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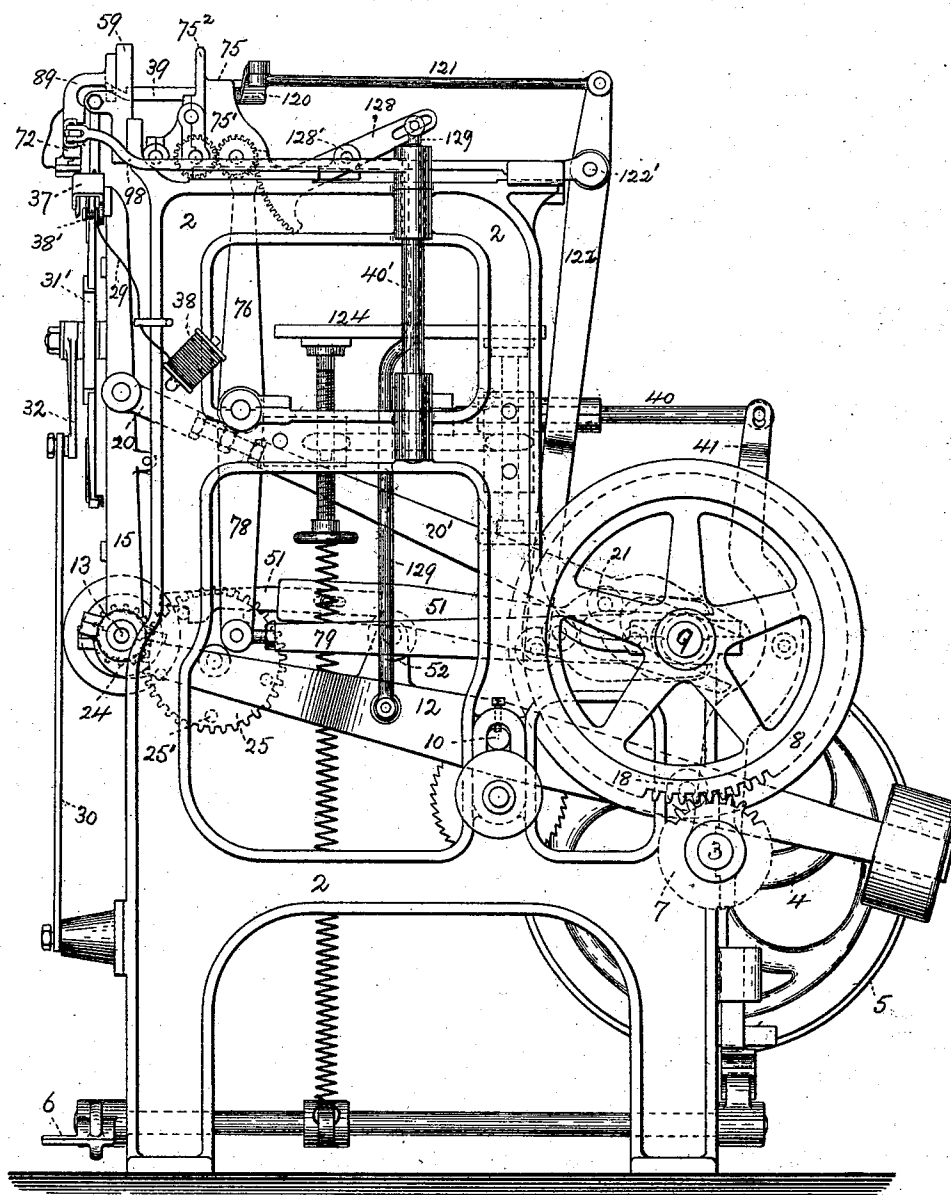
8 Sheets—Sheet 1.

W. I. BLACKMAN.
BOOK SEWING MACHINE.

No. 531,357.

Patented Dec. 25, 1894.

Fig. 1.



Witnesses.

John F. Nelson.
E. C. Baynton

Inventor.

Wm. I. Blackman.
by H. C. Lodge Atty.

(No Model.)

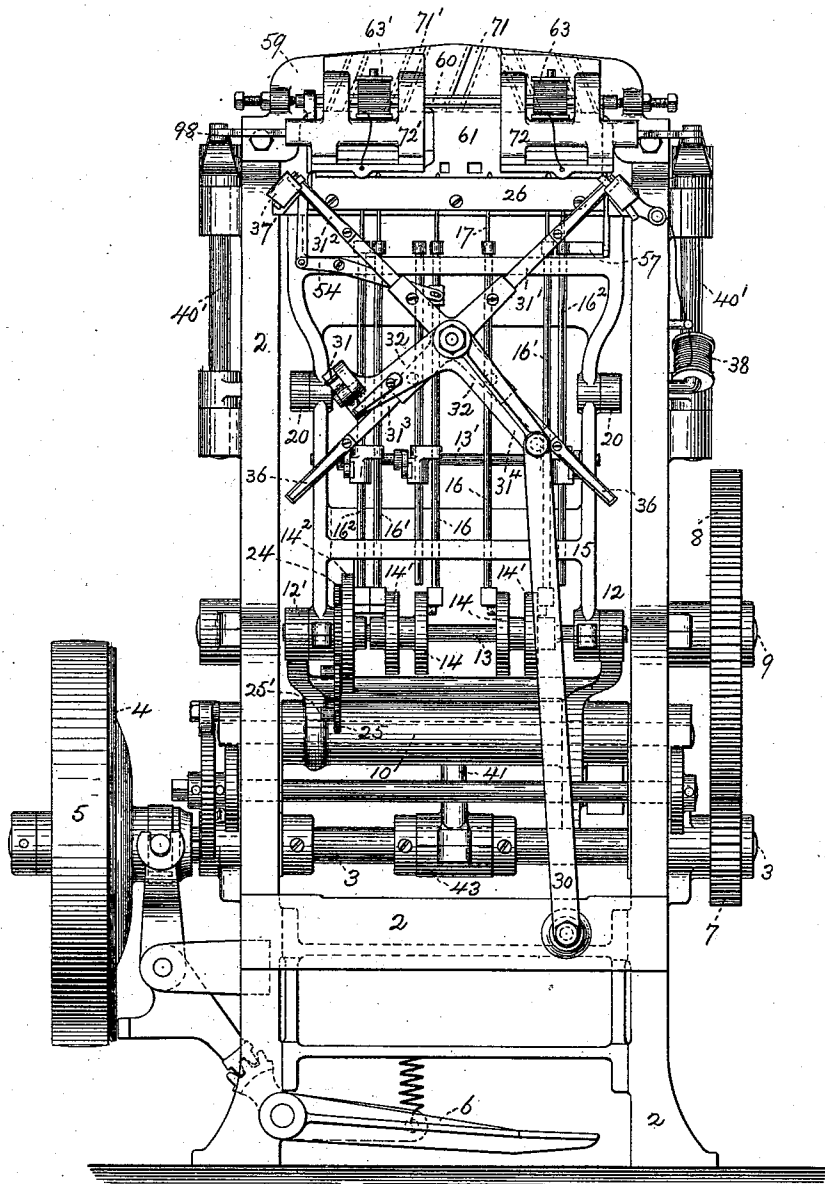
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Fig. 2.



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Fig. 3.

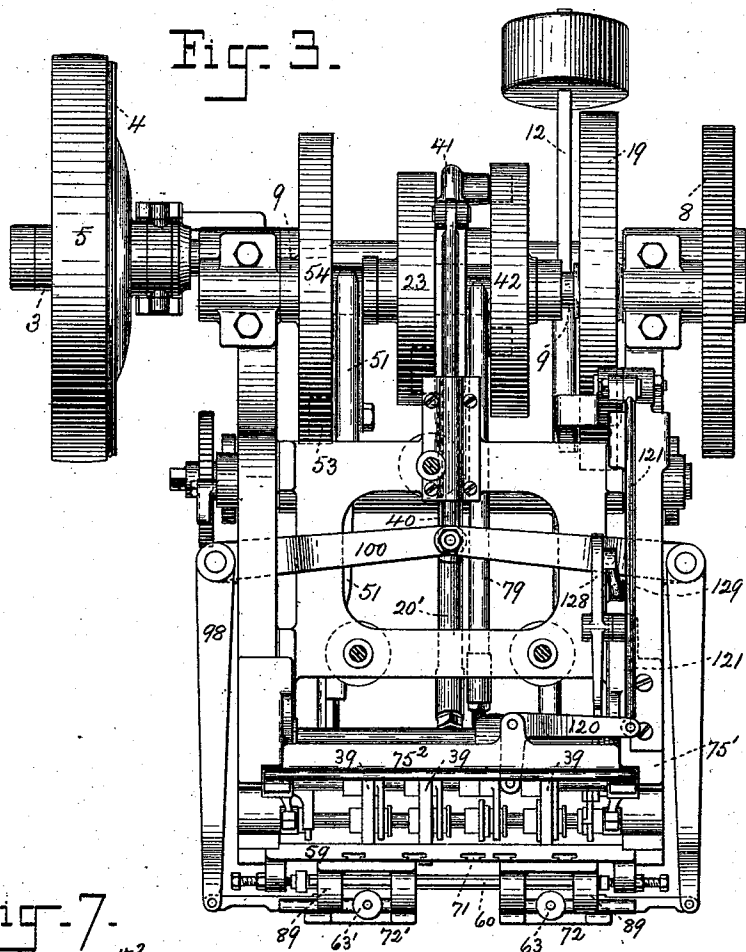


Fig. 8

Fig. 7.

