

Feb. 13, 1940.

E. P. SPAINE ET AL

2,190,614

BUTTONHOLE SEWING MACHINE

Filed Nov. 30, 1938

8 Sheets-Sheet 1

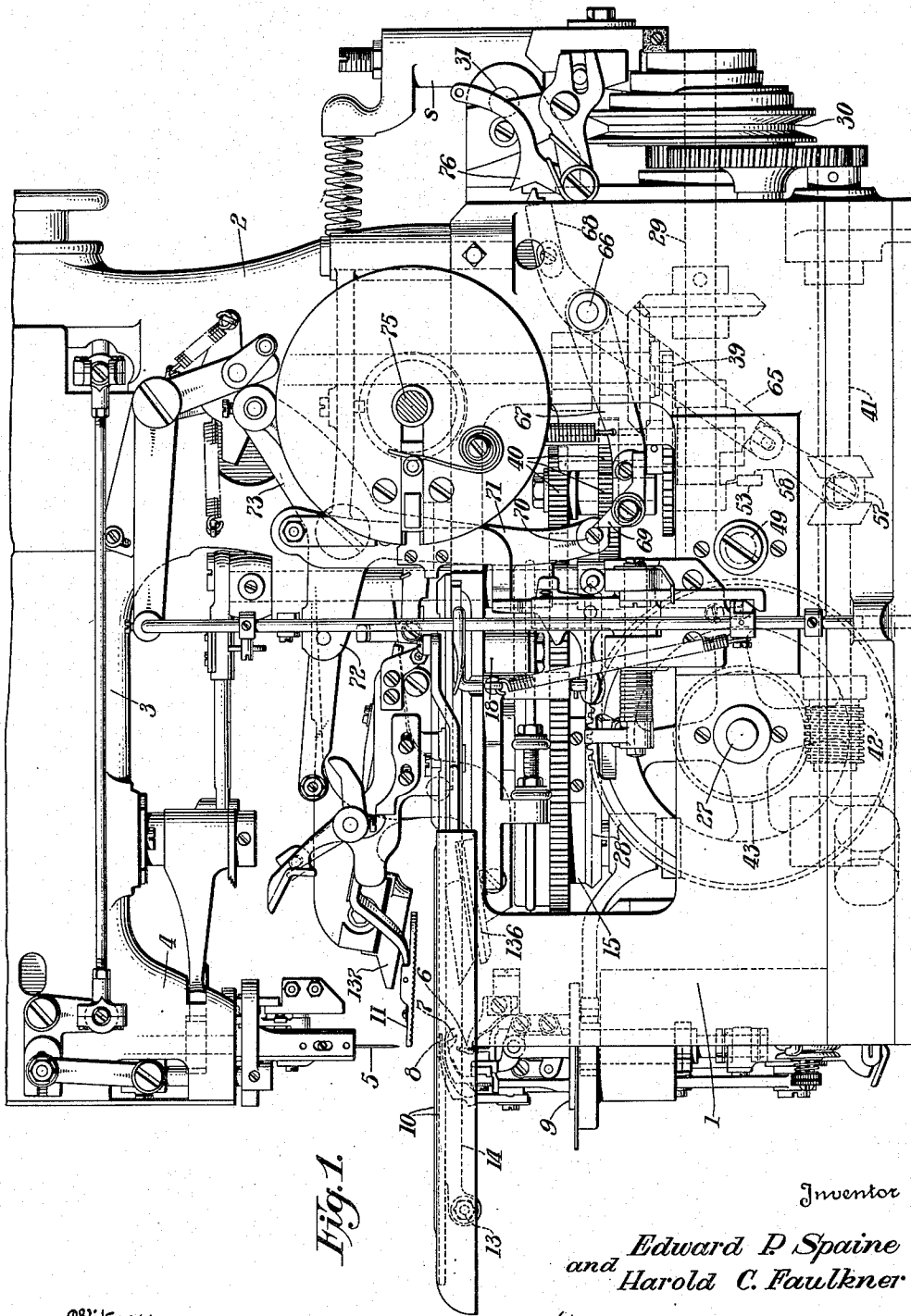


Fig. 1.

Inventor

Edward P Spaine
and
Harold C. Faulkner

Witness:

Gregory Pecina

By

Henry Miller

Attorney

Feb. 13, 1940.

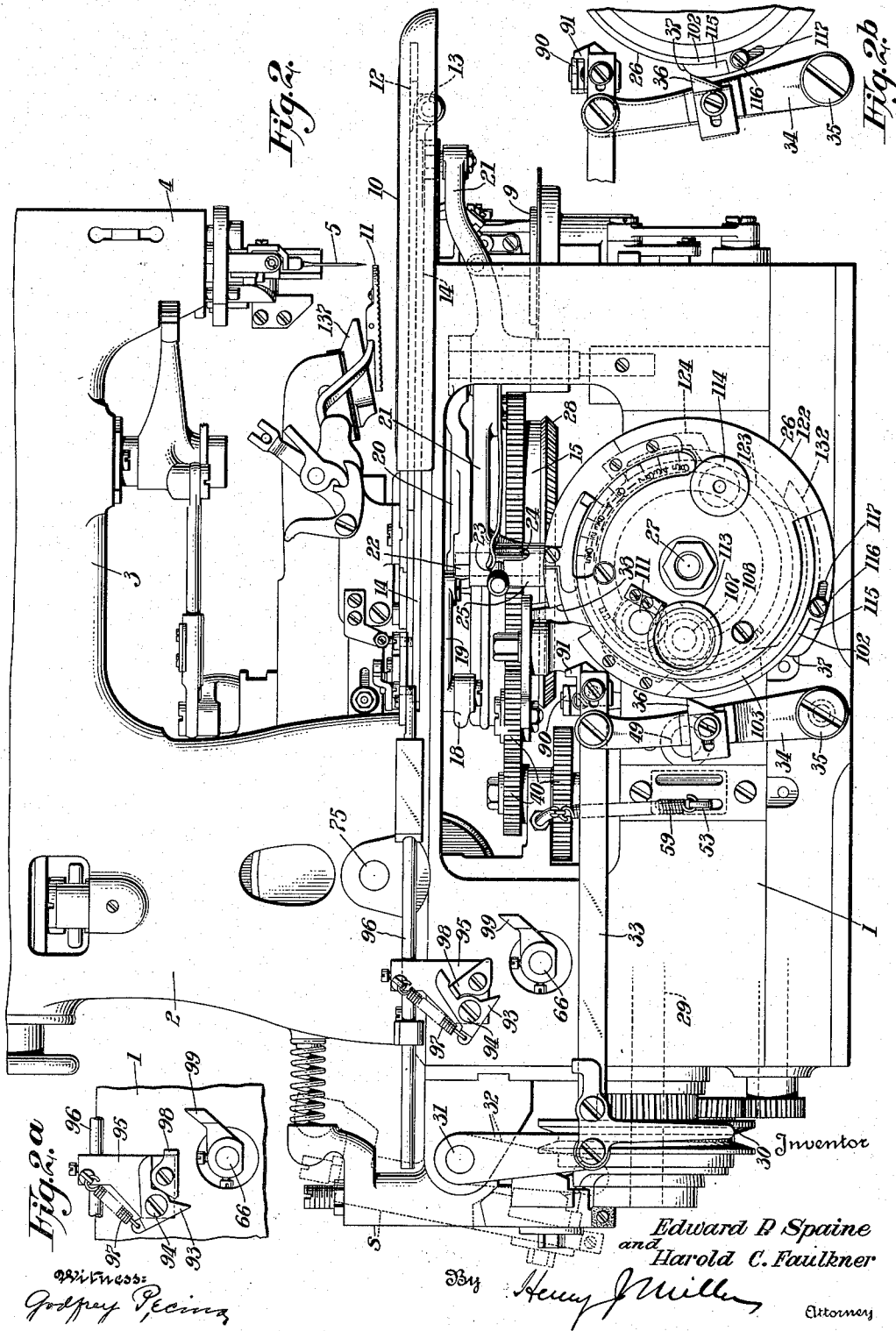
E. P. SPAINE ET AL

2,190,614

BUTTONHOLE SEWING MACHINE

Filed Nov. 30, 1938

8 Sheets-Sheet 2



Feb. 13, 1940.

