E. B. ALLEN.

BUTTONHOLE SEWING MACHINE.

APPLICATION FILED SEPT. 23, 1916.

1,339,732.

Patented May 11, 1920.

8 SHEETS—SHEET 1.

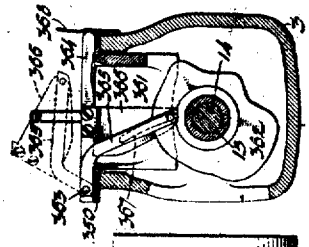

Fig. 28.

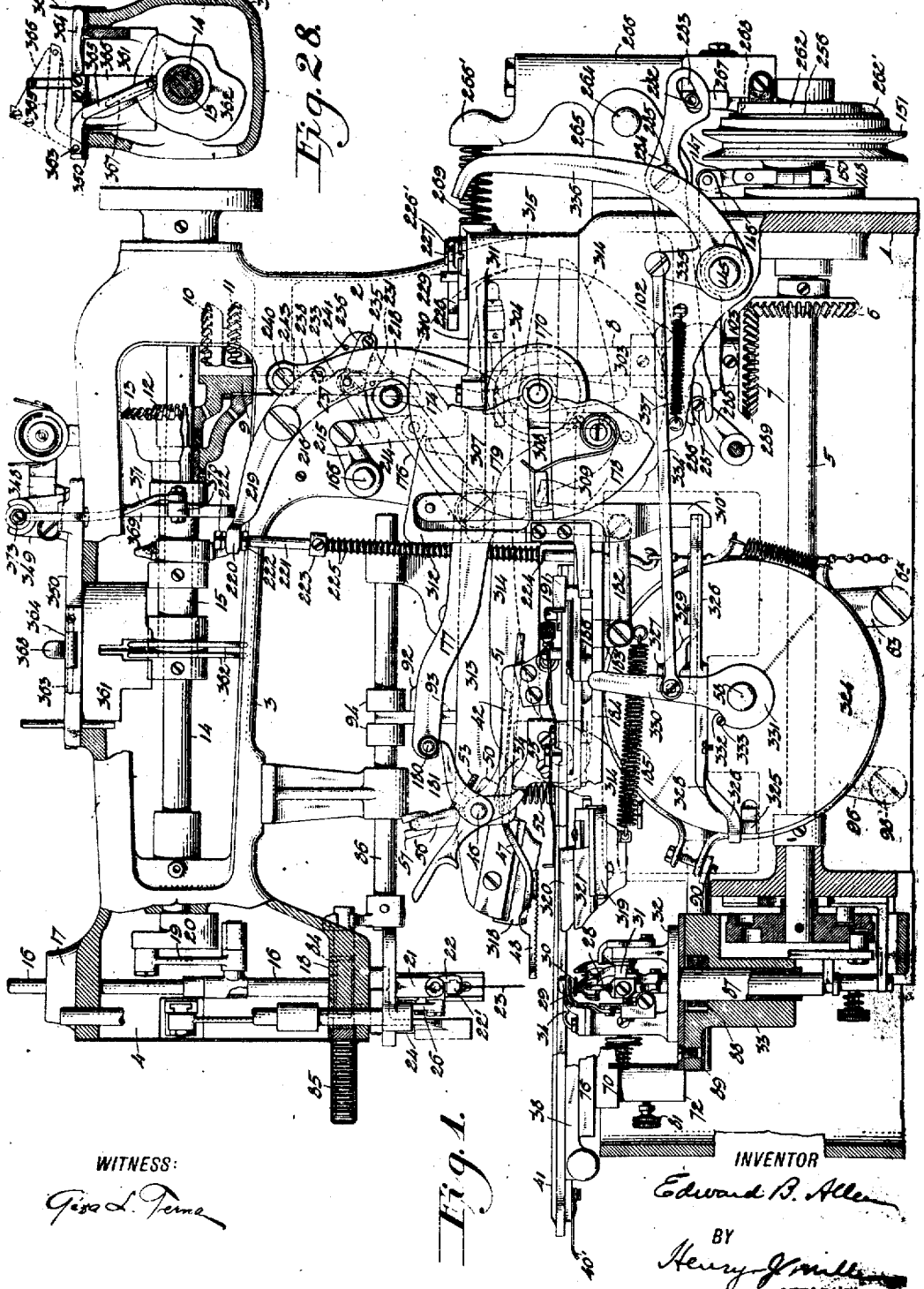

Fig. 1.

WITNESS:

Geo. L. Peirce

INVENTOR

Edward B. Allen

BY

Henry J. Miller

ATTORNEY

E. B. ALLEN.

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8 SHEETS—SHEET 2.

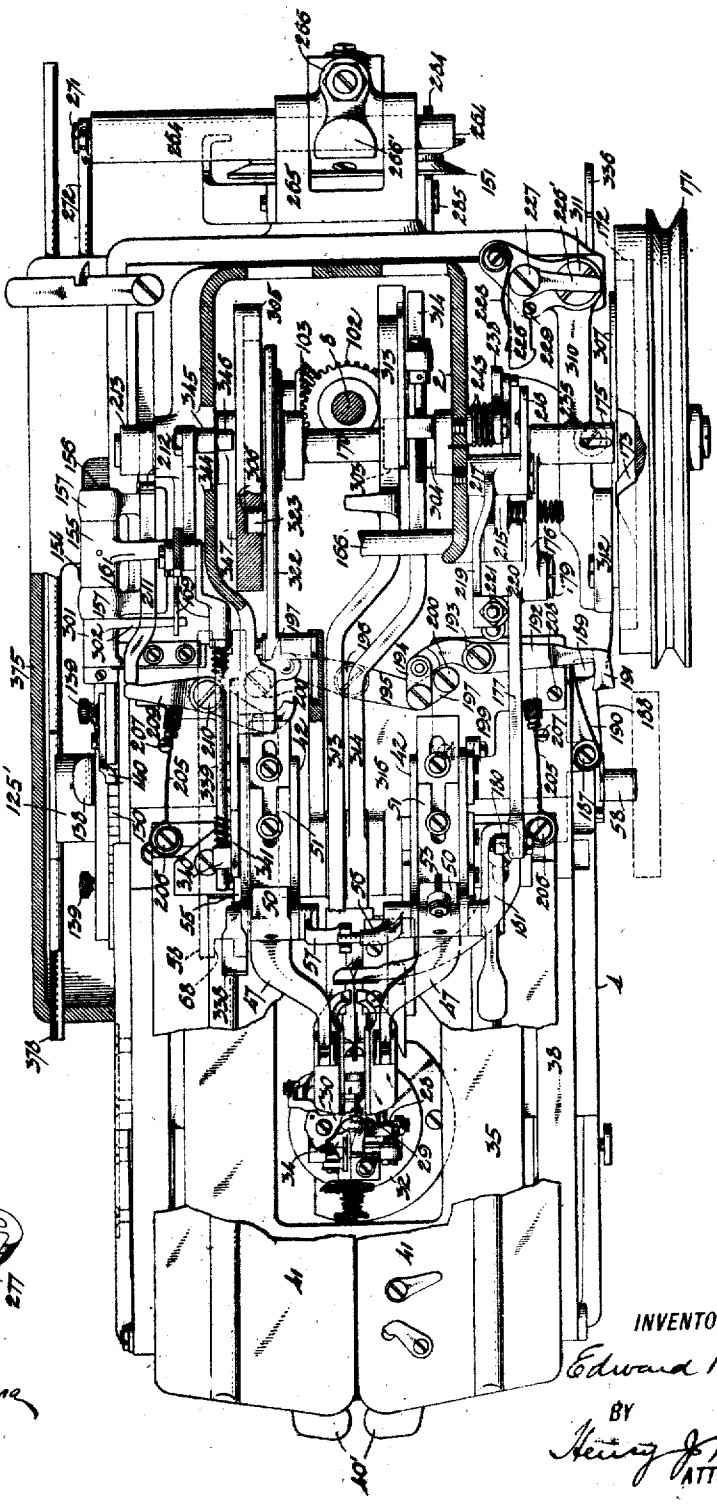

Fig. 2.

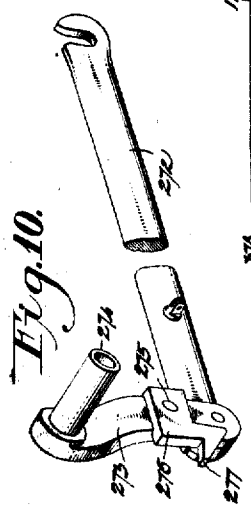

Fig. 10.

WITNESS:

Vera L. Terna

INVENTOR

Edward B. Allen

BY

Henry J. Muller

ATTORNEY.

E. B. ALLEN.

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8 SHEETS—SHEET 3.

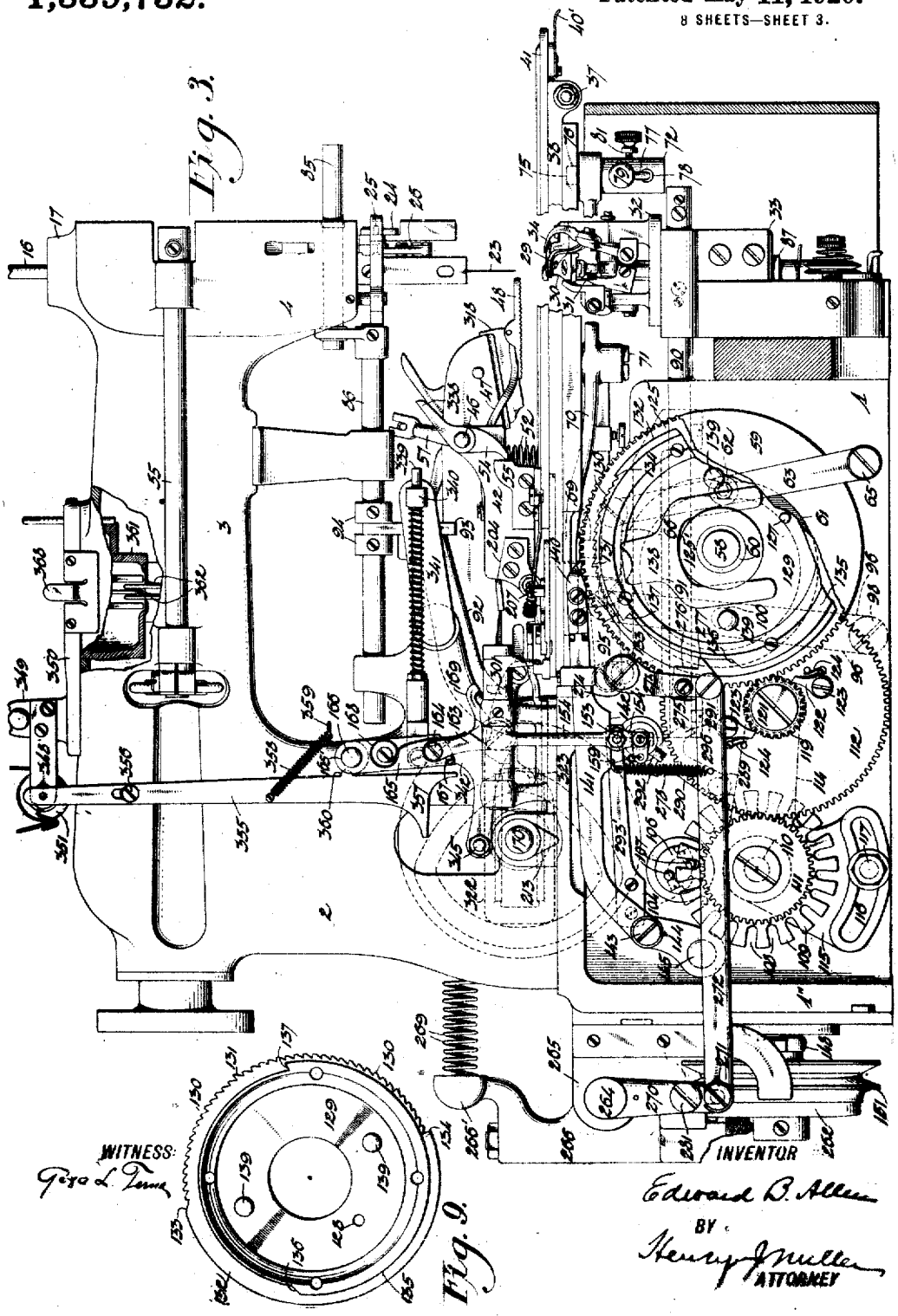

Fig. 3.

Fig. 9.

WITNESS:

Geo. L. Terry

INVENTOR

Edward B. Allen

BY

Henry J. Mullen

ATTORNEY

E. B. ALLEN.

BUTTONHOLE SEWING MACHINE.

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8 SHEETS—SHEET 4.

Fig. 4.

