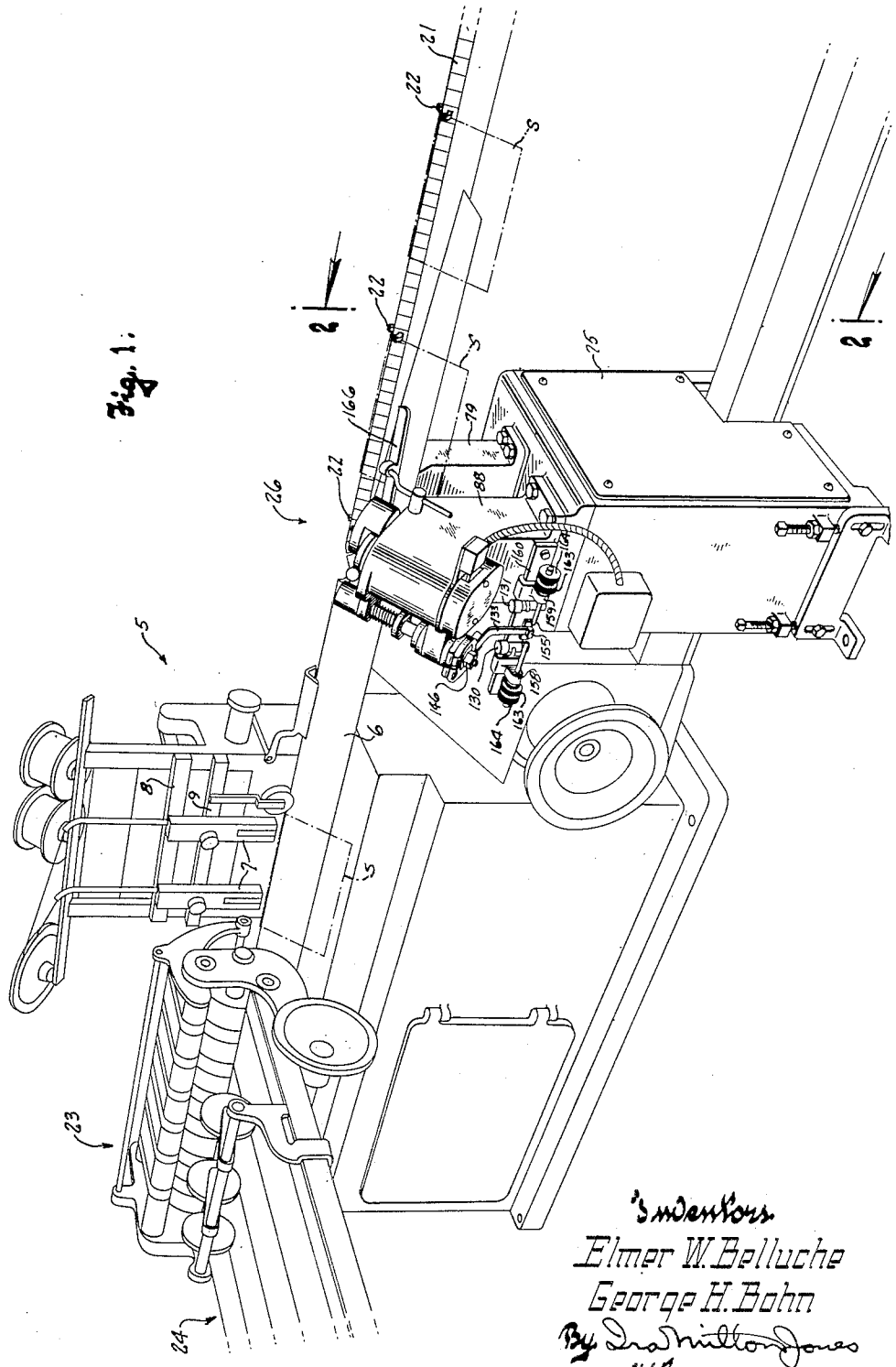
Nov. 9, 1954 E. W. BELLUCHE ET AL 2,693,595

SIGNATURE STITCHING MACHINE HAVING APPARATUS FOR PREVENTING THE STITCHING AND DIVERTING THE DELIVERY OF DEFECTIVE GROUPS OF SIGNATURES

Filed June 11, 1952 9 Sheets-Sheet 1

Fig. 1.



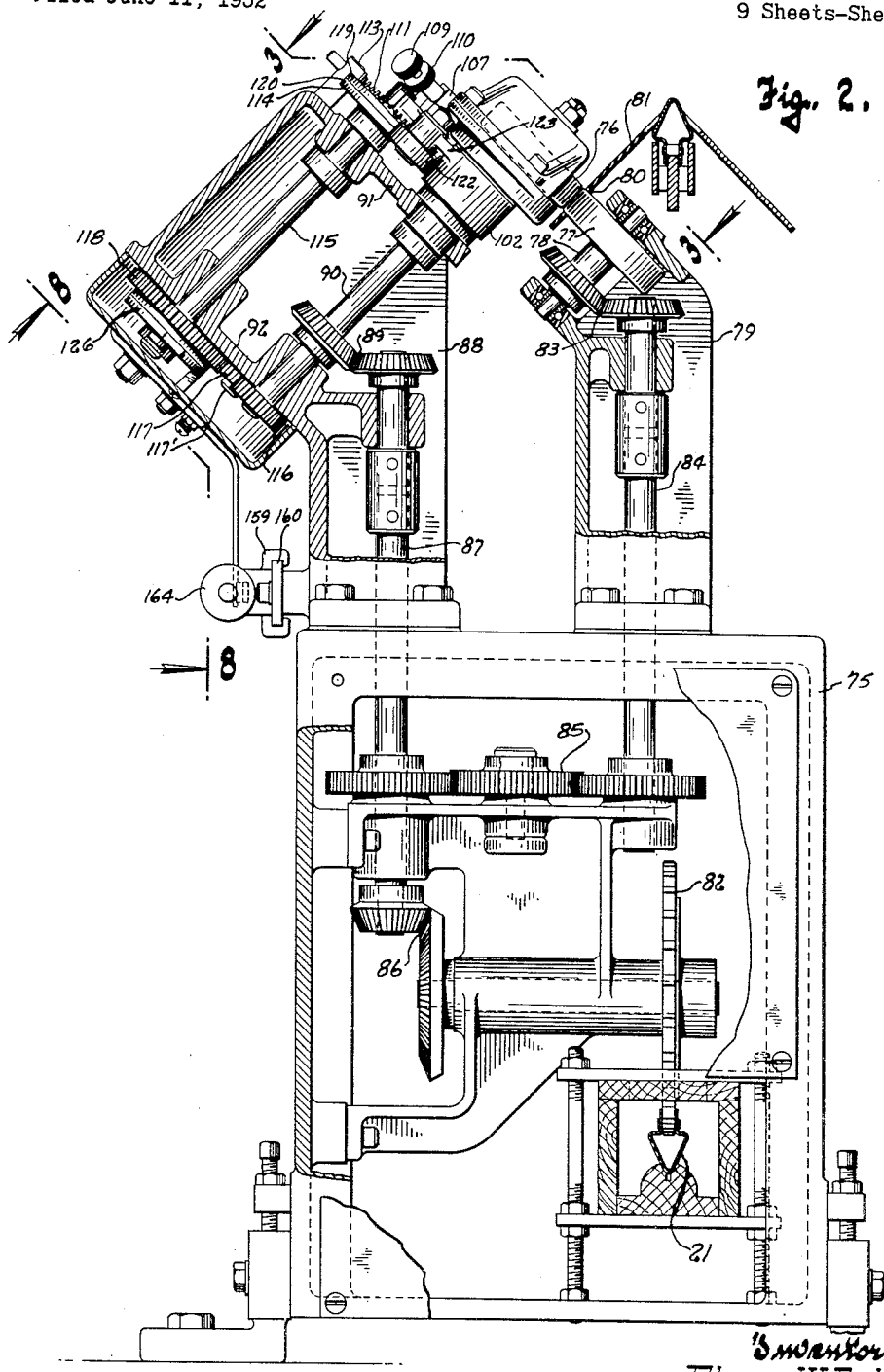
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SIGNATURE STITCHING MACHINE HAVING APPARATUS FOR PREVENTING THE STITCHING AND DIVERTING THE DELIVERY OF DEFECTIVE GROUPS OF SIGNATURES

Filed June 11, 1952 9 Sheets-Sheet 2

Fig. 2.



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SIGNATURE STITCHING MACHINE HAVING APPARATUS FOR PREVENTING THE STITCHING AND DIVERTING THE DELIVERY OF DEFECTIVE GROUPS OF SIGNATURES

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Fig. 3.

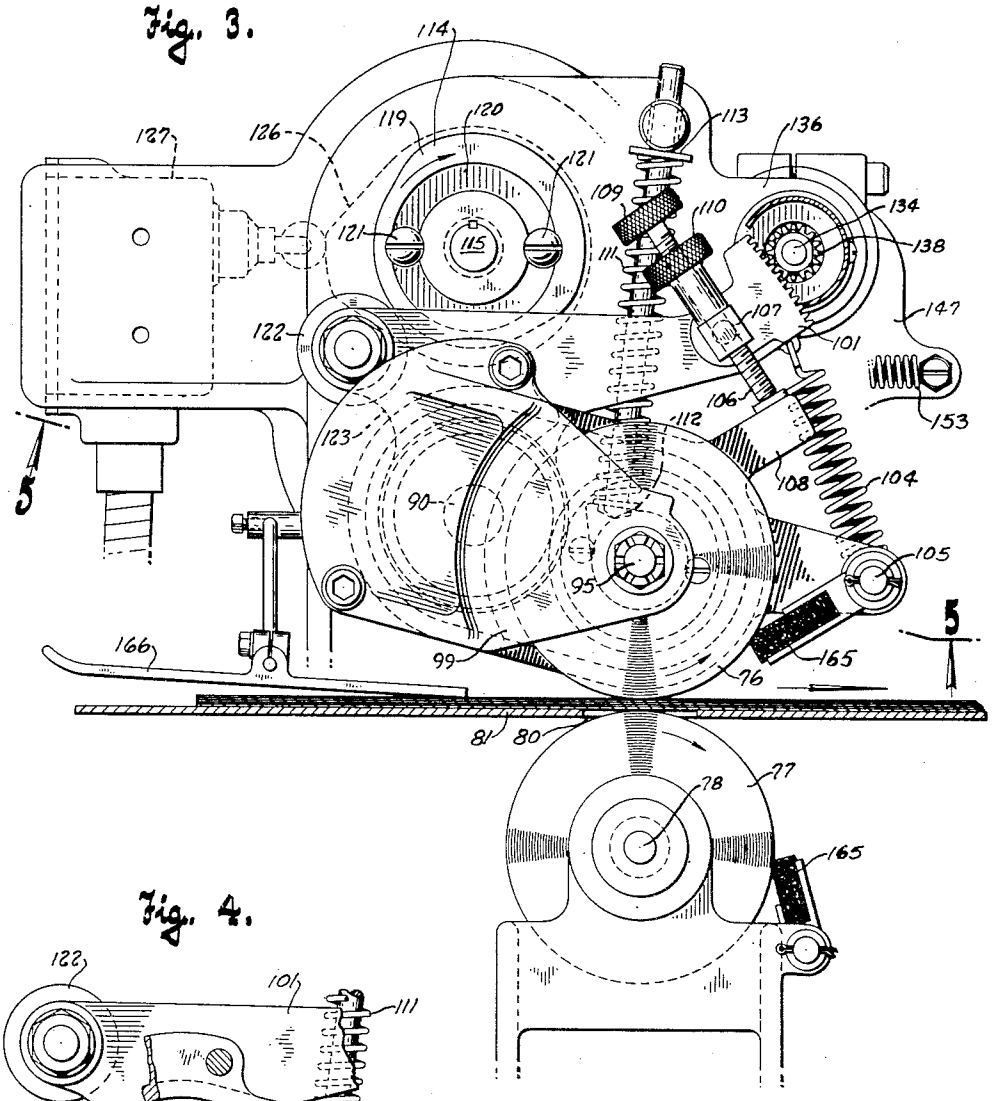
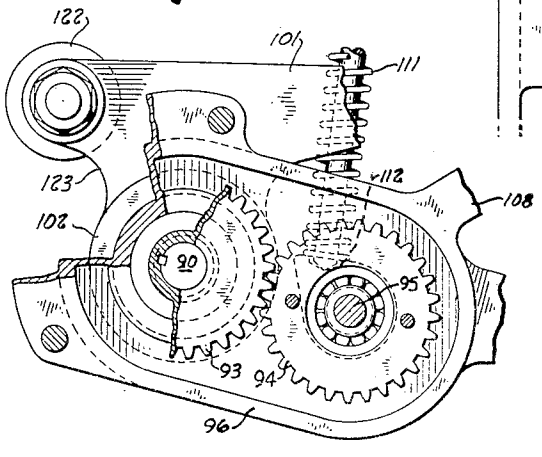


Fig. 4.



