Nov. 10, 1942. E. P. SPAINE 2,301,798

THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

Original Filed Sept. 21, 1940 11 Sheets-Sheet 1

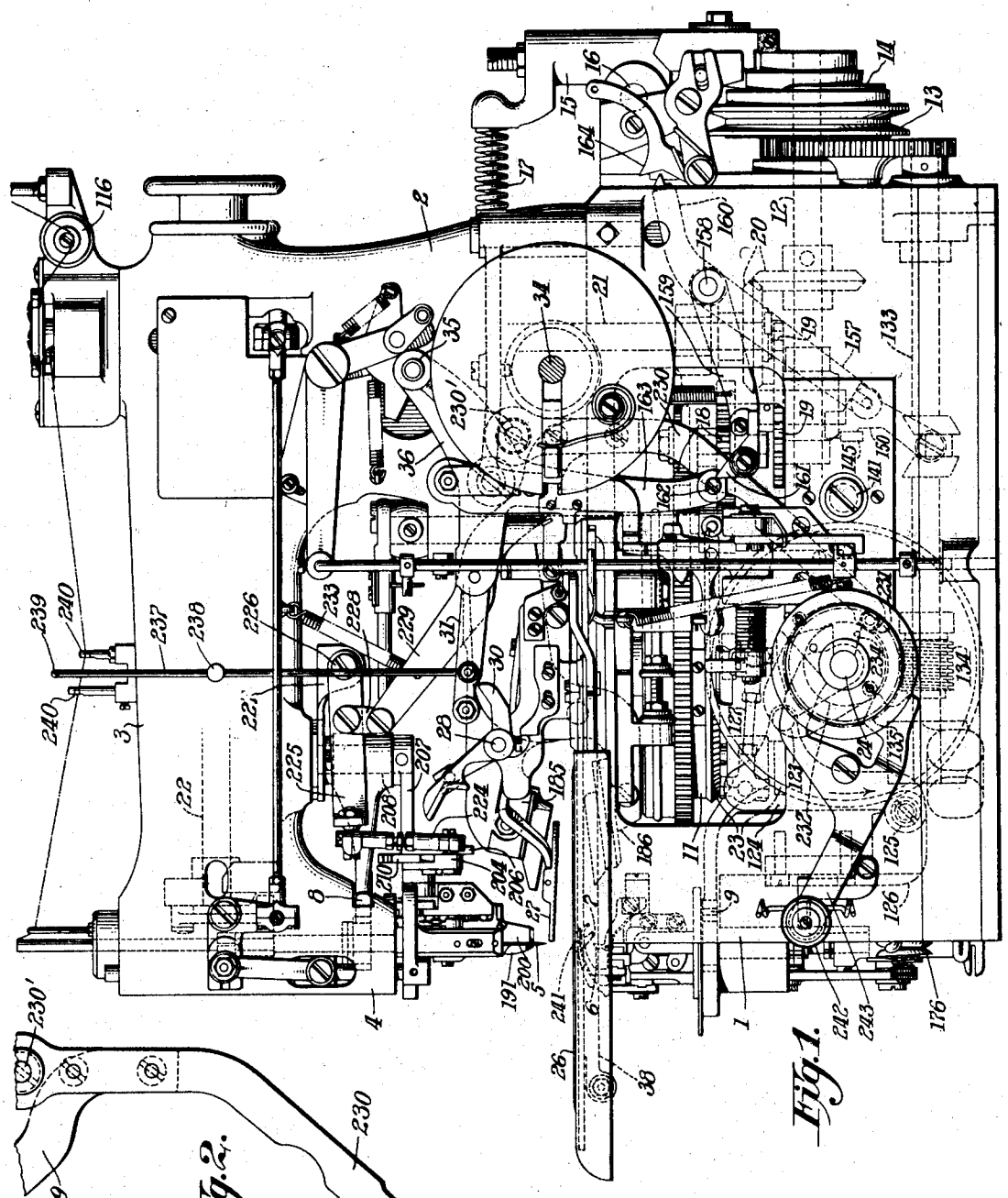

Fig. 1.

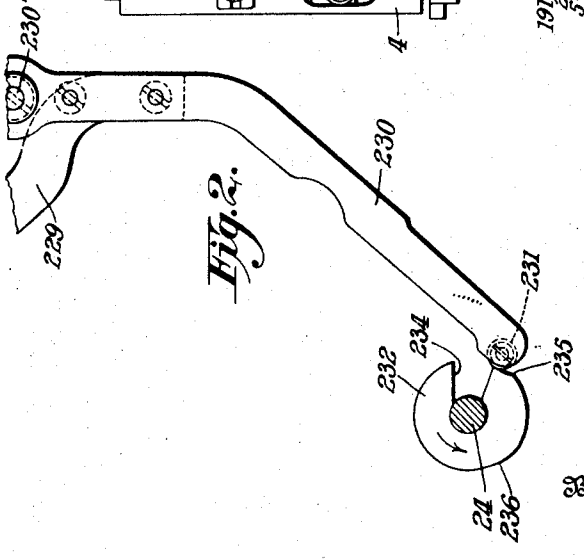

Fig. 2.

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

Original Filed Sept. 21, 1940 11 Sheets-Sheet 2

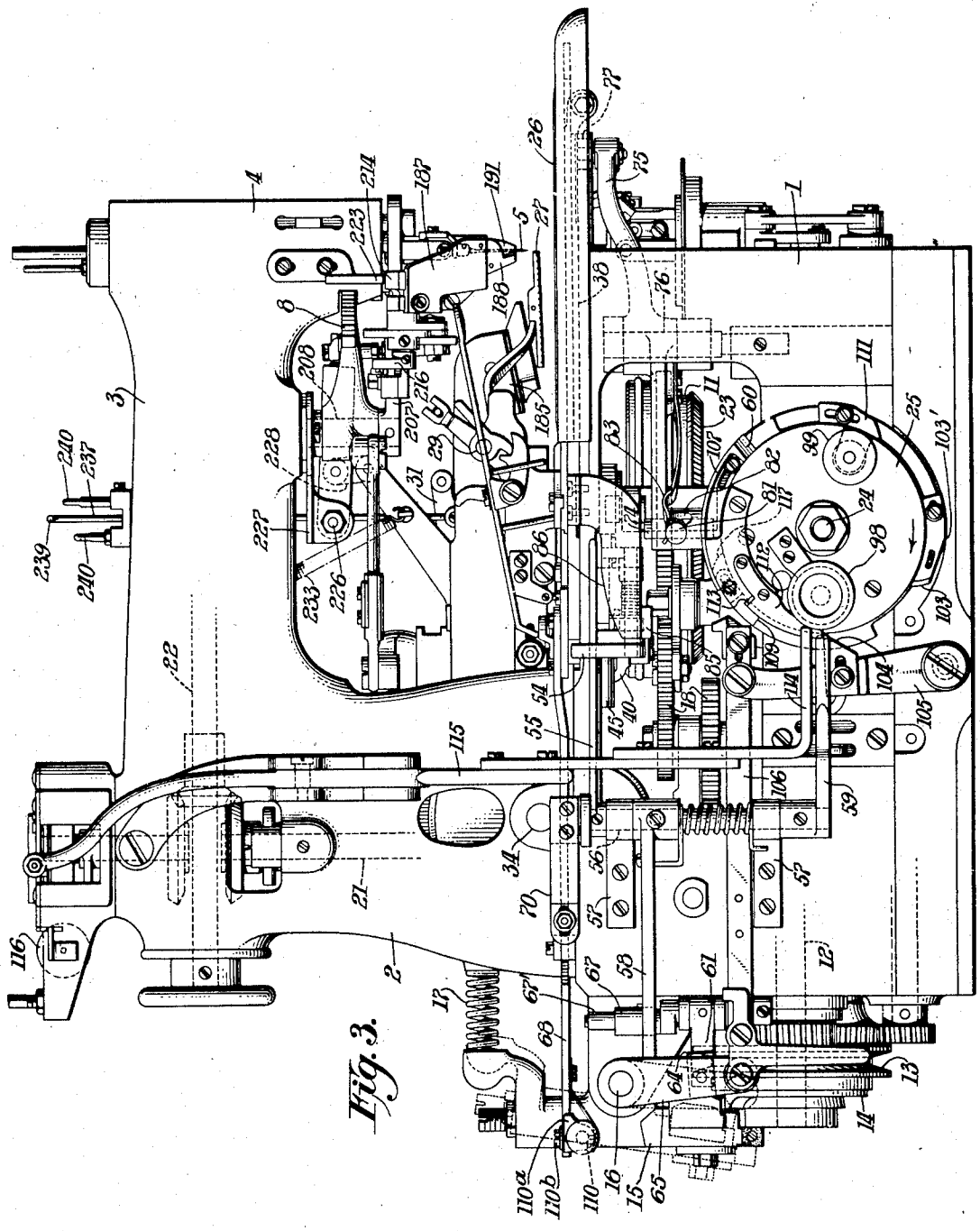

Fig. 3.

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

Original Filed Sept. 21, 1940 11 Sheets-Sheet 3

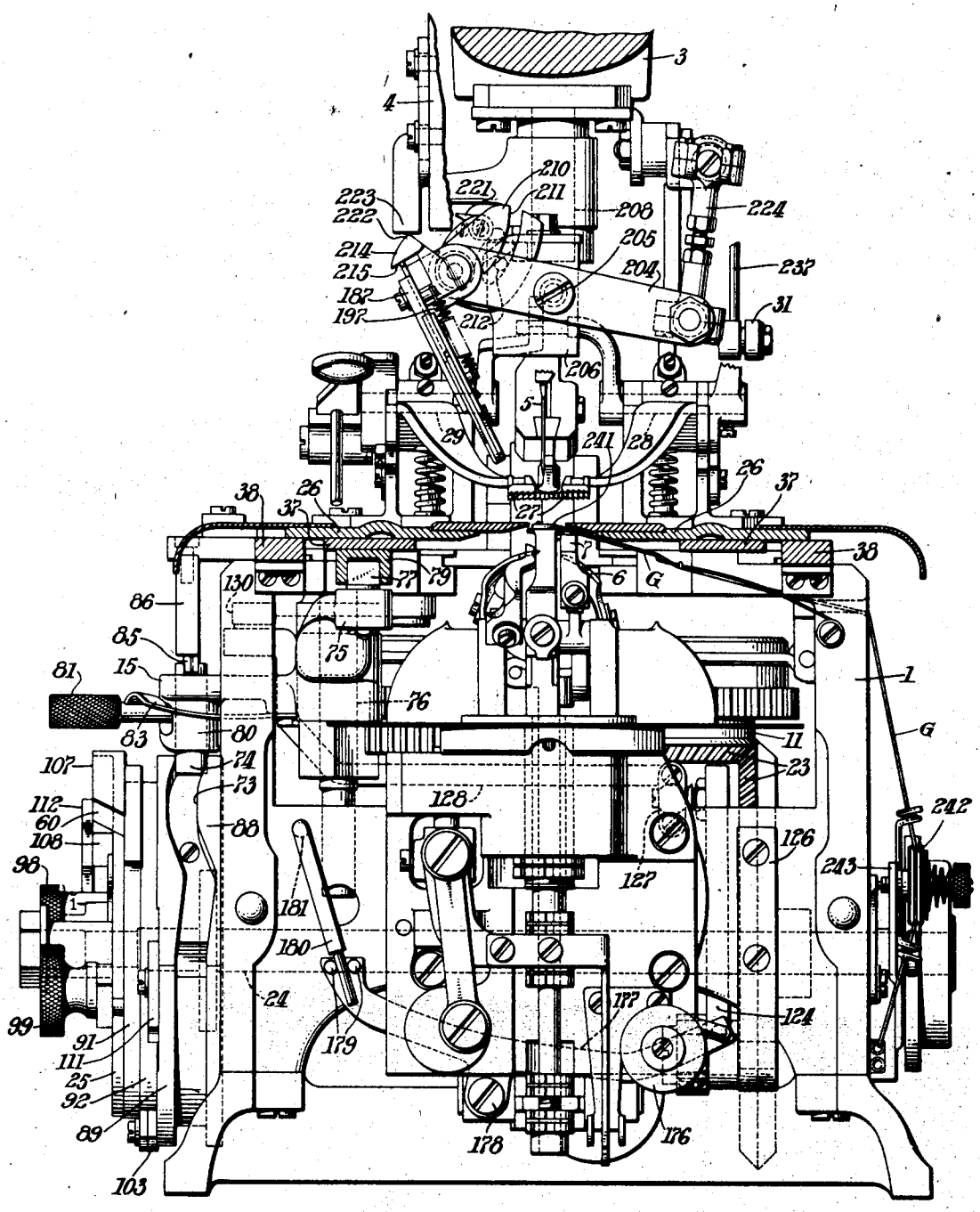

Fig. 4.