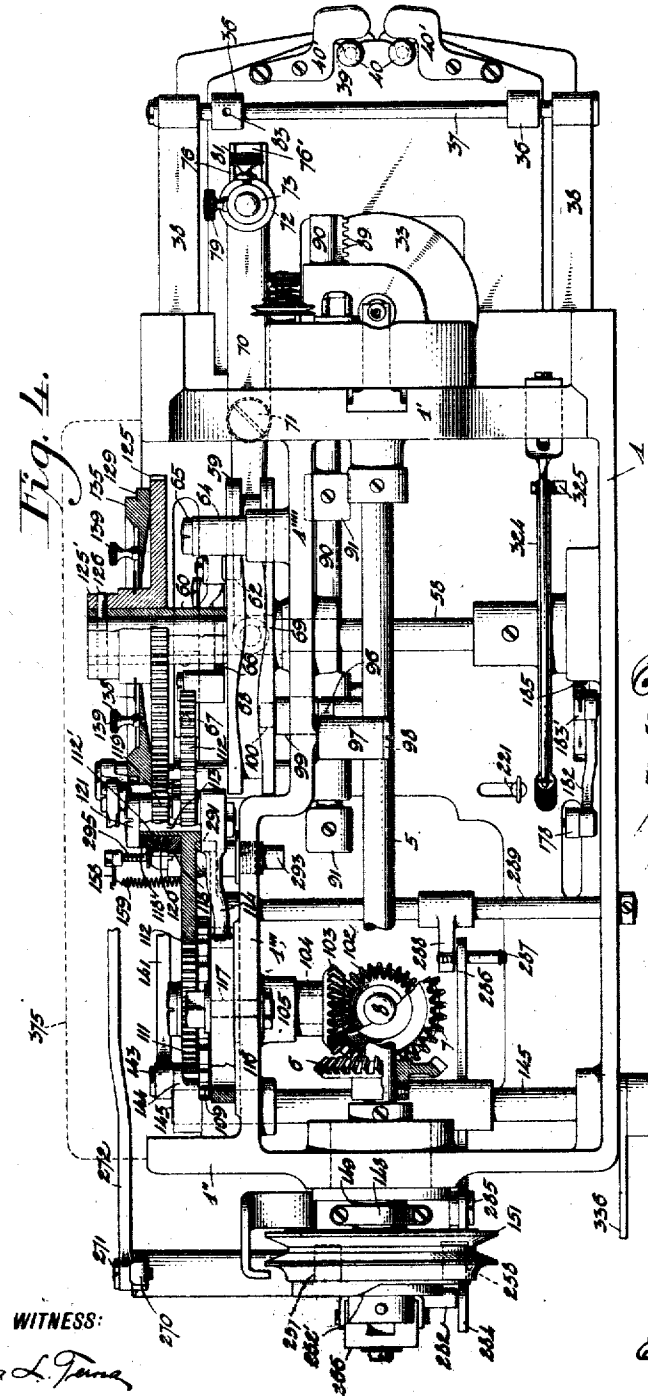


Fig. 30.

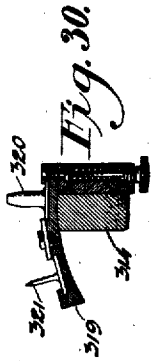
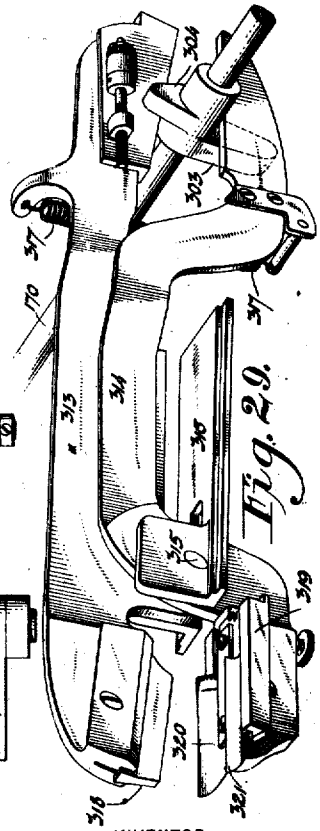


Fig. 29.



WITNESS:

Geo. L. Fox

INVENTOR

Edward B. Allen

BY

Henry J. Miller

ATTORNEY

E. B. ALLEN.

BUTTONHOLE SEWING MACHINE.

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8 SHEETS—SHEET 5.

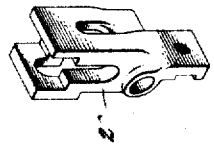


Fig. 27.

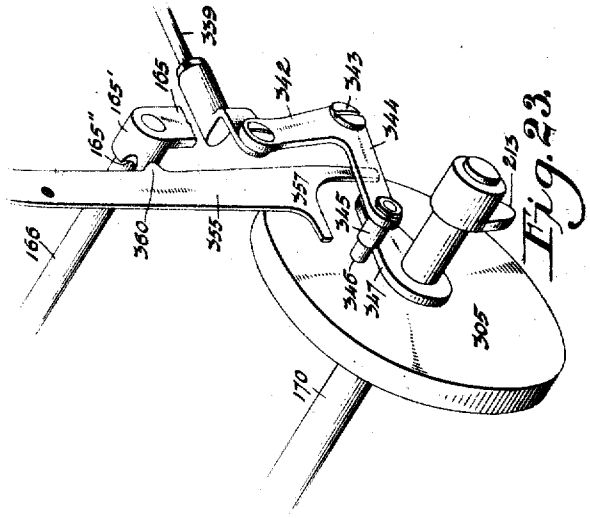


Fig. 23.

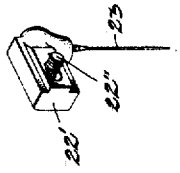
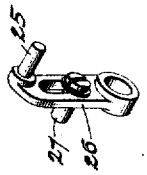


Fig. 26.



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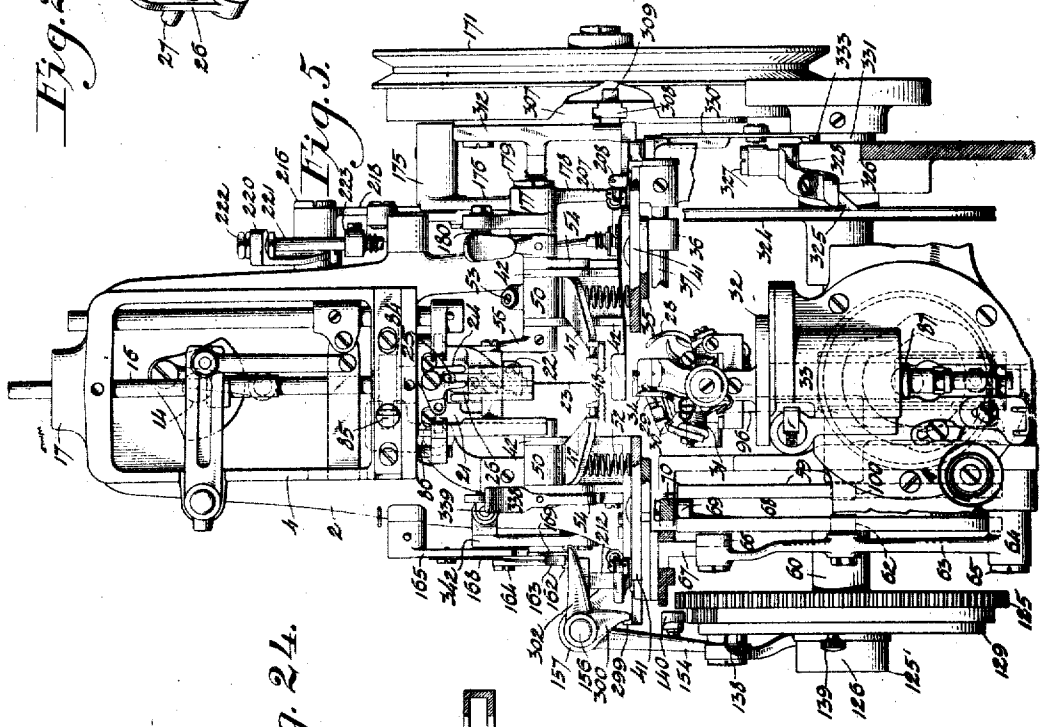

Fig. 5.

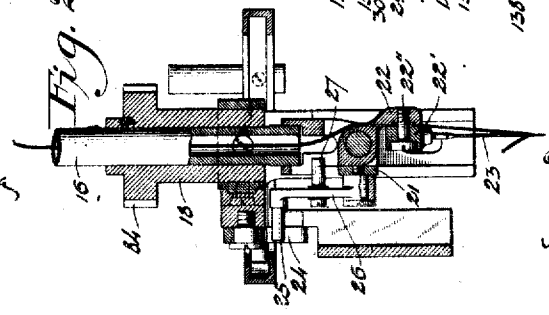

Fig. 24.

WITNESS

Geo. L. Terna

INVENTOR

Edward B. Allen

BY

Henry J. Miller

ATTORNEY

E. B. ALLEN.

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1,339,732.

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8 SHEETS—SHEET 6.

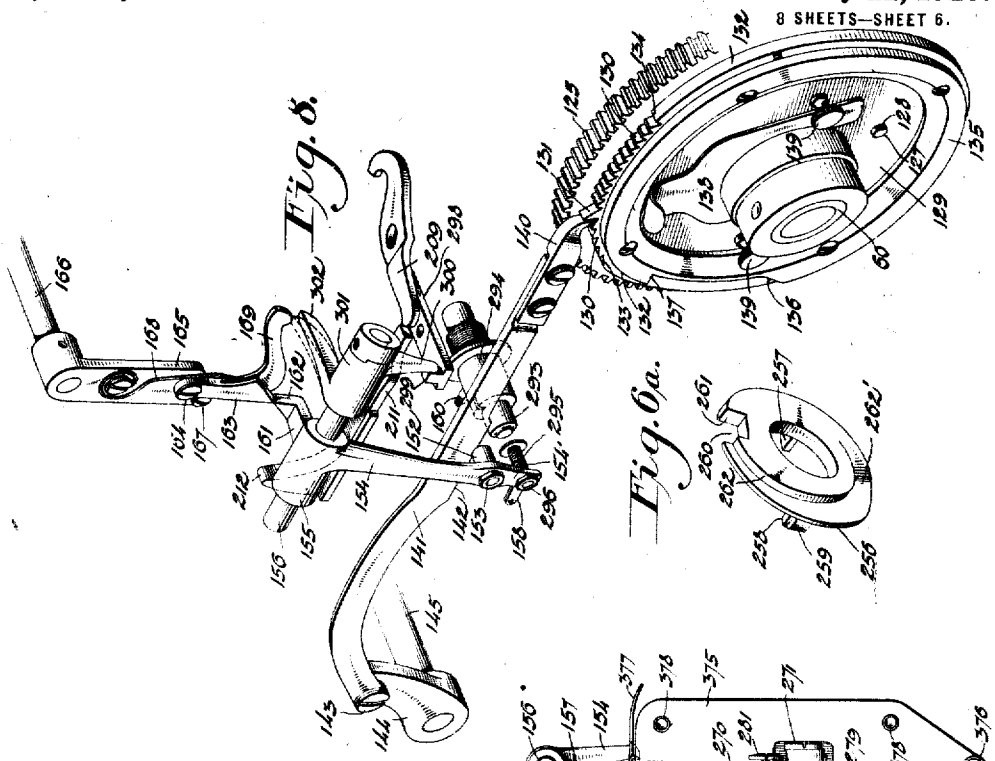


Fig. 6.

Fig. 6a.

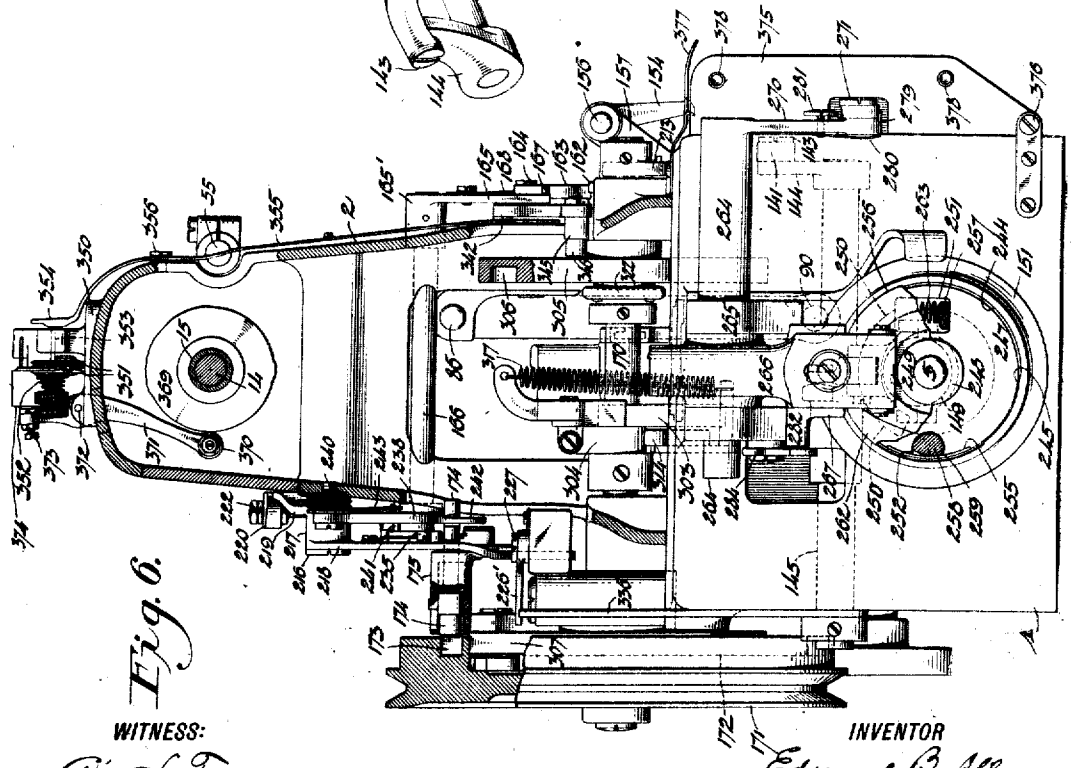


Fig. 6.

WITNESS:

Geza L. Tema

INVENTOR

Edward B. Allen

BY

Henry J. Miller

ATTORNEY

E. B. ALLEN.

BUTTONHOLE SEWING MACHINE.

APPLICATION FILED SEPT. 23, 1916.

1,339,732. **Patented May 11, 1920.**

8 SHEETS—SHEET 7.

Fig. 18.

