

Feb. 10, 1931.

B. T. LEVEQUE

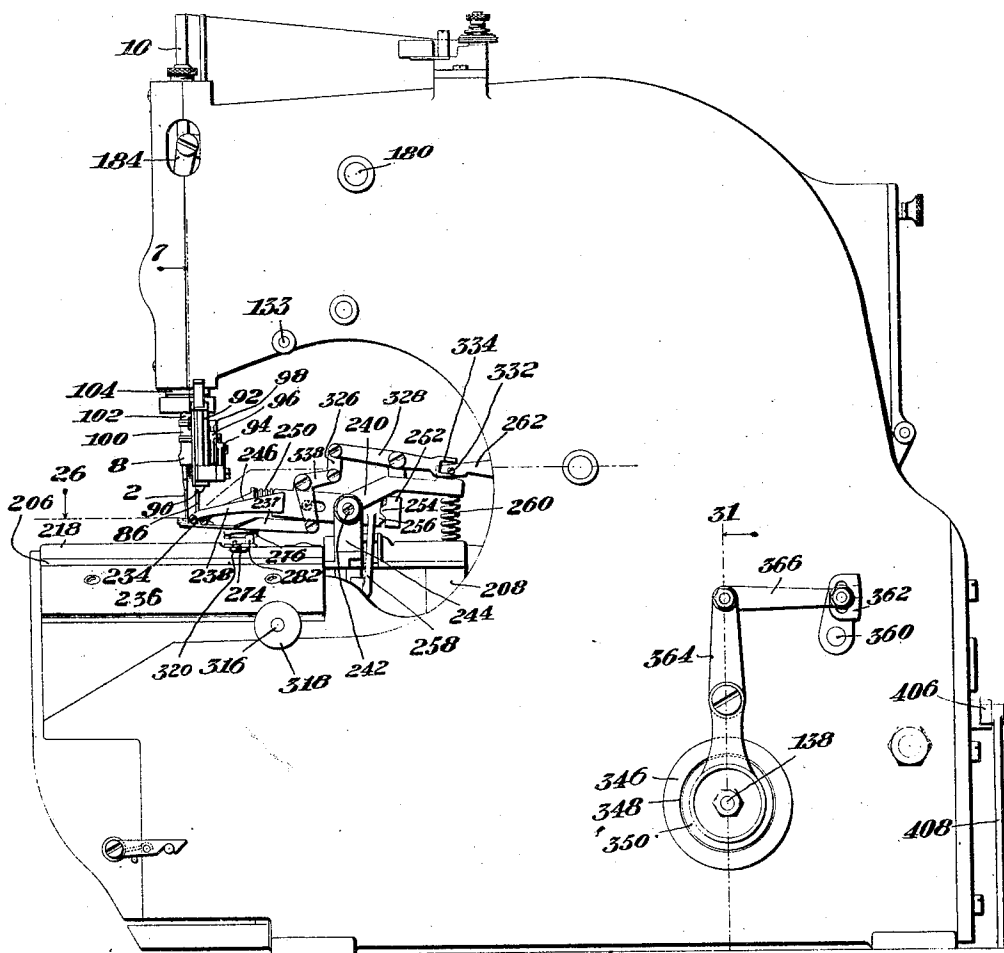
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BUTTONHOLE SEWING MACHINE

Filed Sept. 26, 1918

17 Sheets-Sheet 1

Fig. 1.



Witness

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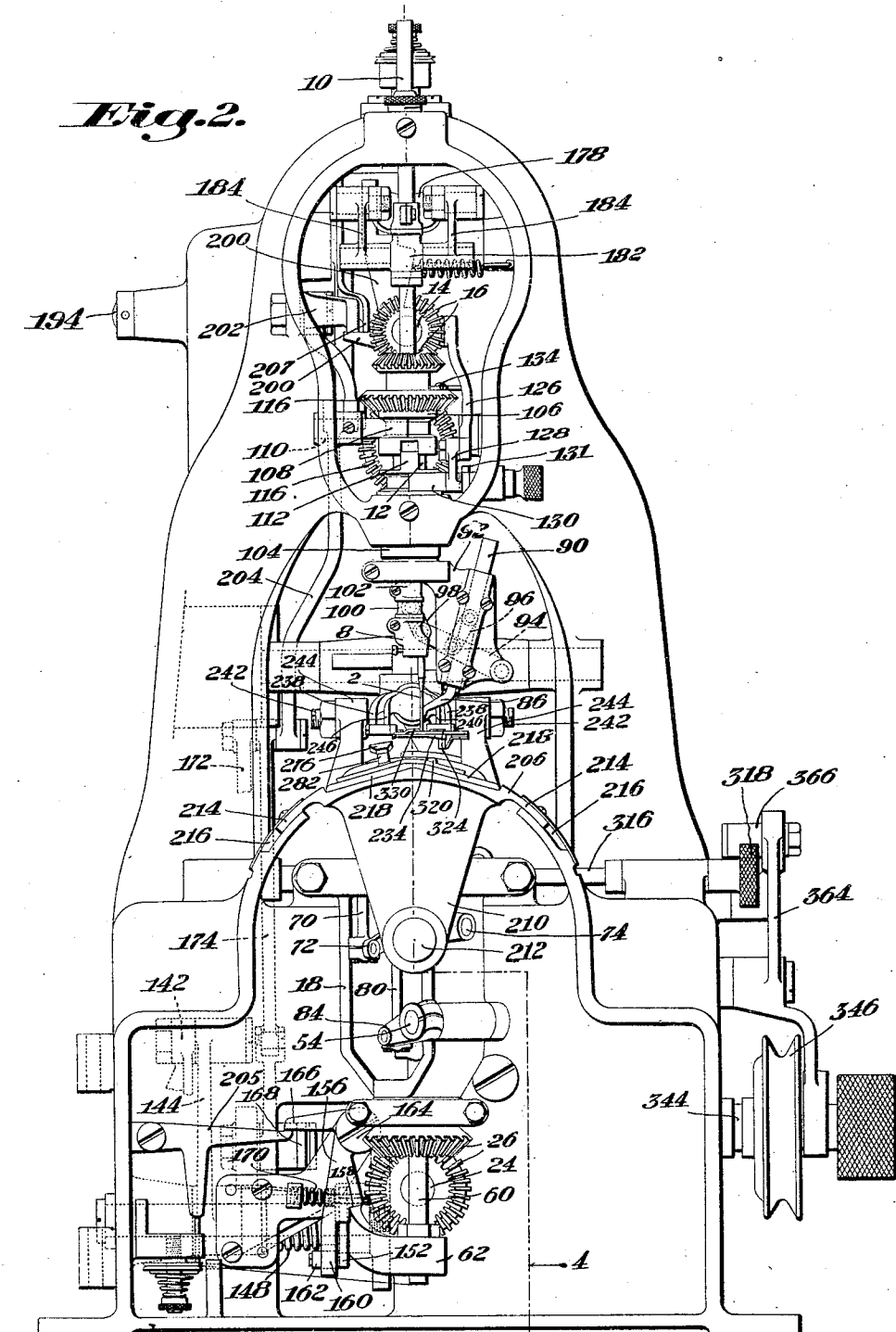
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17 Sheets-Sheet 2



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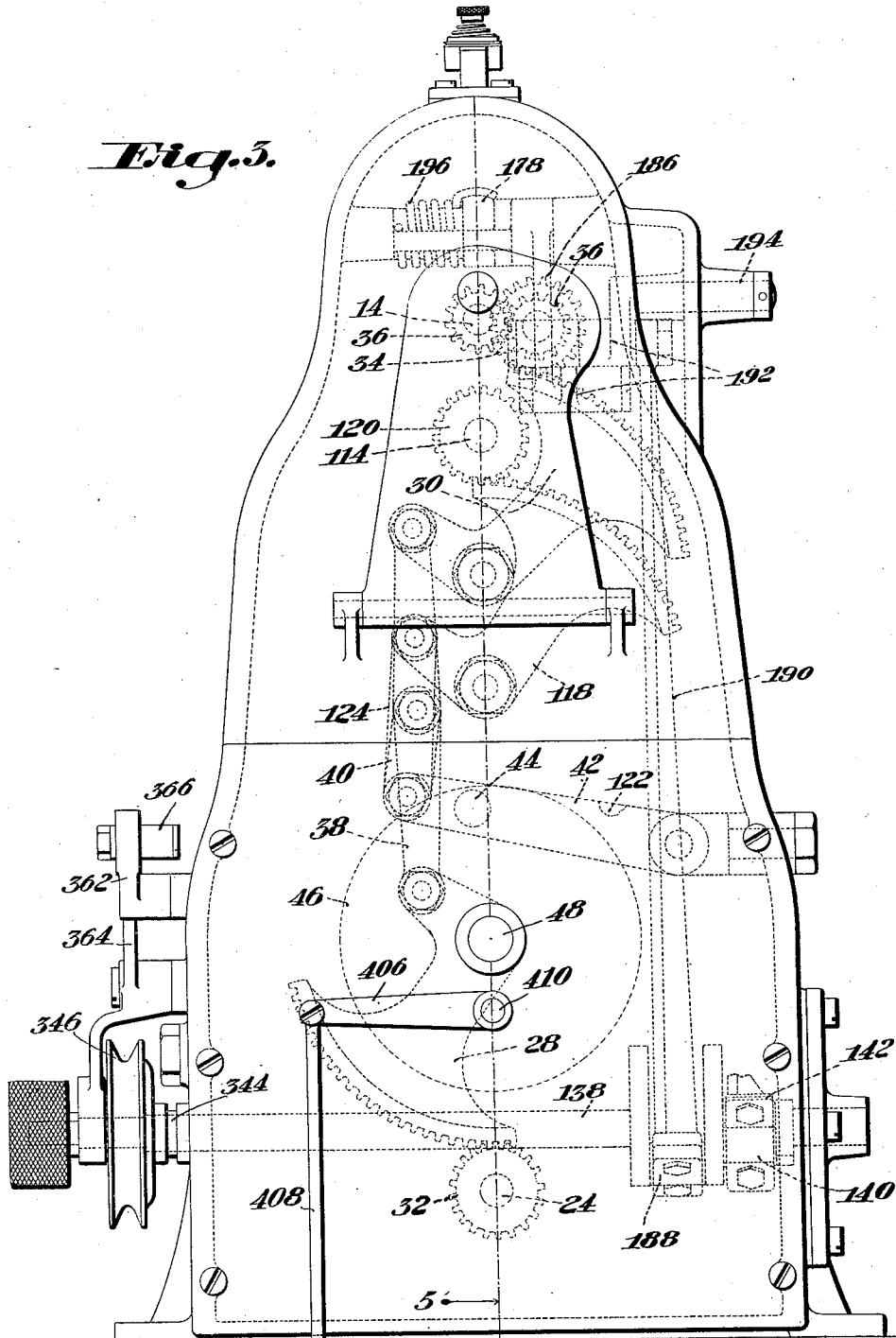
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BUTTONHOLE SEWING MACHINE

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17 Sheets-Sheet 3



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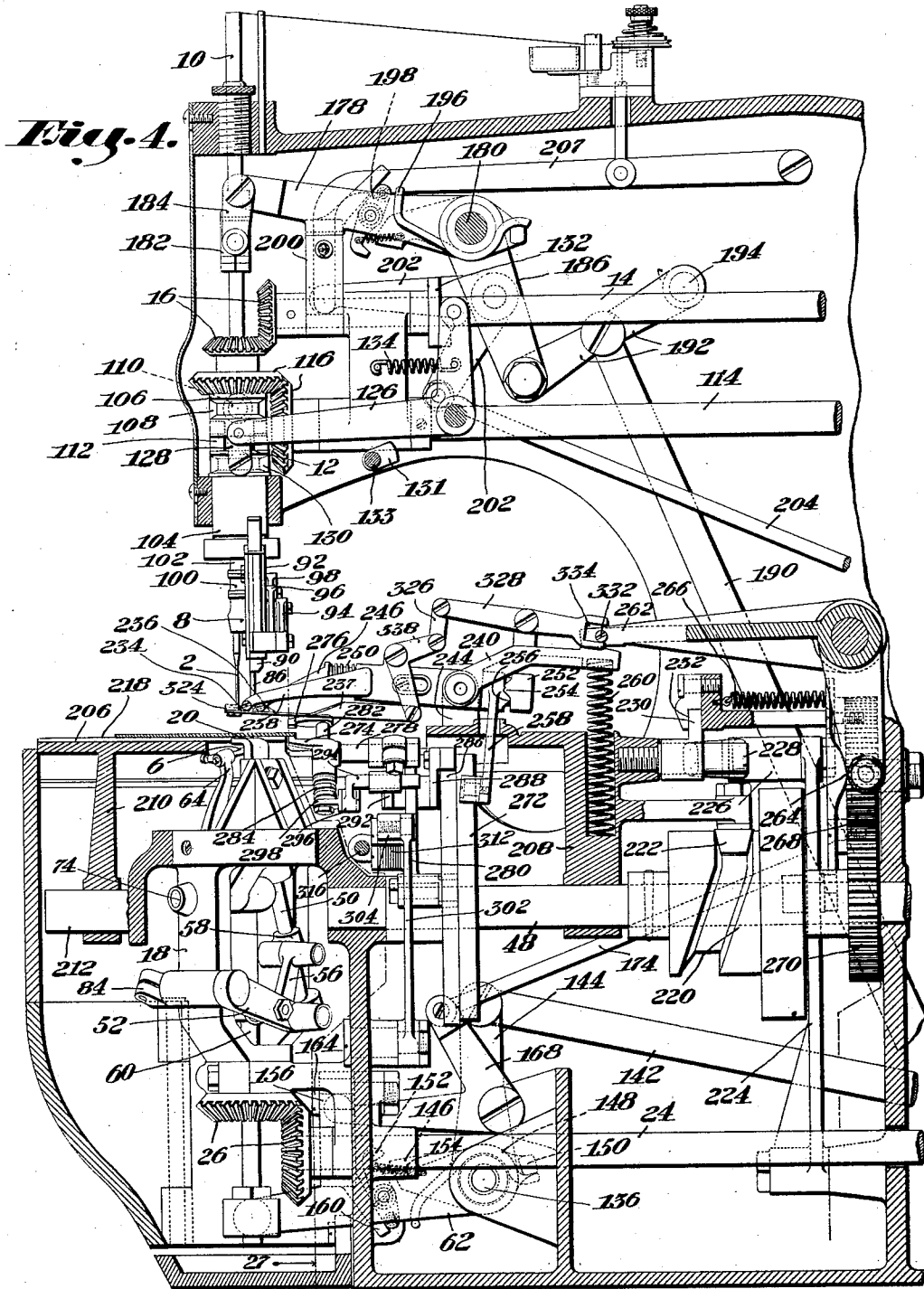
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BUTTONHOLE SEWING MACHINE