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

Original Filed Sept. 21, 1940 11 Sheets-Sheet 4

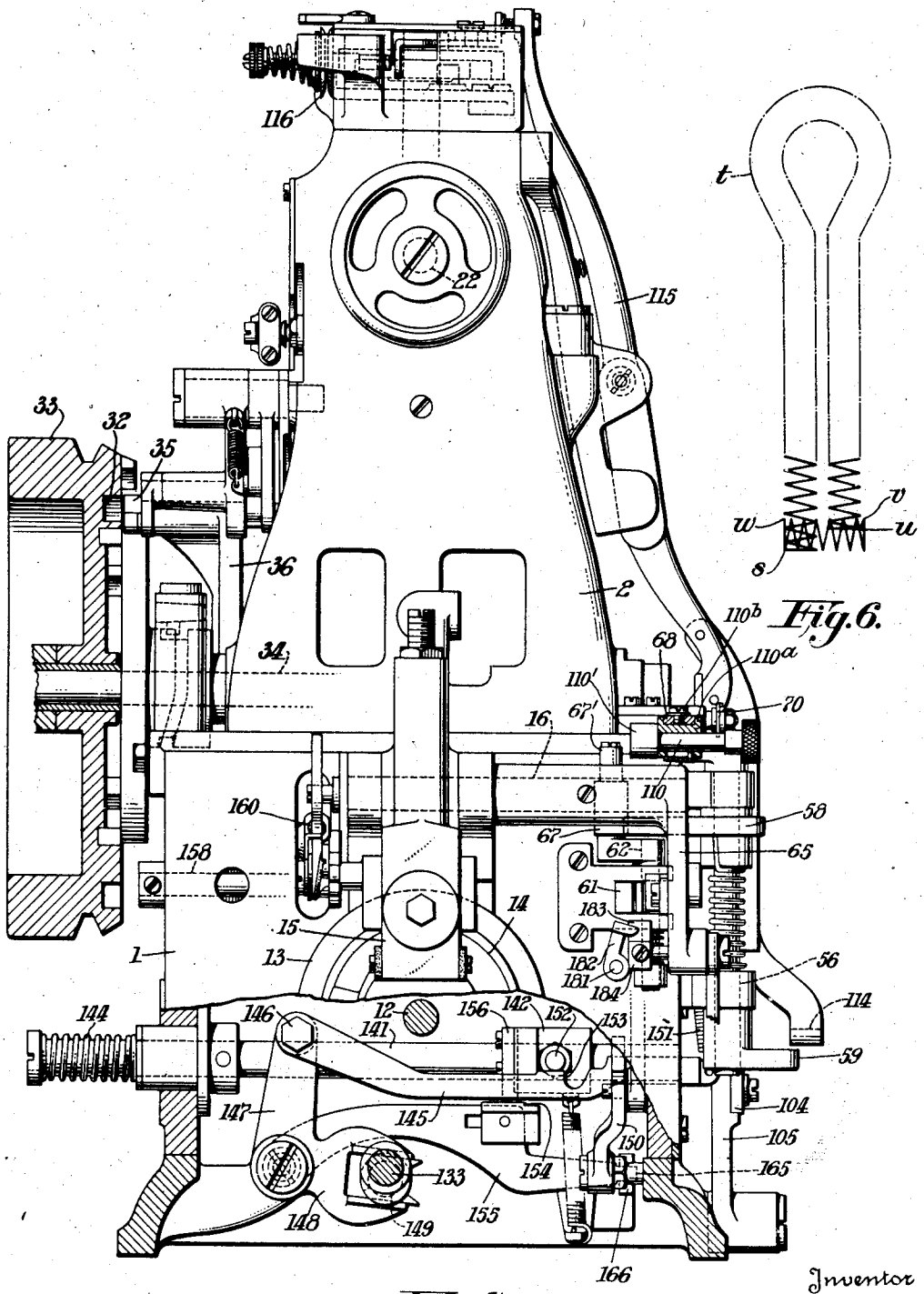

Fig. 6.

Fig. 5.

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

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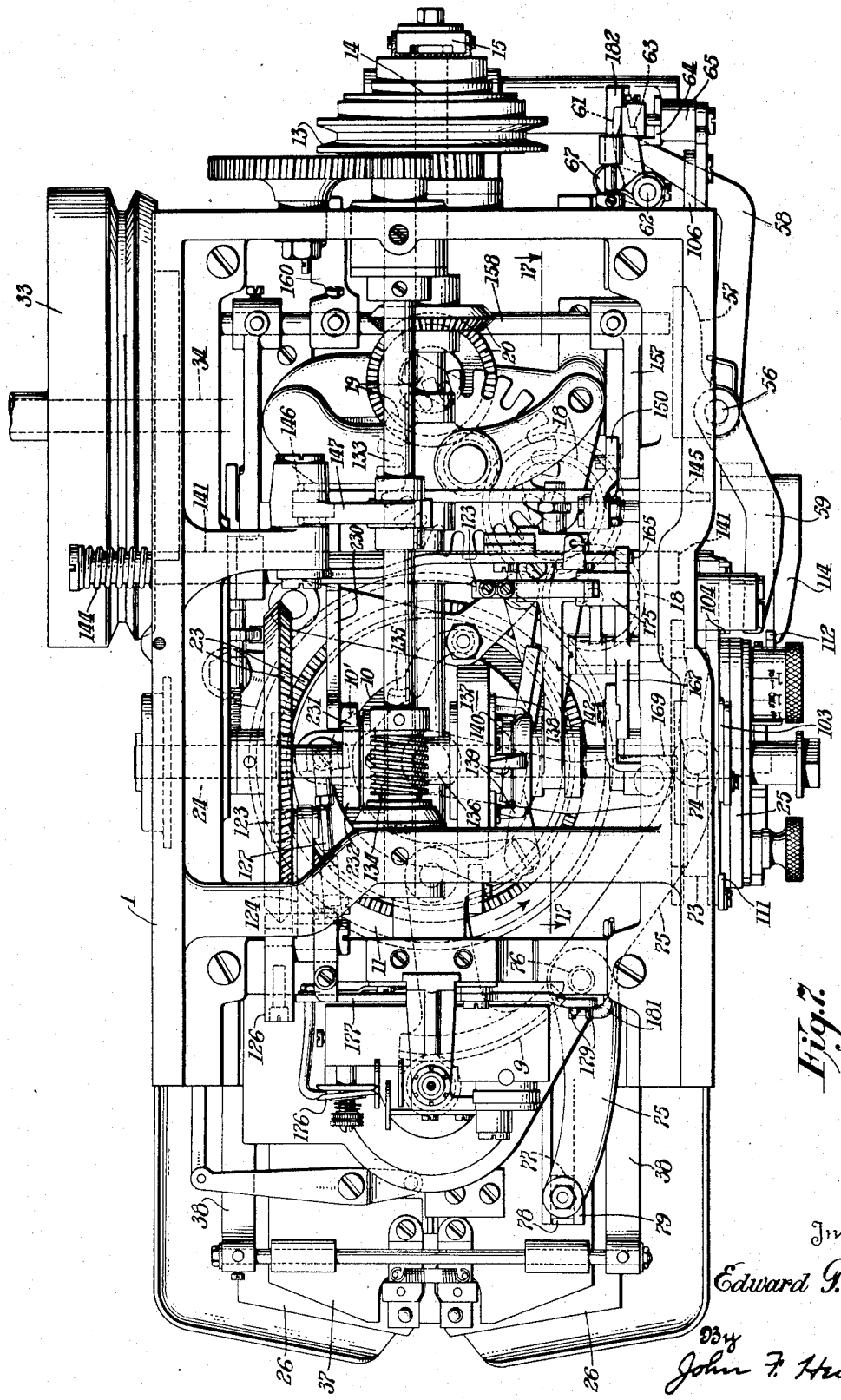

Fig. 7.

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

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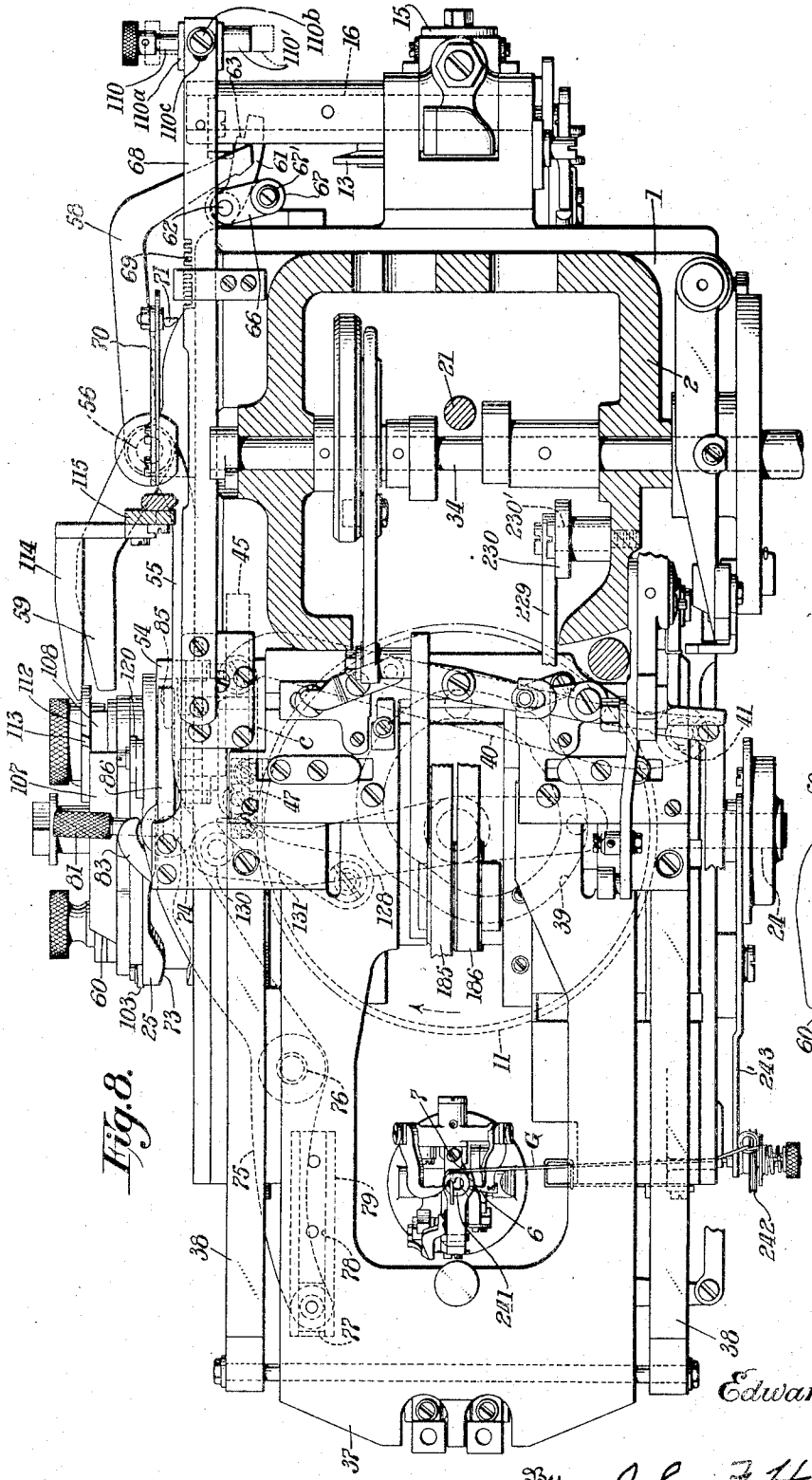

Fig. 8.