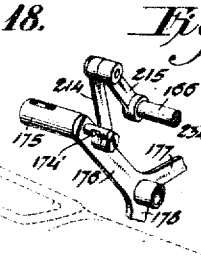


Fig. 19.

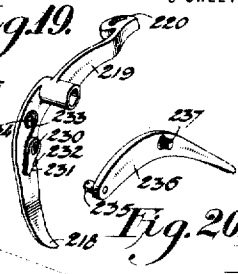


Fig. 20.

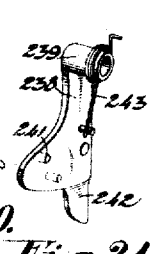
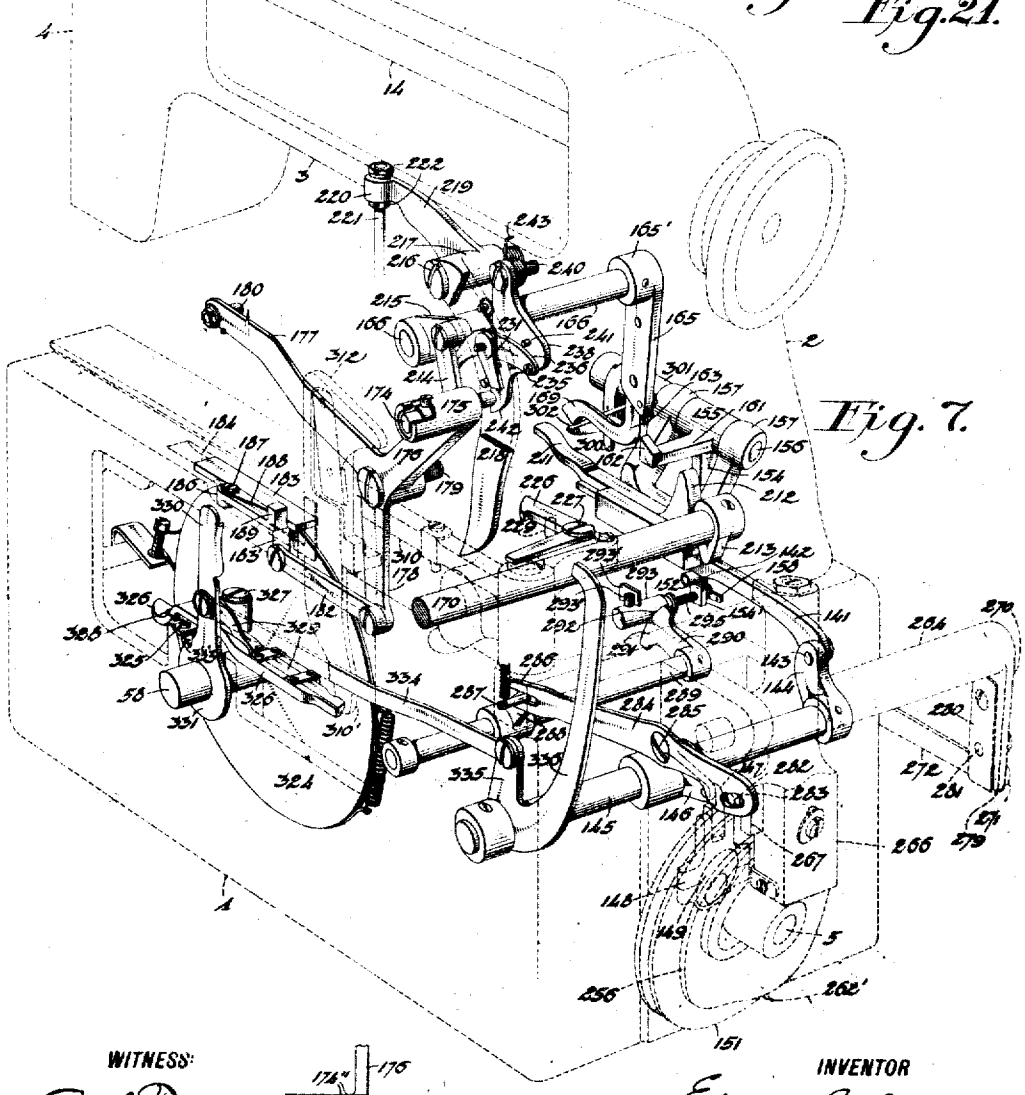


Fig. 21.

Fig. 7.



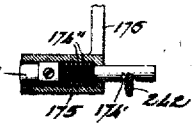


Fig. 22.

WITNESS:

Gerald L. Towne

INVENTOR

Edward B. Allen

BY

Henry J. Miller

ATTORNEY

E. B. ALLEN.

BUTTONHOLE SEWING MACHINE.

APPLICATION FILED SEPT. 23, 1916.

1,339,732

Patented May 11, 1920.

8 SHEETS—SHEET 8.

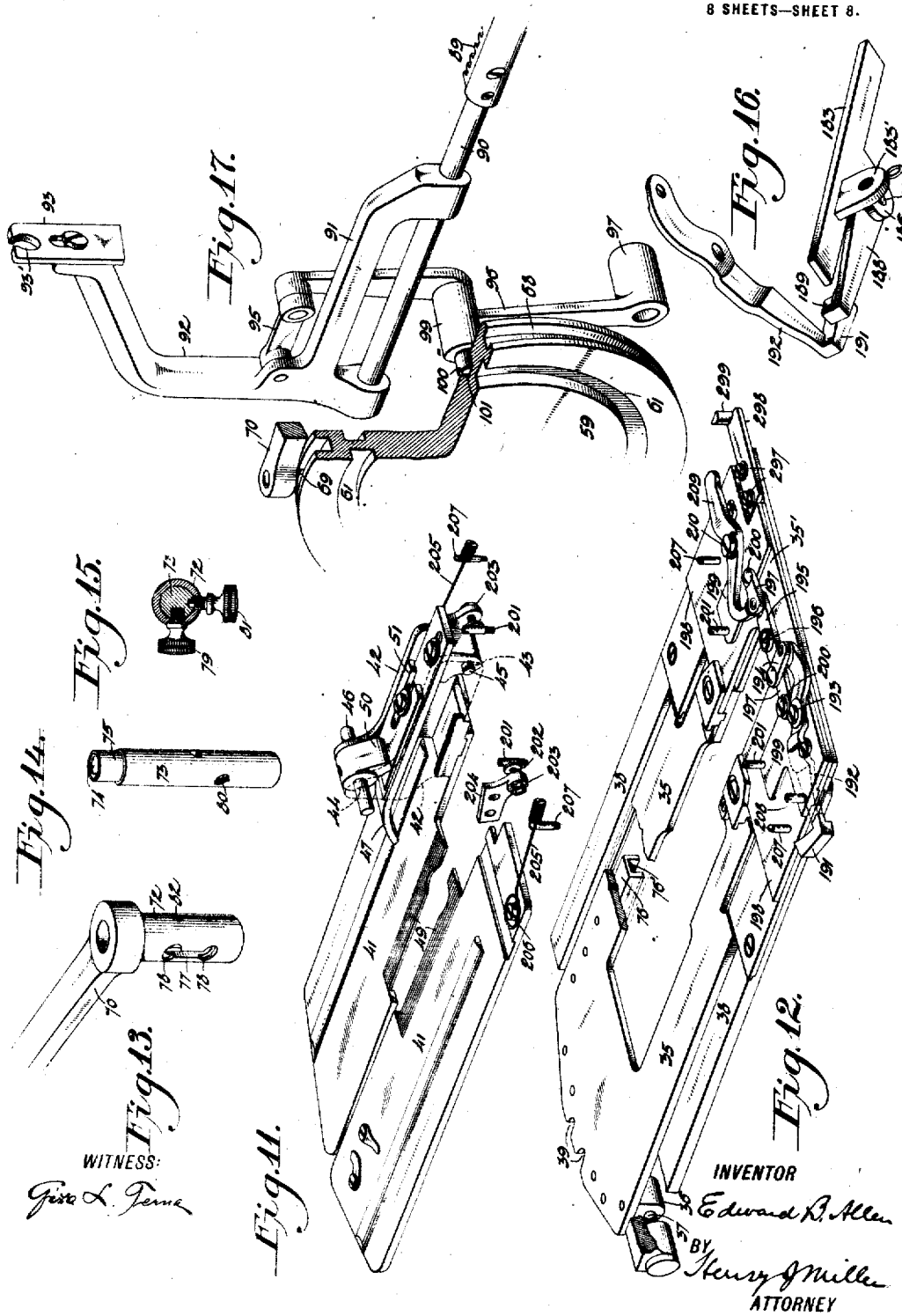


Fig. 17.

Fig. 16.

Fig. 15.

Fig. 14.

Fig. 13.

Fig. 11.

Fig. 12.

WITNESS:

Geo. L. Ferne

INVENTOR

Edward B. Allen

BY Henry J. Miller

ATTORNEY

UNITED STATES PATENT OFFICE.

EDWARD B. ALLEN, OF BRIDGEPORT, CONNECTICUT, ASSIGNOR TO THE SINGER MANUFACTURING COMPANY, A CORPORATION OF NEW JERSEY.

BUTTONHOLE-SEWING MACHINE.

1,339,732. Specification of Letters Patent. Patented May 11, 1920.

Application filed September 23, 1916. Serial No. 121,733.

To all whom it may concern:

Be it known that I, EDWARD B. ALLEN, a citizen of the United States residing at Bridgeport, in the county of Fairfield and State of Connecticut, 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.

Sewing machines, as heretofore constructed for producing buttonholes in textile fabrics, have been customarily provided with adjusting means for determining the period of coöperation of the stitch-forming and feeding mechanisms and the length of travel of the work for production of different sized buttonholes, and variation in the traverse of the work has usually affected its speed of movement in spacing the stitches so as to require readjustment to cause the proper laying of the stitches around the buttonhole. These adjustments required an intimate knowledge of the mechanism of a degree not possessed by the ordinary sewing machine operator, and therefore necessitated the care of the machine under such condition by a special machinist.

The present invention has for an object to so construct machines of this class that they are susceptible of such changes with quickness and precision, so as to insure the greatest economy in the operator's time in changing from one to a different class of work and avoid the employment of an experienced machinist in connection with the ordinary use of a sewing machine under normal working conditions. The invention has for a further object to provide means for changing the spacing of the stitches not only independently of the means for controlling the range of movement of the work but in such manner that this may be quickly and accurately effected regardless of the skill of the operator.

The invention has for a further object to provide a machine which shall be effective in operation and shall have the necessary safe-guards to insure precision in the sequence of operation of its several trains of mechanism.

While the present invention is not limited to embodiment in machines of any particular type or construction, it is especially adapted for buttonhole cutting and stitching machines of the type represented in my United States Patent No. 1,179,378, of April 11, 1916.

According to the present invention, in its preferred embodiment, the machine is constructed with a main-shaft provided with a stop-motion for establishing and interrupting operative relation with the source of power. The stitch-forming and feeding mechanisms are connected with this shaft for coöperation in the feeding of the work and the production of stitches, the feeding mechanism comprising a traveling work-holder and a feed-wheel connected therewith and adapted to impart to it traveling movements suitable for production of the longest buttonhole for which the machine is designed. Removably mounted upon the machine and detachably connected with the feed-wheel, with which it is normally maintained in driving relation, is a controlling wheel provided with a cam-track engaged by a follower connected with the stop-motion whereby both the starting and stopping of the machine shaft is effected. The controlling wheel is further provided with turning means which are active while the main-shaft is at rest, during which period its propulsion of the feed-wheel acts through various connections to perform certain operations auxiliary to the production and spacing apart of the stitches around the buttonhole.

The machine preferably contains buttonhole cutting mechanism comprising traveling coöperative cutting elements actuated by a cutter-shaft independent of the main-shaft and adapted to be automatically coupled to and uncoupled from a continuously running driving element connected with the source of power. Means are preferably provided, which are periodically connected with said driving element, for initially closing the work-holder upon the work and spreading the same and then setting in motion the controlling wheel actuating means in the performance of a buttonhole producing cycle.

The invention will be understood by reference to the accompanying drawings, in which Figure 1 is a front side view of a machine embodying the present improvements, and Fig. 2 a plan of the same with the bracket-arm standard in section and the parts above the section plane removed. Fig.

3 is a rear side elevation of the machine and Fig. 4 a bottom plan of the same. Fig. 5 is a front end elevation of the machine and Fig. 6 a rear end elevation thereof with the bracket-arm standard in transverse section to expose parts within the same. Fig. 6ª is a perspective view representing a portion of the stop-motion device. Fig. 7 is a perspective view representing various operative parts of the machine with the frame represented in dotted lines. Fig. 8 is a perspective view representing the controlling wheel and its actuating and controlling means, and Fig. 9 is a face view of a different controlling wheel detached. Fig. 10 is a perspective view of a portion of the stop-motion controlling mechanism.

Figs. 11 and 12 are perspective views of the lower work-clamping elements and their carrier, respectively, with certain accessories. Figs. 13 and 14 are perspective views and Fig. 15 a sectional plan of parts of the work-clamp side-shifting means. Fig. 16 is a perspective view of a portion of the clamp-spreading means. Fig. 17 is a perspective view of the feed-wheel and the means for imparting turning movements to the stitch-forming mechanism. Figs. 18 to 21, inclusive, are perspective views, and Fig. 22 a sectional plan, representing detached certain coöperating elements of the starting mechanism. Fig. 23 is a perspective view representing portions of the clamp-opening and tension-releasing means. Fig. 24 is a sectional elevation representing the needle-jogging means, and Figs. 25, 26 and 27 are perspective views of certain of its parts detached. Fig. 28 is a transverse sectional elevation of the overhanging member of the bracket-arm and the take-up device. Fig. 29 is a perspective view of the buttonhole cutting device and its actuating means, and Fig. 30 a transverse section representing the cutter-carrier and replaceable cutters sustained thereby.