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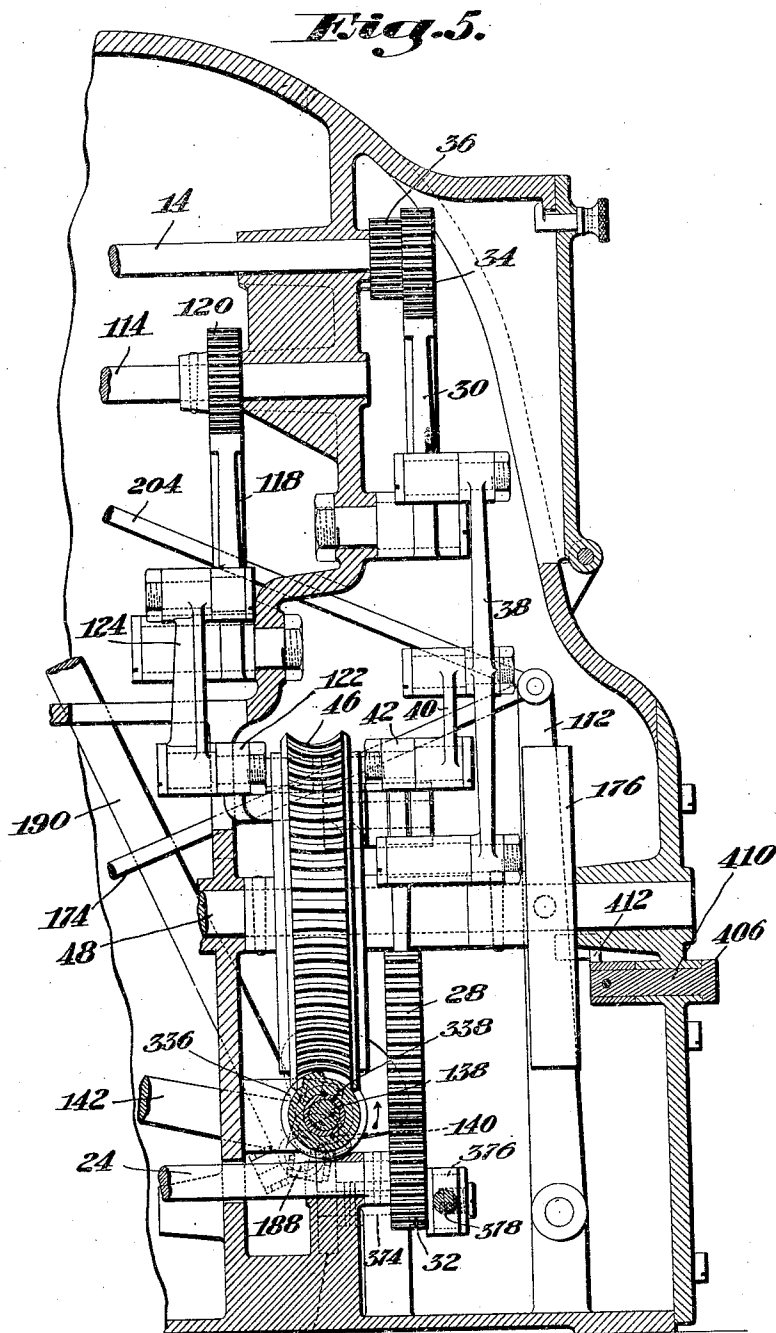
B. T. LEVEQUE

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BUTTONHOLE SEWING MACHINE

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BUTTONHOLE SEWING MACHINE

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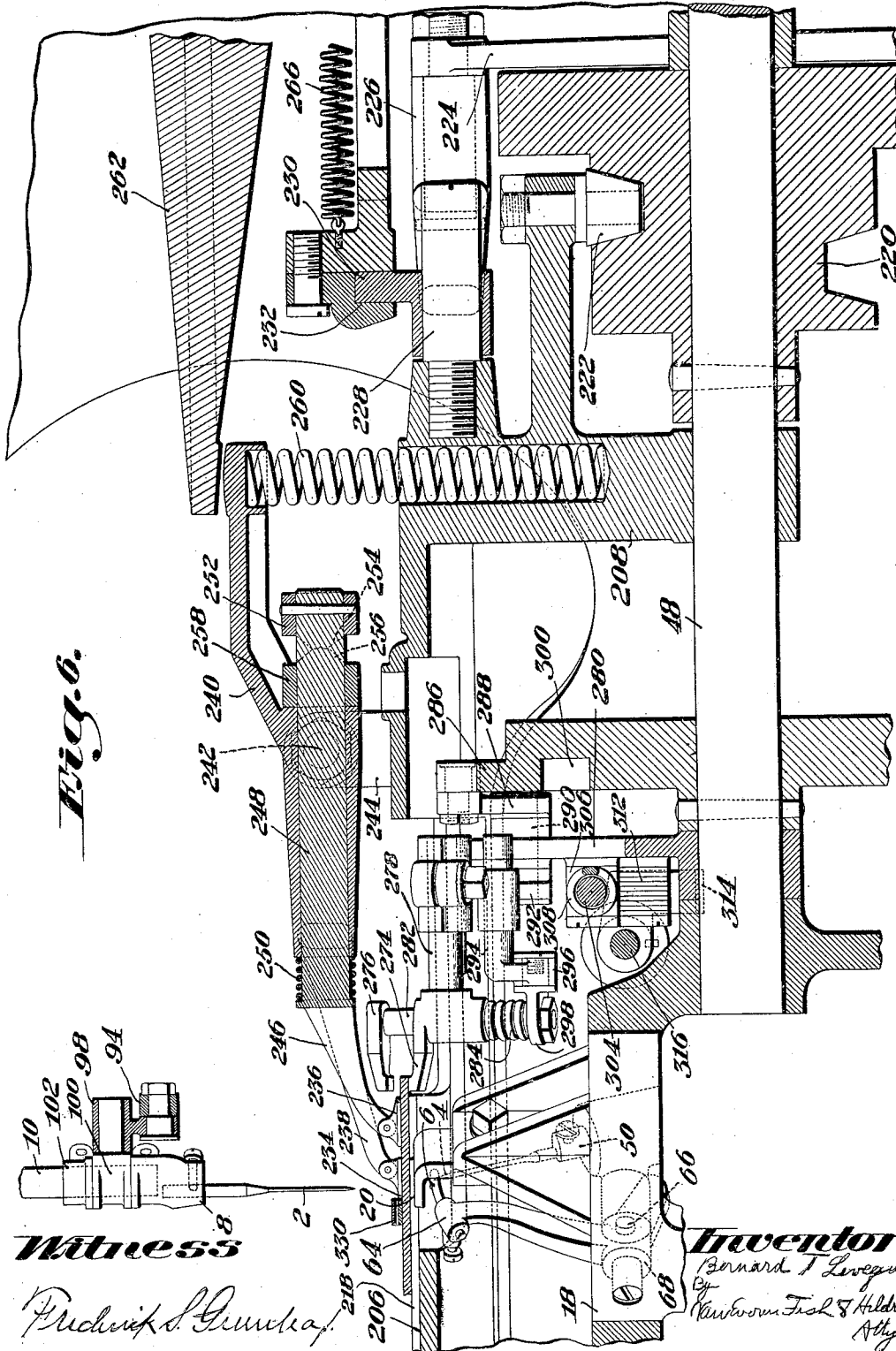


Fig. 6.

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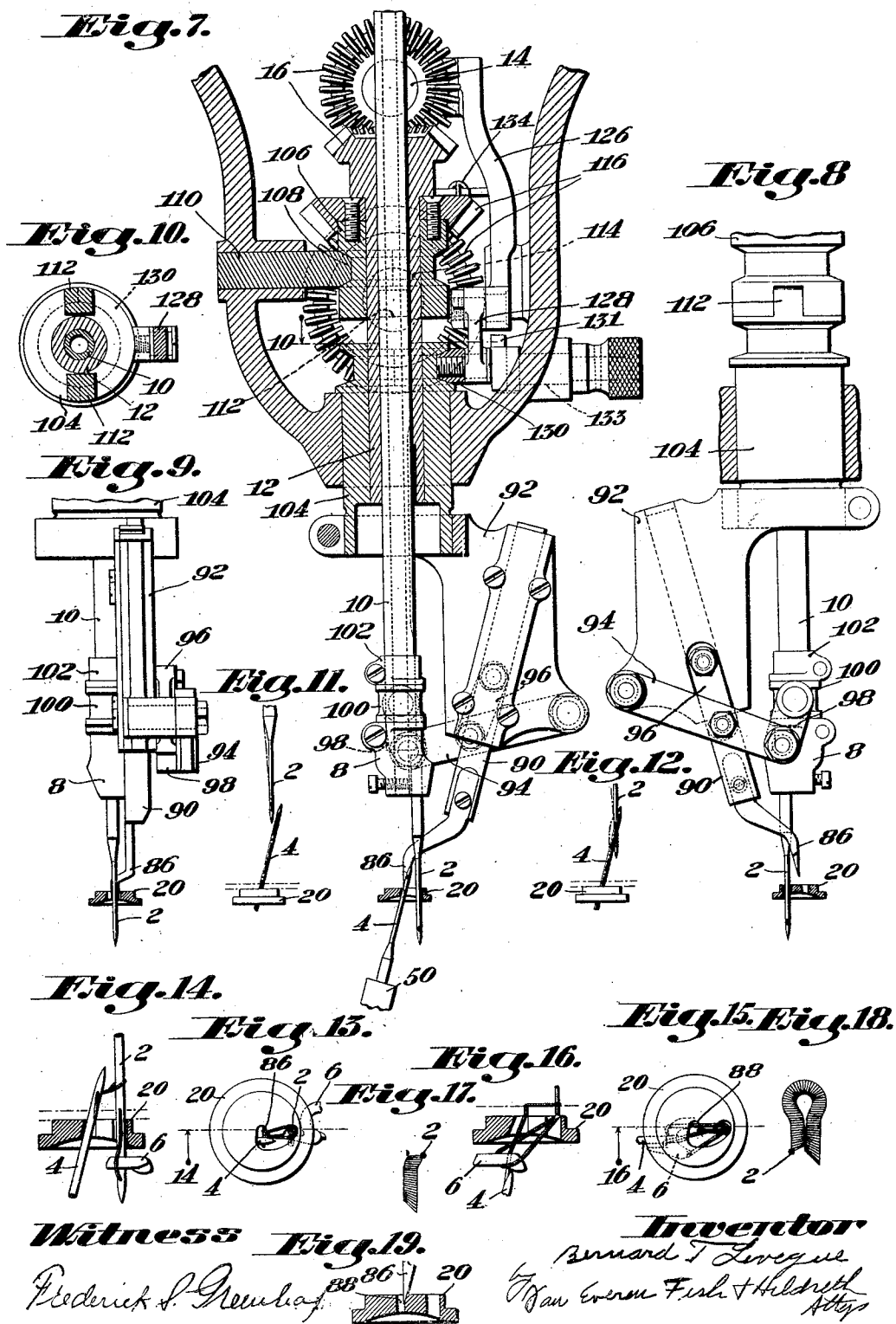
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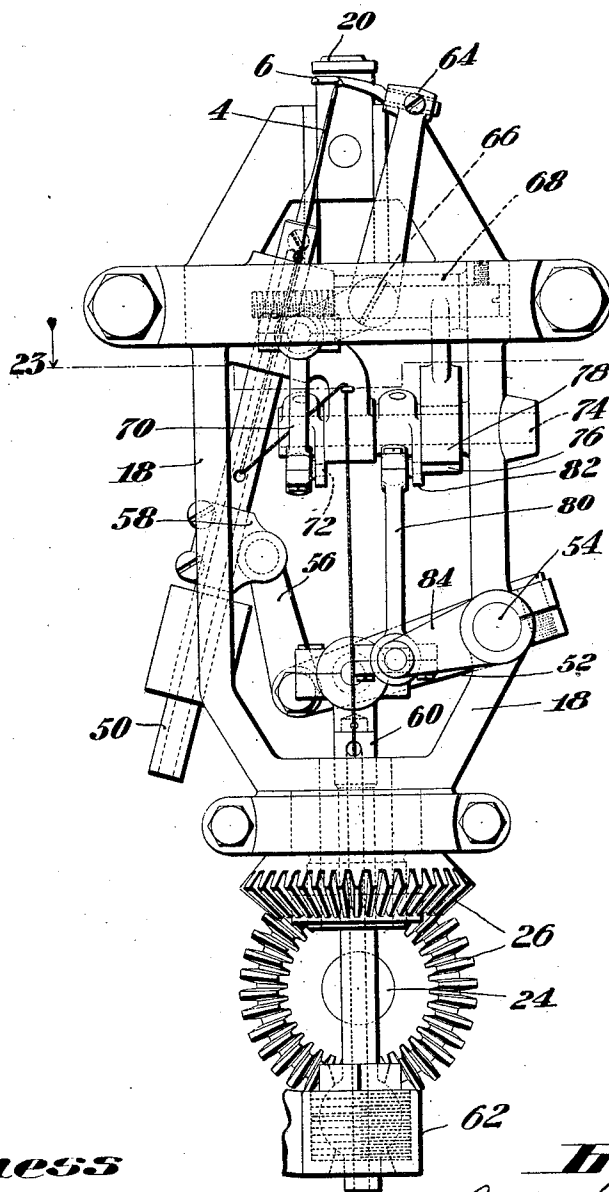
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Fig. 20.



