edges or "backbones" at the top and the leaves thereof straddling the top of the conveyor and hanging downwardly on opposite sides thereof. The signatures are transported to the binding machine of the present invention in this manner, and the binding is inserted through the folded edges or "backbones" of the signatures.

The signature collating system is the subject of my co-pending application, Serial No. 442,149, filed July 8, 1954, and the conveying mechanism for transporting the collated books or booklets from the collating mechanism to the binding machinery is the subject of my co-pending application, Serial No. 454,536, filed September 7, 1954.

The actual binding or stitching unit of the present invention comprises a plurality of stitching devices mounted side by side to a horizontally reciprocating frame. The frame reciprocates back-and-forth in a path parallel to the travel of the conveyor, and the stitching action occurs while the frame is traveling in the same direction as the conveyor. Although the invention is not to be limited to a particular type of binding, in the preferred form the signatures are adapted to be held together by wire metal staples which are dispensed from and inserted into the backbones of the signatures by conventional stapling devices while an apparatus, known in the art as a "clinch" mechanism, is raised to bend or flatten the ends of the staple wires against the center page crease in the usual manner. The clincher apparatus then quickly descends, as the bound book is transported by the conveyor to a collection station.

In the preferred embodiment of the present invention, two binding or stitching units are situated side by side, the stitching mechanism thereof operating in tandem with respect to the moving conveyor. The operation of each of the stitching units is such that it is adapted to bind together the signatures of every other compiled group transported thereto by the conveyor. The reciprocating frames of the two units are driven in out-of-phase relationship by common driving means, so that as one of the stitching units is traveling in the same direction as the conveyor during its operative stroke, the other frame is traveling in the opposite direction during its return or inoperative stroke. This arrangement, of course, permits

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the heavy reciprocating frames to be driven more leisurely and reduces the stresses on the main base frames. In addition, provision is made for driving the reciprocating frames at a relatively slow speed during the return stroke, when a high speed is unnecessary, and for driving the frame at a more rapid speed during the operative stitching stroke when the higher speed is necessary to permit the stitching heads to approach and temporarily exceed the speed of travel of the conveyor during the actual performance of the stitching operation. It is, of course, understood that more than two stitching units operating in out-of-phase relation may be employed if desired.

For a complete understanding of the present invention, reference may be had to the detailed description which follows and to the accompanying drawings in which:

Figs. 1A-1G, inclusive, are illustrative front views showing the out-of-phase operation of the two binding and stitching units of the present invention in relation to the signatures being transported thereto by the conveyor for binding;

Fig. 2 is a front elevation of one of the binding and stitching units of the present invention, with portions of the conveyor mechanism broken away;

Fig. 3 is a view similar to Fig. 2 with the front portion of the machine broken away to show the driving means for the reciprocating frame which carries the stitching mechanism, as well as the driving means to actuate the stitching mechanism;

Fig. 4 is a cross-sectional view taken on the line 4-4 of Fig. 2, looking in the direction of the arrows; and

Fig. 5 is a rear view of the driving mechanism of the unit shown in Fig. 3.

Referring to Figs. 1A-1G, inclusive, a plurality of compilations *a*, *b*, *a'*, *b'* . . . etc., of folded sheets or signatures, each comprising a book or booklet, are transported at equally spaced intervals by a conveyor *A* toward a pair of binding and stitching units *B*, *C*, which reciprocate back-and-forth in directions parallel to the travel of the conveyor in out-of-phase relationship. Each of the stitching units is adapted to bind every other compilation of signatures, the binding operation occurring during the stroke of the unit in the same direction as the direction of travel of the signatures on the conveyor. Thus, by driving the stitching units in out-of-phase relation and having them bind every other compilation of signatures, it is possible to operate the conveyor at double the speed of that which would be possible if only one unit were provided, and at the same time help to balance the stresses set up in the main supporting structure *D*.

The main frame structure *D* comprises vertical frames *D1* supported at their lower ends upon a base *D2*, and the vertical frames *D1* are connected for added support by horizontal frames *D3*.