As represented in the drawings, the frame of the machine is constructed with the hollow base 1 from which rises the bracket-arm composed of the standard 2 and tubular overhanging arm 3 terminating in the hollow head 4. Journaled within and longitudinally of the base 1 is the main-shaft 5 carrying near its rearward end the bevel gear 6 meshing with a similar gear 7 secured upon the lower end of the upright shaft 8. Secured upon the upper end of the shaft 8 is the hub 9 of a bevel gear 10 beneath which and upon the hub 9 is secured the similar bevel gear 11. Meshing with the gears 10 and 11 are the smaller and larger bevel-gears 12 and 13, respectively, the one being fixed upon the upper needle driving shaft 14 journaled in the member 3 of the bracket-arm and the other fixed upon the rearward end of the tubular shaft or sleeve 15 surrounding the shaft 14 and adapted to rotate independently thereof. As represented in Fig. 1, the intermeshing gears 11 and 13 are of the same diameter to transmit operative movements from the shaft 8 to the sleeve 15 in unison, while the driven bevel-gear or pinion 12 is of one-half the diameter of the driving bevel-gear 10, whereby the needle-driving shaft 14 is driven at double the speed of the upright shaft 8.

In general construction and arrangement of parts, the needle mechanism of the present improvement is similar to that of my Patent No. 1,161,277, of November 23, 1915, the tubular needle-bar 16 being journaled in upper and lower bearings afforded respectively by the boss 17 and the rotary sleeve 18, and deriving its reciprocatory movements from connections including the pitman 19 and the crank-element 20 secured upon the forward end of the needle-actuating shaft 14.

The needle-bar sustains at its lower end a yoke 21 upon which is slidingly mounted the laterally jogging needle-holding block 22 in which is secured the shank of the needle 23. The block 22 is provided with a laterally adjustable section 22′ secured thereto by a clamp-screw 22″ by means of which the lateral working position of the needle may be determined. In the present needle-jogging mechanism, the forked arm 24 of the angular switch-lever embraces a lateral pin 25 of an intermediate lever 26 fulcrumed upon the needle-bar yoke 21 and carrying a shouldered stud 27 entering a slot of the needle-holding block. The stud 27 is adjustable in a slot extending lengthwise of the lever 26, so as to provide for adjustment of the amplitude of lateral jogging movements of the needle.

The loop-taking mechanism coöperating with the reciprocating and jogging needle is preferably constructed substantially in accordance with that of my Patent No. 1,030,046, of June 18, 1912, and comprises the eyed looper 28 and opposed non-threaded looper 29 with overlying spreader 30, all mounted upon the rocking looper-carrier 31 which is sustained by the rotary turret 32 journaled in a bearing bracket 33 sustained within the base 1. Coöperating with the threaded looper 29 and working transversely thereof is the loop-detainer 34. The looper mechanism coöperates with the laterally jogging needle 23 in the production of a chain-stitch over-seam.

The work-holder and its operating means are constructed in substantial accordance with my Patent No. 1,136,388, of April 20, 1915, although differing therefrom in certain important features. It is mounted upon the cross slide-plate 35 having at its forward end the depending apertured lugs 36 fitted upon the cross-rod 37 which is sus-

tained by the longitudinally traveling slide-plate 38 mounted in a suitable slideway in the top of the bed 1.

The slide-plate 35 has in its forward end the closely spaced notches 39 entered by the headed pivotal studs 40 depending from the adjacent forward corners of the swinging clamp-plates 41. The studs 40 are detachably confined within their respective notches 39 by means of the angular spring-plates 40' secured upon the under side of the cross slide-plate 35 and notched in their adjacent edges to embrace and engage the heads of the respective studs 40 below which they may be pressed to release the studs for removal of the clamp-plates 41.

Each of the clamp-plates has secured upon its rearward end a bearing bracket comprising the spaced upwardly extending plates 42 formed at opposite ends with apertures 43 and 44 to receive respectively the clamp-arm fulcrum-pin 45 and the clamp-closing rock-shaft 46. Upon the fulcrum-pins 45 are mounted by suitable means the rear ends of the clamp-arms 47 each carrying the pivotally mounted clamping foot 48 with serrated lower face opposed to the correspondingly serrated faces of the work-clamping portions 49 of the clamp-plates 41, whose adjacent edges are recessed as usual to afford clearance for the stitch-forming mechanism in the stitching of buttonholes. The rock-shaft 46 is provided with the usual depending cam projections 50 acting upon wearing plates 51 overlying the clamp-arms 47 and serving to depress the latter in opposition to their lifting springs 52. An adjustable stop-screw 53 sustained by the rock-shaft 46 engages one of the wearing plates 51 to limit the closing movement of the shaft and tappet-arms 54 also carried by said rock-shafts and engaging stop-lugs 55 adjustably secured to the bracket members 42 serve to limit the clamp-opening movements of these rock-shafts.

Upon the adjacent ends of the rock-shafts 46 are secured the upwardly extending arms 56 and 57 which are provided with pin-and-slot connections for insuring the clamp-opening and closing movements of said rock-shafts in unison. Suitably journaled within the bed 1 is a transverse feed-shaft 58 upon which is fixed the feed-wheel 59 formed with the rearwardly extending tubular hub 60. The wheel 59 has in its forward face the work-feeding cam-groove 61 which is entered by a stud 62 intermediate the ends of a lever 63 having its hub 64 journaled upon the fixed fulcrum-stud 65 and connected at its opposite end by means of the link 66 with a lug 67 depending from the work-holder sustaining slide-plate 38. Through the described connections, the feed-wheel imparts to the work-holder longitudinal traveling movements having a range which is uniform for all buttonhole producing cycles.

The feed-wheel is constructed with a peripheral cam-groove 68 which is entered by a roller-stud 69 at one end of the side-shift rock-lever 70 fulcrumed intermediate its ends at 71 and having at its opposite end the depending boss 72 apertured to receive the pin 73 terminating at its upper end in the stud 74 carrying the anti-friction roller 75 which enters the guideway 76' of a block 76 secured to the under face of the cross slide-plate 35. Through the described connections, the work-holder derives from the feed-wheel uniform side-shift movements in each buttonhole producing cycle.

The boss 72 has in one side a longitudinal slot 77 with countersunk recesses 78 at the ends to receive the head of the clamp-screw 79 whose shank passes through the slot 77 and enters a threaded aperture 80 in the pin 73. By retracting the screw 79 sufficiently for its head to emerge from either of the cavities 78, it may be used to shift the roller-stud 75 upwardly or downwardly, respectively, into or out of the guideway 76' of the cross slide-plate 35, the turning of the screw in either of the extreme positions of the pin 73 serving to lock its head within the respective cavity 78.

When the roller-stud 75 is retracted from its normal position in the guideway 76', the rock-lever 70 is adapted to move idly without effect upon the work-holder, and the machine is adapted for stitching straight buttonholes. Under this condition of adjustment, the set-screw 81, normally screwed into a holding aperture 82 of the boss 72, is introduced into a threaded aperture 83, Fig. 4, in one of the lugs 36 and serves to clamp the same to the cross-rod 37 so as to prevent the accidental lateral shifting of the work-holder during the operation of the machine.

Similarly to the machine represented in my said Patent No. 1,030,046, the needle-bar bearing sleeve 18 has fixed thereon the pinion 84 engaged by the rack 85 which is in turn connected for reciprocation with the slide-bar 86 journaled in the machine frame. The tubular spindle 87 of the rotary turret 32 has fixed thereon the pinion 88 meshing with the rack 89 secured in the forward end of the slide-bar 90 which is mounted in bearings within the base 1. The bars 86 and 90 are rigidly connected by means of a frame-member 91 secured upon the bar 90 and having an upwardly and forwardly projecting arm 92 carrying the coupling plate 93 embraced by the spaced collars 94 upon the bar 86 and formed with a notch 93' embracing the bar 86.

The frame 91 is connected by means of the link 95 with the upper end of a swinging lever 96 having its opposite end the ap-

ertured boss 97 journaled upon the fixed stud-pin 98 and having intermediate its ends a laterally projecting boss 99 carrying the roller-stud 100 which enters the cam-groove 101 in the forward face of the feed-wheel 59. In the rotation of the feed wheel, the bars 86 and 90 are moved first rearwardly and then returned to initial position for effecting first a semi-rotation of the stitch-forming mechanism in the stitching of the eye of the buttonhole and then turned in the opposite direction to restore the stitching mechanism to initial position, in a manner well known.

As will be observed by reference more particularly to Fig. 4, the base 1 has a housing recess in its forward side formed between the forward and rearward transverse frame-members 1′ and 1″ and the longitudinally extending member 1‴ having a rearwardly offset portion 1⁗ sustaining the fulcrum-stud 98 and formed with a suitable clearance aperture for passage of the roller-stud 100 entering the cam-groove in the adjacent face of the feed-wheel 59 disposed in the said frame-recess.

The mechanism for actuating the feed-wheel for producing relative feeding movements between the work-holder and the stitch-forming mechanism in each stitching period is similar in general construction to that of my Patent No. 1,234,252, dated July 24, 1917, although differing therefrom in detail. Secured upon the upright shaft 8 is a bevel pinion 102 meshing with a similar pinion 103 fixed upon the transverse shaft 104 which is journaled in the bearing boss 105 of the frame-member 1‴ and carries upon its outer end the driving disk 106 carrying the two diametrically opposite and eccentrically disposed stud-pins 107. The stud-pins 107 are adapted to enter the radial spaces 108 intermediate the peripheral teeth 109 of the driven disk or member mounted upon the bearing stud 110 sustained by the base-member 1‴. As indicated in Fig. 3, the periphery of the driven member embraces the axis of the driving shaft 104, the peripheral teeth 109 differing in form from those of my said patent in the provision of radial interdental spaces, thereby reducing the interval of dwell in the initial engagement of each of the driving pins 107 therewith while in practice providing a sufficient dwell for interruption of the travel of the work while the needle is descending through it and rising sufficiently to present its loop for seizure by the loop-taker. The driven wheel has secured thereto the gear-wheel 111 meshing with a larger gear wheel 112 which is mounted upon the bearing stud 113 carried by a lateral arm 114 of an angle-lever fulcrumed concentrically with the stud 110 and having a depending arm 115 formed with a segmental slot 116 concentric with the stud 110 and entered by the clamp-screw 117 tapped into the frame member 1‴ and adapted to secure the angle-lever in any position of circular adjustment.

Upon the hub 112′ of the gear 112 is loosely mounted the ratchet-wheel 118 having a tubular hub 118′ upon which is loosely fitted the change-wheel 119 formed with an eccentrically disposed aperture entered by the pin 120 projecting from the adjacent face of the ratchet-wheel 118 to cause them to rotate in unison while permitting the replacement of one change-wheel by another of different size. The head of a cap-screw 121 tapped into the end of the stud 113 serves to confine the gears 112 and 119 and the intermediate ratchet-wheel 118 in operative relation.

The ratchet-wheel 118 and the gear 112 are connected to rotate in unison in one direction by means of the clutch-pawls 122 which are mounted upon diametrically opposite studs 123 sustained upon the rearward face of the gear 112 and pressed into operative relation with the peripheral teeth of the ratchet-wheel by means of springs 124. The pawls are spaced apart circumferentially in multiples of a ratchet-tooth length, less a half-tooth length, in a manner well known in connection with ratchet mechanism.

The change-wheel 119 is maintained in mesh with the larger gear-wheel 125 having its hub 125′ fitted upon the hub 60 of the feed-wheel and secured thereon by means of the cross-pin 126 passing through both hubs and the feed-wheel shaft to insure their rotation in unison. By the means described, the driven wheel 108 109 receives two forward impulses for each rotation of the main-shaft throughout a stitching period, these impulses being transmitted through the described train of gearing to the feed-wheel shaft and through it to the feed-wheel fixed thereon, and hence relative feeding movements are produced through the operation of the feed-wheel between the stitch-forming mechanism and the work-holder throughout each stitching period. The wheel which carries the teeth 109 and which partakes of a progressive step-by-step movement in one direction, may be considered as a driving member for the feed-wheel 59. The ratchet-wheel 118 and clutch-pawls 122 thus constitute one-way acting connecting means between the driving member and the feed-wheel.

The gear-wheel 125 has upon its rearward face the laterally projecting pin 127 entering an aperture 128 in the controlling wheel 129 which is formed with two segmental series of ratchet teeth 130 separated by a larger ratchet-tooth 131 extending out-

wardly beyond the points of the adjacent teeth and in circumferential alinement with the smooth peripheral portion 132 of the wheel. Between the peripheral portion 132 and the last ratchet-tooth of the preceding series there is a pawl-lifting incline 133, and between the opposite end of said smooth peripheral portion and the first tooth of the succeeding series of ratchet-teeth there is an abrupt shoulder 134. The controlling wheel 129 has upon its rearward face a stop-motion controlling annular rib 135 cut away upon one side to form a segmental recess terminating at one end in the inclined shoulder 136 and at the other end in an abrupt shoulder 137.

Within the cavity in the rearward face of the controlling wheel surrounded by the rib 135 is interposed a spring locking-plate 138 forked to embrace the gear-wheel hub 125' which is formed with diametrically opposite slits to receive the same (Figs. 3 and 4). Within said recess the controlling wheel is shown provided with thumb-screws 139 whose heads afford handles by which one controlling wheel of a set may be retracted, after withdrawal of the spring locking-plate 138 for replacement by another which may be similarly locked in place.

