May 2, 1967 V. A. ZUGEL ET AL 3,317,026

SIGNATURE HANDLING MECHANISM

Filed Sept. 29, 1964 4 Sheets-Sheet 1

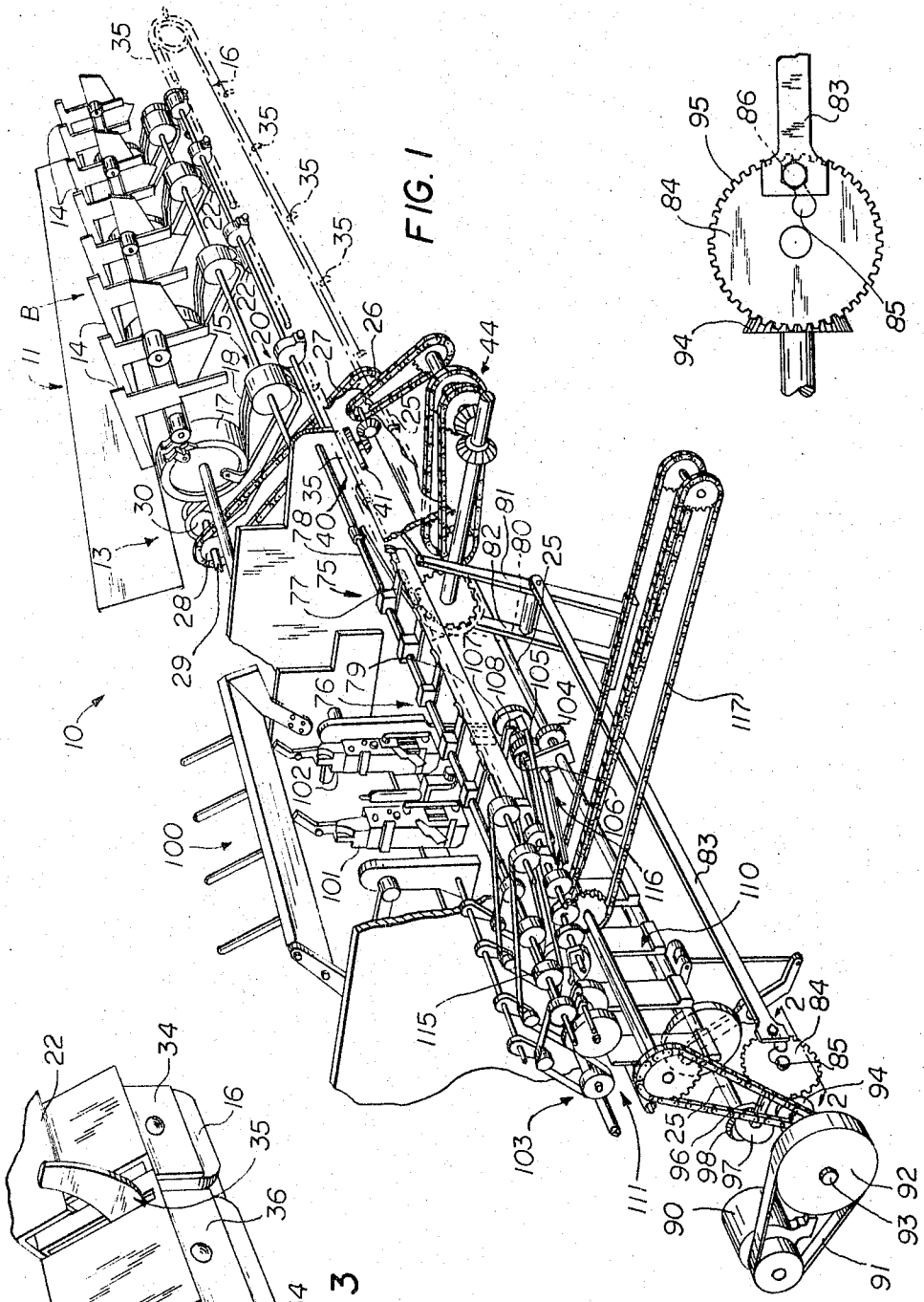


FIG. 1

FIG. 2

FIG. 3

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Filed Sept. 29, 1964 4 Sheets-Sheet 2

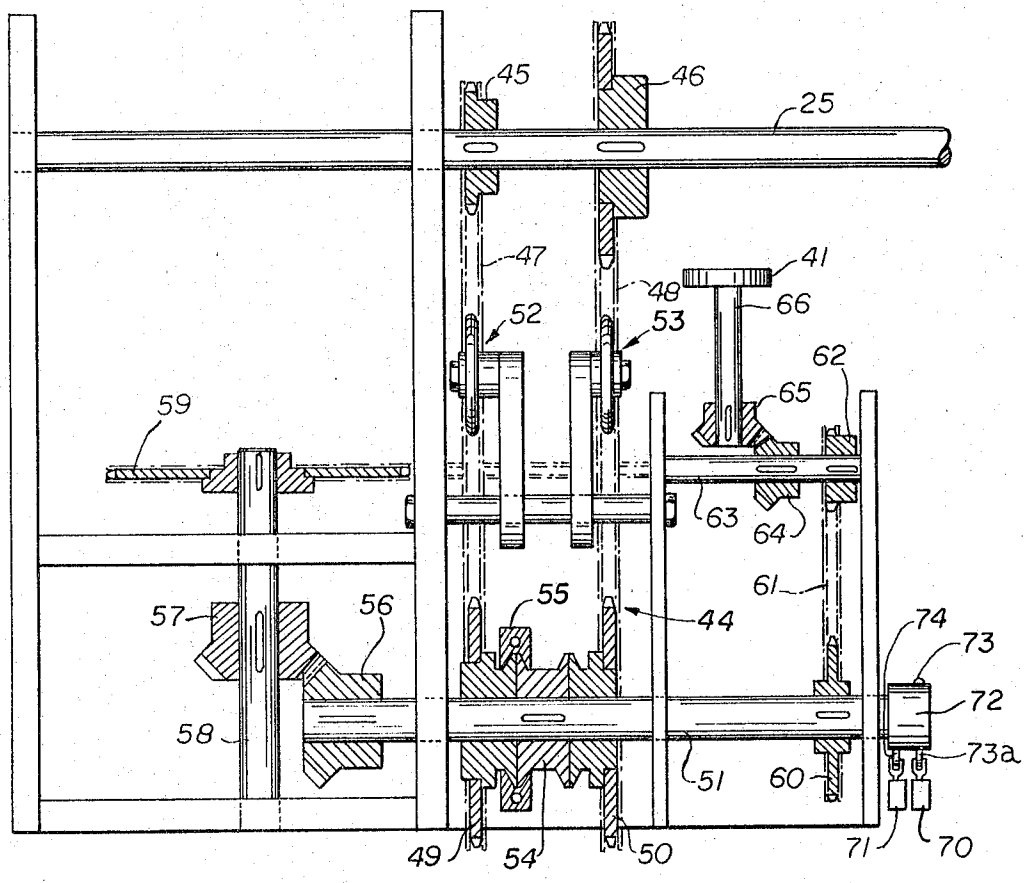


FIG. 4

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SIGNATURE HANDLING MECHANISM

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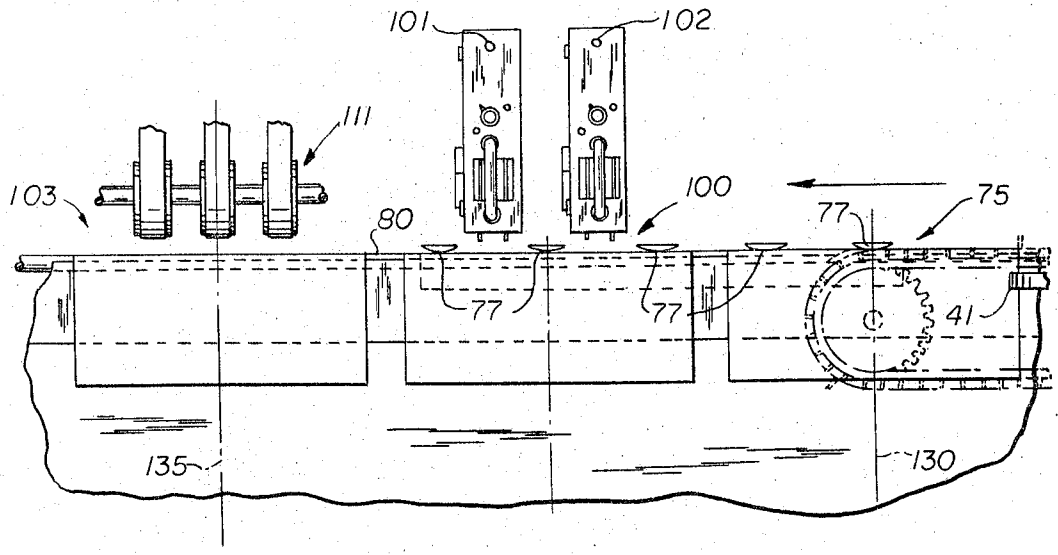