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SIGNATURE STITCHING MACHINE HAVING APPARATUS FOR PREVENTING THE STITCHING AND DIVERTING THE DELIVERY OF DEFECTIVE GROUPS OF SIGNATURES

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Fig. 5.

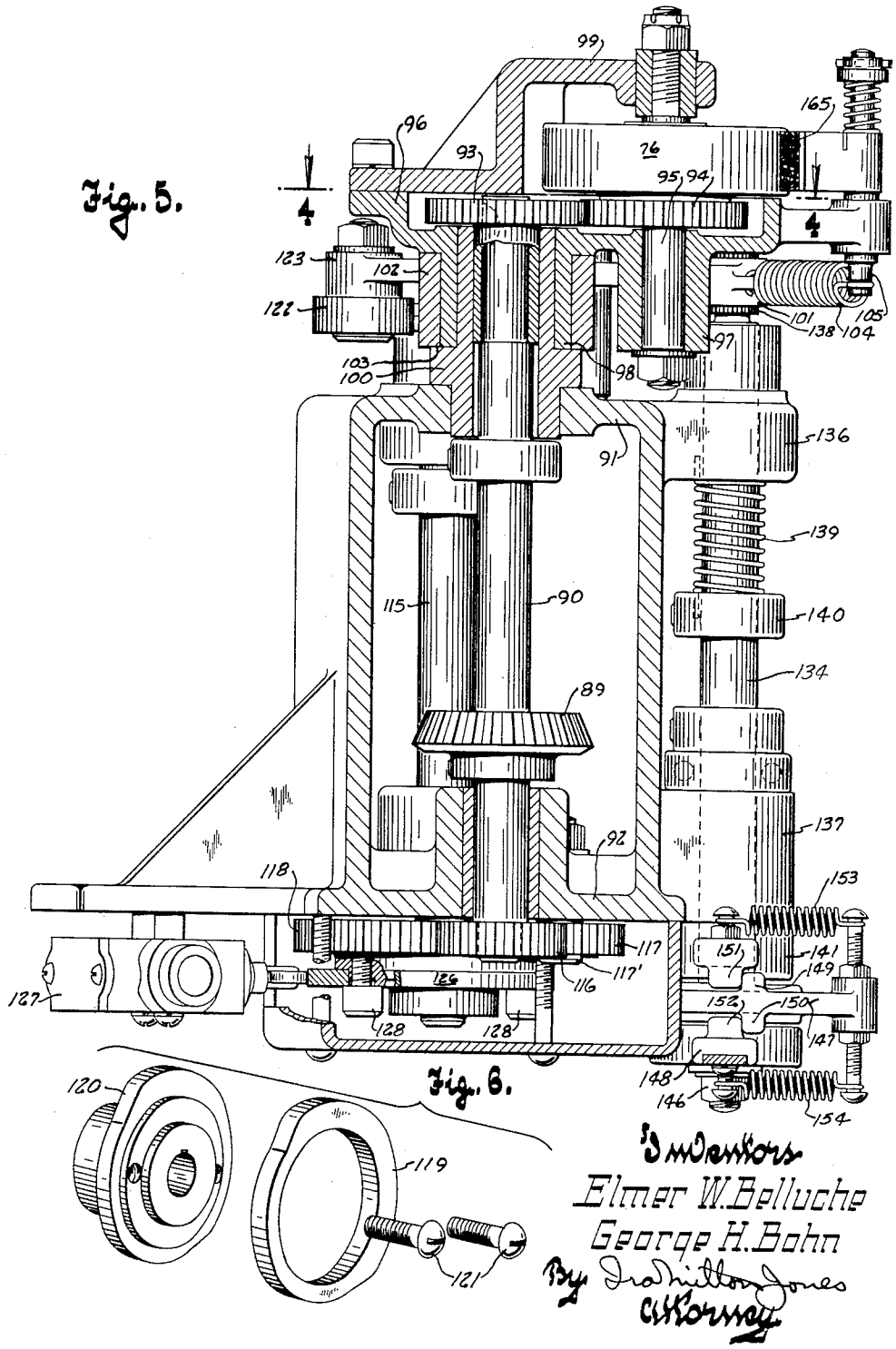


Fig. 6.

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SIGNATURE STITCHING MACHINE HAVING APPARATUS FOR PREVENTING THE STITCHING AND DIVERTING THE DELIVERY OF DEFECTIVE GROUPS OF SIGNATURES

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Fig. 7.

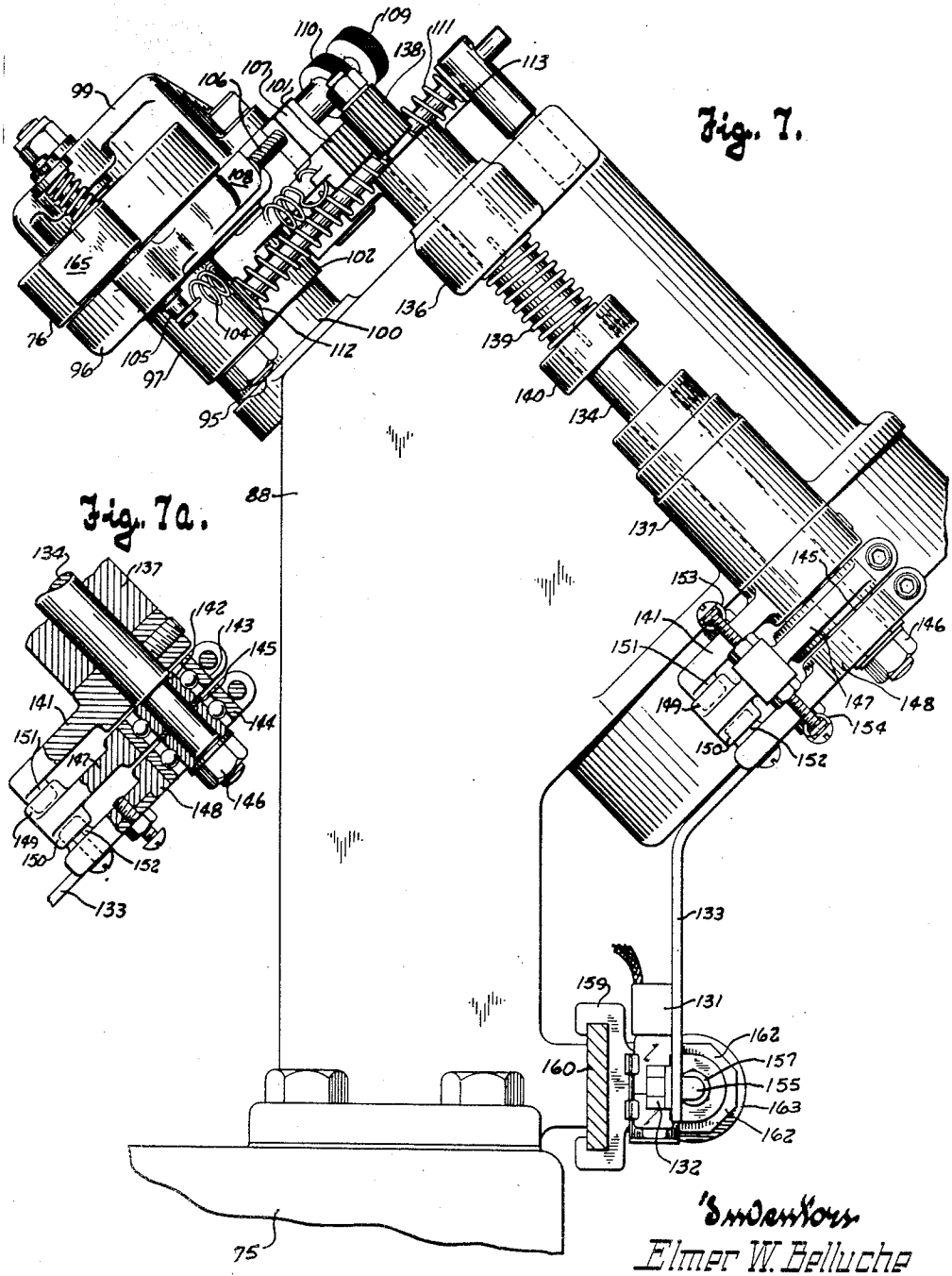


Fig. 7a.

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SIGNATURE STITCHING MACHINE HAVING APPARATUS FOR PREVENTING THE STITCHING AND DIVERTING THE DELIVERY OF DEFECTIVE GROUPS OF SIGNATURES

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Fig. 8.

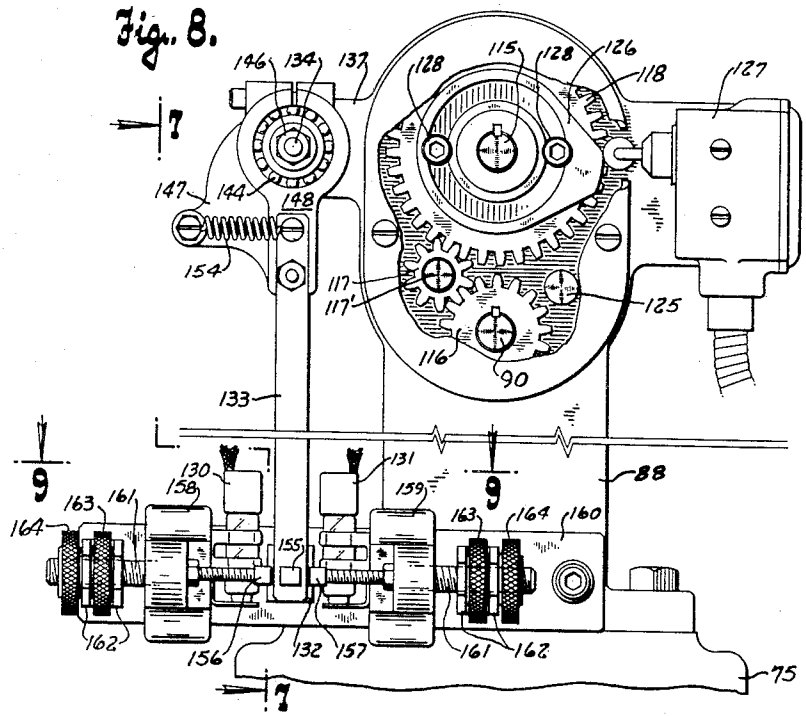


Fig. 12.

