J. G. GREENE & L. F. A. BÜCHNER.

BUTTONHOLE SEWING MACHINE.

APPLICATION FILED AUG. 11, 1910.

1,030,998.

Patented July 2, 1912.

SHEETS—SHEET 1.

Fig. 1.

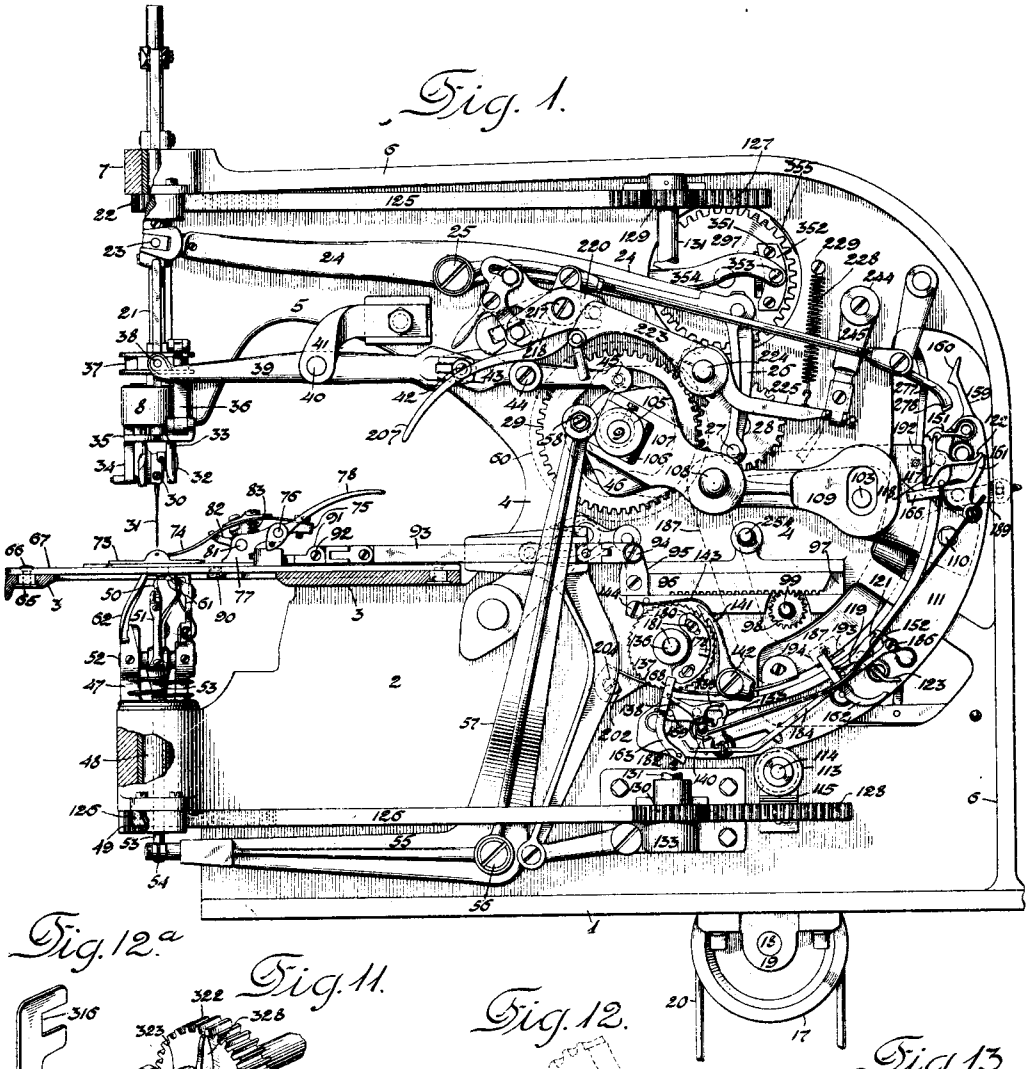


Fig. 12a.

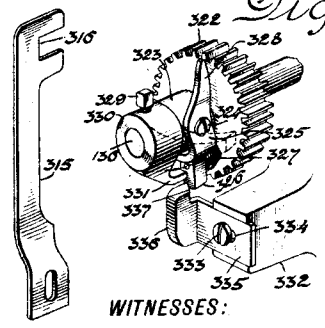


Fig. 11.

Fig. 12.

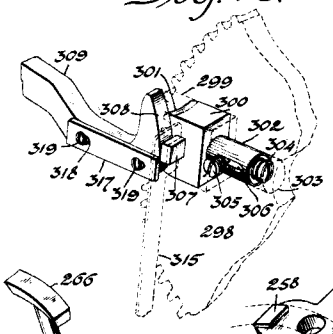
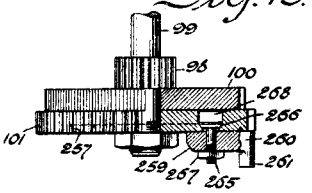


Fig. 13.



WITNESSES:

Geo. Ferrar

H. A. Kommann

Fig. 15.

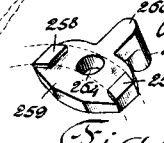


Fig. 14.

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4 SHEETS—SHEET 2.

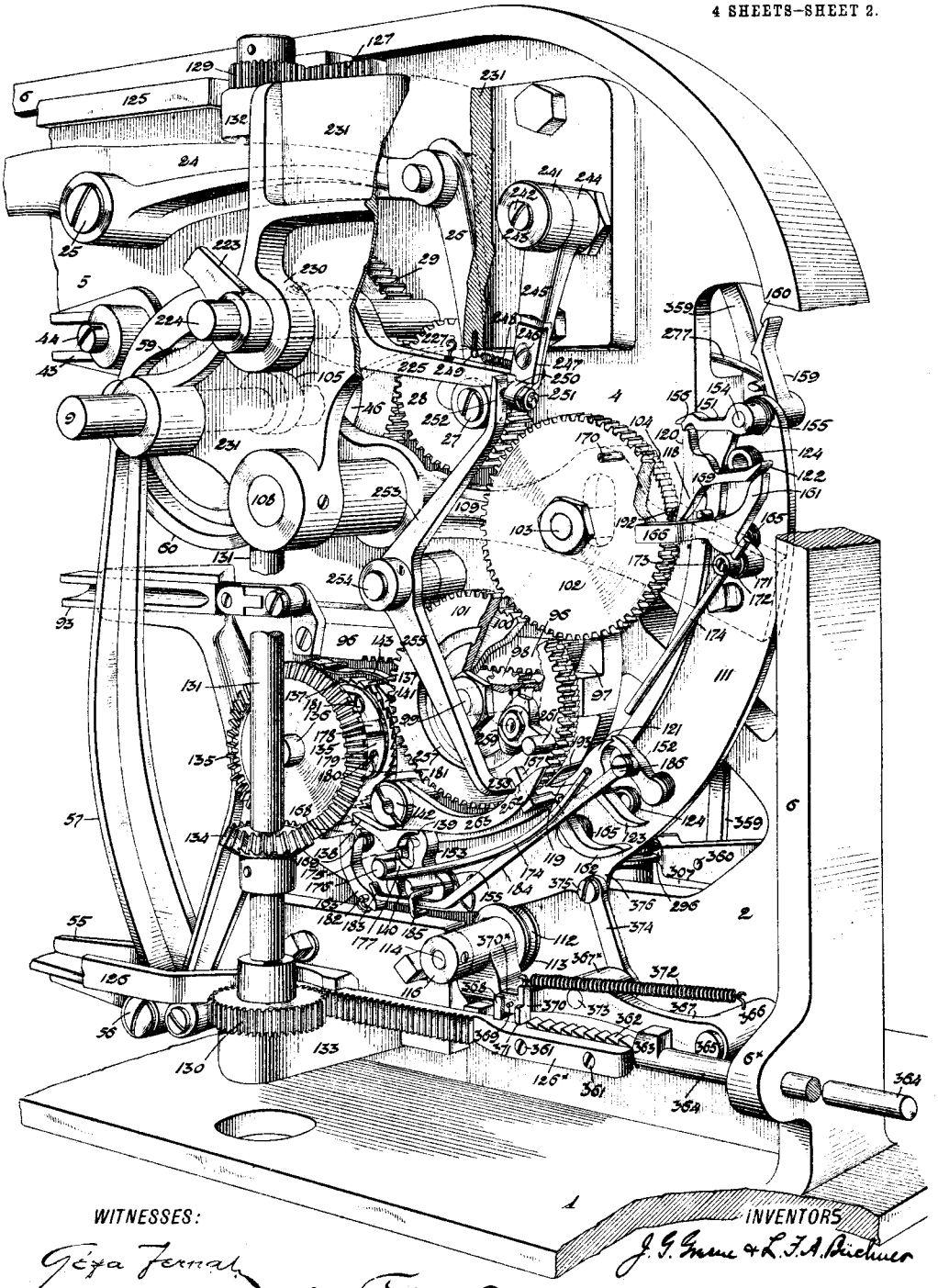

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Fig. 2.

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4 SHEETS—SHEET 3.