FIG. 5

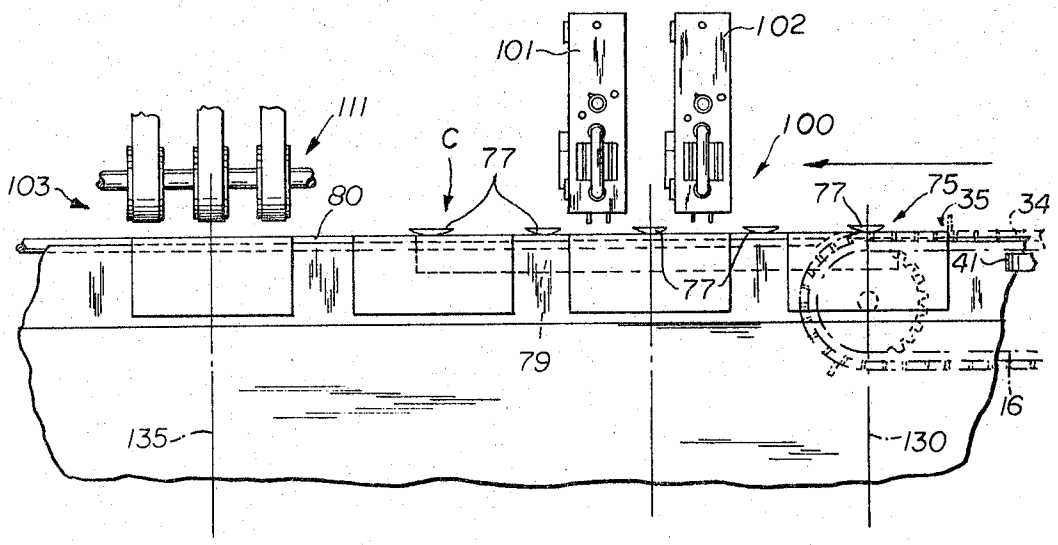


FIG. 6

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SIGNATURE HANDLING MECHANISM

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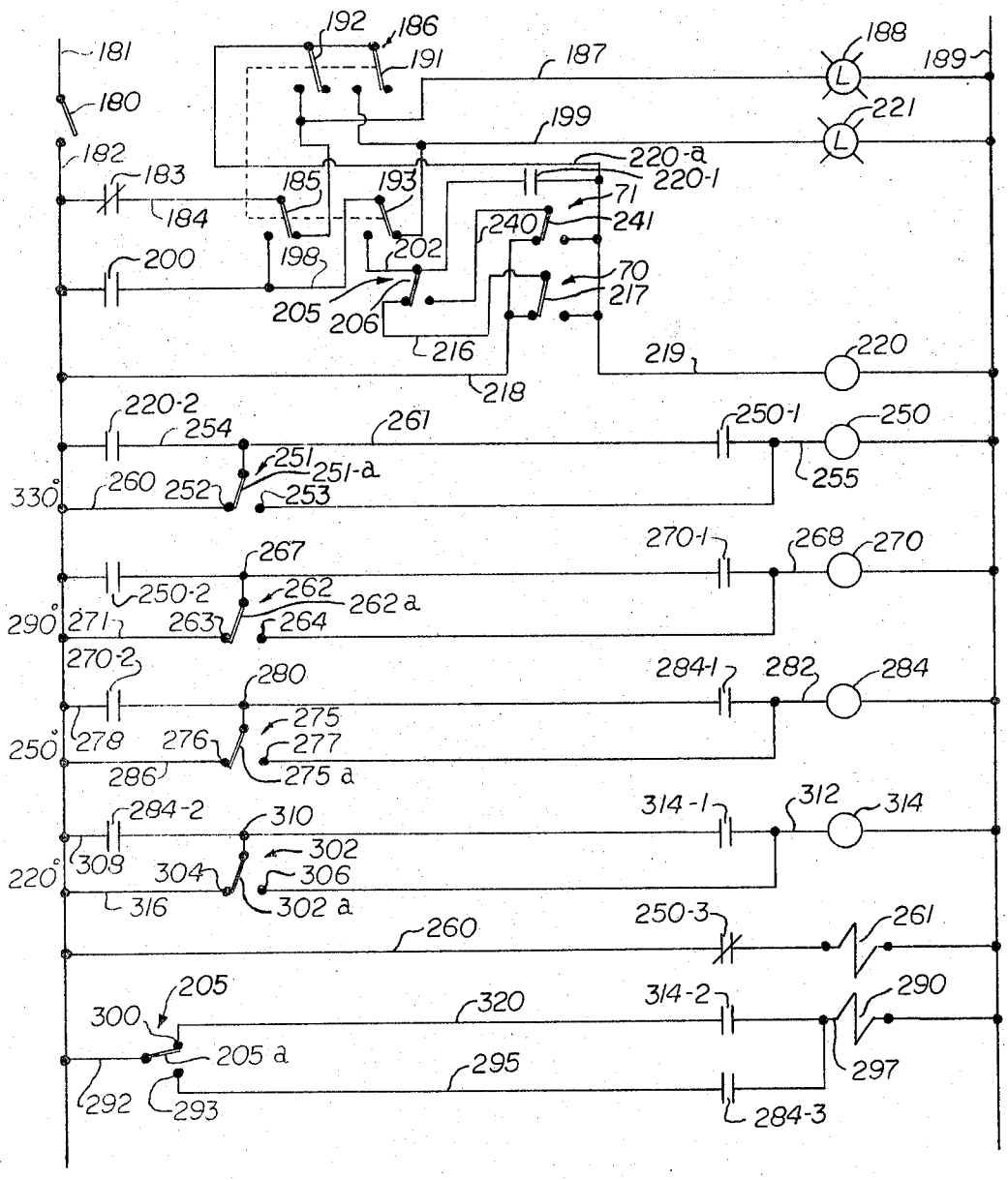


FIG. 7

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3,317,026

SIGNATURE HANDLING MECHANISM

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13 Claims. (Cl. 198—133)

The present invention relates to a signature handling mechanism, and particularly to a signature handling mechanism operable to assemble a plurality of signatures into a book and then inspect the book to determine if it is of the proper thickness.

Known signature handling mechanisms include a collator section in which a plurality of signatures are assembled to form a book, an inspection station at which a detector wheel senses the thickness of the book, and a stitcher station at which the book is stitched or stapled to secure the signatures together. The collator section generally includes a plurality of signature feeder means for feeding individual signatures to a signature conveyor. The signature conveyor has a plurality of pusher members thereon spaced a predetermined distance apart and which engage the signatures to move them upon movement of the signature conveyor. The signature conveyor conveys the assembled signatures or book through the inspection station and to a position adjacent to the stitcher station at which a reciprocating shuttle mechanism engages the book and moves the book to a position at the stitcher station. The known signature handling mechanisms also include an eject station where books of improper thickness are ejected and a trimmer station where the books of proper thickness are trimmed. The shuttle mechanism is operable to move a book from the stitcher station to a position from which the signature may either be fed to the trimmer station or ejected from the machine. These known signature handling mechanisms have not been capable of ready adjustment and setup for the handling of different size signatures. They have required replacement of certain parts, such as the detector wheel, and the use of change gears to achieve the desired driving relationship between the various parts of the machine when being set up for the handling of different size signatures.

Accordingly, the principal object of the present invention is the provision of a new and improved signature handling mechanism which may be readily adjusted for handling different size signatures without the necessity of replacing parts or the use of change gears.

A further object of the present invention is the provision of a new and improved signature handling mechanism which may be readily adjusted for handling different size signatures and which may be operated at different speeds in order to provide for a high signature output and good control of the signatures as they are moved through the machine.

Another object of the present invention is the provision of a new and improved signature handling mechanism having a detector wheel located at an inspection station for sensing the thickness of books conveyed thereby and which need not be changed for the sensing of books of different lengths.

Still another object of the present invention is the provision of a new and improved signature handling mechanism, as noted in the next preceding paragraph, and having a control means selectively responsive to the sensing by the detector wheel of books of different lengths being of improper thickness.

Yet another object of the present invention is the prosion of a new and improved signature handling mechanism wherein the signature pushers on the signature conveyor are adapted to be supported at a first predetermined distance apart for conveying signatures of a first size or at

a second predetermined distance apart which is a whole multiple other than one of the first predetermined distance for conveying signatures of a second size and wherein the detector wheel has a circumference equal to the second predetermined distance and is driven at the same surface speed of the conveyor and is effective for sensing the thickness of signatures of both said first and second sizes.