Witness

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BUTTONHOLE SEWING MACHINE

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Fig. 22.

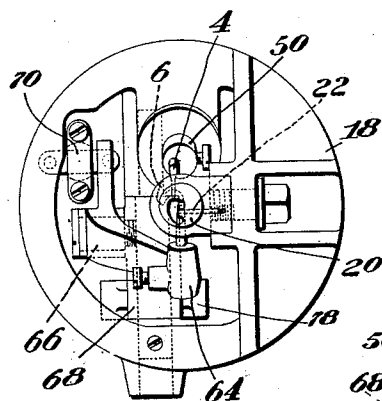


Fig. 23.

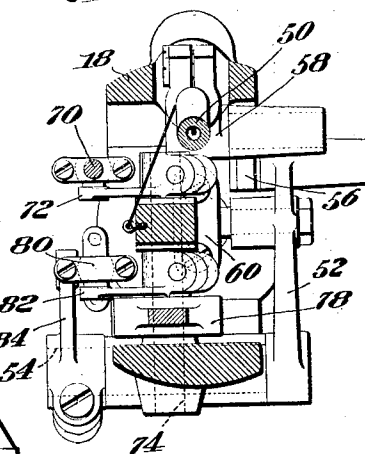
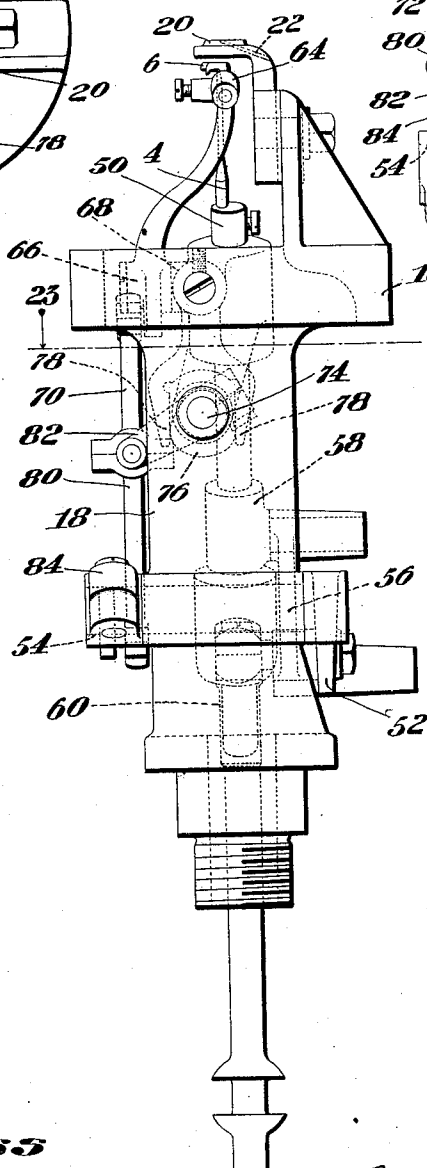


Fig. 21.



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BUTTONHOLE SEWING MACHINE

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Fig. 24.

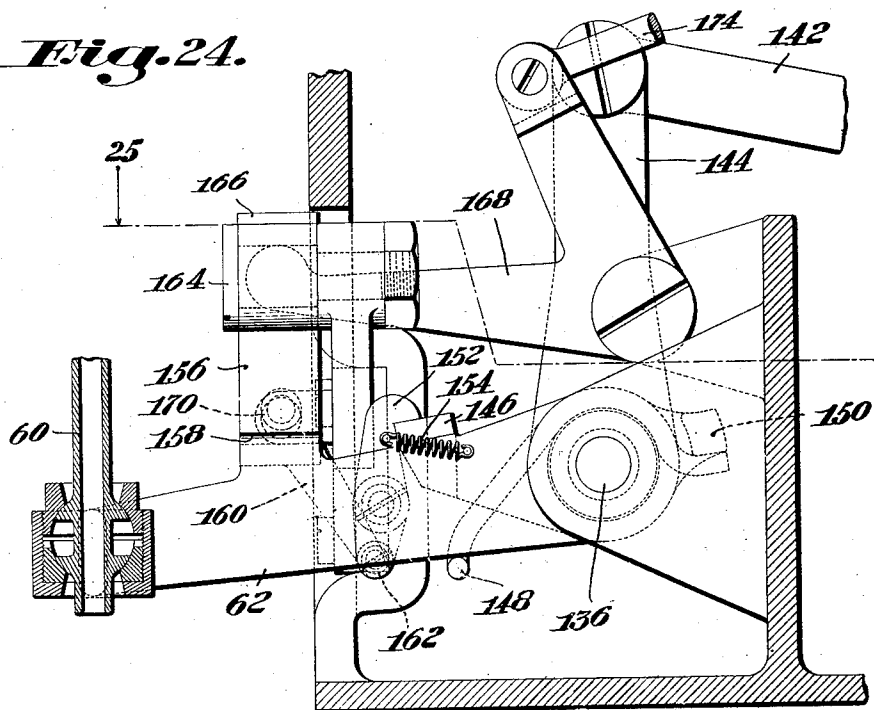
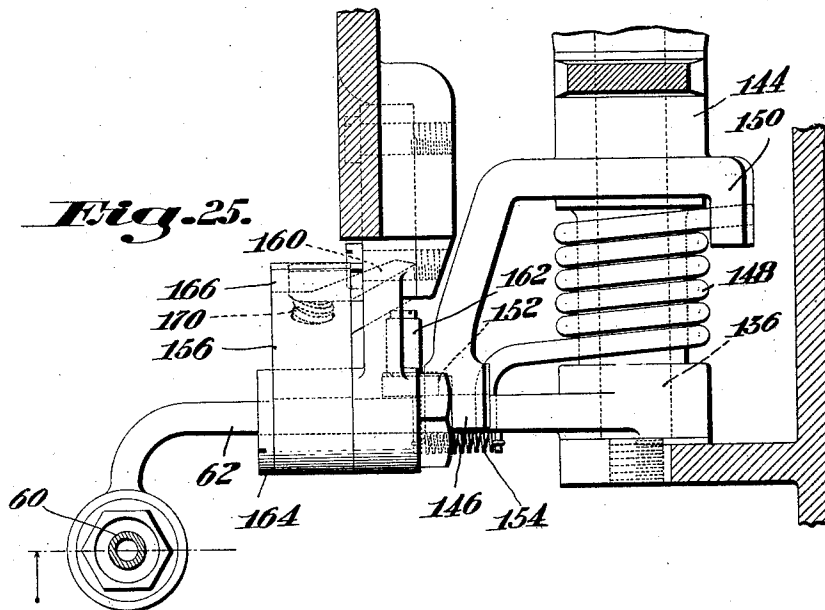


Fig. 25.



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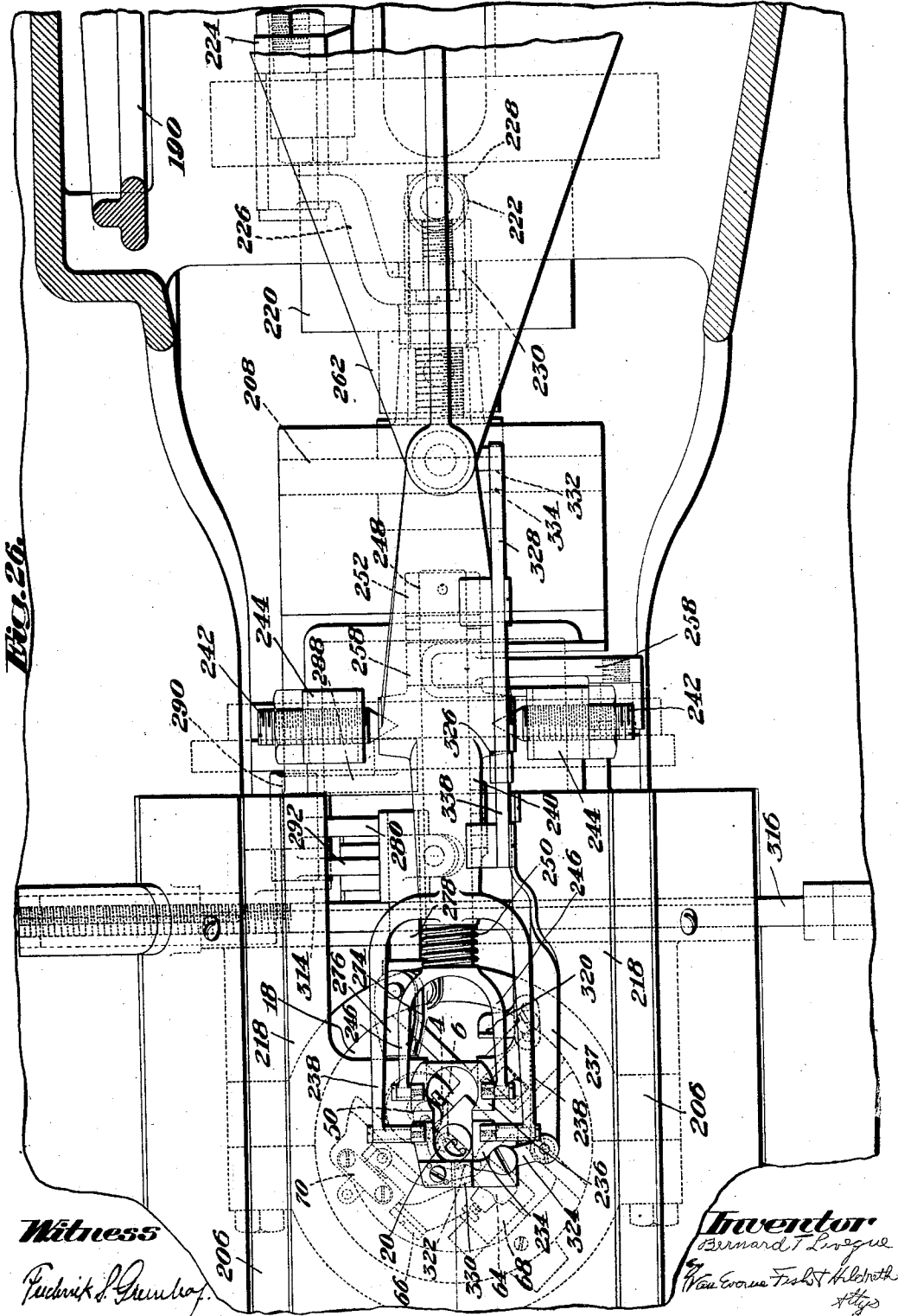
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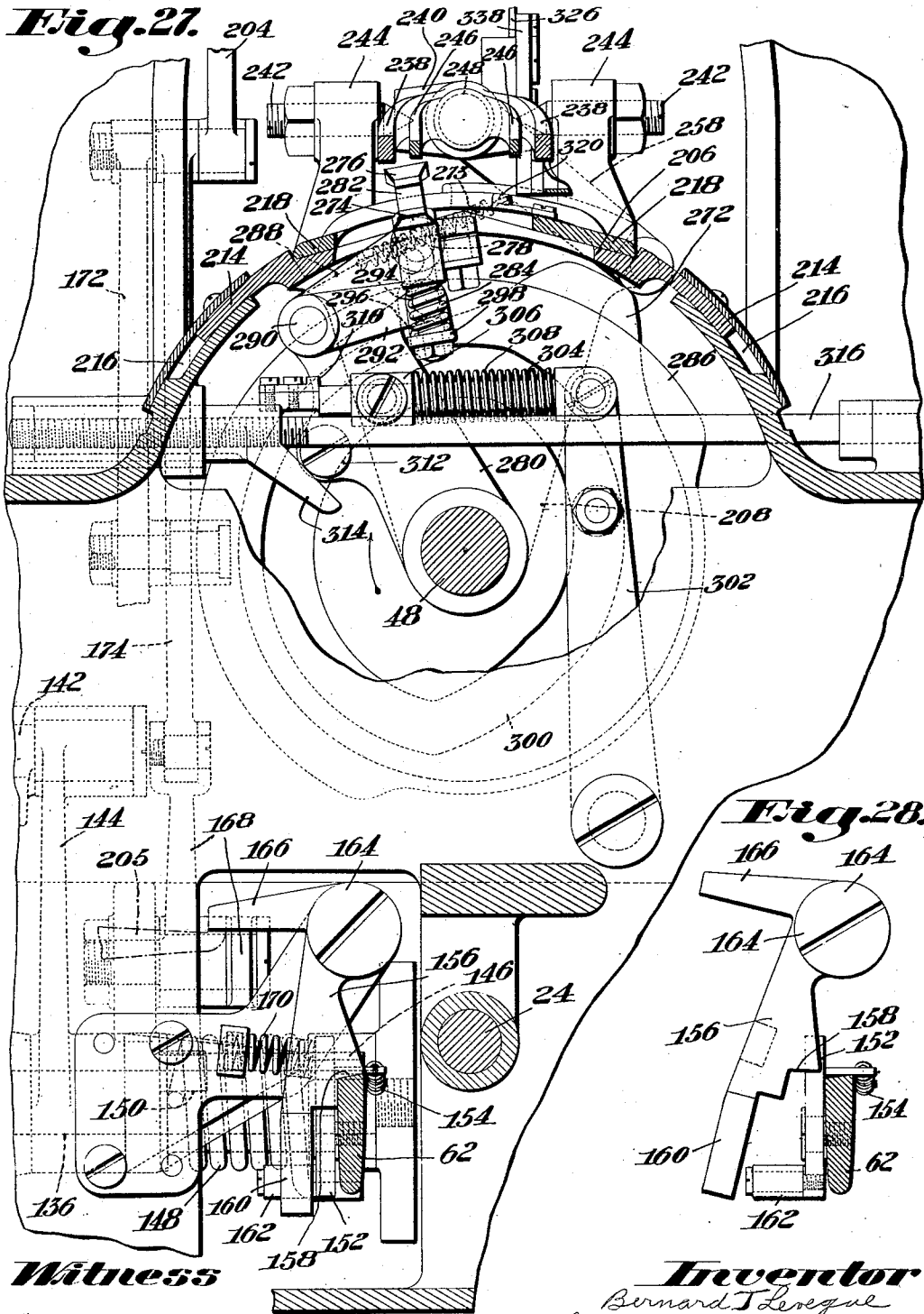
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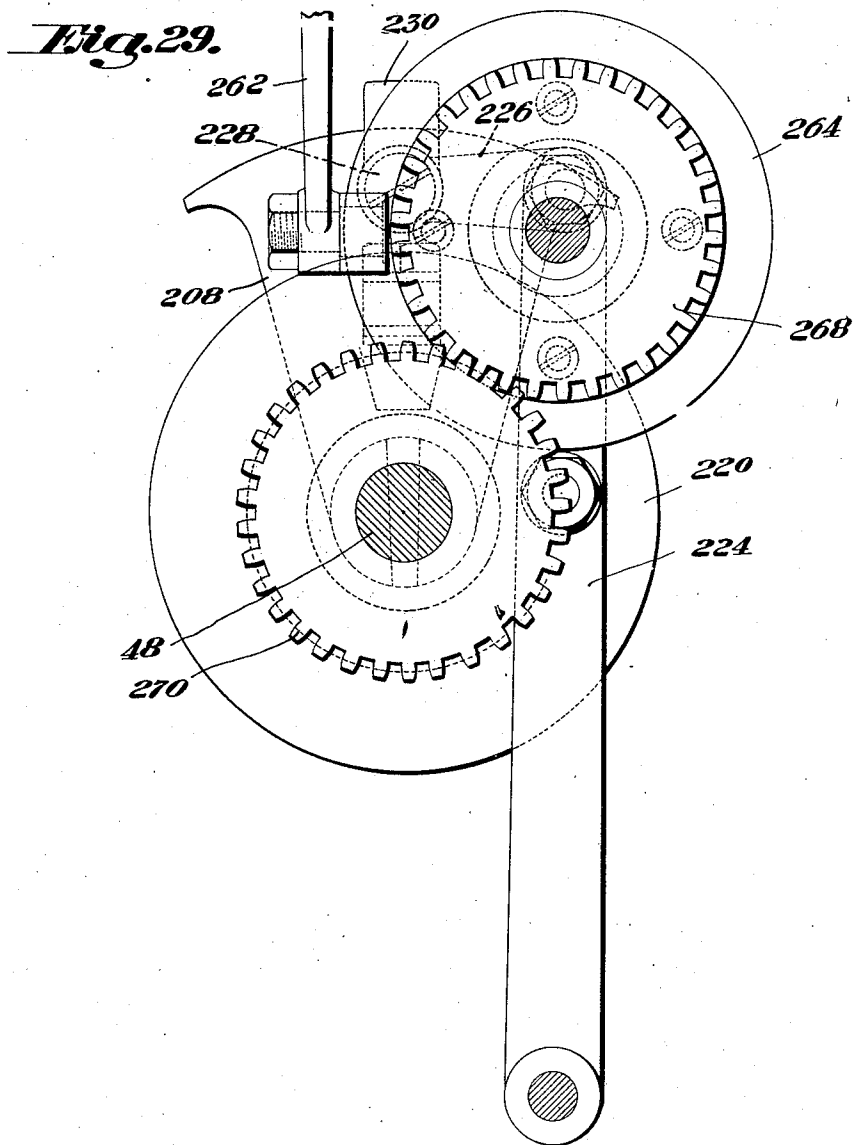
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BUTTONHOLE SEWING MACHINE