E. P. SPAINE ET AL

2,190,614

BUTTONHOLE SEWING MACHINE

Filed Nov. 30, 1938

8 Sheets-Sheet 3

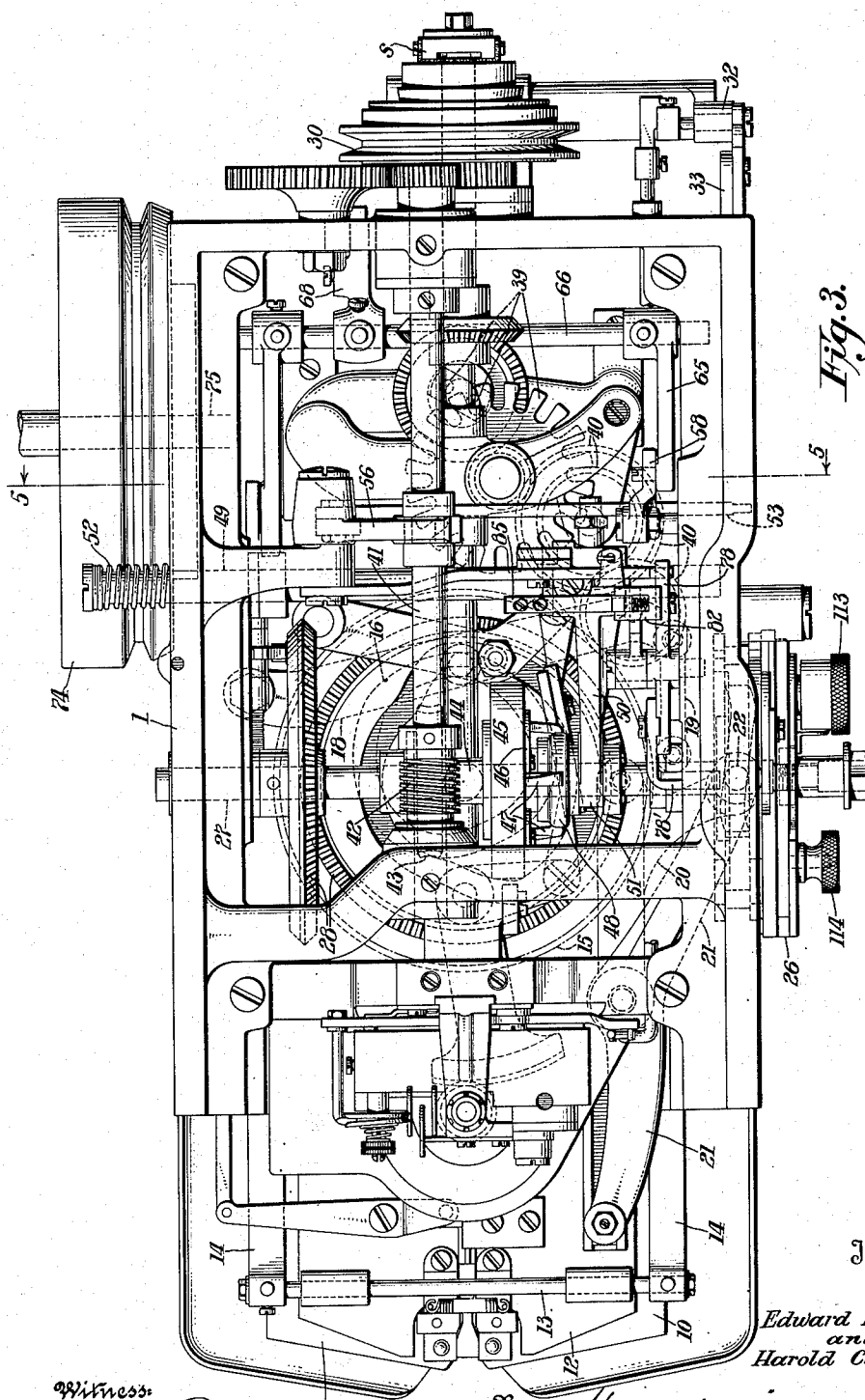


Fig. 3.

Inventor

Edward P. Spaine
and
Harold C. Faulkner

Witness

Godfrey Pecina

By

Harry Miller

Attorney

Feb. 13, 1940.

E. P. SPAINE ET AL

2,190,614

BUTTONHOLE SEWING MACHINE

Filed Nov. 30, 1938

8 Sheets-Sheet 4

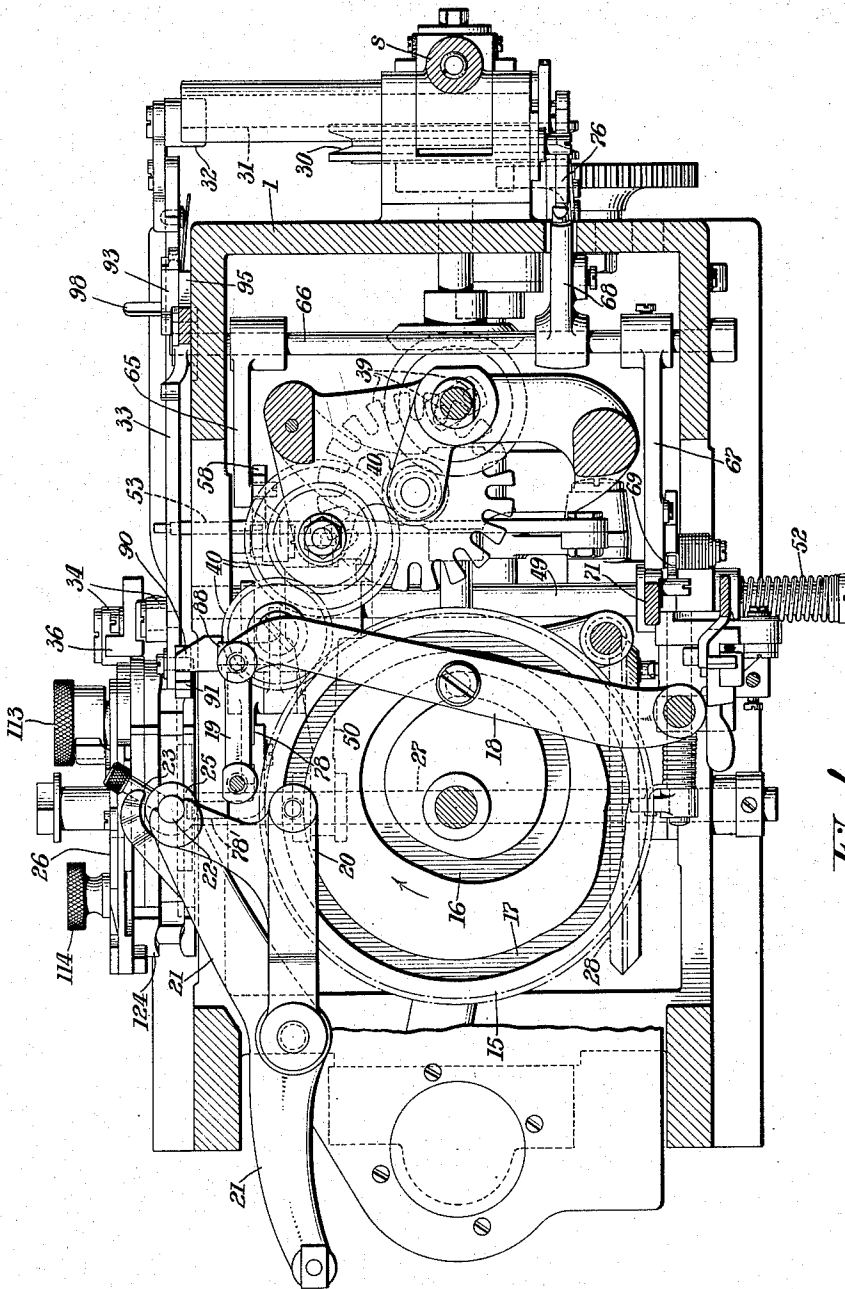


Fig. 4.

Inventor

Edward P. Spaine
and Harold C. Faulkner

Witness:
Grapes P. King

By Henry Miller
Attorney

Feb. 13, 1940.