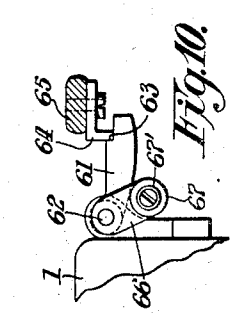

Fig. 10.

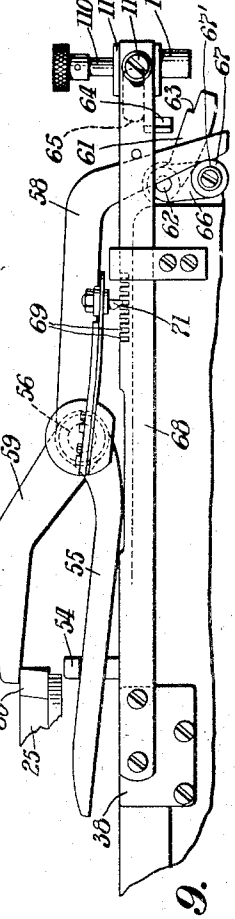

Fig. 9.

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

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Fig. 12.

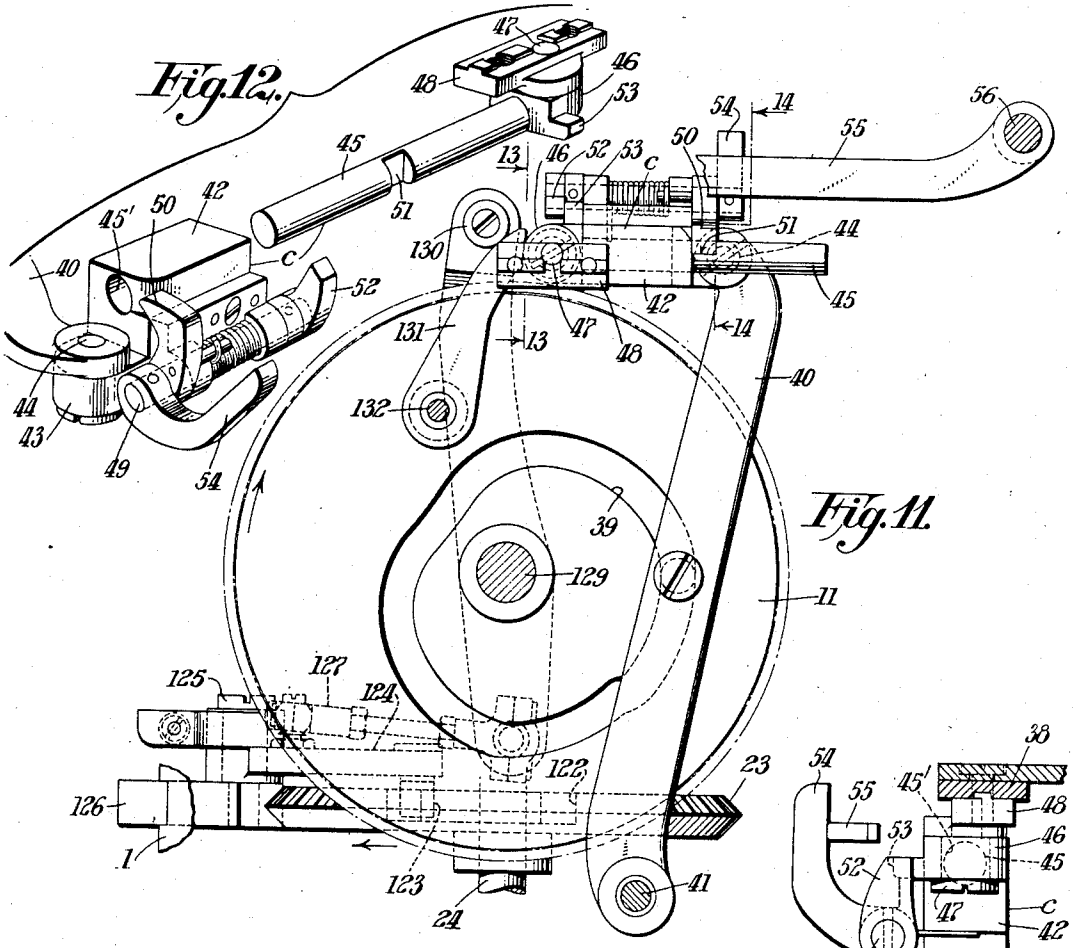
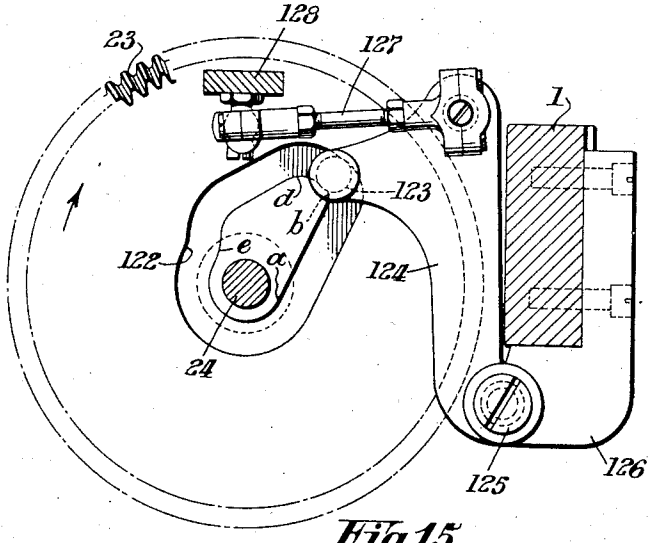


Fig. 11.

Fig. 13.



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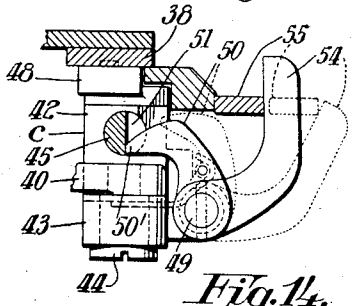

Fig. 14.

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

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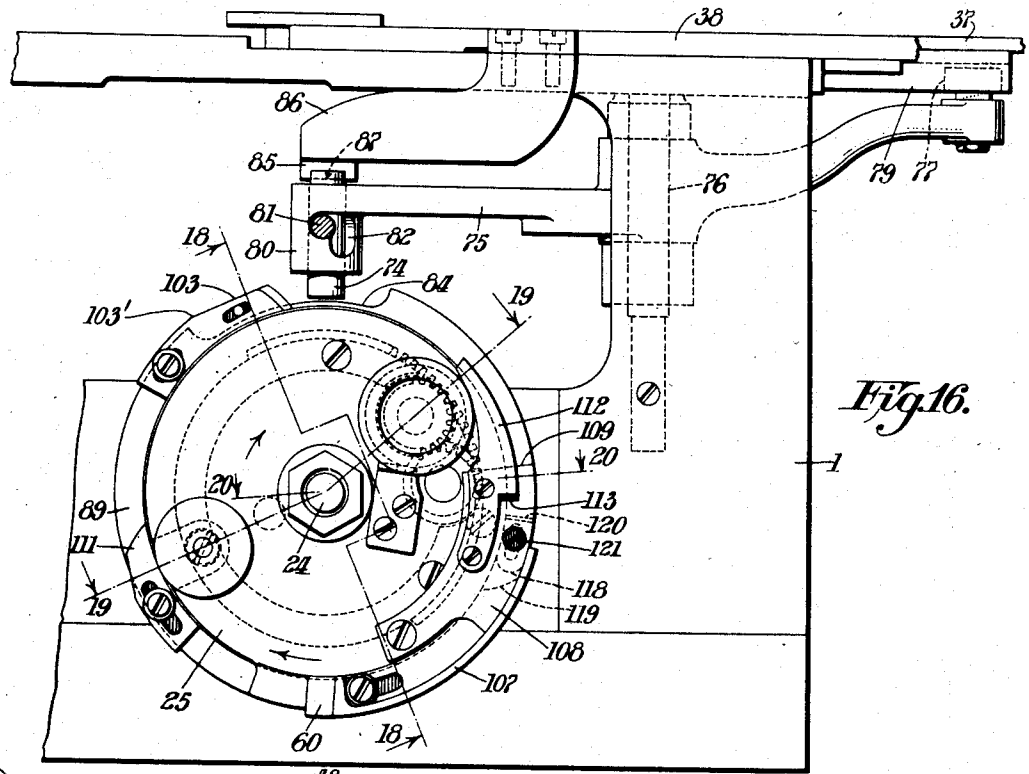

Fig. 16.

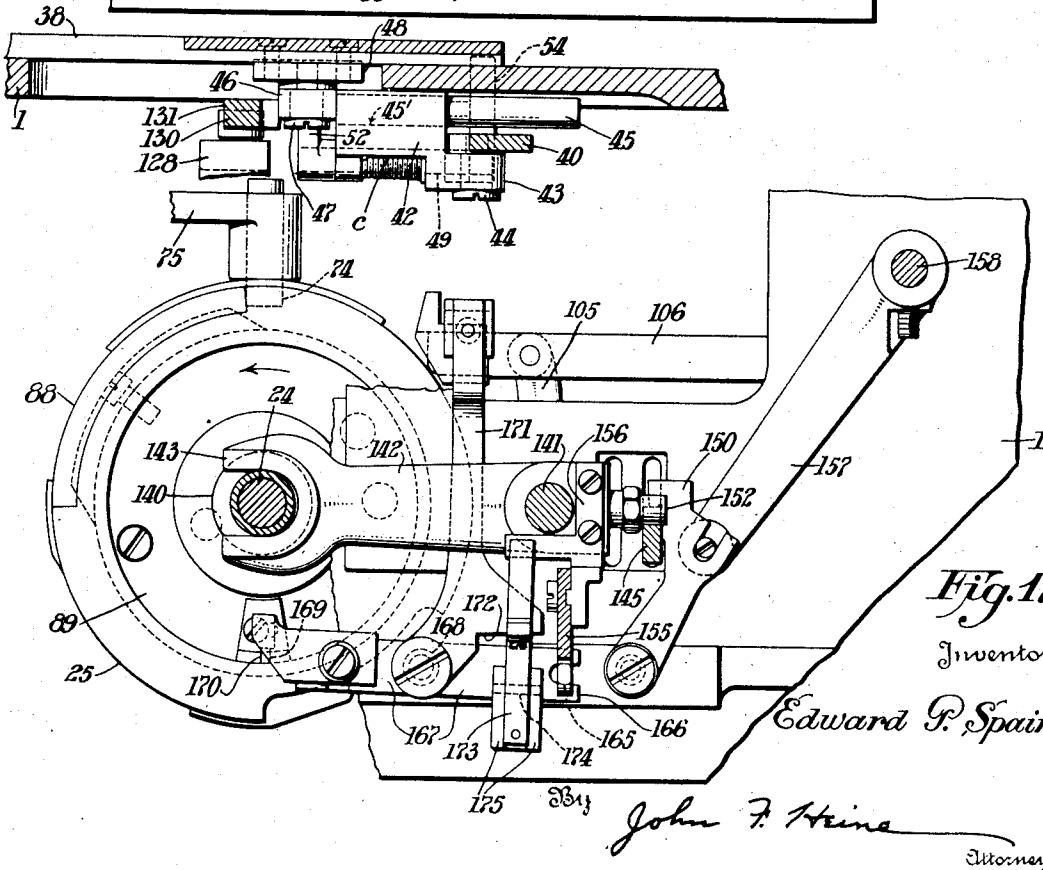

Fig. 17.