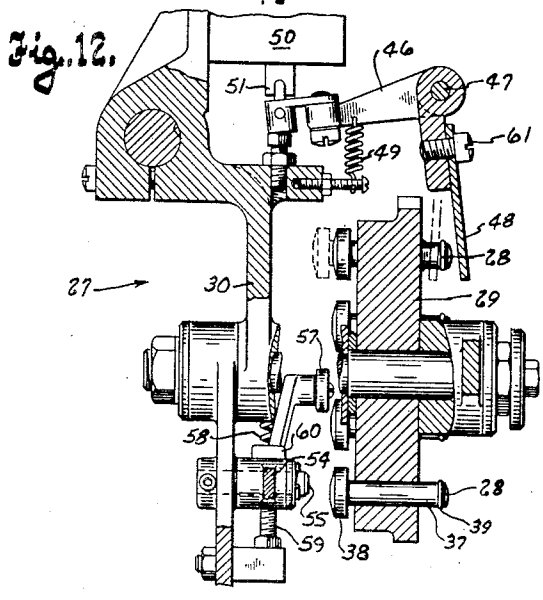
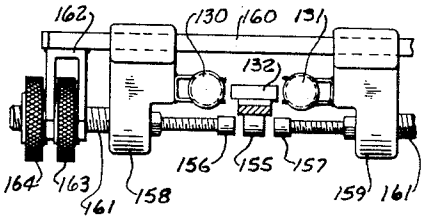


Fig. 9.



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SIGNATURE STITCHING MACHINE HAVING APPARATUS FOR PREVENTING THE STITCHING AND DIVERTING THE DELIVERY OF DEFECTIVE GROUPS OF SIGNATURES

Filed June 11, 1952 9 Sheets-Sheet 7

Fig. 10.

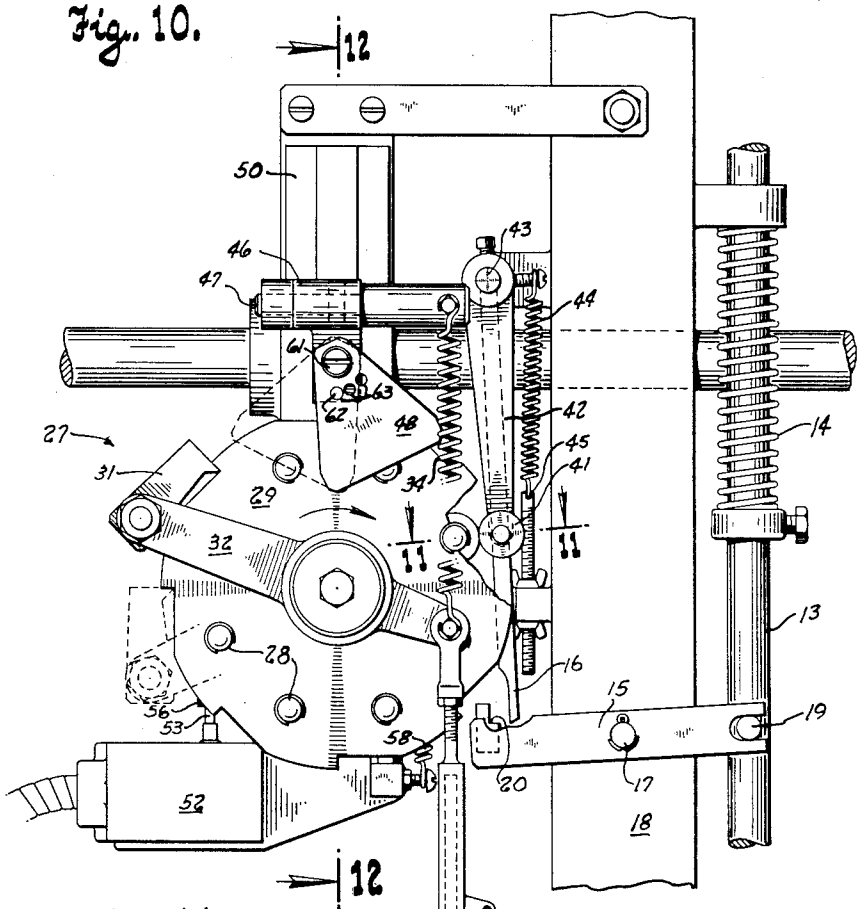
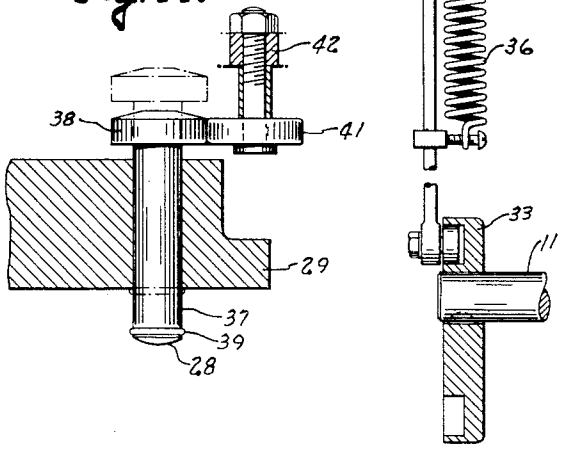


Fig. 11.



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Filed June 11, 1952 9 Sheets-Sheet 8

Fig. 13.

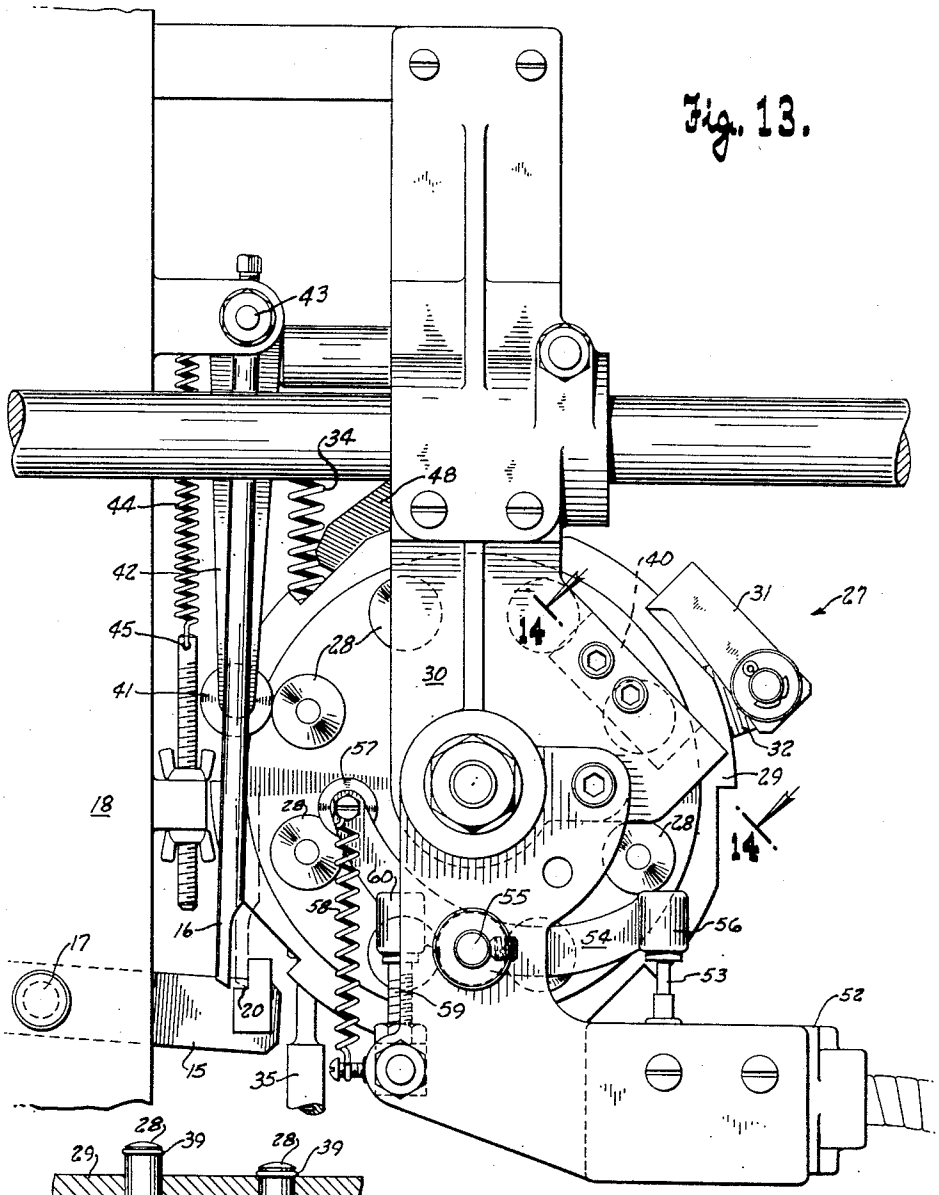
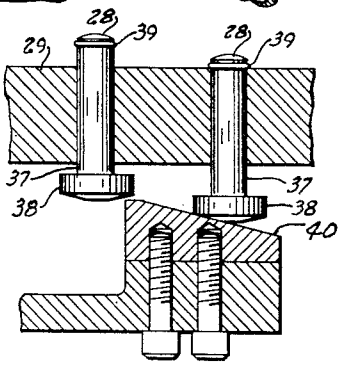


Fig. 14.



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SIGNATURE STITCHING MACHINE HAVING APPARATUS FOR PREVENTING THE STITCHING AND DIVERTING THE DELIVERY OF DEFECTIVE GROUPS OF SIGNATURES

Filed June 11, 1952 9 Sheets-Sheet 9

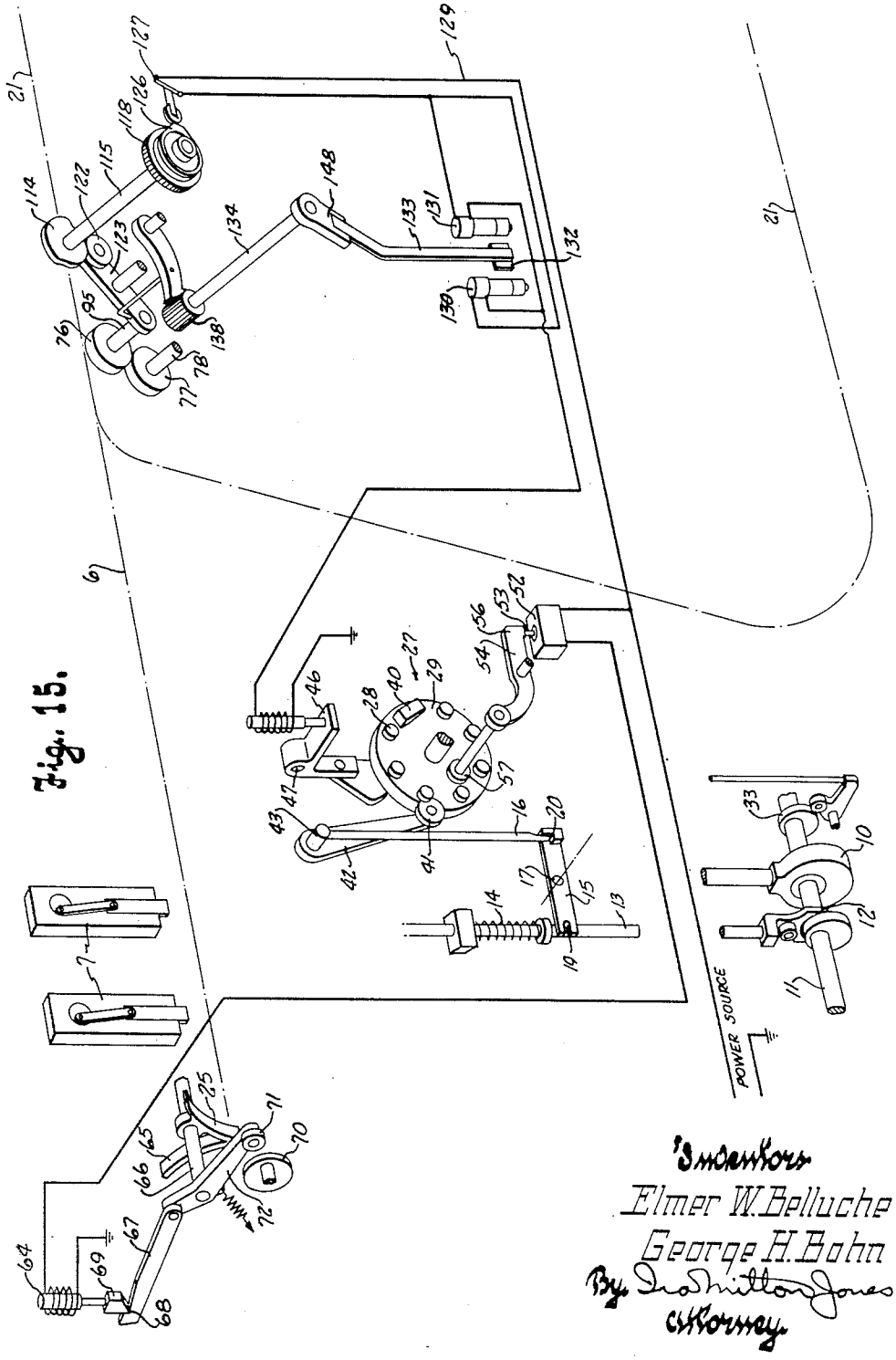


Fig. 15.

