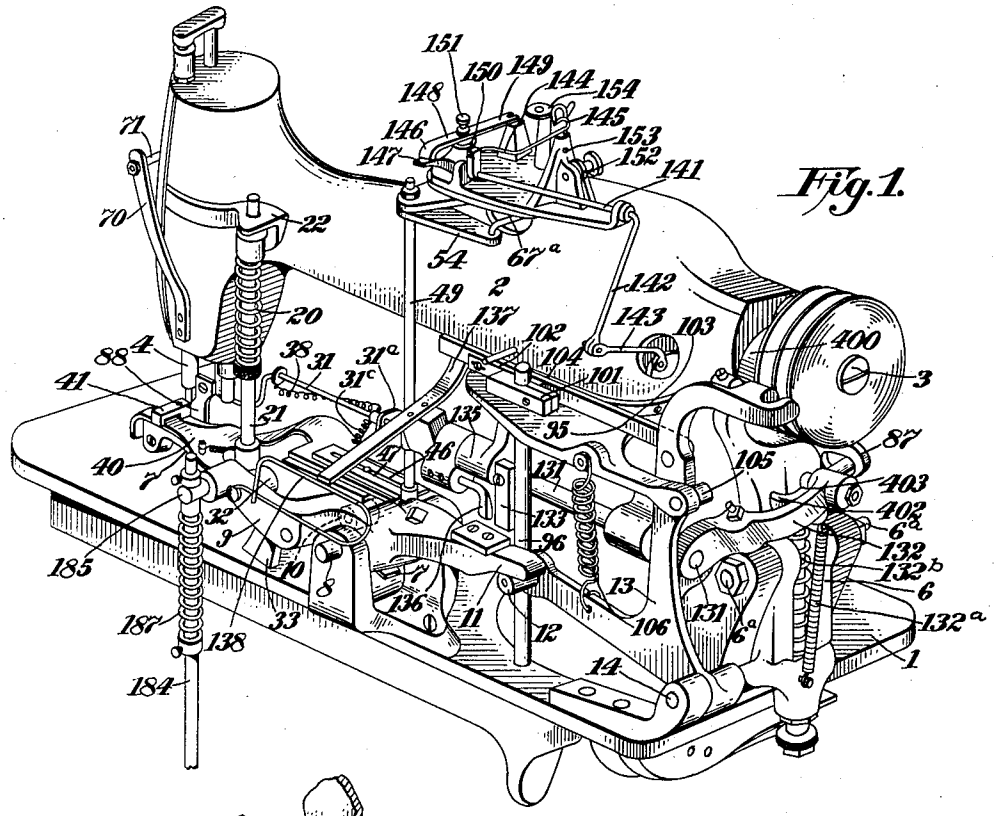
June 12, 1934. H. C. MILLER 1,962,905

BUTTONHOLE SEWING MACHINE

Original Filed April 25, 1931 9 Sheets-Sheet 1



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BUTTONHOLE SEWING MACHINE

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Fig. 2.

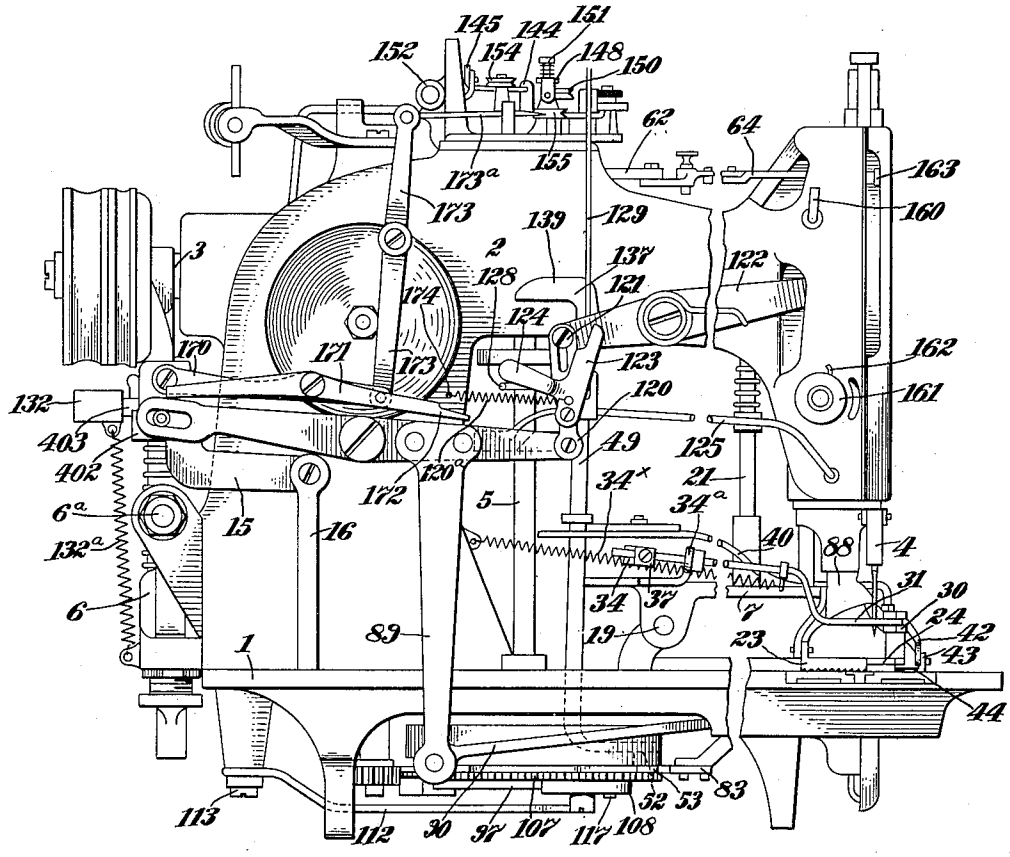


Fig. 14.

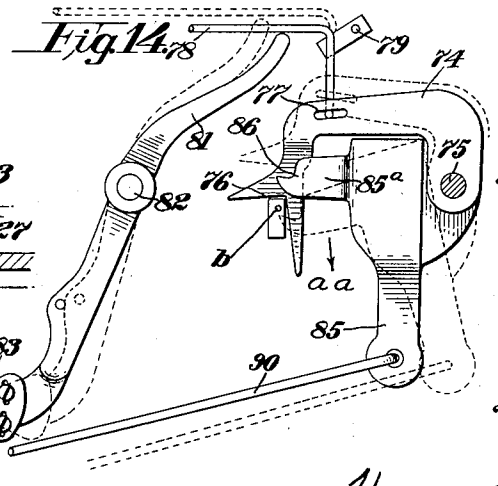


Fig. 15.

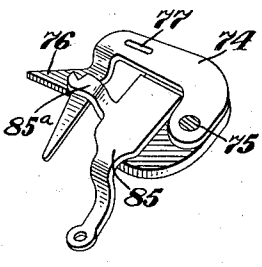
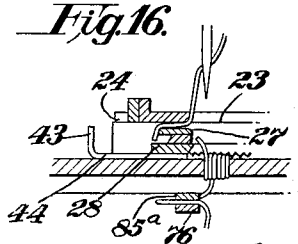


Fig. 16.