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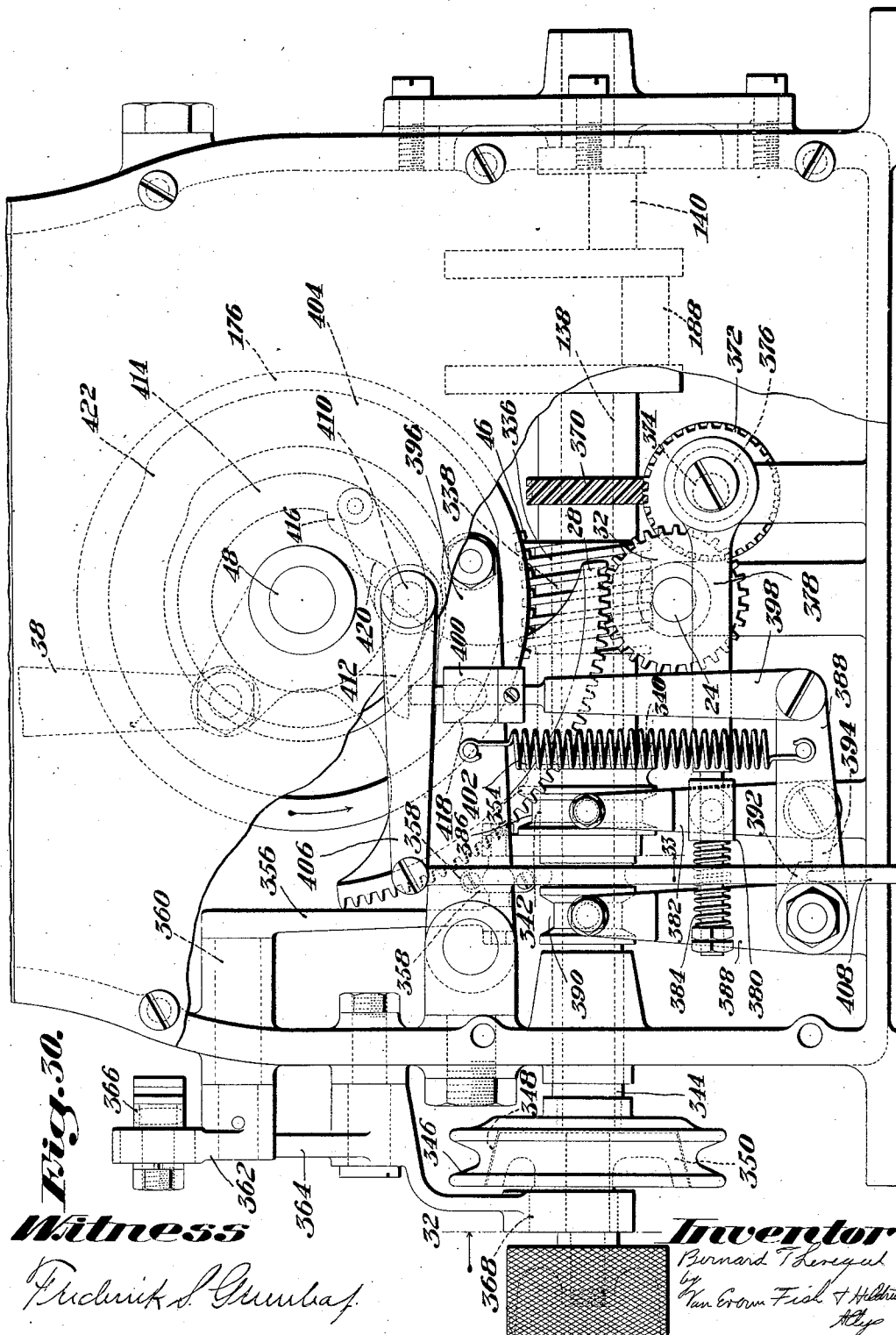
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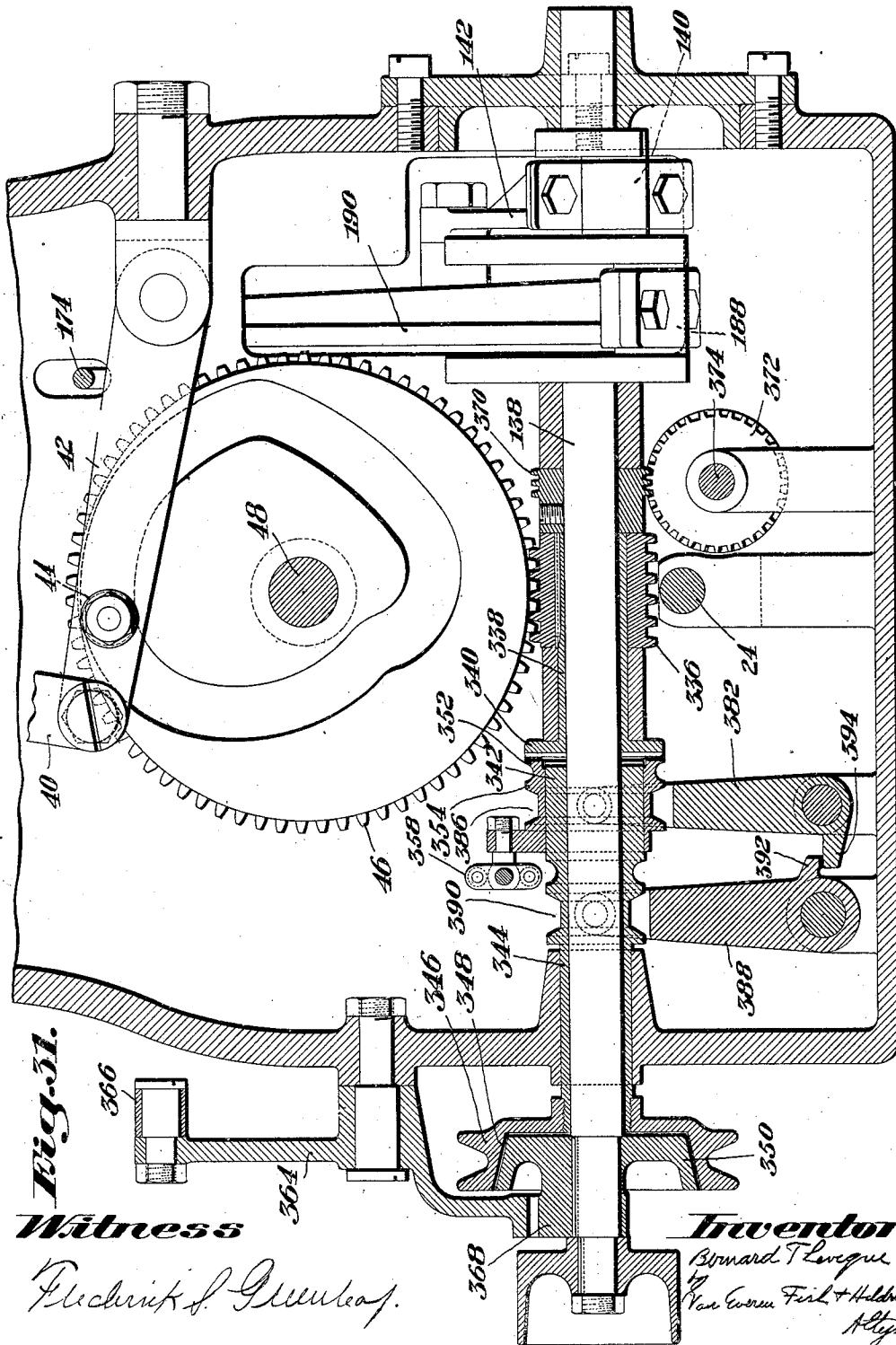
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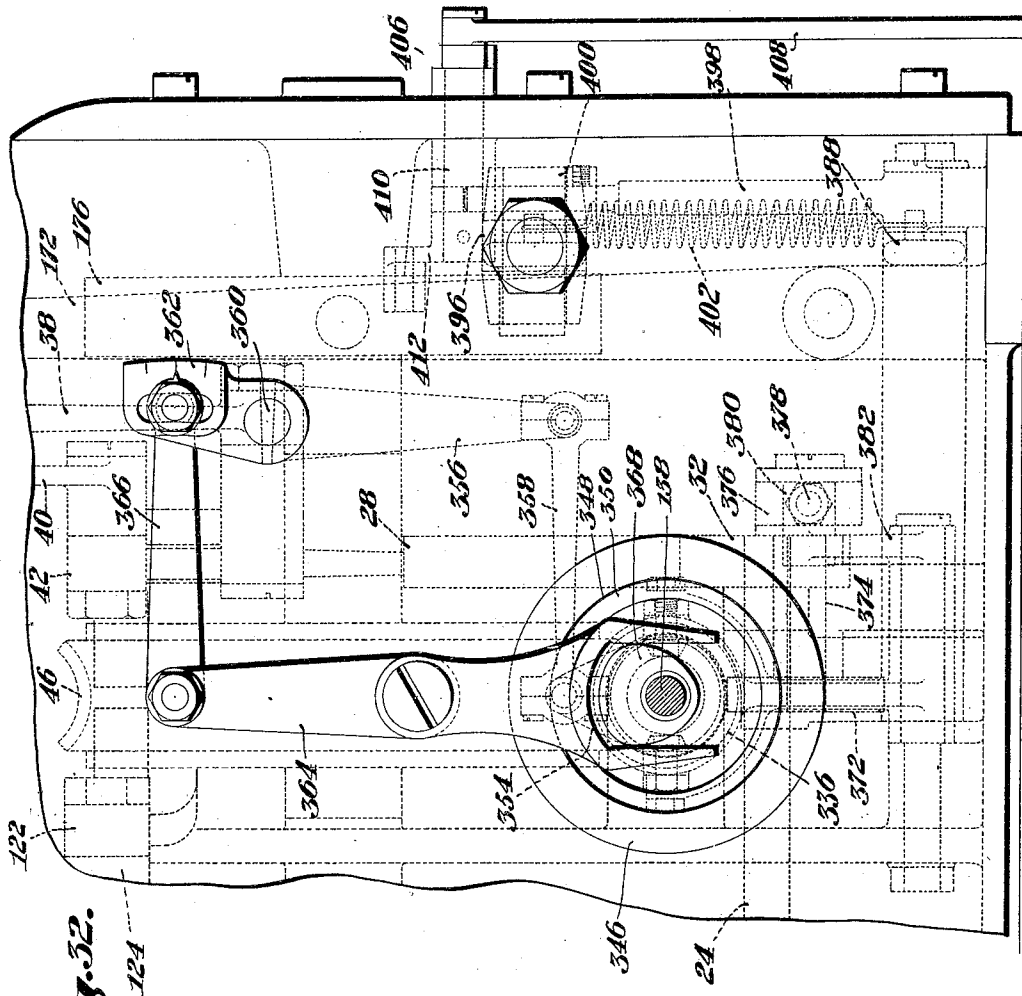


Fig. 32.