E. P. SPAINE ET AL

2,190,614

BUTTONHOLE SEWING MACHINE

Filed Nov. 30, 1938

8 Sheets-Sheet 5

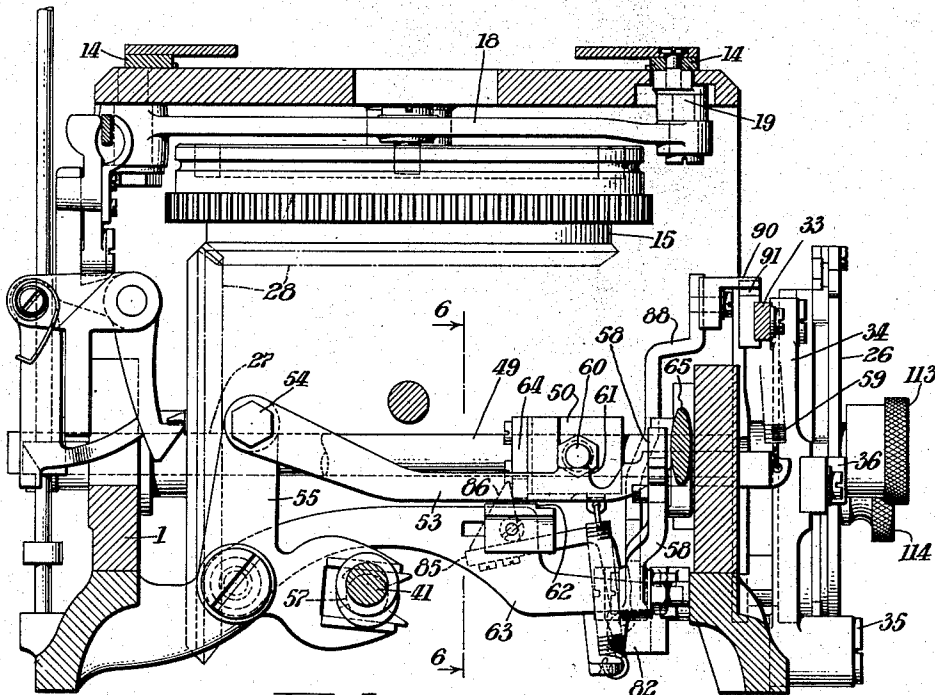


Fig. 5.

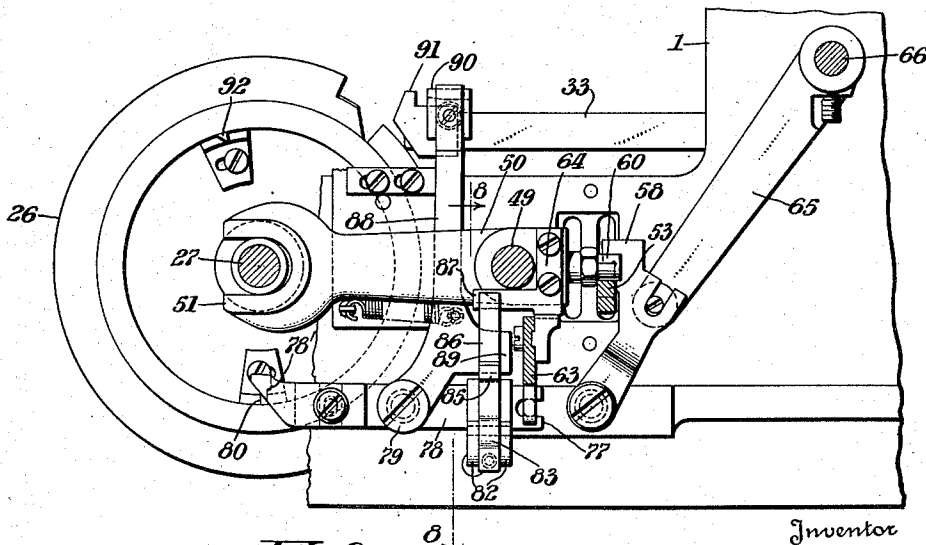


Fig. 6.

Inventor

Edward P. Spaine
and
Harold C. Faulkner

Witness:
Gregory Pecina

By *Henry Muller*
Attorney

Feb. 13, 1940.

E. P. SPAINE ET AL

2,190,614

BUTTONHOLE SEWING MACHINE

Filed Nov. 30, 1938

8 Sheets-Sheet 6

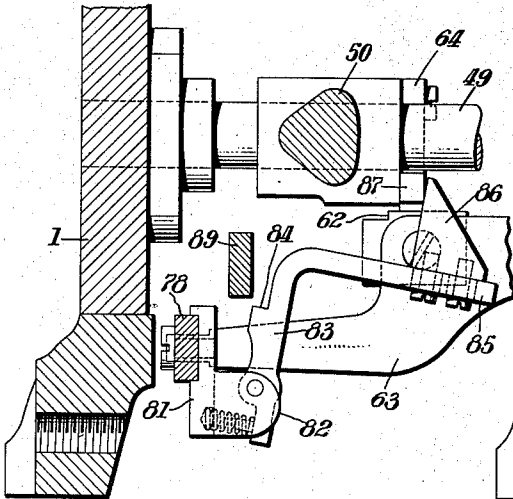


Fig. 8.

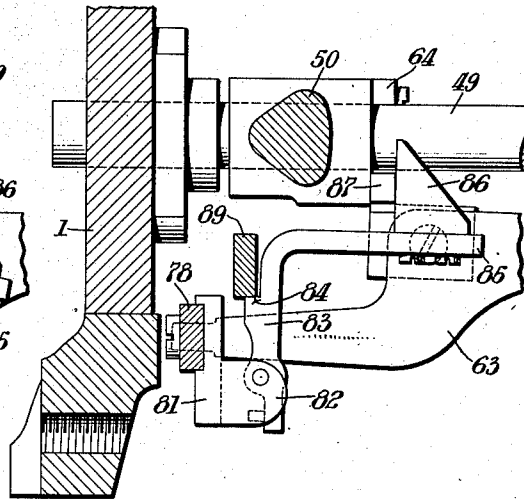


Fig. 9.

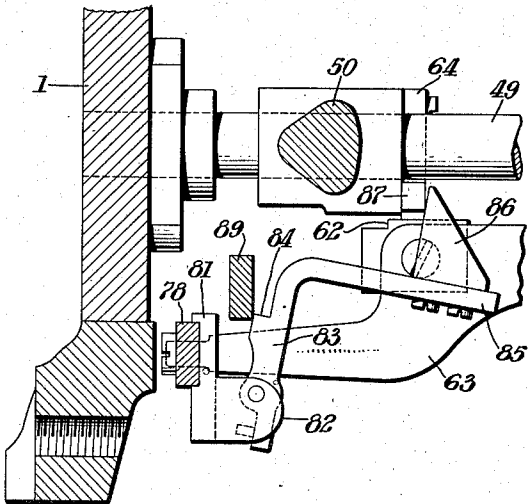


Fig. 10.

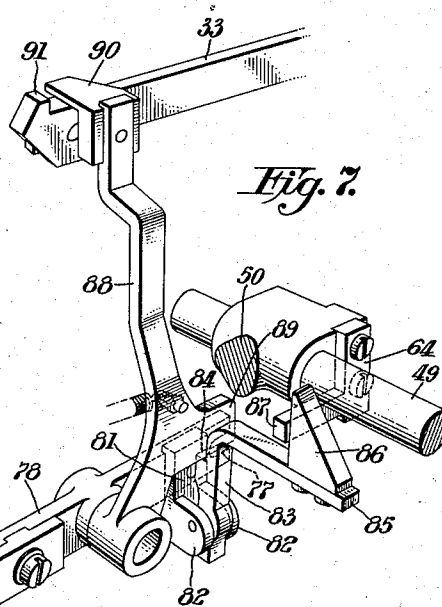


Fig. 7.

Inventor

Edward P. Spaine
and
Harold C. Faulkner

Witness:
Gasper Pecina

By Henry Miller
Attorney

Feb. 13, 1940.