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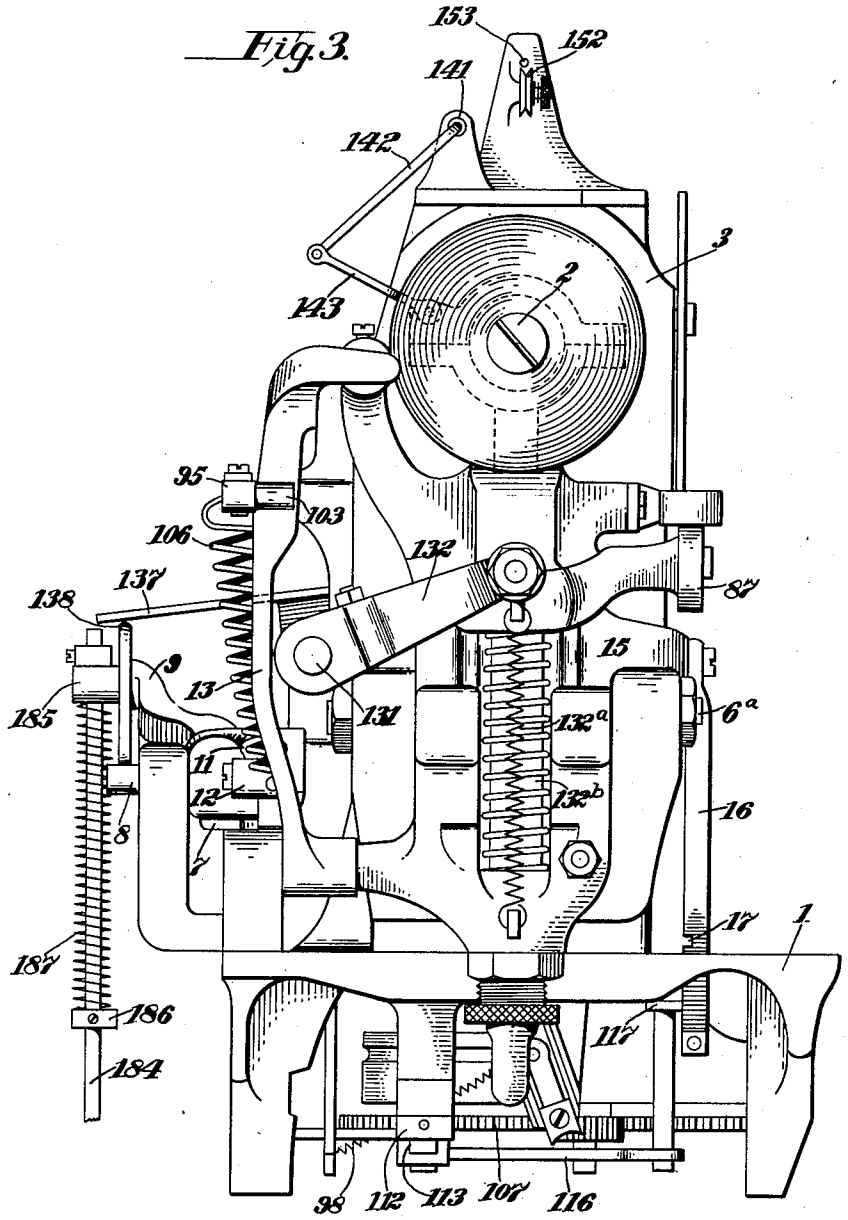
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BUTTONHOLE SEWING MACHINE

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Fig. 3.



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BUTTONHOLE SEWING MACHINE

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Fig. 4.

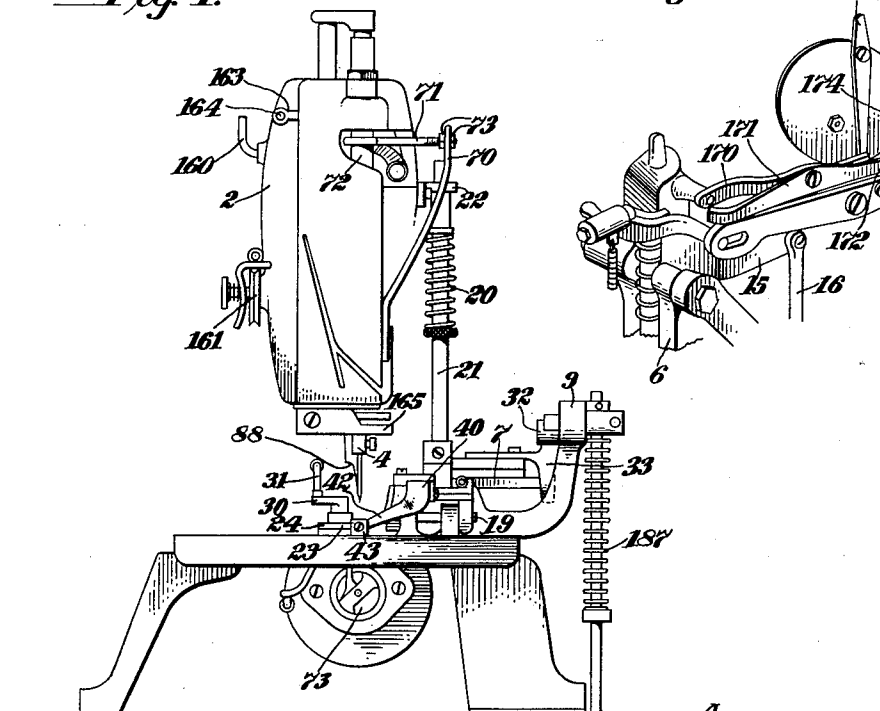
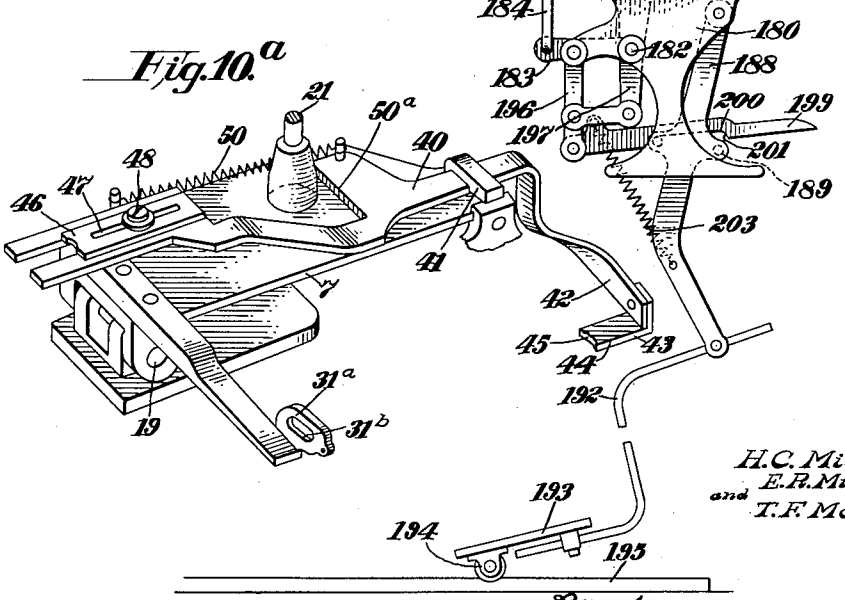


Fig. 7.

Fig. 10a.



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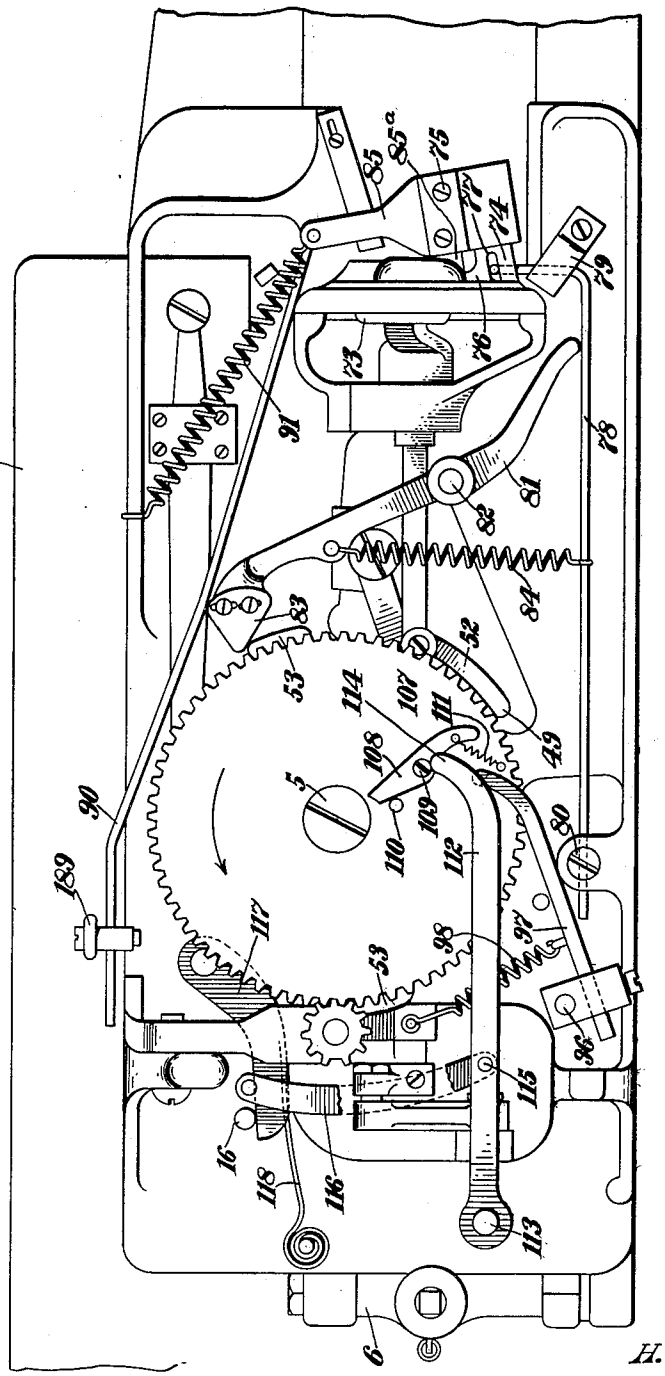


Fig. 5.