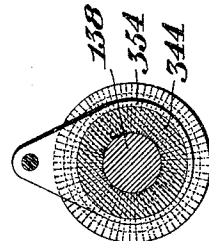


Fig. 33.

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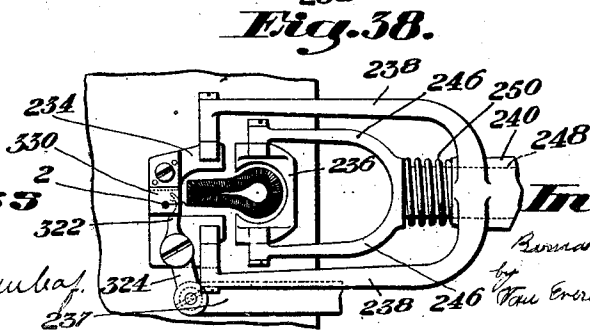
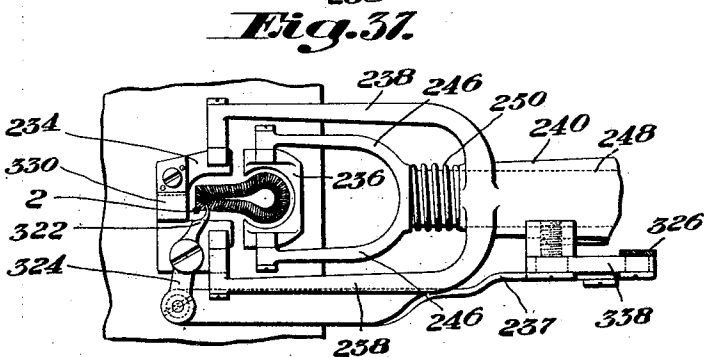
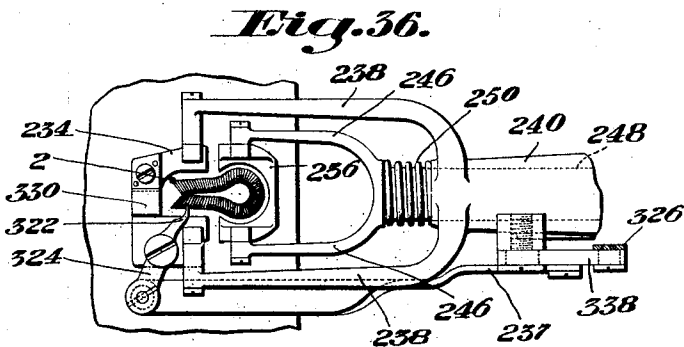
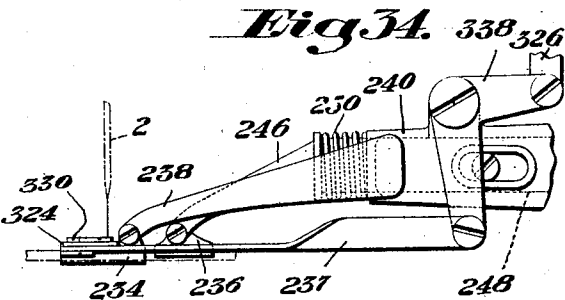
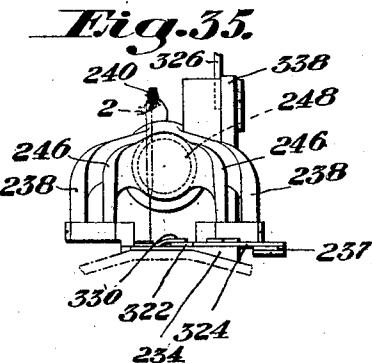
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BUTTONHOLE SEWING MACHINE

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UNITED STATES PATENT OFFICE

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BUTTONHOLE-SEWING MACHINE

Application filed September 26, 1918. Serial No. 255,849.

This invention relates to buttonhole sewing machines, and more particularly to machines in which the work clamp and sewing mechanism are relatively moved to sew an
5 overseam along the sides and about one or both ends of eye-ended buttonholes.

The machine in which the various features of the invention have been incorporated is particularly designed for sewing buttonholes in shoe flies, although the invention is not confined in its application to such machine. The requisite relative movements between the work and sewing mechanism are secured by movement of the work clamp lengthwise and laterally of the buttonhole, and by rotation of the sewing mechanism while sewing about the eye or about the eye and bar ends of the buttonhole, as is usual in this type of machine. The buttonhole slit is cut
20 progressively during the sewing by a small reciprocating cutter which operates just in advance of the needles of the sewing mechanism and cuts through the work just ahead of the sewing point, thus avoiding the loss of time incident to cutting the buttonhole slit either before or after the sewing. The cutter is preferably arranged and operated to cut at an angle to the surface of the work so that the opposite edges of the buttonhole slit are oppositely inclined to give clear-
30 ance for the passage of the under needle without lateral spreading of the slit and the distortion of the finished buttonhole incident thereto. This manner of cutting the buttonhole slit also permits a straight under needle to be reciprocated through the slit into and out of position for the upper needle to pass down through the loop of under thread carried thereby, even when operating
40 upon thick stock which would otherwise require such an extreme spread of the slit in order to remove its upper edge from the path of the under needle as to render the use of a reciprocating straight under needle impracticable. The upper thread is automatically cut and held after the sewing of the buttonhole is completed, the work clamp is opened, and the work is automatically shifted in the work clamp to bring it into position for the sewing of the succeeding button-

hole, thus avoiding the loss of time incident to manually shifting the work and starting the machine after the sewing of each buttonhole. The sewing mechanism is actuated
55 through connections which permit the needle bars to be retained at the limit of their retracting stroke when the seam has been completed, while the shaft and the unarrested members of the connections may continue to move independently, thus avoiding the shock and wear incident to arresting the shaft and connections at a definite point in the cycle in order to bring the needles into proper stopped position at the end of the
60 sewing.

The features of the invention will be understood from an inspection of the accompanying drawings and the following detailed description of the machine illustrated
70 therein.

In the drawings, Figure 1 is a side elevation of a machine embodying the features of the invention in their preferred form; Fig. 2 is a front elevation, parts of the enclosing casing being removed to show the mechanism otherwise hidden thereby; Fig. 3 is a rear elevation; Fig. 4 is a vertical sectional view of the forward part of the machine on line 4,
75 Fig. 2; Fig. 5 is a similar view of the rear part of the machine on line 5, Fig. 3; Fig. 6 is a partial view similar to Fig. 4, on a larger scale, and showing the parts in a different position; Fig. 7 is a vertical sectional view on line 7, Fig. 1; Fig. 8 is a detail view showing a different position of the parts; Fig. 9 is a partial elevation looking toward the left in Fig. 7; Fig. 10 is a sectional view on line 10,
80 Fig. 7; Figs. 11 to 19 are detail views illustrating the operation of the sewing mechanism and buttonhole cutter; Fig. 20 is a detail front elevation of the turret and the mechanism carried thereby; Fig. 21 is a detail elevation looking from the right in Fig. 20; Fig. 22 is a plan view of the parts shown in Fig. 21;
85 Fig. 23 is a horizontal sectional view on lines 23 of Figs. 20 and 21; Fig. 24 is a sectional elevation showing the mechanism for arresting the movement of the under thread mechanism; Fig. 25 is a sectional plan view on
90 100

line 25, Fig. 24; Fig. 26 is a sectional plan view on line 26, Fig. 1, showing the work clamping mechanism; Fig. 27 is a vertical sectional view on line 27, Fig. 4 (the clamp being closed and the jaws spread); Fig. 28 is a detail showing the stop dog for the under thread mechanism in its inactive position; Fig. 29 is a detail elevation showing a part of the mechanisms for closing the work clamp and for moving the clamp laterally; Fig. 30 is a partial rear elevation, the casing being broken away to show the parts hidden thereby; Fig. 31 is a sectional view on line 31, Fig. 1; Fig. 32 is a detail elevation, the sewing shaft being cut on the line 32, Fig. 30; Fig. 33 is a sectional detail on line 33, Fig. 30; Fig. 34 is a detail side elevation showing the thread cutter mechanism; Fig. 35 is a front elevation, looking toward the right in Fig. 34; and Figs. 36, 37 and 38 are detail plan views illustrating the operation of the thread cutter.

The machine illustrated in the drawings comprises generally a work clamp movable lengthwise and laterally of the buttonhole, sewing mechanism which is mounted to rotate while sewing about the eye and about the bar end of the buttonhole, a small reciprocating cutter which acts on the work just ahead of the sewing point and is mounted to rotate about the same axis as the sewing mechanism while cutting the eye of the buttonhole, a thread cutter and holder for cutting and holding the upper needle thread at the completion of the sewing, and a work spacing gripper which grips the work and shifts it into position for the sewing of a succeeding buttonhole after the thread has been cut and the work clamp has been opened.

The sewing mechanism comprises an upper needle 2, an under needle 4, and a looper 6, which co-operate to sew the well-known overseam stitch. The upper needle is clamped in a block 8 secured to the lower end of a hollow needle bar 10 which is mounted to reciprocate through and to turn with a bearing sleeve 12. (Figs. 2, 4, 7 and 10). The sleeve is rotated while sewing about the eye and about the bar end of the buttonhole through a horizontal shaft 14 connected therewith by bevel gears 16. The lower needle and looper are mounted on a rotary turret 18 which also carries the throat plate 20 through which the needles pass, and which is provided with the usual stay cord guide 22 (Figs. 21 and 22). The turret is rotated while sewing about the eye and about the bar end of the buttonhole through a horizontal shaft 24 connected therewith by bevel gears 26. The shafts 14 and 24 are rotated in unison at the proper times during the sewing through two gear segments 28 and 30, the former of which engages a pinion 32 on the rear end of the shaft 24, and the latter of which engages a pinion 34 which is connected with the rear end of

the shaft 14 by pinions 36. The two segments are connected by a link 38 which is in turn connected by a link 40 with a lever 42 which carries a roll 44 engaging a cam groove formed in the side of a worm wheel 46 secured to the cam shaft 48 of the machine. (Figs. 3 and 5.)

The lower needle 4 is a straight eye-pointed needle and it is secured in the upper end of a hollow needle bar 50 which is mounted to reciprocate in bearings on the turret 18. (Figs. 20-23.) The path of movement of the needle is at an inclination to the path of movement of the upper needle, and is such that the under needle passes up through the throat plate and presents a loop of under thread in position for the passage down therethrough of the upper needle, as indicated in Figs. 11 and 12. The needle bar is reciprocated through a lever 52 secured to a rock shaft 54 on the turret and connected by a link 56 with a collar 58 adjustably secured to the needle bar. The lever is oscillated and the shaft 54 rocked through a link 60 connecting the lever with the end of an oscillating lever 62, which will presently be described. The looper 6 which takes a loop of thread from the upper needle and carries it into position over the under needle, as indicated in Figs. 14 to 16, is secured in the upper end of a vertical lever 64 mounted to swing about a pivot 66 which projects horizontally from the hub of a looper carrying lever 68. The looper lever 64 is swung on its pivot through a link 70 which connects the lower end of the lever with a crank 72 which is secured to the end of a rock shaft 74. The carrier lever 68 on which the looper lever is pivoted, is rocked to move the looper laterally by a three-cornered eccentric 76 secured to the rock shaft 74 and arranged between the arms 78 at the lower end of the lever. The shaft 74 is rocked through a link 80 which connects an arm 82 on the rock shaft with an arm 84 on the rock shaft 54.

This under needle and looper mechanism is simple and durable, and well adapted for high speed operation, since the motions are easy and under positive control. The straight needle bar and needle reciprocating at an inclination to the upper needle path contribute to the simplicity and compactness of the mechanism, and are also particularly well adapted for sewing buttonholes, such, for instance, as fly bar buttonholes, in which the under needle penetrates the stock at certain points in the seam, and is therefore subjected to strains which curved under needles are ill adapted to withstand.

The mechanism for cutting the buttonhole slit comprises a cutter blade 86 arranged to pass through an opening 88 formed in the throat plate directly in advance of the path of the under needle 4. The cutting point of the blade is preferably curved in cross-section, as indicated in Fig. 13, so that it will act

to properly shape the buttonhole slit when cutting about the eye. The cutter blade is secured to the lower end of a cutter bar 90 mounted to reciprocate in a guideway in a support 92. The cutter bar is preferably arranged to move in a path parallel to the path of movement of the lower needle, so that the cutter will cut a narrow slit in the work, the inclination of which corresponds to the path of movement of the under needle. The needle will therefore pass through the slit without danger of striking its upper edge, whatever the thickness of the work. The cutter bar is reciprocated from the upper needle bar through a lever 94 connected by a link 96 to the cutter bar, and by a link 98 to a sleeve 100 which surrounds the needle bar and is confined between the needle block 8 and a collar 102 secured to the bar (Fig. 7.) The support 92 for the cutter bar is secured to the lower end of a sleeve 104 which surrounds the sleeve 12, and is mounted for rotation in a bearing in the head of the machine. The cutter carrying sleeve 104 is rotated during the sewing about the eye of the buttonhole through a sleeve 106 surrounding the needle bar sleeve 12 and supported by a semi-circular shoe 108 formed on the end of a fixed stud 110 and engaging an annular groove in the sleeve. This sleeve is connected with the sleeve 104 by coupling lugs 112 which project from the upper end of the sleeve 104 into slots formed in the lower end of the sleeve 106. This coupling permits the sleeve 104 to be moved vertically to render the cutter active or inactive. The sleeve 106 is rotated through a horizontal shaft 114 connected therewith by bevel gears 116 and rocked at suitable intervals through a gear segment 118 engaging a pinion 120 on the rear end of the shaft and operated through a lever 122 connected with the segment by a link 124 and operated by a cam groove in the front face of the worm wheel 46 which is engaged by a roll on the lever. (Figs. 3, 4 and 5.)