The peripheral teeth 130 of the controlling wheel or element are adapted for engagement by the chisel-pointed block 140 adjustably secured upon the reciprocating pawl-bar 141 formed upon its lower edge intermediate its ends with the flat seat 142 and having its downwardly inclined rearward end pivotally connected by means of the stud-pin 143 with a crank-arm 144 secured upon the adjacent end of a transverse rock-shaft 145. The rock-shaft 145 has secured thereon intermediate its ends the crank-arm 146 (Fig. 7) pivotally connected by means of the link 147 to the strap 148 embracing an actuating eccentric 149 formed upon the hub 150 (Fig. 1) of the loose belt-wheel 151 mounted upon the main-shaft 5 and constantly driven by a belt connection with the source of power in a manner well-known.

The pawl-bar 141 thus performs constant reciprocating movements and operates, when in engagement with the ratchet-teeth of the controlling wheel, to impart to the feed-wheel shaft, and hence to the feed-wheel, two step-by-step partial rotations at a comparatively rapid speed, which partial rotations are supplementary to that imparted by the feed-actuating mechanism before described in producing a complete rotation of the feed-wheel for each buttonhole producing cycle.

The pawl-bar 141 is normally maintained lifted out of operative relation with the periphery of the controlling wheel by means of the anti-friction roller 152 (Figs. 7 and 8) mounted upon the stud 153 projecting from the inner face of a depending holding arm 154 having its hub 155 loosely journaled upon the fulcrum-pin 156 mounted in a bearing bracket 157 sustained by the machine frame. The arm 154 has an extension 154' provided with an ear 158 to which is attached one end of a spring 159 having its opposite end attached to a fixed pin 160 (Figs. 4 and 8) by means of which the roller-stud 152 is normally pressed against the side face of the pawl-bar 141 beneath which it snaps when the pawl-tooth at the end of the bar 141 rises sufficiently in its engagement with the inclined face of the ratchet-tooth 131 or the inclined shoulder 133 adjacent the peripheral portion 132 of the controlling wheel. The roller 152 is preferably of slightly taper form toward its outer end so as to act as a wedge under the impulse of the spring 159 to give the pawl-bar a supplemental lifting movement to retract its pawl-tooth clear of the periphery of the controlling wheel when disengaged therefrom. Motion for the rapid feed of the work preparatory and subsequent to stitching is thus derived from the pulley wheel 151 which constitutes a continuously rotating power element. The tooth 131 and shoulder 133 on the feed-controlling wheel 129 constitute tripping means carried by the feed-shaft 58 for effecting the disconnection of the latter from pawl 141 and its actuating connections with the pulley 151.

The hub 155 of the arm 154 has a laterally extending arm 161 having an upturned tooth 162 with an upwardly and forwardly inclined operative face adapted for engagement with the similarly inclined face of a tripping pawl 163 fulcrumed by means of the screw-pin 164 upon the depending crank-arm 165 of a transverse rock-shaft 166 journaled in the standard 2, said pawl being normally maintained pressed in contact with the head of the stop-screw 167 by means of a spring 168 secured upon said crank-arm. The tripping pawl 163 has a lateral arm 169 by means of which it may be moved in opposition to the spring 168 to disengage the flat nose of the pawl-tooth from that of the arm 161 at certain times.

As disclosed more fully in my said Patent No. 1,136,388, the transverse cutter-actuating shaft 170 carries at its forward end a loose constantly driven belt-wheel 171 which is driven by means of an encircling belt connected with the source of power. The belt-wheel is formed in its inner face with the cam-groove 172 having at one point in its periphery the ejecting block 173 with oppositely inclined ends. This cam-groove is adapted to be entered by the spring-pressed and normally retracted plunger-pin 174 mounted within a socket in a boss 175 upon one of the arms 176 of a plural-armed rock-

lever which is formed with a lateral clamp-closing arm 177 and a depending clamp-spreading arm 178, and is fulcrumed at the junction of its arms upon the stud-screw 179 tapped into the arm-standard 2. At the beginning of a buttonhole-producing cycle, the plunger-pin 174 is permitted to enter the cam-groove 172, and in the continued rotation of the belt-wheel 171, the plural-armed lever receives a single rocking movement, after which the plunger-pin is ejected by means of the block 173.

The lever-arm 177 carries at its outer end the roller-stud 180 which is adapted to engage the upper edge of the lateral crank-arm 181 fixed upon the forward end of the rock-shaft 46 of the adjacent work-clamp section whereby the connected rock-shafts are turned to effect the depression of the respective clamping feet 48 upon the work.

The depending lever-arm 178 is connected beneath the top of the base 1 by means of the link 182 with a depending lug 183′ of a slide-plate 183 mounted in a suitable channelway 184 of the base, Fig. 7. A spring 185 connected at opposite ends with an eye of the lug 183′ and a stud of the base 1 serves to draw the slide-plate 183 and the link 182 forwardly into normal position. The slide-plate 183 has a lateral lug 186 sustaining the screw-pin 187 which affords a fulcrum for one end of a swinging latch-lever 188 having at its opposite end the upturned lug 189 normally pressed outwardly by means of a spring 190 secured at one end to the screw-pin 187 and having its opposite end resting against the lug 189.

When the machine is at rest, the lug 189 normally rests against the side face of the depending portion of the transverse head 191 of a rock-lever 192 (Figs. 2 and 16) fulcrumed intermediate its ends upon the stud-screw 193 and having connected with its oppositely extending arm one end of a link 194. The other end of said link is connected to one end of the rock-lever 195 which is fulcrumed upon the stud-screw 196 and is connected at its opposite ends with the toggle links 197. The fulcrum-stud 196 is sustained by a cross-member 35′ of the cross slide-plate 35, and the fulcrum-stud 193 is similarly sustained by one of the overlying plates 198 secured upon said cross slide-plate adjacent opposite edges thereof, (Fig. 12).

Overlying the plates 198 are the spreader slide-plates 199 to which the respective toggle links 197 are pivotally connected by means of the screw-pins 200. The oppositely extending arms of the rock-lever 195 and the links 197 together constitute connected toggle devices for forcing apart and drawing together the spreading slide-plates 199.

Each of the plates 199 carries a stud-pin 201 adapted to engage the head of a stop-pin 202 sustained by a lug 203 having its foot 204 secured upon the outer side face of one of the bearing brackets 42 of the work-holder. The free ends of the clamp-plates are pressed toward each other for such engagement of the stop-pins 202 with the stud-pins 201 by means of springs 205 secured at one end upon the respective clamp-plate by the fastening screws 206 and having their opposite ends resting in contact with the grooved stud-pins 207 upon the plates 198.

In the rocking of the plural-armed clamp-closing lever, the slide-plate 183 is first drawn backwardly by the lever-arm 178 to enable the lug 189 to snap outwardly behind the head 191 of the lever 192 after which in its return movement it turns the lever 192 upon its fulcrum and thereby straightens the toggles 195, 197 and forces apart the slide-plates 199 which correspondingly spreads the clamp-plates with their coöperative work-clamp elements. In this spreading movement, a stop-pin 208 upon the plate 199 serves to prevent the overthrow of the lever 192.

Connected with the spreading rock-lever 195 at its junction with the link 197 toward the rearward side of the machine is one arm of a tappet-lever 209 fulcrumed intermediate its ends upon the screw-stud 210 upon the cross slide-plate and having an oppositely extending arm whose outer end lies within the range of movement of one end of the trip rod 211 slidingly mounted within the base of the bracket 157 and having at its opposite end the upwardly extending lug 212. The lug 212 is normally disposed within the range of action of a cam projection 213 upon the rearward end of the cutter-shaft 179, and in the rotation of said cutter-shaft for actuation of the buttonhole cutting device at the completion of a stitching operation, the cam 213 advances the trip rod to engage the tappet-lever which causes the bending of the toggles and the unspreading of the work-holder.

Connected at one end with the lever-arm 176 is a link 214 pivotally connected at its opposite end with a crank-arm 215 fixed upon the forward end of the rock-shaft 166. The actuation of the clamp-closing lever acts through the described connections to rock the shaft 166 and to thereby impart operative movements to the crank-arm 165 carrying the tripping pawl 163 to effect the operative engagement of the pawl-bar 141 with the controlling wheel.

Journaled upon the fulcrum-stud 216 tapped into the standard 2 is the hub 217 of the starting rock-lever having a depending arm 218 and a forwardly extending arm 219 formed at its free end with a lateral lug 220 having an elongated aperture to receive

the upper end of the treadle rod 221 having at its upper end the spaced thrust-nuts 222 and provided below the same with the thrust collar 223 intermediate which and a collar 224 sustained by the base is interposed the spring 225 acting through the rod 221 to retain the starting lever in stopping position. When actuated to start the machine, the edge of the lever-arm 218 engages the round nose of the latch-arm 226 fulcrumed upon the fixed stud-screw 227 and normally maintained in latching position by means of the spring 228 by which it is held yieldingly in contact with the stop-screw 229. The latch-arm 226 has a lateral extension 226′ by means of which it may be tripped to release the starting lever.

The starting lever-arm 218 has upon its inner face a screw-stud 230 upon which is mounted the tripping arm 231 yieldingly maintained in contact with the stop-pin 232 by means of the spring 233 having one end secured by the screw 234 upon the arm 218 and the other end resting upon the edge of the tripping arm (Fig. 19). Lying within the range of movement of the tripping arm is a lateral stud 235 upon one arm of a latch-release lever 236 fulcrumed intermediate its ends upon the stud-pin 237 sustained by the swinging latch-lever 238 having its hub 239 journaled upon the stud-screw 240 which is tapped in the standard 2. The latch-lever 238 carries a stop-pin 241 to limit the movement of the lever 236 thereon, and has a depending latch-tooth 242.

The plunger-pin 174 has a reduced portion extending rearwardly through the bottom of the socket 175 and provided with a lateral notch 174′ with its farther extremity inclined for engagement with the latch-tooth 242 of the latch-lever 238 which normally maintains the plunger-pin 174 retracted in opposition to its spring 174″. The strength of the spring 243, which normally presses the lever 238 into latching position is sufficient to overcome the tension of the spring 174″ when the latch-tooth 242 engages the inclined end of the notch 174′ to force the plunger-pin backwardly so as to maintain its head slightly retracted from the range of movement of the ejecting block 173 of the cam-groove 172.

When the treadle rod 221 is drawn downwardly, the starting lever is moved into starting position wherein it is held throughout a buttonhole-producing cycle by the latch-arm 226. In this movement, the edge of the tripping arm 231 engages the stud 235 of the release-lever 236 and tilts the latter into engagement with the stop-pin 241, thereby retracting the latch-lever 238 in opposition to its spring to release the plunger-pin 174. In case the plunger-pin should enter the cam-groove 172 in front of the ejecting block 173, it would be merely forced outwardly and permitted to return into the cam-groove while the latch-lever 238 remains in retracted position.

In the rocking of the clamp-closing lever by engagement of the plunger-pin with its actuating cam-groove, the plunger-pin is carried laterally with the lever-arm 176 and engages the tail of the release lever 236 which is thereby rocked to carry its stud-pin 235 below the end of the tripping arm 231, thereby interrupting the rigid connection between the starting lever and the latch-lever and permitting the latter to return to operative engagement with the side of the plunger-pin under the action of its spring 243, the latch-lever following the lateral movements of such pin, and snapping into its holding notch 174′ when next thrust backwardly by encounter with the ejecting block 173. Upon the tripping of the latch arm 226 at the completion of a buttonhole producing cycle, the starting lever springs back into starting position, the tripping arm 231 snapping past the stud 235 without affecting the release lever 236.

While any suitable form of stop-motion may be employed in the present machine, one constructed in substantial accordance with that of the U. S. patent to E. B. Allen, No. 863,129, of August 13, 1907, is represented in the accompanying drawings. The driving pulley or belt-wheel 151 is provided in its forward face (Fig. 6) with a substantially cylindrical cavity 244 having a slightly projecting segmental friction surface 245 at one side of a diameter passing through the eccentric 149. Within the cavity 244 is the body of the clutch-wheel 247 having its hub 248 fixed upon the rearward end of the main-shaft 5 and provided at one side with a stop-screw 249. The clutch-wheel is formed in its forward face with a segmental spring-cavity 250 having at one end a rectangular aperture 251 extending from the opposite face of the clutch-wheel, diametrically opposite which is a segmental bearing cavity 252. At opposite sides of the cavity 252 the clutch-wheel is formed with a depressed peripheral at 253 to receive a suitably apertured clutch-plate 255.

Applied to the rearward face of the clutch-wheel 247 is the clutch-ring 256 having upon its adjacent face the projecting thrust-sustaining lug 257 entering the aperture 251 and diametrically opposite the same the cam projection 258 fitted within the bearing cavity 252 and having at one end of its flattened upper face an inclined thrust shoulder 259 adapted to bear upon the inner face of the clutch-plate 255. The clutch-ring 256 is formed at one side with a peripheral notch 260 affording at one side a stop-shoulder 261 and having led to the other side of the same the outer portion of an eccentric cam-rib 262 outside of the inner

portion of which the clutch-ring has a backwardly extending cam incline 262′. A buffer-spring 263 is interposed between the lug 257 and the opposite end of the spring-cavity 250 and serves to maintain said lug seated against the end of the aperture 251 with the clutch-ring swung to one side to engage the shoulder 259 of the cam projection 258 pressed against the clutch-plate 255 and the latter in clutching engagement with the friction surface 245 of the driving wheel 151.

Fixed upon the rock-shaft 264 journaled in the bearing bracket 265 of the base 1 is the stop-lever 266 having fitted within its lower portion the spring-pressed slide-block 267 formed with the lateral tooth 268. This tooth has a side face adapted to bear upon the adjacent face of the clutch-ring and a lower end face adapted to bear upon the cam rib 262, the clutch-lever being normally pressed toward the clutch-ring by means of a spring 269 interposed between the projection 266′ of the stop-lever and the frame standard 2.