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

Original Filed Sept. 21, 1940 11 Sheets-Sheet 9

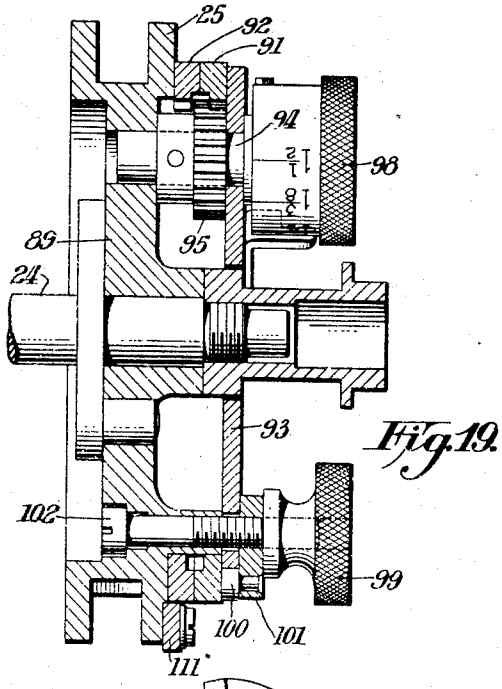

Fig. 19.

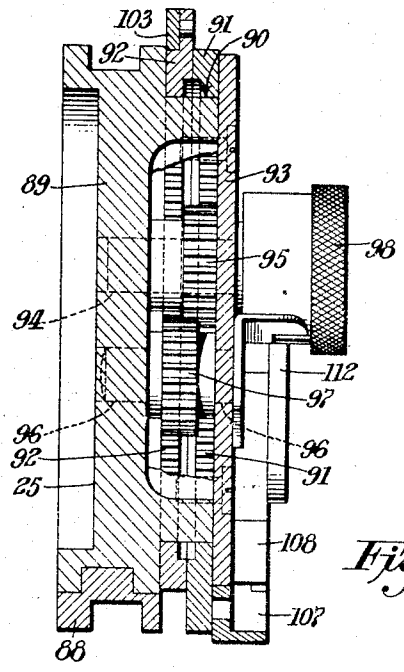

Fig. 18.

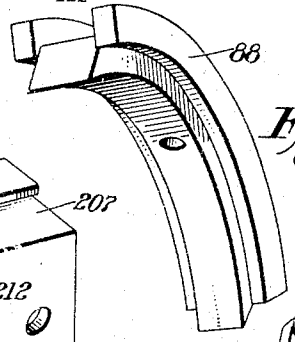

Fig. 21.

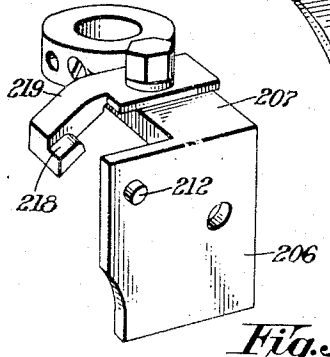

Fig. 36.

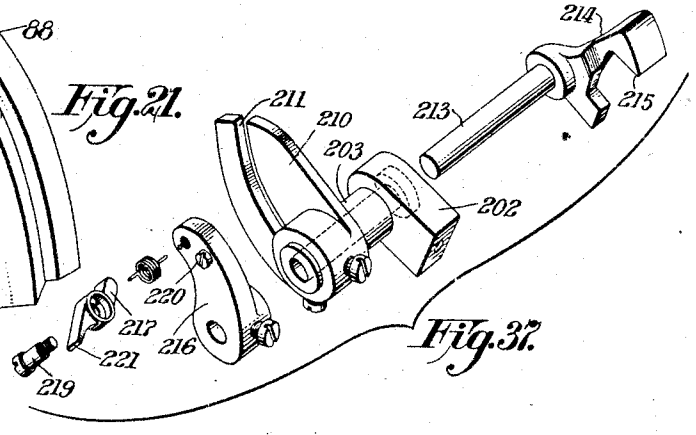

Fig. 37.

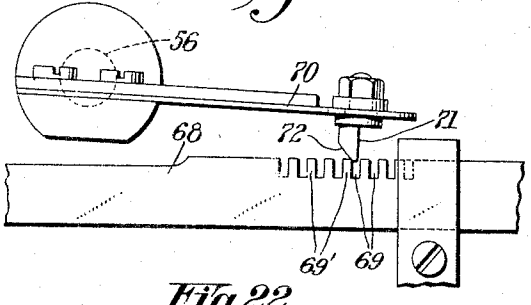

Fig. 22.

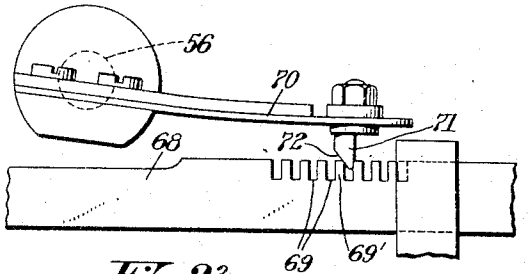

Fig. 23.

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

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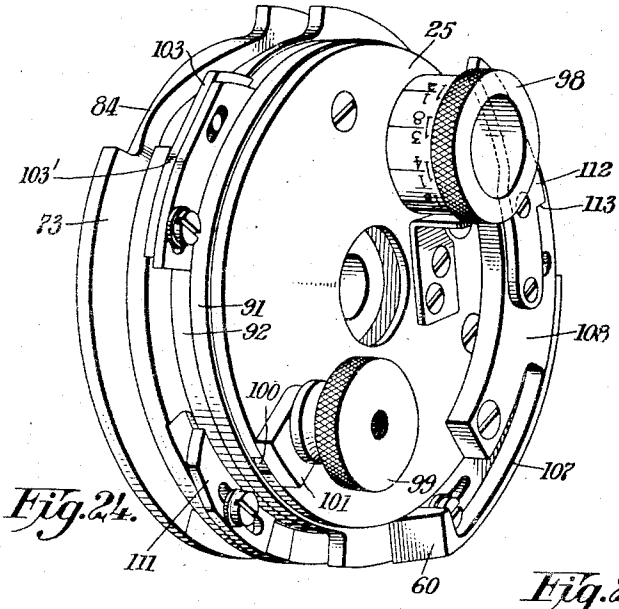

Fig. 24.

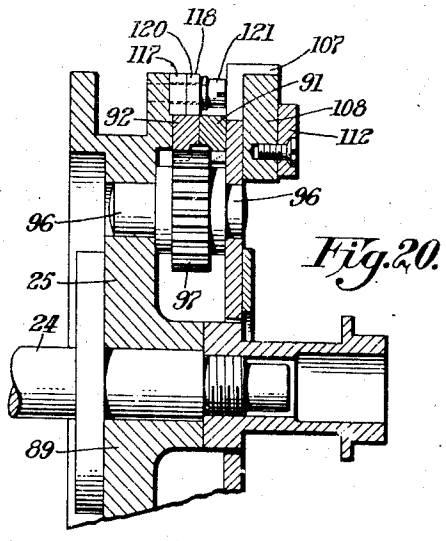

Fig. 20.

Fig. 25.

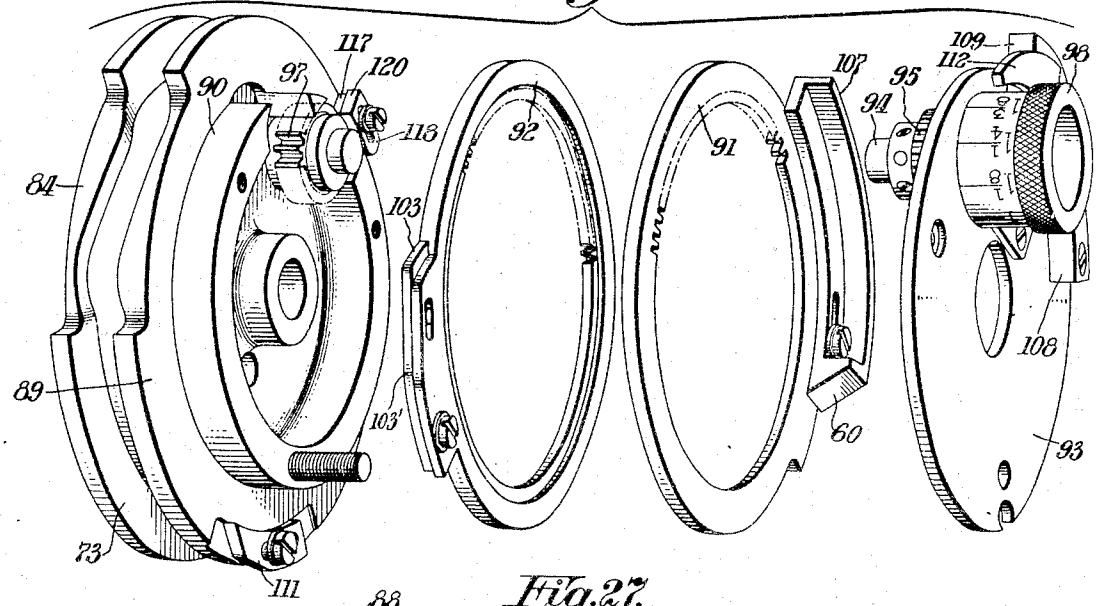

Fig. 27.

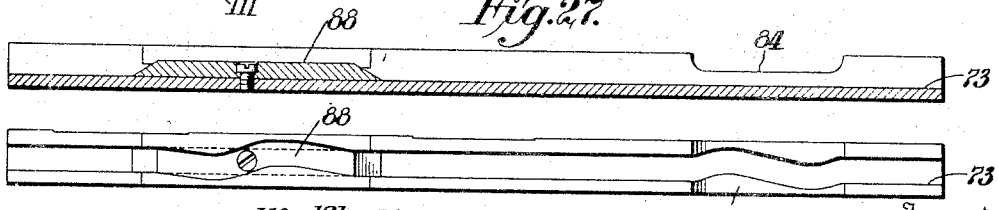

Fig. 26.

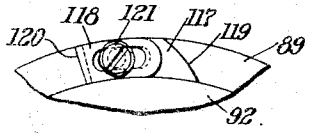

Fig. 24a

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THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

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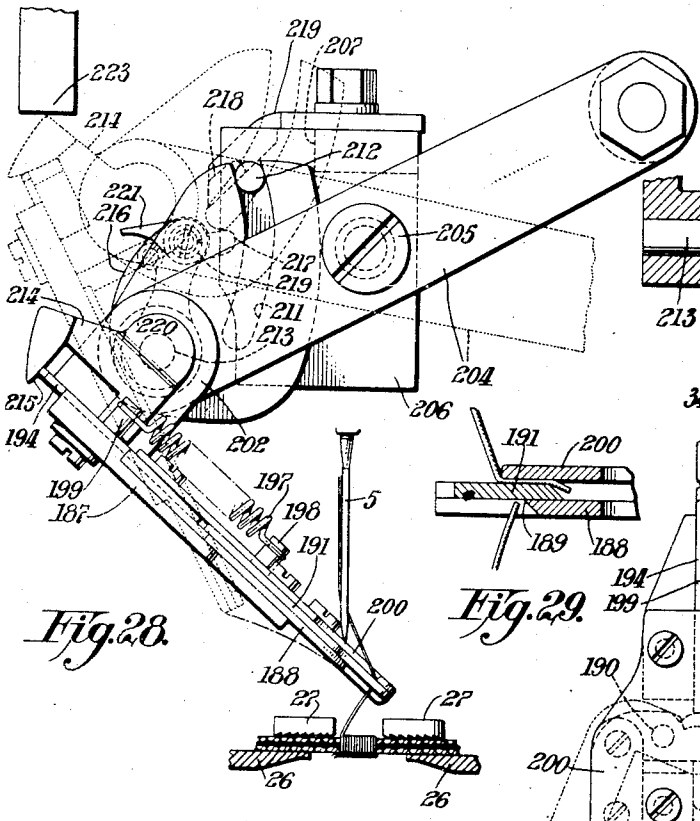

Fig. 28.