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SIGNATURE STITCHING MACHINE HAVING APPARATUS FOR PREVENTING THE STITCHING AND DIVERTING THE DELIVERY OF DEFECTIVE GROUPS OF SIGNATURES

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Application June 11, 1952, Serial No. 292,962

27 Claims. (Cl. 1—106)

This invention relates generally to book stitching machines of the type used, for instance, to stitch together the individual folded sheets or signatures of magazines by driving wire staples through the folded backs thereof; and has as its objective to improve the manner of detecting the reception by the machine of a defective group of signatures and in consequence thereto preventing the functioning of the stitching mechanism when that group of signatures arrives thereat and diverting the defective group of signatures into a discard path when it reaches the delivery end of the machine.

Stitching machines of the type here concerned have a plurality of loading stations upon which operators place the individual signatures, that is, the folded sheets, to be gathered into books by spaced pushers on a conveyor chain which travels successively past the several loading stations. The gathered groups of signatures are deposited by the conveyor chain onto the receiving end of a saddle which forms part of the stitching machine and along which the groups of signatures are advanced by a reciprocating feed mechanism including a plurality of gripper fingers.

The machine operates cyclically and with each cycle the feed mechanism advances the groups of signatures on the saddle a definite distance. Normally a group of signatures is advanced in one cycle from its position on the receiving end of the saddle upon which it is deposited by the conveyor chain to a position under the stitcher heads which drive the wire staples through the groups of signatures, and on the next successive cycle the stitched book is advanced from its stitching position to delivery position where a delivery mechanism discharges the book onto a table-like delivery conveyor.

It is, of course, important that only complete groups of signatures shall be stitched and that any group of signatures which contains more than the prescribed number of pages and any group of signatures which contains less than the prescribed number of pages shall not be stitched and in addition shall not be delivered onto the delivery conveyor.

Many different detector mechanisms have been proposed and employed in the past for the purpose of assuring that only good books will be stitched and delivered. The early schemes, as mentioned in Patent No. 1,716,773 issued June 11, 1929, employed calipering devices for detecting deviation from the prescribed thickness of the groups of signatures, but these early calipering devices had many deficiencies and objections which led to the development of the detector arrangement covered by the aforesaid patent. However, none of the expedients used heretofore has been reliably accurate, especially at high speeds and where inserts such as mailing cards are incorporated in the books being stitched.

This invention returns to the use of a calipering device sensitive to deviations in thickness of the groups of signatures, but provides a calipering mechanism which is accurately reliable at all operating speeds.

One of the problems that must be contended with in calipering the thickness of the work arises from the fact that the groups of signatures to be stitched vary in thickness along the length thereof. This is, of course, obvious where card inserts are incorporated, but it may also result from the nature and distribution of the printing on the signatures. In any event this variation in thickness along the length of the groups of signatures makes it imperative, if accurate calipering is to be obtained, that the actual calipering of work be done for only a short length thereof and always at the same place.

Thus, for instance, where a magazine or book to be stitched measures fourteen (14) inches in length it may very well be that in order to secure accurate calipering only the last inch or two of the advancing group of signatures should be calipered. But, if a calipering mechanism or detector is set to "feel" for only such a short length of the advancing group of signatures it is difficult, if not entirely impossible, to have reliable accuracy, especially at high speeds.

To meet this problem the present invention provides a novel calipering apparatus wherein companion feeler members, and more specifically a pair of rolls, grip the advancing group of signatures well in advance of the relatively short portion thereof which is actually calipered to thus give the mechanism an opportunity to "settle" so that when the actual calipering takes place a reliable measurement is assured.

This objective is achieved through the provision of a pair of electric switches connected in series in a control circuit, the completion of which effects the required lock-out of the stitcher heads and prevents the delivery mechanism from delivering the defective group of signatures onto the delivery table. One of these electric switches is controlled by the caliper rolls to be closed by change in the distance between them resulting from deviation from the prescribed thickness of the group of signatures at the portions thereof being calipered. In other words, one of these switches is closed if the group of signatures is too thick or too thin at the point at which the calipering is done.

The other switch is controlled by a cyclically operating cam to be closed for a short interval once each cycle of the machine and, of course, the cam controlling this switch must be set to effect its closure at the time the portion of the group of signatures to be calipered is passing between the companion feeler rolls. Concurrent closure of both switches completes the control circuit and through appropriate mechanism closure of this circuit prevents operation of the stitcher head or heads when the defective group of signatures is presented thereto and upon its arrival at the delivery station a routing director is actuated to reject the defective group of signatures and keep it from being delivered onto the good book delivery table.

Obviously the location at which the actual calipering is to be done will vary with different books so that the instant when the cyclically operated switch closes must be adjustable to take place at any time in the cycle. Also, since the books for which a particular stitching machine is designed will vary in length between relatively wide limits it is essential that the so-called down-time of the calipering rolls, that is, the time for which the rolls are effective and grip the passing groups of signatures, be capable of adjustment.

This invention recognizes these requirements and has as another of its objects to provide means for so adjusting both the timing of the positively regularly closed switch and the down-time of the feeler rolls. Since the logical position of the caliper is near or ahead of the receiving end of the saddle on the machine so as to act on the groups of signatures as they are being presented by the conveyor chain to the receiving end of the stitching machine, it follows that the lock-out of the stitcher heads to prevent the stitching of a bad book or group of signatures must occur during a cycle subsequent to that during which the calipering is done.

This invention, therefore, has as another of its objects to provide a reliable control mechanism which is activated by closure of the control circuit during one cycle of the machine, to take effect on the mechanism preventing the operation of the stitcher head during a subsequent cycle of the machine and to act upon the routing director of the delivery mechanism during an even later cycle of the machine.

In this connection it is a further object of this invention to provide a control mechanism by which the stitcher head is locked out and the routing director of the delivery mechanism is actuated during cycles of the machine subsequent to that during which the detection of a defective group of signatures was made, and wherein optimum reliability and accuracy are secured by virtue

of the fact that the mechanism operates mechanically and positively.

Another problem which increases the difficulty of reliably detecting the presence of a defective group of signatures results from the need for accommodating relatively short books as, for instance, books no more than five or six inches in length. The trailing end of a group of signatures just deposited upon the saddle of the machine by the conveyor chain is, of course, always in the same position regardless of the length of the book being stitched, but the location of the center of the book from which all positioning is done varies considerably, and in very short books this means that two cycles of the machine must be devoted to advancing a book from its position on the receiving end of the machine saddle to a centered position in the work zone under the stitcher heads, and again from the work zone to the delivery mechanism. This, of course, increases the time delay required; and to provide this additional time when it is needed, it is another object of the invention to provide a control which may be quickly and easily set to effect either single or multiple cycle delay.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a perspective view of a signature stitching machine embodying this invention;

Figure 2 is a vertical sectional view through the machine taken on the plane of the line **2—2** in Figure 1, said view having parts thereof broken away for the sake of clarity;

Figure 3 is a top view of the calipering mechanism per se, taken on the plane of the line **3—3** in Figure 2, but on an enlarged scale;

Figure 4 is a sectional view through Figure 5 on the plane of the line **4—4**, illustrating particularly the manner in which the movable calipering roll is driven, parts of said view being broken away and in section to better illustrate constructional details;

Figure 5 is a longitudinal sectional view taken through Figure 3 on the plane of the line **5—5**;

Figure 6 is an exploded perspective view of the cam which controls the down-time of the caliper roll;

Figure 7 is an upright sectional view through Figure 8 on the plane of the line **7—7** and illustrating the top or movable one of the companion feeler rolls and the switch actuating pendulum driven thereby;

Figure 7*a* is a fragmentary detail view illustrating the manner in which the switch actuating pendulum is drivingly connected with its actuating shaft;

Figure 8 is a view essentially in elevation, taken on the planes of the lines **8—8** in Figure 2;

Figure 9 is a cross sectional view through Figure 8 on the plane of the line **9—9**;

Figure 10 is a rear view of the control mechanism by which closure of the electric control circuit during one cycle of the machine manifests its effect during subsequent cycles of the machine;

Figure 11 is a detail sectional view through Figure 10 on the plane of the line **11—11**;

Figure 12 is a vertical sectional view through Figure 10 on the plane of the line **12—12**;

Figure 13 is a back view of the control mechanism shown in Figure 10;

Figure 14 is a detail sectional view taken through Figure 13 on the plane of the line **14—14**; and

Figure 15 is a diagrammatic view of the entire control system with enough of the machine parts diagrammatically illustrated to show how detection of a defective group of signatures during one cycle of the machine locks out the stitcher heads during a subsequent cycle of the machine and effects the shifting of the routing control at the delivery mechanism during a still later cycle of the machine.

Referring to the accompanying drawings in which like numerals indicate like parts throughout the several views, the numeral **5** designates generally a stitching machine of the type with which this invention is chiefly concerned. As is customary this machine is equipped with an inverted V-shaped saddle **6** upon which the groups of signatures S are supported while being stitched, i. e. have wire staples driven through their folds by stitcher heads **7** coacting with clincher boxes (not shown) located beneath the apex of the saddle in line with the stitcher heads. The number of stitcher heads used ordinarily depends upon the length of the book being stitched. In the machine illustrated two such stitcher heads are shown.

Though the manner in which the stitcher heads operate forms no part of this invention, it should be noted that in forming the stitches the stitcher head formers (not shown) are driven downward toward the saddle, and that this motion results from downward translation of an operating bar **8** with which driving lugs on the stitcher mechanism are connected; and that the stitcher heads are mounted on a face plate **9** in a manner allowing adjustment thereof lengthwise of the saddle.

The operating bar **8** is raised and lowered by an eccentric **10** in the back of the machine (not shown in Figure 1 but diagrammatically illustrated in Figure 15), the eccentric being driven from its shaft **11** whenever a clutch **12** is engaged. The engagement of this clutch **12** is controlled by the calipering apparatus of this invention so that the stitcher heads operate only when the group of signatures in stitching position has passed the caliper without tripping it.

The shaft **11** revolves once each cycle of the machine and the clutch **12** is of the pin type so that the determination of whether or not it shall be engaged during any given cycle requires but a relatively brief portion of the cycle. In other words, if at the start of a cycle mechanism is actuated by which the clutch is held from engagement during a few degrees of rotation of the shaft **11** the clutch cannot be thereafter engaged during that cycle even though the lock-out mechanism is no longer active.

The means by which the clutch is engaged is more or less conventional to this art and includes a vertically reciprocable rod **13** (see Figures 10 and 15) which is biased downwardly by a spring **14** to effect engagement of the clutch. Consequently by blocking the descent of the rod **13** clutch engagement can be prevented. To block the descent of the rod **13** when it is desired to lock out the stitcher heads a latch lever **15** and a latch finger **16** are provided. The lever **15** is medially pivoted as at **17** upon the adjacent portion **18** of the machine frame and has one end thereof connected to the rod **13** as at **19**. Its other end carries a latch keeper **20** with which the latch finger **16** engages whenever the stitcher heads are to be locked out. As long as the latch finger **16** is disengaged from its keeper **20** the latch lever **15** is free to rock with the reciprocation of the rod **13**.