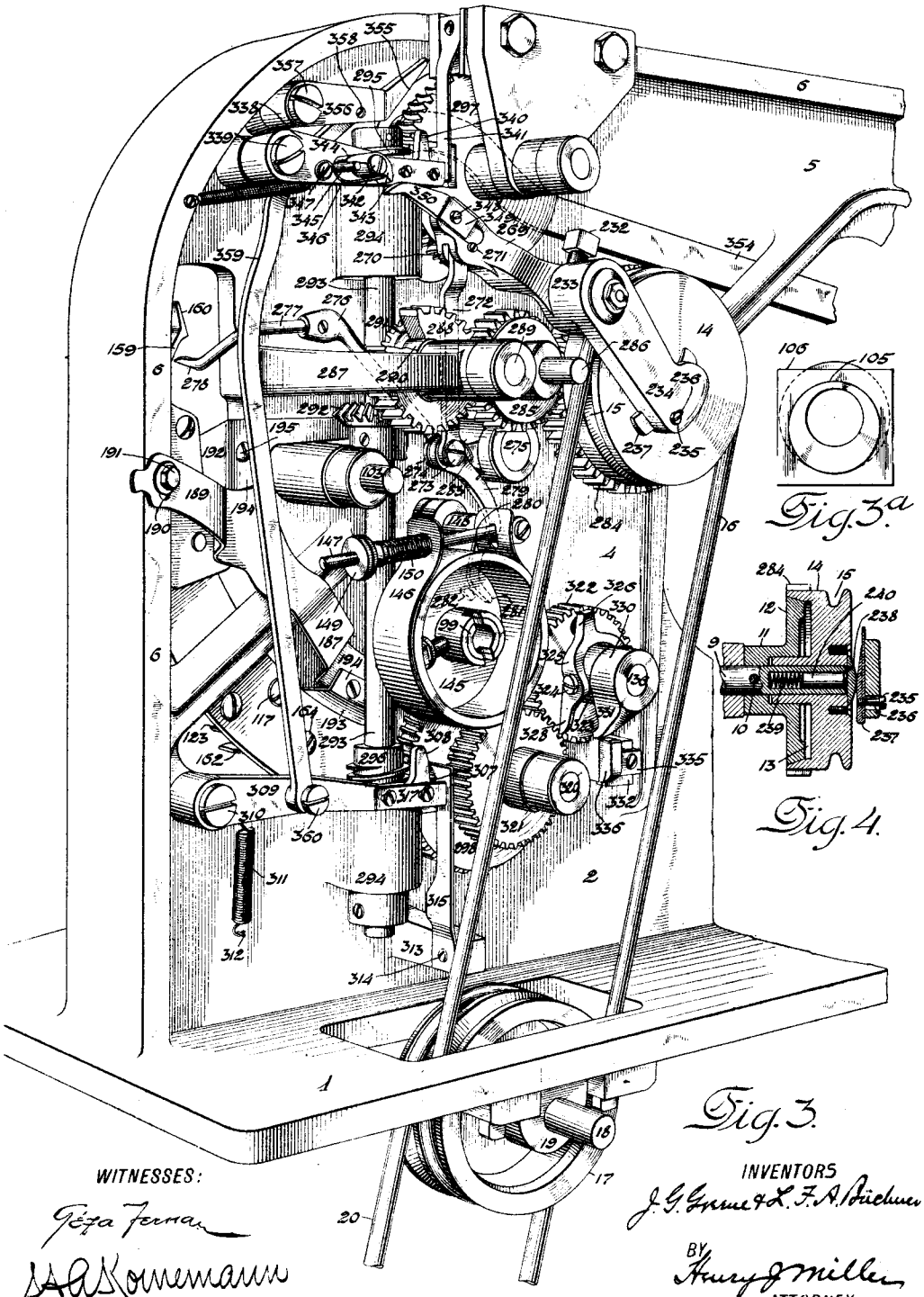

Fig. 3.

Fig. 3a.

Fig. 4.

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4 SHEETS—SHEET 4.

Fig. 5.

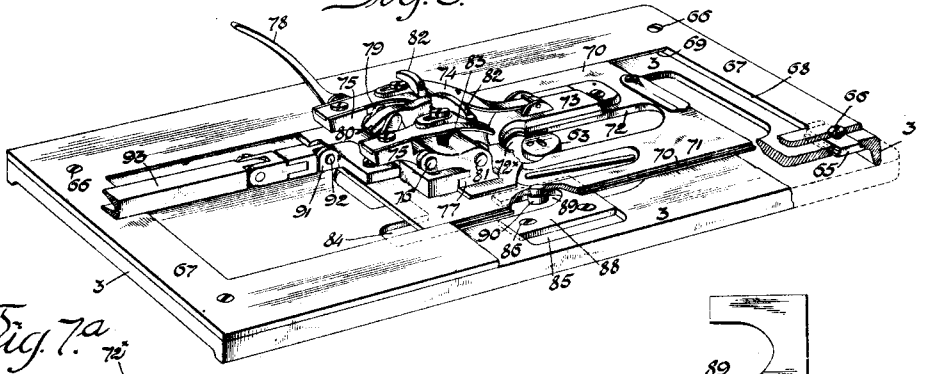


Fig. 7a.

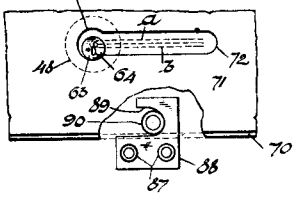
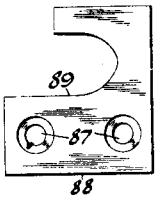


Fig. 7.



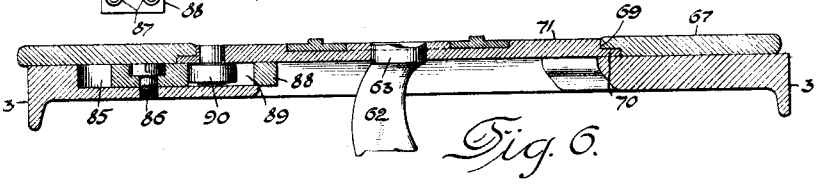


Fig. 6.

Fig. 8.

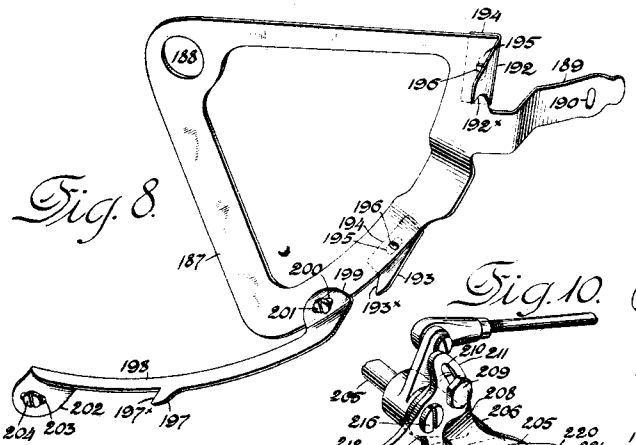


Fig. 9.

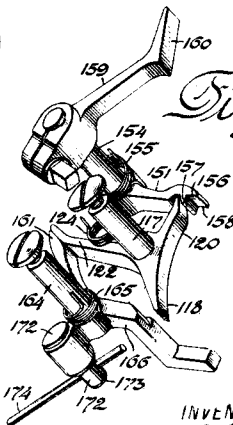
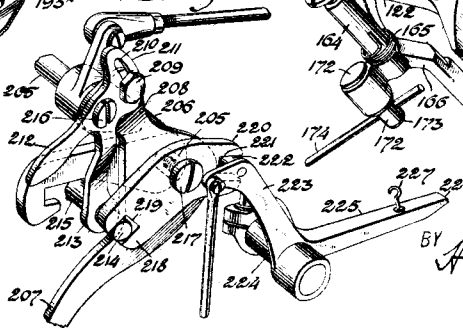


Fig. 10.



WITNESSES.

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UNITED STATES PATENT OFFICE.

JAMES G. GREENE AND LOUIS F. A. BÜCHNER, OF ELIZABETH, NEW JERSEY, ASSIGNORS TO THE SINGER MANUFACTURING COMPANY, A CORPORATION OF NEW JERSEY.

BUTTONHOLE-SEWING MACHINE.

1,030,998. Specification of Letters Patent. Patented July 2, 1912.

Application filed August 11, 1910. Serial No. 576,639.

To all whom it may concern:

Be it known that we, JAMES G. GREENE and LOUIS F. A. BÜCHNER, citizens of the United States, residing at Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Buttonhole-Sewing Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an improvement in buttonhole stitching machines, and more particularly in that class of machines for stitching eyed buttonholes in which the work-clamp has a longitudinal feeding movement to space the side stitches and the stitch-forming mechanism makes a semi-rotation for laying the radial stitches around the semi-circular end of the eye.

The invention has for its object to provide an effective feeding mechanism in which the traverse of the work-clamp shall be equal in both directions regardless of the adjustment of the machine, and in which the spacing of the side stitches and radial eyelet-end stitches will be uniform at any speed of operation of the mechanism and in which the feeding and lateral shifting movements of the work-clamp shall have a predetermined relative timing under all conditions.

In its preferred form, the present improvement is embodied in a machine provided with rotary stitch-forming mechanism and a traveling work-clamp, and comprises a rotary feed-wheel suitably connected with the work-clamp and two ratchet-wheels connected together and to the feed-wheel, such ratchet-wheels being actuated by independent spring-pressed pawls mounted upon a common carrier and provided with lifting means whereby they are alternately retracted from operative relation with their respective ratchet-wheels whose connection with the feed-wheel is such as to turn the same in opposite directions for producing corresponding movements of the work-clamp. The turning device for the stitch-forming mechanism is actuated by a connection with a third ratchet-wheel adapted for engagement by a pawl also mounted upon said reciprocating carrier and provided with suitable lifting means, the operation of the several lifting means being so timed that the stitch-forming mechanism is turned intermediate the actuation of the respective ratchet-wheels acting through the feed-wheel to impart to the work-clamp its advance and retrograde movements.