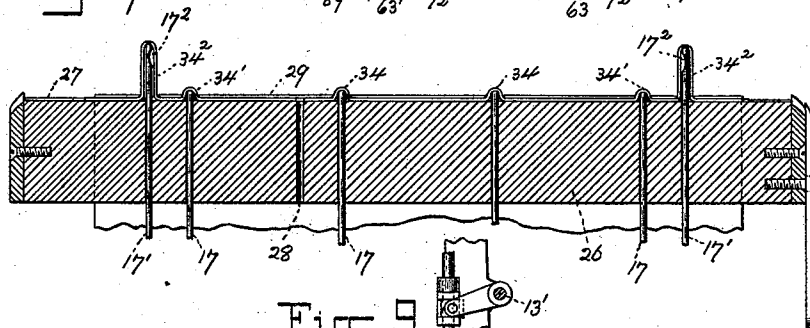
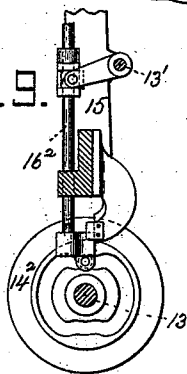


Fig. 9.



Witnesses.

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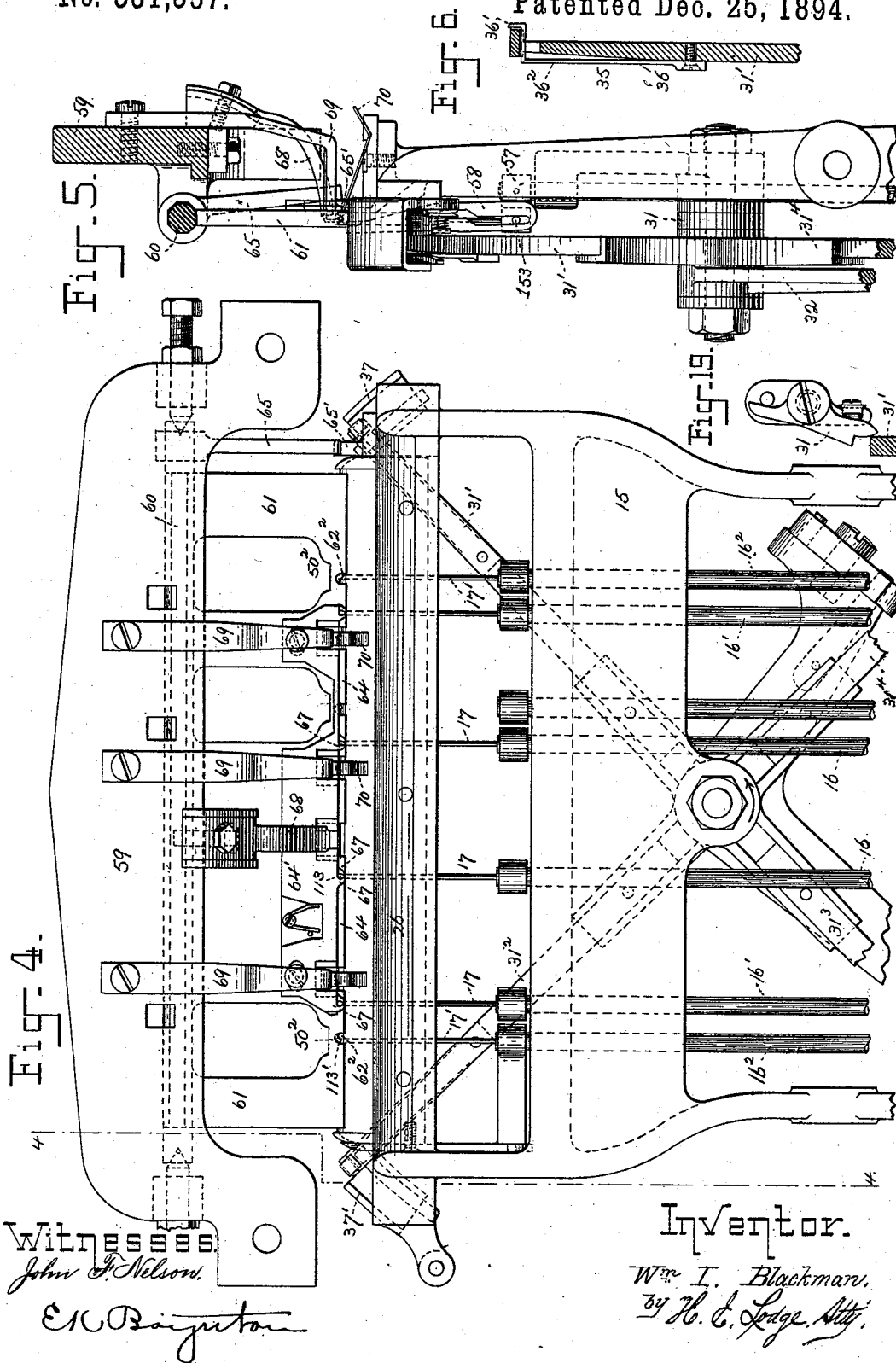
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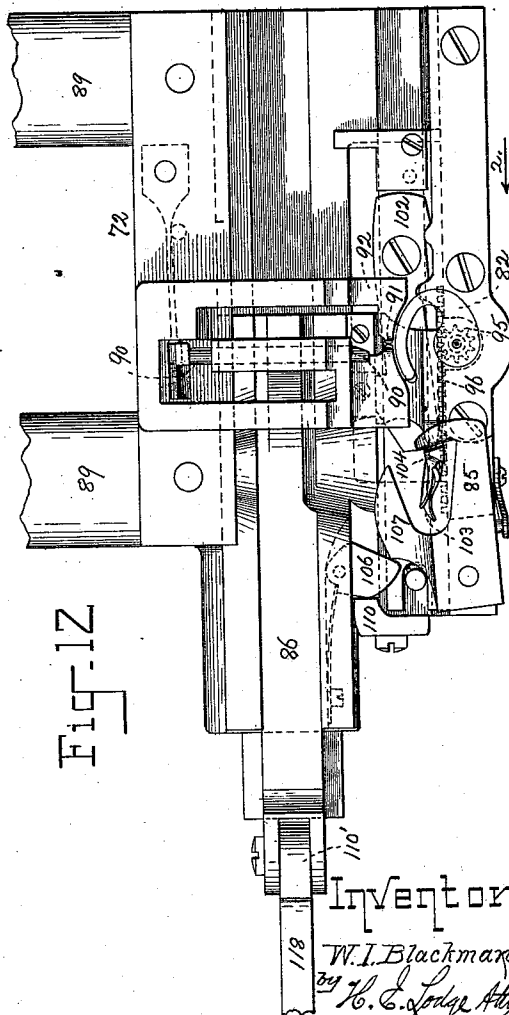
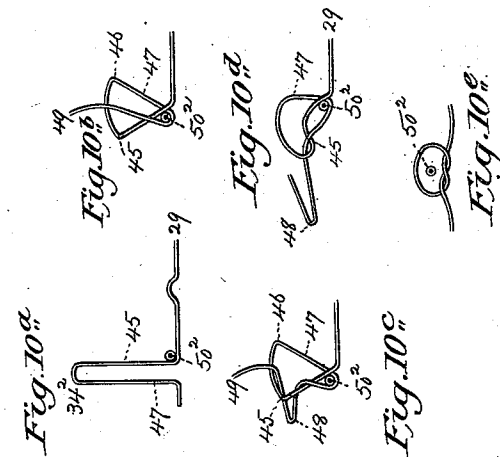
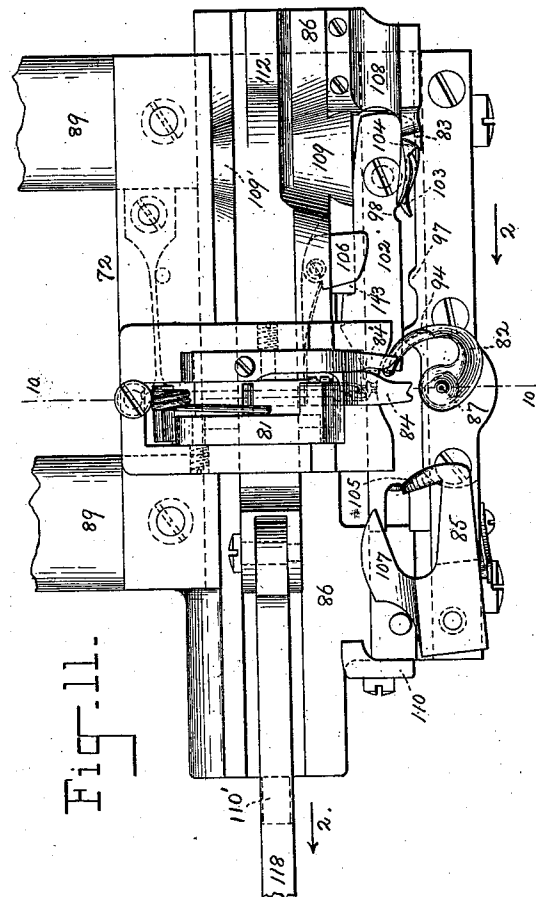
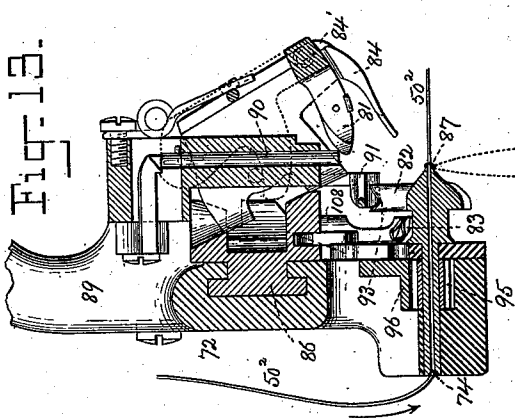
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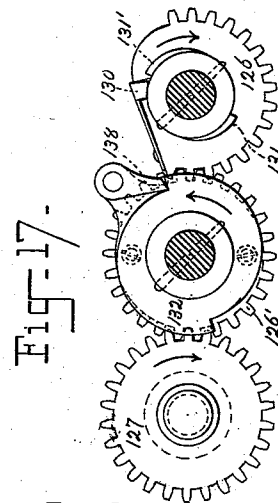
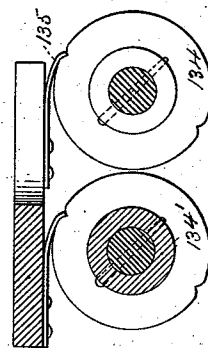
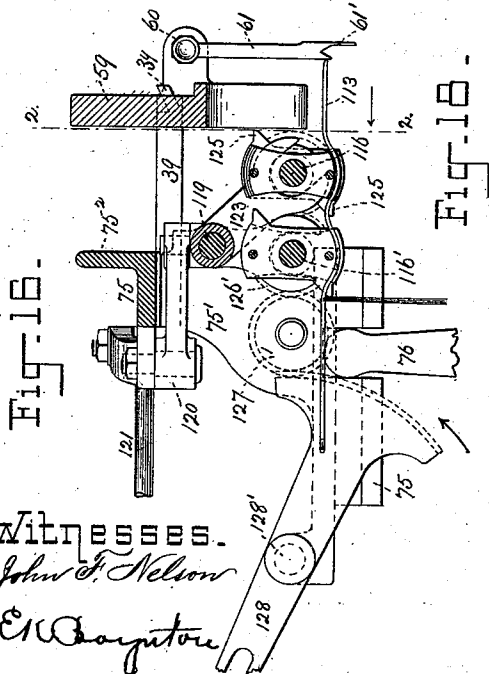
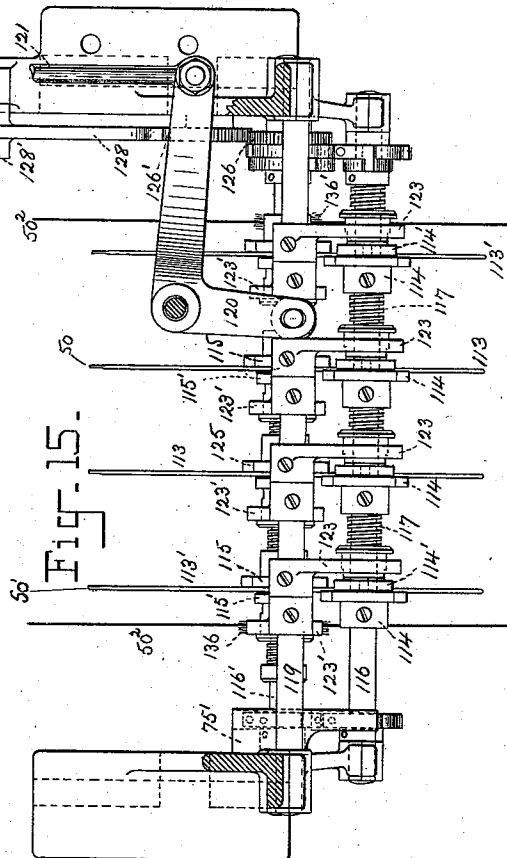
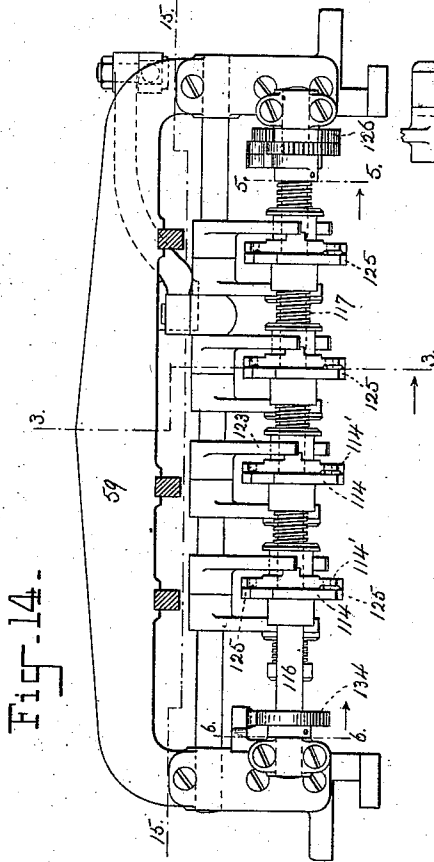
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Fig- 20.