A further object of the present invention is the provision of a new and improved signature handling mechanism, as noted in the next preceding paragraph, having a control circuit for controlling a machine function on a book of improper thickness and which includes detector actuated switch means, a first control switch actuated on each rotation of the detector wheel, and a second control switch actuated once for rotation of the detector wheel a number of times equal to the multiple, and a selector switch for selectively connecting the first and second control switches with the detector actuated switch.

A still further object of the present invention is the provision of a new and improved signature handling mechanism having a conveyor means for delivering books to a shuttle pick-up station where a reciprocating shuttle mechanism engages a book and which is operable to move the book to a shuttle delivery station and where the stroke of the shuttle mechanism may vary between first and second stroke lengths and the distance between the pick-up and delivery stations is nonvariable and is a whole multiple of the first and second stroke lengths of said shuttle mechanism.

Further objects and advantages of the present invention will be apparent to those skilled in the art to which it relates from the following detailed description of the preferred embodiment thereof made with reference to the accompanying drawings and in which:

FIG. 1 is a schematic perspective view of a signature handling mechanism embodying the present invention;

FIG. 2 is a fragmentary view of a portion of the signature handling mechanism of FIG. 1, looking at the signature handling mechanism of FIG. 1 as indicated by the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary perspective view of still another portion of the signature handling mechanism shown in FIG. 1;

FIG. 4 is a schematic view illustrating a portion of the drive mechanism of the signature handling mechanism of FIG. 1;

FIG. 5 is a schematic view illustrating the location of books of a particular length in the signature handling mechanism of FIG. 1;

FIG. 6 is a view similar to FIG. 5 and illustrating the location of the books of a length smaller than that shown in FIG. 5 in the signature handling mechanism of FIG. 5; and

FIG. 7 is a schematic electrical diagram of a portion of the electrical circuit embodied in the signature handling mechanism of FIG. 1.

The preferred embodiment of the present invention is shown in FIG. 1 which illustrates a signature handling mechanism **10**. The signature handling mechanism **10** is operable to collect or assemble a plurality of signatures into a book and secure the signatures together as by stapling. The signatures are assembled in a collator portion **11** of the signature handling mechanism **10** which includes a plurality of signature feeding stations **13** at each of which a hopper **14** supports a plurality of signatures. Each hopper **14** is adjustable so as to support signatures of different lengths. A suitable feeding means **15** feeds signatures individually from a hopper **14** to a position adjacent a signature conveyor **16** which runs through each of the feeding stations **13**. The feeding means **15** may be of any suitable construction and is here shown, by way of example, as including a suitable drum

member 17 operable to deliver individual signatures from a hopper 14 to endless chain members 18 which feed the signatures from the drum 17 toward the signature conveyor 16. Suitable signature opening means 20 is provided at each of the stations 13 in order to effect opening of the signatures and dropping of the signatures on swordlike saddle members 22 adjacent the signature conveyor 16.

The feeding means 15 are driven from a main drive shaft 25 which carries a sprocket 26 located adjacent to the feeding means 15. The sprocket 26 has a chain 27 trained therearound and the chain 27 is also trained around a sprocket 28 carried by a shaft 29 which extends parallel to the conveyor 16. The shaft 29 carries the drive sprockets 30 for the chain members 18 of the feeding means 15. The shaft 29 is suitably geared, not shown, to the drive for the drums 17 and opening means 20. The drive for the feeding means 15 is such that for one revolution of the main drive shaft 25, the feeding means delivers one signature into position on the saddle members 22.

The signature conveyor 16 which receives the signatures delivered by the feeding means 15 comprises an endless chain member having crown members 34 positioned thereon and on which the signatures rest. The chain member also releasably carries a plurality of pusher members 35 which are spaced a predetermined distance apart along the length of the endless chain member. The pusher members 35 may be readily removed or added to the conveyor 16 to vary the spacing therebetween. The spacing between the pusher members is varied when the signature handling mechanism is set up for the handling of signatures of different sizes. The pusher members 35 are supported in slots in the crown members 34 and are held therein by suitable detent securing means which permits ready positioning on the conveyor and ready removal thereof from the chain. The pusher members, as best seen in FIG. 3, cooperate with swordlike saddle members 22 and push the signatures off the saddle members 22 and onto the crown members 34 in front of the pusher members 35 and are moved therewith. It should be apparent that as a given pusher member 35 moves through each of the feeding stations 13, a signature is positioned on the conveyor 16 in front of the pusher, thereby effecting the assembly of a pamphlet or book as the conveyor 16 moves therealong, as is well known.

The signature handling mechanism 10 includes an inspection station 40, at which the assembled signatures or book, as it is being conveyed by the conveyor 16, is inspected to determine whether or not the book is too thick or too thin. The book, of course, would be too thin if one of the feeding means 15 at one of the feeding stations 13 was ineffective to feed a signature, and would be too thick if one of the feeding means 15 fed two or more signatures rather than one. At the inspection station 40, a suitable detector wheel 41 is located and which is driven in timed relation to the feed of the books by the signature conveyor 16 and engages the books so as to effect the inspecting operation. The detector wheel 41 is suitably supported in a well-known manner for movement inwardly in the event a book is conveyed therepast which is missing a signature and is thus too thin, and outwardly in the event that a book is conveyed therepast which has too many signatures therein and is thus too thick. This particular mounting of the detector wheel 41 will not be described in detail, since it is conventional and well known.

The detector wheel 41 and signature conveyor 16 are driven in timed relation with the feeding means 15. The signature conveyor 16 and detector wheel 41 are driven from the main drive shaft 25 by a drive which includes a selective drive mechanism 44, best seen in FIG. 4, for varying the speed of the conveyor 16 and detector wheel 41 relative to the speed of operation of the feeding means 15, so that the feeding means and conveyor 16 may operate at a speed relationship wherein the feeding means delivers one signature to the conveyor for a predetermined amount of movement of the conveyor or at another speed relationship wherein the feeding means feeds a plurality of signatures to the signature conveyor for the same predetermined amount of movement of the conveyor.

The selective drive mechanism 44 in the present embodiment is operable to drive the signature conveyor 16 and detector wheel 41 at two speeds relative to the feeding means 15 and includes a pair of driving members or sprockets 45, 46 carried by the main drive shaft 25 and located adjacent to one end of the signature conveyor 16. The sprockets 45, 46 have chains 47, 48, respectively, trained therearound. The chains 47, 48 are also trained around sprockets 49, 50, respectively, both of which are rotatably supported on a shaft 51 which extends substantially parallel to the drive shaft 25. Suitable tensioning means 52, 53 are provided for providing sufficient tension in the chains 47, 48, respectively.

The sprockets 49, 50 are selectively fixedly secured to the shaft 51 so as to effect rotation thereof upon rotation of the sprockets 49, 50. Specifically, the sprockets 49, 50 may be fixedly secured to a suitable collar member 54 fixedly secured to the shaft 51 by a cooperating collar 55, of conventional construction, which clamps either the sprocket 49 or the sprocket 50 to the collar member 54 so as to effect rotation of the shaft 51 with either the sprocket 49 or the sprocket 50. As shown in FIG. 4 of the drawings, the collar 55 is positioned so as to effect driving of the shaft 51 from the sprocket 49, in which position the sprocket 50 "free wheels" or rotates relative to the shaft 51. The particular selection of the size of the sprockets 45, 49, on the one hand, and sprockets 46, 50, on the other hand, is such as to drive the shaft 51 at two different speeds. The sprocket 45 is approximately one-half the size of the sprocket 46, while the sprockets 49, 50 are approximately the same size as the sprocket 46. This provides a 2:1 drive ratio when the shaft 51 is rotated by the sprocket 45, whereas a 1:1 drive ratio is provided when the sprocket 46 drives the shaft 51. By a 2:1 drive ratio, of course, it is meant that the shaft 25 rotates twice for one revolution of the shaft 51, while a 1:1 ratio is such that the main drive shaft 25 rotates once for one revolution of the shaft 51. It should be apparent, therefore, that the shaft 51 rotates at either a full or half speed relative to the drive shaft 25.

The shaft 51 which may be driven at either full or half speed by the selector drive mechanism 44 is drivingly connected to the signature conveyor 16 and the detector wheel 41 and thus comprises a common drive member therefor. The left end of the shaft 51, as viewed in FIG. 4, is provided with a bevel pinion gear 56 which, in turn, meshes with a bevel pinion gear 57 mounted on a stub shaft 58 which is rotatably supported in the frame of the signature handling mechanism. Stub shaft 58 carries at one end thereof a driving sprocket 59 around which the signature conveyor 16 is trained and which functions as the driving sprocket for the signature conveyor 16.