The improvement includes certain features of construction which will be hereinafter described and set forth in the appended claims.

In the drawings, Figure 1 is a front side elevation of a buttonhole stitching machine embodying the present improvements, and Figs. 2 and 3 are perspective views upon a larger scale representing opposite sides of the rearward portion of the machine. Fig. 3ª is an enlarged detail view of the feed actuating cam. Fig. 4 is a sectional elevation of a portion of the main-shaft and power transmitter applied thereto. Fig. 5 is a perspective view of the work-plate and traveling clamp supported thereby, with certain portions omitted to expose the constructive features, and Fig. 6 a sectional elevation of the work-plate and clamp-slides. Fig. 7 is a plan of the work-clamp shifting cam-plate. Fig. 7ª is a plan view representing the means for producing the side-shifting movements of the work-clamp. Fig. 8 is a perspective view of the feed-pawl controller. Fig. 9 is a perspective view of one of the feed-pawls and its lifter and detainer. Fig. 10 is a perspective view of a portion of the starting device. Figs. 11, 12 and 12ª are detail perspective views showing different portions of the device for restoring the stitch-forming mechanism to initial position at the completion of a stitching operation. Fig. 13 is a sectional plan of the feed-wheel and attached actuating ratchet-wheel and gear-wheel, and Figs. 14 and 15 are detail perspective views of parts of the tripping means for effecting the stoppage of the machine at the completion of the stitching operation.

As represented in the drawings, the machine is constructed with a frame comprising the bed-plate 1 from which rises a vertical web in the form of a thick plate cut out in the forward portion to form the base member 2 supporting the fixed work-plate 3, the standard 4 and overhanging arm 5 which latter with the standard 4 is strengthened by the rib 6 extending from the rear of the bed-plate upwardly and forwardly to the upper boss 7 affording one of the bearings for the rotary needle-bar bushings, the other of which is journaled in the lower

bearing boss 8. The side cover-plates, for inclosing spaces upon opposite sides of such web between the rib 6 and bed-plate 1, are omitted from the drawings to expose the feeding and other mechanisms.

Journaled in suitable bearings in the standard 4 is the transverse main or driving shaft 9 from which the stitch-forming and feeding mechanisms derive their operative movements. The main-shaft has fixed upon its rearward end portion by means of the transverse pin 10 the hub 11 of a clutch-wheel 12 formed with a conical periphery entering the correspondingly shaped recess 13 of the loose clutch-wheel 14 also mounted upon the main-shaft and provided with the peripheral groove 15 adapted to receive the driving belt 16 extending from the double-grooved pulley 17 upon a counter-shaft 18 journaled in bearings 19 depending from the bed-plate 1, the pulley 17 being driven by a belt 20 extending from the source of power. The constantly running clutch-wheel 14 is coupled to the clutch-wheel 12 by means presently to be described.

The stitch-forming mechanism in the present machine is arranged and operated similarly to that shown and described in our United States Patent No. 949,729, dated Februaryq 15, 1910. The needle-bar 21 is mounted for reciprocation in rotary bushings journaled in the bearing bosses 7 and 8, and the upper one is provided with a pinion 22 by means of which it may be rotated. It is provided with a pivotal and sliding connection 23 with the forward end of a rock-lever 24 mounted upon the fulcrum-stud 25 and connected at its rearward end with one end of the pitman 26 whose other end embraces a crank-pin 27 upon the pinion 28 meshing with the gear-wheel 29 fixed upon the main-shaft 9. As shown more fully in our said patent the needle-clamp 30, carrying the needle 31 is pivotally mounted at 32 upon an arm 33 carried by the needle-bar, and receives its lateral jogging movements from a sliding connection with the depending arm 34 of the rocking frame 35 pivotally connected with the reciprocating link-bar 36 having the grooved ring 37 with a pivotal and sliding connection 38 with the forward arm of the rock-lever 39 fulcrumed at 40 upon the bracket 41 and having its rearward arm connected at 42 with the rock-lever 43 fulcrumed at 44 and provided with a roller-stud 45 entering a cam-groove 46 formed in the outer face of the gear-wheel 29.

The looper mechanism is mounted in the frame 47 secured upon the top of the rotary bushing 48 which is provided at the lower end with the pinion 49. The loopers 50, only one of which is shown in Fig. 1, are mounted upon the rocking carrier 51 fixed upon the rock-shaft 52 journaled in the frame 47, the carrier having an operative connection with the reciprocating pitman-rod 53 passing through the bushing 48 and having a sliding pivotal connection at 54 with the lateral arm 55 of a bellcrank-lever fulcrumed upon the base member 2 at 56 and having the upwardly extending arm 57 provided with a roller-stud 58 entering the actuating cam-groove 59 of a disk 60 fixed upon the main-shaft 9 adjacent the gear-wheel 29, the rotation of the cam-disk 60 imparting vertical reciprocating movements to the pitman-rod 53 from which the carrier 51 derives its oscillating movements. The loopers have coöperating therewith spreaders 61, only one of which is shown in the drawings. The frame 47 carries an upwardly extending arm 62 which is provided with the circular needle-throat 63 having the needle-slot 64 and arranged slightly eccentric to the axis of the rotary bushing 48 in relation to a diameter corresponding with the needle-slot, for a purpose to be hereinafter explained.

The rectangular work-plate 3 is provided at opposite ends with alined transverse undercut slots affording guideways for slide-blocks 65 secured by means of fastening screws 66 upon the under side of the cross slide-plate 67 formed with a rectangular opening 68 having parallel undercut longitudinal edges 69 to which are fitted the similarly formed longitudinal edges 70 of the clamp slide-plate 71 which is provided with the longitudinal guide-slot 72 closely embracing the needle-throat 63 and having an enlargement $72^{\times}$ at one end. The marginal portions of the slide-plate 71 adjacent the guide-slot 72 afford the lower jaws of the work-clamp whose upper jaws are afforded by the feet 73 pivotally attached to the clamp-arms 74 fixed to blocks 75 which are mounted upon the rocking pin 76 journaled in the bearing bracket 77 secured upon the slide-plate 71. The rocking pin 76 has secured upon one end the finger-lever 78 and is formed intermediate its ends with a crank 79 embraced by the forked arm 80 fulcrumed upon the transverse pin 81 which is journaled in the bearing bracket 77 and operatively connected with the yoke 82 whose oppositely extending members are adapted to bear upon the clamp-arms 74 to force the upper clamp-jaws 73 downward upon the work in opposition to the springs 83 interposed between said clamp-arms and the top of the bracket-piece 77. The arrangement of the crank is such that the direction of its pressure upon the fork 80 is substantially diametrical relative to the pin 76 when the clamp is closed upon the work.

At one side of the clamp-plate 71, the work-plate 3 is provided with a longitudinal guide-slot 84 and a marginal recess 85 in its upper face near one end of said slot in which is secured by means of fastening

screws 86 passing through suitable apertures 87 therein the cam-plate 88 formed with a substantially U-shaped cam-recess 89 in register with the guide-slot 84 and closed at the end opposite the closed extremity of the enlargement 72ª of the guide-slot 72 of the clamp-plate 71, which latter is provided with a depending roller-stud 90 adapted to enter the cam-recess 89 as the work-clamp approaches one end of its travel.

The clamp-plate 71 is provided at one end with a forked lug 91 to which is connected by means of the pin 92 one end of a jointed link-bar 93 whose other end is similarly connected by means of the screw-pin 94 to a lug 95 upon the sliding rack-bar 96 mounted in a guideway 97 provided therefor upon the standard 4. The rack-teeth upon the lower edge of the rack-bar 96 mesh with the peripheral teeth of the pinion 98 constituting the feed-wheel and fixed upon the transverse rotary shaft 99 journaled in the standard 4. The shaft 99 has fixed upon it adjacent the feed-wheel 98 the ratchet-wheel 100 and the gear-wheel 101 (Fig. 2) meshing with a similar gear-wheel 102 upon the fixed stud 103 and having secured to it the second ratchet-wheel 104. The feed-wheel 98, ratchet-wheel 100 and gear-wheel 101 thus move in unison and are connected to turn in the opposite direction from the gear-wheel 102 and connected ratchet-wheel 104, and thus the actuation of either ratchet-wheel will cause the feed-wheel 98 to rotate in one or the other direction to impart reciprocal longitudinal feeding movements to the clamp-plate 71 through the rack-bar 96 and link-bar 93.