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Fig. 8.

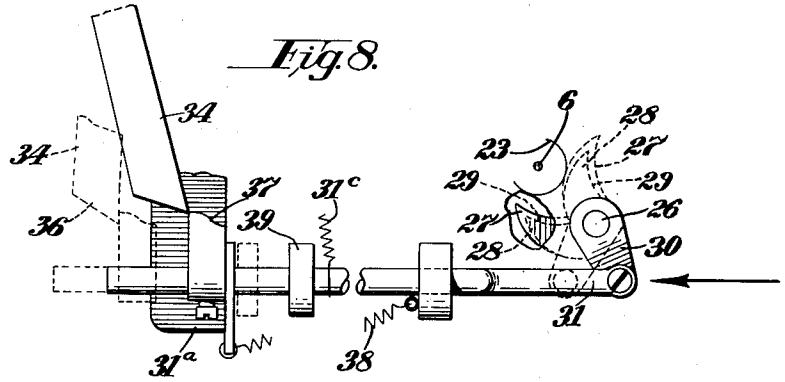


Fig. 9.

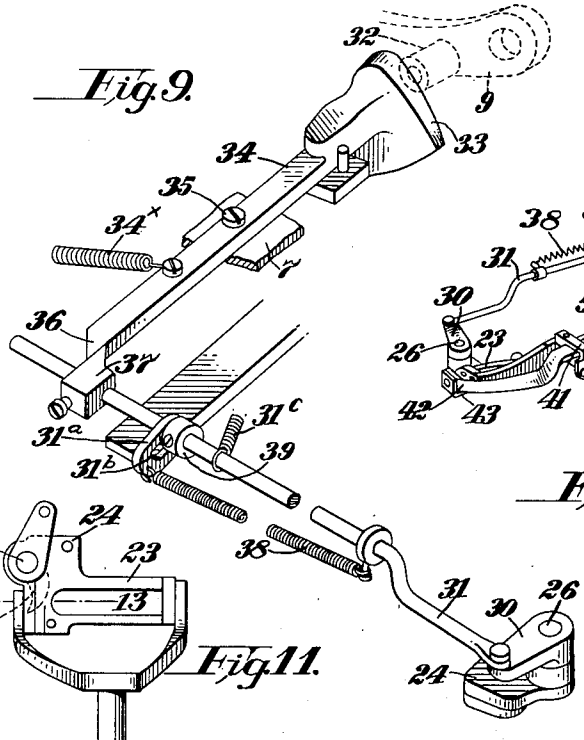


Fig. 10.

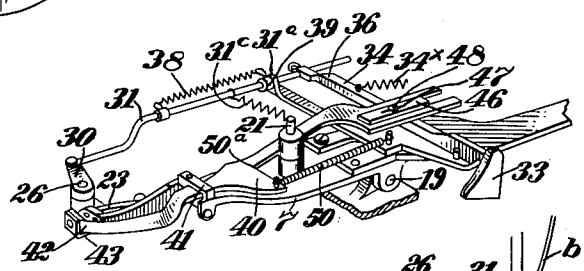


Fig. 11.

Fig. 12.

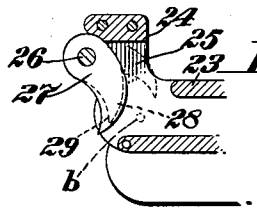
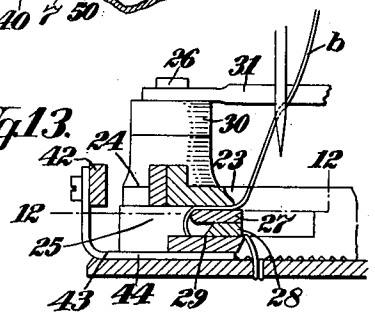


Fig. 13.



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BUTTONHOLE SEWING MACHINE

Original Filed April 25, 1931 9 Sheets-Sheet 7

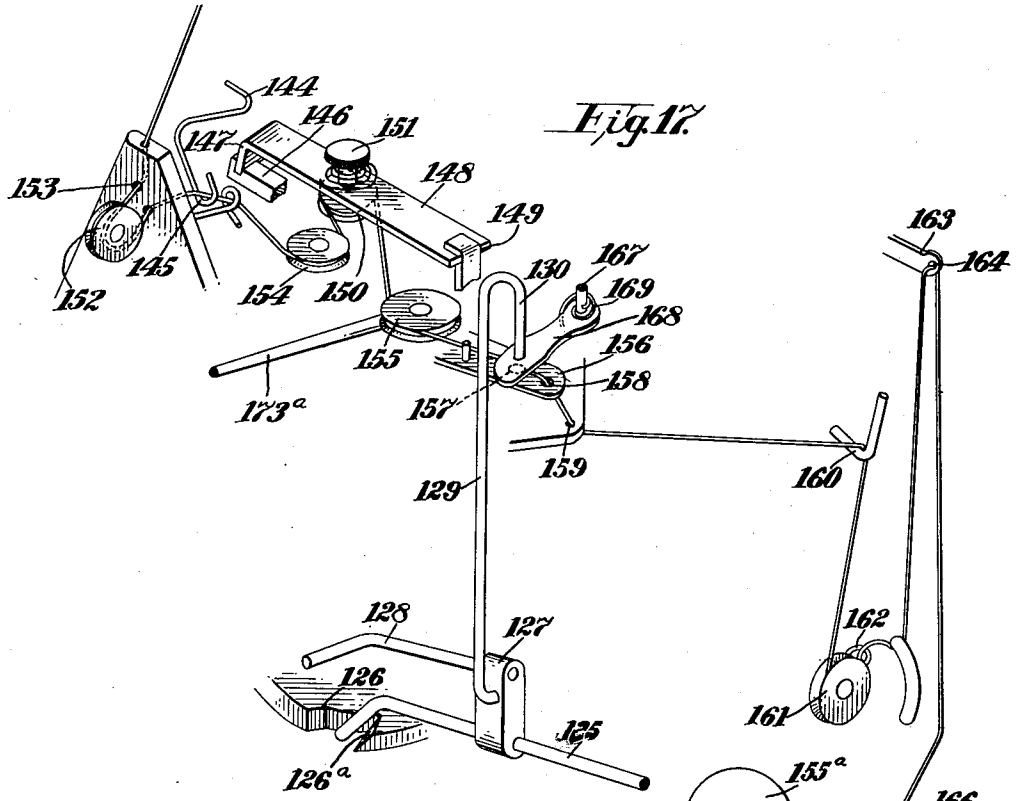


Fig. 17.

Fig. 20.

Fig. 18.

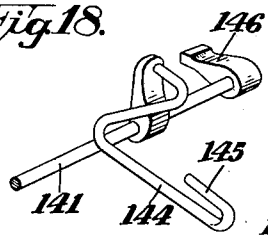


Fig. 21.

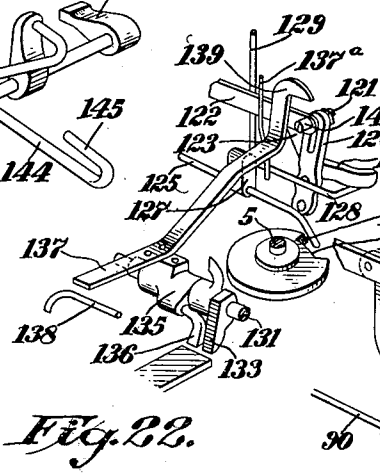


Fig. 22.

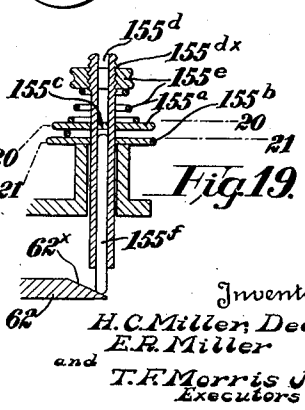


Fig. 19.

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BUTTONHOLE SEWING MACHINE

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Fig. 23.