The end of the shaft 51 opposite the end carrying the pinion gear 56 has a sprocket wheel 60 rotatably supported thereon and around which a chain 61 is trained. The chain 61 is also trained around a sprocket 62 fixedly secured to a stub shaft which carries a bevel pinion gear 64 which meshes with another bevel pinion gear 65 fixedly secured to a substantially vertically extending stub shaft 66 rotatably supported in the frame of the machine. The stub shaft 66 is drivingly connected with the detector wheel 41 to effect rotation thereof upon rotation of the shaft 66. The relative sizes of the sprockets 60 and 62 is such as to provide a 1:2 drive ratio therebetween, that is, one revolution of the sprocket 60 effects two revolutions of the sprocket 62 and, in turn, two revolutions of the detector wheel 41.

The circumference of the detector wheel **41** is such that for one rotation thereof the conveyor **16** moves a distance equal to the circumference thereof so that the surface speed of the detector wheel **41** equals the surface speed of the books conveyed by conveyor **16**. It should be understood that the detector wheel periphery may not be a complete circle but that the detector wheel may have a portion of the periphery forming an arc of a circle which functions as the detecting portion thereof and by circumference it is meant the periphery of the circle on which the detecting arc lies. Normally, the detecting wheel is cut away so as not to engage the signatures at all times but only by the detecting portion or arc. In the preferred embodiment, the circumference equals the distance that the conveyor moves upon half a revolution of the shaft **51** and, as described hereinabove, the detector wheel **41** rotates twice for one revolution of the shaft **51**, and, therefore, once for one-half a revolution of the shaft **51**.

The detector wheel, as noted above, moves inwardly and outwardly to sense a book of improper thickness and upon movement either inwardly or outwardly actuates a suitable control switch means which, in turn, provides for actuating a machine control function, as will be described in detail hereinbelow. It should be apparent from the above description, however, that the detector wheel may sense each book conveyed therepast and provide a control function on that book if it is of an improper thickness. If the pusher members **35** are spaced along the chain conveyor a distance equal to the circumference of the detector wheel, a control signal will result upon each revolution of the detector wheel. However, in the event that the pusher members are located at a distance greater than the circumference of the detector wheel so that the circumference is a whole multiple of the spacing therebetween, such as two times the circumference of the detector wheel, a control signal will result on two revolutions of the detector wheel. To this end, the machine is provided with suitable control switches, one of which is actuated for each revolution of the detector wheel and is operative upon actuation to provide a control signal for controlling the machine function, while the other of the control switches is actuated upon the rotation of the detector wheel a number of times equal to the multiple of the circumference of the detector wheel to the spacing between the pusher members.

These switches are designated **70**, **71**, respectively, and are actuated upon rotation of the shaft **51**. To this end, the outermost end of the shaft **51** carries a suitable collar member **72**. The collar member **72** rotates adjacent to the control switches **70**, **71**. The switches **70**, **71** are actuated by lug members **73**, **73***a*, and **74**, respectively. The switch **71** is actuated by the lug member **74** upon each revolution of the shaft **51**, and since the shaft **51** upon one revolution thereof effects rotation of the detector wheel twice, the lug member **74** actuates the switch **71** once for two revolutions of the detector wheel **41**. The switch **70** is actuated twice for each rotation of the shaft **51**, once by the lug **73** and once by the lug **73***a* which are spaced 180° apart. It can be seen, therefore, that the switch **70** is actuated once per revolution of the detector wheel **41**, while the switch **71** is actuated once every two revolutions of the detector wheel. The particular function of the switches **70**, **71** and the closing thereof by the lugs **73**, **73***a*, and **74**, respectively, will be described in detail hereinbelow in connection with the description of the electrical circuitry included in the apparatus.

After inspection, the signature conveyor **16** moves the books beyond the inspection station **40** and to a shuttle pickup station or conveyor delivery station **75**. At the shuttle pickup station **75**, the signatures are engaged by a reciprocating shuttle feeding mechanism **76**. The shuttle feeding mechanism **76** includes a plurality of signature-engaging clamping fingers **77** supported on a bar **78**, in order to effect a clamping of the signatures for feeding purposes. The mechanism for moving the clamping

fingers **77** toward and away from the plate **79** is conventional and thus is not shown or described. The clamp plate **79** is supported on a bar **80** and is movable so as to be located beneath a book at the shuttle pickup station **75**.

The fingers **77** and the clamp plate **79** are reciprocated along a linear path of movement by a suitable linkage mechanism including a pair of links **81**, **82** pivotally supported at one end thereof. A crank arm **83** is connected at its one end to the links **81**, **82** and is operable to pivot the links **81**, **82**. The links **81**, **82** are connected to the bars **78**, **80**, respectively, by a suitable linkage to effect reciprocation thereof upon pivoting movement of the links **81**, **82**.

The end of the crank arm **83** opposite the end connected to the links **81**, **82** is connected to a suitable rotating crank member **84** having a pair of openings **85**, **86** therein connected by a slot, best seen in FIG. 2. The end of the crank arm **8** opposite the end connected to the links **81**, **82** may be selectively connected in either of the openings **85**, **86**. The openings **85**, **86** are spaced radially of the rotating crank member **84** and it should be apparent that when the link **83** is connected in the opening **86** in the member **84**, the shuttle mechanism will have a relatively long stroke, whereas if it is connected in the opening **85**, the shuttle mechanism will have a short stroke. It should be apparent, of course, that for one rotation of the member **84**, the shuttle mechanism will move through a complete cycle, that is, through a forward and return stroke, regardless of the length of the stroke. When the signature handling mechanism is handling signatures of relatively short size, the shuttle mechanism stroke is maintained relatively short. Whereas, when signatures of a relatively large size are being handled, the stroke is adjusted to a long stroke.

The shuttle feeding mechanism **76** is driven in timed relationship to the signature conveyor **16** by an adjustable speed electric motor **90** which also effects rotation of the main drive shaft **25** of the signature handling mechanism **10**. The output shaft of the motor **90** rotates a suitable pulley around which a drive belt **91** is trained. The belt **91** is also trained around a flywheel **92**. The flywheel **92** is nonrotatably carried at one end of a shaft **93**, the other end of which supports a bevel gear **94**. The bevel gear **94** meshes with gear teeth **95** on the rotating crank member **84** which, as described above, effects movement of the shuttle feeding mechanism **76** through a complete cycle when rotated one complete revolution. The rotating crank member **84** is fixedly secured at one end to a shaft **96** which carries a bevel pinion gear **97** at the other end thereof. The bevel pinion gear **97** is in driving engagement with a pinion gear **98** mounted on the main drive shaft **25** which extends along the length of the signature handling mechanism.

The shuttle mechanism **76** when it moves a book from the shuttle pickup station **75**, moves the book to a stapling or stitching station **100**, at which, in the preferred embodiment, two stapling heads **101**, **102** are located. The stapling heads **101**, **102** may be of any conventional construction and are operated in a vertical direction to effect stapling of the books when they are positioned thereunder. Moreover, the stitching heads **101**, **102** may be adjusted laterally so as to be properly positioned over a signature regardless of the size thereof. After stapling, the books are fed by the shuttle mechanism **76** to a delivery station **103**. The fingers **77** of the shuttle mechanism are positioned on the bar **78** and the clamp plate **79** extends so that the gripper fingers **77** are operable to grip a signature at the stitching station **100**, as well as at the shuttle pickup station **75** to effect simultaneous movement of the books at these stations.

The stitcher heads **101**, **102** are driven vertically by the drive arrangement connected with the main drive shaft **25**. The main drive shaft **25** has a stitcher head driving pinion gear **104** secured thereto and in mesh with a pinion gear **105** carried on a shaft **106** which carries a

suitable cam **107** which effects vertical reciprocation of the stitcher heads **101, 102** upon rotation thereof. A suitable clutch mechanism **108** is interposed between the gear **105** and the cam **107** and when disengaged stops rotation of the cam which, in turn, stops the vertical reciprocatory movement of the stitcher heads **101, 102**. The clutch mechanism **108** is of any conventional construction and is disengaged upon deenergization of a solenoid, as will be clearly described hereinbelow, to prevent the operation of the stitching heads on a book of improper thickness. The deenergization of the solenoid is effected upon sensing by the detector wheel **41** that a book of improper thickness is being conveyed and the detector wheel, as described hereinabove, sets up a control circuit which will be described hereinbelow to prevent the operation of the stitching heads when that book of improper thickness is in position under the stitching heads.

As noted hereinabove, the books are moved to the delivery station **103** by the shuttle mechanism **75**. The books are moved from the delivery station **103** in a direction substantially perpendicular to the direction of feeding by the signature conveyor **16** and the shuttle mechanism **76**. This feeding of the books from the delivery station **103** is effected by a reciprocating blade means **110** which moves vertically and engages a book at the delivery station **103** and moves the book into the nip of a delivery conveyor belt mechanism **111** which, in turn, feeds the book toward the trimmer mechanism, not shown.