The rock-shaft 264 has a depending crank-arm 270 carrying at its lower end the lateral stud-pin 271 embraced by the transversely notched end of the connecting rod 272 having its opposite end pivotally connected with the swinging lever 273 which is fulcrumed upon the stud-screw 274 sustained by the machine bed. The lever 273 has secured thereon by means of the screw 275 the trip-block 276 formed with the blunt-pointed laterally projecting nose 277 having a rearwardly and downwardly inclined side, the nose 277 being adapted under the action of the spring 269 to rest upon the outer periphery of the cam-rib 135 until it encounters the abrupt shoulder 137 when it enters and rests upon the bottom of the segmental cavity until forced outwardly again by encounter with the inclined shoulder 136. The connecting rod 272 is drawn upwardly and the pawl-bar 141 is drawn downwardly by means of an interposed spring 278 by which they are yieldingly connected together.

The rearward end of the rod 272 is supported in engagement with the stud-pin 271 by means of the lateral lip 279 of a flat spring 280 secured to the inner side of the crank-arm 270 and adapted to be pressed backwardly to release the rod 272 by means of a push-pin 281 passing through the crank-arm and attached to said spring.

By the means thus described, the stop-lever 266 is maintained normally in stopping position under the action of its spring 269, with the nose 277 of the trip-block within the segmental cavity of the cam-rib 135, in which position of the stop-lever the locking tooth 268 is within the peripheral notch 260 of the clutch-ring and the clutch-wheel is maintained disconnected from the driving wheel in which condition it remains until the rock-lever 266 is tilted by engagement of the trip-block with the cam incline 136, when the tooth 268 is retracted and the clutch-ring is permitted to swing laterally upon the cam projection 258 as a fulcrum into clutching position. The main-shaft 5 remains clutched to the driving wheel 151 until the nose of the trip-block rides off the cam rib shoulder 137, when under the action of the spring 269 upon the stop-lever 266 the side face of the tooth 268 rests against the rearward face of the clutch-disk and rides down the cam-incline 262′ into operative relation with the eccentric cam-rib 262 which it first presses aside to force the wall of the segmental aperture therein against the stop-screw 249 to unclutch the driving and driven parts after which its further resistance to lateral yield while the driven parts continue to rotate under their momentum causes the lifting of the slide-block 267 until it returns to register with the notch 260 which it finally enters under the action of its spring to lock the main-shaft in initial position.

The slide-block 267 carries a lateral stud 282 carrying an anti-friction roller entering the inclined slot 283 in the rearward arm of a rock-lever 284 fulcrumed intermediate its ends upon the fixed stud-screw 285 and having a forked forwardly extending arm 286 embracing a stud-pin 287 upon a lateral crank-arm 288 of the rock-shaft 289 journaled within and transversely of the base 1. Fixed upon the rock-shaft 289 is an arm 290 formed with a segmental cross-member 291 having an inclined cam face adapted for engagement with the stud-screw 292 projecting from a plunger-pin 293 slidingly mounted within a socket 294 sustained by the frame-member 1‴ and normally pressed inwardly by a spring 293′ resting against the lateral pin 293″ thereon. This plunger-pin is adapted to contact with the head of the contact pin 295 adjustably secured within a threaded aperture in the extension 154′ of the holding arm 154 by means of the lock-nut 296. As the stop-lever slide-block 267 rises in the stopping of the main-shaft, the shaft 289 is rocked and the holding arm 154 is thereby retracted by the connections above described so as to permit the pawl-bar 141 to drop under the action of the spring 278 for engagement with the longer series of ratchet-teeth 130 for resumption of the rapid movement of the feed-wheel to return the work from stitching to initial cutting position and effect the return semi-rotation of the stitch-forming mechanism.

Secured upon the rearward end of the slide-plate 38 by means of screws 297 is the laterally extending plate 298 provided with the upstanding triangular-shaped cam-lug 299 having convergently inclined cam-faces

upon the inner side. In the travel of the work-holder between cutting and stitching positions, these cam-faces engage the depending arm 300 of a tripping member having its hub 301 journaled upon the fulcrum-pin 156 and provided with a lateral arm 302 adapted for engagement with the lateral arm 169 of the tripping pawl 163. To insure against the immediate return of the stud 152 to holding position before the initial descent of the pawl-bar 141 from its elevated position preparatory to the initiation of the quick motion of the feed-cam, it is retained temporarily in retracted position by engagement of the flat nose of the pawl-tooth 163 with that of the arm 161. After the pawl-bar has come into action and when the quick motion of the work-holder is in progress, the encounter of either inclined face of the cam-lug 299 by the arm 300 of the tripping member insures the tripping of the pawl 163 to release the holding arm 154 so as to permit the advance of the stud 152 beneath the bar 141 when the latter is next lifted sufficiently in its operative engagement with the controlling element 129.

The buttonhole cutting mechanism of the present machine is or may be constructed substantially in accordance with that of the U. S. patent to E. B. Allen, No. 1,135,933, of April 13, 1915. The cutter-shaft 170 carries the usual cams 303 and 304 for effecting the closing of the cutting elements upon the work and the cam-disk 305 formed in one face with the cam-groove 306 for effecting the traveling movements of the cutter between retracted and cutting positions. It has also fixed upon its front end the disk 307 carrying a spring-pressed radially movable slide-block 308 having a clutch-tooth 309 for engagement with suitable clutch-teeth upon the loose belt-wheel 171, the control of this clutch-tooth being effected by means of the swinging lever 310 fulcrumed upon the base at 311 and formed at its free end with the cam-plate 312 coöperating with said clutch-lug in effecting the connection and disconnection of the cutter-shaft with the belt-wheel 171 for a single rotation only.

The cams 303 and 304 are adapted for engagement with the upper and lower cutter-levers 313 and 314 which are mounted upon the fulcrum-pin 315 sustained by the slide-plate 316, said levers being maintained in engagement with their respective cams by means of the spring 317. The upper cutter-lever has detachably secured in its forward arm one cutter-block or anvil 318 of an interchangeable series of such blocks of different lengths, and the forward arm of the lower cutter-lever carries a sidewise shiftable holder 319 in which are secured the eyed cutting knife 320 and the straight bladed cutting knife 321 each adapted to replace the other in cutting relation with one of the blocks 318. The fulcrum-carrying slide-plate 316 has connected therewith one end of the link-bar 322 having its opposite end yoked to embrace the cutter-shaft 170 and provided with a roller-stud 323 entering the cam-groove 306 of the disk 305 from which the cutting device derives its traveling movements toward and from cutting position.

Fixed upon the feed-wheel shaft 58 is a disk 324 provided with a tripping point 325 adapted to engage one end of the trip-lever 326 which is fulcrumed intermediate its ends upon the stud-screw 327 and has its opposite end normally in tripping relation with a depending extension 310′ of the cutter-controlling lever 310. As the feed-wheel shaft nears the end of a complete rotation corresponding with a buttonhole producing cycle, the tripping point 325 engages the lever 326 and thereby effects the clutch-releasing movement of the controlling lever 310 whereby the cutter-shaft is given an operative rotation for effecting the operation of the cutting device to cut the previously stitched buttonhole and for actuating certain other parts. The tripping point 325 having passed the lever 326, the latter is returned to initial position by means of the spring 328.

The lever 326 is shown provided in its upper face with a channelway in which is fitted the sliding trip-rod 329 having its rearward end pivotally connected with the throw-out lever 330 which has its hub 331 fulcrumed upon the feed-wheel shaft 58 and provided with a peripheral notch 332 for engagement with the stop-pin 333 sustained by the base to limit its movement.

To the throw-out lever 330 is pivotally connected one end of a link 334 having its opposite end connected with the upwardly extending arm 335 of an angle-lever fulcrumed upon the rock-shaft 145 and having a backwardly and upwardly curved arm 336 whose upper and forwardly extending extremity is adapted to engage the lateral extension 226′ of the latch-arm 226. The link 334 is normally drawn backwardly by means of the spring 337 connecting the same with a stud upon the base 1 whereby the throw-out lever 330 is yieldingly maintained with one end of its peripheral notch 332 in engagement with the stop-pin 333 and the trip-rod 329, constituting an endwise movable section of the lever 326, is in operative relation with the controlling lever extension 310′ (Fig. 1).

When it is desired to prevent the normal operation of the cutting device, as in the case of breakage of the thread or other conditions under which the cutting of a buttonhole slit is not desired, the throw-out lever 330 is manually drawn forward,

thereby retracting the end of the trip-rod 329 from operative relation with the controlling lever extension 310′, whereby the tripping of the lever 326 is ineffective to effect the clutching of the cutting mechanism with the belt-wheel 171. At the same time, the lever-arm 336 is advanced to trip the latch-arm 226, thereby permitting the restoration of the starting lever 218—219 to initial position in readiness for actuation to initiate a succeeding buttonhole producing operation.

Fixed upon one of the clamp-operating rock-shafts 46, and preferably formed integral with the tappet-arm 54, is a second tappet-arm 338 which, when the work-holder is closed upon the work, lies in the path of movement of the end of a spring-retracted trip-rod 339 having its adjacent end portion journaled in an apertured lug 340 upon a supporting arm 341 sustained by the frame. The opposite end of this trip-rod 339 is pivotally connected with the upwardly extending arm 342 of a bell crank fulcrumed upon the fixed stud-screw 343 and having a rearwardly extending arm 344 sustaining the stud 345 carrying the anti-friction roller 346 adapted for engagement with the operative edge of a cam-plate 347 which is secured to the face of the cam disk 305.

Mounted upon a lateral arm 348 of a lug 349 rising from the arm cover-plate 350 is a tension device of well-known form, comprising the separable thread-clamping disks 351 normally pressed together by means of the spring 352 whose tension is adapted to be relieved from said disks by means of the axial pin 353. Overlying the free end of the pin 353 is the cam-faced head 354 of a push-bar 355 slotted in its upper portion to embrace the guide screw-pin 356 and having an enlarged base 357 with cam-shaped lower and rearward edge. The bar 355 is normally drawn downwardly and forwardly by means of a spring 358 connecting it with a pin 359 upon the standard 2, whereby it is normally maintained in contact with the side of the hub 165′ of the crank-arm 165, and a tooth 360 upon the adjacent edge of the bar 355 is adapted to be introduced into a detent notch 165″ of the hub 165′ when the arm 165 is in normal position.

When the stitch-forming mechanism is at rest, the head 354 of the bar 355 operatively engages the end of the release-pin 353 and relieves the pressure of the spring 352 upon the tension disks, but in the initial operative movement of the swinging arm 165, its detent-notch 165″ acts as a cam element to eject the round-nosed tooth 360 whereby the spring 358 is caused to draw the release bar 355 into lower or releasing position, wherein the notch in the inner or operative face of its head 354 (Fig. 6) will come into register with the release pin 353. In the opening of the work-clamp by engagement of the trip-rod 339 with the tappet-arm 338, the rocking of the bellcrank 342 344 causes the engagement of the stud 345 with the base 357 of the release bar 355, and lifts the same into operative engagement with the release pin 353 in which position it is locked by entrance of the tooth 360 into the detent-notch 165″.

Depending from the arm cover-plate 350 is a well 361 having in its bottom a transverse slot to receive the upper side of a compound take-up cam comprising spaced disks 362 fixed upon the tubular shaft or sleeve 15. Pivotally mounted within a transverse channel of the cover-plate 350 by means of a pin 363 is a cross-bar 364 carrying the depending arms 365 formed with thread-eyes at their lower ends and embracing the take-up cam-disks. The cross-bar sustains also a depending plate 366 entering the space intermediate the take-up disks 362 and provided with the curved thread-guiding slot 367 of which the lower end terminates in register with the thread-eyes of the arms 365. The bar 364 is normally maintained in operative position by means of the spring 368 (Figs. 1, 3 and 28).

The take-up disks 362 are of similar contour, each being formed upon opposite sides of its axis of movement with active edge portions at different distances from such axis. The inner edges of these disks, or those nearest the axis, act upon the needle-thread passing through the guide-eyes of the arms 365 in the coöperation of the non-threaded looper and spreader with the needle in a greater degree than the opposite edges in the succeeding reciprocation of the needle in coöperation with the threaded looper. The object of this is to accommodate the take-up to the slightly different conditions involved in the employment of alternately acting loop-taking devices of different character, so as to secure the utmost efficiency in the control of the needle-thread in its manipulation by the loop-taking elements under all conditions.

The tubular shaft 15 is shown having secured thereon the cam-disk 369 peripherally engaging the roller-stud 370 upon the depending arm 371 of a rock lever fulcrumed upon the pin 372 within a slot of the cover-plate 350 and having an upwardly extending arm carrying a contact screw-pin 373 adapted for engagement with a plunger-pin 374 of a needle-thread nipping device of well-known form.

As indicated in Figs. 2, 4 and 6, the rearward side of the housing recess in the base is closed by means of a door 375 recessed upon its inner side and mounted at its lower

edge upon the pivotal stud-screws 376 so as to swing outwardly to expose the parts within such recess, being held in closed position by means of the detent spring 377. Passing lengthwise through this door are the thread-guiding tubes 378 for conducting the lower stitching thread and the gimp to the forward end of the machine from which they are led to the loop-taking mechanism beneath the bed-plate.

As represented in Figs. 1 to 7 of the drawings, the various operative parts of the machine are in the positions which they assume at the completion of a buttonhole producing cycle and in readiness for a succeeding cycle. The drawing down of the treadle rod 221 rocks the starting lever 218, 219, which is retained in running position by means of the spring-pressed latch-arm 226. In its operative movement, the starting lever carries the tripping arm 231 against the stud 235, thereby tilting the release lever 236 into engagement with the stop-pin 241 and locking the latch-lever to the still moving starting lever, whereby the latch-tooth 242 is disengaged from the plunger-pin 174 and the latter released for engagement with the clamp-closing cam-groove 172. The several elements referred to remain locked together in extreme position under the detaining action of the latch-arm 226 while the plural-armed clamp-closing lever performs its operative movement, in the course of which the encounter of the inwardly projecting portion of the plunger-pin 174 with the tail of the release lever 236 tilts the latter upon its respective fulcrum and thereby shifts the stud 235 beyond the outer extremity of the tripping arm 231 and releases the latch-lever 238 which, under the action of its spring, assumes contact relation with the side of the plunger-pin 174 and snaps into the notch of the latter upon its ejection from the cam-groove by the block 173.