Fig. 29.

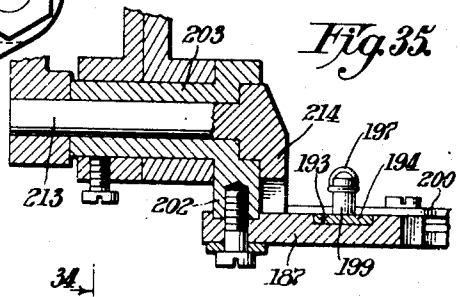

Fig. 35.

Fig. 31.

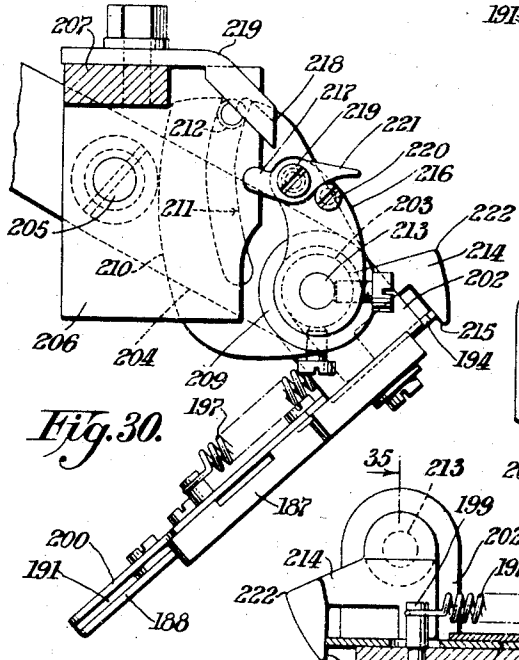

Fig. 30.

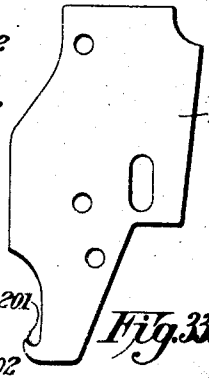

Fig. 33.

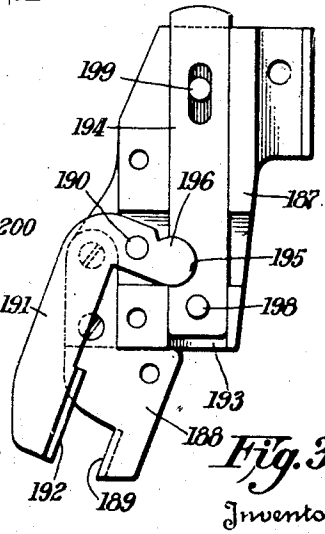

Fig. 32.

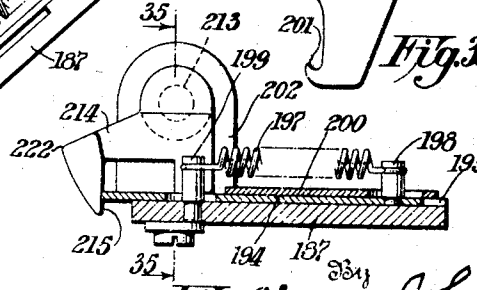

Fig. 34.

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Patented Nov. 10, 1942

2,301,798

UNITED STATES PATENT OFFICE

2,301,798

THREAD-TRIMMING MECHANISM FOR BUTTONHOLE SEWING MACHINES

Edward P. Spaine, Bridgeport, Conn., assignor to The Singer Manufacturing Company, Elizabeth, N. J., a corporation of New Jersey

Original application September 21, 1940, Serial No. 357,698. Divided and this application June 12, 1941, Serial No. 397,682

7 Claims. (Cl. 112—252)

This invention relates to buttonhole sewing machines of the adjustable automatic type which cut and sew buttonholes of variable length within the range of the machine. Such a machine is disclosed in my copending application, Serial No. 357,698, filed September 21, 1940, of which this application is a division.

The present invention has for an object to provide improved needle-thread trimming mechanism particularly adapted for an adjustable automatic buttonhole sewing machine of the above described type, which thread-trimming mechanism will cut and hold the needle-thread between sewing periods, releasing the needle thread and at the begining of a sewing operation and so controlling the needle-thread that the beginning end thereof will be drawn down flush with the work.

Another object of the invention is to provide the thread-trimmer with improved actuating mechanism to avoid clashing with the needle or parts of the work-clamp.

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.

In order to understand the construction and mode of operation of the present invention it is necessary to describe the details of construction and mode of operation of the automatic buttonhole sewing machine in which it is embodied, as set forth in my said copending application.

Of the accompanying drawings, Fig. 1 is a right side elevation of a buttonhole sewing machine embodying the invention. Fig. 2 is a detail view of the thread-cutter actuating cam mounted on the one-revolution cross rotary shaft located in the machine-bed. Fig. 3 is a left side elevation of the machine. Fig. 4 is a front end elevation of the machine with the lower plates of the work-clamp in transverse section. Fig. 5 is a rear end elevation of the machine. Fig. 6 is a diagrammatic representation of a square-bar buttonhole produced by the machine. Fig. 7 is a bottom plan view of the machine. Fig. 8 is a horizontal section through the bracket-arm standard of the machine at the level of the buttonhole cutter shaft and with the separable sections of the work-clamp removed from the machine-bed. Fig. 9 is a plan view of the stop-motion latch-tripping mechanism shown in Fig. 8, at the period of the buttonhole producing cycle when the stop-motion latch is tripped to stop the stitch-forming mechanism at the close of the return side-stitching operation on a buttonhole.

Fig. 10 shows the stop-motion latch holding the shiftable stop-motion lever in running position. Fig. 11 is a top plan view of the longitudinal feed-cam and connections actuated thereby, including the longitudinal feed uncoupling device and the auxiliary mechanism for returning the work-clamp to initial position after a buttonhole has been stitched. Fig. 12 is a disassembled perspective view of the longitudinal feed disabling connection or coupling. Fig. 13 is a section substantially on the line 13—13, Fig. 11. Fig. 14 is a section substantially on the line 14—14, Fig. 11. Fig. 15 is an inside face view of the auxiliary work-clamp return cam and follower connections which are shown in top plan in Fig. 11. Fig. 16 is an outer face view of the adjustable pattern-wheel which is mounted at the left side of the machine-bed, externally of the latter. Fig. 17 is a sectional view substantially on the line 17—17, Fig. 7. Fig. 18 is a sectional view of the pattern-wheel on the line 18—18, Fig. 16. Fig. 19 is a sectional view of the pattern-wheel on the line 19—19, Fig. 16.

Fig. 20 is a sectional view of the pattern-wheel on the line 20—20, Fig. 16. Fig. 21 is a perspective view of the removable and replaceable bar-stitch-controlling section of the lateral feed-cam in the pattern-wheel. Fig. 22 is a plan view of the back-feed and locking means for the longitudinal slide-frame of the work-clamp, taken just before the back-feed is accomplished. Fig. 23 is a similar view taken just after the back-feed is accomplished. Fig. 24 is a perspective view of the pattern-wheel, complete. Fig. 24ª is a fragmentary elevational view of the pattern-wheel showing the bar-stitch start-and-stop control segments for the stitch-forming mechanism. Fig. 25 is a disassembled perspective view of the pattern-wheel. Fig. 26 is a development of the lateral feed-cam-groove in the pattern-wheel. Fig. 27 is a central longitudinal section of the development shown in Fig. 26. Fig. 28 is an enlarged view of the needle-thread-cutting mechanism shown in Fig. 4. Fig. 29 is a transverse sectional view of the thread-cutting and thread-nipping blades of the thread-cutting mechanism.

Fig. 30 is an elevation of the thread-cutting mechanism, the reverse of that shown in full lines in Fig. 28. Fig. 31 is a top face view of the thread-cutter blade-holder, complete. Fig.

32 is a similar view of the thread-cutter blade-holder, with the cover-plate removed. Fig. 33 is a view of the cover-plate for the parts shown in Fig. 31. Fig. 34 is a section on the line 34—34, Fig. 31. Fig. 35 is a sectional view on the line 35—35, Fig. 34. Fig. 36 is a perspective view of the thread-cutter supporting bracket shown in Fig. 30, and Fig. 37 is a disassembled perspective view of the thread-cutter swing-controlling cam and associated parts, shown in Fig. 30.

The machine is constructed with a frame including the hollow box-like bed 1 from one end of which rises the standard 2 of the overhanging bracket-arm 3 terminating in the head 4.

The stitch forming mechanism is constructed substantially in accordance with the disclosure of U. S. Patent No. 1,372,473, dated March 22, 1921, and comprises the usual upper endwise reciprocatory and laterally vibratory needle 5 and under thread-looping devices including the threaded looper 6 and loop-retainer 7, which upper and under stitch-forming devices are mounted to turn about a vertical axis, as in placing the stitches radially about the eyelet-end of a buttonhole. The well known mechanism for turning the stitch-forming devices about a vertical axis is constructed substantially in accordance with the disclosure of U. S. Patent No. 1,162,207, dated November 30, 1915; No. 1,534,017, dated April 21, 1925 and said reissued Patent No. 15,324. The mechanism includes the interconnected upper and lower sector gears 8 and 9 and the stitch-rotating cam-groove 10, Fig. 7, which is cut in the under face of the main feed-wheel 11 mounted as usual in the bed 1.

The stitch-forming devices are driven as usual from the main sewing shaft 12 which receives power from the continuously running belt pulley 13 through a known form of clutch 14 controlled by the usual stop-motion lever 15 which is tiltable with its supporting rock-shaft 16 from full line or "stop sewing" position, Fig. 3, to dotted line or "running" position, to start the sewing operation. The stop-motion lever 15 is biased to "stop sewing" position by the spring 17 and, when permitted, will automatically resume its "stop sewing" position.

When the stitch-forming mechanism is being driven, the main feed-wheel 11 receives a slow step-by-step motion through the gears 18, Fig. 7, from the pin-and-star wheel device 19 which is driven by the main sewing shaft 12 in the usual manner through the bevel gears 20 and vertical shaft 21 from which the upper or needle-operating shaft 22 is driven. The main feed-wheel 11 is permanently connected by the large bevel gears 23 to the cross rotary shaft 24 in the bed 1 which cross rotary shaft carries the adjustable pattern-wheel 25 to be more particularly described.

The work-clamp is of the travelling type and is constructed substantially in accordance with said reissued Patent No. 15,324. It comprises the lower clamp-plates 26 and the upper clamp-feet 27 which are depressed into clamping engagement with the work by the connected rock-shaft sections 28, 29, Fig. 4, the former of which is connected to an arm 30, Fig. 1, adapted to be depressed by the usual clamp-closing lever 31 actuated at the beginning of a buttonhole-making cycle by a cam-groove 32, Fig. 5, in a continuously running belt-pulley 33 loose on the buttonhole cutter shaft 34. A slide-pin 35, carried by the rearwardly extending arm 36 of the clamp-closing lever 31 is permitted to enter the cam-groove 32 for one revolution of the pulley 33, whereupon it is ejected and latched in ejected position, as explained in U. S. Patent No. 1,832,665, November 17, 1931; the present clamp-closing mechanism being constructed substantially in accordance with the disclosure in said U. S. Patent No. 1,832,665.

The clamp-plates 26 are carried by the cross-slide plate 37, Fig. 8, which, in turn, is carried by the longitudinal slide-frame 38 to which travelling movements on and lengthwise of the machine-bed 1 are imparted by the longitudinal feed-cam groove 39 in the main feed-wheel 11 operating on the follower lever 40 fulcrumed at 41 on the bed 1 and connected at its free end through a disconnectible coupling device c, Fig. 12, to the longitudinal slide-frame 38.