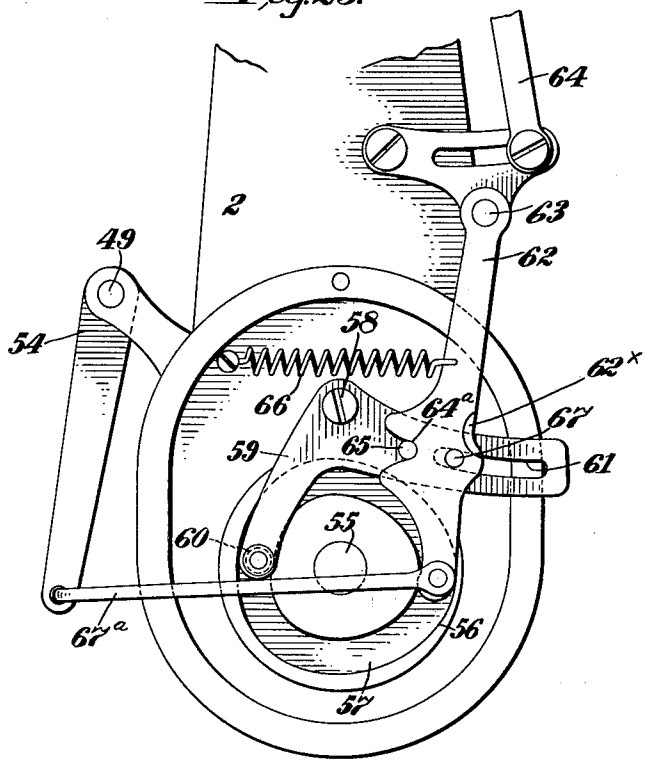
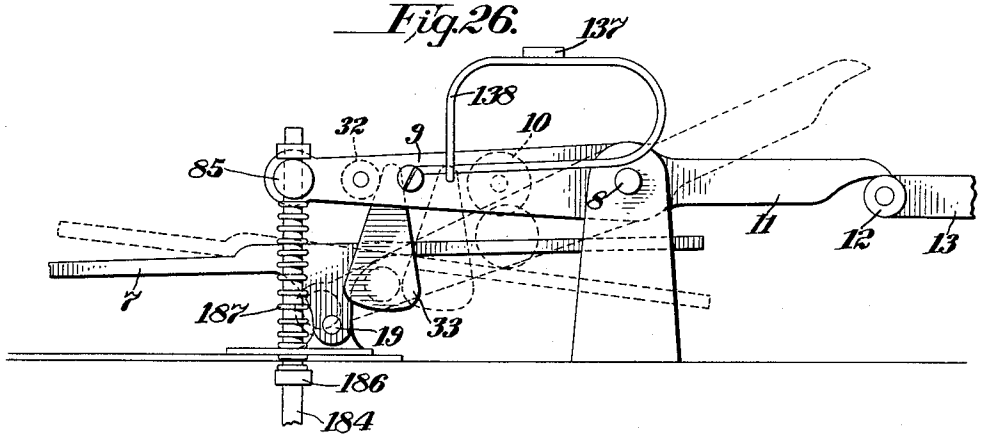


Fig. 26.



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BUTTONHOLE SEWING MACHINE

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Fig. 25.

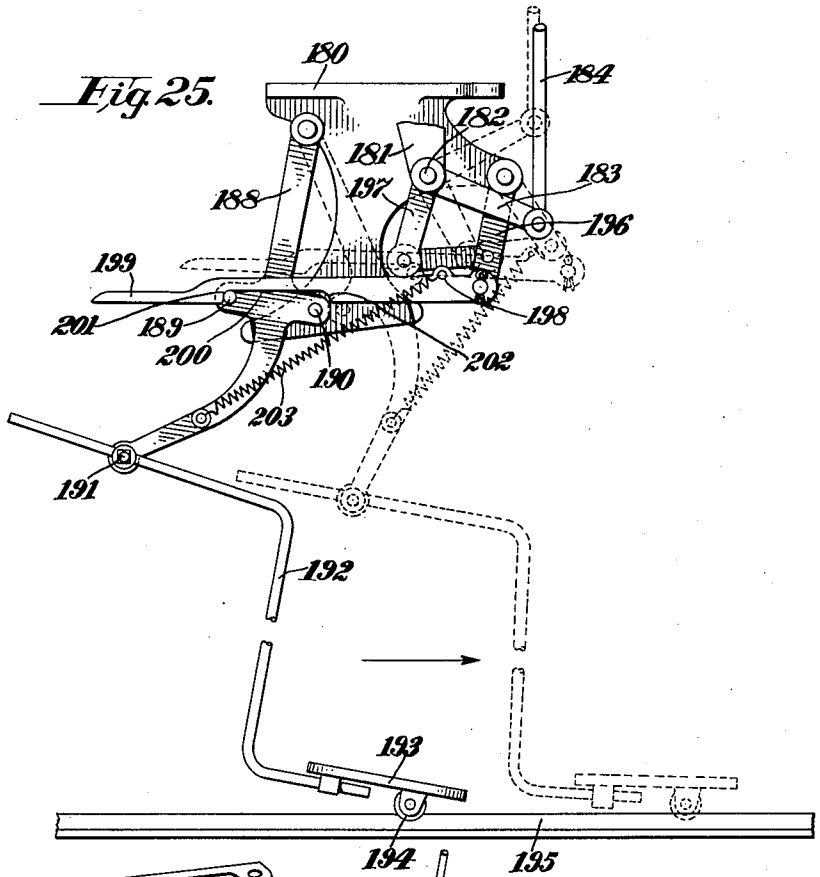
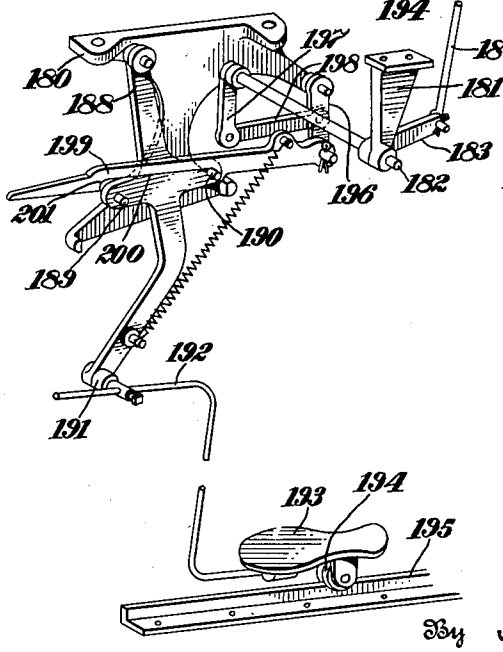


Fig. 24.



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Patented June 12, 1934 1,962,905

UNITED STATES PATENT OFFICE

1,962,905

BUTTONHOLE SEWING MACHINE

Henry C. Miller, deceased, late of Waterford, N. Y., by Elizabeth R. Miller and Thomas F. Morris, Jr., executors, Waterford, N. Y., assignors to The Singer Manufacturing Company, a corporation of New Jersey

Original application April 25, 1931, Serial No. 532,914. Divided and this application May 27, 1933, Serial No. 673,182

7 Claims. (Cl. 112—252)

This invention relates to improvements in buttonhole sewing machines.

An object of the invention is to provide improved means for holding and severing the upper and lower threads.

A further object of the invention is to provide means for laying in the short cut end of the upper or needle thread to be subsequently worked over and held in by the last barring stitches.

The invention also relates to improvements in the details of construction and arrangement of parts as will be hereinafter described and particularly pointed out in the claims.

This application is a division of application Serial No. 532,914, filed April 25, 1931.

In the drawings:

Fig. 1 is a perspective view of a buttonhole sewing machine showing the application of the improvements.

Fig. 2 is a front elevation of the buttonhole sewing machine.

Fig. 3 is an end view.

Fig. 4 is a view from the opposite end.

Fig. 5 is a bottom plan view.

Fig. 6 is a detail perspective view of the belt shifting lever and associated parts, and the stop motion lock.

Fig. 7 is a detail view of the connections associated with the stop motion device for operating the cutting blade.

Fig. 8 is a detail plan view of the connection for operating the upper thread holding and cutting mechanism.

Fig. 9 is a detail perspective view of the same.

Figs. 10 and 10*a* are detail perspective views of the cloth clamp and the connections mounted thereon.

Fig. 11 is a detail plan view of the presser foot.

Fig. 12 is a detail horizontal section of the same on the line 12—12 of Fig. 13.

Fig. 13 is a detail transverse section on the line 13—13 of Fig. 11, the parts being shown somewhat enlarged to illustrate the parts.

Fig. 14 is a detail top plan view of the lower thread holding and cutting mechanism showing the parts in full line position after having operated to cut and hold the thread, and also showing in dotted lines the movements of the lever and plate.

Fig. 15 is a detailed perspective view of the same but showing the parts in open position to receive the lower thread.

Fig. 16 is a detail diagrammatic section illustrating the position of the upper and lower thread cutting and thread holding mechanisms and the ejector for releasing the upper thread.

Fig. 17 is a diagrammatic view illustrating the various tension devices and the course of the upper thread from the source of supply to the needle.

Fig. 18 is a detail view of the connection for operating the upper thread slackening device.

Fig. 19 is a detail section of one of the tensioning devices.

Fig. 20 is a section of same on the lines 20—20 of Fig. 19.

Fig. 21 is a similar view taken on the line 21—21 of Fig. 19.

Fig. 22 is a detail perspective view of the cutting blade interponent and associated parts.