The main-shaft 9 carries an actuating eccentric 105 upon which is fitted the slide-block 106 embraced by the forked arm 107 of a rock-lever mounted upon the fulcrum-stud 108 and provided with a rearwardly extending arm 109 to the outer end of which is secured by means of the bolt 110 a segmental plate 111 disposed concentrically with the fulcrum-stud 108 and constituting the pawl-carrier. The depending lower portion of the carrier-plate 111 enters the taper peripheral groove 112 of a guide-roller 113 fixed upon one end of the shaft 114 which is journaled in a bracket 115 bolted to the standard 4 near the bed-plate 1 and which is provided with a collar 116 upon its opposite end. The carrier is thus steadied in its reciprocatory movements around the fulcrum-stud 108. Journaled in the pawl-carrier parallel with the shaft 99 and studs 103 and 108 are rocking pins 117 to the forward ends of which are fixed the pawls 118 and 119 having angularly disposed detent-arms 120 and 121 and lifting arms 122 and 123, respectively; the pawl 118 being adapted to engage the peripheral teeth of the ratchet-wheel 104 and the pawl 119 to similarly engage the teeth of the ratchet-wheel 100, under the action of their respective springs 124 each having one end secured to the carrier 111 and the other end bearing upon the arm 122 and 123 respectively.

The pinions 22 and 49 upon the upper needle-bar bushing and looper-frame bushing are engaged by teeth upon the forward ends of the rack-bars 125 and 126, having upon their rearward ends series of rack-teeth 127 and 128 engaging pinions 129 and 130 fixed respectively upon the upper and lower ends of the vertical shaft 131 mounted in bearings 132 and 133 of the standard 4. The shaft 131 has fixed thereon the bevel-pinion 134 meshing with a larger bevel-wheel 135 mounted upon a transverse shaft 136 journaled in the standard 4 and having also fixed thereon the ratchet-wheel 137. Journaled upon the reciprocating carrier is a third rocking pin, provided with a pawl-arm 138 adapted for operative engagement with the peripheral teeth of the ratchet-wheel 137, and angularly disposed detent and lifting arms 139 and 140, this pawl member being spring-pressed similarly to that represented in detail in Fig. 9 to cause it to assume operative relation with the ratchet-wheel 137.

To prevent the retrograde movement of the ratchet-wheel 137 under the action of its actuating pawl 138, a detent-pawl 141 is mounted upon a fixed fulcrum-stud 142 and is normally pressed in engagement with the ratchet-wheel by means of a spring 143 having one end secured in position by the screw 144. The ratchet-wheels 100 and 104 are similarly prevented from retrograde movement under the action of their respective actuating pawls by a friction device consisting of a drum 145 secured to the rearward end of the feed-wheel shaft 99 and encircled by a friction-band 146 through whose apertured ends passes the pin 147 secured at one end to the stud 148 and having upon the opposite threaded end the thumb-nut 149 between which and the adjacent end of the band 146 is interposed a spring 150 whose tension, and consequently the effect of the friction-band upon the drum, is adjustable by means of the nut 149.

Adjacent the pawl-members mounted upon the carrier 111 are swinging pawl-detaining arms 151, 152 and 153 each being constructed, substantially as represented in Fig. 9, with a fulcrum-pin 154 around which is coiled a spring 155 connected at one end with the carrier and at the other end with the detaining arm; and said arm is provided at its outer end with a notch 156 to afford a shoulder 157 for engagement with its respective detent-arm 120, 121 or 139 in maintaining the pawl retracted from the ratchet-wheel in opposition to the spring 124. This notch 156 further provides a

stop-shoulder 158 for engagement with the extremity of its respective detent-arm to limit its movement into operative relation therewith. The fulcrum-pin of the pawl-detainer 151 is further provided with an angularly disposed tripping arm 159 provided with an inclined wearing portion 160 for engagement with a member of the starting device to disengage the pawl-detainer from the detent-arm 120 to set the feeding mechanism in operation.

Sustained upon the pawl-carrier adjacent the pawls 118, 119 and 138 are pivotally mounted pawl-lifting arms 161, 162 and 163 respectively, each constructed, substantially as represented in Fig. 9, with an integral fulcrum-stud 164 around which is coiled the spring 165 with one end attached to the pawl-carrier and the other end resting against the tripping arm 166, 167 and 168, respectively, the latter resting normally in contact with the stop-pin 169 upon the pawl-carrier. The reversely moving gear 102 has upon its outer face near the periphery a tripping stud 170 normally distant from the tripping arm 166 of the spring-pressed pawl-lifting arm 161, and after the propelling action has been initiated between the reciprocating pawl 118 and the ratchet-wheel 104, the tripping stud 170 is carried by the rotation of the gear-wheel 102 into a position wherein it is forcibly engaged by the tripping arm 166 upon the retrograde movement of the carrier, which brings the lifting arm 161 into forcible engagement with the arm 122 of the pawl 118, thereby lifting the latter and interrupting the step-by-step rotation of the ratchet-wheel 104 and connected gear 102 from which operative movements are communicated through the gear 101 to the feed-wheel 98.

The lifting member 161, 166 is provided with an arm 171 carrying a swivel-pin 172 in a transverse aperture of which is secured by means of the set-screw 173 one end of a pull-rod 174 whose opposite end is formed with a hook 175 embracing a stud-pin 176 carried by an offset lug 177 of the detent-arm 153; and the engagement of the tripping pin 170 upon the lifting member 161 166 therefore acts through the pull-rod 174 to retract the detent-arm 153 so as to permit the pawl 138 to assume operative relation with its respective ratchet-wheel 137 under the action of its spring. By this means the ratchet-wheel 137 is rotated, and acts through the bevel-wheels 135 and 134 to turn the shaft 131 whose operative connections with bushings carrying the upper and lower stitch-forming devices by means of the rack-bars 125 and 126 produces a semi-rotation of the stitching mechanism at the end of the initial longitudinal feeding operation.

The ratchet-wheel 137 carries a tripping lug 178 formed upon a segmental plate 179 having elongated apertures 180 entered by the fastening screws 181 tapped into the side of the ratchet-wheel 137 and thus serving to secure the tripping lug 178 adjustably thereon. The tripping lug 178 is normally at some distance from the arm 168 of the pawl-lifter 163, but in the travel of the same induced by the reciprocating pawl 138, the lug 178 forcibly engages the arm 168 and shifts the arm 163 into engagement with the arm 140 of the pawl for interruption of its operative relation with the ratchet-wheel 137. The lifting arm 163 carries a tripping pin 182, which, in the operative movement of such arm, engages the inclined extremity 183 of a bent rod 184 embraced by the guide-loop 185 and pivotally connected at its opposite end by means of the screw 186 with the pawl-detainer 152, whereby the latter is disengaged from the arm 121 of the pawl 119 and such pawl is permitted under the action of its spring 124 to assume operative relation with the peripheral teeth of the ratchet-wheel 100. The operative movement of this ratchet-wheel causes the movement of the feed-wheel 98 in a direction opposite to that initially imparted by the rotation of the ratchet-wheel 104, and to the action of the rack-bar 96 whereby the work-clamp is given its reverse longitudinal feeding movement for the stitching of the second side of the buttonhole.

Mounted upon the fulcrum-stud 108 of the rock-lever 107 109 is a plate 187 of sectoral form having an aperture 188 embracing such fulcrum-stud and a radial arm 189 formed with a transverse slot 190 entered by a clamp-screw 191 tapped into the rib 6 of the frame. To the segmental outer member of this plate are adjustably secured the pawl-shield plates 192 and 193 each constructed with an angularly arranged foot 194 formed with a slot 195 entered by a fastening screw 196 by means of which it is secured to the carrying plate 187 for slight circular adjustment. A third shield-plate 197 is formed upon a segmental member 198 having a foot 199 provided with a slot 200 and secured adjustably to the carrying plate 187 by means of the fastening screw 201, while the opposite end of such member is also provided with a foot-piece 202 having a slot 203 entered by the guide-screw 204 which is tapped into the base member 2 of the machine frame. The operative edges $192^{\times}$, $193^{\times}$ and $197^{\times}$ of the shield-plates 192, 193 and 197 are normally so disposed in relation to the actuating pawls 118, 119 and 138 that these pawls engage each alternate tooth of their respective ratchet-wheels in each reciprocation of the pawl-carrier 111, but by loosening the clamp-screw 191 and shifting the shield-carrying plate 187 by means of the arm 189, the several shields

192, 193 and 197 are caused to advance in the direction of operative movement of the several pawls and to maintain the same lifted out of operative engagement with the ratchet-wheels through a portion of their operative movement, so as to pass over the top of one tooth for engagement with the succeeding tooth, thereby providing for adjustment of the machine for a more or less rapid movement of the respective ratchet-wheels by which the spacing of the stitches along the sides and around the eye is produced.

While not an essential part of the present improvement, the starting and stopping device by which the clutch upon the main-shaft is operated is in the present embodiment of this improvement concerned in the initiation of the feeding and side-shifting movements of the work-clamp and its return to initial position, and this will now be described.