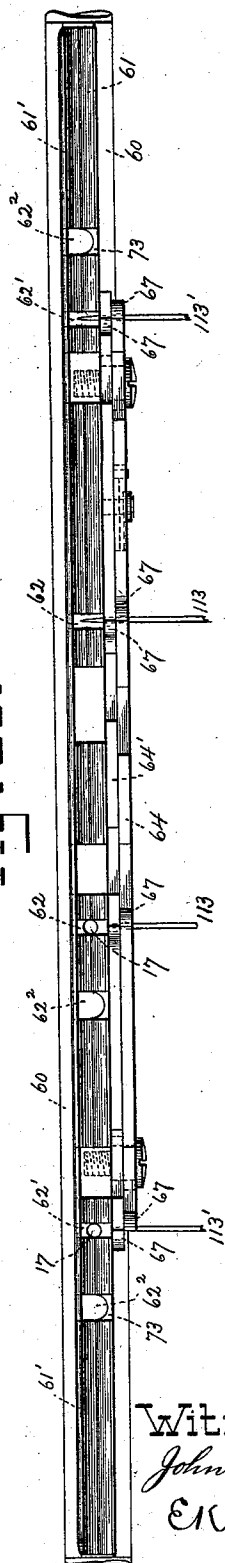


Fig- 21.

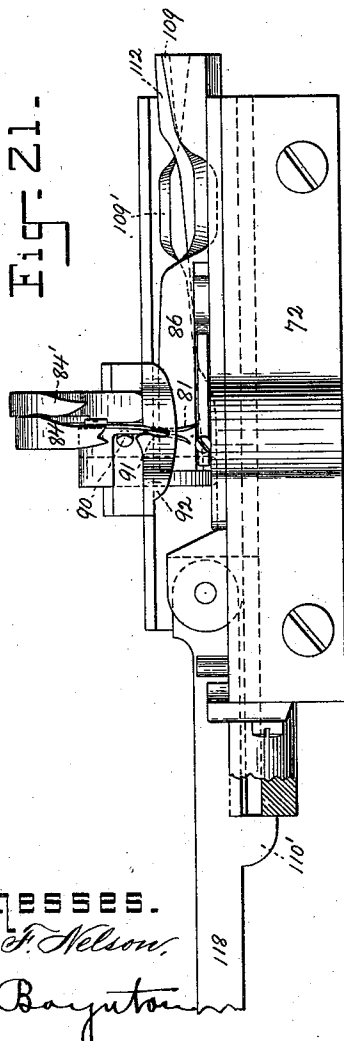


Fig- 23.

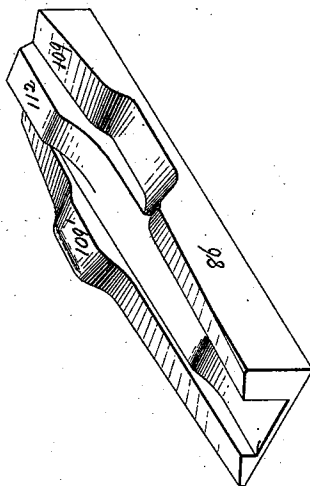
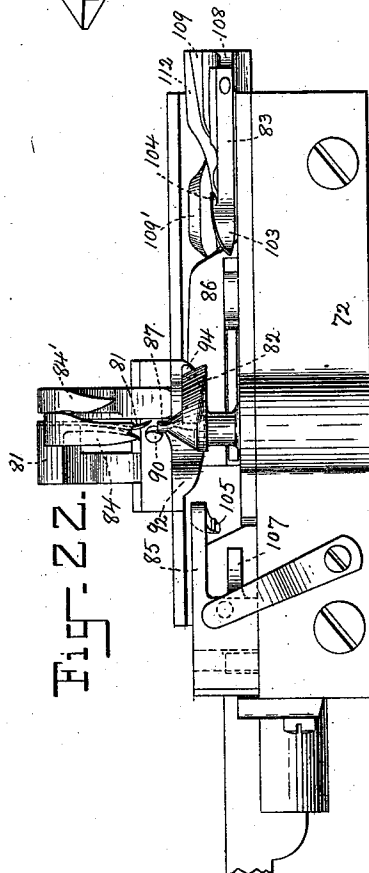


Fig- 22.



Witnesses.
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(No Model.)

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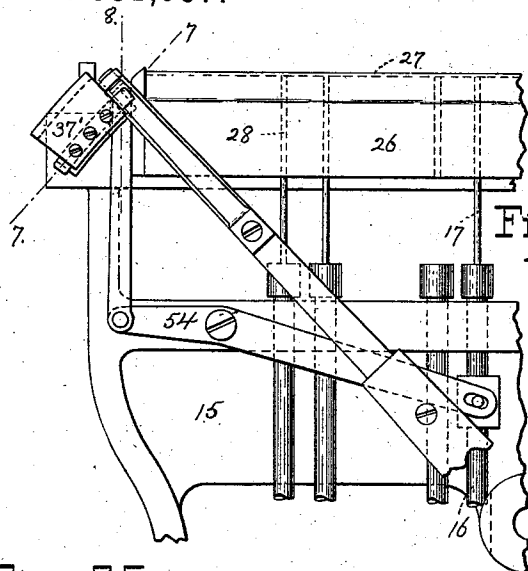


Fig. 27.

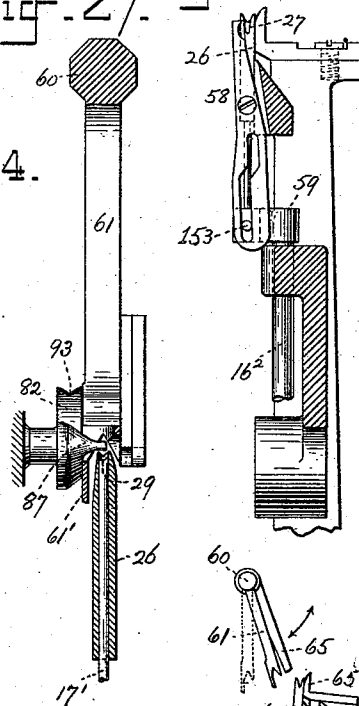


Fig. 25.