Figs. 1A, 1B, 1C represent the stitching unit *C* just before, during and just after the stitching operation, respectively, the stitching unit *B* being shown at different positions during its return or inoperative stroke in all three views. During this sequence, however, no signatures are indicated as having reached the stitching position. Fig. 1D represents the stitching unit *B* during its operative stroke just before the binding operation, and Fig. 1E shows the signatures *b* being bound by the stitching unit *B*, the stitching unit *C* being shown at different stages during its inoperative return stroke.

It will be noticed that the compilation of signatures *a* is not bound by the stitching unit *B*, but passes during the inoperative or return stroke of the unit *B*. The reference Figs. 1F and 1G moreover, show the signatures *a* in positions just before and during the binding operation by the unit *C*, the unit *B* being represented in Figs. 1F and 1G during its return stroke. In Figs. 1A-1G, inclusive, the direction of movement of the stitching units

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B, C is represented by the small arrows above the units in each of the figures.

The conveyor A travels in a closed circuit, first across an upper stretch of the supporting structure to carry the conveyor past a series of collection points (not shown) to receive the signatures in compiled book form, to transport them to the binding and stitching units B, C, and finally to a point of discharge (not shown), and then across a lower return stretch to carry the conveyor back again to the starting position.

The construction and operation of the conveyor A and its supporting structure is more fully shown and described in the above-identified, co-pending application, however, it suffices to say for present purposes that it comprises a pair of parallel moving, flexible linkages which travel side by side in a closed rectangular circuit about the four sprocket wheels 10. As best shown in Fig. 4, the linkages carry oppositely and angularly disposed plates or sheaths, 11, 12 upon which the signatures are received and supported, open at the center with the leaves straddling the opposite sides and the folded edges thereof being aligned at the top suitable for the binding or stitching operation. The signature supporting sheaths or plates 11, 12 are provided with outwardly projecting partitions or separators 13 (see Figs. 2, 3 and especially 4) at spaced intervals therealong, forming pockets between which the compilations of signatures in book form are accommodated.

While the conveyor A is engaged in collecting the signatures and transporting and presenting them to the stitching units for binding, the conveyor travels along spacially separated, horizontal front and rear supports 14, 14a. The upper surfaces of the supports 14, 14a are provided with rails or tracks, and the conveyor is provided with rollers 15 which ride upon the said rails. It may be mentioned at this point that there is a separation between the upper ends of the front and rear plates or sheaths 11, 12 and between the front and rear supports 14, 14a to accommodate the aforementioned clincher mechanism 35 (to be described more fully below) and to provide access for the clincher mechanism to engage the fold or backbone of the bottom signature in the compilation, during the stitching operation. After completing the travel along the upper operative stretch of the circuit, the conveyor passes around upper and lower sprocket wheels 10 and begins its return travel along a lower stretch in inverted fashion. As best shown in Fig. 4, the conveyor is supported during the return trip upon rails or tracks mounted from the angle bracket 16 bolted to the base D2 of the main frame D.

As mentioned above, the stitching units B, C, although operating in out-of-phase relationship from a common drive means, are identical in all respects, and it is deemed necessary to show and describe but one in detail. Accordingly, the stitching unit C has been illustrated in considerable detail in Figs. 2-5, inclusive, and unless otherwise specified, the description of the parts and manner of operation of the stitching unit B is the same.

Referring to Fig. 2, three conventional wire stitching heads 20, preferably stapling devices of the type sold commercially under the trademark "Bostitch," by the Boston Wire Stitcher Company, are mounted side by side in framework 19 which, in turn, is mounted to the front of a reciprocating frame 21. By means to be described below, the framework 19 is supported by the vertically disposed members 19a, and the members 19a may be adjusted vertically in relation to the slide frame 21 to permit the framework 19 and the Bostitch heads 20 carried thereby to be located a proper distance above the conveyor and above clinching mechanism 35 to be described. The upper end of the frame 21 is slidably mounted on a heavy transverse shaft 22, and the lower end of the slide frame 21 is provided with a roller 24 (See Figs. 2 and 4) which travels on a transverse guide-

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way 25, lending additional support to the frame 21. To prevent the bottom of frame 21 from swinging in an arc centered on shaft 22, two rollers 24a are provided (see Figs. 2 and 4) which travel between guideways 25 and 25a separated by spacer 25b.

The transverse supporting shaft 22, guideways 25 and 25a and spacer 25b are supported at their ends by the vertical supports D1 of the main frame structure D.