The books which are of improper thickness and have not been stitched are ejected from the machine as they are being fed toward the trimming mechanism. The ejection of the books is under the control of the detector wheel **41** and ejection is actuated by operation of the detector wheel and the control circuitry to be described hereinbelow. The book is ejected or removed from the machine by operation of ejector guide fingers **115**. The ejector guide fingers **115** are located adjacent the conveyor belt mechanism **111** and are movable into the path of movement of a book. When the fingers **115** move into the path of movement of the book, they guide the book into a magazine **116** and out of the path of movement toward the trimming mechanism. Thus, the books of improper thickness are removed from the signature handling mechanism and are not trimmed in the trimming mechanism. The guide fingers **115** are moved to their position to eject a book upon actuation of a suitable control, to be described hereinbelow. If the book is not ejected, of course, it is fed to the trimming mechanism by a suitable conveyor **117**. The trimming mechanism may take many forms but preferably is such as shown in United States Patent No. 3,148,574.

The signature handling apparatus **10**, due to the particular drive relationship described hereinabove, is readily adjustable for the handling of large and small size signatures at relatively high speeds as desired and with good control of the signatures. For the handling of relatively large size signatures, the pushers **35** on the conveyor **16** are spaced a predetermined distance apart equal to the distance traveled by the conveyor **16** on one revolution of the shaft **51**. The selective drive mechanism **44** is adjusted to drive the shaft **51** in a 1:1 relationship with the cam shaft **25** so that the feeding means **15** delivers one large size signature for movement of the conveyor through the distance between pushers. The detector wheel **41**, as noted above, rotates twice during the movement of the conveyor **16** the distance equal to the distance between the signature pushers. However, due to the operation of the switch **71**, the detector wheel provides a control operation only once for the two revolutions thereof.

The shuttle feeding mechanism **76** is adjusted so as to have its long stroke, and specifically the end of the arm **83** is connected in the recess **86** in the member **84**, thus providing the relatively long stroke. The length of the shuttle stroke, however, is in this position a full multiple of the distance between the centerline of the trimming mechanism at which the center of the books are located when in delivery station **103** and the centerline of the sprocket conveyor at which the center of the books are located when at the shuttle pickup station **75**, so that through a whole number of strokes the books are moved this distance. Moreover, this distance is nonvariable in that it is not changed when handling different size signatures.

When the signature handling mechanism **10** is operating on large size signatures in accordance with the above, the signatures are delivered individually to the signature conveyor **16**, assembled into a book and conveyed through the inspection station to the shuttle pickup station **75**, at which the centerline of the signatures is on the centerline of the sprocket **59** of the signature conveyor **16**. The line **130** in FIG. 5 designates the centerline of the driving sprocket **59** of the signature conveyor **16**. The shuttle mechanism after it engages a book at the shuttle pickup station **75** moves the book in the direction of the arrow to the stitching station **100** intermediate the centerline **130** of the sprocket **59** of the signature conveyor **16** and the centerline **135** of the trimming mechanism.

The shuttle mechanism then returns to the shuttle pickup station **75** to move the next signature into the stitching station. When the shuttle mechanism engages the next signature, it also engages the previously moved signature located at the stitching station **100** and moves the signature at the stitching station **100** to the delivery station and the signature at the shuttle pickup station **75** to the stitching station **100**. Thus, the shuttle mechanism handles two signatures at one time and shifts them an equal distance.

When it is desired to handle smaller size signatures, additional pusher members **35** are positioned on the conveyor **16** and halfway between the pushers **35** which are on the chain conveyor for the handling of large size signatures. The shuttle feeding mechanism **76** is adjusted so that the stroke thereof is relatively short and to this end, the crank connection is moved into the opening **85** in the drive member **84**. The selective drive mechanism **44** is adjusted so as to drive the signature handling conveyor **16** and the detector wheel **41** at a reduced speed relative to the feeding mechanism **15** and specifically at one-half the speed of the feeding mechanism **15**. In this position, the sprocket **45** drives the signature conveyor and at one-half the speed at which the conveyor was driven by the sprocket **46**. However, the conveyor **16**, of course, is capable of carrying twice the number of small signatures and, therefore, the output of the conveyor **16** remains substantially the same, in terms of the number of books per minute. Moreover, since the output speed of the motor **90** is adjustable, the overall speed of the machine may be increased when handling the small size signatures, thereby markedly increasing the output thereof.

FIG. 6 illustrates books located at various positions when the mechanism is handling small size books. A book is located at the shuttle pickup station **75** at the beginning of a cycle of operation and when the shuttle mechanism is in its forward position, is in engagement with the signature at the shuttle pickup station **75** and is ready to move the signature in the direction of the arrow to the stitching station **100**. At the stitching station **100**, the signature is stapled by the stapling mechanism. The signature is then moved from the stitching station **100** to a delay or dead position designated C in FIG. 6, at which no operation is performed on the signature, and then is moved to the delivery station **103** by the shuttle feeding mechanism **76**, from which station the signature is either ejected or fed to the trimming mechanism. Of course, the extent of the feeding fingers and the clamp plate of the shuttle mechanism is sufficient in order to engage a signature at the position C in order to move the signature into the delivery position or station **103**. It should

be apparent from the above that three strokes of the shuttle mechanism is required to move the book from the pickup station **75** to the delivery station **103**.

The operation of the above-described mechanism will be particularly clear from a description of the electrical circuitry embodied therein. The circuit is illustrated schematically in FIG. 7 and comprises a control means responsive to the sensing by the detector of an improper book to effect a machine control function, and includes an on-off switch **180**. The circuit also includes detector wheel actuated contacts **183** and **200**. The contacts **183** are normally closed and are opened by a book which is of proper thickness, while the contacts **200** are normally open but closed by a book which is too thick. Furthermore, the circuit includes a selector switch **205** which is actuated between two positions depending on whether large or small signatures are being handled, thus rendering the circuit selectively responsive to the detector wheel.

Energization of the machine is effected by closing of the on-off switch **180**, thereby connecting the power conductor **181** with the conductor **182**. The closing of the switch **180** completes a circuit from the conductor **182** through normally closed contacts **183** of the detector mechanism, conductor **184**, switch element **185** of a 4-pole run-set switch **186** now in its set position, conductor **187**, and light **188** which is connected to the power line **189** causing energization of the light **188** so as to indicate to the operator that the on-off switch is in its on position.

The motor **90**, not shown on the circuit diagram, is then energized to effect operation of the various operating mechanisms embodied therein, as described hereinabove. The motor **90** may be energized in any manner. The run-set switch **186** includes four switch elements **191**, **192**, and **193**, as well as **185**. The switch elements **191** and **192** when in their set position are not connected in any circuit. The switch element **185** when in its set position is connected in the circuit energizing the light **188**, described hereinabove, while the switch element **193** when in its set position connects the conductor **198** with conductor **199**. However, when in its set position, no current flows through the conductors **198**, **199** because the detector switch contacts **200** which are normally open are connected with the conductor **198**.

Actuation of the run-set switch **186**, as noted hereinabove, causes the switch elements **191**, **192**, **193**, and **185** to be moved to their run positions from their set positions. Movement of the switch element **185** to its run position breaks the circuit to the light **188**, thereby de-energizing the light and connects the conductor **184** with the conductor **198**. No current flows through the conductor **198**, however, since it is connected with the conductor **182** through the switch element **193** which is moved to its run position connecting the conductor **198** with the conductor **202** which, in turn, is connected through a selector switch **205** and switches **71** or **70** to the conductor **182**, depending upon the position of the switch element **206** of the switch **205**.

Movement of the switch elements **191**, **192** from their set position to their run position performs no function since these switch elements are in circuit with the switch elements **193**, **185**, respectively, which have been moved to a position wherein they are not connected with the elements **191**, **192**, respectively.

With the run-set switch **186** in its run position and the on-off switch **180** in its on position, the motor **90** is energized in order to effect operation of the various mechanisms described hereinabove. As the motor **90** begins, signatures are fed from the hoppers **14** to the signature conveyor **16**. The signature conveyor **16**, of course, as described hereinabove, gathers the signatures into a book and conveys the book through the inspection station and past the detector wheel. The detector wheel **41** is operative to sense whether or not the signatures are too thick or too thin. The detector wheel **41** operates the switch contacts **183**, **200**, respectively. The contacts **183** are normally closed and are opened by a book of proper thickness, while the contacts **200** are normally open and are closed by a book which is too thick.

Assuming the books comprised of small size signatures are being handled, when the books which are being handled are of the proper thickness, switch contacts **200** remain open at all times. The normally closed switch contacts **183** are in a circuit which includes the conductor **184**, switch element **185** of the run-set switch **186**, conductor **198**, switch element **193** of the run-set switch **186**, conductor **202**, selector switch element **206** of selector switch **205**, conductor **216**, switch element **217** of switch **70**. The switch element **217** of the switch **170** is normally connected to conductor **218** which, in turn, is connected to the conductor **182**. The switch element **217**, however, is moved by the lugs **73**, **73***a* from its position connected to conductor **218** to a position connected to a conductor **219**. The conductor **219** in turn is connected with a relay **220** which in turn is connected to power line **189**. The timing of the movement of the switch element **217** is such that it is moved by the lugs **73**, **73***a*, when the detector wheel has effected opening of the contacts **183**. Thus, every time that a good book passes the detector wheel **41**, a circuit is not completed through the switch element **217** to the relay **220** due to the opening of the contacts **183** by the book of proper thickness.