The disconnectible coupling device c, whereby the longitudinal feed of the machine may be disabled, comprises the block 42, Fig. 12, having at one end an ear 43 by which it is pivotally connected at 44 to the free end of the lever 40. Drilled in and longitudinally of the block 42 is a hole 45' which slidably receives the pin 45 having at one end a head 46 which is pivoted at 47 to the block 48 screwed to the under side of a member of the longitudinal slide-frame 38 of the work-clamp. Journaled on the block 42 is a spring-biased rock-shaft 49 having rigidly mounted thereon a safety latch-arm 50 received in a safety recess 51 in the side of the pin 45. The rock-shaft 49 also rigidly carries a latch-arm 52 which engages behind the lug 53 on the side of the head 46 of the pin 45 when the safety latch 50 enters the notch 51. At this time the head 46 of the pin 45 is in engagement with the proximate end of the block 42 and is locked there by the latch 52. The safety notch 51 and arm 50 prevent interference between the latch 5' and lug 53 until the lug 53 reaches a position where the latch 52 is free to drop in behind it, Fig. 11. Fast to the rock-shaft 49 is the upstanding operating arm 54 which extends across the outer edge of the lever arm 55, Fig. 3, fast on the vertical rock-shaft 56 journaled in brackets 57 at the left hand side of the bed 1. The rock-shaft 56 also has fast thereto the rearwardly extending stop-motion-latch-tripping arm 58 and the forwardly extending arm 59 which is acted upon by the cam-rise 60 on the pattern-wheel 25.

The stop-motion lever 15 is, at times, latched in running position by the spring-biased latch lever 61 which is fast on the vertical rock-shaft 62 journaled at the rear end of the bed 1. The lever 61 has a notch affording a locking shoulder 63 engaged by the angle-piece 64 on the arm 65 depending from and fast on the rock-shaft 16 which carries the stop-motion lever 15. The rock-shaft 62 also carries the lever-arm 66 having a roller 67 in position to be engaged by the stop-motion latch-tripping arm 58, as shown in Figs. 9 and 10.

Means are provided to lock the longitudinal slide-frame of the work-clamp against movement on the bed 1 whenever the longitudinal-feed coupling c is disconnected. To accomplish this, there is secured to the longitudinal slide-frame 38, Fig. 9, a rearwardly extending bar 68, Figs. 9, 22 and 23, having locking notches 69 in its outside edge. The vertical rock-shaft 56 carries a stiff spring-arm 70 on which is mounted a locking tooth 71 having an inclined cam-face 72. This cam-face 72 initially engages a tooth 69', as shown in Fig. 22 and, in entering the adjoining notch 69, cams the bar 68 forward-

ly, thus imparting a small reverse movement or back-feed to the longitudinal slide-frame **38** which had been moving toward the right, Figs. 8 and 9, in sewing the return side of the buttonhole. The action of the vertical rock-shaft **56** which trips the stop-motion latch **61**, disconnects the longitudinal slide-frame from the longitudinal feed-cam, and imparts a small back-feed movement to the longitudinal slide-frame, is all brought about by the cam rise or incline **60** on the pattern-wheel at the close of the second or return side stitching operation of the buttonhole, before the barring operation.

The lateral feed motions of the work-clamp which are compounded with the longitudinal feed-motions of the work-clamp to sew around a buttonhole are, in the present machine derived from the lateral feed-cam groove **73** in the pattern-wheel **25**. The cam-groove **73** is entered by the lower end of the slide-bolt **74** which is carried by the lateral feed-lever **75** fulcrumed at **76** on the bed **1** and carrying at its forward end a block **77** which is received in the longitudinal slideway **78** in the block **79** screwed to the cross-slide plate **37**. The slide-bolt **74** is carried in the cylindrical boss **80** at the rear end of the lever **75** and has a finger-piece or pin **81** projecting laterally from it through an inverted L-shaped slot **82**, Fig. 16, in the boss **80**. When this pin **81** is turned into the vertical leg of the inverted L-shaped slot, it is depressed by the leaf-spring **83** to the lower end of such slot. In this position the slide-bolt **74** is free to ride the bottom of the lateral feed-cam groove **73** and to follow and be controlled by said cam groove even in the regions **84** where the cheeks of said groove are cut away to a certain radial extent or level. When the slide-bolt is raised to its higher level and the finger-piece **81** thereof turned into the horizontal portion of the inverted L-shaped slot **82**, Fig. 16, the slide-bolt still runs in the cam groove **73** and is controlled thereby in all regions thereof except the region **84** where the cheeks or side walls of the cam groove **73** are cut away. It is in this region that the cam groove **73** controls the lateral feed of the work-clamp in sewing around the eyelet end of the buttonhole. When it is desired to produce a straight buttonhole, that is, a buttonhole having no eyelet end, the slide-bolt is raised to its higher position, Fig. 16, so that it is not under the control of the cam-groove **73** when encountered by the cut away side-portions **84** at the eye-forming portion thereof. At this period of the cycle the travelling key **85** on the bracket **86** fastened to the longitudinal slide frame **38** enters a diametrical slot **87** in the upper end of the slide bolt **74** and locks the work-clamps against lateral displacement when out of control of the lateral feed-cam groove **73**. When in its lower position the slide bolt **74** is not encountered by the locking key **85**. Thus, by setting the slide bolt **74** in either of two positions, the machine may be made to produce either an eyelet-end or a non-eyelet-end buttonhole, at the will of the operator.

The longitudinal feed-cam groove **39** is designed to impart to the work-clamp a certain fixed overall longitudinal motion. 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 **11**, **25**, 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 adjacent the first stitch, at which point the stitch-forming mechanism is stopped. In machines of the prior art adapted to sew unbarred buttonholes of variable length it is customary at this point to throw in the rapid feed driving mechanism to effect a quick return of the work-clamp to its initial position (buttonhole cutting position). In other machines of the prior art adapted to sew taper-barred buttonholes of variable length such, for example, as the machine of U. S. Patent No. 2,190,614; February 13, 1940, the lateral feed-cam includes two barring cam-sections which are peripherally adjustable to vary the timing of their operation in the longitudinal travel of the work-clamp.

The present machine works on a different principle. Here, the lateral feed-cam has only one barring cam-section **88**, Figs. 18, 21, 26 and 27. This barring cam-section is fixed in its timing on the pattern-wheel **25**, that is, it is not peripherally adjustable on the pattern-wheel. It may, however, be removed and replaced by a similar cam-section designed to increase or decrease the number of stitches in the bar. The barring cam-section **88** is so positioned or timed on the pattern-wheel as to encounter the follower slide-bolt **74** as soon as practicable after completion of the return side stitching operation of the longest buttonhole within the range of the machine. For shorter barred buttonholes, instead of providing for a change of timing of the barring cam-section **88** by adjusting it peripherally of the pattern-wheel, it is, in the present machine, retained in a fixed position on the pattern-wheel and, when the return side stitches of the buttonhole are completed, the sewing mechanism is stopped, the work-clamp is disconnected from the longitudinal feed-cam and locked against longitudinal shift. The rapid-feed is thrown into drive the feed-cam system idly around to bar-stitch sewing position, whereupon the sewing mechanism is again started and stopped to sew the bar. After this, the rapid feed-drive is again thrown in to operate an auxiliary mechanism to return the work-clamp to its initial or buttonhole cutting position where it is reconnected to the longitudinal feed-cam in readiness for the next buttonhole-producing cycle.

In the work of the present machine, the bar is what is known as a square-bar. That is, it is sewn square across the end of the buttonhole. To accomplish this, it is preferable that the sewing mechanism be turned about its vertical axis, say 90°, between the time of completion of the last side stitch and the first bar stitch. There is thus an intimate timed relationship between the barring cam-section **88** on the pattern-wheel and the eccentric stitch-rotating portion **10'** of the stitch-rotating cam-groove **10** in the main feed-wheel **11**. This relationship is not disturbed by any adjustment of the present machine. The timing is made right for the longest buttonhole within the range of the machine and, for shorter buttonholes, the cam-system is rapidly and idly turned variable angular distances, depending

upon the length of the buttonhole, from the variable position where the sewing mechanism is stopped at the completion of the return side-stitching operation, to an invariable barring position.

The pattern-wheel 25 with which the present machine is equipped comprises a main supporting disk 89 having a large cylindrical extension 90 constituting a bearing or arbor for a pair of internally toothed rings 91, 92. These rings are held on the arbor 90 by the face-plate 93. Journaled in the coaxial holes in the disk 89 and face-plate 93 is the shaft 94 to which is fixed the pinion 95 meshing with the internal gear teeth of the outer ring 91, only, as shown in Fig. 18. Also journaled in the disk 89 and face-plate 93 are the supporting shaft extensions 96, Fig. 20, of the pinion 97 which is equal in size to and meshes with the pinion 95 and also with the internal gear-teeth of the inner ring 92 but not with the teeth of the outer ring 91. The shaft 94 is fitted with the knurled head 98 by which it may be turned to adjust the rings 91, 92 simultaneously and to equal extents in opposite directions upon and relative to the disk 89. The rings may be clamped in adjusted position by the clamp-nut 99 and pressure head 100, Fig. 19, carried by the small plate 101 under the nut 99 which is threaded upon the bolt 102 passing through the disk 89.

The inner ring 92 carries the "start-sewing" cam rise segment 103 the outer edge of which engages the follower nose 104 of the lever 105, connected by the link 106 to the lever arm 65 of the stop-motion device to shift the stop-motion lever 15 to its dotted line or running position, Fig. 3; the cam-segment 103 having a total height sufficient to shift the lever-arm 65 far enough for the shoulder 63 of the latch-lever 61 to engage the angle piece 64 and latch the stop-motion lever 15 in running position. As shown, the cam-segment 103 has a rather abrupt nose which initially engages the follower 104 and has a rise sufficient to shift the levers 65 and 15 far enough to start the sewing mechanism but not far enough to allow the latch 61 to drop into retaining position relative to the lever 65. The abrupt nose of the cam-segment 103 is followed by a more gradual rise terminating at the crest 103' which is high enough to permit engagement of the shoulder 63 of latch 61 with the angle-piece 64 on lever 65. This provides an easy motion of the parts to sewing position and relieves the parts of undue strain. The outer ring 91, Fig. 25, carries the "stop-sewing" cam 60 which trips the latch 61 at the end of the return side stitching operation. The cam 60 has an arcuate tail portion 107 which holds the follower-lever 59 and longitudinal slide-frame locking tooth 71 in the locking position, Fig. 9, until after the bar is sewn. Each of the elements 103 and 60 is peripherally adjustable upon its respective ring carrier 92 and 91, as shown in Fig. 25.

There is screwed to the face-plate 93 a segmental plate 108 which is thick enough to meet the operative edge of the tail-piece 107 of the longitudinal slide-frame locking cam 60 and hold the lock on, after the tail-piece 107 rides beyond the follower-lever 59. The segmental plate has an end shoulder 109 which finally releases the follower-lever 59 to unlock the longitudinal slide-frame and release the latch-lever 54 of the coupling device c, between the longitudinal slide-frame and the longitudinal feed-cam lever 40. This occurs in the final rapid-feed of the cam-system after the bar-sewing operation is completed.

The present machine may be adjusted to sew buttonholes with or without an eye and to sew around or to suspend sewing at the eye end. To sew a buttonhole without an eye and with sewing suspended, means are provided to stop and start the sewing operation at the eye end of the buttonhole. To this end the locking bar 68 extending rearwardly from the longitudinal slide-frame 38 is fitted at its free end with a cross slide pin 110 which may be manually shifted from inoperative position shown in full lines in Figs. 5, 8 and 9 to dotted line position, Fig. 8, where its enlarged head-end 110' is effective to engage the reduced upper end 67' of the roll 67 and trip the latch-lever 61 to release the stop-motion lever 15 and stop the stitch-forming mechanism, when the longitudinal slide-frame nears the end of its initial travelling movement. The cross slide pin 110 is mounted in a block 110a, Figs. 3 and 8, which is mounted for adjustment on and lengthwise of the longitudinal slide-frame extension bar 68, by the usual screw 110b and slot 110c expedient. Thus, the point at the end of the buttonhole where the first side stitching operation may be stopped, is variable by adjustment of the slide-pin 110 lengthwise of its carrier bar 68.