Wire w is supplied to the stitching heads 20 from spools (not shown) which may be supported upon spool studs 26 (see Fig. 4). The studs 26 are rearwardly disposed and mounted above the machine proper from a transverse member 27. The wire is unwound from the spools and passes through guides 28 (see Figs. 2 and 4) which direct it to the stitcher heads 20, the stitcher heads 20 being provided with wire feeding means which draw the wire in increments as it is needed. The guides 28 are suspended above the machine proper by another transverse horizontal bar 29, and both the transverse bars 27 and 29 are supported at both ends from vertical columns 30 by brackets 31.

The stitching heads 20 carried by the reciprocating slide frame 21 are disposed immediately above the conveyor and the signatures are transported beneath the heads so that the wire staples may be inserted through the backbones or folded edges of the signatures. A clinching mechanism 35, being of standard design manufactured and sold by the Boston Wire Stitcher Company, is associated with each of the stitching heads, and the three clinching mechanisms accommodated between the front and rear supports 14, 14a (see Fig. 4) of the conveyor A, also are carried by the reciprocating frame. As a group of signatures to be bound approaches the stitching unit, they engage the inclined leading edge of a plate 34a (see Figs. 2 and 3) which slightly raises the folded edges of the signatures above the conveyor, although the engagement of the outward pocket-forming projections 13 insure the continued advance of the signatures by the conveyor. Plates 34b, 34c and 34d insure that the signatures are thus raised throughout their travel beneath the stitching heads.

The clinching mechanisms are disposed between the plates 34a and 34b, between the plates 34b and 34c, and between the plates 34c and 34d, respectively. The clinching mechanisms are vertically slidable, and at the time of the stitching operation, the clinching mechanisms 35 are raised to engage the ends of the staples inserted through the center folds of the signatures and to bend the inserted ends of the wire staples against the folded edge of the center page. Thereafter, the clinching mechanisms descend, and the bound book or booklet is transported away from the stitching unit by the conveyor.

As best shown in Fig. 2, the clinching mechanisms 35 are carried at the upper ends of vertically slidable bars 36 which are connected at their lower ends to a common horizontally disposed carriage 37. The carriage 37 is provided with rollers 38 which travel along the upper cam surface of a cam member 39 with the reciprocating frame 21. The horizontally disposed carriage is guided for up and down movement in guides or ways 41 of a forwardly extending portion 21a of the reciprocating slide 21, and the bars 36 also slide in guides 40 supported by the frame portion 21a, which, as best shown in Fig. 4, extends forwardly from the lower end of the reciprocating frame 21.

The cam member 39 is formed with raised surfaces coinciding with the point at which the stitching action takes place during the operative stroke of the reciprocating frame 21 and the clinching apparatus, and the rollers 38 engage the raised surfaces at the same time to raise the carriage 37, thereby lifting the clinching mechanisms 35 into operative engagement with the staples. The further forward movement of the reciprocating slide 21 moves the rollers 38 past the raised surfaces on the cam member 39 and permits the clinching mechanisms 35

to descend. The carriage 37 may be permitted to descend by gravity, but preferably it is returned by spring pressure. The clincher supporting carriage 37, of course, will also be raised by the cam surface during the return travel thereof, however, the stitching heads 20 are not actuated during the return stroke and a stitching operation does not take place.

The manner of driving the reciprocating slide frames 21 of the stitching units B and C in the main frame structure D and the actuation of the operating parts of the units will now be described. Both stitching units B and C are driven by the main drive shaft 45, best shown in Figs. 4 and 5, transversely supported in bearings 46 mounted at the rear of the vertical upright supports D1 of the main frame structure. Referring to Fig. 5, power to drive the stitching units is transmitted through bevel gears 47 mounted on the shaft. Although not shown in the drawings, the drive shaft may, by suitable gearing arrangement, be utilized to drive the conveyor A.

Each of the bevel gears 47 engages a companion bevel gear 48 associated with the stitching unit in question. The driven bevel gear 48 is rotatably mounted on a short fore-and-aft shaft 49 mounted at the rear of the stitching unit in the main frame structure D4 and the bevel gear 48 is rearwardly disposed on the shaft to engage the driving bevel gear. A pinion 50 is formed on the hub at the front side of the bevel gear 48, and it engages and drives two large gear wheels 55 and 56, the upper gear wheel serving, by means to be described, to reciprocate the slide frame 21, and the lower gear wheel 56 serving, also by means to be described, to control the various operations of the stitcher heads 20.