However, in the event that a book which is fed past the detector wheel is too thin, the contacts **183** are not opened, thus upon movement of the switch element **217**, a circuit is completed through the contacts **183**, conductor **184**, switch element **185** of switch **186**, conductor **198**, switch element **193** of switch **186**, conductor **202**, switch element **206** of the selector switch **205**, conductor **216**, switch element **217** of the switch **70**, conductor **219** and relay **220** which is connected to the power conductor **189**, thereby energizing relay **220**. Energization of the relay **220** causes the relay contacts **220–1**, **220–2** thereof to close.

Closing of the contacts **220–1** completes a circuit through the switch contacts **183**, conductor **184**, switch element **185** of switch **186**, conductor **198**, switch element **193** of switch **186**, conductor **202**, now closed contacts **220–1** of relay **220**, conductor **220***a*, switch elements **192**, **191** of switch **186** and conductors **187**, **199** which are connected to lights **188** and **221**, respectively, thus causing the lights **188**, **221** to be energized.

When the lug **73** or **73***a* passes the switch **70**, the switch element **217** thereof returns to its normal position breaking the circuit therethrough to the relay **220**. The relay **220**, however, is not de-energized at this time since a holding circuit therefor has been established through the contacts **220–1** thereof. This holding circuit is broken by de-energizing the relay **220** when contacts **183** are opened by a good book moving past the detector wheel in the next cycle of the machine.

The closing of the contacts **220–2** of the relay **220** actuates a suitable delay circuit mechanism for preventing the stitching mechanism from operating and operating the ejector fingers when the book reaches those mechanisms. The description of the delay circuitry set in operation by the relay **220** is identical regardless of the size of the books or whether the book is too thin or too thick. Therefore prior to the discussion of the delay circuitry, the energization of the relay **220** for thick small size books, as well as for thick and thin large size books will be described.

When a thick book of too small size is fed past the detector wheel **41**, the contacts **200** thereof which are normally open are closed. This completes a circuit through the contacts **200**, conductor **198**, switch element **193** of the run-set switch **186**, conductor **202**, switch element **206** of the selector switch **205**, conductor **216** to switch **70**. When the switch element **217** of switch **70** is moved by either lug **73** or **73***a*, a circuit is completed

through the switch element 217 of the switch 70, conductor 219, and relay 220, causing energization thereof and causing closing of the relay contacts 200–1 and 220–2 thereof, as described hereinabove, with respect to the operation when a too thin book is detected. Closing of the contacts 220–1 establishes a holding circuit for relay 220 which is broken when contacts 200 open which occurs when the thick book passes beyond the detector wheel.

Assuming now that books of large size are to be handled by the mechanism, the selector switch 205 is switched to its position wherein the switch element 206 thereof is connected with conductor 240 which, in turn, is connected with switch 71. The connection of the conductor 240 to conductor 202 performs no function at this time since conductor 240 is connected with the switch element 241 of switch 71 which is connected at this time to conductor 218 which is connected to conductor 182. The switch element 241 of switch 71 is moved to a position connected to the conductor 219 by the passage of the lug 74 past the switch 71.

When a large book of proper thickness is fed past the detector wheel 41, the contacts 200 remain open, whereas the contacts 183 which are normally closed, are opened. The opening of the contacts 183 prevents a circuit from being completed through conductor 184, switch element 185, conductor 198, switch element 193, conductor 202, switch element 206 of the selector switch 205, and conductor 240 when the switch element 241 of the switch 71 is moved to its position connected with conductor 219. The timing is such that the contacts 183 are open when the lug 74 moves the switch element 241. Thus, the relay 220 is not energized when a good book is being conveyed.

In the event a large book which is too thin is being conveyed past the detector wheel 41, the contacts 183 remain closed. When lug 74 moves the switch element 241 to connect with conductor 219, a circuit is then completed through the closed contacts 183, switch element 241, conductor 219 and relay 220, thereby energizing the relay 220. Energization of the relay 220 causes the relay contacts 220–1 and 220–2 to be closed.

As described hereinabove with respect to a small signature, when the large signatures flowing therethrough are too thick, the contacts 200 of the detector mechanism close. Closing of the contacts 200 completes a circuit through the contacts 200, conductor 198, switch element 193 of switch 186, conductor 202, switch element 206 of the selector switch 205, conductor 240, switch element 241 of the switch 71 when the lug 74 effects movement of the switch element 241 thereof, conductor 219 and relay 220, causing energization of the relay 220 and closing of the relay contacts 220–1 and 220–2.

From the above description, it should be apparent that when the signature handling mechanism 10 is handling a large size signature or a small size signature, with the selector switch 205 accordingly positioned in either one of its two positions, the relay 220 is energized when a signature passes the detector wheel 41 if the signature is either too thick or too thin. The relay 220, in all cases, is maintained energized through the contacts 220–1 which provide a holding circuit around the switches 70, 71. When a too thin book has been sensed, the contacts 220–1 are broken to de-energize the relay 220 when a book of proper thickness is fed past the detector wheel causing breaking of the contacts 183. When the contacts 183 break, of course, this breaks the circuit through contacts 220–1 to the relay 220 thereby de-energizing the relay and opening the contacts 220–1, 220–2 thereof. When a too thick book has been sensed, the contacts 220–1 are broken by opening of contacts 200 by the passage of the too thick book past the detector wheel. In any event, the contacts 220–1 and 220–2 remain closed for a predetermined interval of time.

As noted above, the energization of contacts 220–2 actuates delay circuit means for controlling a machine operation on the defective book at a time after the detection occurs and in another cycle of the machine. The closing of the contacts 220–2 performs no function immediately on their closing since they are in a circuit containing the normally open contacts 250–1 of a relay 250. The relay 250 is energized and the contacts 250–1 thereof are closed upon the actuation of a machine controlled switch 251. The machine controlled switch 251 is operated at approximately 330° of the main drive shaft rotation and has a switch element 251*a* moved from its normal position, shown in FIG. 5, wherein it is connected to contact 252 to an actuated position wherein it engages contact 253. The switch element 251*a* when moved to its position in engagement with the contact 253, completes a circuit through the contacts 220–2, conductor 254, switch element 251*a*, conductor 255, and relay 250, causing energization of the relay 250. Energization of the relay 250 causes relay contacts 250–1 and 250–2 thereof to be closed and opening of contacts 250–3 thereof. Closing of the relay contacts 250–1 provides a holding circuit maintaining the relay 250 energized even though the switch element 251*a* is moved to the position where it engages contact 252, and the relay 220 is de-energized causing opening of the contacts 220–2. The relay 250 remains energized through a circuit from conductor 260, switch element 251*a* now engaged with contact 252 of the switch 251, conductor 261, and contacts 250–1 of the relay 250. From this, of course, it should be apparent that the relay 220 is not de-energized until after the switch element 251*a* returns to its position in engagement with contact 252. Thus, the relay 250 remains energized even though the relay 220 is de-energized. It should be apparent, of course, that the relay 250 is de-energized upon movement of the switch element 251*a* from contact 252 of switch 251, breaking the circuit to the relay 250 and causing the energization thereof at 330° of rotation of the shaft 25, which occurs during the next cycle of operation of the machine.

Before the relay 250 is de-energized, the book is moved by the shuttle mechanism 40 to the switching station 100. However, the stitching heads, 101, 102 do not move down into engagement with a signature if of improper thickness in view of the fact that the contact 250–3 which controls the solenoid clutch 108 for controlling the operation of the stitching heads has been opened. The opening of the contact 250–3 upon energization of the relay 250 breaks the circuit through the conductor 260, now open contacts 250–3 to the clutch solenoid coil 261 which is connected to the power line 189. The de-energization of the clutch solenoid 261 causes the clutch mechanism to stop the movement of the stitching heads 101, 102. Thus, the signature which has been sensed as being too thin or too thick during one cycle will not be stitched or stapled at the stitching station during the next cycle of operation of the machine.

The closing of the contacts 250–2 of the relay 250 performs no immediate function. However, at 290° of rotation in the next cycle of operation after the contacts 250–2 have been closed, a machine-operated control switch 262 is actuated caussing movement of a contro/ swtich element 262*a* away from contact 263 thereof and into engagement with contact 264 thereof. The movement of the control switch element 262*a* out of engagement with the contact 263 and into engagement with the contact 264 of the switch 262 causes a circuit to be completed from the conductor 182 through now closed contacts 250–2 of the relay 250, conductor 267, the switch element 262*a*, now in engagement with the contact 264, conductor 268 and relay 270 to the power line 189 causing energization of the relay 270. Energization of the relay 270 causes relay contacts 270–1 thereof and 270–2 thereof to be closed.