The manner in which the position of the latch finger **16** is controlled will be hereinafter described.

The groups of signatures to be stitched into books are deposited upon the saddle **6** of the machine by a long conveyor chain **21** which travels past a plurality of loading stations (not shown) where operators place individual pages or signatures in position to be picked up by pusher pins **22** on the conveyor chain and by which the successive pages or signatures are gathered into complete groups and the complete groups are fed onto the saddle **6**. A reciprocating cyclically operating gripper mechanism (not shown) takes the groups of signatures deposited on the saddle **6** by the conveyor chain and advances them to a stitching position properly centered under the stitcher heads, and after the stitching operation, moves the stitched books along the saddle to a delivery mechanism indicated generally by the numeral **23**.

Upon arrival at the delivery mechanism a cylically operating tucker blade (not shown) lifts the stitched books off the saddle and into the bite of delivery tapes by which good books are deposited in a seriated row upon a delivery table **24**. "Bad books," that is defective groups of signatures which have not been stitched because they include either too few or too many signatures, are automatically kept from being delivered onto the table **24** and instead are diverted into a reject path as a result

of the actuation of a routing director 25 positioned above the apex of the saddle and so arranged that it normally directs the books forwardiy onto the table 24 but when shifted, it deflects them to the rear of the machine.

The shifting of the routing director 25 is coordinated with the lock-out of the stitcher heads as will be hereinafter described, to become effective either during the cycle of the machine directly following that during which the stitcher heads were locked out or during a later cycle, but in any event the shifting of the routing director to reject a defective group of signatures is timed to take place when it is lifted by the tucker blade.

The shifting of the routing director like the lock-out of the stitcher heads is controlled by the calipering mechanism of this invention, indicated generally by the numeral 26, and which, as shown in Figure 1, is positioned to act upon the groups of signatures before they are deposited upon the saddle 6 of the machine and their advance is taken over by the reciprocating gripper mechanism (not shown).

Hence, the calipering mechanism operates upon the work during a cycle of the machine which at least directly precedes the cycle during which that group of signatures is stitched and is at least two cycles ahead of the one during which that designated group of signatures (not stitched into a book) arrives at the delivery mechanism. This entails the provision of mechanism for delaying the manifestation of the calipering mechanism response to a defective group of signatures, upon the stitcher head lock-out mechanism and the routing director of the delivery mechanism. This time delaying mechanism, indicated generally by the numeral 27, is located at the back of the machine adjacent to the latch lever 15 and generally consists of a plurality of control elements or buttons 28 slidably mounted in a ratchet wheel or disc 29.

This ratchet wheel or disc is rotatably mounted on a bracket 30 solidly supported from the frame of the machine, and is advanced stepwise by a pawl 31. The pawl 31 is carried by a lever 32 oscillatable about the axis of the ratchet disc and rocked by a cam 33 fixed to the shaft 11. The cam 33 positively advances the pawl and a tension spring 34 connected to the lever 32 retracts the pawl.

To preclude damage to the mechanism in the event of an obstruction to rotation of the ratchet disc 29, the link 35 through which the lever 32 is connected with the follower of the cam 33 comprises two telescopically connected sections normally held against separation by a heavy spring 36.

The control elements or buttons 28, as best shown in Figures 11 and 14, have uniform diameter shanks 37 slidably received in holes drilled through the disc 29, and enlarged heads 38 all overlying the rear face of the disc 29. Snap rings 39 on the opposite ends of the stems prevent disassembly of the control elements or buttons from the ratchet disc.

As the ratchet disc 29 is rotated the control elements or buttons pass a resetting cam 40 positioned to have the heads 38 of the control elements collide therewith, and as the heads 38 ride over the cam the control elements, if depressed, are projected. In the projected positions of the control elements, their heads 38 lie closely adjacent to the ratchet disc to engage a follower roller 41 on the free end of a lever 42 fixed to a shaft 43 and positioned to swing across the disc in an arc which intersects the path of the heads of the control elements in normal depressed position. The latch finger 16 is also secured to the shaft 43 and a tension spring 44 having one end connected to the hub of the lever 42 and its other end anchored as at 45 yieldingly rocks the shaft in a clockwise direction as viewed from the back of the machine (Figure 10) to swing the follower roller 41 into the path of the heads of the control elements. Such clockwise rotation of the lever 42 about its mounting is limited by the engagement of the latch finger 16 with its keeper 20.

The mechanism is so timed that just before the rod 13 descends or is to descend to effect operation of the stitcher heads, the head of one of the control elements or buttons 28 collides with the roller 41 and swings the latch finger 16 away from its keeper 20 to thereby allow rocking of the latch lever 15 and normal operation of the stitcher heads. The re-engagement of the finger 16 with the keeper 20 is, of course, automatic and takes

place with the ascent of the rod 13 coincidentally with the return of the stitcher head operating bar to its raised position.

Since the pawl 31 is driven from the cyclically rotating shaft 11 it follows that the ratchet disc advances one tooth with each cycle of the machine, and the control elements or buttons 28 are so spaced and positioned that one of them is carried past the follower roller 41 during each advance of the ratchet disc.

A depressed control element or button 28 does not collide with the follower roller 41 but passes the same without contacting it. This is illustrated in dotted lines in the detail view, Figure 11. Consequently, to prevent the operation of the stitcher head or heads during a given machine cycle, it is necessary to depress the control element or button which moves past the follower roller 41 during that cycle.

The depression of the control elements or buttons 28 is effected by rocking a bell crank lever 46 (Figure 12) about its pivotal support 47 and thereby swinging its arm 48 toward the ratchet disc and against the protruding end of the control element or button then under the arm 48. A tension spring 49 yieldingly holds the bell crank lever in its inactive position at which its arm 48 clears the protruding ends of the control elements but this spring is overpowered by the energization of an electromagnet 50, the armature of which is connected to the lever as at 51. Energization of the solenoid 50 is under the control of the caliper as will be hereinafter described.

A depressed actuator element or button 28 not only allows the stitcher head or heads to be locked out during a given cycle of the machine but also effects shifting of the routing director 25 during the following cycle or cycles. For this purpose a micro switch 52 is mounted in juxtaposition to the ratchet disc on an extension of the bracket 30 to have its plunger 53 depressed by a medially pivoted actuating lever 54. (See Figures 12, 13 and 15.) The lever 54 is pivotally mounted on a stub shaft 55 anchored in the bracket extension with one end 56 of the lever directly over the plunger 53. The opposite end of the lever carries a roller 57 so positioned with respect to the ratchet disc as to lie in the path of the head of any control element or button which has been depressed. A tension spring 58 yieldingly holds the lever 54 in a position at which its end 56 just clears the plunger 53, this position being defined by a stop 59 with which a pad 60 on the lever collides.

Attention is directed to the fact that the rollers 41 and 57 are so positioned with respect to one another that a depressed control element or button 28 which has just passed the roller 41 without contacting it and thus leaving it and the latch finger 16 in the stitcher lock-out position, collides with the roller 57 during the next cycle of machine operation.

It should also be noted that the depressor or resetting cam 40 is positioned to be traversed by any depressed control element or button 28 before it moves under the arm 48 of the setting lever 46.

The arm 48 is wide enough to cover two control elements at once, a condition which is necessary with some types of work, but normally is in a position to depress only one of the elements. The arm 48 is secured to the bell crank lever 46 by a screw 61 and a dowel pin 62 projecting from the lever and received in one of three holes 63 in the arm and arranged in an arc about the axis of the screw. As best seen in Figure 10 when the arm 48 is in its position shown in full lines energization of the solenoid 50 will depress one control element or button during the cycle just preceding the cycle at which that control button moves opposite the roller 41. This affords a one cycle delay between the time the control element or button is depressed and the time its depressed condition effects lock-out of the stitcher head and two cycles before that depressed control element or button effects shifting of the routing director 25. This latter function is accomplished by the closure of the micro switch 52 which, as can be seen in Figure 15, closes a control circuit for a solenoid 64 by which the shifting of the routing director is accomplished.

If on the other hand the arm 48 is secured to the bell crank lever 46 in its dotted line position shown in Figure 10 there will be a two cycle delay between the instant energization of the solenoid 50 effects depression of a control element or button and the time at which that

depressed element or button moves opposite the roller 41; and if the arm 48 is secured in its intermediate position, energization of the solenoid 50 will cause the depression of two control elements or buttons so that for two successive machine cycles the stitcher heads will be locked out and the routing director will be shifted to its position diverting the delivered book or group of signatures to the reject path.

The routing director 25 of itself is not new in stitching machines of this kind, and as is customary, it comprises a plurality of endwise spaced aligned V-shaped elements 65 all mounted upon a common rock shaft 66 in such a way that rocking movement of the shaft swings the apex of the V-shaped elements slightly forwardly or rearwardly with respect to the apex of the saddle 6, it being understood that the apexes of the V-shaped elements face and point toward the saddle.

The mechanism which controls the position and rocking of the shaft 66, is diagrammatically illustrated in Figure 15 where it includes a latch bar 67 having a keeper recess 68 and a latch 69 normally engaged with the keeper 68 but adapted to be lifted therefrom by energization of the solenoid 64. A cyclically operating cam 70 and a cam follower 71 carried by a lever 72 fixed on the shaft 66 provides means for cyclically rocking the shaft a slight distance in the direction to free the latch 69 just before energization of the solenoid 64 would occur if a previous detection of a defective group of signatures required shifting the routing director.

The cam 70 also periodically rocks the shaft 66 to reengage the latch 69 after the book has been delivered. Of course, as long as the latch 69 remains in its latching position, that is as long as the solenoid 64 is not energized, the slight rocking of the shaft 66 each cycle to free the latch does not move the routing director from its normal position directing the books onto the delivery table 24.

The calipering mechanism 26 is mounted on a rigid pedestal 75 which straddles the bottom stretch of the conveyor chain 21 and is preferably positioned directly ahead of the receiving end of the saddle 6. A pair of upper and lower companion feeler rolls 76 and 77, respectively, constitute the work engaging elements of the caliper. The lower roll 77 is fixed to a shaft 78 having its opposite ends journalled in bearings carried by a bracket 79 which is firmly bolted to the top of the pedestal 75 in such a position that the roll 77 protrudes slightly through an opening 80 in the adjacent front wing 81 of the saddle. The lower roll 77 is thus firmly mounted to rotate about a fixed axis parallel with the plane of the front wing 81 of the saddle and so disposed with respect thereto that the periphery of the roller protrudes slightly beyond the front face of this wing 81.

The roll 77 is driven from the conveyor chain 21 by means of a sprocket wheel 82 which meshes with the lower run of the conveyor chain 21, bevel gearing 83, a vertical shaft 84, spur gears 85 and bevel gears 86.

The upper roll 76 is also driven from the conveyor chain to turn at exactly the same peripheral speed as the lower roll, by means of a vertical shaft 87 which extends up from the bevel gears 86 through the top of the pedestal 75 and into a bracket 88 also bolted to the top of the pedestal 75.

It is important that the pedestal 75 and the brackets 79 and 88 bolted thereto be perfectly rigid so that any separation of the feeler rolls resulting from the passage of work therebetween will directly and reliably represent the thickness of the work. Hence, these parts must be made strong enough to prevent deflection or spreading between the two brackets.

The drive shaft 87 for the upper roll is drivingly connected through bevel gears 89 with a jack shaft 90 journalled in top and bottom walls 91 and 92, respectively, of a housing structure which forms the upper part of the bracket 88. The shaft 90 protrudes above the top wall 91 and has a gear 93 keyed thereto. This gear meshes with a gear 94 which is freely rotatably mounted on a stub shaft 95 carried by an arm 96 arranged to swing about the axis of the shaft 90.

The gear 94 has the upper roll 76 fixed thereon to turn in unison therewith. Hence, though the arm 96 is free to swing about the shaft 90 to thereby carry the upper roll 76 toward and from its companion roll 77, the upper roll will be driven as well as the lower roll.