Fig. 23 is a detail plan view of the gate operating mechanism.

Fig. 24 is a detail perspective view of the treadle mechanism, showing the parts in neutral or normal position.

Fig. 25 is a detail elevation of the treadle mechanism showing the parts in full lines in one extreme position, and in dotted lines in its other extreme position.

Fig. 26 is a detail in elevation of the starting lever, showing its normal position in full lines, and its operative position to raise the cloth clamp in dotted lines.

To illustrate the invention, the improvements are shown and described in connection with a well known type of "Singer" buttonhole machine. Therefore, it will be necessary to refer in a general way to certain well recognized features in this type of machine, to fully understand and comprehend the construction and operation of the improvements about to be described.

1 indicates the base, 2 the arm or head, 3 the power shaft, 4 the needle bar, 5 a cam shaft carrying the usual cam disc operatively connected with the power shaft, 6 the stop motion device, and 7 the cloth clamp. The essential features of the stop motion device are substantially the same as that disclosed in the patent to Miller, No. 1,438,848, dated December 12, 1922, but the connections associated therewith have been materially changed to perform new functions, as will later appear.

Mounted on the base 1 is a shaft 8, on which is supported a starting lever 9 having an extension 11. On the inside of the starting lever 9 is a roller 10 which cooperates with the cloth clamp 7 to raise the latter. The free end of the extension 11 lies over a roller 12 on a belt shifting lever 13 mounted on a stud 14 and positioned to

engage, but not connected with, the upper end of the stop motion device 6.

Extending from the opposite side of the stop motion device is an arm 15, to which is pivoted a rod 16, provided with a notch 17, Fig. 3.

The cloth clamp 7 is of conventional type and is pivoted at 19 on the usual step by step feeding mechanism, and is held in operative position by a spring 20, mounted on a rod 21 slidably and tiltably supported at its upper end in a bearing 22 on the body of the machine; the lower end of the rod being tiltably supported on the top of the clamp and moving therewith. It is to be noted that the rod carrying the spring 20 does not extend through the clamp to the base, so that the space to receive the cloth extends back as far as the clamp mounting. Thus, the cloth can be operated upon a greater distance from the edge thereof than is possible when the rod is mounted on the base. The forward end of the cloth clamp has secured to it the usual presser foot 23 to engage the cloth. On one end of the presser foot 23 is an extension 24 and under the same, and in the end of the presser foot, is a horizontal recess 25. Mounted on a shaft 26 mounted in the extension 24 are two substantially hook-shaped blades 27 and 28, one 27 serving to pull the upper thread into the recess 25, and the other 28 serving as a knife to sever the thread, the blades cooperating respectively with the upper and lower walls of the recess 25. The cutting edge 29 of the blade 28 is set back from the edge of the blade 27 so that when the blades are turned into the recess, the upper blade 27 will first engage the thread and draw it in and pinch it against the wall of the recess, and subsequently the cutting blade will act to sever the thread. On the upper end of the shaft 26 is an arm 30, to which is pivoted the forward end of a rod 31, the opposite end of the latter being slidably mounted in a bracket 31^a extending from the cloth clamp. The bracket is formed with a slot 31^b through which the rod 31 passed to support its end to permit lateral movement, and a spring 31^c holds the rod up against one wall of the slot and in operative position.

On the inside of the starting lever 9 is a roller 32 which cooperates with a cam 33 on the end of a lever 34, pivoted at 35, on an extension of the cloth clamp 7, the rollers 10 and 32 being so positioned that in the operation of lever 9, roller 32 will first contact with cam 33 and thereafter the roller 10 will engage the rearwardly projecting tail of the cloth-clamp 7 to open the cloth-clamp. The lever 34 is held in normal operative position against a stop pin by a spring 34^x, and the opposite end of said lever is bevelled at 36 to cooperate with a bevelled lug 37 adjustably mounted on the rod 31, the lug 37 being retained in lateral cooperative position to be engaged by the bevelled end 36 of the lever 34 by the spring 31^c. A spring 38 is attached at one end to the rod 31, and at its opposite end to the bracket 31^a and serves to longitudinally and normally pull a stop 39 on the rod 31 up against the bracket, and thus hold the blades 27 and 28 in one end of the recess 25 out of the path of the needle as shown in Fig. 12.

Slidably mounted on the cloth clamp 7 is an arm 40, which is bent down to bear on the upper surface of the clamp, where it is confined by a guide 41. One free end of this arm is bent downwardly and laterally and terminates at 42 opposite the end of the presser foot. Attached to the end of the arm 40 is the bent end of a thread ejector 43. The ejector is in the form of a right angle member, the horizontal portion 44 thereof extending between the end of the presser foot and the base, with its end notched, as shown at 45, to engage the end of the previously severed upper thread, as will be hereinafter explained.

The rear end of the arm 40 is bifurcated, and on the bifurcated portion is mounted a plate 46, provided with a slot 47, the plate being adjustably secured in place by a set screw 48. The rear end of this plate contacts with a shaft 49, Figs. 1 and 2, to limit the movement of the ejector 43 to properly position it out of the path of the needle when the parts are at rest. A spring 50 is secured at one end to the arm 40 and its opposite end is fastened to a pin extending from the cloth clamp. The tension of this spring is such as to draw the arm toward the shaft 49 to normally position the ejector. The arm 40 is formed with a shoulder 50^a normally spaced from the rod 21 when the plate 46 contacts with shaft 49. In the beginning of the stitching operation, the clamp advances until the rod 21 contacts with the shoulder 50^a, and then both arm and clamp move together as will be explained.

The shaft 49 extends below the base and is provided with an arm 52, Fig. 5, in the path of cams 53, which extend from the usual cam disc on the shaft 5. The upper end of the shaft 49 carries an arm 54, which is connected with the gate operating mechanism in the top of the head.

One of the fundamental purposes of this invention is to so improve the mechanism as will permit greatly increased speed. As a means toward this end, the gate operating mechanism has been materially improved by eliminating a number of parts and arranging the construction in a way to accurately and definitely throw the needle bar to exact predetermined positions to insure of uniformity and properly formed purl and barring stitches. This mechanism consists of a stub shaft 55 mounted in the top of the head of the machine, and geared to the power shaft is the usual cam disc 56, provided with a cam groove 57. Pivoted at 58 is a substantially L-shaped lever 59 provided at one end with a roller 60, which engages in the cam groove 57, while the opposite arm of the lever is formed with a curved slot 61. 62 indicates a lever pivoted at 63 to the usual connection 64 leading to the gate. This lever is provided with a notch 64^a in which seats a pin 65 extending from the lever 59, a spring 66 serving to normally hold the pin seated in the notch. On one side of the lever 62 is formed a cam 62^x, Figs. 19 and 23, to operate a tension device to be hereinafter referred to. A pin 67 extends from the lever 62 and fits in the slot 61 to guide said lever in its movement over the lever 59 and to retain the relationship between said levers to permit the desired motion from the cams. A link 67^a connects the arm 54 with the free end of the lever 62 to transmit motion from the cams 53 to shift the gate to form the end barring stitches.

Because of the rapidity of movement of the gate and the simplicity of the mechanism employed for operating the same, it is highly important that means be provided for insuring of the gate uniformly stopping at the end of its throw to avoid overthrow of the needle bar and consequent overlashing of the stitches. This is accomplished by providing a stiff spring 70 fastened to one side of the end of the head. 71 indicates a link formed at one end with an eye to snugly fit around the bar 72 of the gate, while the opposite end of the link is threaded and passes

through an opening in the upper end of the spring 70. The link 71 is clamped to the spring by nuts 73 so as to permit ready adjustment between the spring and the gate to insure uniformity of throw to the needle bar.

The spring 70 is without tension when the needle bar is in the center of the buttonhole, hence when the gate is oscillated to one side or the other of the end barring stitches, the tension of the spring is increased toward the end of the throw, which assists in limiting the movement of the gate under the action of the operating cams, and at the same time this tension tends to return the needle bar in the opposite direction.

Spring 70 is rather stiff, for obviously the flexibility of the parts between the gate and its operating means is quite susceptible of permitting overthrow of the needle bar. It is to cure this defect and insure of the needle bar being limited in the throw in its rapid vibration, the stiff spring has been located to act directly on the gate. This means to prevent overthrow of stitches in a high speed machine has been found to be effective and reduces to a minimum the liability of the stitches overlapping the line of cut of the cutting blade.

The lower stitch forming mechanism 73 is of the known "Singer" type and only parts are conventionally illustrated for the purpose of showing its relation to lower thread holding and severing means. Fitted close to the under surface of the base 1, is a substantially U-shaped lever 74 pivoted to the base at 75. The lever 74 is provided with a finger 76 located to swing adjacent the path of the lower thread.