Loosely mounted upon a rock-shaft 205 journaled in the frame is the hub 206 of a starting lever 207 having an angularly arranged arm 208 carrying a clamp-screw 209 entering a segmental slot 210 in one of the arms 211 of a plural-armed lever having an operating arm 212 and a depending arm 213 carrying the oppositely extending transverse pins 214 and 215, this plural-armed lever being fulcrumed by means of the stud-screw 216 upon the arm 208 of the starting lever with which it is thus rigidly and adjustably connected. Fulcrumed upon the stud-screw 217 tapped into the end of the rocking pin 205 is an angle-lever having one arm 218 formed in its extremity with a notch 219 adapted to embrace the pin 214 and another arm 220 with a notch 221 in its extremity embracing a stud 222 upon a forwardly extending arm 223 fixed upon the rocking stud 224 carrying a rearwardly extending arm 225 provided with a tapered extremity 226 and having upon its upper side a hook 227 to which is connected one end of a spring 228 having its opposite end connected to the screw-stud 229 tapped into the standard 4. The stud 224 is journaled in a suitable bearing boss 230 of the bracket 231 secured to the front side of the machine frame, and has secured thereto upon the opposite side of the standard 4 by means of the set-screw 232 the hub 233 of the clutch-lever formed with an arm 234 having secured adjustably thereto by means of the screw 235 entering a slot 236 therein the segmental wedge-plate 237 adapted to bear upon the round operative surface of the wearing disk 238 set in the outer face of the loose clutch-wheel 14 which is normally pressed outwardly out of operative relation with the fixed clutch-wheel 12 by means of the spring 239 interposed between the inner end of an axial socket in the main-shaft 9 and the inner end of a plug 240 whose outer end rests against the inner face of the disk 238. The rocking of the stud 205 by the actuation of the starting lever 207 thus operates to force the driving clutch-wheel 14 into operative relation with the driven clutch-wheel 12 to set in motion the stitch-forming and feeding mechanisms, and the reverse movement of this stud under the action of the spring 228 upon the lever-arm 225 causes the disengagement of such clutch-wheels in stopping the stitch-forming and feeding mechanisms.

Journaled upon a stud 241 tapped into the foot of the bracket 231 and held thereon by means of the screw 242 and washer 243 is the hub 244 of a latch-lever 245 having secured to its outer end by means of the screw 246 the latch-plate 247 having a notch in its lower forward corner to afford an engaging shoulder for the extremity of the lever-arm 225 upon the rocking stud 224. The latch-lever 245 has secured thereto one end of a spring 248 whose opposite end is connected to a screw-eye 249 secured in the bearing bracket 231 by which the latch-lever is drawn forwardly normally into engagement with the lever-arm 225. The lever 245 is further provided in its lower portion with a perforated boss 250 carrying the adjustable contact-screw 251 adapted for engagement with the operative end portion 252 of the upwardly extending arm 253 of a shift-lever fulcrumed upon the fixed stud 254 and having a depending arm 255 with an inturned toe 256 extending toward the rim of the gear-wheel 101.

The gear-wheel 101 is formed in its outer face with an undercut annular groove 257 entered by guide-lugs 258 upon the inner face of the block 259 provided with a lug 260 carrying an outwardly projecting tripping pin 261 whose path of movement embraces the toe 256 of the lever-arm 255 and the curved inner cam-edge 262 of a rearwardly projecting arm 263 upon the hub of the detent-pawl 141. The block 259 is formed with an aperture 264 entered by the shank of a clamp-bolt 265 having an undercut T-head 266 fitted within the groove 257 of the gear-wheel 101 and provided with the clamp-nut 267 by means of which the block 259 is secured for circular adjustment upon such gear-wheel. The gear-wheel is formed with a transverse aperture 268 to permit the insertion of the head 266 of the bolt 265 in assembling the parts.

Extending from the hub 233 in the opposite direction from the clutch-arm 234 is a second arm 269 having a forked lug 270 in which is secured by means of a pivotal screw-stud 271 one end of a link 272 whose opposite end is connected by means of the screw-stud 273 with a crank-arm 274 fulcrumed upon the fixed stud 275 and having an upwardly and rearwardly extending

member 276 in which is secured the tripping pin 277 having an inclined wearing face 278 at its extremity adapted to engage the extremity 160 of the arm 159 upon the fulcrum-pin 154 of the pawl-detaining arm 151. The pivotal screw-stud 273 also affords a fulcrum for the angular catch-lever 279 having a shoulder 280 adapted for engagement with the under side of the fixed stud 148 and a tail 281 extending beyond the same and normally lying in the path of the stud 282 upon the rear wall of the friction drum 145 carried by the feed-wheel shaft 99. The catch-lever 279 is normally pressed by means of a spring 283 toward operative relation with the stud 148.

When the parts are in starting position, prior to the actuation of the starting lever 207, the operative extremity of the lever-arm 225 is in upper position and out of locking relation with the latch-lever 245, the clutch-arm 234 is lowered out of operative relation with the driving clutch-wheel 14, the clutch-lever arm 269 correspondingly raised and the crank-arm 274 elevated to bring the locking shoulder 280 of the catch-lever 279 above the center of the stud 148, while the operative extremity of the tripping pin 277 is above the wearing face 160 of the tripping arm 159. The tripping pin 261 upon the gear-wheel 101 is in stopping position and in contact with the toe 256 of the angle-lever 253 255 whereby the latch-lever 245 is held retracted from engagement with the lever-arm 225, and the tripping pin 261 is also in engagement with the arm 263 of the holding pawl 141 by means of which the ratchet-wheel 137 is freed for rotation in either direction. Downward pressure upon the starting lever 207 causes the turning of the rock-shaft 205 for the coupling of the driving and driven clutch-wheels 14 and 12 and depression of the fulcrum-stud 273 of the catch-lever 279, which latter, under the action of its spring 283, snaps into engagement with the stud 148 whereby the parts are temporarily locked in such position. The rocking of the clutch-lever simultaneously causes, through the connections 272, 274 and 276, the operative engagement of the tripping pin 277 with the arm 159 of the pawl-detaining arm 151, by means of which the pawl 118 is permitted to assume operative engagement with the ratchet-wheel 104 whereby the train of gearing between the pawl-carrier 111 and feed-wheel 98 is set in motion to impart the initial longitudinal feeding movement to the work-clamp. The connection of the gear-wheel 102 with the wheel 101 causes the movement of the latter in a direction to retract the tripping pin 261 from the parts 256 and 263, whereby the latch-lever 245 is permitted, under the action of its spring 248, to assume operative relation with the lever-arm 225 to lock the clutch-controlling parts in operative relation and permit the detent-pawl 141 to assume operative relation with its ratchet-wheel 137. The parts just referred to continue in substantially the same relations throughout the cycle of operation of the stitch-forming and feeding mechanisms, with the exception that somewhat prior to the end of such cycle the lug 282 engages the tail 281 of the catch-lever 279 by which the latter is disengaged from the stud 148 to permit the rise of the lever-arm 269 in stopping the machine. In the actuation of the feed-wheel 98 for producing the retrograde feeding movement of the work-clamp, the ratchet-wheel 100 with its attached gear-wheel 101 are rotated in the opposite direction from that imparted initially by the gear-wheel 102 attached to the ratchet-wheel 104; and the tripping pin 261 thus advances toward the members 256 and 263 which it engages at substantially the same time for retraction of the detent-pawl 141 upon the ratchet-wheel 137 and disengagement of the latch-lever 245 from the lever-arm 225, which latter is thereupon drawn upwardly by its spring 228 and the rocking stud 224 turned to disengage the clutch-arm 234 from the driving clutch-wheel 14. The rise of the clutch-lever arm 269 by this action draws the crank-arm 274 upwardly and the shoulder 280 of the catch-lever 279 out of register with the stud 148, at the same time bringing the operative end 278 of the tripping pin 277 again above the cam-shaped extremity of the pawl-detent tripping arm 159.

The driving clutch-wheel 14 is provided upon its rim with an annular series of gear-teeth 284 meshing with the teeth of an idler-pinion 285 upon the stud 286 mounted in the bearing bracket 287, such idler-wheel meshing with a pinion 288 mounted upon the stud 289 also journaled in the bearing bracket 287. The pinion 288 is fixed upon the hub 290 of a bevel pinion 291 meshing with a similar pinion 292 upon the upright worm-shaft 293 mounted in bearings 294 and having upon its upper and lower ends the worms 295 and 296, in operative relation with the worm-wheels 297 and 298, respectively. The worm-wheels 297 and 298 are constructed each with an annular series of peripheral teeth of which a section equivalent in width to the length of the operative portion of the worm is mounted upon a radially yielding spring-pressed block, as represented in detail in Fig. 12 in connection with the worm-wheel 298. As shown in this figure, the worm-wheel is cut away upon one side to form a radial slot 299 for reception of the slide-block 300 provided upon the outer end with worm-teeth 301 and upon the

opposite end with a boss 302 slidingly fitted within a radial socket 303 formed in the worm-wheel, between the inner end of which and the opposite end of an aperture in the boss 302 is interposed the spring 304 for normally pressing the worm-wheel section or block 300 outwardly into register with the adjacent peripheral teeth, its range of motion being limited by means of the stop-screw 305 extending through the side of the worm-wheel into the socket 303 and entering a longitudinal slot 306 in the boss 302 whose ends it is adapted to engage. The block 300 is provided with a lateral lug 307 normally engaged by the cammed extremity 308 of a lever 309 fulcrumed upon the stud-screw 310 and normally drawn downwardly into engagement with the top of the lower bearing lug 294 by means of the spring 311 connected at one end with said lever and at the other end to a pin 312 upon the machine frame. Fixed upon the lug 313 projecting from the frame by means of the screw 314 is the foot of a spring-holding-arm 315 whose enlarged upper end is provided in one edge with a notch 316 normally embracing the lug 307 of the yielding worm-wheel section 300 in its inner or retracted position, when engaged with the heel of the cammed extremity 308 of the lever 309. The lifting of the lever 309 by means presently to be described acts to disengage the lug 307 from the lower end of the cam member 308, and thus permits the worm-wheel section 300 to spring outward into operative engagement with the worm 296 whereby rotary motion is imparted to the worm-wheel. As the worm-wheel nears the completion of a rotation, the lug 307 engages the upper end of the cammed end 308 of the lever 309, on the return to initial lowered position, and is gradually forced inwardly so as to disengage the toothed section 300 from the worm, the lug 307 at the same time swinging the yielding arm 315 backwardly until it comes into register with the holding notch 316 at the end of a complete rotation, when the arm 315 snaps into normal position wherein it embraces and securely holds the lug 307 to prevent the further turning of the worm-wheel, the opposite face of the arm 315 resting against the adjacent end of the stop-plate 317 having the elongated screw-apertures 318 entered by the fastening screws 319 by which it is adjustably secured upon the side of the lever 309. It will thus be seen that the notched operative end of the spring-arm 315 first snaps over the lug 307 to lock the worm-wheel from further movement at the end of a rotation, while the disengagement of such lug from the cam-member 308 permits the same to escape from the holding notch 316 for a succeeding rotation.