The descent of the lever-arm 177 operates initially to close the clamp which is spread in the return movement of the depending lever-arm 178, as before described. As the lever-arm 176 performs its to-and-fro clamp-closing and spreading movements, the cross-shaft 166 is rocked through the link and crank-arm connection 214, 215, to impart to the tripping pawl carrying arm 165 its idle forward and operative backward movement at the completion of which the pawl 163 retracts and locks the holding arm 154 in its outer position wherein the stud 152 is disengaged from the constantly reciprocating pawl-bar 141 which is thus permitted to assume operative relation with the shorter series of pawl-teeth 130.

As the controlling wheel 129 performs the initial stage of its step-by-step rotary movement in communicating to the feed-wheel its preliminary accelerated movement to shift the work-holder from cutting to stitching position, the forward inclined face of the cam-lug 299 encounters and thrusts aside the arm 300, thereby lifting the arm 302 whose engagement with the arm 169 of the tripping pawl serves to disengage the latter from the member 161 of the holding arm and permits the latter, under the action of its spring, to carry the stud 152 into contact with the side face of the pawl-bar 141 and to snap beneath the same when the pawl-bar is next lifted sufficiently by engagement of its nose with the incline 133 of the controlling wheel.

Just prior to this action the nose 277 of the tripping block 276 rides up the inclined shoulder 136 of the cam-rib 135 for effecting actuation of the stop-motion, thereby initiating the stitching and normal work-feeding operations which continue until the nose 277 rides off the shoulder 137 to terminate the stitching and work-feeding operations. As the slide-block 267 of the stop-motion device rises under the action of the cam 262, the cam element 291 acts through the described connections to thrust outwardly the plunger-pin 293 and thereby retract the holding arm 154 for disengagement of the roller-stud 152 from the pawl-bar 141, thereby permitting the latter to resume engagement with the longer series of ratchet-teeth 130 of the controlling wheel 129 which acts, as in the initial stage of the cycle, to impart an accelerated movement to the feed-wheel in returning the work-holder to initial position, in the course of which the rearward face of the cam-lug 299 encounters the arm 300 and causes the release of the holding arm 154 for final engagement of the pawl-bar under the action of its spring at the completion of the buttonhole-producing cycle.

Just as the feed-wheel shaft is completing a rotation, the tripping point 325 of the disk 324 engages the trip-lever 326 which shifts the cutter-controlling lever 310 and initiates the coupling of the cutter-shaft with the loose belt-wheel 171 for effecting the cutting operation which is produced by the means before described. As the cutting elements retire after a buttonhole cutting action, the cam 213 acts upon the trip-rod 211 to break the clamp-spreading toggle, and at substantially the same time the cam-plate 347 encounters the stud 345 which acts upon the tappet-arm 338 through the described connections to open the work-holder, while the engagement of the stud 345 with the tension release bar 355 acts to open the needle-thread tension device which remains open by engagement of the tooth 360 with the detent notch 165″ until the starting mechanism is again operated.

One of the many practical advantages of the present machine, as thus described, is the accessibility of the moving parts, and

particularly those which are liable to require more or less attention, substantially all of which are so disposed that they may be reached without turning over the machine frame. While the various features of construction and arrangement are herein represented in their preferred embodiments, it will be readily understood that they may be greatly modified within the scope of the present invention.

It will be observed that the function of the set of interchangeable pattern or controlling wheels, as hereinbefore described, is to adapt a given machine, without adjustments dependent upon the skill of an attendant, to produce buttonholes of different contours, which may involve either variations in length or in the character of the ends (as by provision or omission of eyelet ends), or both; each of such interchangeable wheels being designed to effect the control of the machine to produce buttonholes having one of the desired contours. It is evident that the present invention includes within its scope mechanism including a controlling wheel or element provided in itself with means acting directly to effect a variation in the normal relative travel between the stitch-forming mechanism and the work, as disclosed, for instance, in my pending application Serial No. 179,139, filed July 7, 1917.

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

1. In a buttonhole sewing machine, in combination, stitch-forming instrumentalities, a work-holder, a sewing shaft and driving connections for actuating the stitch-forming instrumentalities and for relatively feeding the latter and the work-holder to sew around a buttonhole, and a removable feed-controlling element distinct from and coöperating with said driving connections for production of a buttonhole of a given contour and replaceable by a different controlling element adapted to coact with said driving connections for production of a buttonhole of different contour.

2. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder, feeding mechanism including an actuating element and a follower therefor for producing between the stitch-forming mechanism and the work-holder relative feeding movements in a defined path in cooperation of the work-holder with the stitch-forming mechanism during a stitching period, and a controlling element normally connected with said feeding mechanism for determining the range of said relative feeding movements and replaceable by another controlling element without change of the coöperative relation of the actuating and follower element of the feeding mechanism for effecting variation in said range of movement in the coöperation of the work-holder with the stitch-forming mechanism.

3. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism for producing relative feeding movements between the stitch-forming mechanism and the work and comprising an actuating member and a follower sustained in permanent coöperative relation therewith and means for imparting to said member in consecutive periods relatively slow and rapid operative movements, and a removable controlling element for controlling the relative lengths of said periods and replaceable by a different controlling element for changing the relative lengths of said periods.

4. In a buttonhole sewing machine, in combination, stitch-forming mechanism, actuating means therefor, coupling means for effecting the connection and disconnection of the stitch-forming mechanism and its actuating means, and means including a removable controlling element for determining the timing of said connection and disconnection and replaceable by a different controlling element for changing said timing.

5. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism including a feed-wheel, and a follower sustained in permanent coöperative relation therewith, and actuating means for said feed-wheel acting during the period of operation of the stitch-forming mechanism, and a controlling element for said actuating means normally partaking of the movements of said feed-wheel and replaceable by a different controlling element for changing the period of action of said actuating means upon the feed-wheel.

6. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism including a feed-wheel and a follower sustained in permanent cooperative relation therewith, actuating means for said feed-wheel, and means including a removable controlling element acting upon said actuating means to determine the period of action of said mechanism and replaceable by a different controlling element for changing said period of action.

7. In a buttonhole sewing machine, in combination, stitch-forming mechanism and feeding mechanism for producing relative feeding movements between the stitch-forming mechanism and the work and comprising a feed-wheel and means permanently connected therewith for imparting thereto operative movements during stitching periods and means for imparting thereto further movements intermediate stitching periods, and a removable controlling element for determining the relative periods

of action of the feed-wheel actuating means and replaceable by a different controlling element for changing the relative lengths of said periods of action.

8. In a buttonhole sewing machine, in combination, a supporting frame, stitch-forming mechanism, feeding mechanism comprising a feed-wheel permanently mounted in said frame and connections for producing the necessary relative feeding movements between the stitch-forming mechanism and the work in sewing around a buttonhole, and a removable feed controlling element normally connected to and movable with said feed-wheel and mounted upon said frame accessibly and unobstructedly to facilitate replacement by a different controlling element.

9. In a buttonhole sewing machine, in combination, a supporting frame, stitch-forming mechanism, feeding mechanism comprising a feed-wheel permanently mounted in said frame and connections for producing the necessary relative feeding movements between the stitch-forming mechanism and the work in sewing around a buttonhole, a removable feed controlling element normally connected to and movable with said feed-wheel and mounted upon said frame accessibly and unobstructedly to facilitate replacement by a different controlling element, and a detachable locking device for confining said controlling element in position.

10. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism comprising a feed-wheel for producing relative feeding movements between the stitch-forming mechanism and the work, a removable controlling element, an axially detachable driving connection between the same and said feed-wheel, and a locking device for confining said controlling element axially in operative relation with said feed-wheel.

11. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism comprising a feed-wheel, a removable controlling wheel normally maintained in driving relation with said feed-wheel and replaceable by a different controlling wheel, and actuating means for imparting to the feed-wheel a partial rotation and for imparting to the feed-wheel through said controlling wheel a further partial rotation.

12. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism comprising a feed-wheel, a removable controlling wheel normally maintained in driving relation with said feed-wheel and replaceable by a different controlling wheel, actuating means for imparting to the feed-wheel a partial rotation, and actuating means acting independently thereof for imparting to the feed-wheel through said controlling wheel a further partial rotation.

13. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism comprising a feed-wheel, a removable controlling wheel normally maintained in driving relation with said feed-wheel and replaceable by a different controlling wheel, and actuating means for imparting to the feed-wheel a partial rotation and for imparting to the feed-wheel through said controlling wheel a further partial rotation, means being provided upon said controlling wheel for effecting a complete rotation thereof composed of two partial rotations under the action of its own actuating means and an intermediate partial rotation under the action of the first-named actuating means of the feed-wheel.

14. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a stop-motion for determining the period of operation of the same, feeding mechanism comprising a feed-wheel, a removable controlling wheel with which said feed-wheel normally moves in unison and provided with stop-motion operating means, said controlling wheel being replaceable by a different controlling wheel, and actuating means whereby said controlling wheel is moved at different speeds, respectively, during and intermediate successive operative periods of the stitch-forming mechanism.

15. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a stop-motion for determining the period of operation of the same, feeding mechanism comprising a feed-wheel, a removable controlling wheel with which said feed-wheel normally moves in unison and provided with means acting through said stop-motion to both establish and interrupt driving relation between the stitch-forming mechanism and the source of power, said controlling wheel being replaceable by a different controlling wheel, and actuating means whereby said controlling wheel is moved at different speeds, respectively, during and intermediate successive operative periods of the stitch-forming mechanism.

16. In a buttonhole sewing machine, in combination, a frame comprising a base with a laterally open housing recess, stitch-forming mechanism, feeding mechanism, and a removable controlling element mounted in said recess of the base and replaceable by a different controlling element for action upon said feeding mechanism for determining the length of the period of action of the feeding mechanism while the stitch-forming mechanism is in action.

17. In a buttonhole sewing machine, in combination, a frame comprising a base with a laterally open housing recess, stitch-

forming mechanism, feeding mechanism comprising a feed-wheel mounted in said base, and independent actuating means for said feed-wheel of which the one comprises a removable controlling element disposed within said recess in the base and replaceable by a different controlling element.

18. In a buttonhole sewing machine, in combination, a frame comprising a base with a laterally open housing recess, stitch-forming mechanism, feeding mechanism comprising a feed-wheel mounted in said base, and independent actuating means for said feed-wheel of which the one comprises a removable controlling element disposed within said recess in the base and replaceable by a different controlling element, said controlling element having provision for determining the length of the period of action of each of said actuating means.

19. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism comprising a feed-wheel, an intermittently moving actuating gear, an adjustable carrier, means for securing it in the desired position of adjustment, and a removable intermediate gear mounted thereon and adapted to transmit motion from said actuating gear to the feed-wheel and replaceable by a gear of different size for varying the speed of movement of the feed-wheel.

20. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism comprising a feed-wheel, an intermittently moving and positively driven actuating gear, a removable intermediate gear through which motion is transmitted from said actuating gear to the feed-wheel and replaceable by a gear of different size for varying the speed of movement of the feed-wheel, and an adjustable carrier for said intermediate gear with means for securing it in a fixed position of adjustment throughout a complete buttonhole-producing cycle.

21. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism comprising a feed-wheel and independent actuating means therefor of which the one comprises a removable and replaceable motion-transmitting element and the other comprises a removable and replaceable controlling element for determining respectively the speed and length of movement of the feed-wheel during a stitching period.

22. In a buttonhole sewing machine, in combination, a frame comprising a base with a laterally open housing recess, stitch-forming mechanism, and feeding mechanism comprising a feed-wheel and independent actuating means therefor of which the one comprises a removable and replaceable motion-transmitting element disposed within said housing recess and the other comprises a removable and replaceable controlling element also disposed within said housing recess for determining respectively the speed and extent of movement of the feed-wheel during a stitching period.

23. In a buttonhole sewing machine, in combination, a shaft, stitch-forming mechanism operatively connected therewith, feeding mechanism comprising a feed-wheel, a removable controlling wheel connected in driving relation with said feed-wheel and replaceable by a different controlling wheel, and means for imparting to it operative movements for control of the operation of both the feed-wheel and the stitch-forming mechanism.

24. In a buttonhole sewing machine, in combination, a shaft, stitch-forming mechanism operatively connected therewith, a stop-motion for determining the period of operation of said shaft, feeding mechanism including a feed-wheel connected in driving relation with said shaft, and a removable controlling wheel replaceable by a different controlling wheel and provided with means for operating said stop-motion and for actuating said feed-wheel while said shaft is at rest.

25. In a buttonhole sewing machine, in combination, stitch-forming mechanism, actuating means therefor, a stop-motion for establishing and interrupting operative relation between the stitch-forming mechanism and its actuating means, and means including a controlling element provided with a plurality of spaced operative portions, a rotary member deriving operative movements from said actuating means and to which said controlling element is detachably connected in invariably the same fixed relation but replaceable by a similar controlling element with differently spaced operative portions, and connections between said controlling element and the stop-motion whereby the latter is actuated to start and stop the stitch-forming mechanism.

26. In a buttonhole sewing machine, in combination, stitch-forming mechanism, actuating means therefor, a stop-motion for establishing and interrupting operative relation between the stitch-forming mechanism and its actuating means, and means including a detachable and replaceable controlling element provided with a plurality of relatively fixed operative portions, and connections between said controlling element and the stop-motion whereby the latter is actuated to start and stop the stitch-forming mechanism.