To start the sewing mechanism for the sewing of the return side of the buttonhole there is adjustably mounted on the pattern-wheel disk 89 a "start-sewing" cam-segment 111 which is in the same plane as the cam-segment 103 previously described and, like the latter, has an abrupt nose followed by a gradual rise sufficient to shift the stop-motion lever to a position where it will be retained in running position by the latch-lever 61, after the segment 111 rides beyond the follower-nose 104.

There is screwed to the thick segmental plate 108 a thinner segmental plate 112 which has a cam-incline 113 timed to engage and operate the lower horizontal leg 114 of the needle-thread tension-release lever 115 at a time in the cycle immediately after completion of the bar sewing operation and substantially simultaneous with the unlocking of the longitudinal slide-frame. The needle-thread tension-release mechanism between the lever 115 and the tension device 116 is of usual construction and is disclosed in U. S. Patent No. 2,165,016, July 4, 1939. When the machine is at rest, Fig. 3, the needle-thread tension device 116 is held released. It is restored during the initial rapid feed of the work-clamp from buttonhole cutting position to the position where sewing begins, when the machine is set to produce the longest buttonhole within its range.

To start and stop the stitch-forming mechanism for the sewing of the bar there is secured directly to the pattern-wheel body-disk 89 the segmental plates 117, 118, the former presenting the "start-bar-sewing" cam-rise 119 and the latter the "stop-bar-sewing" drop-off shoulder 120 which plates ride under and are engaged by the follower nose 104 of the stop-motion control lever 105. The outer radially coincident edges of the segmental plates 117 are not high enough to displace the stop-motion lever 65 far enough for engagement of the latch 61 with the angle-plate 64, consequently the follower-nose 104 rides the coincident circular edges of the segmental plates 117, 118 throughout the bar-sewing period and the sewing stops when the nose 104 drops off of the shoulder 120. The plates 117, 118 are secured to the body disk 89 by the screw 121 which passes

through arcuate slots in the plates 117, 118 permitting independent timing adjustments thereof. The purpose for these adjustments is to compensate for either an increase or decrease of the width of bight of the sewing, or width of buttonhole cutting space between the side stitches of the buttonhole, which changes would call for an increase or decrease in the length of the stitched bar. Also, these adjustments permit the bar to be shifted to the right or left of the buttonhole.

After the buttonhole has been completely stitched and barred, the longitudinal slide-frame 38 is unlocked by the dropping of the lever 59 off of the end shoulder 109 of the thick segmental plate 108 on the pattern-wheel 25 and it remains to shift the longitudinal slide-frame, which at this time is not coupled to the longitudinal feed-cam 39, back to initial or buttonhole cutting position. To this end there is provided an auxiliary clamp-shifting mechanism, as follows:

Cut in the inner face of the bevel gear 23 on the cross rotary shaft 24 of the cam system of the machine is the cam-slot 122, Fig. 15, entered by the follower roll 123 on the vertical lever 124 fulcrumed at 125 on the frame-bracket 126. The lever 124 is connected by the link 127 to the horizontal lever 128, Fig. 11, fulcrumed on the bearing stud 129 which supports the main feed-wheel 11 and carrying at its free end a roller stud 130 in position to engage and operate the floating intermediate lever 131 fulcrumed at 132 on the bed 1. The lever 131 floats between the roller stud 130 and the head 46 of the coupling rod 45 which pivotally carries the block 47 screwed to the longitudinal slide-frame 38. The function of the floating lever 131 is to transmit the rather sharply curved or arcuate motion of the roller-stud 130 on the lever 128 to the rectilinearly movable head 46 of the coupling rod 45 in pushing the longitudinal slide-frame back to initial position. The portion of the cam-slot 122 from *a* to *b*, Fig. 15, acts to restore the longitudinal slide-frame to initial position, while the portion from *d* to *e* is shaped to withdraw the lever 128 from the floating lever 131 fast enough to avoid blocking the advance of the longitudinal slide-frame under the influence of the longitudinal feed-cam 39 early in a buttonhole-producing cycle.

When the lever 59 is released by the pattern-wheel shoulder 109 to unlock the longitudinal slide-frame and release the latch-lever 54 from its dotted line position, Fig. 14, the rock-shaft 49 and safety latch-arm 50 immediately move under the influence of their biasing spring until the nose 50' of the lever 50 engages the cylindrical wall of the coupling rod 45 on which it rides until the rod and longitudinal slide-frame 38 are restored to initial position, whereupon the nose 50' drops into the safety-notch 51, as shown in Fig. 14, and the latch-arm 52 engages behind the lug 53 on the slide-pin head 46 and locks the latter to the block 42. This re-connects the longitudinal slide-frame 38 to the longitudinal feed-cam 39. When the machine is at rest, Fig. 11, the lever 128 and follower-roll 130, with the floating intermediate lever 131 are at one extreme position and serve to lock the longitudinal slide-frame against movement from initial position until the machine is started, whereupon the follower-roll 130 is withdrawn as above explained.

The rapid feed mechanism is called upon to operate at least three times in the buttonhole-producing cycle of the present machine; first, to rapidly shift the work-clamp from buttonhole-cutting position to a position where the sewing is to begin; second, to idly turn the feed-cam system to barring position at the close of the return side stitching operation; and third, to restore the work-clamp to buttonhole-cutting position after the bar is sewn. It may be called upon to operate to rapid feed at the eye end of a non-eyed buttonhole, in case the machine is set to stop the sewing near the end of the first side-stitching operation by setting the slide-pin 116 in its dotted line position, Fig. 8.

The rapid-feed drive of the connected feed-cam 11 and pattern-wheel 25, is accomplished by the constantly running rapid-feed drive-shaft 133 which carries a worm 134 meshing with a gear 135 fixed to the hub 136 of a live clutch element 137 loose on the cross rotary shaft 24. Within the live-clutch element 137 is a driven-clutch element 138 including the tails 139 of clutch-dog operators. When the tails 139 are expanded by the cone 140, slidable on the cross rotary shaft 24, the clutch is released and the cross rotary shaft 24 is disconnected from the rapid-feed drive-shaft 133. When the cone 140 is withdrawn from the tails 139 of the clutch-dog-operating levers, the clutch is engaged and the shaft 24 is coupled to its drive-shaft 133 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. Reissue Patent 15,324.

The clutch-operator is constituted by a cross-slide rod 141 carrying an arm 142 having at its free end a fork 143 which engages the grooved hub of the cone 140. The cross-slide rod 141 is biased by the coil-spring 144 in a direction to throw out the rapid-feed. The rod 141 is shoved endwise against the pressure of the spring 144, to throw in the rapid-feed, by the continuously reciprocating push-bar 145 which is pivoted at 146, Fig. 5, to the arm 147 of a bell-crank 148 actuated by the crank 149 the rapid-feed drive-shaft 133. The push-bar 145 is held by the latch 150 in a depressed position, Figs. 1 and 17, where it may reciprocate idly. When the latch 150 is swung over to release the push-bar 145, the latter is drawn upwardly by its spring 151, effecting engagement of the stud-pin 152 on the cross-slide shaft 141 by the shoulder 153 on the push-bar 145 which thereupon shoves the cross-slide shaft 141 to its extreme rapid-feed throw-in position in which it is retained by engagement of the shoulder 154 on the latch-lever 155 by the lower edge of the plate 156 on the hub of the forked arm 142.

The latch 150 is engaged by a lever-arm 157 on the rock-shaft 158 which is journaled in the bed 1 and has rigidly connected to it two arms 159, 160 by means of which it may be operated to throw in the rapid-feed. The first mentioned arm 159 carries a spring-pressed tripping tooth 161 which is engaged and depressed by the pin 162 on the downwardly extending arm 163 of the three-armed clamp-closing lever 31, 36, 163, 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 33 loose on the buttonhole-cutter shaft 34, previously referred to. The second mentioned arm 160 of the rock-shaft 158 is actuated to throw in the rapid-feed by the toothed lever 164 which engages the arm 160 whenever the stop-motion lever 15 acts to stop the sewing operation. The actuating mechanism for the toothed lever is the same as that disclosed

in U. S. Patent No. 1,504,306, of August 12, 1924.

The throw-out of the rapid feed is accomplished by tripping the latch-lever 155 to release the spring-biased clutch-operator slide-rod 141. The latch-lever 155, Figs. 5 and 17, has an extension 165 which enters the forked end 166 of a lever 167 fulcrumed at 168 on the inner wall of the bed 1. The lever 167 has a free end portion 169 which is in position to be engaged by the rapid-feed throw-out tooth 170 fixed on the inner face of the pattern-wheel 25. The tooth 170 is the tooth which throws out the final rapid-feed action after the work-clamp has been restored to buttonhole-cutting position at the close of a buttonhole-producing cycle. All of the rapid-feed actions in the present machine which precede this final rapid-feed action are terminated by the shift of the stop-motion control link 106 through the usual mechanism disclosed in U. S. Patent No. 2,190,614, February 13, 1940. Such mechanism includes the upstanding link-actuated lever 171, Fig. 17, fulcrumed on the screw 168 and having a lateral extension 172 which bears upon the thrust-bar 173 which is fulcrumed at 174 between the spaced ears 175 rigid with the lever 167. Further details of this known mechanism are fully disclosed in said U. S. Patent No. 2,190,614 and need not be more particularly described herein. It will suffice to explain that every time the link 106 is shifted endwise to start the sewing mechanism, the immediately preceding rapid-feed action is automatically thrown-out by action of the lever 171 on the lever 167 through the thrust-bar 173. This automatically takes care of (1) the discontinuance of the initial rapid feed of the work-clamp from starting position to the position where the sewing is to begin; (2) the discontinuance of the rapid feed at the eye-end of the buttonhole when the machine is set to sew a non-eyed buttonhole and the sewing is stopped and started at such end to avoid overcrowding of the stitches; and (3) the discontinuance of the rapid-feed action between the return side stitching operation and the bar stitching operation. The final rapid-feed action is, as before explained, terminated by action of the tooth 170 on the lever 167.

The machine has a conventional under thread tension-device 176, Fig. 4, and spring-biased tension-release lever 177 fulcrumed at 178 on the bed-frame and carrying two spaced pins 179 between which extends the arm 180 of a rock-shaft 181 extending with and lengthwise of the bed 1 and through the rear end wall of the latter where it carries the arm 182 that is acted upon by the inclined face 183 of a block 184 carried at the lower end of the stop-motion operating lever 65. The mechanism functions to release the under thread tension when the stop-motion device functions to stop the stitch-forming mechanism. The mechanism is fully disclosed in U. S. Patent No. 2,210,638; granted August 5, 1940.

The machine has the conventional buttonhole-cutting mechanism including the coacting upper and lower cutter levers 185, 186, Fig. 1, which are driven in the usual manner by the one-rotation buttonhole-cutter shaft 34. While the present machine is designed to cut the buttonhole after sewing, it is entirely immaterial to the invention whether the buttonhole is cut before or after sewing.

The machine is provided with the following means to cut and hold the needle-thread. The thread-cutting and -nipping implement comprises a thick plate-like body-member 187 on which is rigidly mounted a thin fixed blade 188 having a shear cutting edge 189. Fulcrumed on the pin 190 is the movable blade 191 having a shear cutting edge 192 complemental to the fixed shear cutting edge 189. The body-member 187 has a slideway 193 cut longitudinally thereof and in this slideway is located the slide-bar 194 having in one edge a semi-circular recess 195 for the circular end 196 of the movable blade 191. A biasing spring 197 connects a pin 198 on the slide-bar 194 to a fixed pin 199 on the body-plate 187. This spring urges the movable cutter to close to full line position, Figs. 29 and 31. A cover-plate 200, having a hook 201 at its lower end, is screwed to the body-plate 187 to hold the slide-bar and movable cutter-blade in their respective ways in the body plate 187. From the foregoing it will be apparent that a push at the end of the bar 194 remote from the shear cutters will open the latter and when such a push is relieved the cutters will close and sever the thread, at the same time nipping the needle end of the thread between the movable blade 191 and the cover-plate 200.