The arm 96 is preferably a casting with a hub 97 in which the stub shaft 95 is secured, and a hub 98 coaxial with the gear 93 and by which the lever is pivotally mounted to swing about the shaft 90. A cover casting 99 is secured to the top of the arm 96 to provide a guard for the gears 93 and 94, and an offset portion of this cover provides an outboard bearing for the stub shaft 95. A bored post 100 secured to the top wall 91 of the bracket 88 has the hub 98 of the arm freely rotatably mounted thereon, and its bore provides a bearing for the hub of the gear 93 and consequently the upper end of the shaft 90. In this manner the arm 96 is mounted to swing about the axis of the shaft 90.

A gear sector 101 is also mounted to swing about the shaft 90, the mounting for the sector being provided by its hub 102 embracing the hub 98 of the arm. Relative axial displacement between the gear sector and pivoted arm 96 is prevented by having the hub 102 of the gear sector confined between a shoulder on the underside of the arm and a flange 103 on the bored post 100. The flange 103 also provides a thrust bearing for the arm 96.

Though the gear sector and arm are movable with respect to one another, during the functioning of the caliper they swing in unison about the axis of the shaft 90. To tie the gear sector and arm together for such conjoint pivotal motion a heavy tension spring 104 connects the outer end of the gear sector with a pin 105 fixed in the outer end of the arm. The spring 104 draws the gear sector and arm together an amount determined by the setting of an adjusting screw 106.

The screw 106 is threaded in a block 107 mounted on the outer end of the gear sector and has its end bearing against a pad 108 on the outer end of a boss extended from the arm 96. A knurled head 109 provides means for adjusting the screw, and a lock nut 110 serves to secure the screw in adjusted position. As will be hereinafter more fully described, the adjustability of the relationship between the gear sector and arm 96 provides means by which the caliper may be set to any prescribed thickness for the groups of signatures within the range of the machine.

The arm 96 and consequently the upper feeler roll carried thereby is yieldingly urged toward the lower feeler roll by a spring 111 confined between a spring seat 112 on the arm 96 and a spring stop 113 mounted on the top wall 91 of the bracket 88. This spring tends to maintain the companion feeler rolls in engagement at all times but since it is desirable to have the groups of signatures moved between the rolls without opposition and also since it may be desirable to have the feeler rolls contact the work for only part of its length, a control cam 114 is provided by which the so-called down-time of the upper feeler roll is determined. This control cam is mounted on a cam shaft 115 parallel to the shaft 90 and journalled in the top and bottom walls 91 and 92 of the bracket 88. Gears 116, 117 and 118 (see Figure 8) drivingly connect the shafts 90 and 115.

The cam 114 (as best shown in Figure 6) comprises a top section 119 and a bottom section 120 the latter having a hub by which it is secured to the upper end of the shaft 115. The contour of the two cam sections is identical. Each has a concentric low and a concentric high and by interfitting cylindrical portions on the cam sections, they may be rotated with respect to each other to increase or decrease the effective angular length of the high and low of the cam. Clamping screws 121 provide means for securing the cam sections in any desired positional relationship.

As best shown in Figure 3 the cam 114 is tracked by a follower roller 122 freely rotatably mounted on an arm 123 which is preferably formed as an integral part of the gear sector 101. The radii of the high and low portions of the cam 114 are such that as long as the follower roller 122 rides the high of the cam the upper feeler roll is lifted clear of its companion roll to allow work to pass freely between the rolls without opposition and without having the rolls ride thereon. But when the low of the cam is opposite the follower 122 the cam has no effect upon the position of the upper feeler roll.

Thus, the angular duration of the low of the cam determines the down-time of the feeler roll, and in actual practice the parts are so proportioned that with the cam sections 119 and 120 completely in register so that the maximum low dwell is obtained the down-time is ten inches of book travel, whereas when the cam sections are rotated with respect to one another to reduce the low

dwell of the cam to minimum, a down-time of five inches of book travel is allowed. In other words, by rotating the cam sections **119** and **120** with respect to one another the down-time of the feeler roll may be varied between a minimum of five inches and a maximum of ten inches of book travel.

Since the location of the length of the book or group of signatures traversed by the caliper rolls is a function of the speed of the cam shaft **115** and since the spacing between the pusher pins on the conveyor chain which feed the groups of signatures to the stitching machine may be at least either of two selected distances as, for instance twenty-one (21) inches and twenty-four (24) inches, it is necessary that means be provided to coordinate the speed of the cam shaft with the length of chain between the pusher pins. This latter distance is generally referred to in the art as chain travel.

The needed coordination between the speed of the cam shaft **115** and the chain travel is obtained by removing the gears **116** and **118** and replacing them with gears of different diameter. This gear change also involves removing the idler gear **117** from its stub shaft **117'** and transferring it to a stub shaft **125**.

In addition to the cam **114**, the cam shaft **115** also has a timing cam **126** mounted thereon to close a micro switch **127** for a brief interval once each cycle of the machine. This cam **126** is secured to the underside of a hub on the gear **118** by means of clamping screws **128** in a manner allowing for rotational adjustment of the cam about the cam shaft **115**. By this adjustment it is possible to select the location in the length of the work and the time during the machine cycle when the micro switch **127** is closed.

The closure of the micro switch **127** is necessary to activate the control circuit **129** diagrammatically illustrated in Figure 15, but the closure of this switch of itself is not sufficient to do so. In addition one or the other of two mercury switches **130** and **131** must be closed at the time the micro switch **127** is closed. The closure of these mercury switches results from detection by the caliper of deviation from a prescribed thickness of the groups of signatures passing between the caliper rolls. Thus, if a group of signatures between the caliper rolls is thicker than the prescribed thickness or in other words the error is on the plus side, the switch **131** will be closed but if the error is on the negative side, or in other words the group of signatures is thinner than the prescribed thickness, then the switch **130** will be closed. In either event, the control circuit **129** is completed during the interval the micro switch **127** is closed and as a result thereof the solenoid **50** is energized to project one of the control elements **28** to its operative position.

The closure of the mercury switches **130** and **131** is the direct result of bringing a permanent magnet **132** into proximity therewith. This magnet is carried by a pendulum **133** swung in one direction or the other by rotation of a pinion shaft **134**. The pinion shaft **134** is journalled in bushings mounted in bosses **136** and **137** projecting from the side of the bracket **88**. At its upper end it has a pinion **138** fixed thereto which meshes with the gear sector **101** so that any swinging movement of the gear sector resulting from movement of the upper feeler roll toward or from its companion imparts rotation of the pinion shaft. To take up back-lash between the pinion and the gear sector a torsion spring **139** encircles the pinion shaft and has one end anchored to the boss **136** and its other end secured to a collar **140** fixed on the shaft.

The lower end of the pinion shaft has an arm **141** secured thereon, as by a set screw or the like, to swing as the pinion shaft is turned. Beyond the hub of the lever **141** the pinion shaft is reduced in diameter to provide a shoulder **142** and against this shoulder there are clamped the inner races of two ball bearings **143** and **144**, with a spacing washer **145** interposed therebetween, the clamping being effected by a nut **146** threaded on the outer end of the shaft. The outer race of the bearing **143** has an intermediate lever **147** clamped thereto and the outer race of the bearing **144** has a lever **148** clamped thereto.

The outer end of the intermediate lever **147** has a pair of oppositely projecting stop lugs **149** and **150** projecting upwardly and downwardly therefrom. These lugs coact with abutments **151** and **152** on the levers **141** and **148**, respectively. A tension spring **153** having one end anchored to the lever **141** and its other end connected to the intermediate lever **147** yieldingly holds the lugs **151** and **149** in engagement and a tension spring **154** having one end anchored to the lever **148** and its other end connected to the lever **147** holds the lugs **150** and **152** in engagement.

Consequently, if swinging movement of the pendulum **133** is not interfered with or arrested the pendulum swings in unison with the arm **141** which is fixed to the pinion shaft **134** but if free swinging movement of the pendulum is prevented or the extent of its movement is restricted, then the tension springs **153** and **154** permit overtravel of the pinion shaft **134** in either direction. Since the ratio of the gear sector and pinion and the length of the pendulum greatly multiply any bodily movement of the upper feeler roll (the actual amplification of motion being in the neighborhood of one to forty), such overtravel is necessary to enable adjustment of the mechanism to different thicknesses of stock and to prevent damage to the parts by substantial movement of the upper feeler roll away from its companion as, for instance, each time the cam **114** lifts the feeler roll. This relatively great multiplication of motion makes the caliper extremely sensitive. A difference of as little as three-thousandths of an inch (.003") can be reliably detected since such a movement at the upper feeler roll produces a movement of one hundred twenty thousandths of an inch (.120") at the end of the pendulum if it is not restrained. This distance between mercury switch **130—131** and the magnet **132** is sufficient to prevent closure of the switches.

If the caliper is set to trip at plus or minus three-thousandths of an inch (.003"), which represents very thin stock, the travel of the pendulum in either direction from its neutral position is limited to the amount it is swung by such .003" deviation of the upper roll from its prescribed position, and to limit the travel of the pendulum a boss **155** thereon collides with one or the other of two adjustable stops **156** and **157**. These stops are threaded into brackets **158** and **159** slidably mounted upon a base plate **160**. The mercury switches are also carried by these brackets, the switch **130** being mounted on bracket **158** and the switch **131** on bracket **159**.

To slide the brackets along the base plate **160** and thereby enable adjustment of the switches toward and from the pendulum, each bracket has a screw **161** projecting therefrom and slidably passed through aligned holes in a pair of arms **162** projecting forwardly from and fixed to the base plate, with a nut **163** threaded on the screw and confined between the arms **162**. Lock nuts **164** also threaded on the screws **161** secure the brackets in adjusted positions.

In setting up the mechanism for a given job a group of signatures of the correct thickness is placed between the companion feeler rolls. This will undoubtedly cause the pendulum to be swung toward the right (Figure 8) the full distance allowed by the setting of the stop **157**, the overtravel of the pinion shaft being accommodated by the spring **154**. With a proper group of signatures thus positioned between the feeler rolls the screw **109** is turned to adjust the angle between the lever **96** and the gear sector **101** until the rotation of the pinion shaft **134** resulting from such adjustment brings the pendulum to its neutral vertical position. At this adjustment the lock nut **110** is tightened.

The thickness of the group of signatures between the feeler rolls is next diminished by the thickness of one signature which, for illustration, may be three-thousandths of an inch (.003") and, of course, is accomplished by simply removing one of the signatures. Such diminution of the thickness of the group of signatures between the caliper rolls results in rotation of the cam shaft **134** in a clockwise direction as viewed in Figure 8 and a consequent movement of the pendulum to the left toward the mercury switch **130**. It should, of course, be understood that the brackets **158** and **159** should be apart far enough during this setting operation to preclude interference with free swinging movement of the pendulum.

With the pendulum swung toward the left, as viewed in Figure 8, the amount caused by the one sheet reduction in the thickness of the group of signatures between the calipering rolls, the bracket **158** is carefully adjusted toward the pendulum until its mercury switch **130** is close enough to the magnet **132** to be closed by the attraction of its mercury toward the magnet. Then

with the bracket **158** locked in this position the stop **156** is adjusted to bring the same just up against the lug **155**. This completes the adjustment for the detection of a negative deviation from the prescribed thickness of the work.

To set the mechanism for the detection of a positive deviation from prescribed thickness, the group of signatures between the calipering rolls is increased in thickness by the addition of one more than the proper number, whereupon the pinion shaft **134** is rocked in a counterclockwise direction, as viewed in Figure 8, to swing the pendulum to the right and toward the mercury switch **131**. The same adjustment as described in connection with the switch **130** is then made for the switch **131**, that is, its bracket **159** is adjusted along the base plate to bring the switch into the zone of influence of the magnet and then the stop **157** is adjusted to bring the same just up against the lug **155**.

