

Feb. 3, 1970

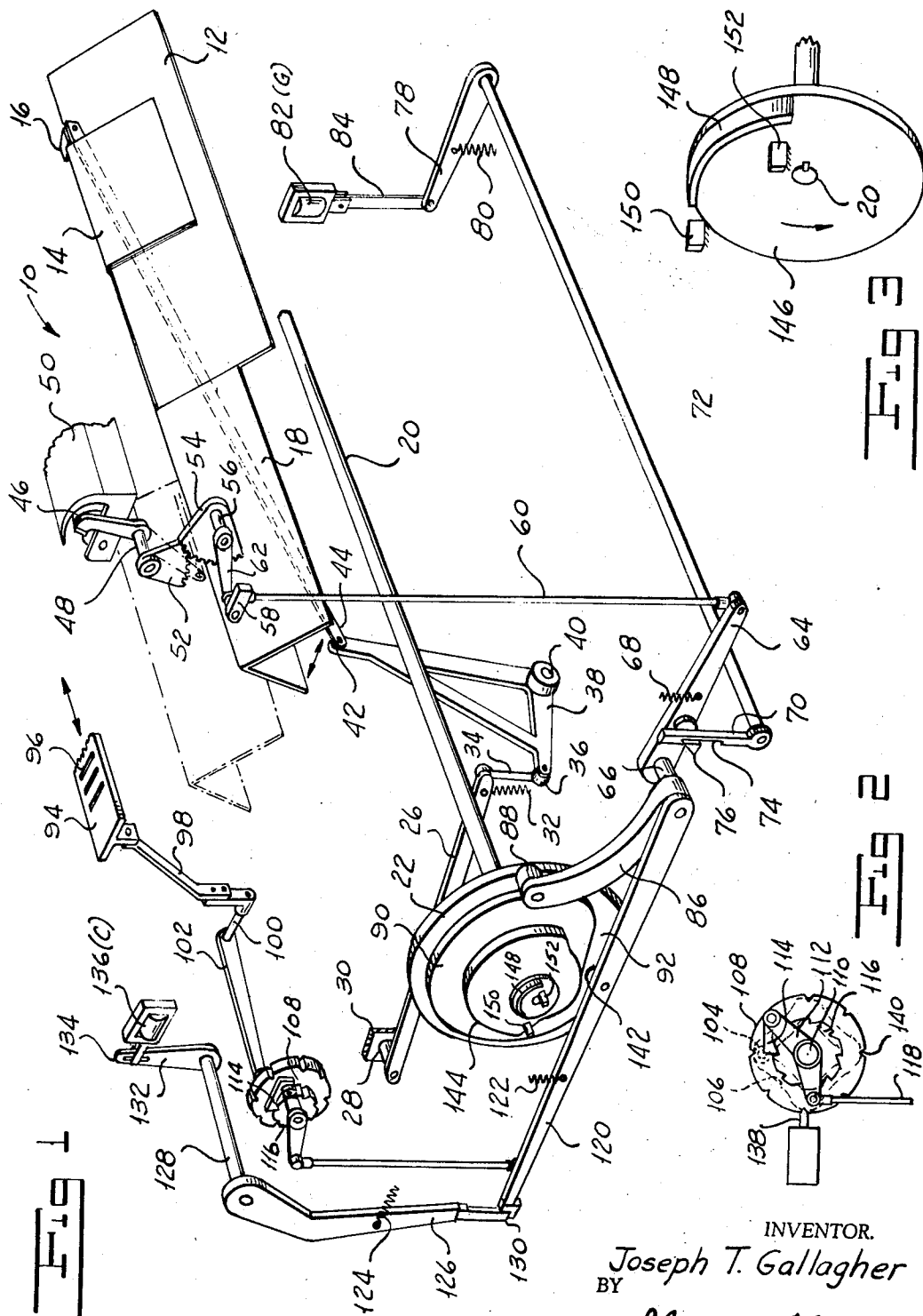
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AUTOMATIC CONTROL SYSTEM FOR BOOK SEWING MACHINE