Considering first the driving means for the reciprocation of the slidable frame 21, the upper gear wheel 55 is mounted at the rearward end of a fore-and-aft crank shaft 57 rotatably mounted in bearings 58 and 59 of the frame structure D4. The forward end of the crank shaft carries the crank arm 60, and the crank arm 60 carries a forwardly projecting stud or pin 61 fitted with crosshead 61a which is adapted to travel in a longitudinal slot 62 formed in a large pivotally mounted reciprocating lever 63. A collar or washer 64 may be attached to the forward end of the pin or stud 61 to maintain the crosshead within the slot.

As best shown in Fig. 3, the large reciprocating lever 63 is pivotally mounted at its lower end upon a shaft 65 supported above the base frame D2 by a block 69, and the reciprocating arm is connected at its upper free end to the slide frame 21 by means of a horizontally disposed link 67. One end of the link 67 is connected to the frame 21 by means of a pivot pin 68 and the other end is connected to the reciprocating lever by a pivot pin 66.

Thus, it is understood that the reciprocating motion is imparted to the slide frame 21 by means of the pivotal reciprocation of the lever 63 through the link 67. In turn the reciprocating motion is imparted to the lever 63 from the main drive shaft 45 through the gear wheel 55 and the crank arm 60 of the shaft 57, the pin or stud 61 of the crank arm traveling in a circular path carrying the crosshead 61a which is adapted to slide within the vertical slot 62 of the lever 63.

As shown in Fig. 3, the crank pin 61 travels in a counterclockwise direction and since the crank pin travels in a circular path at a constant speed, a greater portion of the circle described thereby will be devoted to moving the slide frame in the return stroke, and a smaller part of the circular path will be devoted to moving the slide frame in the direction of the path of travel of the conveyor during which the stitching operation occurs. The angle x represented in Fig. 3, represents that portion of the arc which is devoted to moving the slide frame in its operative stitching stroke, and in the preferred embodiment of the present invention, the angle x is approximately 150°. Thus, it is clear that the speed

of travel of the slide frame is increased during its operative stroke so that the stitcher heads may be traveling at approximately the same speed as or greater speed than the conveyor and the signatures to be stitched during the operative stroke, and the speed decreased to permit more leisurely travel of the slide frame during its return or inoperative stroke. It is believed that this is an important feature of the machine because the maximum speed of the slide frame is increased and accelerated only at the point where such increased speed and/or acceleration is necessary, and decreased during that portion of the time when increased speed is unnecessary and even undesirable. An advantage of accelerating the stitcher frame to exceed the speed of travel of the conveyor during the stitching operation is that the signature will be moved ahead of the separators 13 during this period to prevent damage to the edge of the signature by contact with the separators while the signature is being advanced under the control of the stitcher mechanism.

As mentioned above, the various operations associated with the stitching heads are controlled by the lower gear wheel 56. There are three essential operations associated with the stitching heads, namely feeding the wire, cutting and forming the wire into staples and driving the staples into and through the backbones or folded edges of the signatures. The mechanism for performing these operations is conventional and built into the Bostitch heads, and, it is customary, as in the present embodiment wherein three heads are mounted side by side, to provide means for operating the corresponding mechanism of each head simultaneously.

According to the present invention, two horizontally disposed actuating rails 70 and 71 are mounted for vertical movement in the frame 19 immediately behind the stitching heads 20, and these actuating rails serve to operate the necessary mechanism of the stitching heads, the upper rail 70 actuating the mechanism of the stitching head to advance the wire and to drive the staple into the backbones of the signatures, and the lower rail 71 actuating the wire bending or staple forming mechanism of the stitching head and a slidable element housed within the stitching head which is lowered to bring the staple into position for insertion. The horizontal rails 70, 71 are guided at their ends in guides or ways at the front of the frame 19, and the actuation of these rails is controlled by the rotation of the gear wheel 56 through mechanical linkages to be described.