Closing of the contacts 270–1 of the relay 270 completes a holding circuit for holding the relay 270 energiz-

ed when the switch element 262*a* moves out of engagement with the contact 264 and into engagement with the contact 263. When the switch element 262*a* moves into engagement with the contact 263, a circuit is completed holding the relay 270 energized, which circuit includes contacts 250–2 and contacts 270–1 of the relay 270. The switch element 262*a* is moved into position in engagement with the contact 263 prior to 330° of rotation of the cam shaft, namely, prior to the time when the relay is de-energized. When the relay 250 is de-energized, the relay 270 is maintained energized through a circuit including conductor 271, switch element 262*a*, now in engagement with the contact 263 of the switch 262, conductor 267, now closed contacts 270–1 of the relay 270, conductor 268, to the relay 270. The relay 270, of course, remains energized as long as the switch element 262*a* remains in engagement with the contact 263 and is de-energized upon the movement of the switch element 262*a* from the contact 263 which, of course, occurs at 290° of rotation in the next cycle of operation of the machine, which of course causes de-energization of the relay 270 and opening of the contacts 270–1, 270–2 thereof.

Before the switch element 262*a* of the switch 262 is moved out of engagement with the contact 263 to cause de-energization of the relay 270, another machine controlled switch 275 is actuated causing a switch member 275*a* to be moved out of engagement with a contact 276 of the switch 275 and into engagement with the contact 277 thereof. The movement of the switch member 275*a* occurs at approximately 250° in the cycle of rotation of the machine drive shaft which, of course, is prior to the time when the switch element 262*a* is moved which occurs at approximately 290° of rotation of the cam shaft.

When the switch element 275*a* of the switch 275 moves into engagement with the contact 277 thereof, a circuit is completed from the conductor 182 through now closed contacts 270–2 of the relay 270, conductor 280, switch element 275*a* of the switch 275 now in engagement with the contact 277, conductor 282, and relay 284 to the power line 189 causing energization of relay 284. Energization of the relay 284 causes the normally closed contacts 284–1, 284–2, and 284–3 thereof to be closed.

The closing of the contacts 284–1 of the relay 284 causes the relay to remain energized even though the switch element 275*a* moves out of engagement with the contact 277 and into engagement with the contact 276. This movement occurs prior to 290° of the cam shaft rotation so that it occurs while the contacts 270–2 are closed. Thus, the relay 284 remains energized through a circuit which includes the contacts 270–2 and the contacts 284-1 of the relay 284. After the contacts 270–2 open, namely, at 290° of rotation of the cam shaft 25, the relay 284 is maintained energized through a circuit which includes the switch element 275*a* of the switch 275 now in engagement with the contact 276, conductor 280, closed contacts 284–1 of the relay 284, conductor 282, and the relay 284. The relay 284 is maintained energized until 250° of rotation in the next cycle of operation of the machine when the switch element 275 is moved out of engagement with the contact 276, thereby breaking the circuit to the relay 284.

It should be apparent from the above description that when the relay 284 is energized in the operation of the machine, two cycles of the machine have lapsed since the detecting operation on a book effected energization thereof. When the large size signatures are being handled by the machine, the signatures are at the delivery station on the centerline of the trimmer mechanism. The contacts 284–3 of the relay 284, when closed, provide for actuation of the ejector guide fingers 215 causing the signature to be rejected. The energization of contacts 284–3 of the relay 284 effects energization of a solenoid control 290 for effecting movement of the fingers 215. The solenoid coil 290 is energized through a circuit from conductor 182 through selector switch element 205*a* of the selector switch 205 now in contact with contact 293, conductor 295, now closed contacts 284–3 of the relay 284, conductor 297, and coil 290 of the solenoid to the power line 189. Energization of the solenoid 290 effects the movement of the feeding fingers to eject the signature.

In the event that the signature handling mechanism is operating on small size signatures, the signature at this time is located at position C, shown in FIG. 6. The switch element 205*a* will be in a position in engagement with contact 300 thereof. In this position, the closing of the contacts 284–3 will perform no function since they will be in series with the contact 293 of the switch 215.

Closing of the contacts 284–2 of the relay 284 performs no function immediately since they are connected with a switch element 302*a* of a machined-controlled switch 302 having contacts 304 and 306 between which the element 302*a* is moved. The element 302*a* is moved into engagement with contact 306 at 220° of the cycle of operation of the machine, and when so moved causes energization of the relay 314. When the switch element 302*a* engages contact 306 of the switch 302, a circuit is completed from the conductor 182 through now closed contacts 284–2 of relay 284, switch element 302*a* now in engagement with contact 306 of switch 302, conductor 312, and relay 314 to the power line 189. Energization of the relay 314 causes the relay contacts 314–1 and 314–2 thereof to be closed. The closing of the contacts 314–1 of the relay 314 maintains the relay 314 energized, even though the switch element 302*a* returns to the position wherein it engages contact 304. The relay 314 is maintained energized through a circuit including contacts 284–2 and 314–1. When contacts 284–2 open, the relay 314 is maintained energized through a circuit from conductor 182, switch element 302*a* now in engagement with contact 304, conductor 310, now closed contacts 314–1 of the relay 314, conductor 312, and the relay 314. The relay 314 remains energized as long as the contact 304 is engaged by the switch element 302*a* which is moved from contact 304 at 220° during the next cycle of operation of the machine, thereby de-energizing the relay 314.

The relay contacts 314–2 when closed energize the reject solenoid coil 290. The closing of the contacts 314–2 completes a circuit from the conductor 182 through now closed contacts 300 of the selector switch 215, conductor 320, now closed contacts 314–2 of the relay 314, conductor 297, and the coil 290 which is connected to the power line 189, thereby energizing the coil 290. Energization of the coil 290, as described above in connection with the large size signatures, actuates the reject fingers to be operative to reject a signature. The reject solenoid coil 290 is thus energized after the cycles of operation have lapsed since the detection occurred.

From the above description, it should be apparent that the control circuit described hereinabove is responsive to the sensing of a book of improper thickness. Specifically, it is selectively responsive to the sensing by a single detector wheel of a book of improper thickness depending on the size thereof and is effective to control a machine operation or function thereon, namely, preventing of the stitching thereof or ejection thereof.

From the above description, it should be readily apparent that a new and improved signature handling mechanism is provided by the present structure. It should be further understood that certain modifications, changes, and adaptations may be made therein by those skilled in the art to which it relates, and it is hereby intended to cover all such modifications, adaptations, and changes falling within the scope of the appended claims.

Having described our invention, we claim:

1. A signature handling mechanism comprising a signature conveyor, a plurality of signature pushers adapted to be supported on said signature conveyor at a first predetermined distance apart for conveying signatures of a

first size or at a second predetermined distance apart which when multiplied by a whole number other than one approximately equals said first predetermined distance for conveying signatures of a second size, said pushers being operable when at said first predetermined distance apart to move signatures assembled into books of a first size through an inspection station and operable when at said second predetermined distance apart to move signatures assembled into books of a second size through said inspection station, a detector wheel located at said inspection station and engageable with books of said first and second size conveyed by said conveyor and having a detecting peripheral portion lying on a circle having a circumference equal to said second predetermined distance, drive means for said signature conveyor and detector wheel for driving said signature conveyor and detector wheel at the same surface speed including means for varying the speed of the signature conveyor and detector wheel in accordance with the size of signatures being handled, and control means selectively responsive to the sensing by the detector wheel of a book of said first or said second size being of improper thickness and operable to effect a machine control function thereon.

2. A signature handling mechanism comprising a signature conveyor, a plurality of signature pushers adapted to be supported on said signature conveyor at a first predetermined distance apart for conveying signatures of a first size or at a second predetermined distance apart which when multiplied by a whole number other than one approximately equals said first predetermined distance for conveying signatures of a second size, said pushers being operable when at said first predetermined distance apart to move signatures assembled into books of a first size through an inspection station and operable when at said second predetermined distance apart to move signatures assembled into books of a second size through said inspection station, a detector wheel located at the inspection station and engageable with books of said first and second size conveyed by said conveyor and having a detecting peripheral portion lying on a circle having a circumference equal to said second predetermined distance, drive means for said signature conveyor and detector wheel for driving said detector wheel and signature conveyor at the same surface speeds including means for varying the speed of the signature conveyor and detector wheel in accordance with the size of signatures being handled, and control means selectively responsive to the sensing by the detector wheel of a book of said first or said second size being too thick or too thin and operable to effect a machine control function thereon.