Filed May 26, 1967

2 Sheets-Sheet 1



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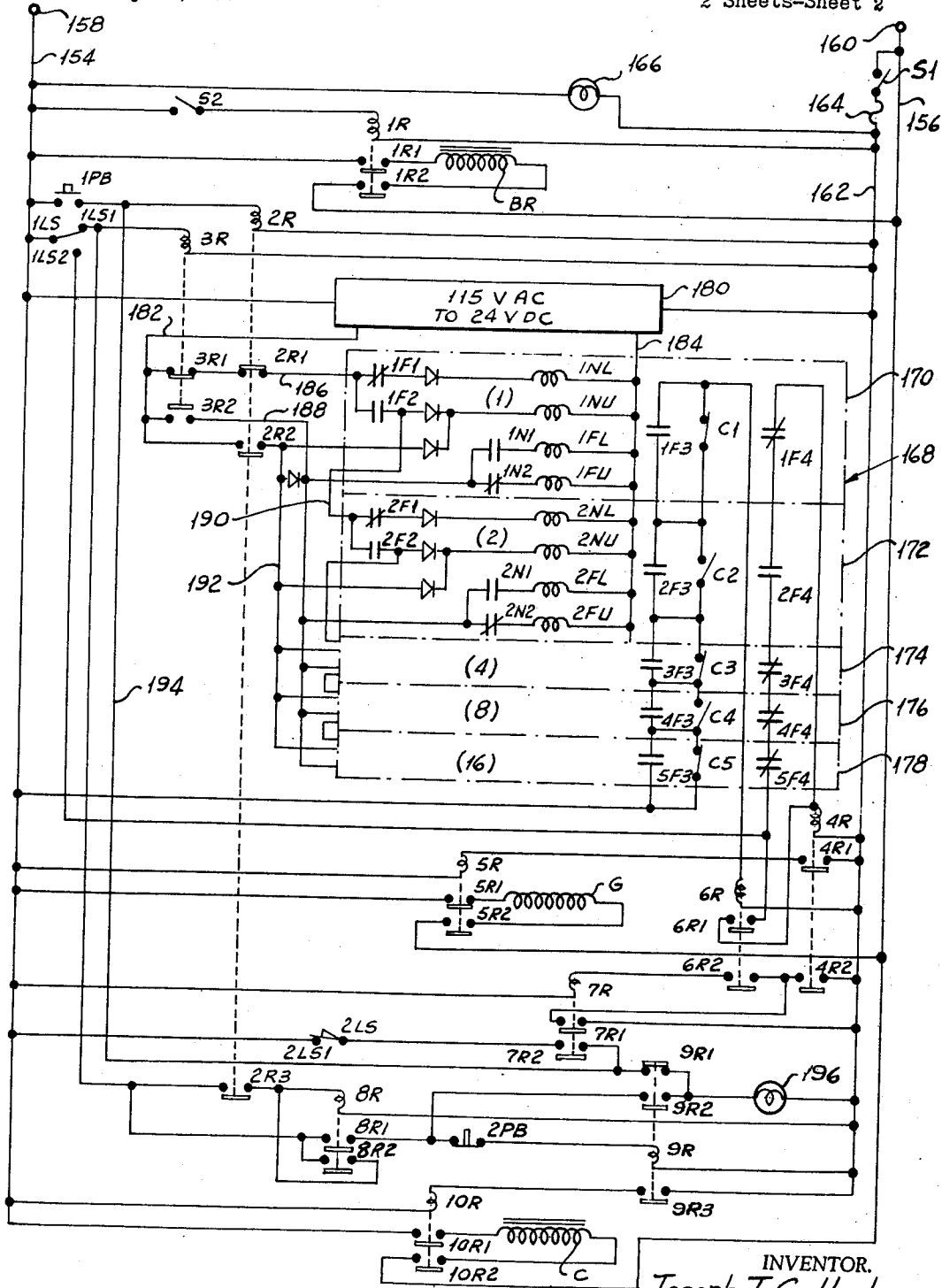
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AUTOMATIC CONTROL SYSTEM FOR BOOK SEWING MACHINE

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Filed May 26, 1967, Ser. No. 641,689

Int. Cl. B42b 1/02; D05b 65/00; B65h 39/02

U.S. Cl. 112—21

22 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for automatically assembling signatures into books in which successive signatures fed to the machine are sewed to each other, the first and second signature of each book and the next to last and last signature of each book are glued to each other, the threads between successive books are cut and the system is recycled after completion of one book and before the first signature is fed to the sewing station without interrupting feeding of signatures to the machine.

As is known in the art of manufacturing books, to make up a book a plurality of signatures comprising the book are sewed to each other, the first signature is glued to the second signature and the next to last and last signatures are glued to each other. When the signatures have been sewed and glued in this manner, threads between successive books are cut.

There are known in the prior art machines for performing the operations described above. Machines generally in use for achieving these operations are controlled by the operator. Owing to the fact that the operator must manually place the signatures one by one on the machine saddle, the other operations are controlled by foot pedals. If production of defective books is to be minimized, control of the gluing and cutting operations by means of the foot pedals must be done in an accurately timed relationship to the feeding of signatures from the saddle to the sewing station. Thus, if any significant rate of production is to be achieved on machines of this type, a skilled operator must be employed. Owing to the necessity for using highly skilled operators, production of books in this manner is relatively expensive.

There have been a number of attempts in the prior art to automate the operations required to assemble signatures into books. In one attempt of the prior art, after a number of signatures have been fed to the machine, an auxiliary control mechanism is employed to initiate a glue-cut-glue sequence of operations as the end of a book is approached. The difficulty with this arrangement is that the entire sequence must be completed and cannot be interrupted without involving wasted operations when production has once been stopped and must again be started as when shifting from one book to another containing a different number of signatures.

In another system which has been proposed in the prior art for automating operations of assembling signatures into books, a blank space is provided between books to permit the necessary operations at the end of a book to take place. Owing to the presence of this blank space between successive books, production is not continuous and is considerably below what is desirable, particularly where books containing only a few signatures are being assembled.