With these adjustments made, any movement of the upper feeler roll resulting from deviation in the thickness of the work passing therebetween either on the positive or the negative side by an amount equivalent to the thickness of one signature will cause one or the other of the switches **130—131** to be closed. Movement of the upper feeler roll in excess of that amount, though producing an overtravel of the pinion shaft **134**, will have no effect upon the mechanism due to the fact that the motion of the shaft **134** is transmitted to the pendulum only through the springs **153—154**.

To assure against false detection which might result from the adherence of a piece of paper or other substance on the surface of the feeler rolls, each feeler roll is equipped with a wiper **165** which is spring biased against the periphery of the rollers and to guide the groups of signatures smoothly between the feeler rolls a shoe **166** is mounted in the path of the groups of signatures approaching the feeler rolls to flatten and hold them against the wing **81** of the saddle.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent to those skilled in this art that this invention provides an absolutely reliable and extremely sensitive calipering mechanism especially adapted to signature stitching machines to prevent the operation of the stitcher heads upon the presentment to the machine of defective groups of signatures and to prevent the delivery of such defective groups of signatures along with the good stitched books. It will also be apparent to those versed in this art that this invention affords the same reliable and sensitive control in work requiring two cycles of the machine operation to effect stitching of the book as well as work which can be stitched in one cycle. Other advantages of the invention lie in the fact that while its use of an electric control circuit affords instantaneous manifestation of the detection of imperfect work, its novel control unit can delay the effect of this manifestation until subsequent cycles of a machine equipped with this invention; and that while the invention is especially valuable on a signature stitching machine it is readily adaptable to other machines handling sheet material.

What we claim as our invention is:

1. In a cyclically operating machine of the character described having instrumentalities which perform an operation upon the work passing through the machine, the combination of means for preventing the operation of said instrumentalities upon the presentation of defective work, comprising: an electric control circuit; trip means controlled by said circuit and operable upon actuation to prevent the operation of said instrumentalities; a pair of switches connected in series in said circuit, both of said switches being biased to positions maintaining the circuit inoperative to actuate the trip means; cyclically operating means driven by the machine and connected with one of said switches to actuate the same against the bias thereon once each cycle of the machine to a position at which it would render the circuit operative to actuate the trip means providing the other switch were also in a position to render the circuit operative; detector means positioned to operate upon the work being fed to said instrumentalities, said detector means being sensitive to a predetermined defectiveness in the work and operable upon its detection to produce a response capable of actuating an electric switch; and means connecting the detector means with said other switch to translate a switch actuating response at the detector means into actuation of said other switch against the bias thereon to its position necessary to render the circuit operative to actuate the trip means.

2. The structure set forth in claim 1 further characterized by the incorporation in said trip means of means for delaying its manifestation, comprising a plurality of control elements constrained to movement in unison along a defined recurrent path; machine driven means for indexing said control elements along said path; said control elements being shiftable between operative and inoperative positions on said path; electrically responsive means connected in the control circuit and operable upon actuation thereof to shift one of the control elements to its operative position; and mechanism positioned to be actuated by a control element in operative position upon engagement of such element therewith.

3. In a signature stitching machine including a saddle along which signatures to be stitched into books are advanced, and a stitcher head for stitching said groups of signatures into books, the combination of mechanism for preventing the operation of the stitcher head upon the presentation thereto of a group of signatures which is defective due to its being either too thick or too thin, comprising: lock-out mechanism for restraining the operation of the stitcher head; an electrically responsive trip device for actuating said lock-out mechanism; a control circuit for said electrically responsive trip device; a pair of electric switches connected in series in said control circuit; means providing a reference surface over which the groups of signatures move in their passage to the stitcher head; a feeler roll; means mounting the feeler roll opposite the reference surface and for movement thereof toward and from the same so that the groups of signatures pass between the feeler roll and said surface and the positional relationship between the feeler roll and the reference surface depends upon the thickness of the groups of signatures passing therebetween; means biasing the feeler roll toward said reference surface; a connection between one of said two switches and said feeler roll whereby movement of the feeler roll from a predetermined positional relationship with respect to the reference surface in consequence to the passage of a defective group of signatures therebetween closes said switch and holds the same closed as long as said roll and the defective group of signatures are in engagement; and machine driven means connected with the other switch and operable to close the same for an interval of the time the feeler roll is in engagement with each succeeding group of signatures.

4. In a cyclically operating machine having instrumentalities operable upon work presented thereto, and having cyclically operating means for presenting work to said instrumentalities, the combination of means for preventing the operation of said instrumentalities upon the presentation thereto of work which deviates from a prescribed normal condition, said means comprising a plurality of spaced apart movable control elements; means timed with the cyclic operation of the machine for advancing said control elements along a predetermined recurrent path, said control elements being movable to and from an operative position; means positioned in the path of the control elements and actuatable by a control element in operative position to prevent the operation of said instrumentalities; electrically responsive means positioned adjacent to the recurrent path of the control elements ahead of the point in said path at which an operative control element actuates the means for controlling said instrumentalities, said electrically responsive means being operable to move a control element to its operative position; detector means positioned to act upon work being moved toward said instrumentalities; and a control circuit for said electrically responsive means connected between it and said detector means and governed by the detector means, said detector means activating the control circuit by its response to deviation from a predetermined condition of the work passing the detector means.

5. In a signature stitching machine having a cyclically operated stitcher head, a delivery mechanism including means for routing the finished work one way or the other, and cyclically operating mechanism for advancing groups of signatures to the stitcher head and from the stitcher head to the delivery mechanism, the combination of: mechanism for locking out the operation of the stitcher head; mechanism for shifting said routing

device; a calipering device positioned to act on groups of signatures moving toward the stitcher head; electrically responsive means for rendering said stitcher head lock-out mechanism effective and for shifting said routing device; a control circuit governed by said calipering device for activating said electrically responsive device; and time delay means for delaying the response of the stitcher head lock-out mechanism and the routing device of the delivery mechanism to take place during cycles of the machine subsequent to that in which detection of a bad group of signatures is made.

6. In a signature stitching machine having a stitcher head normally operated during each cycle of the machine, the combination of means for preventing the operation of the stitcher head upon the presentation thereto of a group of signatures which fails to have a predetermined thickness, comprising: an electric control circuit; trip means controlled by said circuit and operable upon actuation to prevent the operation of said sticher head; a pair of switches connected in series in said control circuit, both of said switches being biased to positions maintaining the circuit inoperative to actuate the trip means; cyclically operating means driven by the machine and connected with one of said switches to actuate the same against the bias thereon once each cycle of the machine to a position at which it would render the circuit operative to actuate the trip means providing the other switch were also in a position to render the circuit operative; a mechanical caliper positioned to operate upon the groups of signatures being fed to the stitcher head, said caliper including a feeler movable from a predetermined position in consequence to deviation from a prescribed thickness of the groups of signatures passing the caliper; and means connecting the caliper with said other switch to translate movement of the feeler into actuation of said other switch against the bias thereon to its position necessary to render the circuit operative to actuate the trip means.

7. In a signature stitching machine, having a normally cyclically operated stitcher head, a delivery mechanism including a routing device for directing the work leaving the machine one way or another, and cyclically operating mechanism for advancing groups of signatures to the stitcher head and from the stitcher head to the delivery mechanism, the combination of: a caliper positioned to inspect the groups of signatures moving toward the stitcher head and having a feeler movable from a normal position in response to the detection of a group of signatures which fails to have the prescribed thickness; mechanism for preventing the operation of the stitcher head and for effecting the shifting of the routing device; electrically responsive means for activating said last named mechanism; a control circuit for said electrically responsive means including a pair of switches connected in series, so that both of said switches must be closed to effect the functioning of said electrically responsive means; means connecting one of said switches with the movable feeler and through which movement of the feeler in either direction in consequence to deviation in thickness of the group of signatures passing through the caliper, effects closure of said switch and retains it closed for as long as the deviation in thickness is detected by the caliper; cyclically operating means for closing the other switch once during each cycle of the machine; and means for delaying the effect of the operation of said electrically responsive means which results from concurrent closure of said two switches to a cycle subsequent to that during which such concurrent closure of the two switches took place.

8. The combination set forth in claim 7 further characterized by the fact that the means for delaying the effect of the operation of said electrically responsive means comprises a plurality of movable control elements; means mounting and constraining the control elements to movement along a recurrent path while enabling shifting thereof from normal inoperative positions to operative positions; machine driven means for indexing the control elements a step at a time along their recurrent path; means actuated by the electrically responsive means and located at one point in the path of the control elements for shifting a control element to its operative position; means cooperable with a control element in operative position to activate the means for preventing operation of the stitcher head; and other means cooperable with a control element in operative position for activating the means for effecting the shifting of the routing device, said two means which cooperate with a control element in operative position being located at spaced points in the path of the control elements beyond the point at which the control elements are shifted to operative position and so positioned as to be reached by the control element in operative position during machine cycles subsequent to that at which the control element was shifted to operative position.

9. In a cyclically operating machine which performs work upon sheet material fed thereto and has instrumentalities to perform one operation during one cycle of the machine and other instrumentalities to perform another operation upon the sheet material during a subsequent cycle of the machine, the combination of means for preventing the operation of said instrumentalities if the sheet material fed thereto is imperfect, said means comprising: a detector positioned in the path of the sheet material being fed through the machine and responsive to detection of an imperfect condition of the sheet material; an electric switch closed by such response of the detector; another electric switch; means driven by the machine for closing said other switch once each cycle of the machine; a control circuit having said two switches connected in series therein so that concurrent closure of both is required to close the control circuit; mechanism for controlling each of said instrumentalities; electrically responsive means connected in said control circuit for actuating said mechanisms; and means for delaying the effect upon said mechanisms of the activation of the electrically responsive means until the sheet material which occasioned the response of the detector arrives at each of said instrumentalities.

10. A caliper for sheet handling machines, comprising: coacting feeler members between which the sheet material passes; means mounting one of said feeler members for pivotal movement toward and away from the other feeler member; means for operating the movable feeler member at predetermined intervals; a pair of spaced apart mercury switches; a pendulum having its free end portion disposed between said switches; means mounting said pendulum for pivotal movement about an axis independently of the pivotal axis of the movable feeler member; a permanent magnet carried by the free end portion of the pendulum and operable upon movement thereof into proximity with either of said switches to effect closure thereof; and a motion transmitting connection between the pendulum and the movable feeler member through which movement of the latter toward the other feeler member an extent in excess of a prescribed distance positions the pendulum to effect closure of one of said switches, and movement of the movable feeler member toward the other feeler member an extent less than said prescribed distance positions the pendulum to effect closure of the other of said switches.

11. A caliper for sheet handling machines, comprising: a rigid reference surface across which the sheet material passes; a movable feeler member opposite said reference surface; means urging said movable feeler member toward the reference surface, said movable feeler member occupying a predetermined position as long as the sheet material moving between it and the reference surface does not deviate from a prescribed thickness; a pivoted arm connected with the movable feeler member to be swung by movement of said feeler member in either direction from its predetermined position; a pendulum mounted to swing about a fixed axis spaced from the axis about which the arm swings; a motion transmitting connection between the pendulum and said arm including a gear on the arm meshing with a pinion concentric to the axis about which the pendulum swings; and means located adjacent to the free end of the pendulum for translating swinging movement of the pendulum in either direction from a normal vertical position into a control impulse.

12. The caliper set forth in claim 11 further characterized by the provision of: stop means for limiting swinging movement of the pendulum; and yieldable means in the motion transmitting connection located between the pinion and the pendulum so that rotation of the pinion may be continued despite stoppage of swinging movement of the pendulum.