The mechanism for raising the cutter carrier sleeve 104 to render the cutter inactive comprises a bell crank lever 126, the forward end of which is connected by a link 128 with a semi-circular shoe 130 which engages an annular groove in the sleeve, and the other end of which carries a roll which is held in engagement with a cam 132 on the rock shaft 14 by a spring 134.

At the beginning of the sewing the under needle passes up through the work into the position indicated in Fig. 11, and as it starts downward throws out a loop of under thread in position for the passage therethrough of the upper needle, as indicated in Fig. 12. During the downward stroke of the upper needle the cutter bar is moved downward and the cutter blade acts to cut a slit in the work just in advance of and close to the under needle, as indicated in Figs. 7 and 13. After the looper has taken a loop of upper needle thread the needles are returned to active positions and the looper carries the loop of thread over the under needle, the return movement of the upper needle bar raising the cutter into its upper position clear of the work. The feed of the work then takes place and the slit cut by the cutter is brought into register with the under needle so that the needle passes up through this slit during its next upward movement. These operations are repeated during each stitch-forming cycle and the buttonhole slit is progressively cut just in advance of the sewing point. When the sewing of the first side of the buttonhole has reached the point indicated in Fig. 17, the cutter bar carrier is rotated to progressively cut the semi-circular end of the buttonhole eye as the sewing progresses. During the sewing down the opposite side of the buttonhole the cutter continues to act progressively and cuts this edge of the buttonhole slit at an angle to the surface of the work corresponding to the inclination of the under needle path and opposite to the inclination of the opposite edge of the slit. As the bar end of the buttonhole is reached, or substantially at the point in the sewing indicated in Fig. 18, the cam 132 acts to raise the cutter carrier sleeve 104 into the position indicated in Fig. 8 so that the downward movement of the needle bar will not bring the cutter into engagement with the work, and thus renders the cutter inactive during the continued operation of the sewing mechanism in sewing about the bar end of the buttonhole. In case the seam is to extend beyond the end of the buttonhole slit, as, for instance, in the case of a fly bar buttonhole, the mechanism for rendering the cutter active and inactive should be constructed to hold the cutter out of active position during the sewing of the beginning as well as the end of the seam, and should throw it into action when the desired point in the sewing of the first side of the buttonhole is reached, and again throw it out of action when the same point is reached in sewing the second side of the buttonhole. The cutter may be rendered inactive at the will of the operator by a cam 131 secured on a manually-operable rock shaft 133 and arranged to lift the lever 126 and support it in raised position.

Both the upper needle bar and the under needle and looper mechanism are connected with parts which reciprocate synchronously therewith, and are actuated from a continuously rotating shaft through connections which permit the reciprocating parts to be arrested and held at the limit of their needle retracting strokes without requiring the arrest of the shaft and connections through which motion is normally transmitted to the reciprocating parts. Means is also provided

for disconnecting the power from the actuating shaft and for arresting the movement of the reciprocating parts and the connected needles to stop the stitch-forming mechanism in proper position for the spacing of the work when the sewing of the buttonhole has been completed.

The mechanism for actuating the under needle and looper mechanism comprises the lever 62, which, as before stated, is connected with the needle and looper mechanism on the turret through the link 60 so that the reciprocation of the under needle is synchronous with the reciprocation of said lever. The lever 62 is mounted on a fixed shaft 138 and is oscillated during the sewing from a continuously running shaft 138 which is provided with a crank 140 connected by a link 142 with one arm of a bell crank lever 144, the other arm of which is provided with a lateral projection 146 overlying the lever 62. (Figs. 4, 5, 24, 25, 27, 28 and 31.) The lever 62 and lever 144 are normally held in engagement so that they move in unison by a heavy spring 148 coiled about the hub of the lever 144 and having one end engaging a lug 150 on the lever and the other end engaging the under side of the lever. The levers 62 and 144 are also normally locked together by a latch 152 pivoted on the lever 62 and provided at its upper end with a shoulder adapted to overlie the projection 146 on the lever 144. The latch is held normally in engagement with the projection 146 by a spring 154. After the sewing of the buttonhole is completed the latch 152 is disengaged from the lever 144 and the lever 62 is locked in its lower or needle retracted position, by a stop dog 156 having a shoulder 158 adapted to be brought into position over the lever, and also provided with a latch controlling finger 160 adapted to be brought into the path of a roll 162 on the lower end of the latch 152 during the final downward movement of the lever. The stop dog is mounted upon a fixed pivot 164, and is provided with a laterally projecting tail piece 166 which overlies the forward end of a bell crank lever 168. During the sewing the bell crank lever holds the dog 156 in its inactive position, indicated in Fig. 28. When the stitch-forming mechanism is to be arrested at the end of the sewing, the bell crank lever is rocked to release the dog, which is then forced towards its active position by the spring 170 (Fig. 27). The bell crank lever is thus rocked when the lever 62 is in its upper or needle advanced position during the last stitch-forming cycle by a cam lever 172, the upper end of which is connected by a link 174 with the bell crank lever. The lever 172 is operated at the proper intervals during the operation of the machine by a cam groove formed in a cam disk 176 which is secured to the cam shaft 48 (Fig. 5). When the stop dog is released it swings towards the

right in Fig. 28, and rides against the side of the lever 62 during the downward or needle retracting stroke of the lever. This movement of the dog brings the finger 160 into the path of the roll 162 so that the latch 152 is disengaged from the lever 144 during the downward movement of the lever 62. When the lever passes below the shoulder 158 the dog snaps forward into active position, as indicated in Fig. 27, and retains the lever and the connected under needle and looper mechanism in retracted position during the continued movement of the actuating shaft 138 and the lever 144, which is permitted by the yielding of the spring 148.

The upper needle bar is reciprocated through a lever 178 mounted on a stationary shaft 180 and connected to an adjustable sleeve 182 on the bar by links 184, so that the lever reciprocates synchronously with the bar. The lever 178 is oscillated about the shaft 180 by a bell crank lever 186. The lever 186 is oscillated to advance and retract the upper needle bar by a crank 188 on the shaft 138, which is connected by a link 190 to the knuckle of two toggle links 192 which connect the lower end of the bell crank lever to a fixed pivot 194. The devices for connecting the levers 178 and 186 and for disconnecting these levers and retaining the lever 178 in its upper or needle retracting position at the end of the sewing, are the same in construction and mode of operation as the devices already described for connecting the levers 62 and 144, and include the spring 196, latch 198, and stop dog 200, which is controlled by the bell crank lever 202 connected by a link 204 to the upper end of the cam lever 172, and is released by said lever during the last stitch-forming cycle, so that it retains the lever 178 and the connected upper needle bar in retracted position during the continued movement of the actuating shaft and the connections through which motion is normally transmitted therefrom to the lever 178. The clutch through which the shaft 138 is driven is disengaged as the sewing is completed, and the resistance of the springs 148 and 196, after the levers 62 and 178 have been arrested, act to overcome the momentum of the shaft and the motion-transmitting parts, and also act through the cranks 140 and 188 to finally bring the shaft to rest with the bell crank levers 144 and 186 in engagement with the levers 62 and 178.

The action of the stitch-forming mechanism is thus arrested or stopped by disconnecting it from the actuating shaft when the needles are in retracted position and the mechanism is at rest. The stopping of the mechanism is therefore effected without shock or jar, regardless of the speed at which the machine is being run, and without the necessity of stopping the actuating shaft and the entire train of mechanism through which motion is transmitted, at a definite point in the

rotation of the shaft. The sewing mechanism may therefore be run at high speed, and may be uniformly brought to stopping position at the end of the sewing without undue shock or wear, and regardless of variations in speed incident to operating conditions.

When the stitch-forming mechanism is stopped, the tension devices through which the upper and under needle threads are led to the needles, are operated to relieve the tension on the thread by the movement of the stop dogs 156 and 200 into stopping positions. The tension device for the under thread is operated to relieve the tension by the engagement of the tail of the stop dog 156 with a tension release lever 205 (Fig. 2), while the tension device for the upper thread is operated to release the tension by the engagement of the tail of the dog 200 with a tension release lever 207. (Figs. 2 and 4.)

The work clamp carriage comprises a curved plate 206 and two supporting arms 208 and 210 mounted to slide and rock on the cam shaft 48 and on a stud 212 projecting from the turret bracket in line with the shaft. (Figs. 2, 4, 6, 26 and 27.) The plate is substantially concentric with the shaft and stud, and is provided along each edge with a flange or wing 214 fitted within guideways 216 on the machine base, which are also concentric with the shaft and stud. The plate is provided with an opening which registers with the mechanism on the turret and with the work spacing gripper mechanism, and the forward part of this opening is covered by two work-supporting plates 218 which are removable to give access to the mechanism below the plates. The work-supporting plates are slotted to embrace the throat plate, and are provided at their rear ends with an opening in which the work spacing gripper plays. (Figs. 26 and 27.) The clamp carriage is moved longitudinally or lengthwise of the buttonhole by a feed cam 220 secured to the cam shaft 48 and provided with a cam groove engaging a roll 222 mounted on an arm projecting from the supporting arm 208. The clamp carriage is moved laterally by a cam groove formed in the rear face of the feed cam 220 and engaged by a roll on a lever 224, the upper end of which is connected by a link 226 with a stud 228 projecting from the clamp carriage. (Figs. 4, 6 and 29.) The stud 228 is arranged to slide through the end of the link during the backward and forward movement of the clamp carriage, and this end of the link is provided with a vertical projection 230 arranged to move laterally in a fixed guideway 232.

The work is clamped on the work plates 218 by front and rear clamping jaws 234 and 236 arranged to engage the upper surface of the work and shaped to embrace the path of action of the stitch-forming mechanism. (Figs. 6 and 26.) The front clamping jaw

234 is pivotally supported in the arms 238 of a yoke formed on the forward end of the clamp lever 240, which is pivotally supported on pivot screws 242 adjustably secured in lugs 244 projecting from the clamp carriage. The rear clamping jaw 236 is pivotally supported in the arms 246 of a yoke formed on the forward end of a bar 248 which is mounted to slide lengthwise of the buttonhole within the clamp lever 240, and is forced yieldingly forward by a spring 250. The position of the rear clamping jaw with relation to the front clamping jaw is determined by a collar 252 secured to the rear end of the bar 248 and provided with V-shaped cam projections 254 arranged to engage similar projections 256 on the hub of a lever 258. When the work clamp is closed, the rear jaw is moved away from the front jaw to strain or tension the work lengthwise of the buttonhole by the movement of the lever 258 from the position indicated in Figs. 1 and 4, to the position indicated in Fig. 6, the cam projections 254 and 256 acting during this movement of the lever to move the bar 248 rearwardly against the tension of the spring 250. The lever is thus moved by cam 272 secured to the cam shaft and engaging a roll on the lower end of the lever which is held in engagement with the cam by a spring 273. This lengthwise straining of the work prevents spreading or distortion of the buttonhole slit after one side has been progressively cut by the cutter, and ensures the proper cutting of the eye and second side of the buttonhole slit, and the accurate and uniform shaping of the buttonholes.

The work clamp is held in closed position during the sewing by a spring 260 which underlies the rear end of the clamp lever and tends to force the clamping jaws against the work supporting plates. When the work clamp is in the position which it occupies at the beginning and at the completion of the buttonhole, the rear end of the work clamp underlies the forward end of a clamp operating lever 262, the other end of which is provided with a roll held in engagement with a cam 264 by a spring 266. The cam 264 is formed by the rear face of a disk secured to a gear 268 which is engaged and driven by a similar gear 270 on the cam shaft 48. After the sewing of the buttonhole has been completed, the high part of the cam acts upon the lever 262 to open the clamp, as indicated in Fig. 4. After the work has been spaced or positioned and the cam shaft started, in case it has been stopped between the sewing of successive buttonholes, the high part of the cam rides from under the lever, so that the forward end of the lever is raised and the work clamp is closed, as indicated in Fig. 6. After the clamp is closed, the lever 258 is operated to strain or stretch the work lengthwise of the buttonhole.

After the buttonhole has been completed and the work clamp opened, the work is moved laterally of the buttonhole to space it or bring it into position for the sewing of a succeeding buttonhole by a work spacing gripper comprising a lower jaw 274 and a vertically movable upper jaw 276. The lower jaw is formed at the forward end of a bar 278 which is adjustably clamped in the upper end of a gripper carrying lever 280. The upper jaw is formed on the upper end of a bar 282 which slides vertically through a bearing in the lower jaw, and is forced yieldingly toward the lower jaw by a spring 284 which tends to close the gripper jaws. The opening and closing of the gripper jaws is controlled by a cam 286 secured to the cam shaft and engaging a roll on the end of an arm 288, which is secured to the rear end of a rock shaft 290 mounted in the gripper carrying lever 280. The forward end of the rock shaft carries an arm 292, the end of which is provided with a bearing engaged by a rod 294 which is free to turn and slide in the bearing. The forward end of the rod is provided with a bearing 296 by which it is pivotally connected to a plate 298 on the lower end of the gripper bar 282.

The gripper carrying lever 280 is mounted to oscillate about the cam shaft 48, and is actuated by a cam groove 300 formed in the forward face of the cam disk 286 and engaging a roll on a lever 302. The upper end of the lever is pivotally connected to a link 304 arranged to slide through a block 306 pivoted to the side of the gripper carrier lever. A spring 308 surrounding the link tends to hold a stop 310 at the rear end of the link in engagement with the rear side of the pivot block 306. Through this connection the cam 300 will operate to move the gripper carrying lever and gripper toward the right in Fig. 27 to a fixed point, and will move them toward the left to a point determined by the engagement of a stop pin 312 on the lever with a fixed adjustable stop 314. The stop 314 may be adjusted to vary the travel of the work spacing gripper, and therefore the spacing between successive buttonholes by adjustment of the screw-threaded rod 316, the rear end of which is threaded in the stop and the forward end of which is provided with a knurled head 318.