I have invented an automatic control system for a book sewing machine which overcomes the defects of book sewing machines of the prior art. My system permits books to be made continuously in a rapid and expeditious manner. It does not necessitate the provision of a blank space between successive books. It greatly facilitates shift-

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ing between books containing different numbers of signatures. My system automatically recycles in less than a single revolution of the main drive shaft of the machine. My system can readily be reset at any point in the course of a book making operation in the event of a malfunction. A machine equipped with my system does not require a skilled operator. It is readily adapted to installation on existing machines. My machine appreciably increases production over that of which machines in use are capable.

SUMMARY OF THE INVENTION

One object of my invention is to provide an automatic control system for a book sewing machine for continuously producing books in a rapid and expeditious manner.

Another object of my invention is to provide an automatic control system for a book sewing machine which does not require a blank space between successive books in the signature feed to the machine.

Still another object of my invention is to provide an automatic control system for a book sewing machine which greatly facilitates shifting between books made up of different numbers of signatures.

A further object of my invention is to provide an automatic control system for a book sewing machine for achieving a substantially higher rate of production than do machines presently in use.

A still further object of my invention is to provide an automatic control system for a book sewing machine which can readily be reset at any point in the machine cycle.

Still another object of my invention is to provide an automatic control system for a book sewing machine which automatically recycles in less than one revolution of the machine shaft.

Other and further objects of my invention will appear from the following description.

In general my invention contemplates the provision of an automatic control system for a book sewing machine in which successive signatures fed to the machine are counted and in response to the counting operation, the first and second signatures are glued, the last and next to last signatures are glued and the threads between successive books are cut. At the end of a book, the machine automatically recycles without interrupting the signature feed to initiate the operations required for assembling the next book before the first signature of the next book is fed to the sewing station.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

FIGURE 1 is a schematic view of one form of book sewing machine adapted to be provided with my automatic control.

FIGURE 2 is a fragmentary view of a portion of the machine illustrated in FIGURE 1.

FIGURE 3 is a fragmentary view illustrating the cam and switch arrangement of my automatic control system.

FIGURE 4 is a schematic view of my automatic control system for a book sewing machine.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to drawings, one form of book sewing machine indicated generally by the reference character 10 to which I may apply my control system includes a stationary saddle portion 12 on which signatures 14 are deposited by the machine operator. A feed pawl 16 is

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adapted to be moved to the left, as viewed in FIGURE 1, in a manner to be described to engage the signature 14 and deliver it to a movable saddle portion 18.

The machine 10 includes a main drive shaft 20 adapted to be driven from a motor (not shown) through the medium of a clutch and brake system (not shown). Shaft 20 carries a signature feed cam 22 having a track which receives a follower supported on a lever 26 pivotally supported on a shaft 28 on the machine frame 30. A spring 32 normally urges the lever 26 to rotate in a clockwise direction, as viewed in FIGURE 1, to hold the follower in engagement with the cam track. A link 34 connects the end of lever 26 remote from shaft 28 to a ball joint connection 36 on one arm of a bell crank 38 pivotally supported on a shaft 40. A pin 42 pivotally connects the other arm of bell crank 38 to a bar 44 which supports the pawl 16. As cam 22 rotates, lever 26 oscillates to oscillate the bell crank 38 to reciprocate rod 44 to move the pawl 16 back and forth along the saddle 12 to deliver signatures 14 from the stationary saddle 12 to the movable saddle 18.

As has been pointed out hereinabove, the first and second signatures of a book and the next to last and last signatures of a book are glued together. The glue or paste applying means of the machine 10 includes a bail 46 carried by a shaft 48 for movement therewith from a position in a paste trough 50 to a position shown in broken lines at which it applies paste along the edge of a signature supported on the movable saddle portion 18. Shaft 48 also carries for movement therewith a gear segment 52 which cooperates with another gear segment 54 supported on a shaft 56 for movement therewith. A fitting 58 on a vertically movable rod 60 connects the rod to a crank 62 on shaft 56. The other end of the rod 60 is pivotally connected to a crank 64 carried by a shaft 66 for rotation therewith. A spring 68 normally urges crank 64 to rotate in a counterclockwise direction as viewed in FIGURE 1.

Owing to the fact that the glue applying operation is to be performed only twice during the manufacture of each book, means is provided for locking the lever 64 at times other than the times at which the glue applying operation is to be done. A lockout arm 70 supported on a shaft 72 for rotation therewith is provided with a notch 74 which receives a detent stud 76 on crank 64. As long as the detent 76 is in the recess 74, spring 68 cannot move the rod 60 upwardly.

A crank 78 on shaft 72 is normally urged by a spring 80 to rotate in a counterclockwise direction, as viewed in FIGURE 1, to hold arm 70 in a position at which it receives detent 76. A solenoid 82 is adapted to be energized in a manner to be described to move crank 78 in a clockwise direction by means of a linkage 84 to move arm 70 away from detent 76 to free crank 64. Shaft 66 carries for rotation therewith an arm 86 having a cam follower 88 thereon for engaging the surface of a cam 90 carried by the shaft 20. If, in a manner to be described, solenoid 82 is energized to move the latching arm 80 out of engagement with detent 76 to permit spring 68 to urge crank 64 in a counterclockwise direction, follower 88 is moved into engagement with the surface of cam 90. When the low surface 92 of the cam is adjacent roller 88, spring 68 moves rod 60 upwardly to drive the bail 46 in one direction. When the high point of the cam 90 engages roller 88, rod 60 is moved downwardly to return bail 46 to its initial position. As that occurs, detent 76 again engages in the recess 74 of crank 70 since solenoid 82 is de-energized.