E. P. SPAINE ET AL
BUTTONHOLE SEWING MACHINE

2,190,614

Filed Nov. 30, 1938

8 Sheets-Sheet 7

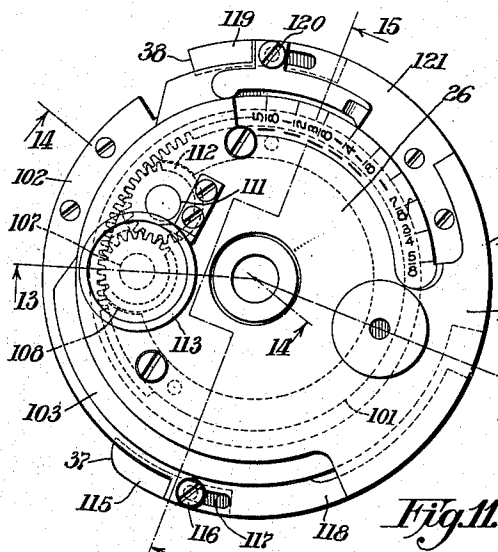


Fig. 11

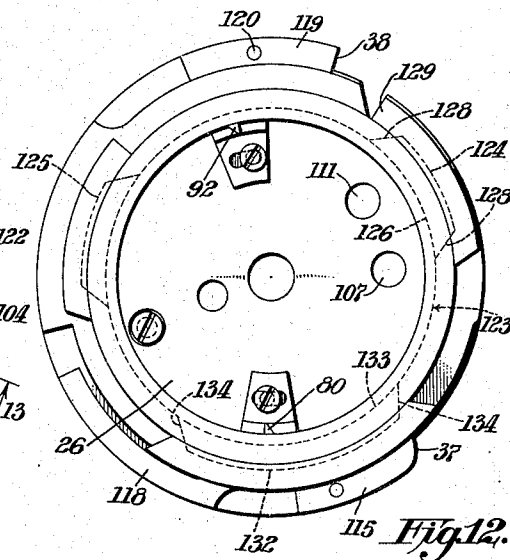


Fig. 12

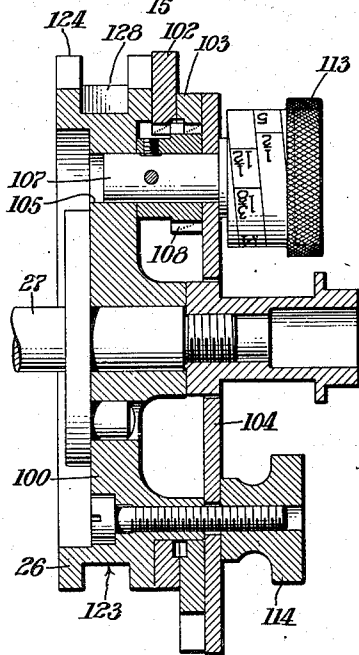


Fig. 13

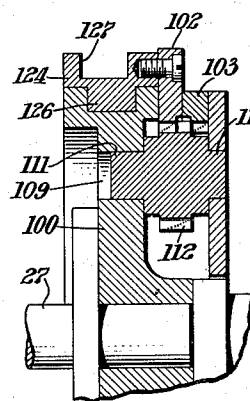


Fig. 14

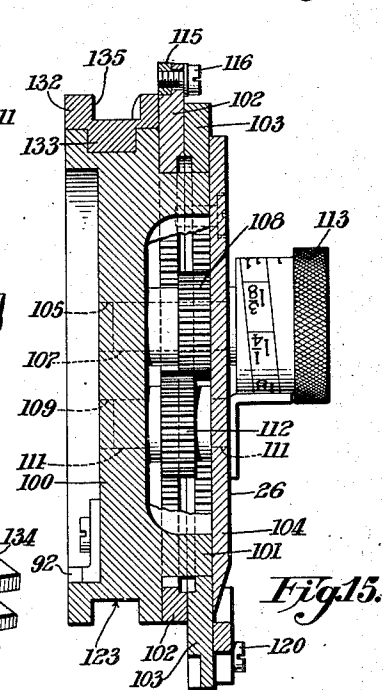


Fig. 15

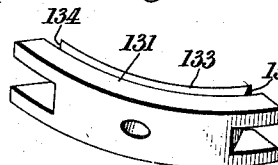


Fig. 16

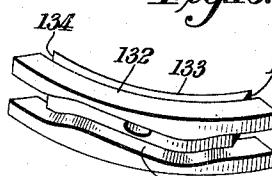


Fig. 17

Witness:
Joseph Reim

Inventor
Edward P. Spaine
and
Harold C. Faulkner

By Henry J. Miller

Attorney

Feb. 13, 1940.

E. P. SPAINE ET AL
BUTTONHOLE SEWING MACHINE

2,190,614

Filed Nov. 30, 1938

8 Sheets-Sheet 8

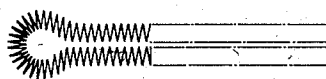
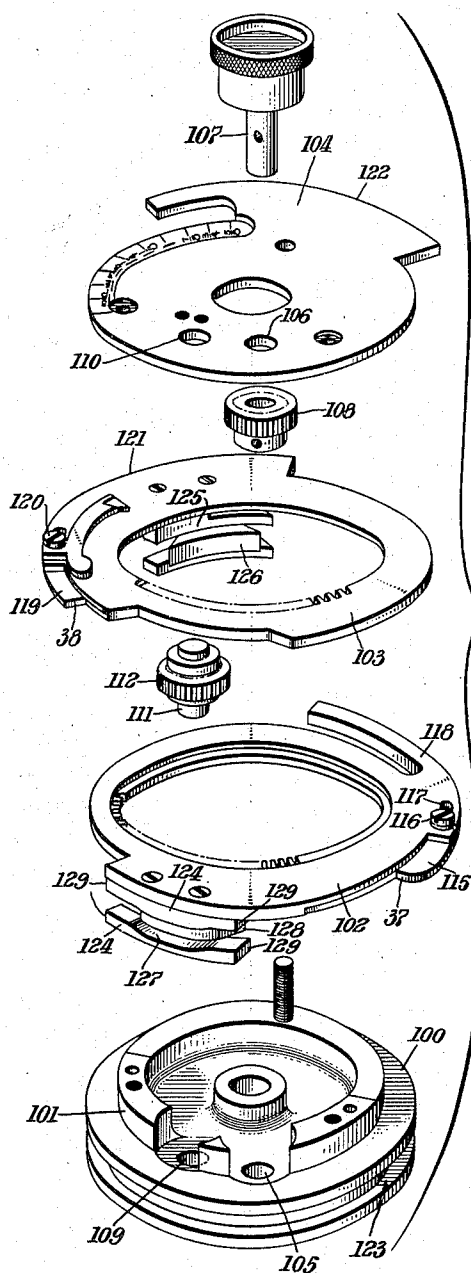


Fig. 19.

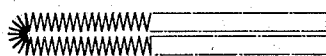


Fig. 20.

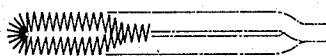


Fig. 21.

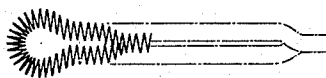


Fig. 22.

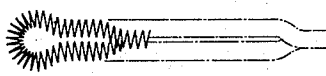


Fig. 23.

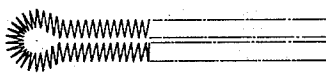


Fig. 24.

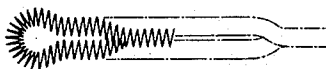


Fig. 25.

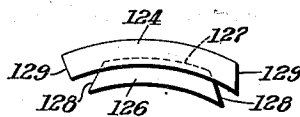


Fig. 18.a

Inventor

Edward P. Spaine
and Harold C. Faulkner

Witness
Joseph P. P. P.

By Henry Miller

Attorney

UNITED STATES PATENT OFFICE

2,190,614

BUTTONHOLE SEWING MACHINE

Edward P. Spaine, Bridgeport, and Harold C. Faulkner, Long Hill, Trumbull, Conn., assignors to The Singer Manufacturing Company, Elizabeth, N. J., a corporation of New Jersey

Application November 30, 1938, Serial No. 243,126

18 Claims. (Cl. 112-71)

This invention relates to buttonhole sewing machines and has for an object to provide an eyelet-end buttonhole sewing machine of the readily accessible pattern-wheel-controlled type which may be quickly and conveniently set to sew a buttonhole of any one of a variety of types and of any length within the range provided, without interchange of pattern-wheels.

The invention also aims to provide a buttonhole-sewing-machine-controlling pattern-wheel which may be adjusted to make a taper-barred buttonhole of any desired length. Another object of the invention is to improve the rapid-feed throw-out mechanism of the machine, so that it will not be necessary to make a separate adjustment of a rapid-feed throw-out tripping point on the pattern-wheel each time the pattern-wheel is re-set to sew a different length of buttonhole.

The invention also aims to provide a machine which will sew buttonholes with eyelet-ends of different sizes, or without eyelet ends, of any desired overall length, either taper-barred or unbarred and, if taper-barred, with a barred portion of any desired length within the range provided.

With the above and other objects in view, as will hereinafter appear, the invention comprises the devices, combinations and arrangements of parts hereinafter set forth and illustrated in the accompanying drawings of a preferred embodiment of the invention, from which the several features of the invention and the advantages attained thereby will be readily understood by those skilled in the art.