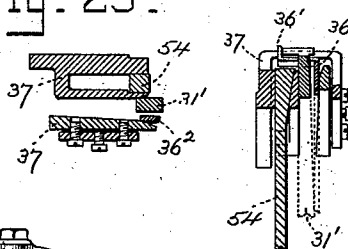


Fig. 26.

Fig. 29.

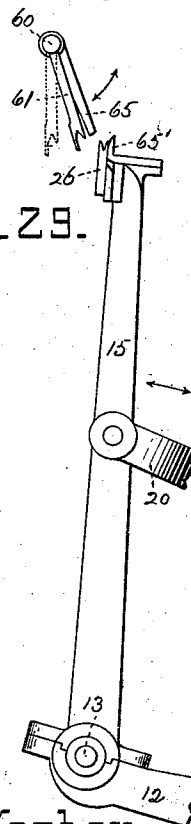


Fig. 30.

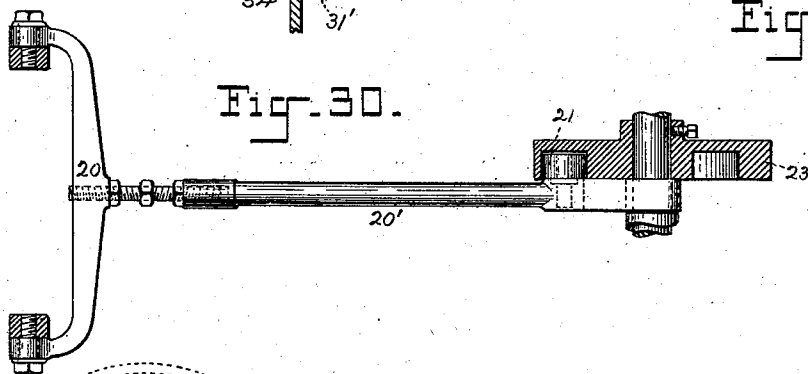
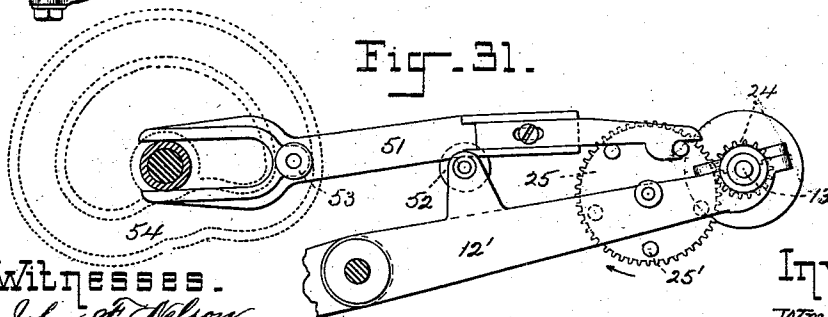


Fig. 31.



Witnesses.

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UNITED STATES PATENT OFFICE.

WILLIAM IRELAND BLACKMAN, OF COLUMBUS, MISSISSIPPI.

BOOK-SEWING MACHINE.

SPECIFICATION forming part of Letters Patent No. 531,357, dated December 25, 1894.

Application filed June 28, 1894. Serial No. 516,031. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM IRELAND BLACKMAN, a citizen of the United States, residing at Columbus, in the county of Lowndes and State of Mississippi, have invented certain new and useful Improvements in Apparatus for Sewing Book-Signatures; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to figures of reference marked thereon, which form a part of this specification.

This invention relates to apparatus for sewing or uniting together by the aid of threads signatures, so-called, and comprises one of the steps in the process of binding books. This machine is intended to perform automatically and mechanically the several identical steps as now are produced by the process of hand sewing.

In the process of assembling and uniting the various signatures which compose a book, it is to be understood that each signature contains a single thread termed the signature thread to be laid lengthwise in the fold of the signature; furthermore that a number of cords are positioned transversely of the thread upon the backs of the signatures taken as a group and enter a loop in the signature thread formed by passing said thread through the fold of the signature; lastly, each signature thread is tied at each end to one of the binding cords with a kettle or end-stitch, and these two transverse outer threads are styled bar threads being smaller than the central or main binding cords.

The various instrumentalities which comprise the machine now to be described and which include my invention are intended to accomplish the following steps, it being understood that the signatures are always held in a vertical position with the back or outside of the signature fold uppermost: First, one group of elements embraces mechanism for laying and cutting the signature threads of the requisite length, together with a set of loop inserting punches which pierce the signature said punches being actuated one at a time and thrust the signature thread partly

through the fold of the signature to form a loop, in this way avoiding the necessity of sawing the signature to create saw-cuts or notches. The second group of elements comprises a set of binding-cord carriers horizontally arranged, each of which carries a binding cord, and these carriers co-operate with a rocking plate adapted to support the points of the binding-cord carriers and likewise the signature at the time the loop-inserting punches operate to create loops in the signature thread. The third group of elements comprises mechanism by which both ends of the signature thread are secured by a kettle or end-stitch about their respective bar threads. The fourth assemblage of parts comprises various instrumentalities by which an open path is created for the signature thread, now looped over the binding cord carriers which are adapted to carry the binding cords, by means of which path the signature is pushed back along over the said carriers until it is in readiness to be thrust upon the binding cords proper. The principal elements here assembled comprise two parallel plates which have hook-like projections, the plates themselves being adapted to slide in opposite directions. Hence in one position the ends of two hooks touch or overlap thus producing an orifice or hole transversely of the two plates, while in the reverse position the hooks being apart the hole is thus converted into an open slot. This fourth group of parts likewise includes two rocking or semi-rotary shafts each with groups of clamping disks, the said clamps operating oppositely on the two shafts, that is when the one set is active the other set is inactive. These clamps it will be understood are to hold the binding cord carriers, before premised, which carry the binding cords, and said clamps are necessary in order to enable each signature to be conveyed back over the carriers. Thus as the signature approaches that part of the carrier adjacent to the first set of clamps the latter are released from the carrier, while simultaneously the rear clamp grasps the carrier. Thus the signature is free to pass along on the carrier. Meantime as the signature approaches the second set of clamps the operating mechanism has not only caused the first set of clamps to grasp the carrier, but

has released the carrier from the second set of clamps again affording a free passage for the signature to advance still farther back upon the carriers.

5 It is to be understood that only the binding cords are fitted with carriers, the two bar threads, which are positioned parallel with the binding cords at either end of the signature being fed continuously from spools under
10 tension, not having carriers, since they are fastened to the signature thread by the kettle or end-stitch before alluded to.

Other features and the various co-operating elements necessary to the completion of
15 the various steps in properly sewing these signatures will be hereinafter fully described and explained.

The drawings accompanying this specification represent in Figure 1 a side elevation,
20 and Fig. 2 is a front elevation of a signature sewing machine embodying my invention. Fig. 3 is a plan with signature receiving table omitted for purposes of showing the various parts therebeneath. Fig. 4 is a front
25 elevation enlarged of the thread-laying and punch-bearing frame, also the transfer plate showing the relation of the parts at the time of transfer. Fig. 5 is a vertical cross section on line 4. 4. Fig. 6 is a longitudinal
30 cross section of one of the thread laying arms with thread holder. Fig. 7 is a longitudinal vertical section of the signature plate showing the signature and the method of creating the loops in the signature thread. Fig. 8 is
35 an end view of the same. Fig. 9 is a side elevation of one of the cams for operating the loop-inserting punches. Figs. 10^a, 10^b, 10^c, 10^d, and 10^e, represent the mode of forming the kettle-stitch. Fig. 11 is a rear side elevation
40 of the mechanism for creating said stitch the parts being in position to commence the formation of a knot. Fig. 12 is a similar view showing the knot completed with the end of the thread drawn through in part and corresponding to the position shown in Fig. 10^d.
45 Fig. 13 is a cross section on line 10. 10, Fig. 11. Fig. 14 is a front sectional elevation of carrier holders, feed teeth and mechanism for actuating said parts on line 2. 2 Fig. 16. Fig.
50 15 is a horizontal sectional plan of the carrier-holding clamp shafts taken on line 15 in Fig. 14. Fig. 16 is a transverse vertical sectional elevation on line 3. 3, Fig. 14, showing the two binding-cord carriers holding shafts
55 and the actuating shaft therefor. Fig. 17 is a sectional elevation, on line 5. 5. in Fig. 14, of the gear train for operating the carrier-holding shafts. Fig. 18 is a sectional view on line 6. 6. in Fig. 14, showing the checks for
60 stopping the clamp shafts at designated places. Fig. 19 is a side view of the dog which serves to engage the arms of the thread carriers. Fig. 20 is a bottom plan enlarged of the transfer plate. On the right the binding-
65 cord carriers are shown in normal position. On the left the carriers are drawn back to allow the loop inserting punches to enter the

transfer plate. Fig. 21 is an end elevation of the head and knot-tying elements, showing the knot-clamp down, and with the revoluble
70 looper, the reciprocating looper and the hold-fast omitted. Fig. 22 is a similar view with the knot-clamp raised and the omitted parts in place. Fig. 23 is a perspective view of the knot cam-plate for positively operating the
75 plunger and clearer. Fig. 24 is a front view in part of the punch-frame, punches, signature plate, thread-carrying arm and shield beneath which said arm swings. Fig. 25 is a section on line 7. 7. Fig. 26 is a section on
80 line 8. 8. Fig. 27 is a transverse vertical sectional elevation of the signature plate, a punch, the transfer plate and tying point with the revoluble looper. Fig. 28 is a transverse sectional elevation of the punch-frame
85 showing the knife for severing the signature thread. Fig. 29 is a side elevation in diagram showing the relative positions of the signature plate and the swinging transfer plate. Fig. 30 is a sectional plan of the yoke
90 for rocking the punch frame. Fig. 31 is a side elevation enlarged of the mechanism for producing limited intermittent rotation of the punch-actuating cam shaft.