On each operation of the machine 10 the movable saddle 18 moves from the full line position to the broken line position to permit the sewing mechanism (not shown) to act on the signature to sew it to the preceding signature. Since the sewing mechanism per se is well known in the art and forms no part of my invention, it will not be described in detail. The mechanism includes a needle plate

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94 having needle guide slots 96 through which the needles move in performing the sewing operation. It will be appreciated that at the end of a sewing operation, threads extend from the last signature up through the slots 96 in plate 94 to the needles of the sewing mechanism. In order to achieve the operation of cutting the threads, plate 94 is merely shogged as indicated by the double-headed arrow to break the threads. A crank 98 supported on a shaft 100 is connected to plate 94 to reciprocate the plate in response to an oscillatory movement of shaft 100. That shaft carries a crank 102, the end of which remote from shaft 100 carries a follower 104 which rides in a cam track 106 in a cam 108 rotatably supported on a shaft 110.

Shaft 110 pivotally supports a bell crank 112, one arm of which carries a pawl 114 adapted to engage in the recesses of a ratchet wheel 116 connected to the cam 108 for movement therewith. A rod 118 connects the other arm of bell crank 112 to a lockout lever 120 supported on shaft 66 for pivotal movement. A spring 122 normally urges the lever 120 to rotate in a clockwise direction as viewed in FIGURE 1. A spring 124 normally urges a lockout arm 126 carried by a shaft 128 for rotation therewith in a counter-clockwise direction, as viewed in FIGURE 1, to a position at which the lower end of the lever engages a fitting 130 on lever 120 to prevent the lever from being driven under the action of the spring 122. A crank 132 on shaft 128 is connected to the armature 134 of a solenoid 136. A spring-loaded detent 138 is adapted to engage in notches 140 in the periphery of cam 108 so as to position the cam accurately after it has been driven in a manner to be described.

Lever 120 also carries a follower 142 adapted to coast with the periphery of a cam 144 carried by shaft 20. With the parts in the position shown in FIGURE 1, the cam 144 will not drive lever 120. When, however, the solenoid 136 is energized to rotate crank 132 in a clockwise direction, arm 126 moves away from lever 120 and spring 122 tends to move the lever in a clockwise direction. This action can occur, however, only when the low portion of cam 144 is adjacent the follower 142. When that condition exists, rod 118 is driven to rotate the bell crank 112 in a clockwise direction to move pawl 114 back two notches along the periphery of the ratchet wheel 116. Now, when the high portion of the cam engages the follower 142, lever 120 is moved in a counterclockwise direction and rod 118 drives the bell crank 112 to rotate ratchet wheel 116 and cam 108 in a clockwise direction through a quarter of a revolution. As will readily be apparent from the showing of FIGURE 2, the track 106 is so shaped that a quarter revolution of the cam 108 provides a reciprocating motion of plate 94 so as to cut the threads.

It is to be understood that the mechanical structure thus far described is known in the art and for that reason has not been shown in detail. In machines of the prior art, the operations described hereinabove as being achieved in response to energization of solenoids 82 and 136 have usually been performed in response to actuation of foot pedals. I have provided an improved control system for so energizing the solenoids 82 and 136 as to permit books to be continuously made on the machine 10 without requiring either wasted operations or blank spaces in the signature feed between adjacent books.

I mount a cam 146 on shaft 20 for movement therewith. I provide cam 146 with a peripheral segment 148 of a suitable magnetic material such, for example, as iron or steel secured to the cam disc 146 in any suitable manner. I mount respective proximity limit switches 150 and 152 in predetermined spaced relationship around the periphery of the cam 146 to control the operations of the machine 10. It will readily be appreciated that the switches 150 and 152 are actuated in response to the presence of the magnetic material 148 adjacent the switches.

Referring now to FIGURE 4, I have shown one form

of my control system for operating the machine 10 in such a way as to permit continuous manufacture of books thereon. I connect respective main supply conductors 154 and 156 to the terminals 158 and 160 of a suitable source of electrical energy such, for example, as 115 v., 60 cycle, A.C. A switch S1 may be closed to connect a control circuit conductor 162 to terminal 160 through a fuse 164. When that operation has been achieved, a signal lamp 166 lights to indicate that the control panel is energized.

With the control panel energized, to initiate the book sewing operation, a foot pedal switch S2 is operated to energize a relay winding 1R to close respective normally open switches 1R1 and 1R2 to connect the clutch solenoid BR across conductors 154 and 156. In a manner known to the art, this operation causes shaft 20 to rotate. I rotate the shaft until the pickup pawl 114 moves to the right, as viewed in FIGURE 1, to a position about six inches in back of that at which it will engage a signature 14 on the stationary saddle 12 upon its return movement to the left.