The body-plate 187 and parts carried thereby is screwed to the head 202 of a tubular shaft 203 which is journaled in a bearing support at one end of a carrier lever 204 fulcrumed at 205 on the vertical arm 206 of a bracket 207 pinned to the lower end of the stationary fulcrum stud 208 of the upper stitch-rotating sector gear 8. Fast to the tubular shaft 203 is the hub 209 of a cam-plate 210 having a curved cam-slot 211 therein that receives a roller-stud 212 on the vertical arm 206 of the bracket 207. The cam-slot 211 and stud 212 serve to impart a limited rocking movement to the thread-cutter implement on the axis of its tubular fulcrum shaft 203 relative to its carrier-lever 204, when such carrier-lever is operated to advance the thread-cutter implement from retracted position (dotted lines Fig. 28) to thread-cutting position (full lines Fig. 28).

Journaled in the tubular fulcrum shaft 203 is a rock-shaft 213 having at one end a tappet arm 214 the toe end 215 of which is so positioned as to engage and push upon the end of the slide-bar 194 to open the thread-cutter blade 191. The rock-shaft 213 has fixed to its opposite end a crank-arm 216 carrying at its free end the pivoted and spring-biased toe-piece 217 which, in the cutter-advancing movement of the carrier-lever 204 engages the cam-piece 218 of the arm 219 fixed to the bracket 207. This engagement of the toe-piece 217 with the cam-piece 218 rocks the shaft 213 in the tubular shaft 203 and causes the tappet toe 215 to push in the slide-bar 194 and open the cutter-blade 191. As soon as the toe-piece 217 passes beyond the cam-piece 218 the slide-bar 194 is released and drawn by its spring 197 to close the blades 191, 188, 200 upon the needle-thread, as shown in Fig. 28. In the return movement of the carrier-lever 204, the top-piece 217 wipes idly past the cam-piece 218, being free to swing on its pivot-screw 219 in this direction. The stop-screw 220, which is engaged by the tail 221 of the toe-piece 217, prevents swinging of the toe-piece 217 in the reverse direction when the thread-cutter is advanced to full line position, Fig. 28.

When the thread-cutter is retracted after cutting and nipping the end of needle thread leading to the needle 5, the heel 222 of the tappet-arm 214 is brought into engagement with the stationary abutment 223 vertically adjustably mounted on the bracket-arm head 4 of the machine frame. The initial engagement of the heel

222 with the abutment 223 is a mere contact, not sufficient to cause the tappet-arm 214 to open the thread-nipper blade 191. A slight further retraction of the carrier-lever 204, before the initial stitch of the next buttonhole is made, opens the blade 191 and releases the beginning end of the needle-thread.

The carrier-lever 204 is connected by the link 224, Figs. 4 and 1, to a lever 225 fulcrumed at 226 to the bracket 227 fast to the under side of the frame-arm 3. The lever 225 is connected by the link 228 to the crooked lever 229 which is screwed to a lower lever-arm 230 fulcrumed at 230' within the standard 2 and having at its lower end a roller 231 tracking the cam 232 on the cross rotary shaft 24. The spring 233, Fig. 1, applied to the lever 229 retains the follower-roll 231 against the cam 232. The cam 232 has a let off notch 234 which releases the lever 229 and allows the thread-cutter to advance and cut and seize the needle-thread during the final rapid-feed movement of the cross rotary shaft 24. The cam 232 also has a slight rise at 235 to effect the release of the beginning end of needle-thread before the needle starts down on its first stitch. This release rise terminates at the point 236, Fig. 2.

To pull sufficient slack needle-thread from the supply for the beginning of the sewing operation, there is secured to the clamp-closing lever 31, Fig. 1, a pull-off rod 237 which rises through the guide 238 and has at its upper end a horizontal portion 239, Fig. 3, working between two stationary thread-guides 240. At the time the clamp-closing lever 31 operates, the needle-thread tension is held open by the lever 115 and tail of the tension-release segment 112 on the pattern-wheel 25. The pull-off is adjusted to measure enough needle-thread from the supply so that the beginning end of needle-thread will be drawn down flush with the work by the stitch-forming instrumentalities.

The usual gimp or cord G is supplied to the needle-throat member 241 through a gimp pull-off and slack-giving device including the gimp-tension device 242 which is carried by the lever 243, Fig. 1, actuated by the cross-rotary shaft 24, substantially in accordance with the disclosure of U. S. Patent No. 2,210,638, granted August 6, 1940.

Operation

The operation is briefly as follows: At the start of the operation the tripping of the clamp-closing mechanism causes the actuation of the three-armed clamp-closing lever 31, 36, 163 which closes the work-clamp and actuates the needle-thread pull-off 239. The thread trimmer is in retracted position and is closed. The recovery motion of the clamp-closing lever causes the stud-pin 162 to engage and operate the lever 159 to trip the rapid-feed into action to shift the work-clamp from initial position to the position where sewing is to begin. In that shift of the work-clamp the thread-trimmer is further retracted to cause the stationary abutment 223 to release the needle-thread end. The pattern-wheel cam-rise 103 starts the sewing mechanism; the stop-motion lever being latched in running position. The sewing starts at the point *s*, Fig. 6, and continues to and around the eyelet-end *t* to the point *u* which is a little short of the starting point *s* measured lengthwise of the buttonhole. When the end point *u* is reached the stitch-forming mechanism is stopped and the longitudinal slide-frame of the work-clamp is uncoupled from the longitudinal feed-cam and given a slight reverse feed movement by the inclined face 72 of the locking pin 71 which locks the longitudinal slide-frame in barring position. The action of the stop-motion causes the pawl 164, Fig. 1, to trip the rapid feed into operation to feed the cam system idly around to a constant barring position just previous to which the stitch-forming mechanism is preferably turned around its vertical axis to bar-stitching position.

The cam rise 119 on the pattern-wheel starts the bar-sewing operation which proceeds from the point *v*, Fig. 6, square across the end of the buttonhole to the point *w*. It will be noted that the bar overlaps the end stitches at both sides of the buttonhole. When the bar is completed the drop-off shoulder 120 on the pattern-wheel releases the stop-motion lever 15 which returns to stopping position to stop the sewing mechanism. The stop-motion operation again throws in the rapid-feed mechanism which returns the work-clamp to buttonhole-cutting position for the buttonhole-cutting operation. The thread is cut after the bar is completed and before the work-clamp is shifted out of barring position.

When the machine is at rest, the thread-cutter is in its retracted position closed upon the end of needle-thread running to the needle. When the machine is started, the pull-off is operated by the clamp-closing lever to pull a constant amount of thread from the supply so that the initial thread end will be drawn down flush with the work in the formation of the first stitch. During the initial rapid feed movement of the cross-rotary shaft 24, before the sewing starts, the thread-cutter is further retracted by the rise 235 on cam 232 sufficiently to release the needle-thread end. This occurs before the work-clamp is moved away from initial position. The machine now sews and bars the buttonhole. Early in the final rapid feed, after barring, the thread-cutter is advanced and closed upon the needle-thread. The tension is released by the cam incline 113 on pattern-wheel segmental plate 112. During reverse rotation of stitch-forming mechanism and return movement of work-clamp to initial position, the closed thread-cutter is retracted to initial position and it pulls a constant length of thread downwardly through eye of needle for any length buttonhole the machine may be set to produce, to begin the next sewing operation and secure uniformity in the final hidden disposition of the beginning end of needle-thread flush with the work.

The present thread-trimmer is mounted to operate in a fixed path with respect to the sewing needle while the work-clamp is locked in barring position regardless of the length of the buttonhole within the range of the machine.

The compound motion of the thread-trimmer, shown by the upwardly convex curved dot-and-dash line in Fig. 28, carries the trimmer over the top of the clamp-foot 27 and thence downwardly to clear the needle-point by a sufficient margin.

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

1. A buttonhole sewing machine having stitch-forming mechanism including an upper endwise reciprocatory needle, a work-holder, feeding mechanism to relatively move the stitch-forming mechanism and work-holder into and out of sewing relation and to sew about a buttonhole, a stop-motion device for the stitch-forming mechanism adjustable to vary the times of starting and

stopping of the stitch-forming mechanism, whereby buttonholes of various lengths may be sewn, a thread-trimmer mounted at the needle side of the work independently of the work-holder, and means to actuate said thread-trimmer at the close of a sewing period and before the stitch-forming mechanism and work-holder are relatively shifted out of sewing relation.

2. In a buttonhole sewing machine, the combination with stitch-forming mechanism including an upper thread-carrying needle and complemental under thread mechanism, work-holding means, feeding mechanism including feed-cams and connections for relatively moving the stitch-forming mechanism and work-holding means to sew about a buttonhole, a rapid feed drive including a cross rotary shaft journaled in the machine bed and connected to said feed-cams for driving the latter between sewing periods, a needle-thread trimmer mounted above the work-holding means, and a cam on said cross rotary shaft and connections for operating said needle-thread trimmer.

3. In a sewing machine, a frame including a bed and an overhanging bracket-arm, a lever fulcrumed on said bracket-arm, a thread-cutter comprising a complete scissors device mounted for pivotal movement on and relative to said lever, a cam for controlling said pivotal movement, and means to actuate said lever to advance said thread-cutter from a retracted position to a thread-severing position.

4. In a sewing machine, a frame including a bed and an overhanging bracket-arm, a lever fulcrumed on said bracket-arm, a thread-cutter comprising a complete scissors device mounted for pivotal movement on and relative to said lever, a cam for controlling said pivotal movement, and means to actuate said lever to advance said thread-cutter from a retracted position to a thread-severing position, and means to open and close said scissors device in the advancing movement of the latter.

5. A buttonhole sewing machine having stitch-forming mechanism including a reciprocatory eye-pointed needle and complemental under thread mechanism, a stop-motion device for the stitch-forming mechanism, a tension device for the needle-thread, an antomatic tension releaser, a needle thread cutter and nipper mounted at the needle side of the work for bodily movement from retracted position to thread-cutting and -nipping position and return, an automatic needle-thread pull-off device operative on the needle-thread before it is released by said nipper, and means to effect the release of the needle-thread by said nipper before the needle descends on the first stroke of a sewing period.

6. In a sewing machine, a thread-carrying needle, a needle thread-cutter and -nipper, a carrier therefor, means to actuate said carrier to advance said thread-cutter and -nipper from a retracted position to needle-thread-cutting and -nipping position and return, means to impart a further retractive movement to said thread-cutter and -nipper, and an abutment engaged by said thread-cutter and -nipper in its further retractive movement and operative to open said nipper and release the needle-thread end.

7. A buttonhole sewing machine having stitch-forming mechanism including an upper endwise reciprocatory needle, a work-holder, feeding mechanism to relatively move the stitch-forming mechanism and work-holder into and out of sewing relation and to sew about a buttonhole, a stop-motion device for the stitch-forming mechanism adjustable to vary the times of starting and stopping of the stitch-forming mechanism, whereby buttonholes of various lengths may be sewn, a combined thread-trimmer and thread-end-holder mounted at the needle side of the work independently of the work-holder, means to advance said thread-trimmer and thread-end-holder and to close the same on the thread leading from the needle-eye to the last stitch at the end of a sewing period before the stitch-forming mechanism and work-holder are relatively shifted out of sewing relation, and means to withdraw said closed thread-trimmer and thread-end-holder to a constant retracted position to pull a constant length of needle-thread downwardly through the eye of the needle for buttonholes of any length the machine may be set to produce.

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