The various component parts comprising
95 this machine are grouped together and mounted in a primary standard or casting 2. The main shaft is at 3 with a spring brake 4 adapted normally to hold the pulley 5 at rest. Depression of the lever 6 permits the machine
100 to operate. A pinion 7 at one end of the main shaft meshes with a toothed gear 8 on the main cam shaft 9. Pivotally secured in the frame upon the transverse rocker shaft 10 are twin arms 12. 12' which support a shaft 13 likewise
105 with cams 14. 14' 14². Vertically upon the shaft is carried the open rectangular frame 15. In this are fitted a number of rods 16. 16' 16² each armed with a loop-inserting punch 17, the two outer punches 17' being formed
110 with a notch 17² near the upper extremity. See Fig. 7. To balance the weight of the punch frame and other parts one of the arms 12 is extended rearwardly and adjustably weighted, while a roller 18 attached at this
115 end engages a cam 19. Moreover a yoke 20 Fig. 30 at the rear of the frame 15 near the top is joined to a rod 20', this latter being furnished with a roller 21 which engages the cam 23.
120

It will be observed that the ends of the rods which engage the cams on the main cam shaft are bifurcated in order to allow them to pivot upon said shaft and likewise permit a certain travel transversely of said shaft due to the
125 eccentricity of the cams. Hence as the main shaft revolves the frame 15 not only rises and falls but swings to and fro. To give proper movement to the loop-inserting punches and to time them, as will be hereinafter explained,
130 a pinion 24 Figs. 31 and 1 is made fast on the shaft 13 and a toothed wheel 25 journaled on a pin in the arm 12' meshes therewith, while a series of studs 25' project laterally there-

from and engage an oscillating lever 51 which rests centrally on a roller bearing 52 likewise on the arm 12'. The rear end of this lever is bifurcated and fitted with a roll 53 which enters the cam 54. See Figs. 3 and 31. The front end of the lever 51 is shouldered and adapted to engage the studs 25'. Thus as the cam 54 is of a certain eccentricity the lever 51 is thrust to and fro and in this way rotates the shaft 13 to actuate the loop-inserting punches, the free end successively engaging the studs, while the forward thrust occasioned by its cam produces a positive feed which revolves the punch operating cams one half turn, in order to make the punches perform one complete reciprocation at each forward thrust of this lever 51.

Transversely across the top of the frame 15 is a plate 26 longitudinally grooved to receive the signature thread 29 which is to be laid therein, Fig. 7. The loop-inserting punches are adapted to pass through holes 28 in said plate 26, which is variously bored to suit different sizes of books the punches being shifted to correspond with the length of the signature which is to straddle the plate, one half of the signature on each side. This locates the thread 29 along the inside fold of the signature. The laying of the signature thread along the receiving plate 26 is accomplished as follows: To the front of the standard near the base is attached a lever 30, while centrally in the front of the frame 15 are secured four thread-carrying arms 31'. 31², 31³, 31⁴, at quadrature and adapted to revolve intermittently but simultaneously in the same direction. The lever 30 is affixed to one end of a bell-lever 32 whose pivot is the center of revolution of the thread carrying arms. The opposite end of said bell-lever is armed with a dog 31, see Figs. 2 and 19, which is spring-actuated and as the frame 15 rises the bell-lever swings the dog back of one of the arms in readiness to receive it. The next descent of the table drops the pivot of the bell lever with the result to rock the bell-lever upward and swings the arms through an arc of ninety degrees, thus moving the arm 31' over to the place now occupied by 31², the rotation being as indicated in Fig. 4.

To properly grasp and carry, as well as to lay the signature thread in place, and moreover to cut it of the right length and release it at the proper moment when the loop-inserting punches rise, the following instrumentalities are employed: Before proceeding it is to be understood that the cams 14, 14', 14² Fig. 2 are timed to operate in pairs, and further that those rods 16, 16 carrying the central loop-inserting punches 17, 17 have a lead over the others. Hence these rise and operate first, then follow the two designated as 16', 16', and lastly the outside ones or 16², 16². This method I find necessary because as the loop-inserting punches rise and lift the signature thread, the loops 34, 34', 34² are created by drawing the slack from the ends

inwardly. Providing the loops were formed simultaneously the thread would be broken since the ends of the thread would be held fast by the loop-inserting punches. Thus the loops are formed successively from the center outwardly and the thread is not harmed it being free to follow toward the center as material is needed in creating the loops. With this premise I will say that each arm is equipped with a thread clamp 35. See Fig. 6. This consists of a spring plate 36, the free end 36' adapted to hold the thread against the arm proper. The portion 36² projects laterally and is intended to wipe the fixed shields 37, 37' at proper designated times. The signature thread is supplied from a spool 38 through a tension 38' and is conducted beneath the shield 37. When the arm 31' enters the shield the free end 36' of the clamp 35 is thrust away from the arm and allows the severed end of the thread to enter. This act occurs just after the clamp has entered the shield. When the arm swings out from the shield the spring plate 36 forming the clamp closes and the thread is held fast. As the frame now descends the arm is swung across the plate 26 carrying the thread which is laid smooth and straight in the groove 27 prepared for it and in readiness for the signature which is presently to be placed over it. It will be seen that the thread is now held at both ends by the clamps in the arms; but it now becomes necessary to release it at one end from the clamp and to sever it at the other end before the punches can be operated to form the loops. In the present instance four of these loops 34, 34' are to receive the binding cords 50, 50', while the others 34² are created in order to allow the bar threads 50² to be tied to them. To one of the punch rods 16, see Fig. 24 is attached one end of a bell-lever 54, the vertical free end of which serves to actuate the spring clamp 36 the moment said loop-inserting punch starts to rise. The punch rod 16² at the opposite end of the signature Fig. 28 likewise carries a bracket 59 having a small stud 153 which plays in a slot in a pivoted knife 58. The latter rocks transversely across the path of the signature thread and is affixed to the plate 26. At the proper time consequent upon the rise of the loop-inserting punch 17' the signature thread is severed and is now free at both ends. The movement of the punches, as before premised, is effected by rotation of the shaft 13 carrying the cams 14, 14', 14². The latter control the punch rod 16², while to actuate the corresponding punch rod 16² at the opposite end of the signature a secondary rock-shaft 13' is provided and united with the punch rod 16² as shown in Fig. 9.

Upon the top of the standard and across the front is bolted a stationary vertical casting 59 longitudinally of which is placed a shaft 60 from which depends a swinging plate 61 styled the transfer plate. This latter is of inverted V shape along the lower edge,

see Figs. 16 and 27, to receive the signature, while a lip 61' serves to protect the signature from the knot-tying mechanism located just in front. See Figs. 2 and 16. The lower edge of this plate, see Figs. 4, and 20, is notched at 62, 62' 62² the latter to receive continuous bar threads 50² which are supplied from the spools 63, 63', the notches 62, 62', 62'. to receive the binding-cord carriers 113, 113', 113'. 113'. These notches 62, 62', 62'. are created by means of two plates 64, 64' movably attached to the rear of the transfer plate, said plate being rocked or thrust back forcibly against a spring by means of the finger 65 which engages a boss 65' on the punch frame 15. See Figs. 4, 5, and 20. These two plates 64, 64' are formed with oppositely disposed hooks 67 which face each other and are normally in contact. See Fig. 4. Hence a number of holes are created, as shown, in which rest the front ends or points of the carriers; but when the transfer plate is swung back a traverse bar 68 enters a slot transversely across the lower edge of both these plates and forces them to slide oppositely. In this way the holes or apertures adapted to receive the points of the carriers now become open notches identical with those in the plate at 62, 62' for the bar threads. From inspection of the drawings it will be seen that the binding-cord carriers extend through holes transversely in the lower edge of the transfer plate directly above the punches. Hence when the latter pass up into said plate during the process of punching the signature and creating the loops 34² it is necessary that the carriers should be retracted. These latter are supported by suitable means hereinafter described upon a movable carriage 75, this latter being retracted when the loop-inserting punches rise and enter the transfer plate. This is effected by means of a movable carriage 75 formed with two side guide-blocks 75', 75', and a connecting cross piece 75², and adapted to slide on the top of the standard 2. To and fro motion is imparted by means of twin levers 76 at each side of the machine. These levers engage the guide-blocks and are connected by a cross bar from which hangs a common operating lever 78. The lower end of the latter is united with a connecting rod 79 which engages the cam 42. See Figs. 1 and 3. Thus a free path is created for the punches which at this moment form the loops in the signature thread. Immediately upon their descent the carriage 75 moves forward when the points of the binding-cord carriers enter the holes transversely in the transfer plate, which position is their normal one. This re-entry of the carrier points upon retreat of the punches causes said carrier to be inserted through the loops 34² of the signature thread. This movement, or to and fro travel of the carriers is very slight and the carrier points always have entered the loops before the signature thread is knotted on the bar threads. Springs 69, see Figs. 4 and 5, serve to steady

and make rigid the transfer plate, while flat springs 70 bent at their extremities perform the duty of holding the signature against the upper edge of the punch frame 15 during the time the kettle-stitches are formed, and just prior to the transfer of the signature upon the binding-cord carriers.

In the front face of the casting 59 are created parallel guides 71, 71' oppositely disposed. See Figs. 2 and 3. In these are mounted movable heads 72, 72' in which are assembled the various elements necessary for the making or tying of a knot. In the formation of a knot it is necessary that the punches 17' 17' should advance as shown in Fig. 7 in order to form the loops 34². Hence the transfer plate is cut away laterally at 73, see Fig. 20, to allow passage of these loop-inserting punches. Now normally the bar thread 50² and the duct 74 through which it passes are directly above and in line with the punches 17'. See Fig. 2. Consequently the heads must be shifted laterally and raised slightly when the punches 17' carrying the bar threads rise in the formation of the successive loops 34². Transversely of said carriage and extending forward are two upwardly bent thrust-bars 39, which enter the rear of the heads passing through the fixed plate. Thus movement of the fingers horizontally compels the carriages to rise or fall obliquely in the guides 71. Thus mechanism has been provided by which the loops 34² of the signature thread 29 have been passed through the signature and delivered by the loop-inserting punches 17' to the knot-tying elements. It is to be understood that the punches 17', 17', are cut away as shown at 17² to enable a side portion of the loops 34² to be seized in the act of making a knot.