My control system includes a counter 168 made up of a plurality of flip-flop switching units 170, 172, 174, 176 and 178, of which only the first two units are shown in detail. Each of the units, such as the unit 170, includes an input relay latching winding 1NL, an input relay unlatching winding 1NU, respective normally open and normally closed input relay switches 1N1 and 1N2, an output relay latching coil 1FL, an output relay unlatching winding 1FU and output relay switches 1F1, 1F2, 1F3 and 1F4 as well as a number of isolating diodes. In the arrangement of unit 170, switches 1F1 and 1F4 are normally closed switches while switches 1F2 and 1F3 are normally open. The unit 172 includes similar components with the exception that they are designated by the initial numeral 2. Moreover, switch 2F4 is a normally open switch rather than a normally closed switch. I have not shown the details of the units 174, 176 and 178 but have only shown the F3 and F4 output switches of these units to simplify the explanation of the system.

First, to explain the operation of the counter 168, it is adapted to be responsive to a direct current potential such, for example, as that which is provided by a rectifier circuit 180 connected between conductors 154 and 162 to provide its output voltage on conductors 182 and 184. The first input pulse to unit 170 of counter 168 is provided in a manner to be described on a conductor 186 connected to switches 1F1 and 1F2. Considering the effect of this first input signal, it passes through switch 1F1 to coil 1NL to change switches 1N1 and 1N2 from their respective normally open and normally closed conditions to closed and open. The next input to the system is provided in a manner to be described on a conductor 188 connected to the common terminal of switches 1N1 and 1N2 to energize winding 1FL. When winding 1FL is energized, switches 1F1, 1F2, 1F3 and 1F4 change, respectively, from normally closed, normally open, normally open and normally closed, to open, closed, closed and open. Closing of switch 1F3 represents a count of 1 provided by the counter.

On the occurrence of the third input pulse on conductor 186, winding 1NU is energized to return switches 1F3 and 1F4 to their normal conditions. This pulse also passes through a conductor 190 to the winding 2NL through switch 2F1. Consequently, the switches 2N1 and 2N2 change, respectively, from open to closed and from closed to open. The fourth pulse to the system appears on conductor 188 from whence it is fed to the winding 2FL to change switches 2F1, 2F2, 2F3 and 2F4 from respective conditions of closed, open, open and open to open, closed, closed and closed.

The switches 1F3 to 5F3 respectively represent the five places of significance from most to least significant of a natural binary coded number. With all of the switches open a count of zero=00000 is represented. With all

switches closed the maximum count of thirty-one=11111 in the natural binary code is represented. It will readily be appreciated that my counter 168 contains as many units as are necessary to generate the maximum count desired. The closing of switch 2F3 with switch 1F3 now being open provides a representation in the natural binary system of 00010 representing 2. On the next two successive input pulses, switch 1F3 closes while switch 2F3 remains closed so as to provide a count of 00011 representing 3. The remainder of the system may be followed through in an analogous manner to demonstrate that the switches 1F3 to 5F3 provide a count representation in response to successive pairs of input pulses from zero to thirty-one.

I so arrange my system as to permit the count or the number of signatures for each book to be determined with ease. I connect respective switches C1 to C5 across the respective normally open switches 1F3 to 5F3 to permit the latter switches selectively to be removed from the counter circuit so as to give the desired count. For example, where I wish to assemble books having only 10 signatures each, I close switches C5, C3 and C1 leaving only switches C2 and C4 open to provide a count of 2+8 or 10. It is to be noted also that only switch 2F4 of all the switches 1F4 to 5F4 is normally open. As will be apparent from the explanation hereinafter, this arrangement is necessary to perform the first gluing operation at the proper point in the cycle.

Having operated the machine in the manner described above, to position the pickup pawl 16 at a position at which it is about to pick up a signature 14 on the saddle 12, the operator then presses the recycle pushbutton 1PB to energize a recycle relay winding 2R to open a normally closed switch 2R1 to close a normally open switch 2R2 and to close a normally open switch 2R3. Owing to this operation, a pulse is applied through switch 2R2 and through a conductor 192 to all of the output relay unlatching windings 1FU to 5FU to reset all of the units. When the pushbutton is released, the recycle relay 2R is de-energized and its associated switches return to their initial conditions. Actuation of 1PB also completes a circuit to a "start" lamp 196 through a normally closed relay switch 9R1, to be described hereinafter.

At this point in the cycle of operations, the leading portion of segment 148 in the direction of rotation indicated in FIGURE 3 has not yet reached switch 152 so that this switch is not active. In this condition of switch 152 its contact arm, which is designated as 1LS in FIGURE 4, engages contact 1LS1. When the segment 148 moves to a point at which it is adjacent switch 152, contact arm 1LS moves into engagement with contact 1LS2. Considering the beginning of the operation with arm 1LS in engagement with contact 1LS1, a relay winding 3R is energized to close a switch 3R1 and to open a switch 3R2. In this condition of the system both switches 3R1 and 2R1 are closed so that winding 1NL is energized and switches 1N1 and 1N2 are, respectively, closed and open. When shaft 20 is rotated to a point at which the segment is adjacent switch 152, arm 1LS moves out of engagement with contact 1LS1. Winding 3R is thus de-energized and contact switch 3R1 opens while contact 3R2 closes. In this manner a signal is supplied to winding 1FL from conductor 188 through switch 1N1 to close switch 1F3.