The U-shaped lever 74 is provided with a slot 77 to receive the end of a resilient connecting rod 78 held by a guide 79 and having its opposite end adjustably fixed to the under side of the base at 80. A lever 81 is pivoted at 82 to the under side of the base, and one end of this lever engages the resilient connecting rod 78, while the opposite end is provided with an adjustable cam 83 to be engaged by the cams 53 on the cam disc mounted on the shaft 5. A spring 84 is connected between the lever 81 and the resilient connecting rod 78 to retain the cam 83 in position to be engaged by the cams 53.

Pivoted at 75, below the U-shaped lever 74, is a swinging plate 85, from one edge of which projects a combined thread puller and cutter blade 85^a, notched at 86, and sharpened to sever the lower thread. This blade operates directly under the base 1 and over the finger 76 and works in conjunction therewith to insure holding the thread and cutting it.

Depending from a lever 87 which transmits motion from the stop motion device to the usual buttonhole cutting blade 88, is a lever 89, to the lower end of which is adjustably pivoted a connecting rod 90, located under the base, and pivotally connected to an extension on the end of the swinging plate 85 so that upon operation of the lever 87, the blade 85^a will move in an arc toward and away from the finger 76. A spring 91 tends to draw the blade to its normal position and out of the way of the lower thread in the stitching operation.

95 indicates a bracket fastened to one side of the body of the machine, and in a bearing formed in this bracket and a bearing formed in the base 1, is a shaft 96. On the lower end of the shaft 96 is secured a cam lever 97, held in normal operative position by a spring 98. On the upper end of the shaft 96 is adjustably mounted a stop 101 which cooperates with a latch 102, adjustably mounted on a link 103, pivoted to the belt shifting lever 13. A spring 104 secured to the head engages the inner surface of the link and normally tends to press the latch 102 toward the stop 101.

The rear end of the bracket 95 is provided with a stop 105, against which the lever 13 abuts when returned to normal position, a spring 106 serving to draw the lever against the stop when released by the latch 102.

On the shaft 5 is mounted a gear wheel 107 and mounted on the face of this gear wheel, by a pivot 109, is a cam lever 108, the cam being held in normal operative position against a stop pin 110 by a light spring 111. The free end of the lever 97 is in the path of the cam 108, and in each revolution of the gear wheel, the cam contacts with said lever and rocks the shaft 96 to release the latch 102 from the stop 101.

112 indicates a lever pivoted to the base at 113. The free end of this lever is curved to form a cam end 114, which is engaged by the pivot 109 in the rotation of the gear wheel 107. Pivoted to the lever 112 at 115 is a link 116, the opposite end of which is pivotally connected to a latch lever 117, pivoted on the under side of the base and held in operative relation against the rod 16, by a spring 118, and is adapted to engage the notch 17 to lock the stop motion device during a cycle of operation in forming a buttonhole.

The lever 87 which imparts motion to the cutting blade is pivoted to the side of the sewing machine head, and is operated by the stop motion device in the usual manner. One end of lever 87 is connected by a link 120 through the medium of a pin 121 to a lever 122 pivoted to the head and extended into the end portion of same and connected to the bar to which the usual cutting blade 88 is attached. The link 120 is slotted to permit movement on the pivot pin 121, and pivoted to the link is a T-shaped interponent 123, one leg of which is notched to engage under the pin 121, while the other leg 124 cooperates with a latch about to be described. A spring 120^a attached to the interponent and a pin on the head serves to normally position the interponent so that the notched end will be in position to engage the pin when the lever 87 is actuated.

A rod 125 is pivoted to the head and extends towards the opposite end of the machine and is bent down to engage in a cam slot 126 formed in a disc mounted on the shaft 5. Secured to the rod 125 is a block 127 and attached thereto is a rod or latch 128, bent at its free end to lie under the leg 124 of the interponent 123. Also secured to the block 127 is a rod 129 which extends up above the top of the head and is bent downwardly at 130 to cooperate with a thread tension and control device.

Mounted in bearings on one side of the machine is shaft 131, and attached to one end thereof is an arm 132 under control of the stop motion device, rocked in one direction by a spring 132^a and in the opposite direction by the spring actuated rod 132^b of said stop motion device. Secured to the shaft 131 is a latch 133, the lower end of which is adapted to lie over the rear extension 11 of the starting lever 9. Also freely mounted on the shaft 131, is a hub 135 to which is attached a depending latch 136 also adapted to lie over the starting lever 9. To the hub is secured a trip lever 137 which extends transversely across the machine and is retained

in position by a light spring 137a, Fig. 22. One end of this lever overlies the starting lever 9 and is adapted to be engaged at one end by a resilient or cushion-like wire member 138, supported on said starting lever, while the opposite end of lever 137 is bent upwardly and shaped to form a hook-like latch 139, Fig. 2. This latch, when in one position, is adapted to be engaged by a roller 140, Fig. 7, supported on the pivot pin 121.

In bearings on top of the machine head is mounted a shaft 141 extended to form a crank arm 142. To the lower end of the crank arm 142, is pivoted a link 143 pivoted to the upper end of a reciprocating connection in the head which is operated by the usual power operating mechanism. On a lug secured on the shaft 141, is fastened a thread guide 144, the free end of which is bent over to form an eye 145 for the passage of the needle thread. Extending from one end of the shaft 141 is a lug 146, on which rests the downturned end 147 of a plate 148 hinged at 149 to a lug on the head. Below this plate is a thread tensioning device 150, and a screw 151, passing through the plate, tension device, and lug, provides a means for adjusting the tension on the thread.

Rising from the top of the head is a standard on which is mounted a thread tension device 152. The standard is provided with an opening 153 to form a guide for the thread coming from a source of supply.

Interposed between the standard and the plate 148, is a tension device 154, and adjacent the hinge of the plate is another tension device 155.

The tension device 155, while maintaining normal tension on the thread when the purl stitches are formed, releases the tension at the time the bar stitches are being placed. It comprises two discs 155^a and 155^b, between which the thread passes, the upper disc 155^a having an opening intercepted by a central bar 155^c to fit in a slot 155^d in a post 155^{dx}. The tension is regulated by a spring and nut 155^e, while a pin 155^f fitted in the post is actuated by the cam 62^x on the lever 62, when the end bars are formed, to release the tension on the thread. The lower end of the pin 155^f is positioned over the lever 62 and adjacent the cam 62^x, so that when this lever is shifted to throw the gate for the end bars, the cam engages the pin and releases the tension for freer paying out of the thread.

When the stop motion is returned to normal position, the lever 62 has assumed position to form the purl stitches in the next operation but tension device 155 is engaged by the rod 173^a to release the tension to free the thread, so that when the upper thread trimming device is operated, the blades can readily pull out and then cut the thread. Closely associated with the tension device 155 is an overhanging plate 156 formed with an opening 157 in vertical alignment with the bent end 130 of rod 129. In the overhanging portion of the plate 156 is a thread guide opening 158, and below this opening is another thread guide opening 159. Projecting from the side of the head is a thread guide 160, and below same is a thread tension device 161 having the usual check-spring 162. Mounted in the free end of the bracket-arm 2 is the usual take-up 163 formed with a thread guide opening 164. From the take-up 163 the thread is passed through a slot 165 in the head and is then passed over a guide 166 to the needle.

Mounted on a pivot 167 on the top of the head is a thin plate 168 which lies over the upper surface of the overhanging plate having the guide 158. This plate is normally held under the bent end 130 of the rod 129 by a light spring 169 on the pivot 167.

Pivoted to the upper part of the stop motion device is one end of a link 170. To this link is pivoted a lever 171, the latter being reduced at one end to form a latch 172 which cooperates with a stationary pin 174. A lever 173 is pivoted to the side of the head, and its lower end is pivoted to the other end of the link 170, while its upper end is pivoted to the rod 173^a sharpened at its free end to engage between the discs of the tension device 155 to release tension on the thread at the appropriate time in the stitching operation.

Under the support or platform A on which the stitching mechanism is mounted, are two brackets 180 and 181. Supported in bearings in the brackets 180 and 181 is a shaft 182 from which extends an arm 183. Pivoted to the arm 183 is the operating rod 184 which passes freely through a lug 185 on the starting lever 9. A collar 186 is adjustably fixed on the rod 184 and between this collar and the lug 185 on the starting lever is a spring 187, which normally tends to force the rod 184 in a downward direction. The purpose of the spring however, is to serve as a buffer when the rod starting lever 9 is operated. In other words, when the rod 184 is actuated up further than is necessary, the spring absorbs the excess movement and thus relieves strain on the parts.