The worm-wheel 298 is mounted upon a shaft 320 which carries a gear-wheel 321 adapted to rotate with said worm-wheel and meshing with a gear-wheel 322 having a hub 323 loosely mounted upon the rearward end of the shaft 136. Pivotally mounted upon the gear-wheel hub 323 by means of screw-pins 324 is a rocking yoke 325 having a radially projecting dog 326 normally pressed outwardly by means of a spring 327 interposed between the same and a socket in the gear-wheel 322. The yoke is provided with a stop-finger 328 adapted to engage the adjacent face of the gear-wheel to limit the tilting motion of the yoke. Fixed upon the rearward end of the shaft 136 by means of the set-screw 329 is a collar 330 having an offset and inwardly projecting finger 331 adapted for engagement with the side of the dog 326 when maintained in its outer position under the action of the spring 327. Below the gear-wheel 322 the frame is provided with an outwardly projecting lug 332 to which is adjustably secured by means of the screw 333 entering a slot 334 therein the shank 335 of a tripping lug 336 having an inclined operative face 337 arranged in the normal path of circular movement of the dog 326, and with its inner extremity in substantial register with the inner end of the finger 331. The lifting of the lever 309 after the stitching of the buttonhole brings the continuously rotating worm-shaft 293 into operative relation with the gear-wheel 322 upon which the yoke 325 is mounted, whereby the dog 326 is caused to move from the upper position represented in Fig. 3 engaging and carrying with it the finger 331 of the collar 330, whereby the turning shaft 136 for the stitching mechanism is rotated until the dog 326 encounters the inclined operative edge 337 of the tripping lug 336 upon completion of a semirotation, as represented in Fig. 11, when the dog is forced inwardly and thus disengaged from the finger 331, and the gear-wheel 322 completes its rotation idly, the stitch-forming mechanism having been returned to initial position preparatory to a succeeding stitching operation.

As before stated, the worm-wheel 297 is provided with a yielding section which is similarly controlled by means of the lever 338 mounted upon the fixed fulcrum-pin 339 carrying at its outer end the cam member 340 acting in conjunction with the spring locking-arm 341 to control the yielding worm-wheel section. The lever 338 carries a fulcrum-pin 342 upon which is mounted a catch-block having a forwardly extending contact arm 343 and a rearwardly extending arm 344 normally held in contact with a stop-pin 345 by means of a spring 346 secured upon the lever by a screw 347. The clutch-lever arm 269 has secured to its channeled outer end by means of the screw 348

the shank 349 of a wiper-arm 350 whose inclined outer extremity is adapted to engage the contact arm 343 of the catch-block.

The front face of the worm-wheel 297 has secured thereon by means of the screws 351 a cam-block 352 carrying the crank-pin 353 to which is connected the rearward end of the reciprocatory buttonhole-cutter actuating bar 354, the cam-block 352 being adapted for engagement with the inclined edge 355 of a lever 356 fulcrumed upon the screw-stud 357 and connected by means of the pivotal screw-pin 358 with one end of a bent link 359 whose opposite end is connected by means of the screw-pin 360 with the lever 309, whereby the latter is actuated from the cutter-actuating worm-wheel 297 through the swinging lever 356.

As before described, when the machine is at rest, the clutch-lever arm 269 is in its upper position, in which the operative extremity of the wiper-arm 350 is above the contact arm 343 of the catch-block. When the clutch-lever is rocked for starting the machine, the wiper-arm 350 moves downwardly with its carrying arm 269 and in engaging the catch-block arm 343 merely turns the same aside in opposition to the spring 346; but when the catch-lever is turned in the opposite direction in stopping the machine, the wiper-arm 350 is prevented from turning the catch-block upon its fulcrum-pin 342 by the engagement of the arm 344 with the stop-pin 345, and hence the lever 338 is lifted to disengage the cam member 340 from the movable section of the worm-wheel 297, whereby the latter is given a complete rotation by the worm 295 for successive actuation of the cutting mechanism and lifting of the lever 356 whereby the stitch-forming mechanism is returned to initial position. When the initially acting pawl 118 is in operative relation with the ratchet-wheel 104, the ratchet-wheel 137 is in its normal position, in which the tripping lug 178 is farthest removed from the arm 168 of the pawl-lifter 163, and the finger 331 of the collar 330 is in its lower position as represented in full lines in Figs. 3 and 11. At the end of the eyelet stitching operation, the shaft 136 has been turned under the action of the ratchet-wheel 137 and pawl 138 through a quarter-rotation, and occupies the lateral position represented in dotted lines in Fig. 11 as before explained.

To insure against overthrow of the stitch-forming mechanism in stitching the buttonhole eye, an escapement device for the turning mechanism may be provided such as that represented in Fig. 2. In the figure referred to, the rearward end of the rack-bar 126 is shown provided with a forwardly offset portion $126^{\times}$ to which is removably secured by screws 361 a supplemental rack-bar having its overlapping portion provided with a series of rack-teeth 362 terminating in an upwardly extending stop-lug 363 and formed with a rounded portion 364 passing through an aperture in a guide-lug $6^{\times}$ formed upon the rib 6 of the machine frame. Mounted upon a fixed stud 365 extending from the base 2 is the hub 366 of a swinging lever 367 having at its free end a laterally extending member 368 formed in its upper portion with a longitudinal slot within which is pivotally mounted, by means of the pin 369, the rearwardly extending lug $370^{\times}$ of a tooth-plate 370 formed with wedge-shaped lower edge 371 normally disposed above the plane surface of the initial end of the auxiliary rack-bar and adapted to successively engage the teeth 362 thereof and finally encounter the stop-lug 363 in the turning of the stitch-forming devices. The tooth-plate 370 is yieldingly held in normal position with its toothed lower edge in operative relation with the supplemental rack-bar by means of the spring 372 having its opposite ends connected with hooks carried by the tooth-plate and the hub 366 of the lever 367, respectively, and is adapted to yield upwardly freely when the rack-bar is moved rearwardly during the turning of the stitch-forming mechanism into initial position after a buttonhole stitching operation. The lever 367 has a rearwardly extending boss $367^{\times}$ carrying a stud 373 embraced by the lower end of a link 374 pivotally connected at its opposite end by means of the screw-stud 375 with a depending ear 376 of the segmental pawl-carrier 111. The reciprocation of the carrier 111 for each alternate stitch causes the corresponding rising and falling movement of the detaining tooth 371 intermediate the teeth 362, the device thus serving as the escapement for positively limiting the forward movement of the rack 126 for each impulse imparted thereto through its connections with the ratchet-wheel 137 in turning the stitching devices. To provide for different spacings of the eye-stitches, interchangeable auxiliary rack-bars with ratchet-teeth of different pitch may readily be employed.

In the use of the machine, the operator sits at the extreme left, as viewed in Fig. 1, and a single movement of the hand toward the rear serves to throw the clamp-operating lever 78 backwardly to close the clamp and move the starting lever 207 backwardly and downwardly to actuate the clutch-lever for bringing the clutch-wheels 12 and 14 into operative relation whereby the main-shaft 9 is rotated, and the wiper-arm 277 278 is simultaneously depressed to tilt the pawl-detaining lever-arm 159 for release of the pawl 118 for operative engagement with the driving ratchet-wheel 104 acting through the gear wheels 102 and 101 to rotate the feed-wheel 98 for imparting the initial side-stitching feed-motion to the