Of the accompanying drawings, Fig. 1 is a right side elevation of a buttonhole sewing machine embodying the invention. Fig. 2 is a left side elevation of the machine. Fig. 2^a is a side elevation of the rapid-feed throw-in tripping point mechanism in position to operate at the radially stitched end of a buttonhole without an eye. Fig. 2^b is a similar view of the stop-motion control devices of Fig. 2, taken at the instant the stitch-forming mechanism starts its operation and the initial rapid-feed action of the machine is thrown out. This occurs shortly before the stop-motion lever is tilted all the way to dotted line position, Figs. 2 and 2^b. Fig. 2 includes a showing of this same mechanism thrown to an inoperative position. Fig. 3 is a bottom plan view of the machine. Fig. 4 is a horizontal section through the machine bed at a level above the main feed-cam and feed-levers actuated thereby. Fig. 5 is a transverse section through the machine bed on the line 5-5, Fig. 3. Fig. 6 is an inside elevation of the mechanism within the machine bed, adjacent the pattern-wheel. This figure is a section taken substantially on the line 6-6, Fig. 5. Fig. 7 is a perspective view

of the rapid-feed throw-out mechanism which is operated by the pattern-wheel. Figs. 8, 9 and 10 are a series of transverse sectional views on the line 8-8, Fig. 6, in different successive positions of the parts assumed during a buttonhole-producing cycle, as will be explained. Figs. 11 and 12, are, respectively, outer and inner face views of the universal adjustable pattern-wheel of the machine. Fig. 13 is a substantially diametrical section of the pattern-wheel on the line 13-13, Fig. 11. Fig. 14 is a radial section on the radius 14-c, Fig. 11. Fig. 15 is a segmental section on the line 15-15, Fig. 11, turned upside down. Fig. 16 is a perspective view of a substitute detachable cam-block section of the pattern-wheel used to shift control of the lateral feed of the eye of a buttonhole to the main feed-cam for sewing a large size eyelet-end. Fig. 17 is a substitute cam-block attachable to the pattern-wheel for sewing a medium size eyelet-end. Fig. 18 is a disassembled perspective view of the pattern-wheel. Fig. 18^a is a side elevation of one of the taper-bar cam-blocks removed from the pattern-wheel of the machine, and Figs. 19 to 25, inclusive, are diagrammatic plan views of a selected set of buttonholes which may be made by the machine, such set being illustrative of the wide variety of buttonholes which may be made without removal of the pattern-wheel.

The machine in which the present invention is embodied for the purposes of the present disclosure is a "cut-after" eyelet-end buttonhole sewing machine of the type represented in U. S. Patent Reissue 15,324, reissued Apr. 4, 1922. It is, however, quite immaterial insofar as the present invention is concerned, whether the machine cuts the buttonhole after sewing it or before sewing it; both types of machines being well known in the art.

The machine illustrated has a frame including the hollow box-like bed 1 from which rises the standard 2 of the overhanging bracket-arm 3 terminating at its free end in the head 4.

The stitch-forming mechanism has a fixed operative position in the frame of the machine and is constructed substantially in accordance with the disclosure of U. S. Patent No. 1,372,473, of Mar. 22, 1921, and comprises the upper end-wise reciprocatory and laterally vibratory needle 5 and the under thread-looping devices including the threaded looper 6 and the needle-thread-loop retainer 7; the usual needle-throat member or button through which the upper needle 5 works being indicated at 8. The under thread-looping devices and needle-throat member are carried by a turret 9 which turns about a vertical axis together with the upper needle mechanism to place the stitches radially about the eyelet-end of a buttonhole.

The work is held in a work-clamp which partakes of traveling movements longitudinally of the bed 1 and side-shift movements laterally of the bed 1, to distribute the stitches about a buttonhole. The work-clamp comprises right and left clamp sections each comprising a lower clamp-plate 10 and an upper clamp-foot 11 carried thereby and movable toward and away from the lower clamp-plate to grip and release the work. These clamp sections are carried by a cross-slide plate 12, Fig. 3, slidable laterally of the machine bed 1 on the cross-rod 13 of the longitudinal slide-frame 14 which partakes of traveling movements longitudinally of the bed 1.

As the present work-clamp and the means for moving it are constructed substantially in accordance with the disclosure of said Reissued Patent 15,324, a brief description of the mechanism should suffice. There is mounted in the box-like bed 1 a main feed-wheel 15 having in its upper face a longitudinal feed-cam groove 16, Fig. 4, and a lateral feed-cam groove 17. The longitudinal feed-cam groove 16 acts through the lever 18 and link 19 to impart traveling movements to the longitudinal slide-frame 14. The lateral feed-cam groove 17 acts upon the follower-lever 20 which may be coupled to the follower-lever 21 by the vertically movable slide-bolt or plunger 22 to impart lateral movement to the cross-slide plate 12.

As shown in Fig. 2, the levers 20 and 21 are coupled together by the slide-bolt 22 which carries a lateral pin 23 resting in the horizontal portion of the inverted L-shaped slot 24 in the side wall of the boss 25 on the end of the lever 21 which carries the slide-bolt 22. In this elevated position, the lower end of the slide-bolt 24 is entirely out of range of any cams on the pattern-wheel 26 which is mounted externally of and at one side of the machine bed 1 on the cross rotary shaft 27 connected by one-to-one bevel gears 28 to the main feed-wheel 15. Thus the main feed-wheel 15 and the pattern-wheel 26 always run together in one-to-one timed relationship.

The longitudinal feed-cam groove 16 is designed to impart to the work-clamp a certain fixed overall longitudinal motion including the motion required to shift the work-clamp from sewing position to buttonhole-cutting position to give room for the buttonhole-cutter to act without clashing with the stitch-forming mechanism. At the start of a buttonhole-producing cycle the work-clamp occupies a position at one extreme end of its range of longitudinal traveling movement, known as buttonhole-cutting position. When the machine is started, the connected feed- and pattern-wheels 15, 26, are at first driven by a rapid-feed driving mechanism to carry the work-clamp quickly from starting position to the point of its longitudinal motion where the stitching is to begin. When this point is reached the stitch-forming mechanism is started and the rapid-feed drive is thrown out. The stitching then progresses down the first side of the buttonhole, around the eyelet-end and back along the return side of the buttonhole to a point even with the first stitch, at which point the stitch-forming mechanism is stopped and the rapid-feed drive is re-connected to carry the work-clamp quickly back to its extreme or initial position where the buttonhole is to be cut. At this position the return rapid-feed drive is thrown out of action.

From the foregoing, it will be understood that the length of a buttonhole made by the machine depends upon the position in the total longi-

tudinal travel of the work-clamp at which the sewing is started and stopped. By arranging to start the sewing later and stop it correspondingly earlier in a complete cycle of motion or revolution of the connected feed- and pattern-wheels 15, 26, a shorter buttonhole may be made, and vice versa. Of course, the rapid-feed drive controls must be correspondingly adjusted to take care of the changed positions at which the first rapid-feed motion is thrown out and the return rapid-feed motion is started.

The stitch-forming mechanism is driven by the main sewing shaft 29, the operation of which is controlled by the usual stop-motion device including the stop-motion lever *s* which is tilted from its full-line or stop position, Fig. 2, to dotted line or running position to connect the sewing shaft 29 to the source of power represented by the grooved belt-pulley 30. The stop-motion lever *s* is fixed to the pivot-shaft 31 carrying the crank-arm 32 which is connected by the link 33 to the lever 34 fulcrumed at 35 on the machine bed and carrying the cam-follower nose 36 in position to be engaged by the "start-sewing" cam-rise 37 and released by the "stop-sewing" drop-off shoulder 38 on the pattern-wheel 26. When the stitch-forming mechanism is operating, the main feed-cam 15 and with it the pattern-wheel 26 are driven in step-by-step fashion from the main sewing shaft 29 by means of the usual pin-and-star-wheel drive 39 and connecting gearing 40.