Pivoted to the bracket 180 is a lever 188 having oppositely disposed extensions provided with studs 189 and 190. The lower end of lever 188 has a pivoted lateral lug 191 formed with an opening for the reception of the end of a Z-shaped connecting bar 192. On the lower portion of the Z-shaped bar is fastened a foot pedal 193, and depending therefrom is a bearing in which is mounted a grooved roller 194. The roller travels on a track 195 secured to the floor. Pivotally mounted on the bracket 180 is a depending lever 196 and secured to the shaft 182 is a corresponding lever 197, the lower end of the latter and the lever 196 being pivotally connected together by a link 198. At the lower end of the lever 196 is pivoted a latch lever 199 provided on its under side with a cutout portion 200 to form two abutting shoulders 201 and 202; which cooperate with the two studs 189 and 190. A spring 203, attached to the latch lever 199 and the lever 188, tends to draw the stud 190 against the shoulder 202 and thus hold the parts in normal position.

One of the purposes of this construction is to provide treadle operating means whereby in the operation of the mechanism, the operator simply moves the pedal and foot forward and backward rather than the usual tilting motion as now customarily employed. A further and additional purpose of the construction is to provide means to cooperate with the mechanism associated with the sewing mechanism whereby to operate certain of said mechanisms in one movement and perform another operation in the opposite movement. Once the machine is started, the various movements of the foot may take place, but the operation of the mechanisms previously actuated cannot again be effected until the cycle of the stitching operation is over, and even then, operation cannot take place unless the stitching has been properly formed.

In operation, assume the parts are in normal position, that is, a previous operation has been completed, and it is desired to remove the piece of cloth and insert another piece to form a buttonhole.

The operator forces the treadle rearwardly against the tension of spring 203, which rocks the lever 188 and places the stud 189 in engagement with the shoulder 201, and hence, the latch lever 199 is pulled rearwardly, and through the lever connections 196, 197, 198 and 183, pull is exerted on the rod 184, as shown in full lines in Fig. 25. Pull on the rod 184 rocks the starting lever 9, and roller 32 first engages the cam 33 and rocks the lever 34. In this movement of the lever 35, the bevelled end 36 engages the lug 37, and slides the rod 31 which in turn partially rotates the stub shaft 26 to open up the cutting blade 28 and the thread holding blade 27 to pass the needle thread to a position to engage the thread when the movement of the blades is reversed. The bevelled end 36 of lever 34 of course swings in an arc and slips past the lug 37 as shown in full lines in Fig. 8, and immediately the spring 38 returns the cutting blade and thread holding blade to normal position, as shown in dotted lines in said figure. In returning to normal position, the needle thread is first engaged by the thread holding blade 27 and forced into the recess 25 in the presser foot and is pinched or held between the upper wall of the recess and the blade. As previously stated, the cutting edge of the cutting blade 28 is stepped back of the edge of the thread holding blade so that when the blades enter the recess 25, the thread will first be pinched and held, then the cutting edge engages the lower wall of the recess 25 and severs the thread close to the work but leaving a short end. After operation of the blades 27 and 28, and upon continued movement of the treadle, the roller 10 contacts with tail of the cloth clamp lever 7 and raises the forward end for the withdrawal of and the insertion of another piece of work in which is to be formed a buttonhole. The work is inserted under the presser foot and the operator reverses the movement of the treadle and the cloth clamp is closed by the action of spring 20. In reversing the treadle, it is moved past the neutral position, shown in Fig. 24, to the position shown in dotted lines in Fig. 25. Obviously in reversing the movement of the treadle, the stud 190 will engage the shoulder 202 on the latch lever 199, and through the connections, raise the rod 184. Raising rod 184 rocks the extension 11 of lever 9, and its end engages the roller 12 and rocks the belt shifting lever 13 and tilts the stop motion device 6 on its pivots 6^a, and throws the belt from the loose to the fast pulley. In rocking the belt shifting lever 13, the link 103 is moved and the latch 102 springs back of the stop 101 to lock the belt shifting lever in position during the stitching operation and thus prevent the operator carelessly or inadvertently shifting the belt during a cycle of stitching.

In tilting or setting the stop motion device through operation of lever 13, the rod 16 is depressed to permit the latch lever 117 to engage the notch 17 and lock said stop motion device in operative relation. Simultaneously the link 170 is advanced and rocks lever 173 to withdraw the device 173^a from between the tension discs of tension device 155, whereby the latter places the necessary tension on the thread for proper stitching. In setting the stop motion device in running position, the shaft 131 is also rocked by the spring 132^a, Fig. 1, and throws the latch 133 over the starting lever to prevent the operator opening the clamp when the stitching mechanism is operating, or if for any reason the stop motion should fail to come back to its normal position.

In operating the starting lever 9 to throw in the stop motion device, the cushion member 138 contacts with the end of the transverse lever 137 and positions its hooked end 139 over the roller 140, so that if the stitches are properly formed and the cutting blade has operated properly, the roller 140 will strike the hooked end of the lever and free the latch 136 from the starting lever 9. The purpose of tilting the transverse lever 137 is to position the latch 136 over the starting lever 9 and lock the same to prevent the operator raising the cloth clamp during the time the stitching mechanism is in operation or until such time as the buttonhole cutting blade returns to its normal position.

Setting the stop motion device starts the mechanism, and as shaft 5 rotates, the cam 126^a on one wall of notch 126, engages the bent end of rod 125 and raises the rod 128 under the arm 124 of the interponent and at the same time rod 129 is elevated and the bent end 130 is removed from the opening 157 and at the same time frees plate 168 and permits spring 169 to throw it to position covering the hole 157 but free of drag upon the thread.

The stitching mechanism is now operating and about three or four tying-in stitches are formed to tie in the thread, then the cloth clamp and usual step by step movement feed the cloth under the needle. The first row of purl stitches are formed, and then one of the cams 53 trips the arm 52 and the gate operating mechanism is shifted to form the first end barring stitches, then the second row of purl stitches, and finally the gate is shifted again and the last barring stitches are formed. As the cloth clamp 7 moves in forming the first row of purl stitches, pull is exerted on the spring 34^x and the latter is tensioned. When sufficient tension in spring 34^x is accumulated to overcome the tension of spring 31^c, the bevelled end 36 of bar 34 engages the bevelled face of the lug 37, and forces the rod 31 laterally in slot 31^b, and lug 37 slips back of the end of bar 34 in position for a subsequent operation, as shown in full and dotted lines in Fig. 8.

When the machine was last operated, the lever 87 actuated the swinging plate 85, through the connections 89 and 90, and left the free end of the lower thread pinched or held between blade 85^a and the finger 76 of lever 74. At the time of forming the several tying-in stitches, previously referred to, one of the cams 53 engages the cam 83 and actuates the lever 74 and finger 76 thereof releases the lower thread at or about the time the cloth clamp commences to move. In other words while the tying-in stitches are being formed, the lower thread is held and released by the action of the cooperating cams. Then cam 83 snaps back and resets the lever 74 and its finger 76 to cooperate with the blade 85^a at or about the completion of the stitching operation.

It might be here noted that while the opposite or companion cam 53 in a revolution of the gear wheel actuates the thread holding plate, the latter simply idles because at this time it is free of the lower thread.

After the tying stitches are completed, the cloth clamp advances, and while the next four or five purl stitches are being formed, the arm 40 re-

mains stationary until the shaft 21 on the clamp abuts against the shoulder 50. At this time, the end of the presser foot contacts with the bent end 42 of the arm 40 and the latter and cloth clamp then move together as further stitches are formed. As the four or five stitches mentioned are formed, the cloth is advanced while the ejector 44 remains stationary. Consequently, the beginning end of the thread held by the thread holding blade 27 engages the notched end 45 of the ejector, and the latter pulls or frees it from the blade 27 and lays or bends it down on the cloth to be sewed in with the last barring stitches.

In the reverse movement of the cloth clamp, it of course carries with it the arm 40 until the plate 46 on the bifurcated end of the arm contacts with the shaft 49, at which time the ejector 43 is stopped just in advance of the needle, while the cloth clamp continues to move to normal position, at which time the last end barring stitches are formed and the free or starting end of the needle thread laid down by the ejector 43 is sewed in. Before the last barring stitches are completed, the cam lever 108, Fig. 5, engages the cam end of lever 97 and disengages the stop 101 from the latch 102 and the spring 106 rocks the belt shifting lever 13 and the belt is thrown from the fast to the loose pulley. The mechanism from this time on runs by momentum, the purpose of which is to reduce the shock and strain on the parts when the stop motion device is finally returned to its normal position and the mechanism is stopped. To ease the release of the latch 102 at the same time provide a convenient way of arranging the trips on the gear wheel, the cam lever 97 is spring actuated, at the same time the pivot for the cam lever is utilized for another purpose.