When segment 148 leaves switch 152, arm 1LS returns to contact 1LS1 to energize winding 3R to close switch 3R1 and to open switch 3R2. As a result of this action, winding 1NU is energized to unlatch the input relay of unit 170. Further, conductor 190 supplies a signal to winding 2NL through switch 2F1 to close switch 2N1 and to open switch 2N2. When segment 148 again influences switch 152, switch 3R1 opens and switch 3R2 closes to provide a signal to winding 2FL to close switch 2F3 and to close switch 2F4. Closing of switch 2F3 with switch 1F3 open represents a count of 2.

As has been pointed out hereinabove, all of the switches 1F4 and 3F4 to 5F4 are normally closed. Closing of switch 2F4 completes a circuit through all of the series-connected switches 1F4 through 5F4. I connect the switches 1F4 through 5F4 and a glue initiating relay winding 4R in series between contact 1LS2 and the conductor 162. Thus, when switch 152 is activated so that its arm 1LS moves away from contact 1LS1 to complete the second count and then into engagement with contact 1LS2, winding 4R is energized. Winding 4R closes a normally open switch 4R1 as well as a normally open switch 4R2. With switch 4R1 closed, glue solenoid control relay winding 5R is energized to close contacts 5R1 and 5R2 to energize solenoid 82, the winding of which is designated as G in FIGURE 4. When that occurs, arm 70 is moved away from the lug 76 to permit spring 68 to drive crank 64 to cause the bail 46 to apply glue to the second signature. As that signature is sewed to the first, it will also be glued to the first signature. In this way the first gluing operation is achieved.

Following the completion of the gluing operation, the count proceeds as before in response to movement of the arm 1LS into and out of engagement with contact 1LS1 on each revolution of shaft 20. After the fourth signature is fed, switch 3F3 closes. When the eighth signature is fed, switch 4F3 closes. It will be appreciated that at this time switch 2F3 is open. As the tenth signature is fed, however, switch 2F3 closes.

Assuming that I have set my machine to assemble books of ten signatures, each, switch C5 is closed and feeding of the tenth signature completes a circuit of a reset relay winding 6R from conductor 154 through switch C5, switch 4F3, switch C3, switch 2F3 and switch C1 to the relay winding 6R and to conductor 162. The first operation produced by energization of winding 6R is the second gluing operation. Switch 6R1, which closes in response to energization of winding 6R, is connected in parallel with switches 1F4 to 5F4 to energize winding 4R when arm 1LS engages contact 1LS2. As before, winding 4R closes switch 4R1 to energize winding 5R to close switches 5R1 and 5R2, to energize the glue solenoid winding G to cause glue to be applied to the last signature in the manner described above so that the last signature is glued to the next to last signature as it is sewed thereto.

Concomitant energization of windings 4R and 6R closes switches 4R2 and 6R2 to energize a first auxiliary relay winding 7R to close switches 7R1 and 7R2. Closing of the switch 7R1 provides a holding circuit for the auxiliary relay winding 7R after arm 1LS leaves contact 1LS2 to deenergize 4R. Closing of switch 7R2 completes a circuit for the recycle winding 2R from conductor 162, through winding 2R, through conductor 194, through switch 7R2, and through the switch 150, the contact arm 2LS of which normally engages a contact 2LS1 connected to conductor 154. At the same time a signal lamp 196 lights. The resultant energization of winding 2R closes switch 2R2 to provide a signal on conductor 192 to unlatch the relays of all of the units of counter 168. It also closes switch 2R3 to energize the second auxiliary relay 8R to close a switch 8R1. Winding 8R also closes switch 8R2 to bypass 2R3 and provide its own holding circuit. When the arm 1LS returns to the contact 1LS1 a circuit is complete for the cut relay control winding 9R from 1LS and 1LS1 through 8R1 through a normally closed pushbutton 2PB and through winding 9R to conductor 162. Winding 9R when energized opens contact 9R1 and closes winding 9R2 to provide a holding circuit through 9R2 to maintain light 196 on. Winding 9R further closes switch 9R3 to energize winding 10R to close contacts 10R1 and 10R2 to energize the winding C of the cut solenoid 136.

As has been explained hereinabove, when winding C is energized, shaft 128 is rocked to move arm 126 away from the end of lever 120 to rotate bell crank 112 in a clockwise direction. Then as cam 144 engages follower

142 the bell crank 112 is moved in a counterclockwise direction through a quarter revolution. When that occurs, plate 94 oscillates to cut the threads extending through opening 96. With the solenoid 136 de-energized, arm 126 is automatically reset in response to movement of lever 120 under the action of cam 144.