The rapid-feed drive of the connected feed-cam 15 and pattern-wheel 26, which carries the work-clamp rapidly over those portions of its longitudinal travel where there is to be no stitching, is accomplished by the constantly running rapid-feed drive-shaft 41 which carries a worm 42 meshing with a gear 43 fixed to the hub 44 of a live clutch element 45 loose on the cross rotary shaft 27. Within the live-clutch element 45 is a driven-clutch element 46 including the tails 47 of clutch-dog operators. When the tails 47 are expanded by the cone 48, slidable on the cross rotary shaft 27, the clutch is released and the cross rotary shaft 27 is disconnected from the rapid-feed drive-shaft 41. When the cone 48 is withdrawn from the tails 47 of the clutch-dog-operating levers, the clutch is engaged and the shaft 27 is coupled to its drive-shaft 41 or, in other words, the rapid-feed is thrown in. This rapid-feed mechanism is, so far, constructed substantially in accordance with the disclosure of said U. S. Patent Reissue 15,324.

The clutch-operator is constituted by a cross-slide rod 49 carrying an arm 50 having at its free end a fork 51 which engages the grooved hub of the cone 48. The cross-slide rod 49 is biased by the coil-spring 52 in a direction to throw out the rapid-feed. The rod 49 is shoved endwise against the pressure of the spring 52, to throw in the rapid-feed, by the continuously reciprocating push-bar 53 which is pivoted at 54, Fig. 5, to the arm 55 of a bell-crank 57 on the rapid-feed drive-shaft 41. The push-bar 53 is held by the latch 58 in a depressed position, Figs. 5 and 6, where it may reciprocate idly. When the latch 58 is swung over to release the push-bar 53, the latter is drawn upwardly by its spring 59, effecting engagement of the stud-pin 60 on the cross-slide shaft 49 by the shoulder 61 on the push-bar 53 which thereupon shoves the cross-slide shaft 49 to its extreme rapid-feed throw-in position in which it is retained by engagement of the shoulder 62 on the latch-lever 63 by the lower edge of the plate 64 on the hub of the arm 50.

The latch 58 is engaged by a lever-arm 85 on the rock-shaft 66 which is journaled in the bed 1 and has rigidly connected to it two arms 67, 68 by means of which it may be operated to throw in the rapid-feed. The first mentioned arm 67 carries a spring-pressed tripping tooth 69 which is engaged and depressed by the pin 70 on the downwardly extending arm 71 of the three-armed clamp-closing lever 71, 72, 73, which at the beginning of a buttonhole-producing cycle receives an impulse from a clamp-closing cam-groove in the inner face of the continuously running belt-pulley 74 loose on the buttonhole-cutter shaft 75. The clamp-closing lever actuating mechanism is preferably constructed substantially in accordance with the disclosure of U. S. Patent No. 1,832,665, of November 17, 1931. The second mentioned arm 68 of the rock-shaft 66 is actuated to throw in the rapid-feed by the toothed lever 76 which engages the arm 68 when the stop-motion 8 acts to stop the sewing operation when the stitching along the return side of the buttonhole has progressed to a point even with the first stitch. The actuating mechanism for the toothed lever 76 is the same as that disclosed in U. S. Patent No. 1,504,306, of Aug. 12, 1924.

The throw-out of the rapid-feed is accomplished by tripping the latch-lever 63 to release the spring-biased clutch-operator slide-rod 49. This must be accomplished twice in a buttonhole-producing cycle, once when the sewing is started and again when the work-clamp reaches buttonhole-cutting position after the buttonhole has been stitched. The latch-lever 63 engages the forked end 77 of a lever 78 fulcrumed at 79 on the inner wall of the bed 1. The lever 78 has a lateral extension 78', Fig. 7, which is in position to be engaged by the rapid-feed throw-out tooth 80 on the inner face of the pattern-wheel 26. The tooth 80 is the tooth which throws out the second or final rapid-feed of the work-clamp at the completion of a buttonhole-producing cycle. It occupies a fixed position on the pattern-wheel for all lengths of buttonholes which the pattern-wheel may be set to produce. Heretofore, the pattern-wheel carried another similar tooth, which is not present in the machine herein disclosed. Such tooth was positioned to throw out the rapid-feed at the time the sewing operation was started.

The tooth, heretofore used to throw out the initial rapid-feed when the sewing starts, has been eliminated from the present machine in favor of a connection with the stop-motion-actuating link 33, as will now be described.

Fixed to the lever 78, Fig. 7, is a block 81 having two ears 82 between which is fulcrumed a thrust-bar 83 having a thrust-receiving shoulder 84 and a lateral extension or tail 85 which carries a tooth 86 in position to be engaged at times by the extension 87 of the plate 64 on the hub of the forked arm 50 which engages the rapid-feed clutch cone 48. Fulcrumed on the same screw with the lever 78 is a lever 88 having a rearward extension 89 in position to engage the thrust shoulder 84 of the thrust member 83 when the tail 85 is released by the arm 87, as shown in Figs. 7 and 9, which show the rapid-feed clutch-operating slide-rod 49 in rapid-feeding position. The lever 88 carries at its upper end a lateral extension 90, Fig. 7, in position to be engaged by the tooth 91 on the stop-motion operating link 33 when the "start-sewing" cam-rise 37 shifts the lever 34 and link 33 to start the sewing operation. This motion of the link 33 causes the tooth

91 to engage and actuate the lever 88, thereby causing the rearward extension 89 to swing the lever 78 and depress the latch-lever 63, Fig. 9, thus releasing the slide-rod 49 which is shifted by its spring 52 to the position shown in Fig. 10, to throw out the rapid-feed as the sewing starts. The tooth 91 is adjustable longitudinally of the link 33, Fig. 2, and is so set as to effect the throw-out of the rapid-feed at the same instant the stitch-forming mechanism is thrown in. At this instant, as shown in Fig. 2b, the cam-follower nose 36 has not ridden to the crest of the "start-sewing" cam-rise 37. Hence, immediately after the sewing starts and the initial rapid-feed is thrown out, the lever 34, link 33, and tooth 91 receive a further rearward motion sufficient to swing the lever 88 and lower its rearwardly extending arm 89 from the rapid-feed throw-out position, Fig. 9, to the position shown in Fig. 10 where it is below the level of the shoulder 84 and cannot be re-engaged by such shoulder in the event the rapid-feed action is again thrown-in while the sewing mechanism is operating at the eye end of a buttonhole. It is quite evident that this mechanism will function to throw-out the initial rapid-feed when the sewing starts, regardless of when, during the longitudinal travel of the work-clamp, the sewing starts. Thus, a change of position or timing of the "start-sewing" cam-rise 37 will require no corresponding change of position or timing of a rapid-feed throw-out tripping tooth on the back of the pattern-wheel, as heretofore. The purpose of the tail 85, block 86 and extension 87 are to hold the thrust-member shoulder 84 out of the path of movement of the arm 89 of lever 88, when the machine is not rapid feeding, so that when the arm 89 is lowered slightly to a position below the shoulder 84 by the last portion of the rise 37 of the stop-motion controlling cam on the pattern-wheel, the rapid-feed may be thrown into and out of operation by other means to be described in sewing a reduced number of radial stitches at the eye-end of a lapel-type of buttonhole, such as shown in Fig. 20. This disconnection of the arm 89 from the shoulder 84, as shown in Fig. 10, frees the lever 78 and the latch-lever 63 so that the latter will be free to move upwardly to latching position, with its shoulder 62 engaged by the lower edge of the plate 64 on the cross-slide shaft 49, when the rapid-feed is thrown in while the sewing is progressing around the eye-end of a buttonhole, as may be accomplished by the following means.

The means for throwing in the rapid-feed while sewing at the eye-end of the buttonhole comprises the tooth 93 pivoted at 94 on a plate 95 fixed to the rod 96 which is connected to and partakes of the longitudinal travel of the longitudinal slide-frame 14. The tooth 93 is biased to operative position, Fig. 2a, by a spring 97 and may be held in an inoperative position, Fig. 2, by a manually operable pivoted catch 98. When the catch 98 is shifted from the position shown in Fig. 2, to the position shown in Fig. 2a, the tooth 93 is swung downwardly around its pivot 94 to a position where it will strike the arm 99 on the rapid-feed throw-in control rock-shaft 66 when the sewing reaches the eye-end of the buttonhole. As before stated, the special tripping point 92 throws out the rapid-feed at the eye. The machine may thus be caused to rapid-feed at the eye-end of a buttonhole, without stopping the sewing mechanism, and the number of eye stitches may thus be reduced. This is useful.

in sewing a lapel-type hole, such as shown in Fig. 20, where the end stitches are apt to be overcrowded.