As best shown in Fig. 4, the lower gear wheel 56 is mounted on a fore-and-aft shaft 75 rotatably mounted in the bearings 76, 77, 78 of the main frame structure. The forward end of the shaft, or the left end thereof as viewed in Fig. 4, carries thereon two cams 80 and 81. The rearwardly disposed cam 80 (that is to say, the rightwardly disposed cam as viewed in Fig. 4) controls the operation of the upper wire feeding and driving rail 70, and the forwardly disposed cam 81 (that is to say, the leftwardly disposed cam as viewed in Fig. 4) controls the operation of the wire forming and bending rail 71.

The cams 80 and 81 operate through mechanical linkages which include the transversely and symmetrically disposed bell crank levers 85, 86, the vertically disposed connecting rods 87, 88 and the transverse rock shafts 89, 90 rotatably journaled at their ends in bearings of the main frame structure D. As best shown in Fig. 3, the bell crank levers 85, 86 are pivotally mounted at 91, 92, respectively, to the base of the main frame structure member D.

Turning now to a description of the operation of the upper wire feeding and staple driving rail 70, the bell crank lever 85 is formed with a cam follower arm 85a carrying at the end thereof a roller 85b which may be engaged by the cam surface of the cam 80, and another arm 85c angularly disposed with respect to the cam follower arm to which the lower end of the vertically

disposed connecting rod 87 is pivotally attached. The upper end of the rod 87 is pivotally connected to the forward end of an arm 95 (see Fig. 5) affixed to the rock shaft 89. By means of the connection above described, the rock shaft 89 is adapted to be pivotally rocked or oscillated at predetermined times by the cam 80.

Each end of the rock shaft 89 is provided with a forwardly disposed lever 100 (see Figs. 4 and 5) and the forwardly disposed oscillating ends of these levers are connected by means of rods 101 to an upper transversely disposed shaft 102 which is mounted at each end within arc-shaped guides 103. As best shown in Fig. 4, the arc-shaped guides 103 are mounted to one of the cross members of the main frame D by means of brackets 104. Thus, the oscillation of the rock shaft 89 controlled by the cam 80 effects the upward and downward translation of the shaft 102 in the curved guides 103, and this movement of the shaft 102 is transmitted through a lever 105 to a rock shaft 106, the lower of two horizontally disposed shafts mounted centrally and at the upper end of the slide frame 21 between a pair of vertical slide members 107. The lever 105 is attached to the right end (as viewed from the front in Figs. 2 and 3) of the rock shaft 106, and the said rock shaft serves as a center pivot for the lever 105, the rearward end being slidably mounted along the shaft 102, for a reason to be described, and the front end being connected to the right end of the actuating rail 70 by means of a connecting link 108. The left end of the rock shaft 106 carries a forwardly disposed arm 109 which is connected to the left end of the actuating rail 70 by means of another connecting link 108.

Thus, the upward and downward translation of the shaft 102 in the guides 103 rocks the shaft 106 through the lever 105, and the levers 105 and 109 mounted at opposite ends on the rock shaft 106 translate the transverse actuating rail 70 upwardly and downwardly to operate the wire feeding mechanism of the stitching heads 20, as well as the mechanism for driving the staples through the signatures to be bound.

The operation of the lower actuating rail 71 which operates the wire bending or staple forming mechanism of the stitching heads 20 and which lowers the staple into position for insertion may now be described. The operating parts are very similar to the operating parts described above in connection with the operations of the actuating rail 70.

The operation of the rail 71 is controlled by the cam 81 and the bell crank lever 86 which, like the bell crank lever 85, has a follower arm 86a carrying a cam follower roller 86b and another arm 86c pivotally connected to the lower end of the connecting rod 88. The upper end of the connecting rod 88, as best shown in Fig. 5, is pivoted to the forward end of an arm 110 attached to the transverse rock shaft 90. The transverse rock shaft 90 is mounted to the left, but somewhat higher than the corresponding shaft 89. Each end of the rock shaft 90 is provided with a forwardly disposed lever arm 111, and the ends of these lever arms are connected by rods 112 to a horizontally disposed shaft 113 which is mounted at each end within arc-shaped guides 114. Thus, by means of the above-described mechanism, the operation of the cam 81 imparts oscillating rotation to the rock shaft 90 which, in turn, is transmitted to raise and lower the shaft 113 in the arc-shaped guides 114.