When arm 1LS returns to contact 1LS1, relay winding 4R drops out as explained hereinabove. As the pickup pawl 16 returns to pick up the next signature, which is the first signature of the next book, segment 148 is in proximity to switch 150 to activate the switch to cause its contact arm, indicated as 2LS in FIGURE 4, to move away from contact 2LS1 to interrupt the circuit of winding 2R. Arm 1LS leaves 1LS1 to de-energize 8R, 9R and 10R to ready the machine for the next operation. A normally closed pushbutton 2PB may be operated to disable the cutter operation if desired.

The operation of my automatic control system for a book sewing machine will readily be apparent from the above description. To summarize, the machine operator when preparing to assemble signatures into books first sets switches C1 to C5 which may be operated in response to a dial, for example, for the number of signatures which each book is to contain. For example, as shown in FIGURE 4, switches C1, C3 and C5 may be closed while switches C2 and C4 are open to make books containing ten signatures each. When that has been done, the operator turns on the power by closing switch S1. Next, switch S2 is closed by means of a foot pedal or the like to energize the brake and clutch solenoid BR to drive the machine to a point at which the pickup pawl 16 occupies a position somewhat before the pawl picks up a signature 14. Next, the recycle pushbutton PB1 is pressed to cause relay winding 2R to open switch 2R1 and to close switch 2R2 to provide a reset input signal to the counter to reset all of the counter switches. In this condition of the parts, the arm 1LS is in engagement with contact 1LS1 and an input is provided to the first counter unit 170 to energize its latching relay 1NL. As a signature advances through the machine, cam segment 148 influences switch 152 to move arm 1LS away from contact 1LS1 to cause relay 3R to supply a pulse to the counter to operate the output relay winding 1FL of unit 170 to close switch 1F3 indicating one count. The second count is registered in an analogous manner to close switches 2F3 and 2F4. Under these conditions, when arm 1LS engages contact 1LS2, winding 4R is energized through all the F4 switches to cause the first gluing operation to take place by energizing solenoid 82 to cause bail 46 to apply glue along the edge of the second signature as it is fed to the sewing station.

The count continues until finally the tenth count is registered wherein switch 4F3 is closed to complete a circuit through switch C5, switch 4F3, switch C3, switch 2F3 and switch C1 to energize winding 6R. First, switch 6R1 closes to provide the second gluing operation by energizing winding 4R. Simultaneous closing of contacts 6R2 and 4R2 energizes winding 7R to energize the reset relay winding 2R to close contacts 2R3 to energize auxiliary relay winding 8R which energizes winding 9R to maintain start lamp 196 lit and to energize winding 10R to complete the cutter solenoid circuit which results in the cutting operation described above. Energization of winding 2R also recycles the counter and ultimately switch 2LS leaves contact 2LS1 and the machine is ready for the next operation.

From the structure and operation described it will be clear that successive books are made without interruption of feeding of signatures by the operator. Moreover, if a malfunction occurs at any point in the cycle, the operator need only press the recycling button 1PB to start the machine over again.

It will be seen that I have accomplished the objects of my invention. I have provided an automatic control circuit for a book sewing machine which permits books

to be made continuously without interrupting feeding of signatures by the operator. My automatic control system does away with the necessity for employing skilled operators. It does not involve any wasted operations of the machine. It greatly facilitates switching between books requiring different numbers of signatures. It is especially adapted for use in making books requiring a small number of signatures.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. It is further obvious that various changes may be made in details within the scope of my invention. It is, therefore, to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. A control system as in claim 19 including means for automatically resetting said counting means at the end of a book-assembling operation.

2. A control system as in claim 19 including manually operable means for resetting said counting means.

3. A control system as in claim 19 in which said machine comprises a shaft, means for feeding a signature into said machine on each revolution of said shaft, said signal producing means actuating said counting means to produce a count on each revolution of said shaft and means responsive to rotation of said shaft for resetting said counting means within a revolution of said shaft.

4. A control system as in claim 19 in which said first and second signal-responsive means comprise a common relay adapted to be actuated to operate said gluing means, said first signal-responsive means comprising a normally open switch adapted to be closed on the second signal to energize said relay, said second signal-responsive means comprising a second normally open switch adapted to be closed on the signal corresponding to the last signature of a book for closing said relay.

5. A control system as in claim 19 in which said counting means comprises a plurality of respective normally open switches closed as said counter reaches various counts, said counter being adapted to register a maximum count upon closure of all of said switches and means for selectively shunting said switches to set said counter for a count within said maximum count.

6. A control system as in claim 19 in which said counting means comprises a plurality of normally open switches corresponding to the respective places of significance of a binary coded representation, means responsive to successive pairs of input pulses for alternating the switch corresponding to the least significant place between its normally open state and a closed state and means responsive to every other pair of input pulses for changing the state of the switch corresponding to the next-to-least significant place to cause said counter switches to produce an output binary coded representation and means responsive to signal of said series for feeding pairs of pulses to said counter.

7. A control system as in claim 19 in which said counting means is adapted to provide an output representation in response to pairs of input pulses and means responsive to signals of said series for feeding pairs of pulses to said counter.

8. A control system as in claim 19 in which said machine has a shaft and in which said counting means is adapted to produce an output representation in response to pairs of input pulses, said signal producing means comprising a proximity switch and an influence cam on said shaft for feeding pairs of pulses to said counter in response to rotation of said shaft.