The mechanism for producing a kettle or end-stitch comprises the following principal parts: a knot-clamp 81, operated by the rise of the punches 17' to seize the signature thread 29, two loopers, one revoluble 82 and the other 83 adapted to reciprocate; an oscillating finger 84 to place the thread in the path of the loopers and a holdfast 85 together with a reciprocating knot cam-plate 86. Since the two groups of knot-tying elements are duplicates of each other, I shall merely describe the co-operating actions and duties of one group in the production of a knot. It is to be also understood that the bar threads 50² from the spools 63 under tension are passed through the duct 74, as shown in Fig. 13, and that the knot is tied about the reduced extremity 87 of this duct in order to have a fixed point to enable the knot to be drawn tight. After formation it is slipped off and passes along upon the bar thread as the signature advances rearwardly.

As before mentioned the movable heads are at 72 and they consist of body portion held vertically in front of the transfer plate by aid of two arms 89, which span the shaft 60 and engage in the guide-slots 71 before mentioned. Furthermore it is to be assumed

that the parts are positioned relatively as shown in Figs. 11 and 13, the former being a view from the rear and the signature is in the position shown in Fig. 13 by the broken lines. The loop-inserting punch 17' now rises and carries the thread-end up until the punch-end strikes the pin 90, which releases the spring knot-clamp 81 forked at the end, one tine of the fork passing between the thread and the hollow 17² in the punch at this point, thus engaging the free end portion of the signature thread which is forced down into the slot 91 in the block 92 supporting the clamp. This latter element does not hold the end fast but permits it under a proper pull to slip out, thus insuring a properly tied knot. On the lower rear side of the body part of the head is mounted the revolvable looper 82 which in the present instance forms one end of the thread duct 74. However, it may be made separate and revolve thereabout. This looper is a sickle-shaped or hooked device with a cone-shaped outer hub and with the end notched at 93 in order to seize the thread as the hook revolves, while a shoulder 94 is created exteriorly in order to separate and flex the thread, to produce a loop. The inner hub or journal of this looper is toothed at 95 and meshes with a rack 96 secured to the cam carriage 86. A notch 98 on the carriage, see Fig. 11, engages a tooth 97 in order to limit the looper in its motion. This notch is formed on a rocker arm 102 which is forced forward by the boss 143 on the cam carriage. See Fig. 11. When the notch registers with the tooth 97 the forward end of the arm drops and the boss disengages and passes along with the cam carriage. The rack is now held locked and the looper 82 remains stationary. The position of the loop is now just to the right of the duct point 87, see Fig. 11, or where the knot is to be formed. Fig. 10^a shows the relative positions of the loop of the signature thread 29 with the bar thread 50². The cam carriage is now advanced in direction of arrow 2. This is effected by means of compound lever arms 98, 100, Fig. 3 pivotally attached by an upright shaft 40' to a connecting rod 40. This latter is joined to a bent lever 41 adapted to engage the cam 42 the extremity of said lever terminating in a split sleeve 43 loosely on the main shaft. See Fig. 2. This movement or advance of the cam carriage causes the looper to revolve in the path of the thread which now extends from the signature to the knot clamp. Reference to Fig. 13 shows that the signature is to one side or in front of the nose of the looper. The forked end of the looper 82 seizes the thread and after the first half revolution the loop portion 45 has been carried to the right side of the bar thread 50² leading directly from the hole in the signature. As the looper completes its revolution the loop portion 45 is thrust obliquely across to the left, while the end part 47 now caught upon the shoulder 94 is carried be-

neath the part 45 and passed out toward the right, see Fig. 10^b, the remainder of the free end still within the knot clamp lying diagonally across the new loop. It will be seen that the loop portion 45 is to one side or above the loop portion 46 where they are contiguous to the bar thread. Hence all that is now necessary to the completion of the knot is to pull or pass the free end through the loop just formed. To accomplish this the oscillating plunger now moves into the loop from the front rearwardly, its split end pushing the free end portion 49 through the loop while the clearer 84' removes the flexure 46 from the shoulder 94, this thread portion now being held between the said clearer and the plunger. The free end 49 from the action of the plunger now rests in the path of the reciprocating looper 83 which moves in direction of arrow creating the flexure 48, the knot now being in the condition. See Fig. 10^c.

Owing to the limited space for traversing the actuating elements, I find the following steps are necessary in order to get the free portion 49 through the loop: The looper 83 advances with the cam carriage, seizes the portion 48 and carries it beneath the flexure 45 with the flexure 46 bearing against the plunger. This looper includes a split head 103 with a barb 104. In connection with this looper is a holdfast 85. This device comprises a rocking plate with a hook 105 adjusted to swing across the looper 83 and thus intercept the free end portion 49 of the thread. Proper rocking of the holdfast is effected by means of a latch 106, which wipes against a tooth 107 and forces the hook back until the thread has passed by. The latch meantime wipes past the tooth and releasing the latter permits the holdfast to swing across the thread just as the looper 83 commences its retreat. The knot clamp released and put into activity by the rise of the punch 17' has remained stationary up to this time, but just prior to the holdfast engaging the thread a cam surface 112 has met the knot clamp and raising it, frees the loose end portion 49 of the signature thread. The flexure 48, see Fig. 10^d, is now engaged by the holdfast while the looper 83 sliding therebeneath has again caught the free end portion in the barb and as the looper returns the loose end portion is constantly being dragged through the loop until the end is reached and has passed out when the knot is completed. In order to allow free passage of the block 108 to which the looper 83 is affixed across and beneath the plunger and clearer, these two elements are raised by means of a cam surface 109, while a similar surface 109' serves to depress them in a positive manner since springs are found not to be active or positive enough. The limit for the throw of the cam carriage is by means of the stop 110, while a boss 110' on the actuating rod 118 serves the same purpose in the opposite direction. The knot now formed in the signature thread and termed the kettle

or end-stitch is now complete and the movement of the frame backward against the transfer plate pushes the knot off the tying point 87 along upon the bar threads, the springs 70, see Fig. 5, being raised as the punch frame and signature move back. As the transfer plate swings back the thrust bar 68 has moved the plates 64 64' laterally and has separated the hooks 67 which now create open slots, while the binding cord carriers are free to pass out from the slots as the transfer plate rises due to its oscillation. The signature is now thrust back by the frame 15 still farther in direction of arrow, see Fig. 16, along upon the carriers and is held at this time in position by the springs 70 since the transfer plate has been lifted above the signature. The punch frame conveys the signature rearwardly until it is grasped by the feed teeth for conveying it back out of the way and for assembling the signatures as fast as each one is properly knotted and threaded upon the binding cords.

The carriers to which the binding cords are attached are shown in Fig. 15 at 113 and they are preferably made of round steel pointed at the front ends to readily enter the loops projecting from the fold of the signature. About midway of their length two ox-yoke bends are created, these two bends being positioned in a vertical plane. These carriers are held firmly in position by a series of carrier-holders 114, 115 arranged in pairs and mounted upon two parallel shafts 116, 116' adapted to revolve at intervals one half a revolution and journaled on the carriage 75. One of each pair of holders 114, 115 is firmly fixed on the shafts. The other members 114', 115', are loose and free to slide being held against the fixed ones by springs 117.

Reference to Figs. 15, 16, and 17 further shows a reciprocating shaft 119 likewise mounted in the carriage above the shaft 116'. Endwise movement is imparted to this shaft by the aid of a bell-crank lever 120 mounted on a bracket cast upon the carriage one end being secured to a pin in the shaft the other end of said bar being connected with a rod 121 which is united to a lever 122 pivoted at 122' on the rear of the main frame; the lower end of said lever engaging with and being actuated by the cam 19.

To produce the proper feed movement, as likewise to allow free passage for the signature to pass along upon the binding-cord carriers, which as it is seen, are held in parallelism and positively supported by the carrier holders 114, 115, the following operating devices are provided: Projecting laterally from the shaft 119 and secured rigidly thereupon by tubular hubs are a series of yokes 123, 123', one set extending forward and operating the movable carrier holders on the shaft 116, the other set positioned rearwardly and actuating the holders on the shaft 116'. Thus it is evident that when one set of holders is open the other set is closed and it further fol-

lows, as shown in Fig. 16, that the carriers at all times are positively supported while the signature is free to travel lengthwise of the carriers. Upon the assumption that the carriers are released by the holders upon the shaft 116 or front one the carriers can be sprung downwardly and the signature pushed along while the carrier itself is supported by the rear holders. Conversely, after the signature has passed the front holders, the latter are closed while the rear holders are separated and release the carrier, when a similar action occurs. After this last step the signatures are to be assembled in a vertical position, as shown in Fig. 16. To support them and to relieve the binding cord carriers of the weight of numerous signatures an adjustable table 124 is located beneath the carriers. See Fig. 1.

To advance the signature longitudinally of the carriers at the time the latter are released, as heretofore described, two feed teeth 125 are formed on the periphery and diametrically opposite upon each of the carrier-holders which are fast on the shafts. Furthermore the bend in the carrier corresponds to the curvature of the holder at this point in order to permit of rotation and no interference with the carrier. These shafts 116, 116' are intended to revolve intermittently a half revolution, which act carries a signature beneath and past the carrier-holders. To accomplish this feed movement, each shaft is equipped with a gear loosely thereupon respectively 126, 126' for the front and rear, while an intermediate gear 127 on the carriage interconnects them with an oscillating toothed sector 128. The latter is pivoted at 128' while its free end is united with an upright rod 129 pivoted to the arm 12. The front gear 126 is loose upon its shaft which is furnished with a spring pawl 130 adapted to interlock with corresponding shoulders 131, 131' on a hub fast to the shaft. The rear gear 126' is likewise loose upon its shaft and has a gravity pawl 138 also adapted to engage a shouldered hub 132 fast to the shaft. Each shoulder is intended to limit the rotation of the shaft to a half revolution. At the opposite ends of the shafts two notched disks 134 and spring catches 135 further serve as stops to positively hold the said shafts except when rotation is to occur.