It now remains to describe the universal adjustable pattern-wheel with which the present machine is equipped to enable it to make buttonholes of different lengths. This pattern-wheel comprises a main supporting disk 100 having a large cylindrical extension 101, Fig. 18, constituting a bearing or arbor for a pair of internally toothed rings 102, 103. These rings are held on the arbor 101 by the face-plate 104. Journaled in the coaxial holes 105, 106 in the disk 100 and face-plate 104 is the shaft 107 to which is pinned a pinion 108 meshing with the internal teeth of the ring 103, only, as shown in Fig. 15. Journaled in the holes 109 and 110 in the disk 100 and face-plate 104 are the supporting shaft extensions 111 of the pinion 112 which is equal in size to and meshes with the pinion 108 and also with the internal teeth of the ring 102, but not with the teeth of ring 103, as shown in Fig. 15. The shaft 107 is fitted with a knurled head 113 by which it may be turned to rotate the rings 102 and 103 simultaneously and in opposite directions upon and relative to the disk 100. The rings may be clamped in adjusted position by the clamp-nut 114, Fig. 13.

The inner ring 102 carries the "start-sewing" cam-rise 37 which is formed as a curved nose at one end of a ring segment 115 secured by a screw 116 to the ring 102; the screw 116 passing through an arcuate slot 117 in the ring 102. The ring 102 has an arcuate portion 118 which forms a continuation of the ring segment 115. The outer ring 103 carries the "stop-sewing" drop-off shoulder 38 which is at the end of the ring segment 119 peripherally adjustable on the ring 103 by virtue of the screw and slot expedient 120. The circular outer edge of the ring segment 119 is of the same radius as the adjacent circular outer edge-portion 121 of the ring 103, which is the same as the radius of the outer edge of the portion 118 and ring segment 115 of ring 102. The face-plate 104 has a circular outer edge-portion 122 of the same radius to bridge the variable gap between the similar portions of the rings 102 and 103.

The main supporting disk 100 is formed with a peripheral cam-groove or laterally closed cam-track 123 having no side throws and suitable to receive the lower end of the plunger 22, when the pin 23 is shifted over to the vertical portion of the inverted L-shaped slot, and control the lateral feed of the work-clamp in sewing a straight, non-barred, buttonhole such as shown in Fig. 20. It will be remembered that when the plunger 22 is dropped to engage the lateral feed-cam groove in the pattern-wheel, the upper end of the plunger 22 is dropped below the lever 20 and hence the work-clamp is disconnected from the lateral feed-cam groove in the main feed-wheel. This is in accordance with the disclosure in said U. S. Patent Reissue 15,324.

To make taper-barred buttonholes the pattern-wheel may be equipped with taper-bar cam-blocks 124, 125. Each of these cam-blocks is of arcuate shape and has an inner circular rib 126 adapted to fit and ride in the cam-groove 123 in the pattern-wheel disk 100. Each taper-bar cam-block also has a laterally closed cam-groove 127 which has the proper side throws to effect the desired lateral shift of the work-clamp to offset the taper-barring stitches. One of the taper-bar cam sections is detachably mounted

on the ring 102 and the other is detachably mounted on the ring 103 by suitable screws, as shown in Fig. 18.

The position of the taper-bar cam-block 124 peripherally of the ring 102 is such that the follower-plunger 22 will be in the offset portion of the cam-groove 127 when the "start sewing" cam-rise 37 on the ring 102 engages the follower 36. The offset portion of the cam 127 is long enough to contain the plunger 22 for any position of adjustment of the "start sewing" cam-segment 115 relative to the ring 102. The cam-block 124, Fig. 12, is formed at the ends of its rib 126 with inclines 128 flanked by side wall extensions or cheek-pieces 129. The leading incline 128 lifts the plunger 22 out of the straight cam-groove 123 in the pattern wheel and into the side throw cam-groove 127 of the taper-bar cam-block. The plunger 22 is, however, not lifted high enough by the bottom wall of the cam-groove 127 to effect coupling of the lateral feed-levers 20 and 21. The pattern-wheel 26 remains in sole control of the lateral feed when the taper-bar cam-blocks are acting.

The final taper-bar cam-block 125 is like the first cam-block 124 except that the cam-groove therein is offset from the rib 126 oppositely to the direction of offset of the cam-groove 127 in the cam-block 124. The cam-block 125 is so positioned peripherally of the ring 103 to which it is connected that when the "stop sewing" drop-off shoulder 119 reaches the stop-motion follower nose 36 the plunger 22 will be riding in the offset portion of the cam-groove in the cam-block 125. In other words the "stop sewing" drop-off shoulder 38 trails the second taper-bar cam-block 125 the same number of degrees peripherally of the pattern-wheel 26 that the "start sewing" cam-rise 37 trails the first taper-bar cam-block 124. This relationship is maintained for any adjustment of the knurled head 113 to vary the length of the buttonhole. Taper-bar buttonholes of any selected length within the range of the machine may be sewn with one setting of the knurled head 113. The length of the taper-bar may be varied by adjusting the ring segments 115, 119 relative to their respective supporting rings 102, 103.

With the pattern-wheel 26 there may be provided detachable cam-block sections such as the "large eye" section 131 shown in Fig. 16 and the "medium eye" section 132 shown in Fig. 17. Each of these sections has the rib-portion 133 which fits in the cam-groove 123 of the pattern-wheel and has inclines 134 at its opposite ends to lift the follower-plunger 22 out of the straight cam-groove 123 and lower it back into such groove at the beginning and end of the eye-stitching period. The "medium eye" cam-block 132 has a cam-groove 135 with offsets designed to take care of the lateral shift of the work-clamp required to sew a medium eyed buttonhole, such as shown in Figs. 23, 24 and 25. The "large eye" section 131 has no lateral feed-cam groove. This section 131 merely serves to lift the plunger 22 high enough to couple the lateral feed-levers 20 and 21 together, whereby the large eye lateral feed-cam groove 17 in the main feed-wheel 15 takes over the lateral feed-control from the pattern-wheel 26 in sewing around the eye. The cam-block 131 is used in sewing the large eye buttonholes shown in Figs. 19 and 22.

To sew the lapel-type buttonhole of Fig. 20, the taper-bar cam-blocks 124, 125 and eye-blocks 131 or 132 are detached and removed from the pat-

tern-wheel, so that the lateral feed is held at zero by the cam-groove 123 in the pattern-wheel. To sew the "no-eye" taper-bar buttonhole of Fig. 21, the taper-bar cam-blocks 124 and 125 are attached to their respective rings 102, 103 on the pattern-wheel. Any of the buttonholes selected may be varied in length as desired between the extreme lengths indicated by full and dotted lines in Figs. 19 to 25, inclusive. While sewing a no-eye or medium-eye buttonhole, the lateral position of the work-holder is continuously under the control of the pattern-wheel cams. The plunger 22 passes under the control of the terminal cheek-pieces of the taper-bar cam-sections, large-eye cam-section or medium-eye cam-section before being ejected from the straight side-stitch-controlling cam-groove 123 in the pattern-wheel by the inclined terminal portions of the ribs of said cam-sections.

Of course, for any selected length of buttonhole, a buttonhole-cutting block 137 of appropriate length must be applied to one of the usual buttonhole-cutter levers. Knife blocks must be interchanged whenever the machine is re-set to sew a different length buttonhole. The other buttonhole-cutter lever carries the knife 136 which is long enough to cut the longest buttonhole produced by the machine. The present buttonhole-cutting mechanism and the means for tripping it into operation at the close of a buttonhole-sewing period are substantially the same as in the machine of said U. S. Patent Reissue 15,324. It is to be understood however, that the present invention is not limited to a "cut-after" machine; it being obviously immaterial to the invention whether the buttonhole is cut before or after sewing.

Having thus set forth the nature of the invention, what we claim herein is:

1. In a buttonhole sewing machine, the combination with work-holding means, of stitch-forming mechanism, rotary cam means for moving said work-holding means and stitch-forming mechanism relative to each other to cause the stitches to be formed along the sides and around the eye-end of the buttonhole, two circularly adjustable controlling members rotating one-to-one with said rotary cam, means by which the length of the buttonhole is determined, and two separate barring cams circularly adjustable with said controlling members by which the work-holding means and stitch-forming mechanism are given a relative lateral movement thereby to form a bar at the end of the buttonhole.