9. A control system as in claim 19 in which said machine has a shaft, said pulse pair feeding means comprising a relay said signal producing, means responsive to rotation of said shaft for alternately energizing and deenergizing said relay, means responsive to energization of said relay for applying a first pulse to said counter and means

responsive to deenergization of said relay for applying a second pulse to said counter.

10. A control system as in claim 19 in which said last signal-responsive means comprises a cutter actuating switch, said counting means comprising a plurality of normally open switches and means responsive to said signals for closing said counter switches and means responsive to closing of all of said counter switches for closing said cutter actuating switch.

11. A control system as in claim 19 including a recycling relay, a normally closed limit switch, a normally open auxiliary relay switch and means responsive to said last signal corresponding to the last signature of a book for closing said normally open auxiliary relay switch to energize said recycling relay through said limit switch.

12. A control system as in claim 19 including a recycling relay, a normally closed limit switch, a normally open auxiliary relay switch, means responsive to said last signal corresponding to the last signature of a book for closing said normally open auxiliary relay switch to energize said recycling relay through said limit switch, said last signal-responsive means comprising a normally open cutting means control switch and means responsive to said recycling relay for closing said cutting means control switch.

13. A control system as in claim 19 including a recycling relay, a normally closed limit switch, a normally open auxiliary relay switch, means responsive to said last signal corresponding to the last signature of a book for closing said normally open auxiliary relay switch to energize said recycling relay through said limit switch and means responsive to said recycling switch for resetting said counting means.

14. A control system as in claim 19 in which said last signal-responsive means comprises a normally open cutting means control switch, said machine including a shaft, a cam on said shaft, a recycling relay, a normally closed limit switch adapted to be actuated by said shaft, means responsive to said last signal corresponding to the last signature of a book for closing said normally open relay switch to energize said recycling relay through said limit switch and means responsive to energization of said recycling relay for actuating said cutting means control switch.

15. A control system as in claim 22 in which said machine comprises a shaft and means for feeding a signature into said machine on each revolution of said shaft, said signal producing means including means responsive to rotation of said shaft for actuating said counting means to produce a count on each revolution of said shaft.

16. A control system as in claim 22 in which said machine comprises a shaft, means for feeding a signature into said machine on each revolution of said shaft, said signal producing means including means responsive to rotation of said shaft for actuating said counting means to produce a count on each revolution of said shaft and means responsive to rotation of said shaft for resetting said counting means within a revolution of said shaft.

17. A control system as in claim 22 in which said first and second signal-responsive means comprise a common relay adapted to be actuated to operate said gluing means, said first signal-responsive means comprising a normally open switch adapted to be closed on the second count of said counter to energize said relay, said second signal-responsive means comprising a second normally open switch adapted to be closed on the signal corresponding to the last signature of a book for closing said relay.

18. A control system as in claim 22 including a recycling relay, a normally closed limit switch, a normally open auxiliary relay switch, means responsive to said last signal corresponding to the last signature of a book for closing said normally open auxiliary relay switch to energize said recycling relay through said limit switch and means responsive to said recycling switch for resetting said counting means.

19. A control system for a book sewing machine for assembling a series of signatures fed to said machine into a book, said machine having means adapted to be actuated to apply adhesive to a signature passing through said machine and having means adapted to be actuated to cut threads extending from a book assembled on said machine including in combination, means responsive to signatures fed to said machine for producing a series of signals corresponding respectively to the signatures of said series, said series of signals comprising a second signal corresponding to the second signature of said series and a last signal corresponding to the last signature of said series, means for counting said signals, means comprising said counting means responsive to said second signal for actuating said adhesive applying means to glue the first signature of said book to the second signature thereof, and means comprising said counting means responsive to said last signal for actuating said adhesive applying means to glue the last signature of said book to the next-to-last signature thereof and to actuate said cutting means at the end of said book assembly operation.

20. A system as in claim 19 in which said book is a first book, and in which said signature feed responsive means produces a second series of signals corresponding respectively to the signatures of a series of signatures making up a second book said second series of signals being continuous with the first series of signals, and in which said second signal responsive means is responsive to the signal of the second series corresponding to the second signature of the second book.

21. A control system in claim 19 in which said counting means comprises a normally open switch and means responsive to said second signal for closing said switch, said second signal responsive means comprising of a relay

and means responsive to closing of said switch for energizing said relay.

22. A control system for a book assembling machine for assembling a series of signatures fed to said machine into a book, said machine having means adapted to be actuated to apply adhesive to a signature passing through said machine including in combination, means responsive to signatures fed to said machine for producing a series of signals corresponding respectively to the signature of said series, said series of signals comprising a second signal corresponding to the second signature of said series and a last signal corresponding to the last signature of said series, means for counting said signals, means including said counting means responsive to said second signal for actuating said adhesive applying means to glue the first signature of said book to the second signature thereof, and means including said counting means responsive to the last signal for actuating said adhesive applying means to glue the last signature of said book to the next-to-last signature thereof.

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U.S. Cl. X.R.

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