work-clamp. The clamp-plate 71 carries its depending roller-stud 90 along one edge of the guide-slot 84, and into the cam slot 89 of the fixed cam-plate 88, and simultaneously causes the edges of the needle aperture 72 of the slide-plate 71 to move in contact with the guiding needle-throat 63. The needle-throat reaches the junction of the straight portion 72 of the needle aperture with the enlargement 72^x simultaneously with the arrival of the roller-stud 90 at the rounded end portion of the cam-slot 89 in the cam-plate 88, and the further advance of the slide-plate 71 thus causes the stud 90 to move laterally to the extreme end of and into the center of the width of the cam-slot 89, while the needle-throat similarly follows the curvature of the enlargement 72^x of the needle aperture, to a position at one end of the transverse diameter of such enlargement, whereby the first side-shifting movement of the clamp-plate 71 and work-clamp is produced, as represented diagrammatically in Fig. 7^a, wherein the dotted line *a* represents the path of the axis of the needle-bar and looper-support guiding bushings relative to the clamp-plate 71, the feed being arrested when such axial line reached the center of the needle-aperture enlargement 72^x. At this time, the movement of the tripping pin 170 into engagement with the arm 166 of the pawl-lifter 161 causes the latter, by engagement with the pawl-arm 122, to retract the pawl 118 and simultaneously, through the pull-rod 174 and pawl-detainer 153, to release the pawl 138 for engagement with the ratchet-wheel 137 which effects the turning of the stitching mechanism for applying the radial stitches to the buttonhole eye, whereby the eccentrically arranged needle-throat 63 is caused to perform a semi-rotation with the looper-supporting frame 47 so as to bring the throat to the opposite side of the needle-aperture enlargement 72^x. At the completion of its turning operation, the engagement of the tripping stud 178 of the ratchet-wheel 137 with the arm 168 of the pawl-lifter 163 effects, by engagement of the latter with the pawl-arm 140, the retraction of the pawl 138 from the ratchet-wheel 137 and simultaneously brings the tripping pin 182 into engagement with the extremity 183 of the reciprocating rod 184 whereby the pawl-detainer 152 is disengaged from the arm 121 of the pawl 119 and the latter is permitted under the action of its spring to assume operative relation with the driving ratchet-wheel 100 which operates to turn the feed-wheel 98 in the reverse direction for production of the retrograde feeding movement of the work-clamp. In the initial portion of its retrograde clamp-feeding movement, the inclined adjacent side of the needle-aperture enlargement 72^x serves as a side-shift cam acting upon the needle-throat 62 to produce a second side shift of the clamp so as to position the work for the stitching of the straight portion of the second side of the buttonhole, the second side of the cam-slot 89 of the fixed cam-plate 88 acting in conjunction with the roller-stud 90 as a supplemental guide for confining the needle-throat 63 in operative relation with the edge of the needle-aperture 72^x, 72, the clamp-plate 71 being thereby given a path of movement represented by the dotted line *b* in Fig. 7^a relatively to the axis of rotation of the needle-bar and looper-frame bushings. At the completion of the second side-shifting operation, the tripping pin 261 carried by the gear-wheel 101 first engages and shifts the arm 263 of the detaining pawl 141 to free the ratchet-wheel 137 for subsequent retrograde movement, and then encounters the arm 255 of the shift-lever whose other arm 253 retracts the latch-lever 245 in opposition to the spring 248 so as to release the lever 225 and thus enable the clutch-lever to return under the action of its spring 228 to initial unclutching position for interrupting the rotation of the main-shaft 9, the catch-lever 279 having been previously disengaged from the stud 148 as before explained. The rise of the clutch-lever arm 269 in the unclutching operation operates to shift the cutter-controlling lever 338, and thereby produces a single rotation of the worm-wheel 297 for actuation of the buttonhole cutting mechanism, and the subsequent lifting of the lever 356 whose link connection 359 with the controlling lever 309 of the turning mechanism causes the latter to establish operative relation between the worm 296 and gear 322, whereby the shaft 136 is given a retrograde quarter-rotation to return the stitch-forming mechanism to initial relation with the work-clamp. The semi-rotation of the looper-supporting frame thus produced effects the corresponding turning movement of the concentrically disposed needle-throat 63 whose engagement with the walls of the needle aperture 72 adjacent its smaller end causes the shifting of the cross-slide plate 71 laterally into initial position, and the several parts of the machine are thus positioned for a succeeding buttonhole cutting and stitching operation.

It will be observed that the primary function of the ratchet-wheel 137 as related to the control of the work-clamp is to impart the side-shifting movements thereto at the completion of each longitudinal feeding movement, the performance of its secondary function of turning the stitching mechanism being dependent upon the type of buttonhole stitching for which the machine may be designed, and it is therefore obvious that this part of the present im

provement is not limited to the particular type of buttonhole stitching machines herein shown and described. It will be evident that the adjustment of the tripping pin 261 upon its carrying gear-wheel 101 simultaneously determines the length of each advance and retrograde side-feed movement of the work-clamp, for the reason that the stopping position of the gear 101 absolutely fixes the initial position of the gear 102 and the distance of its tripping stud 170 from the pawl-lifter arm 166, so that in all adjustments the machine must of necessity produce lines of stitching of equal length and number of stitches along both sides of the buttonhole slit.

The starting mechanism, as represented more particularly in Fig. 10, is somewhat more complicated in construction than would be required in the performance of its function herein described, for the reason that, as represented, it is designed for adjustment to coöperate with buttonhole cutting mechanism timed to operate before instead of after the stitching operation, and certain of the parts connected therewith are not described in detail, as they form no part of the present invention.

From the foregoing description, it will be seen that the characteristic features of the present improvement are the relation of the advance and retrograde feed-actuating devices to each other and to the stitching mechanism turning device and the means whereby their operative movements are derived from a common reciprocating member; and it is therefore evident that other clutch mechanisms involving suitable clutch-wheels and coöperating clutch-dogs than those herein shown and described, and other modifications of the mechanism of the improvement in its present embodiment, may be readily employed within the scope of the present invention.

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

1. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of feeding mechanism comprising a rotary feed-wheel and reversely rotating driving-wheels permanently connected to rotate therewith, an operative connection between said feed-wheel and work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, independent actuating devices alternately engaging said driving-wheels to turn each in the same direction for imparting to said feed-wheel step-by-step turning movements in opposite directions, and automatically acting means for establishing operative relation alternately between each of said actuating devices and the feed-wheel.

2. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, independent actuating devices adapted for imparting to said feed-wheel step-by-step turning movements in opposite directions, means for establishing operative relation alternately between each of said actuating devices and the feed-wheel, and additional means whereby each of said actuating devices is retracted out of operative relation with the feed-wheel when the other is thrown into operative relation therewith.

3. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and the work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, independent and alternately effective and ineffective actuating devices adapted for imparting to said feed-wheel step-by-step turning movements in opposite directions, means whereby each of said actuating devices is rendered effective in turning the feed-wheel, means for successively rendering said actuating devices ineffective, and means for maintaining each of said actuating devices ineffective while the other is effective in turning the feed-wheel and for maintaining both of said actuating devices ineffective during a plurality of stitch-forming cycles intermediate their respective periods of effectiveness.

4. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, a pair of clutch-wheels connected with the feed-wheel suitably for turning the same in opposite directions, clutch-dogs adapted for operative engagement with said clutch-wheels, actuating means for imparting reciprocating movements to said clutch-dogs, and means for establishing operative relation alternately between each of said clutch-dogs and its respective clutch-wheel.

5. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, a pair

of ratchet-wheels connected with the feed-wheel suitably for turning the same in opposite directions, pawls adapted for normal operative engagement with said ratchet-wheels, a pawl-carrier, means for reciprocating said carrier, pawl-lifters adapted for engagement with said pawls, and means for alternately actuating said pawl-lifters to cause the alternate disengagement of said pawls with their respective ratchet-wheels.

6. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, a pair of ratchet-wheels connected with the feed-wheel suitably for turning the same in opposite directions, pawls adapted for normal operative engagement with said ratchet-wheels, a pawl-carrier, means for reciprocating said carrier, pawl-lifters adapted for engagement with said pawls, means for alternately actuating said pawl-lifters to cause the alternate disengagement of said pawls with their respective ratchet-wheels, pawl-detainers adapted to maintain the pawls disengaged from their respective ratchet-wheels. and means acting upon said pawl-detainers for releasing said pawls.

7. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, a pair of ratchet-wheels connected with the feed-wheel suitably for turning the same in opposite directions, pawls adapted for normal operative engagement with said ratchet-wheels, a pawl-carrier, means for reciprocating said carrier, pawl-lifters adapted for engagement with said pawls, means for alternately actuating said pawl-lifters to cause the alternate disengagement of said pawls with their respective ratchet-wheels, pawl-detainers mounted upon said carrier and adapted to maintain the pawls disengaged from their respective ratchet-wheels, and means acting upon said pawl-detainers for releasing said pawls.

8. In a buttonhole sewing machine, the combination with stitch-forming mechanism, a work-clamp, and turning mechanism for producing relative turning movements between the stitch-forming mechanism and the work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, a pair of ratchet-wheels connected with the feed-wheel suitably for turning the same in opposite directions, pawls adapted for normal operative engagement with said ratchet-wheels, a pawl-carrier, means for reciprocating said carrier, pawl-lifters mounted upon said carrier and adapted for engagement with said pawls, pawl-detainers adapted to maintain the pawls disengaged from their respective ratchet-wheels, means connected with the lifter of the initially acting pawl for setting said turning mechanism in action, and means connected with the detainer of a subsequently acting pawl and controlled by the turning mechanism for interrupting the action of the latter and bringing the second-named pawl into operative relation with its respective ratchet-wheel.

9. In a buttonhole sewing machine, the combination with stitch-forming mechanism, a work-clamp, and turning mechanism for producing relative turning movements between the stitch-forming mechanism and the work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, independent actuating devices comprising a plurality of interengaging parts and adapted for turning said feed-wheel in opposite directions, independently acting disengaging devices for interrupting operative relation between the interengaging parts of said actuating devices, means for establishing operative relation between the interengaging parts of one of said actuating devices, means connected with and controlling the action of the same one of said disengaging devices and adapted to simultaneously render the latter inactive and set the turning mechanism in action, means controlled by said turning mechanism for throwing the same out of action and simultaneously initiating the operation of a second of said actuating devices, and means for throwing the last-named actuating device out of action.

10. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of turning mechanism including a clutch-wheel for producing relative turning movements between the stitch-forming mechanism and the work-clamp, feeding mechanism comprising two clutch-wheels and connections between the same and the work-clamp for producing relative feeding movements in opposite directions between the latter and the stitch-forming mechanism, clutch-dogs adapted for operative engagement with their respective clutch-wheels, controlling means for

establishing and interrupting such operative relation, and tripping members carried by the initially actuated feeding clutch-wheel and the turning mechanism clutch-wheel for simultaneously arresting the operation of said feeding clutch-wheel and initiating the operation of the turning mechanism and for simultaneously interrupting the operation of the turning mechanism and initiating the operation of a second feeding clutch-wheel.

11. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of turning mechanism including a clutch-wheel for producing relative turning movements between the stitch-forming mechanism and the work-clamp, feeding mechanism comprising two clutch-wheels and connections between the same and the work-clamp for producing relative feeding movements in opposite directions between the latter and the stitch-forming mechanism, clutch-dogs adapted for operative engagement with their respective clutch-wheels, a common reciprocatory actuating member to which said clutch-dogs are connected and from which they derive their operative movements, controlling means for establishing and interrupting such operative relation, and tripping members carried by the initially actuated feeding clutch-wheel and the turning mechanism clutch-wheel for simultaneously arresting the operation of said feeding clutch-wheel and initiating the operation of the turning mechanism and for simultaneously interrupting the operation of the turning mechanism and initiating the operation of a second feeding clutch-wheel.

12. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of feeding mechanism comprising a feed-wheel, an operative connection between said feed-wheel and work-clamp for imparting relative feeding movements between the latter and the stitch-forming mechanism, actuating devices adapted for turning said feed-wheel in opposite directions, a rotary wheel, means connected therewith for producing relative turning movements between the stitch-forming mechanism and the work-clamp, actuating means for turning said rotary wheel, and means for establishing alternately operative relation between each of said actuating devices and the feed-wheel and intermediate thereto establishing operative relation of said rotary wheel with its actuating means while the first-named actuating devices are inoperative relative to the feed-wheel.

13. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of mechanism for producing relative turning movements between the stitch-forming mechanism and the work-clamp, feeding mechanism comprising means for producing relative longitudinal feeding movements between the stitch-forming mechanism and the work-clamp, means controlled by said longitudinal feeding movements for producing relative side-shifting movements between the stitch-forming mechanism and the work-clamp, and means controlled by said turning mechanism for producing a relative side-shifting movement in the opposite direction between the stitch-forming mechanism and the work.

14. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of mechanism for producing a partial rotation of the stitch-forming mechanism, and feeding mechanism comprising means for producing the longitudinal feed of the work-clamp, and means including a needle-throat operatively connected with the work-clamp and eccentrically disposed relatively to the axis of rotation and movable with said turning mechanism and acting in conjunction with the work-clamp to produce side-shifting movements thereof to move the work from one to the other side-stitching position.

15. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of mechanism for producing a partial rotation of the stitch-forming mechanism, mechanism for imparting a return partial rotation of the stitch-forming mechanism to initial position, and feeding mechanism including means for imparting a longitudinal feeding motion to said work-clamp, and means including a guide-member carried by and bodily movable with said turning mechanism and operatively connected with the work-clamp throughout the cycle of operation of the machine and adapted for imparting an initial side-shifting movement at the completion of the initial feeding movement and a return side-shifting movement at the completion of the second feeding movement.

16. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of feeding mechanism comprising means for imparting longitudinal feeding movements to the work-clamp, actuating devices for said feeding means adapted to be disconnected therefrom at the completion of each longitudinal feeding movement, and side-shifting means for the work-clamp including a stud and a cam member formed with a closed cam-slot having a straight portion with an enlargement at one end, said stud and cam member being carried by the work-clamp, a fixed cam member adapted for engagement with said stud, a stud adapted for engagement with the cam member of said work-clamp and

supported for movement transversely of the direction of feed, and means for shifting said movably mounted stud intermediate the longitudinal feeding movements of the work-clamp.

17. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of feeding mechanism for imparting relative longitudinal feeding and side-shifting movements between the stitch-forming mechanism and the work-clamp and comprising a plurality of clutch-wheels, connections between two of said clutch-wheels and the work-clamp whereby said feeding movements in opposite directions are produced and a connection between said work-clamp and a third clutch-wheel whereby the said side-shift movements are produced; actuating means acting independently upon said clutch-wheels for imparting thereto operative movements, and additional actuating means connected with the third clutch-wheel whereby the latter is operated to produce a retrograde side-shift movement between the stitch-forming mechanism and the work-clamp.

18. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and work-clamp for producing relative feeding movements between the stitch-forming mechanism and the work-clamp; a plurality of ratchet-wheels connected with said feed-wheel, pawls adapted for normal operative engagement with said ratchet-wheels, actuating means for imparting to said pawls operative movements of uniform extent, pawl-shields for controlling the period of engagement of each pawl with its respective ratchet-wheel for each operative movement of said pawl, a pawl-shield carrier, and means for adjusting the position of said carrier to simultaneously vary the period of operative engagement of each pawl with its ratchet-wheel.

19. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of feeding mechanism comprising a clutch-wheel, operative connections between said clutch wheel and the work-clamp for producing relative feeding movements between the stitch-forming mechanism and the work-clamp, a clutch-dog normally in operative relation with said clutch-wheel, a reciprocating actuator operatively connected with said clutch-dog whereby operative movements are imparted to the same by advance movements of the actuator, a clutch-dog disengaging member and a tripping member therefor, one of which members is connected with said clutch-wheel and the other is connected with and adapted to be brought into operative engagement with the other by the retrograde movement of said actuator.

20. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of feeding mechanism comprising a clutch-wheel, operative connections between said clutch-wheel and the work-clamp for producing relative feeding movements between the stitch-forming mechanism and the work-clamp, a clutch-dog normally in operative relation with said clutch-wheel, a reciprocating actuator operatively connected with said clutch-dog whereby operative movements are imparted to the same by advance movements of the actuator, clutch-dog disengaging means connected with and partaking of the movements of said actuator, and tripping means brought into the path of movement of said disengaging means by a connection with said clutch-wheel whereby the disengaging means are actuated by the retrograde movement of said actuator.

21. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of feeding mechanism comprising a plurality of clutch-wheels and operative connections between said clutch-wheels and work-clamp whereby relative feeding movements in opposite directions between the latter and the stitch-forming mechanism may be produced, clutch-dogs adapted for operative engagement with said clutch-wheels, a reciprocating actuator for said clutch-dogs, and means, controlled by the retrograde movement of said actuator succeeding an advance operative movement thereof to impart operative movements to said clutch-dogs, whereby the latter are thrown out of operative relation with their respective clutch-wheels.

22. In a buttonhole sewing machine, the combination with stitch-forming mechanism and a work-clamp, of feeding mechanism comprising a plurality of clutch-wheels and operative connections between said clutch-wheels and work-clamp whereby relative feeding movements in opposite directions between the latter and the stitch-forming mechanism may be produced, clutch-dogs adapted for operative engagement with said clutch-wheels, a reciprocating actuator for said clutch-dogs, clutch-dog disengaging means connected to and movable with said actuator for interrupting operative relation of said dogs with their respective clutch-wheels, and means carried by said clutch-wheels for tripping said disengaging means into action.

23. In a buttonhole sewing machine, the combination with stitch-forming mechanism, a work-clamp and a stop-motion device, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and the work-clamp where-

by feeding movements between the latter and the stitch-forming mechanism are produced, means for imparting to said feed wheel step-by-step turning movements in opposite directions, and controlling means for tripping said stop-motion into action to stop the machine and comprising a tripping stud deriving to-and-fro movements from the feed-wheel and acting in conjunction with a tappet arm normally lying in its path of movement whereby the feed-wheel is caused to move equal distances from and backward into initial starting and stopping position.

24. In a buttonhole sewing machine, the combination with stitch-forming mechanism, and a work-clamp, of feeding mechanism comprising a rotary feed-wheel, an operative connection between said feed-wheel and work-clamp whereby relative feeding movements between the latter and the stitch-forming mechanism may be produced, reversely rotating driving clutch-wheels permanently connected with said feed-wheel, a reciprocating carrier having a path of travel at the same side of the axes of movement of both said clutch-wheels, clutch-dogs sustained by said carrier and each adapted to operatively engage its respective clutch-wheel, and automatically acting means for establishing operative relation alternately between each of said dogs and its respective clutch-wheel.

25. In a buttonhole sewing machine, the combination with stitch-forming mechanism, including a reciprocating needle-bar carrying a needle and complemental loop-taking devices, a rotary bushing in which said needle-bar is mounted, a rotary support for the loop-taking devices, means for turning said bushing and support in unison, a work-clamp, a laterally and longitudinally movable carrier therefor provided with a longitudinal guideway, feeding mechanism for producing a longitudinal travel of the work-clamp carrier, and a stud mounted upon said support eccentrically to its axis of rotation and entering said guideway of the work-clamp carrier and serving as a shifting guide to determine the lateral position of the work-clamp.

In testimony whereof, we have signed our names to this specification, in the presence of two subscribing witnesses.

JAMES G. GREENE.
LOUIS F. A. BÜCHNER.

Witnesses:
HENRY J. MILLER,
H. A. KORNEMANN, Jr.