The upward and downward translation of the shaft 113 rocks the shaft 120, located just above the shaft 106, by means of the lever 121. The lever 121 is mounted at its center to the left end of the shaft 120, the rear end thereof is free to slide on the shaft 113. The right end of the shaft 120 carries a forwardly disposed arm 123, and the forward ends of the lever 121 and the arm 123 are connected by means of short links 126 to vertical slides 127 mounted within the frame 19. The lower ends of the slides 127 are attached to opposite ends

of the actuating rail 71, so that the oscillation of the shaft 120 raises and lowers the rail 71 to effect simultaneously the wire bending or staple forming operations of all of the stitching heads simultaneously.

It may be incidentally mentioned at this point that the sliding connection between the shaft 102 and the lever 105, and between the shaft 113 and the lever 121 permits the levers 105 and 121 to travel back and forth with the slide frame 21.

As mentioned above, the stitcher heads 20 may be accurately adjusted in bank upwardly or downwardly relative to the slide frame 21 to permit the lower operative ends thereof to be located a proper distance above the clinching mechanism 35 and the signatures transported by the conveyor. Toward this end, the framework 19 which carries the Bostitch heads 20 is adapted to be vertically adjusted under the control of the slide members 107, which are themselves vertically adjustable in guides or ways of upright posts 129 of the slide frame 21 by means of eccentrics or cams (not shown) attached at the extreme ends of a transverse shaft 130. The transverse adjusting shaft 130 is rotatably mounted between the upright posts 129 of the slide frame 21, and the shaft is adapted to be rotatably adjusted by means of hand wheels 132 mounted thereon. Each of the wheels 132 may have a plurality of holes spaced around the periphery thereof, and a key or handle may be inserted in the holes to permit the shaft to be manually adjusted. The eccentrics or cams (not shown) at the extreme ends of the shaft 130 are located just beneath the slide members 107, so that the rotation of the shaft 130 will move the members 107 upwardly or downwardly as desired.

The upper ends of the slide members 107 serve as center supports for fore-and-aft, horizontally disposed levers 137 (see Fig. 4) anchored at their rearward ends to supporting brackets 138 of the slide frame 21. The forward ends of the levers 137 are connected by means of connecting rods 140 to the upper ends of the vertical members 19a by means of which the framework 19 is supported. Thus, with the rearwardly disposed ends anchored to the brackets 138, the upward and downward adjustment of the slide members 107 permits the movement of the forward free ends of the levers 137 to raise or lower the framework 19 as desired. It is to be pointed out that the timing of the stitching operation is not affected by the up and down adjustment of the framework 19 just described, because the pivot points of the stitcher actuating levers 125, 121 and 105 are also mounted in the vertical slides 107. Thus, if vertical slide 107 is adjusted, the left hand ends (as viewed in Fig. 4) of levers 137, 125 and of the horizontal lever connected to the upper end of link 108, all move up and down in unison. Further assurance of this condition lies in the fact that the right hand ends of levers 137, 121 and 105 are all located on substantially the same vertical centerline.

The present invention is provided with means to prevent the operation of the stitching heads 20 under certain conditions, such as, for example, in the event that a particular pocket of the conveyor has not received all of the signatures comprising a complete book or booklet. Referring to Figs. 4 and 5, it will be observed that the driving power for the operation of the stitching heads 20 is transmitted from the gear wheel 56 to the shaft 75 by means of the engagement of a pawl 152, pivotally mounted at 152a to one of the spokes of the gear wheel, with a notched shoe 153 of a clutch disc 154 mounted on the shaft 75. The pawl 152 is normally spring urged into operative engagement with the shoe 153, but it is capable of being pivotally rotated against the spring pressure to disconnect the gear wheel 56 and the shaft 75.

The shaft 75 is also provided with a brake drum 160 and a brake band 161 which may be operated to bring the shaft to a stop when the clutch has been released.

The clutch and brake mechanisms are controlled by a solenoid 150 (see Fig. 5) mounted at the back of each of the stitching units B, C. The solenoid is adapted to be controlled by a memory unit (not shown) which receives information from the sheet inserters which assemble the sheets on the conveyor A. In the event that a particular pocket of the conveyor has not received all of the signatures to make up a complete book or booklet, that information will be sent to a memory unit (not shown) where it will be stored until that particular book or booklet is about to be stitched, whether it be by the unit B or the unit C, at which time the solenoid 150 of the appropriate unit will be operated to disengage the clutch and to apply the brake mechanism during that particular cycle of the machine so that the incomplete book will not be stitched. Thereafter, although forming no part of this invention, the defective or incomplete book is delivered by the conveyor to a reject station so that the missing signatures can be inserted.