The work is placed in the work clamp by the operator with its edge against the edge gage 320 and in position for the sewing of the first buttonhole. During the sewing of the buttonhole the upper jaw of the work spacing gripper is held in raised position by the cam 286, as indicated in Fig. 27. Before the buttonhole is completed the cam 300 acts to move the gripper toward the right, and the gripper is held at this end of its throw until the buttonhole is completed. Just before the work clamp is opened, the cam 286 releases

the upper jaw of the gripper so that it closes upon the work under the influence of the spring 284. After the clamp opens and releases the work the gripper is moved toward the left a distance depending upon the adjustment of the stop 314 to space the work for the succeeding buttonhole, the work being guided by the operator to maintain its edge against the edge gage during the spacing for successive buttonholes.

After the sewing has been completed, and before the work clamp is opened, the upper needle thread is severed and held by a thread-cutting and holding device mounted upon the front work clamping jaw. (Figs. 4, 26 and 34 to 38.) This device comprises a thread-engaging finger 322 formed on the free end of a lever 324 pivoted to the upper side of the jaw 234 and having its outer end connected by a twisted link 237 with one arm of a bell crank lever 338 which is pivoted on the clamp lever 240 and is connected by a link 326 with the forward end of a lever 328 which is also pivoted on the clamp lever. The thread finger is arranged to carry the needle thread under a co-operating thread-holding plate 330, and against a cutter formed by the upper inner edge of the jaw 234 above which the plate 330 is located. The thread cutter and holder is operated from the clamp opening and closing lever 262 by means of a pin 332 projecting from the side of the lever into a slot 334 in the rear end of the lever 328. The slot is made of sufficient width to provide for lost motion between the lever 262 and the lever 328. At any convenient time during the sewing of the buttonhole the lever 262 is rocked slightly to withdraw the thread cutting and holding finger from the position indicated in Fig. 38 to the position indicated in Fig. 36. The finger remains in this position until the sewing of the buttonhole is completed, at which time the parts are in the position indicated in Fig. 37, the upper needle thread extending vertically from the needle to the end of the buttonhole seam and lying between the finger and the plate 330. After the sewing mechanism has been stopped, the lever 262 is rocked by the cam 264 to open the clamp. During the first part of this movement, and before the end of the lever engages the rear end of the clamp lever, the pin 332 engages the lower side of the slot 334 and operates the lever 328 to swing the thread finger from the position indicated in Fig. 37 to the position indicated in Fig. 38, so that the upper needle thread is severed close to the work and the end of the thread held between the finger and the plate 330. The continued movement of the lever 262 then opens the work clamp, as indicated in Fig. 4. When the lever 262 is operated to close the clamp, the thread-cutting mechanism, including the lever 328, moves with

the work clamp lever, so that the thread finger remains in position beneath the plate 330 and continues to hold the end of the thread until the lever 262 is given an additional upward movement sufficient to bring it into engagement with the upper side of the slot 334.

Assuming that the parts are in position for the closing of the clamp preparatory to sewing a buttonhole, the cycle of operations performed by the machine are briefly as follows: The cam shaft 48 is driven at high speed for a partial revolution to close the work clamp, to stretch the work, and to give the work clamp a slight forward movement into sewing position. The sewing mechanism is then thrown into operation, and during the sewing the cam shaft is given a step-by-step movement by mechanism driven from the sewing shaft 138 to feed the work, and to rotate the stitch-forming mechanism and the cutter while sewing about the eye of the buttonhole, and to rotate the stitch-forming mechanism while sewing about the bar end of the buttonhole. When the end of the seam is reached the sewing mechanism is stopped and the cam shaft 48 is again driven at high speed for the remainder of its revolution to return the work clamp to its initial retracted position to operate the thread cutter, to open the work clamp, and to operate the work spacing gripper to space the work, and to turn the sewing mechanism and cutter back or partially back to initial position. This completes the cycle of operations, which may be immediately repeated without appreciable interruption in the operation of the machine, until the desired series of buttonholes has been sewn.

The mechanism for thus driving the cam shaft comprises the worm wheel 43 and a worm 336 engaging the worm wheel and adapted to be rotated either continuously at high speed or intermittently from the shaft 138. (Figs. 30 to 33.) As shown in Fig. 31, the worm is secured to a sleeve 338 mounted to turn on the shaft 138 and provided at its end with a clutch member 340. The inner zone of the clutch member is arranged to be engaged by a clutch member 342 formed on the inner end of a sleeve 344 which is mounted to rotate and slide on the shaft 138. The outer end of the sleeve 344 carries a driving pulley 346 which is provided with a clutch member 348 adapted to be engaged by a clutch member 350 secured to the outer end of the shaft 138. The outer zone of the clutch member 340 is adapted to be engaged by a clutch member 352 formed on a sleeve 354 which is mounted to rotate and slide on the inner end of the sleeve 344. The clutch sleeve 354 is oscillated during the sewing and intermittently engaged with and disengaged from the clutch member 340.

The mechanism for oscillating the clutch

sleeve comprises a lever 356, the lower end of which is connected by a link 358 to the sleeve, and the upper end of which is carried on the inner end of a rock shaft 360. The outer end of the rock shaft is provided with an arm 362 which is connected to the upper end of a lever 364 by a link 366. The lower end of the lever 364 is slotted to embrace a three-cornered eccentric 368 formed on the hub of the clutch member 350. Through these connections oscillating movements are imparted to the clutch sleeve 354 whenever the shaft 138 is being driven to actuate the stitch-forming mechanism. By adjustment of the pivotal connection between the end of the lever 364 and the arm 362, the movement imparted to the clutch sleeve may be varied to vary the feed for each stitch-forming cycle and hence the number of stitches in the buttonhole being sewn.

The mechanism for engaging and disengaging the clutch sleeve 354 comprises a spiral gear 370 secured to the shaft 138 and engaging a similar spiral gear 372 which is secured to a shaft 374. The shaft 374 carries an eccentric 376 which is engaged by the rear end of a link 378, the forward end of which is shaped to slide through a block 380 pivoted to one arm of a lever 382. The block is held yieldingly in engagement with a shoulder on the link 378 by the spring 384. The other arm of the lever 382 is provided with arms embracing the clutch sleeve 354 and carrying pins projecting into an annular groove 386 in the sleeve. The eccentric 376 is timed to engage the clutch sleeve 354 with the clutch member 340 during the dwell at the end of the return movement of the sleeve, to retain the clutch member in engagement during the forward movement of the clutch sleeve, and to disengage the sleeve from the clutch member 340 during the dwell at the end of the forward movement of the sleeve.

This mechanism enables the cam shaft to be intermittently advanced while operating at high speed, since the clutch 352 affords a positive connection between the worm and the actuating eccentric 368 during the entire active stroke of the clutch sleeve, said positive connection being broken only when the worm and clutch sleeve are at rest.

The mechanism for controlling the operating clutches for the cam shaft comprises a clutch shifting lever 388, the upper end of which is provided with arms embracing the clutch sleeve 344 and provided with pins engaging an annular groove 390 in the sleeve. The hub of the lever is provided with a finger 392 arranged to engage a finger 394 on the lever 382 to disengage the clutch member 352 when the lever 388 is moved to shift the clutch sleeve 344 into neutral position or into position to engage the clutch member 342 with the clutch member 340.

The horizontal arm of the lever 388 is connected with a cam lever 396 by a link 398, the upper end of which slides through a block 400 pivoted to the lever 396. A spring 402 normally holds a collar on the link in engagement with the under side of the block so that the levers 396 and 388 will move in unison. The lever 396 carries a roll engaged by a cam groove 404 formed in the rear face of the cam disk 176. The cam groove is so shaped that at the end of the cycle of operations above referred to it will hold the parts in the positions indicated in Figs. 30 and 31, with the driving clutches for the cam shaft 48 and sewing shaft 138 in disengaged or neutral position. The machine is started by a starting lever 406 connected by a rod 408 with a treadle. The starting lever is secured to the outer end of a rock shaft 410, to the inner end of which a lever 412 is secured. One end of the lever is arranged to engage the upper end of the link 398, and the other end carries a roll engaging a concentric groove 414 formed in the rear face of the cam disk 176 and provided with a recess 416 which registers with the roll when the parts are in starting and stopping position, or at the end of the cycle. To start the machine the starting lever is operated to depress the link 398 and thus operate the cam shifting lever 388 to engage the high speed clutch member 342 with the clutch member 340. This starts the cam shaft at high speed, and during the first part of the revolution of the cam shaft the starting lever is held by the operator. As the point 418 in the cam groove 404 reaches the roll on the end of the lever 396, the cam 420 at the end of the recess 416 acts on the lever 412 to release the link 398 so that during the remainder of the cycle the levers 396 and 388 move in unison. At this point the cam 404 moves the levers 396 and 388 to shift the clutch sleeve 344 toward the left in Fig. 31, disengaging the clutch member 342 and engaging the clutch members 348 and 350. This starts the sewing shaft 138 and also starts the intermittent feed of the cam shaft. The parts are so timed that as the sewing of the buttonhole seam is completed, the point 422 in the cam 404 reaches the roll on the lever 396 and the cam moves the levers 396 and 388 to shift the clutch sleeve 344 toward the right in Fig. 31, disengaging the clutch members 348 and 350 and engaging the clutch members 342 and 340. The cam shaft is now driven at high speed for the remainder of its revolution, when the cam 404 moves the levers 396 and 388 to shift the clutch sleeve 344 into neutral or stopped position. The recess 416 is now again in register with the roll on the lever 412, so that the starting lever 406 may be operated by pressure on the treadle to start or continue the operation of the machine.

The driving and stopping mechanism shown and described is claimed in a divisional application Serial No. 605,002, filed December 5, 1922, upon which Patent No. 1,589,976 issued on June 22, 1926.

What is claimed is:

1. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism mounted to rotate while sewing about the eye of a buttonhole, and a cutter for progressively cutting the buttonhole during the sewing, mounted to rotate while cutting the eye.

2. A buttonhole sewing machine, having, in combination, a reciprocating and laterally-moving work clamp, rotary stitch-forming mechanism, a cutter for progressively cutting a buttonhole slit during the sewing, a cutter support, mechanism for feeding the work clamp and rotating the stitch-forming mechanism to sew along the sides and about the eye end of the buttonhole, and for reciprocating the cutter during the sewing, and for rotating the cutter support to cut about the eye.

3. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism, a cutter arranged to cut the work approximately at the sewing point, a cutter support, and mechanisms for rotating the stitch-forming mechanism and the cutter support while sewing about the eye of the buttonhole.

4. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism, mechanism for relatively moving the stitch-forming mechanism and work clamp, and for rotating the stitch-forming mechanism to sew along the sides and about the eye and bar ends of a buttonhole, a cutter arranged to progressively cut the buttonhole slit during the sewing, a cutter support, mechanism for rotating the support while sewing about the eye, and mechanism for rendering the cutter inactive while sewing about the bar end of the buttonhole.

5. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising upper and under needles and a looper, a cutter arranged to progressively cut along the path of operation of the under needle, mechanism for relatively moving the clamp and stitch-forming mechanism and for rotating the stitch-forming mechanism and the cutter to cut and sew along the sides and about the eye of the buttonhole.

6. A buttonhole sewing machine, having, in combination, a work clamp, including means for straining the work lengthwise of the buttonhole, stitch-forming mechanism, a cutter for progressively cutting a buttonhole slit during the sewing, and mechanism for

reciprocating the cutter while sewing along each side of the slit.

7. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism, mechanism for relatively moving the stitch-forming mechanism and work clamp and for rotating the stitch-forming mechanism to sew about a buttonhole, a cutter for progressively cutting the buttonhole, mechanism for rotating the cutter to cut about the eye end of the buttonhole and for rendering the cutter inactive while sewing at the bar end of the buttonhole.

8. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism, mechanism for relatively moving the stitch-forming mechanism and work clamp and for rotating the stitch-forming mechanism to sew about a buttonhole, a cutter for progressively cutting the buttonhole slit during the sewing, mechanism for actuating the cutter and for rotating it while sewing about the eye of the buttonhole, and mechanism for rendering the cutter inactive during a part of the sewing.

9. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising an upper needle and an under needle reciprocating in a path inclined to the path of the upper needle, and means for cutting a buttonhole slit for the passage of the under needle, the edges of which have substantially the inclination of the under needle path.

10. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising an upper needle and an under needle reciprocating in a path inclined to the path of the upper needle, a cutter for progressively cutting a buttonhole slit during the sewing mounted to reciprocate in a path having substantially the same inclination as the under needle path.

11. A buttonhole sewing machine having, in combination, a work clamp, a rotary stitch forming mechanism, and means for progressively cutting the buttonhole slit during the sewing.

12. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising a vertically reciprocating upper needle, a straight under needle mounted to reciprocate in a right line inclined and close to the upper needle path, a looper for presenting a loop of upper needle thread in position below the work for the passage therethrough of the under needle, a cutter for progressively cutting the buttonhole slit at an inclination corresponding substantially to the inclination of the under needle path, and mechanism for relatively moving the stitch-forming mechanism and the work clamp to sew about a buttonhole.

13. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming

mechanism comprising a vertically reciprocating upper needle bar, a cutter bar, connections for reciprocating the cutter bar from the needle bar during successive reciprocations of the needle bar, and mechanism for relatively reciprocating and rotating the work clamp and stitch-forming mechanism to sew about a buttonhole.

14. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising a vertically reciprocating upper needle bar, a cutter bar, connections for reciprocating the cutter bar from the needle bar during successive reciprocations of the needle bar, means for varying the path of reciprocation of the cutter bar to render the cutter active or inactive, and mechanism for relatively moving the work clamp and stitch-forming mechanism to sew about a buttonhole.

15. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising a vertically reciprocating upper needle bar, a rotary support for the bar, a cutter bar, a rotary support for the cutter bar, and connections for reciprocating the cutter bar from the needle bar during the sewing.

16. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising a vertically reciprocating upper needle bar, a rotary sleeve in which the bar is mounted, a cutter bar, a support for the bar, a rotary sleeve carrying the support and surrounding the needle bar sleeve, a second sleeve surrounding the needle bar sleeve, a coupling between the sleeves, connections for reciprocating the cutter bar from the needle bar during the sewing, and means for raising and lowering the support sleeve to render the cutter active or inactive.

17. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising an upper needle, an under needle and a looper, a vertical looper lever on the upper end of which the looper is carried, a supporting lever having a transverse pivot on which the looper lever is mounted, mechanism for swinging the looper lever on its pivot to take the loop from the upper needle, mechanism for rocking the supporting lever to move the looper lever transversely of its swinging movement, and mechanism for relatively moving the stitch-forming mechanism and work clamp to sew about a buttonhole.

18. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising an upper needle, an under needle and a looper, a vertical looper lever on the upper end of which the looper is carried, a supporting lever having a transverse pivot on which the looper lever is mounted, a rock shaft provided with an eccentric connected to rock the supporting lever,

and with a crank connected to swing the looper lever on its pivot, and mechanism for relatively moving the stitch-forming mechanism and work clamp to sew about a buttonhole.

19. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising an upper needle, an under needle and a looper, a vertical looper lever on the upper end of which the looper is carried, a supporting lever having a transverse pivot on which the looper lever is mounted, and having spaced arms at its lower end, a rock shaft, a three-cornered eccentric on the shaft embraced by the arms of the supporting lever, a crank on the shaft, and a link connecting the crank and looper lever.

20. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising a vertically reciprocating upper needle bar, an under needle bar reciprocating at an inclination to the upper needle bar, and a looper, a rotary carrier for the upper needle bar, a turret carrying the under needle bar and looper, a looper lever on the upper end of which the looper is carried, a supporting lever having a transverse pivot on which the looper lever is mounted, a rock shaft on the turret connected to swing the looper lever on its pivot, to rock the supporting lever, and to reciprocate the under needle bar, and mechanism for relatively moving the stitch-forming mechanism and work clamp to sew about a buttonhole.

21. A buttonhole sewing machine, having, in combination, a work clamp, stitch-forming mechanism comprising a vertically reciprocating upper needle bar, an under needle bar reciprocating at an inclination to the upper needle bar, and a looper, a rotary carrier for the upper needle bar, a turret carrying the under needle bar and looper, a vertical looper lever on the upper end of which the looper is carried, a supporting lever having a transverse pivot on which the looper lever is mounted, a rock shaft provided with an eccentric connected to rock the supporting lever and with a crank connected to swing the looper lever on its pivot, a rock shaft having an arm connected to rock the former rock shaft and an arm connected to reciprocate the under needle bar, and mechanism for relatively moving the stitch-forming mechanism and work clamp to sew about a buttonhole.

22. A buttonhole sewing machine, having, in combination, stitch-forming mechanism comprising a vertically reciprocating upper needle, an under needle for presenting a loop of under needle thread in position above the work for the passage of the upper needle down therethrough, and a looper for presenting a loop of upper thread in position below the work for the passage of the under needle up therethrough, a toggle connected to reciprocate the upper needle and arranged to be

substantially straight when the needle is retracted, mechanism for actuating the toggle, and mechanism for relatively moving the work and stitch-forming mechanism to sew about a buttonhole.

23. A buttonhole sewing machine, having, in combination, stitch-forming mechanism comprising a vertically reciprocating upper needle bar, an under needle for presenting a loop of under thread in position above the work for the passage of the upper needle down therethrough, and a looper for presenting a loop of upper thread in position below the work for the passage of the under needle up therethrough, a lever having one end connected with the needle bar, a toggle connected to the other end of the lever, and arranged to be substantially straight when the needle bar is retracted, a crank connected to actuate the toggle, and mechanism for relatively moving the work and stitch-forming mechanism to sew about a buttonhole.

24. A buttonhole sewing machine, having, in combination, stitch-forming mechanism comprising a vertically reciprocating upper needle bar, an under needle for presenting a loop of under thread in position above the work for the passage of the upper needle down therethrough, and a looper for presenting a loop of upper thread in position below the work for the passage of the under needle up therethrough, a lever having one end connected with the needle bar, a toggle connected to the other end of the lever and arranged to be substantially straight when the needle bar is retracted, a crank connected to actuate the toggle, a second crank connected to actuate the under needle and looper, and mechanism for relatively moving the work and stitch-forming mechanism to sew about a buttonhole.

25. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a clamp carriage mounted to move longitudinally of and to rock laterally about an axis arranged below and lengthwise of the buttonhole, work-supporting plates and clamping jaws mounted on the carriage, and mechanism for reciprocating the carriage and rocking it laterally.

26. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a clamp carriage comprising a curved plate and depending supporting arms, pivots on which the arms are mounted to slide and turn arranged lengthwise of the buttonhole, work-supporting plates and clamping jaws on the carriage, and mechanism for reciprocating and laterally rocking the carriage.

27. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a clamp carriage comprising a curved plate and depending supporting arms, pivots on which the arms are mounted to slide and turn arranged lengthwise of the buttonhole, con-

centric flanges at the sides of the plate, guide-ways embracing the flanges, work-supporting plates and clamping jaws mounted on the carriage, and means for reciprocating and laterally rocking the carriage.

28. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a clamp carriage, front and rear work-clamping jaws mounted on the carriage, mechanism for closing the jaws and separating them lengthwise of the buttonhole, and mechanism for relatively moving the stitch-forming mechanism and clamp to sew about a buttonhole.

29. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a clamp carriage, front and rear clamping jaws mounted on the carriage, mechanism for closing the jaws and for moving the rear jaw back to stretch the work lengthwise of the buttonhole, and mechanism for relatively moving the stitch-forming mechanism and clamp to sew about a buttonhole.

30. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a clamp carriage, a clamp lever, a front work-clamping jaw pivoted at the forward end of the lever, a bar mounted to slide in the clamp lever, a rear work-clamping jaw pivoted on the forward end of the bar, means for closing and opening the clamp, means for retracting the bar when the clamp is closed and advancing it when the clamp is opened, and mechanism for relatively moving the stitch-forming mechanism and clamp to sew about a buttonhole.

31. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, mechanism for causing the clamp to travel during the sewing about a buttonhole, mechanism for opening the clamp, a work spacer, mechanism for advancing the spacer to space the work while the clamp is opened and for returning it to initial position before the completion of the succeeding buttonhole making cycle.

32. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, mechanism for moving the work clamp and rotating the stitch-forming mechanism to sew about an eye-ended buttonhole, a work spacer, and mechanism for actuating the spacer to intermittently engage and space the work between successive buttonhole sewing cycles.

33. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, mechanism for relatively moving them to sew about a buttonhole, means for cutting the buttonhole slit, mechanism for opening the clamp at the end of the buttonhole making cycle, a gripper arranged to grip the edge of the work at the rear of the clamp, and mechanism for re-

ciprocating the gripper transversely of the buttonhole.

34. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, mechanism for relatively moving them to sew about a buttonhole, mechanism for severing and holding the thread above the work and for opening the clamp at the completion of the sewing, and work spacing means intermittently engaging the work.

35. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, means for relatively moving them to sew about a buttonhole, mechanism for severing and holding the thread above the work and for opening the clamp at the completion of the buttonhole, a work spacer, and mechanism for reciprocating the spacer transversely of the buttonhole.

36. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, mechanism for relatively moving them to sew about a buttonhole, mechanism for severing and holding the thread and for opening the clamp at the completion of the sewing, and a work spacing gripper arranged at the rear of the work clamp to reciprocate transversely of the buttonhole.

37. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, a feed cam shaft, a driving clutch sleeve provided at one end with a clutch member for driving the feed cam shaft at high speed and at the other end with a clutch member for driving the stitch-forming mechanism, mechanism driven from the latter clutch member for driving the cam shaft, and mechanism for shifting the sleeve to render its clutch members alternatively active.

38. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, a feed cam shaft, a sewing shaft, a driving clutch sleeve provided at one end with a clutch member for driving the cam shaft at high speed and at the other end with a clutch member for driving the sewing shaft, an oscillating clutch for intermittently turning the cam shaft, actuating mechanism therefor connected with the sewing shaft, and mechanism for shifting the clutch sleeve to render its clutch members alternatively active.

39. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, a sewing shaft, a cam shaft, a worm wheel on the cam shaft, a worm sleeve surrounding the sewing shaft and having a worm engaging the worm wheel, a clutch member on the end of the sleeve, a driving sleeve loose on the sewing shaft and having a clutch member at one end for engaging the inner zone of the clutch member on the worm sleeve, and a clutch member on the other

end for engaging a clutch member on the sewing shaft, a feed clutch member for engaging the outer zone of the clutch member on the worm sleeve, connections between the sewing shaft and feed clutch member for oscillating and for engaging and disengaging said feed clutch member, and mechanism for shifting the driving clutch sleeve.

40. A buttonhole sewing machine having, in combination, stitch-forming mechanism, a work clamp, feed mechanism and devices for controlling the closing and opening of the clamp connected to move with the feed mechanism, a rotary driving member, a clutch and connections for driving the stitch-forming mechanism and operating the feed mechanism at slow speed during the sewing from the rotary driving member, and a clutch and connections for driving the feed mechanism at high speed before and after the sewing from said rotary driving member.

41. A buttonhole sewing machine having, in combination, a work clamp, stitch forming mechanism, mechanism for relatively moving the stitch forming mechanism and work clamp and for rotating the stitch forming mechanism to sew along the sides and about the end of a buttonhole, and means for progressively cutting the buttonhole slit during the sewing.

42. A buttonhole sewing machine having, in combination, stitch forming devices, a work clamp, means for relatively moving the stitch forming devices and work clamp to sew about a buttonhole, means for cutting the buttonhole slit, an additional reciprocating work engaging spacer, and mechanism for imparting to and from movements to the spacer for each buttonhole making cycle of the machine to shift the work relative to the work clamp between sewing periods.

43. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work clamp, mechanism for relatively moving them to sew about a buttonhole, mechanism for opening the clamp, means for cutting the buttonhole slit, an additional reciprocating work spacer, and mechanism for actuating the spacer to intermittently engage the work and for advancing the spacer and retracting it to space the work between successive buttonhole cycles.

44. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work clamp, mechanism for relatively moving them to sew about a buttonhole, mechanism for opening and closing the clamp, means for cutting the buttonhole slit, an additional work spacing gripper mounted to reciprocate transversely of the buttonhole, and means for actuating the gripper to engage and release the work.

45. A buttonhole sewing machine having, in combination, stitch forming mechanism, a

work clamp, mechanism for relatively moving them to sew about a buttonhole, mechanism for opening the clamp at the end of the buttonhole making cycle, means for cutting the buttonhole slit, an additional gripper reciprocating transversely of the buttonhole to space the work in the clamp between successive buttonhole making cycles, and means for actuating the gripper to engage and release the work.

46. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work clamp, mechanism for relatively moving them to sew about a buttonhole, means for cutting the buttonhole slit, an additional work spacing gripper, mechanism for closing the gripper, for advancing it to space the work while the clamp is opened, for opening the gripper and for returning it to initial position before the succeeding buttonhole making cycle is completed.

47. A buttonhole sewing machine having, in combination, stitch forming mechanism and a work clamp relatively movable to sew a buttonhole, a cutter for cutting the buttonhole slit, an additional work-gripper including co-acting gripping elements for feeding the work between sewing periods, an arm carrying said elements, a pivotal support for said arm, an actuating cam making one revolution for each buttonhole making cycle, a follower lever having a fixed fulcrum and adapted to be vibrated by said cam, a link connection between said follower lever and said arm, and means for closing and opening said gripper.

48. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work holder, mechanism for relatively moving the stitch forming mechanism and work holder to sew about a buttonhole, means for cutting the buttonhole slit, an additional reciprocating work engaging element for advancing the work to the said work holder between sewing periods, and means for varying the length of travel of said work engaging element to vary the spacing of the buttonholes.

49. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work holder, mechanism for relatively moving the stitch forming mechanism and work holder to sew about a buttonhole, means for cutting the buttonhole slit, an additional work engaging element movable in opposite directions toward and away from sewing position, a stop for limiting its movement in one direction, and means for shifting the stop to vary the spacing of the buttonholes.

50. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work holder, feeding mechanism for relatively moving the stitch forming mechanism and work holder to sew about a buttonhole, means for cutting the buttonhole slit, an ad-

ditional travelling work gripping device for shifting the work relatively to the work holder between buttonhole stitching operations, means for closing the work gripping device upon the work preparatory to a travelling movement, and means for varying the length of travel of said gripping device.

51. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work clamp, mechanism for relatively moving them to sew about a buttonhole, means for cutting the buttonhole slit, an additional work spacer, mechanism for advancing the spacer to space the work while the clamp is open and for returning it to initial position before the completion of the succeeding cycle, and means for varying the spacing stroke of the spacer.

52. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work clamp including means for straining the work lengthwise of the buttonhole, means for cutting the buttonhole slit, and mechanism for relatively moving the stitch forming mechanism and clamp to sew about a buttonhole.

53. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work clamp including means for straining the work lengthwise of the buttonhole, a cutter for progressively cutting the buttonhole slit during the sewing, and mechanism for relatively moving the stitch forming mechanism and clamp to sew about a buttonhole.

54. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work clamp, mechanism for causing the clamp to travel during the sewing about a buttonhole, a work spacer, and mechanism for actuating the spacer to intermittently engage and space the work between successive buttonhole sewing cycles.

55. A buttonhole sewing machine having, in combination, a reciprocating and rotating upper needle bar and a cutter for progressively cutting the buttonhole during the sewing actuated by the needle bar.

56. A buttonhole sewing machine having, in combination, stitch forming mechanism mounted to rotate while sewing about the buttonhole, and mechanism for progressively cutting the buttonhole slit during the sewing.

57. A buttonhole sewing machine having, in combination, stitch forming mechanism including a needle, mechanism for relatively rotating the stitch forming mechanism and work while sewing about the buttonhole, and a cutter mounted to move with relation to the needle during its cutting stroke and actuated by the stitch forming mechanism for progressively cutting the buttonhole slit during the sewing.

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