Reference to Figs. 16 and 17 shows by the arrows that the toothed sector is rising, in other words that the punch frame is falling. As a result the gear 126 is given rotation as shown and the spring pawl 130 has met the shoulder 131' and compels the shaft 116 to rotate. This swings the feed tooth 125 down over the signature which has just been taken from the punch frame 15 and delivered upon the binding cord carriers. The frame continues to fall and thereby swings the sector a full oscillation by which the signature is passed back to a point where it can be reached by the feed teeth 125' on the shaft 116'. When the frame 15 again rises and the sector swings

back or downwardly the motion of the gear train is reversed. As a result the front gear 126 carries the spring pawl with a wiping movement over the back of the shoulders and no movement of the shaft takes place, because now the carrier holders on this shaft 116 firmly clasp the carriers, and no signature is then passing. On the other hand, the carriers are now released by the holders on the rear shaft. This reverse movement of the gear 126' however now brings the pawl 138 in contact with one of the shoulders on the hub 132 and rotates the rear shaft 116' a half revolution. This act passes the signature from a point between the two shafts along the binding-cord carriers to a position to the rear of the back shaft 116' where they are assembled in the form of a book.

In order to bring the spare end of the signature thread or that portion not required in tying the end stitch, two brushes 136, 136' are mounted upon the rear shaft 116'. Hence as the latter rotates said spare ends are picked up and with a wiping motion of the bristles are all laid in proper position on the backs of the signature in readiness to be trimmed or otherwise adjusted in the subsequent act of binding.

The operation of this entire group of assembled parts as above described in the several acts necessary to sew the signature, and which is performed without previously creating saw cut or notches in the signatures is as follows; it being understood that the most prominent characteristics of this invention are embodied in the loop forming punches and that the signature threads are supplied from a spool filled with a continuous thread, while the bar threads so termed, to which the signature threads are tied are likewise fed from spools with continuous threads, these latter being cut only at such times as a book is completed, or when the requisite number of signatures have been assembled to form several books.

For purposes of description it is assumed that the various parts are in the position as in Figs. 1 and 2, no signature being in process of sewing. The brake is released and the machine at once is put in action. The frame 15 descends, and the thread carrying arm which has seized the severed end of the signature thread is swung over the grooved plate, thus mechanically laying a thread, it being laid when the frame reaches its lowest point of travel. The signature folded but without other preparation is now laid by hand upon the plate which now rises until it engages the transfer plate. The punch cams now cause a slight rise of the punches sufficient to release the thread from the clamp at one end and sever the thread at the opposite end this latter act being effected when the punches 17' rise. The entire frame 15 with the plate and all parts attached are now as shown in Fig. 2 the frame swinging in at the top to carry the signature into and between the V notch in the

transfer plate. Just prior to this act the points of the binding cord carriers which normally extend through said transfer plate are retracted. At the same time this rearward movement of the carriage has carried with the carriers the finger bars 39, 39' thereby causing the heads with the knotting elements to rise and move laterally in order to allow the loop-inserting punches 17' to push past the tying point 87 of the duct 74. This motion of the carriage is effected by the levers 76 attached to the carriage 75, this latter element carrying the shafts 116, 116' which hold the carriers. After the frame 15 has placed the signature in position in the transfer plate, the loop-inserting punches rise quickly, the inner ones first and the others in succession outwardly toward both ends of the signature, and entering the vertical holes in the transfer plate punch holes in the signature and at the same time force the signature threads through and form loops. As soon as the latter are made the cams 14, 14', 14² drop the punches and this act is followed by a forward motion of the carriage 75 which permits the carriers to return to place, thus inserting their points through the loops just formed by the punches. At the same time the heads 72, 72' are returned to their normal position in readiness for the tying of the knot. Rotation of the main cam shaft 9, see Fig. 3, now actuates the cam lever 40 likewise the intermediate levers 98, 100 and rapidly reciprocates the knot cam plate 86 tying the kettle or end stitch about the bar thread. During this act and while the cam knot plate 86 is making one complete reciprocation the frame 15 is kept motionless, the grooved signature plate resting in the V groove in the transfer plate. The main cam shaft now draws back the lever 20', see Fig. 1, and the frame 15 again advances. When the transfer plate is pushed rearwardly, the plates 64, 64' are thrust laterally releasing the points of the carriers as said transfer plate swings upwardly, the frame pushing the signature along upon the binding-cord carriers beneath the said transfer plate. The frame now having performed its duty drops vertically and as it descends swings forward at the top during which act the bell lever which operates the thread carrying arms 31' is shifted in position to cause an arm to mechanically lay a fresh length of thread in the grooved signature plate. The frame remains stationary for a short time after the laying of the signature thread to allow the operator to place a signature in position. It will be noticed that at the moment a signature is passing beneath the rear shaft 116' a new signature has reached the transfer plate and a retreat movement of the carriage occurs to clear the shuttle points from the transfer plate but this does not affect the rotation of said shaft. To follow the path of the signature now with the signature thread looped over the binding cord carriers at certain designated places and likewise tied about the bar threads, reference will

be made to Figs. 1, 3, 15, 16, and 17. Proper formation of the cam groove in cam 19 operates the lever 122, rod 121 and bell lever 120 to release in succession the two sets of carrier holders while simultaneously the descent of the frame 15 on the rocking arms 12, 12' has oscillated the toothed sector by means of the connecting rod 129 to produce alternate semi-rotation of the shafts 116, 116' with the feed teeth which push the signature along. This rotation has likewise revolved the brushes 136 which pick up the spare ends of the signature thread and carry them upward upon the back of the signature in readiness to be cut and properly adjusted subsequently.

What I claim is—

1. In apparatus for sewing book signatures, the combination with a group of carriers suitably supported for carrying parallel binding cords, a frame transversely thereof adapted to receive a signature, and means for laying a signature thread longitudinally in the frame, of a series of punches operating to force the thread in loops through the fold of the signature, mechanism for knotting said signature thread-ends about the two outside cords, together with means for inserting the remaining cords of the group through the loops of the signature thread, substantially as and for the purposes explained.

2. In apparatus for sewing book signatures, a group of parallel binding cord carriers horizontally supported, a frame adapted to swing transversely of said carriers, a grooved plate which surmounts said frame, and a series of parallel punches which reciprocate through the plate, combined with revoluble arms for placing the signature thread, mechanism for holding, and mechanism for cutting said thread, means for actuating the punches in succession from the signature center toward each end, to loop the signature thread, and mechanism by which the signature is transferred upon the binding cord carriers, substantially as set forth.

3. In apparatus for sewing signatures, a swinging frame adapted to rise and fall, a grooved plate upon which the signature is supported along its fold, a group of parallel punches adapted to reciprocate transversely across the groove upon movement of the frame, combined with a group of rotary arms to lay successively a thread along the groove, thread-holders in the end of each arm, means to cause the holders to grasp and release the thread, together with mechanism for severing the thread to produce a signature thread of the proper length, substantially as specified.

4. In apparatus for sewing book signatures, the combination with a main driving shaft, a main cam-shaft, and rocking arms, a vertical frame pivotally mounted in the ends of said arms, a grooved plate which surmounts said frame, and an actuating cam lever, of a secondary cam-shaft, a series of punches adapted to reciprocate across and through the groove of the plate, toothed wheels for actuating the

secondary cam shaft, and a cam lever adapted to engage at intervals one of the toothed wheels, the punches moving in pairs and in succession from the middle of the plate outwardly toward either end, for purposes stated.

5. In combination with a swinging frame adapted to rise and fall, a longitudinally grooved plate, and a series of punches to move intermittently, a group of arms adapted to move upon a common center and supported in the frame, a bell-lever affixed upon the same center, an actuating lever joined to one end of said bell-lever, a dog secured upon the other and free end, the descent of the frame causing each arm to lay a signature thread along the grooved plate, substantially as stated and set forth.

6. In combination with a movable frame, a grooved plate thereupon, a series of thread-carrying arms pivoted thereupon, and means for operating the same at intervals, of twin shields oppositely on the frame, clamps at the free end of each arm, means for opening each clamp to receive the severed thread-end as the arm enters one shield, a spring to close the clamp as the arm leaves this shield, a lever operated by a punch rod to actuate a clamp and release the thread end in one arm, and a second cutter-armed lever attached to an opposite punch to sever the thread, substantially as explained.

7. In apparatus for sewing signatures, the combination with a plate adapted to support a signature and constructed to receive a mechanically-laid signature thread, of a series of punches to force said thread through the signature fold to produce a series of loops, a group of binding-cord carriers, and mechanism operating to present the several loops to the carriers which pass therethrough, substantially as described.

8. In a machine for sewing signatures, a rocking frame, a grooved plate, revolving arms adapted to lay a signature thread lengthwise in said plate, a group of punches carried in the frame, cams to force said punches through the folded signature supported on the plate, combined with a pendent transfer plate co-operating with the punches, and a group of carriers positioned to enter loops in the signature thread, substantially as stated.

9. The combination with a plate adapted to receive a mechanically-laid signature thread, and punches to force said threads in loops through the signature which straddles the plate, of a group of carriers for carrying binding cords, two shafts, two sets of holders to grasp the carriers, mechanism to cause the holders to alternately grasp and release the carriers, and means to advance the signature along upon the carriers, as explained.