To effect the disengagement of the clutch, the solenoid 150 is connected by means of the connecting rod 150a to a pivotal clutch throw-out lever 155. The throw-out lever 155 is provided with four arms 155a, 155b, 155c and 155d, the rod 150a of the solenoid being connected to the arm 155b. The arm 155b is acted upon by a vertically disposed compression spring 159 which normally maintains the throw-out lever 155 in inoperative position. The arm 155c of the throw-out lever 155 is connected by means of a pin 156 to an elongated slot of a pivotal cam member 157, and the clockwise operation (as viewed in Fig. 5) of the lever 155, as controlled by the energization of the solenoid 150, interposes the cam member 157 in the path of the release end of the clutch pawl 152. The clutch pawl 152 is thereby disengaged from the clutch disc 154 to break the driving connection to the mechanism which operates the stitching heads 20.

At the same time, through suitable linkage arrangement, namely the arm 155d, link 162 and the bellcrank 163, braking pressure is applied to the brake band 161, thereby applying friction to the brake drum to stop the shaft 75. The actual force required to tighten the brake band 161 is exerted by spring 166, after the toggle formed by link 162 and arm 155b is broken by a clockwise rotation of lever 155 caused by the energized solenoid.

When the incomplete book or booklet reaches the stitching position, the solenoid 150 is energized through the memory unit and the throw-out lever 155 is pivoted to shift the cam member 157 into position to trip the pawl 152, thereby disengaging the gear wheel 56 and the shaft 75. At the same time, the brake 161 is applied to stop the further rotation of the shaft 75 to prevent the operation of the stitching heads 20 during that cycle of the stitching unit. If during the next cycle of operation the solenoid 150 is de-energized, the pawl 152 will re-engage the clutch disc 154, cam 160a which is formed on the flange of brake drum 160 will depress arm 163 and thus allow lever 155b and link 162 to form the toggle as shown in Fig. 5 which locks the brake lever 163 in the released position, and the stitching operations will continue as usual until the solenoid is again energized.

Summarizing the operation of the present invention, the compilations of signatures forming a book are advanced by the conveyor A to the stitching units B and C, and the reciprocating frames 21 of the stitching units, as described above, reciprocate in out-of-phase relationship, each unit stitching alternate books delivered by the conveyor. The books are carried in straddling fashion by the conveyor with the folds at the top, and the conveyor introduces the book to be stitched between the stitching heads 20 and the companion clinching elements 35 during the forward stroke of the moving frame. Thereupon, the clinching elements are driven upwardly, moving between the plates 11, 12 of the conveyor, for the stitching operation. The clinching elements 35 are carried by the carriage 37, and the rollers 38 travel across the cam

surface of cam member 39, which cam surface controls the raising and lowering of the clinching elements 35. The carriage 37 is carried by the reciprocating slide 21, so that the carriage moves in synchronism with the slide.

The stitching heads and the clinching elements move together at a speed slightly faster than the speed of the conveyor, so that when they engage the book to be stitched, the book is advanced ahead of the separators 13 of the conveyor. The reciprocating motion is imparted to the slide frame 21 by means of the pivotal reciprocation of the lever 63 (see Fig. 3) which is pivoted at its lower end and connected at its upper end to the slide frame by means of a link 67. Reciprocation is imparted to the lever 63 by the rotation of a crank arm 60, the pin or slide 61 thereof being accommodated in the longitudinal slot 62 of the lever 63.

The operation of the stitching heads 20 are controlled simultaneously by the horizontal actuating rails 70, 71 which are mounted for vertical displacement immediately behind the stitching heads. The upper rail 70 actuates the mechanism of the stitching heads to advance the wire and to drive the staples into the backbones of the books, and the lower rail 71 actuates the wire bending or staple forming mechanism of the stitching heads and lowers the staple toward the signature in preparation for the insertion thereof. The operation of the rail 70 is controlled by a driven cam 80 and the operation of the rail 71 is controlled by a driven cam 81.