13. A caliper for sheet handling machines, comprising: a movable feeler roll; a pivoted lever mounting said feeler roll in position for engagement with the sheet material passing through the machine, said lever holding the feeler

roll in engagement with the sheet material and enabling movement of the roll in one direction or the other with deviation from a prescribed thickness of the sheet material; a gear sector pivoted to swing about the axis of the arm which carries the movable feeler roll; a pinion mounted to rotate about a fixed axis meshing with the gear sector; a lever mounted to swing about the axis of the pinion; stop means limiting the swinging movement of the lever to a predetermined arc extending to opposite sides of a neutral position; a yieldable motion transmitting connection between the pinion and said lever through which the lever is held in its neutral position when the feeler is in contact with sheet material of the prescribed thickness, and through which rotation of the pinion in consequence to motion of the feeler roll normally effects swinging movement of the lever, the yieldability in the motion transmitting connection enabling rotation of the pinion due to abnormal movement of the feeler roll even though the swinging movement of the lever has been stopped; an adjustable connection between the gear sector and the arm carrying the movable feeler roll and through which the relationship between the feeler roll and the lever may be varied to enable the lever to assume its neutral position with any prescribed thicknesses of the sheet material; and mechanism in juxtaposition to the free end portion of the lever for translating movement thereof in either direction from its neutral position into a control impulse.

14. In a calipering device of the character described: a pair of spaced apart mercury switches; a pivoted lever mounted with a free end portion between said switches; a permanent magnet carried by said free end portion of the lever, the spacing between the switches being such that with the lever in a position substantially equispaced from the two switches the permanent magnet carried thereby has no effect upon the switches; a movable feeler mounted independently of said lever to move from a position spaced clear of the material to be calipered toward and into engagement with said material; means for operating said feeler; and a driving connection between said feeler and said lever through which movement of said feeler an extent in excess of a prescribed distance to engage said material positions said lever to bring said magnet into switch closing proximity with one of said switches, and movement of said feeler an extent less than said prescribed distance positions said feeler to bring said magnet into switch closing proximity with the other of said switches.

15. In a calipering device of the character described, the structure set forth in claim 14 but wherein the pivoted lever is a pendulum normally hanging in a vertical position.

16. In a calipering device of the character described, the structure set forth in claim 14 further characterized by the provision of stop means for limiting the swinging movement of the pivoted lever in either direction to preclude collision thereof with the mercury switches; and further by the incorporation of yieldable means in the driving connection between the movable feeler and the pivoted lever through which overtravel of the feeler with respect to the permitted motion of the lever is accommodated.

17. In a calipering device of the character described: a movable feeler member movable in either direction from a position corresponding to the correct thickness of the material being calipered; an arm mounted to swing about a fixed axis; a motion transmitting connection between the movable feeler member and said arm through which movement of the feeler member swings the arm about its mounting, said motion transmitting connection multiplying the motion of the feeler member so that a relatively small motion on the part of the feeler member swings the free end of the arm through a substantial arc; a pair of mercury switches each adapted to be closed by bringing a magnet in close proximity thereto; a permanent magnet carried by the free end portion of the arm; and means mounting said mercury switches at opposite sides of the free end portion of the arm and across the path of the permanent magnet carried thereby but spaced apart a distance sufficient to prevent closure of the switches by the permanent magnet as long as the arm is in a neutral position corresponding to the position of the feeler member when the material being calipered has the correct thickness.

18. In a caliper of the character described, the structures set forth in claim 17 further characterized by the provision of: means for adjusting the mercury switches toward and from one another to thereby enable greater or lesser swinging movement of the pivoted arm; stops fixed with respect to the mercury switches and cooperable with a part on the pivoted arm to positively limit the swinging movement thereof; and yieldable means forming part of the driving connection between the pivoted arm and the movable feeler member for accommodating travel of the feeler member beyond points corresponding to the limitations of swinging movement of the pivoted arm.

19. In a signature stitching machine having a conveyor chain for advancing groups of signatures to be stitched, the combination of means for calipering the groups of signatures and closing an electric circuit upon detection of deviation from a prescribed thickness for the groups of signatures being advanced by the conveyor chain, said means comprising: a timing switch; a rotatable cam for periodically closing the timing switch; a drive for said cam driven by the conveyor chain, said drive timing the rotation of the cam to effect closure of the timing switch once for each fixed amount of chain travel; complementary feeler rolls mounted to have the groups of signatures pass therebetween; means mounting one of the rolls for movement thereof toward and from the other; means biasing said movable roll toward the other; a rotatable cam reacting against said biasing means and controlling the periods of cooperation between said rolls; means driven by the conveyor chain for rotating said last named cam so that the periods of cooperative relationship between the rolls is coordinated with the closure of the timing switch; a pair of switches connected in series circuit with the timing switch; and switch closing means connected with the movable roll for closing one or the other of said pair of switches in response to movement of the movable roll in either direction from a predetermined positional relationship with respect to the other roll.

20. In a calipering device of the character described: a pair of companion feeler rolls; a pivoted arm mounting one of the feeler rolls for movement toward and from the other; an electrical control circuit; a member arranged to be electrically actuated by said circuit; a normally open electric switch connected in said circuit; a switch closing mechanism drivingly connected with said pivoted arm and operable to close the switch upon movement of the arm occasioned by movement of the movable roll from a predetermined positional relationship with respect to its companion; a normally open electric timing switch connected in said circuit, both said switches when closed rendering said circuit operative to electrically actuate said member; a cam shaft; a pair of cams on said shaft; a cam follower riding on one of said cams and connected with the timing switch for periodically closing the same as the cam shaft rotates; and a cam follower connected with said pivoted arm and riding on the other cam to lift the movable roll out of cooperative relationship with its companion during part of the rotation of the cam shaft, whereby said cam shaft coordinates the closure of the timing switch with the periods of cooperation between the rolls.

21. In a calipering device of the character described: a movable feeler roll adapted to ride the work to be calipered; a pivoted supporting arm carrying said movable feeler roll for downward movement toward the work and upward movement therefrom; a spring acting on said pivoted arm and yieldingly biasing the same downward to hold the roll in engagement with the work being calipered; a rotatable cam for controlling the down time of the roll; a cam follower connected with the pivoted arm and riding on said cam to lift the roll out of operative engagement with the work during part of the rotation of the cam while allowing the roll to operatively engage the work during the remainder of the rotation of the cam; an electrical control circuit; a member arranged to be electrically actuated by said circuit; a normally open electric switch connected in said circuit; switch actuating mechanism connected with the pivoted arm and operative to close the switch in response to movement of the arm caused by response of the feeler roll to deviation from a prescribed condition of the work; an electric timing switch connected in said circuit in series with said first named switch, both said switches when closed rendering said circuit operative to electrically actuate said member; a cam for closing said timing switch; and a

common cam shaft for said two cams, said cams being rotationally adjustable with respect to one another about the cam shaft so that the period of closure of the timing cam may be adjusted to take place during a predetermined part of the down time of the feeler roll.

22. In a stitching machine having a saddle upon which groups of signatures are supported during the stitching operation, and a conveyor chain for advancing groups of signatures to the saddle, the combination of calipering device for calipering the groups of signatures being advanced to the saddle and for preventing the operation of certain instrumentalities of the machine upon the passage of a group of signatures which fails to have a prescribed thickness, said calipering device comprising: a pair of companion upper and lower feeler rolls mounted in the path of the groups of signatures advanced by the conveyor chain with their peripheries engageable upon a plane substantially tangent to the outer face of one wing of the saddle; the lower roll being rotatable about a fixed axis; a pivoted arm carrying the upper roll for bodily up and down movement from and toward the lower roll; a spring acting upon said pivoted arm and yieldingly urging the same in the direction to hold the upper roll down on the lower roll and thus on top of the groups of signatures passing between the rolls; a cam reacting against said spring to lift the upper roll away from its companion and to hold the same out of coaction therewith for part of the rotation of said cam while allowing free movement of the upper roll toward and from its companion during the remainder of the rotation of the cam; an electric switch; switch actuating mechanism drivingly connected with the pivoted arm and operable to close said switch upon movement of the arm with the movable feeler roll out of a predetermined normal position corresponding to a prescribed thickness for the groups of signatures; a timing switch connected in series circuit with the first named switch so that both switches must be closed to effect the desired control function; a timing cam operable to periodically close the timing switch; a common cam shaft for said two cams; and means driven from the conveyor chain for rotating the cam shaft so that the period of possible concurrent closure of the two switches is coordinated with the advance of the groups of signatures by the conveyor chain.

23. A calipering device of the character described, comprising: a pair of companion stationary and movable feeler rolls; means mounting the stationary roll for rotation about a fixed axis; means mounting the movable roll for rotation about an axis parallel to that of the stationary roll and for bodily movement toward and from the same; common drive means for rotating both rolls in unison and with identical peripheral speeds; means biasing the movable roll toward the stationary roll; a cam reacting against said biasing means for controlling the periods during which the rolls are in cooperative relation capable of effecting a calipering function; an electric switch; switch closing mechanism connected with the means for mounting the movable roll and operable to close the switch whenever the movable roll deviates from a predetermined positional relationship with respect to the stationary roll; a timing switch connected in series circuit with said first named switch so that both switches must be simultaneously closed to effect their controlling function; a timing cam for periodically closing the timing switch; a common cam shaft for the two cams so that the relative positions of the cams on said common cam shaft determines when simultaneous closure of both switches can take place; and means for driving the cam shaft from the drive of the feeler rolls.

24. In a calipering apparatus of the character described: a movable feeler engageable with the work to be calipered and movable one way or the other in response to deviation from a prescribed thickness of the work; a pair of electric switches to be closed by such movement of the feeler; a gear sector pivoted to swing about a fixed axis and connected with the movable feeler to be swung by movement of the feeler from a predetermined normal position; a pinion meshing with the gear sector; a pinion shaft on which the pinion is secured; and switch closing mechanism connected with the pinion shaft and operable by rotation of the pinion shaft in one direction to close one of said switches and upon rotation in the opposite direction to close the other switch.

25. In a calipering apparatus of the character described: a movable feeler; a pivoted arm carrying said feeler for movement toward and from the work being calipered; means biasing said arm in a direction to hold the feeler against the work being calipered so that deviation from a prescribed thickness of the work effects swinging movement of the arm in one direction or the other; a gear sector connected with the arm to be rocked by movement of the arm; a pinion meshing with the gear sector; a pinion shaft on which the pinion is fixed; a pendulum mounted to swing about the axis of the pinion shaft; instrumentalities mounted adjacent to the free end of the pendulum to be actuated by swinging movement of the pendulum in either direction from a neutral position; and a driving connection between the pinion shaft and the pendulum through which rotation of the pinion shaft effects swinging movement of the pendulum.

26. The calipering apparatus of claim 25 further characterized by the fact that said driving connection between the pinion shaft and the pendulum comprises a lever fixed to the pinion shaft; a lever fixed to the pendulum but free with respect to the pinion shaft; an intermediate lever free with respect to the pinion shaft and the pendulum, all of said levers being pivotal about the axis of the pinion shaft; cooperating stop abutments on said levers; and springs holding said stop abutments in engagement so that all of said levers and the pendulum move in unison with rotation of the pinion shaft unless movement of the pendulum is interfered with.

27. In a signature stitching machine having a normally cyclically operated stitcher head and cyclically operating means for advancing groups of signatures to the stitcher head, the combination of: mechanism for preventing the operation of the stitcher head; and means for detecting during one cycle of the machine a group of signatures which fails to meet prescribed thickness and for actuating the mechanism for preventing operation of the stitcher head during a subsequent cycle of the machine, said means comprising a caliper positioned to caliper the groups of signatures being advanced to the stitcher head, a plurality of movable control elements, means mounting and constraining the control elements to movement along a recurrent path while enabling shifting thereof from normal inoperative positions to operative positions, machine driven means for indexing the control elements along their recurrent path once during each cycle of the machine, means actuated by response of the caliper to detection of a group of signatures which fails to have the prescribed thickness, and located at one point in the path of the control element for shifting a control element to its operative position, and means located to coact with a control element in operative position to render operative the means for preventing operation of the stitcher head, said last named means being positioned to be reached by a control element in operative position during a cycle of the machine subsequent to that during which said element was shifted to its operative position.

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