10. In combination with a swinging frame, a grooved plate to receive a mechanically laid signature thread, and a series of punches which thrust the thread in loops through the signature, a series of horizontal carriers, two sets of holders which grasp and release the

carriers, a pendent transfer plate adapted to support the ends of the binding-cord carriers, and mechanism for reciprocating the carriers to allow said binding cord carriers to enter the loops of the signature thread, substantially as herein stated.

11. The combination with a mechanically-laid signature thread, and punches for creating loops in the signature thread, of a series of carriers, two shafts in horizontal alignment, two sets of holders arranged to operate in pairs and mounted on said shafts, and means for alternately operating one set of holders to release all the carriers, and thereby permit advance of the signature along the carriers at that point, substantially as explained.

12. In apparatus for sewing book signatures, a plate adapted to receive a mechanically-laid signature thread, punches for looping said thread through the signature, and mechanism for forming a kettle or end-stitch, combined with a group of carriers in parallelism, two rotating shafts transversely above said carriers, a set of carrier-holders on each shaft arranged to alternately release and grip the carriers, feed-teeth arranged diametrically on the shafts, and means for operating the shafts and the feed-teeth to advance the signature along the carrier at the point of release, substantially as and for purposes set forth.

13. In apparatus for sewing book signatures, the combination with a series of binding cord carriers in parallelism, adapted to receive book signatures, of mechanism to support said carriers and comprising two transverse revolving shafts, groups of carrier-holders in pairs thereon, one movable and one fixed, a non-rotary shaft, lateral yokes secured to said shaft, and mechanism to impart endwise movement to said non-rotary shaft to cause the yokes to engage the movable holders and actuate each set alternately, substantially as described.

14. In a machine for sewing book signatures, an oscillating frame, a series of binding-cord carriers, two rotating shafts, carrier-holders and feed-teeth thereupon, combined with shouldered disks fast upon the shafts, two gears loose upon said shafts and furnished with pawls to engage the disks, an intermediary gear, and a toothed sector actuated by the rise and fall of said frame, all operating substantially as stated.

15. In combination with a rising and falling frame suitably mounted, a plate thereupon longitudinally grooved, and a series of reciprocating punches, a fixed casting, a pendent transfer plate pivotally mounted on said casting, a longitudinal V groove in the lower edge of said transfer plate, transverse apertures likewise in said edge adapted to register with the punches, binding-cord carriers to enter said transverse apertures, together with vertical openings to allow the two outermost

punches to pass through said transfer plate, substantially as described.

16. The combination with a main standard, a fixed casting thereupon, a pendent swinging transfer plate, and two plates reciprocating on the transfer plate and having oppositely disposed hooks upon their lower edges, of a thrust bar affixed to the casting and which engages apertures common to the two reciprocating plates, whereby swinging of the transfer plate causes lateral travel of the plates to separate the hooks and thus creates a series of open notches, as and for purposes explained.

17. In apparatus for sewing book signatures, the combination with a frame, a longitudinally grooved plate, and means for causing the rise and fall of both frame and plate, a main standard, a fixed casting, an oscillating transfer plate pendent therefrom and formed with a V lower edge which engages with the grooved plate, of a finger secured to said transfer plate, and a boss upon the frame whereby movement of the frame oscillates the transfer plate, substantially as stated.

18. In apparatus for sewing signatures, a main standard, a swinging frame to rise and fall, a group of punches, a fixed casting on the standard, and a pair of heads adapted to reciprocate transversely of the casting, combined with a carriage movable to and fro with respect to the casting, thrust-bars affixed to the carriage and means to advance the carriage to produce opposite rise and fall of the heads, as explained and stated.

19. In apparatus for sewing book signatures, the combination with a fixed casting, and a head movably secured in guide slots obliquely in said casting, of a knotting device comprising a thread clamp, a reciprocating looper, an oscillating looper, a holdfast, a plunger, a clearer plate, an actuating cam surface, and means for operating the latter to cause the said knotting devices to tie a kettle or end-stitch, for purposes explained.

20. In machines for sewing book signatures mechanically, a rising and falling signature plate armed with reciprocating punches, a group of parallel binding-cord carriers supported on revoluble shafts, and a carriage movable upon the machine frame and on which the shafts are mounted, combined with a swinging transfer plate likewise secured on the machine frame, vertical holes for the punches and horizontal holes for the ends of the binding cord carriers, and mechanism operating to retract the carriers from the transfer plate at the time the punches enter said plate, substantially as stated.

21. In machines for sewing book signatures mechanically, a rising and falling signature plate, equipped with reciprocating punches, a group of binding-cord carriers co-operating therewith, a carriage movable on the machine frame, combined with two heads containing knot-tying elements and adapted to rise and

fall obliquely on the machine frame, thrust bars affixed upon the carriage and engaging the heads, and means for causing to and fro travel of said carriage to produce oblique motion of the heads, for purposes explained.

22. In apparatus for sewing book signatures, the combination with a suitable machine standard, a rising and falling signature plate, an oscillating transfer plate fixed on the machine standard, and a group of binding-cord carriers arranged to enter transverse holes in the transfer plate, of two sliding plates 64, 64'. secured on the back of the transfer plate, a stationary traverse bar on the machine standard, and means for rocking the transfer plate to cause the traverse bar to slide the said plates 64, 64'. oppositely upon each other to release the points of the carriers, for purposes described.

23. In mechanism for forming a kettle-stitch in a signature thread, a fixed tying-post secured in a head or casting and adapted to deliver a thread centrally from said post, a spring-actuated knot-clamp, means for presenting the loop of a signature and releasing said clamp to grasp one side of the loop, combined with a revoluble looper, an oscillating plunger, and clearer, and a reciprocating looper to carry the free end of the thread through the loop formed, substantially as specified.

24. In combination with a main head, a continuous bar thread centrally of a tying post, a looped signature thread transversely of and across the bar thread, a spring-actuated knot-clamp, a revoluble looper adapted to carry the signature thread from one side of the tying-post to the other, and mechanism for producing a limited movement to said looper, a reciprocating knot cam plate 86, an oscillating plunger adapted to thrust the free end of the thread through the loop created by the revoluble looper, a clearer moving in consonance with the plunger to retain one portion of the loop, and a reciprocating looper actuated by the cam plate 86 in a plane to one side of the revoluble looper to draw the free end of the thread through the loop, substantially as specified.

25. In mechanism for creating an end-stitch in a signature thread, the combination with a suitable head, a fixed tying-post, and a spring knot-clamp released by the act of looping the signature thread, of a revoluble looper, an oscillating plunger, a clearer, a barbed looper reciprocated by the knot cam plate 86, and a rocking holdfast adapted to move across the path of the thread-end, together with cam surfaces to time the oscillations of the plunger and clearer, substantially as stated.

26. In apparatus for sewing book signatures, a rising and falling signature plate armed with punches to loop the signature thread through the signature, and a movable head adapted to deliver a bar thread continuously across the signature thread, combined with a knot clamp caused to grasp the thread

when a punch creates a loop, a reciprocating knot cam plate 86, a revoluble sickle-shaped looper, a plunger and clearer operated positively by cam surfaces on the plate 86, a reciprocating barbed looper adapted to carry the free thread-end forward and back, a rocking holdfast, means for timing the motion of the holdfast with respect to the barbed looper, and devices for limiting the travel of the plate 86, substantially as specified.

27. In knot-tying mechanism, the combination, with a central tying-point 87, of a revoluble sickle-shaped looper adapted to carry a thread thereabout to produce a loop, a shoulder on said looper to separate the two sides of a loop, the plunger to carry the flexed free end of the thread in part through the loop now formed, a barbed looper to pull said end through the loop, a clearer to free the thread from the shoulder, and a cam-surfaced plate to time said co-operating elements in accordance with the duties to be performed.

28. In combination with a fixed tying-point, a head supporting the same, a hook-shaped looper having a toothed arbor, a reciprocating knot cam-plate, a movable toothed rack affixed to the cam-plate, and a latch operated by the movement of the cam-plate to lock the rack, and thus limit and control the rotation of the hooked looper and hold it stationary at certain predetermined intervals of time.

29. In apparatus for sewing book signatures, a plate adapted to receive a mechanically-laid signature thread, punches for looping the same through the signature, means for producing a kettle-stitch in the ends of the signature thread, combined with a group of binding-cord carriers in parallelism, two rotating shafts, a set of carrier-holders on each shaft, feed-teeth diametrically on the shafts, means for operating the shafts to advance the signature along the carrier at the point of release, and two brushes upon the rear shaft and in alignment with the bar threads, said brushes being adapted to position all the ends of the signature threads above and upon the backs of the signatures, for purposes set forth.

30. In combination with a rising and falling signature plate, a series of reciprocating loop-forming punches, a group of transverse binding cord carriers, means for causing advance and entrance of said carriers through the loops created by the punches, revoluble spools to supply continuous bar-threads, and mechanism adapted to tie each end of a signature thread to a bar thread, substantially as specified.

31. In mechanism for tying a knot, comprising a support for the various elements, and a fixed tying post, a device for holding the thread end, means for seizing the thread and creating a loop, mechanism for thrusting the thread end transversely across the plane of the loop and through the latter in part, an element for holding a portion of the loop stationary, and means for seizing and complet-

ing the passage of the thread end through the loop, substantially as explained.

32. In mechanism for sewing signatures, the combination with a movable plate adapted to carry a signature, and a transfer plate to receive said signature, a group of binding-cord carriers, mechanism to support said carriers, and instrumentalities adapted to cause the points to enter and withdraw from holes in said plate at stated intervals of time, substantially as described.

33. The combination with shuttles in parallelism, a swinging transfer plate, a series of horizontal and vertical holes interconnecting as shown, a group of binding-cord car-

riers the points of which enter the horizontal holes, a series of punches each in alignment transversely of one of the carriers and adapted to enter the vertical holes, means for causing the carrier to advance and retreat at stated times, and mechanism to reciprocate the punches within the vertical holes, substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM IRELAND BLACKMAN.

Witnesses:

H. E. LODGE,

FRANCIS C. STANWOOD.