At about the time the last bar stitch is formed, the pivot 109 engages the end of the lever 112 and releases the latch 117 from the notch 17 and unlocks the stop motion device. Then the usual stop-cam 400 acts on the usual plunger bar 132^b of the stop motion device and rocks the lever 87 to actuate the cutting blade 88. At this time, the bar 128 has been dropped by reason of the slot 126 having been positioned to permit the end of bar 125 to fall, and spring 120^a pulls the interponent 123 in position to engage the pin 121. When pin 121 is raised by actuation of lever 87, the roller 140 strikes the hook 139 and removes the latch 136 from the starting lever 9. Movement of the lever 87 imparts motion to the lever 89 and link 90 and actuates the combined thread puller and cutting blade 85^a. That is to say, because of the rapid movement of the lever 87, the blade 85^a is first rocked in direction of arrow *a*—*a* in Fig. 14 past the thread "*b*" as shown in dotted lines in said figure, so as to position the blade in front of the thread to pull it over. Then with a quick snap action, the movement of the blade 85^a is reversed and it drags the thread over on the finger 76 and under the base of the machine. This results in the thread being held between the finger 76 and blade 85^a and it is simultaneously severed between the said blade 85^a and the base of the machine.

At the time the stop-cam 400 depresses the stop-motion plunger rod 132^a, the cam lug 402 catches under the spring pin 403, and when the rod 132^a springs upwardly, it rocks the arm 132 and tilts the latch 133 and frees the starting lever 9 and the cloth clamp is free to be raised.

One of the fundamental features of this improvement is to automatically lock the mechanism to prevent the operator disturbing the operation of the machine in a cycle of movement and thus prevent breaking the parts and ruining the work. Several of these locking features are controlled entirely by the thread, so that if in a given cycle of operation anything happens which produces improper stitches, or the thread should break, or the cutting blade should stick or otherwise not come back to its normal position, the operator cannot lift the work clamp. Hence, in case of skipped, loose, or improper stitches, or if the cutting blade sticks, the work remains under the work clamp and the operator cannot remove it until the thread is repaired or other imperfections are cured and the locks reset. Then the machine can be again started and the previously stitched buttonhole is worked over again, and the work is saved. Therefore, the various locking devices assume importance.

Let it be assumed the tension of the thread becomes so loose as to form improper stitches, the thin resilient plate 168 has not been moved by the drag of the thread from its position over the opening 157 at the time the stop motion device is thrown to normal stopping position at the end of the cycle of movement. While the mechanism is stopped, the rod 129 is held suspended by the plate 168 and the bar 128 remains under the arm 124 of the interponent 123 and prevents the upper notched end of the latter being positioned under the pin 121. Thus when bar 87 is operated, it merely raised the interponent without operating the bar 122 to trip the cutting blade 88. As the notched end of the interponent cannot engage the pin 121, the position of the transverse bar 137 is not disturbed, hence the latch 136 remains in engagement with the starting lever and cannot be actuated by the operator, and therefore the clamp cannot be raised. The thread is repaired or the desired adjustment is made, then without releasing the latch 136, the operator can operate the treadle and start the stitching mechanism and the same piece of cloth can be worked over again in identically the same place.

It very frequently happens that the cutting blade 88 sticks and fails to come back to normal position. When this occurs, the operator in the rush to insert another piece of work actuates the treadle, and as the cutting blade is in the path of the clamp and other parts, the blade is bent or broken and undue strain is put on the mechanism.

To prevent this occurring, means are provided to prevent the operator starting the mechanism if the cutter should stick, although the treadle is free to be moved idly. When the bar 87 is actuated by the stop motion device to drive the cutting blade down to cut the slit in the cloth, it rocks the lever 171 and brings the latch end 172 up adjacent the pin 174. Now if the cutting blade 88 should stick, bar 87 will not come back to its normal position, hence the shoulder of latch end 172 of the lever is positioned in front of the pin 174, and any attempt to tilt the stop motion device to running position results in the shoulder contacting with the pin and thus forming a lock. As the arm 132 cannot return to its normal position until the bar 87 assumes its normal position, it follows shaft 131 will not be disturbed, hence the latch 133 remains in engagement with the starting lever 9. Therefore, should the operator attempt to open the clamp to remove the work without having noticed that the cutting blade was stuck, she will only be able to idly actuate the treadle, then she is apprised something is wrong. If the operator at-

tempts to move the treadle to start the stitching mechanism without noting that the cutting blade is stuck, it cannot be done, because of the position of the shoulder of the latch end 172 of the bar 171 being in position to engage the pin 174. Any attempt to start the mechanism under the conditions noted, it will be obvious at once that the latch bar 171 prevents tilting of the stop motion device to running position, and until the cutting blade 88 is returned or adjusted so that it assumes normal position, the latches 172 and 133 and the stop motion device cannot assume their normal positions. Even though in the partial operation of the cutting blade the transverse lever 137 is tripped and the latch 136 released, it follows that latch 133 prevents the starting lever being operated to open the clamp.

If the operator has any doubt as to the slit in the buttonhole having been correctly formed, and desires to re-work it, the slit-cutting blade is adjusted, the latches and stop motion device are reset, and without lifting the clamp, the cloth is in identically the same place and can be reworked with assurance that the buttonhole has been properly formed.

It is of importance in a machine of this type that the thread be properly measured to supply the desired length of thread. The improvements make ample provision to meet this contingency as will be evident from the following description.

During the stitching operation, the shaft 141 is oscillated, and in one direction of movement, the guide 145 exerts a pull on the thread about sufficient to draw off a length of thread to form a stitch, while at the same time, the lug 146 moves down and restores the tension on the thread passing around the tension device 150. In the reverse movement of the shaft 141, the guide 145 slackens the thread, while the lug 146, acting on the bent end 147 of the plate, releases the tension and permits of the slack thread pulled off by the guide 145 to be readily fed in the stitching operation. The tension device 155 retains a normal tension on the thread from the first tension device 152, except at the time the barring stitches are formed, and at the same time tensions the thread properly for the thread feed. That is, as the stitches are formed, pull is exerted on the thread, and as the latter passes over the plate 156, the thread is frictionally dragged step by step under the thin spring plate 168 until the required number of stitches have been produced in the making of a buttonhole. When the buttonhole stitches are completed, the bent end 130 of the rod 129 drops in the opening 157 in the plate which drops rods 128 and 126, as previously described. When the end 130 of the rod drops, it holds the thin plate 168 against the tension of its spring until the next stitching operation is started.

Having thus set forth the nature of the invention, what is claimed herein is:—

1. A buttonhole machine comprising stitching mechanism, including a needle bar, a work clamp, means for creating relative movement between the work clamp and needle bar, upper thread cutting and holding means, and a thread ejector for releasing the cut end of the needle thread in the relative movement between the needle bar and the work clamp after the stitching operation is started.

2. A buttonhole machine comprising stitching mechanism, including a needle bar, a work clamp, means for creating relative movement between the work clamp and needle bar, upper thread cutting and holding means, means for forming tying-in stitches at the beginning of the stitching operation, and a thread ejector for releasing the cut end of the needle thread after the formation of the tying-in stitches and in the relative movement between the cloth clamp and needle bar.

3. A buttonhole machine comprising stitching mechanism, including a needle bar, a work clamp, means for creating relative movement between the work clamp and needle bar, upper thread cutting and holding means, a thread ejector for releasing the cut end of the needle thread in the relative movement between the needle bar and the work clamp after the stitching operation is started, and means associated with the stitching mechanism for forming end barring stitches, the thread ejector placing the cut end of the needle thread to be worked over by the last barring stitches.

4. A buttonhole machine comprising stitching mechanism, a cloth clamp, feed mechanism, means for cutting and holding the thread, a thread ejector carried by the cloth clamp, means for mounting the ejector to remain stationary while the cloth clamp moves in the formation of the first several stitches to release the held end of the thread and lay the same on the work to be stitched over and to thereafter move with the clamp.

5. A buttonhole machine comprising stitching mechanism to form purl and end barring stitches, a movable cloth clamp, means for severing and holding the thread at the end of the stitching operation, and a thread ejector, and means for holding the thread ejector stationary while the cloth clamp moves to release the held thread and lay the same on the work to be subsequently stitched over by the last end barring stitches.

6. A buttonhole sewing machine having, in combination, stitching mechanism, a cloth clamp, feeding mechanism for relatively moving the stitching mechanism and cloth clamp, a stop-motion device, means for cutting and holding the thread, and means operative after the next stitching operation is started to release the held thread and lay the same upon the work in position to be stitched over by the final stitches of the buttonhole.

7. A buttonhole sewing machine having stitch-forming devices including cooperative upper and under thread mechanisms, a movable sharpened under thread cutting blade, a non-sharpened blade with which the thread cutting blade cooperates to hold the under thread, means for moving the sharpened blade only to cut and hold the under thread, and other means for moving the non-sharpened blade only to release the under thread.

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