The operating linkage by means of which the cam 80 operates the rail 70 includes the vertical rod 87 controlled by the cam, the arm 95 of the rock shaft 89, the rod 87 being connected to the arm and thereby imparting movement to the rock shaft 89, the levers 100 carried by the rock shaft 89, the transverse shaft 102 mounted within arc-shaped guides 103, and the rods 101 connecting the levers 100 and shaft 102. Thus, the rotation of the cam 80 imparts predetermined movement to the shaft 102, moving the axis of the shaft 102 upwardly and downwardly in a curved path. The reciprocating slide frame 21 carries a lever 105, the rear end of which is slidably connected to the transverse shaft 102, thereby permitting the lever 105 to be actuated, although it is carried by the reciprocating slide frame, and the lever 105 is connected to the rail 70 by means of the links 108. The curvature of the slots in the guides 103 permits the lever 105 on shaft 106 to be pivotally operated.

The operating linkage by means of which the rail 71 is actuated by the cam 81 includes a vertical connecting rod 88 controlled by the cam 81, the arm 110 of the rock shaft 90 which connects the upper end of the rod 88 to the rock shaft 90 for the reciprocation of the latter, an arm 111 of the rock shaft 90, the transverse shaft 113 supported in arc-shaped guides 114, and the rods 112 connecting the arms 111 and the transverse shaft 113. A rearwardly disposed lever 121 of the reciprocating frame 21 is slidably connected to the transverse shaft 113, so that the lever 121 may be actuated even though it is carried by the reciprocating frame. The curvature of the slots in the guides 114, as in the guides 103, permits the lever 121 on shaft 120 to be pivotally operated. The lever 121 is connected to the rail 71 by the linkage which includes the arms 125 of the rock shaft 120, the vertical slides 127 and the links 126 connected at their upper ends to the arms 125 and at their lower ends to the slides 127.

It is evident, therefore, that by means of the above-described operating mechanisms the stitching heads 20 and the clincher elements 35 may be actuated during the reciprocation of the slide frame 21 in synchronized relationship with the feed of the books on the conveyor A.

The present invention has been shown and described in preferred form and by way of example, and obviously many modifications and variations may be made therein without departing from the spirit of the invention. It is understood, therefore, that the present invention is not to

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be limited to any specific form or embodiment except insofar as such limitations are expressed in the claims.

I claim:

1. In a machine for stitching signatures, a combination of a main frame structure, a reciprocating frame supported in said main frame structure, a plurality of stitching means carried by the reciprocating frame, an actuator for said stitching means, the operation of said actuator effecting the operation of said stitching means, a mechanical linkage including a pivotal lever and a transverse member serving to operate the said actuator, the one carried by the reciprocating frame and the other mounted to the main frame structure, guide means for guiding said transverse member in a curved path relative to the pivot for the lever and a slidable connection between the transverse member and the pivotal lever whereby the stitching means may be operated while carried by the reciprocating frame.

2. A combination as set forth in claim 1 wherein the guide means for guiding the transverse member comprises brackets which support the transverse member at both ends, said brackets having arc-shaped slots, whereby the transverse member is guided in an arcuate path.

3. A combination as set forth in claim 2 including an oscillating shaft for controlling the operation of the transverse member, and a cam for effecting the oscillation of the shaft.

4. In a machine for stitching signatures assembled in book form, a main frame structure, a reciprocating frame supported in the main frame structure, stitching means and clinching means carried by the reciprocating frame, means for supporting the signatures to be stitched between the

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stitching means and the clinching means with the leaves of the signatures straddling the supporting means, means for actuating the stitching means, and a stationary cam track mounted to the main frame structure for moving the clinching means toward and away from the signatures to be stitched.

5. In a machine for stitching signatures assembled in book form, the combination of a main frame structure, a reciprocating frame supported in the main frame structure, stitching means carried by the reciprocating frame, a carriage movable with the horizontally reciprocating frame, clinching means carried by the carriage, said carriage also being movable relative to the reciprocating frame during the reciprocation of the frame to permit the clinching means to be translated toward and away from the path of travel of the signatures, means for supporting the signatures to be stitched between the stitching means and the clinching means, and a stationary cam track mounted to the main frame structure for controlling the movement of the carriage relative to the reciprocating frame.

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