2. In a buttonhole sewing machine, the combination with work-holding means, of stitch-forming mechanism, rotary cam means for moving said work-holding means and stitch-forming mechanism relative to each other to cause the stitches to be formed along the sides and around the eye-end of the buttonhole, two circularly adjustable controlling members rotating one-to-one with said rotary cam means by which the length of the buttonhole is determined, and two separate barring cams circularly adjustable with said controlling members by which the work-holding means and stitch-forming mechanism are given a relative lateral movement thereby to form a bar at the end of the buttonhole, each of said barring cams being connected to a respective one of said controlling members, and adjusting means to move said members simultaneously and equally in opposite directions.

3. In a buttonhole sewing machine, the combination with work-holding means, of stitch-form-

ing mechanism, means for giving said work-holding means and stitch-forming mechanism a relative movement of fixed amplitude longitudinally of the buttonhole, rotary and circularly adjustable means for controlling the operation of the stitch-forming mechanism by which buttonholes of different lengths may be formed, a barring cam rotatable with said rotary and circularly adjustable means and circularly adjustable into different positions according to the length of the buttonhole being sewed, and means operated thereby to produce a relative lateral movement between the stitch-forming mechanism and work-holding means by which barring stitches are formed at the end of the buttonhole.

4. In a buttonhole sewing machine, a feed-cam having a laterally closed cam-track, a cam-block having a laterally closed cam-track superposed upon and adjustable along said first mentioned cam-track, a cam-track follower, and means to guide said follower from one to the other of said cam-tracks for any position of adjustment of said cam-block on said feed-cam.

5. In a buttonhole sewing machine, a rotary feed-cam having a laterally closed cam-track, a cam-block carried by said rotary feed-cam and adjustable circularly about the axis of rotation of said feed-cam, said cam-block having a laterally closed cam-track superposed upon and laterally positioned by said first mentioned cam-track, a cam-track follower, and means to direct said follower from one to the other of said cam-tracks for any position of circular adjustment of said cam-block.

6. In a buttonhole sewing machine, a feed-cam having a laterally closed cam-groove, a cam-block detachably carried by said feed-cam and having a rib received in said cam-groove, said cam-block having a laterally closed cam-groove in the portion thereof overlying said rib, a cam-follower, inclined means at the ends of said rib to eject said follower from the first mentioned cam-groove, said cam-block having cheek-pieces at the sides of said inclined means, said cheek-pieces constituting terminal portions of the side walls of the laterally closed cam-groove in said cam-block.

7. In a buttonhole sewing machine, the combination with work-holding means, of stitch-forming mechanism, means for giving said work-holding means and stitch-forming mechanism a relative movement of fixed amplitude longitudinally of a buttonhole, circularly adjustable rotary means for controlling the operation of the stitch-forming mechanism by which buttonholes of different lengths may be formed, rotary taper-barring cams separately and circularly adjustable and means operated thereby to produce the relative lateral movement of the stitch-forming mechanism and work-holding means by which a bar is formed lengthwise of the buttonhole.

8. In a buttonhole sewing machine, a feed-cam having a first cam-groove, a cam-block having a second cam-groove and a rib underlying said second cam-groove and received in said first cam-groove, said rib having inclined terminal portions leading from the bottom wall of the first cam-groove to the bottom wall of the second cam-groove.

9. In a buttonhole sewing machine, a feed-cam block having a rib and a cam-groove overlying said rib, said rib having inclined terminal portions leading from the bottom wall of said rib to the bottom wall of said cam-groove.

10. In a button hole sewing machine, a feed-cam block having a rib and a cam-groove overlying said rib, said rib having inclined terminal portions leading from the bottom wall of said rib to the bottom wall of said cam-groove, and cheek-pieces flanking said inclined terminal portions.

11. In a buttonhole sewing machine, a universal adjustable pattern-wheel having a main supporting disk formed with a cylindrical extension, a pair of internally gear-toothed stop-motion-controlling rings mounted on said cylindrical extension, a pair of directly intermeshing and laterally offset pinions journaled on said main supporting disk, each of said pinions directly meshing with the internally toothed portion of a respective one of said rings, and manually operated means to turn one of said pinions.

12. In a buttonhole sewing machine, a universal adjustable pattern-wheel having a main supporting disk formed with a cylindrical extension, a pair of internally gear-toothed rings mounted on said cylindrical extension, intermeshing pinions meshing each with the internally toothed portion of a respective one of said rings, one of said rings being formed with a "start-sewing" cam-rise and a circular external edge-portion leading therefrom, the other ring being formed with a "stop-sewing" drop-off shoulder and a circular external edge-portion leading thereto, and a plate fixed to said main supporting disk and having a circular edge-portion overlapping the outer circular edge-portions of said rings and serving as a bridge therebetween.

13. In a buttonhole sewing machine, a universal adjustable pattern-wheel having a main supporting disk formed with a cylindrical extension, a pair of internally gear-toothed rings mounted on said cylindrical extension, intermeshing pinions meshing each with the internally toothed portion of a respective one of said rings, one of said rings being formed with a "start-sewing" cam-rise and a circular external edge-portion leading therefrom, the other ring being formed with a "stop-sewing" drop-off shoulder and a circular external edge-portion leading thereto, and a plate fixed to said main supporting disk and having a circular edge-portion overlapping the outer circular edge-portions of said rings and serving as a bridge therebetween, said main supporting disk having a lateral feed-cam groove in its peripheral edge, and a pair of taper-barring cam-blocks received in said cam-groove and connected each to a respective one of said rings.

14. In a buttonhole sewing machine, stitch-forming mechanism, a stop-motion device therefor, a work-holder, feeding mechanism including a longitudinal feed-cam and connections for relatively moving the stitch-forming mechanism and work-holder longitudinally of the machine, said feeding mechanism also including a lateral feed-cam wheel and connections for controlling the relative lateral positions of the stitch-forming mechanism and work-holder in sewing along the sides of a buttonhole, a pair of rotatively adjustable rings on said lateral feed-cam wheel, means on one of said rings to cause the stop-motion to start the stitch-forming mechanism, means on the other of said rings to cause the

stop-motion to stop the stitch-forming mechanism, a pair of taper-bar cam-blocks carried by said lateral feed-cam wheel and each connected to a respective one of said rings, and means to simultaneously and equally adjust said rings rotatively and in opposite directions on said lateral feed-cam to change the length of a taper-barred buttonhole produced by the machine.

15. A buttonhole sewing machine having work-holding means and stitch-forming mechanism, a stop-motion device for the stitch-forming mechanism, feed-cam means to relatively move the work-holding means and stitch-forming mechanism over a fixed range longitudinally of the buttonhole, the stitch-forming mechanism being rotatable about an axis normal to the plane of the work to sew around the eye-end of a buttonhole, rapid-feed means to drive the feed-cam means before and after the buttonhole it stitched, control means for the stop-motion device to start the stitch-forming mechanism after the initial rapid-feed has been completed, rapid-feed throw-out means controlled by the stop-motion throw-in means, means to throw in the rapid-feed while the stitch-forming mechanism is active at the eye-end of the buttonhole, and means independent of the stop-motion control to throw out the rapid-feed at the eye-end of the buttonhole so that the return side stitches may be made under a normal stitching feed the same as the first side stitches.

16. In a buttonhole sewing machine, work-holding means, stitch-forming mechanism, a main feed-cam for relatively moving the work-holding means and stitch-forming mechanism longitudinally of the buttonhole, a pattern-wheel having a lateral feed-cam for controlling the relative position of the work-holding means and stitch-forming mechanism transversely of the direction of length of the buttonhole, a lateral feed-cam section carried by said pattern-wheel and peripherally adjustable thereon to vary the time at which it comes into action in a buttonhole-producing cycle, and control means for the stitch-forming mechanism also carried by said pattern-wheel and peripherally adjustable on the latter.

17. In a buttonhole sewing machine, a rotatory feed-cam having a laterally closed cam-track, a cam-follower having a lateral movement controlled by said cam-track and a cam-section having a cam-track-engaging portion complementary to and laterally fixed in position by said cam-track and slidable along the latter to different operative positions, said cam-section having a laterally closed cam-track constructed to pick up said follower from said first-mentioned cam-track and take over the control of the lateral movement of said cam-follower.

18. In a buttonhole sewing machine, a feed-cam having a cam-groove, a cam-follower having a lateral movement controlled by said cam-groove and a cam-section having a rib-portion engaging and slidable along said cam-groove to different operating positions, said cam-section having a cam-groove constructed to pick up said follower from said first cam-groove and take over the control of the lateral movement of said cam-follower.

EDWARD P. SPAINE.
HAROLD C. FAULKNER.