3. A signature handling mechanism comprising a signature conveyor, a plurality of signature pushers adapted to be supported on said signature conveyor at a first predetermined distance apart for conveying signatures of a first size or at a second predetermined distance apart for conveying signatures of a second size, said pushers being operable when at said first predetermined distance apart to move signatures assembled into books of a first size through an inspection station and operable when at said second predetermined distance apart to move signatures assembled into books of a second size through said inspection station, a detector wheel located at said inspection station and engageable with said books to sense the thickness thereof, drive means for said signature conveyor and detector wheel for driving said signature conveyor and detector wheel at the same surface speed, detector actuated switch means actuated in response to said detector wheel sensing a book of improper thickness, first control switch means actuated once for each book of said first size conveyed past said detector wheel, second control switch means actuated once for each book of said second size conveyed past said detector wheel, and selector switch means for selectively connecting said first and second switch means with said detector wheel actuated switch means.

4. A signature handling mechanism comprising a signature conveyor, a plurality of signature pushers adapted to be supported on said signature conveyor at a first predetermined distance apart or at a second predetermined distance apart which when multiplied by a whole number other than one approximately equals said first predetermined distance for conveying signatures of a second size, said pushers being operable when at said first predetermined distance apart to move signatures assembled into books of a first size through an inspection station and operable when at said second predetermined distance apart to move signatures assembled into books of a second size through said inspection station, a detector wheel located at said inspection station and engageable with said books to sense the thickness thereof, said detector wheel having a detecting peripheral portion lying on a circle having a circumference which is substantially equal to said second predetermined distance, drive means for said signature conveyor and detector wheel for driving said signature conveyor and detector wheel at the same surface speed, detector actuated switch means actuated in response to said detector wheel sensing a book of improper thickness, a first control switch actuated on each revolution of the detector wheel, a second control switch actuated once for a number of detector wheel revolutions equal to said whole number, and selector switch means for selectively connecting said first or second control switch with said detector actuated switch means to provide a control signal when the detector wheel senses books of either said first or second size being of improper thickness.

5. A signature handling mechanism as defined in claim 4 wherein said selector switch has first and second contacts connected in series with said first and second control switches, said contacts being selectively connected with said detector actuated switch means.

6. A signature handling mechanism as defined in claim 4 wherein said first and second control switches are supported adjacent a shaft member rotatable in timed relation to the rotation of the detector wheel, said shaft member carrying switch actuators for actuating said switches upon rotation thereof.

7. A signature handling mechanism as defined in claim 6 wherein said shaft and detector wheel have a drive means therebetween for effecting the number of detector wheel revolutions equal to the whole number for one revolution of said shaft.

8. A signature handling mechanism as defined in claim 7 wherein said shaft comprises a common drive member for said signature conveyor and detector wheel and effects rotation of said detector wheel said whole number of times while said conveyor moves for one revolution of said common drive member.

9. A signature handling mechanism comprising a signature conveyor, a plurality of signature pushers, means on said conveyor for mounting said pushers a first predetermined distance apart or a second predetermined distance apart which is twice said first predetermined distance, said pushers being operable when spaced said first predetermined distance apart to move signatures assembled into a book of a first size through an inspection station to a conveyor delivery station and operable when spaced said second predetermined distance apart to move signatures assembled into books of a second size through said inspection station to said conveyor delivery station, a detector wheel located at said inspection station and engageable with books conveyed therethrough to sense the thickness thereof, said detector wheel having a peripheral portion lying on a circle having a circumference which is substantially equal to said first predetermined distance, drive means for said signature conveyor and detector wheel for driving said signature conveyor and detector wheel at the same surface speed including means for varying the speed of the signature conveyor and detector wheel in accordance with the size of signatures being handled, and control means responsive to said detector wheel sens-

ing a book of improper thickness and effecting a machine control function thereon.

10. A signature handling mechanism comprising a signature conveyor, a plurality of signature pushers, means on said conveyor for mounting said pushers a first predetermined distance apart or a second predetermined distance apart which is twice said first predetermined distance, said pushers being operable when spaced said first predetermined distance apart to move signatures assembled into a book of a first size through an inspection station to a conveyor delivery station and operable when spaced said second predetermined distance apart to move signatures assembled into books of a second size through said inspection station to said conveyor delivery station, a detector wheel located at said inspection station and engageable with books conveyed therethrough to sense the thickness thereof, said detector wheel having a peripheral portion lying on a circle having a circumference which is substantially equal to said first predetermined distance, drive means for said signature conveyor and detector wheel for driving said signature conveyor and detector wheel at the same surface speed, detector actuated switch means actuated in response to said detector wheel sensing a book of improper thickness, a first control switch actuated on each revolution of the detector wheel, a second control switch actuated once for two revolutions of the detector wheel, selector switch means for selectively connecting said first or second control switch with said detector actuated switch means to provide a control signal when the detector wheel senses a book of either said first or second size being of improper thickness, a reciprocating shuttle mechanism movable to convey signatures between said conveyor delivery station and a shuttle delivery station, the centers of the conveyor delivery station and shuttle delivery station lie on spaced lines perpendicular to the direction of movement of the signatures with the distance therebetween being nonvariable, and means for reciprocating said shuttle mechanism through a stroke including means for varying the length of the stroke of said shuttle between first and second different stroke lengths only which when multiplied by different whole numbers equals the distance between the centers of the conveyor and shuttle delivery station whereby books of said first size are moved between the conveyor delivery station and the shuttle delivery station in a first number of strokes of the shuttle mechanism and books of said second size are moved therebetween in a second number of strokes of the shuttle mechanism.

11. A signature handling mechanism comprising a signature conveyor, a plurality of pushers, means on said conveyor for mounting said pushers a first predetermined distance apart or a second predetermined distance apart for conveying signatures of first and second sizes to a conveyor delivery station, a shuttle mechanism reciprocable between said conveyor delivery station and a shuttle delivery station for moving signatures therebetween, the distance between the center of said conveyor delivery station and the center of said shuttle delivery station being nonvariable, the center of said signatures as measured on a line perpendicular to the direction of movement of the signatures being located at the center of said conveyor delivery station and said shuttle delivery station when located thereat, and means for reciprocating said shuttle mechanism through a stroke including means for varying the stroke of said shuttle mechanism between first and second different stroke lengths only with the first and second stroke lengths when multiplied by whole different numbers equalling the distance between the centers of the conveyor delivery and shuttle delivery stations.

12. A signature handling mechanism comprising a signature conveyor, a plurality of signature pushers, means on said conveyor for mounting said pushers at a first predetermined distance apart for moving signatures of a first size to a conveyor delivery station or at a second predetermined distance apart which is twice said first distance for moving signatures of a second size to said conveyor delivery station, feeder means for feeding signatures of either said first or second size into position for engagement by said pushers as they move with said conveyor, drive means for said feeder means and signature conveyor means operable to vary the drive relationship therebetween from a 2:1 speed relationship wherein said feeder means delivers one signature of said first size for each pusher spaced said first predetermined distance apart and a 1:1 relationship wherein said feeder means delivers one signature of said second size for each pusher spaced said second predetermined distance apart, a reciprocating shuttle mechanism movable through a stroke to move signatures from said conveyor delivery station to a shuttle delivery station, the distance between the center of said conveyor delivery station and the center of said shuttle delivery station being nonvariable, the center of said signatures as measured on a line perpendicular to the direction of movement of the signatures being located at the centers of said conveyor delivery station and said shuttle delivery station when located thereat, and means for reciprocating said shuttle mechanism including means for varying the stroke of said shuttle between first and second stroke lengths only with the first and second stroke lengths when multiplied by whole different numbers equalling the distance between the centers of the conveyor delivery and shuttle delivery stations.

13. A signature handling mechanism comprising a signature conveyor, a plurality of signature pushers adapted to be supported on said signature conveyor at a first predetermined distance apart for conveying signatures of a first size or at a second predetermined distance apart which when multiplied by a whole number other than one approximately equals said first predetermined distance for conveying signatures of a second size, said pushers being operable when at said first predetermined distance apart to move signatures assembled into books of a first size through an inspection station and operable when at said second predetermined distance apart to move signatures assembled into books of a second size through said inspection station, a detector wheel located at the inspection station and engageable with books of said first and second size conveyed by said conveyor and having a detecting peripheral portion lying on a circle having a circumference equal to said second predetermined distance, drive means for said signature conveyor and detector wheel for driving said detector wheel and signature conveyor at the same surface speeds, control means selectively responsive to the sensing by the detector wheel of a book of said first or said second size being too thick or too thin and operable to effect a machine control function thereon, said control means including detector wheel actuated switch means, first control switch means actuated once for each book of said first size conveyed past said detector wheel, second control switch means actuated once for each book of said second size conveyed past said detector wheel, and selector switch means for selectively connecting said first or second switch means with said detector wheel actuated switch means.

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