27. In a buttonhole sewing machine, in combination, stitch-forming and feeding mechanisms, cutting mechanism comprising a plurality of carriers each sustaining a cut-

ting element of which one is replaceable by a different cutting element upon its respective carrier, and means comprising a set of interchangeable controlling elements operative respectively to time independently of all adjustments of parts the periods of operation of the stitch-forming and feeding mechanisms and the cutting device for production of buttonholes of different contours.

28. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism including a permanently mounted rotary member, and a detachable and replaceable controlling element operatively connected with said member and provided with means for determining the period of operation of the stitch-forming mechanism and of the feeding mechanism in advancing the work to space the stitches, and with means for effecting an accelerated motion of the feeding mechanism intermediate stitching periods.

29. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism constructed and adapted to move the work in a fixed path, and operating means comprising a removable controlling element movable with a member of the feeding mechanism and acting to determine the starting and stopping of the stitch-forming mechanism while the feeding mechanism is in operation, and means for confining said controlling element in invariably the same fixed relation with said member of the feeding mechanism, said controlling element being replaceable by a different controlling element for changing the length of the stitching period.

30. In a sewing machine, in combination, stitch-forming mechanism, a work-holder comprising laterally separable work-gripping jaws and opposed jaws movable toward and from the same; clamp-closing means including a rocking element fulcrumed upon a fixed support and acting upon said opposed jaws during its movement in one direction to effect the gripping of the work, and means connected with said rocking element and deriving operative movements therefrom during the return motion of said rocking element for separating said work-gripping jaws to stretch the work.

31. In a sewing machine, in combination, stitch-forming mechanism, a work-holder comprising laterally separable work-gripping jaws and opposed jaws toward and from which they are respectively movable, and means comprising a rocking element mounted independently of said work-holder and having independent connections with said work-gripping jaws for successively closing said jaws upon the work and separating them.

32. In a sewing machine, in combination, stitch-forming mechanism, a work-holder comprising laterally separable work-gripping jaws and opposed jaws toward and from which they are respectively movable, a reciprocatory element, a connection between said reciprocatory element and said work-gripping jaws whereby they are closed upon the work in an initial movement of said element, and a connection between said element and said work-gripping jaws whereby the latter are separated in the succeeding return movement of said element.

33. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder comprising opposed work-gripping jaws, means including a cam and independent actuating elements therefor for imparting to the work-holder normal work-feeding movements lengthwise of the buttonhole preceded and followed by accelerated work-shifting movements lengthwise of the buttonhole within each buttonhole producing cycle, a reciprocatory element, a connection between the latter and the work-gripping jaws by which they are closed upon the work, and an independent connection with said element disposed above the level of the work-holder whereby the accelerated motion means are set in action.

34. In a sewing machine, in combination, stitch-forming mechanism, a cutting device, a constantly moving cutter-actuator periodically connected therewith for imparting thereto operative movements, a work-holder comprising laterally separable work-gripping jaws and opposed jaws toward and from which they are respectively movable, means operated by said actuator independently of the cutting device for closing the jaws upon the work, and means also operated by said actuator for separating said work-gripping jaws for stretching the work.

35. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder comprising laterally separable clamping jaws, and means including a toggle device interposed between and exerting a toggle action upon said separable clamping jaws for separating said jaws to stretch the work.

36. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder comprising laterally separable clamping jaws, a toggle device affording a connection between said jaws, and means for straightening and bending said toggle device for moving said jaws reciprocally.

37. In a buttonhole sewing machine, in combination, stitch-forming mechanism, cutting mechanism, an element performing operative movements while both the stitch-forming and cutting mechanisms are inactive, a work-holder comprising laterally separable clamping jaws, a toggle device affording a connection between said jaws, independently acting means connected with

said cutting mechanism and with said element for straightening and bending said toggle device in separating and drawing together said clamping jaws.

38. In a buttonhole sewing machine, in combination, stitch-forming mechanism, cutting mechanism including a cam-shaft, a constantly running actuator, a work-holder comprising laterally separable clamping jaws, a toggle device affording a connection between said jaws, an operative connection between the cam-shaft and the toggle device for moving the latter in one direction, and a connection between the actuator and the toggle device for moving the latter in the opposite direction.

39. In a buttonhole sewing machine, in combination, stitch-forming mechanism, cutting mechanism including a cam-shaft, a constantly running actuator, means for periodically connecting it with the cam-shaft, a work-holder comprising laterally separable clamping jaws, a toggle device affording a connection between said jaws, an operative connection between the cam-shaft and the toggle device for moving the latter in one direction, and a connection independent thereof between the actuator and the toggle device for moving the latter in the opposite direction.

40. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder, and actuating means therefor comprising a ratchet-toothed member, a plurality of means for driving it in the same direction, one of which consists of a constantly reciprocating pawl adapted for engagement with said ratchet-toothed member, pawl-lifting means, a holding element for maintaining the pawl retracted from the ratchet-toothed member, a retractor for said holding element, and a tripping element operated through a connection with the work-holder actuating means and operated by the latter to disengage said retractor from the holding element.

41. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder comprising work-clamping means, clamp-closing means, work-holder actuating means comprising a ratchet-toothed member, a constantly reciprocating pawl adapted for engagement with said ratchet-toothed member, pawl-lifting means, a holding element for maintaining the pawl retracted from the ratchet-toothed member, a retractor for said holding element operatively connected with said clamp-closing means, and a tripping element operated through a connection with the work-holder actuating means for disengaging said retractor from the holding element.

42. In a buttonhole sewing machine, in combination, stitch-forming mechanism, work feeding means comprising a ratchet-toothed member, a constantly reciprocating pawl adapted for engagement with said ratchet-toothed member, pawl-lifting means, a holding element for maintaining the pawl retracted from the ratchet-toothed member, a plurality of independently actuated and successively acting means for disengaging said holding element from the pawl, and means independent thereof for establishing operative relation of said holding element with the pawl.

43. In a buttonhole sewing machine, in combination, stitch-forming mechanism, work-feeding means comprising a ratchet-toothed member, a constantly reciprocating pawl adapted for engagement with said ratchet-toothed member, pawl-lifting means, a holding element for maintaining the pawl retracted from the ratchet-toothed member, a plurality of independently actuated and successively acting means for disengaging said holding element from the pawl, and means including an element partaking of the traveling movements of the work for effecting the reëngagement of said holding element with the pawl.

44. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a controlling stop-motion therefor, work-feeding means comprising a ratchet-toothed member, a plurality of means for driving it in the same direction, one of which consists of a constantly reciprocating pawl adapted for engagement with said ratchet-toothed member, pawl-lifting means, a holding element for maintaining the pawl retracted from the ratchet-toothed member, means including an operative connection with the stop-motion for disengaging said holding element from the pawl, and means independent thereof for effecting the reëngagement of said holding element with the pawl.

45. In a sewing machine of the class described, the combination with the frame, of stitch-forming mechanism and feeding mechanism comprising a permanently mounted feeding element and a removable controlling element coöperating therewith during the action of the stitch-forming mechanism in producing a relative travel in a predetermined path between the stitch-forming mechanism and the work, said controlling element being disposed accessibly in a position exterior to and at the side of the machine frame for ready replacement by another controlling element adapted to effect a change in said path of relative travel.

46. In a sewing machine of the class described, the combination with the frame, of stitch-forming mechanism and feeding mechanism comprising a permanently mounted feeding element and a removable controlling element coöperating therewith during the action of the stitch-forming mechanism in producing a relative travel in

a predetermined path between the stitch-forming mechanism and the work, said controlling element being disposed accessibly in a position exterior to and at one side of the machine-frame below the work for ready replacement by another controlling element adapted to effect a change in said path of relative travel.

47. In a sewing machine of the class described, the combination with the frame, of stitch-forming mechanism and feeding mechanism comprising a permanently mounted feeding element and a removable controlling element coöperating therewith during the action of the stitch-forming mechanism in producing a relative travel in a predetermined path between the stitch-forming mechanism and the work, said controlling element being mounted upon an axis transverse to the machine frame and disposed accessibly in a position exterior to and laterally of the machine frame for replacement by another controlling element adapted to effect a change in said path of relative travel.

48. In a sewing machine of the class described, the combination with the frame, of stitch-forming mechanism and feeding mechanism comprising a permanently mounted feeding element and a removable controlling element coöperating therewith during the action of the stitch-forming mechanism in producing a relative travel in a predetermined path between the stitch-forming mechanism and the work, said controlling element being mounted upon an axis below the work and transverse to the machine frame and disposed accessibly in a position exterior to and laterally of the machine frame for replacement by another controlling element adapted to effect a change in said path of relative travel.

49. In a sewing machine of the class described, in combination, a frame, stitch-forming mechanism, a work-holder, feed-actuating mechanism for relatively moving the stitch-forming mechanism and work-holder to sew around a buttonhole, and a removable feed-controlling element additional to and coöperating with said mechanism for production of stitching in a pattern of given contour, said controlling element being disposed accessibly in a position exterior to the machine frame for ready replacement by another controlling element adapted to effect a change in the contour of said pattern.

50. In a sewing machine of the class described, the combination with the frame, of stitch-forming mechanism, feeding mechanism and a removable controlling element coöperating with said mechanisms for production of stitching in a pattern of given contour, said controlling element being mounted upon an axis below the work and transverse to the machine frame and disposed accessibly in a position exterior to and laterally of the machine frame for replacement by another controlling element adapted to effect a change in the contour of said pattern.

51. In a buttonhole sewing machine of the class described, in combination, stitch-forming mechanism and primary feeding mechanism for producing between the stitch-forming mechanism and the work relative feeding movements in a defined path, and a removable feed controlling element auxiliary to said feeding mechanism for determining the size of the buttonhole being stitched, said feed-controlling element being replaceable by a different controlling element for effecting variation in the size of said buttonhole.

52. In a buttonhole sewing machine, in combination, stitch-forming mechanism and feeding mechanism for producing relative feeding movements between the stitch-forming mechanism and the work and comprising a feed-wheel and means permanently connected therewith for imparting thereto operative movements during stitching periods, and a removable controlling element for determining the relative periods of action of the feed-wheel actuating means and replaceable by a different controlling element for changing the relative lengths of said periods of action.

53. In a buttonhole sewing machine, in combination, sewing mechanism, a stop-motion therefor, buttonhole cutting mechanism, a work-holder, feeding mechanism for relatively moving the sewing mechanism and work-holder in the production of buttonholes of a given length, said feeding mechanism including stitching feed actuating means for effecting the relative shift of the work and sewing mechanism while the latter is in operation, and rapid feed-actuating means for effecting the relative shift of the work and sewing mechanism from cutting to sewing position and from sewing to cutting position, a controlling element included with the feeding mechanism for timing the throw-out of the rapid feed when stitching is to begin and for controlling the times of starting and stopping of the sewing mechanism, said controlling element being relatively removable and replaceable by another similar element having differently arranged active parts timed to control the operation of the sewing and feeding mechanisms in the production of buttonholes of different length.

54. In a buttonhole sewing machine, in combination, stitch-forming mechanism, actuating means therefor including a stop-motion device, a work-holder, and feeding mechanism for producing relative movement between said stitch-forming mechanism and work-holder, said feeding mechanism includ-

ing a continuously rotating element, a feed-shaft, a main feed-wheel permanently connected to said feed-shaft, controlling means carried by said feed-shaft for initiating the starting and stopping of the stitch-forming mechanism at predetermined times, means for establishing driving relation between said continuously rotating element and said feed-shaft, means carried by said feed-shaft for interrupting driving relation between said shaft and said rotating element when the stitch-forming mechanism is started, and one-way acting connections for driving the main feed-wheel during the stitching operation from the stitch-forming mechanism actuating means.

55. In a buttonhole sewing machine, in combination, a continuously running power element, stitch-forming mechanism, a work-holder, a main feed-wheel for producing relative movement between the stitch-forming mechanism and the work-holder, a feed-wheel driving member having a progressive step by step movement in one direction, one-way acting connecting means between said driving member and feed-wheel whereby said main feed-wheel may be driven in one direction only by said member, stitching feed actuating connections between said stitch-forming mechanism and said member, and rapid feed actuating connections between said continuously running element and said main feed-wheel for driving the latter while the stitching mechanism is inactive, thereby effecting relative feeding movements between the stitch-forming mechanism and work-holder between initial and stitching positions.

56. In a buttonhole sewing machine, in combination, the driving element, a feed-shaft, a feed-wheel connected to said feed-shaft to rotate at the same speed as the latter, automatic connecting and disconnecting means between said driving element and said feed-shaft, stitch-forming mechanism, an automatically controlled stop-motion therefor, means for tripping said automatic connecting and disconnecting means into action at the beginning of a buttonhole-producing cycle to initiate a relatively rapid movement of the feed-shaft, means actuated by said stop-motion for again tripping said connecting and disconnecting means into action after the buttonhole has been stitched, and tripping means carried by said feed-shaft for effecting the disconnection of the latter from said driving element at the beginning of the stitching and at the end of one rotation of said feed-shaft.

57. In an automatic buttonhole sewing machine, in combination, stitch-forming mechanism, a work-clamp, feeding mechanism, automatic clamp unspreading and opening means adapted to act at the end of a button-hole-producing cycle, and manually controlled means operable during a cycle of operations for preventing the normal automatic action of said means.

58. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-clamp, feeding mechanism, buttonhole cutting mechanism adapted to act automatically to cut the buttonhole at the end of a stitching cycle, manually controlled means for preventing the action of said cutting mechanism, and means controlled by the action of said cutting mechanism for opening said work-clamp to release the work.

59. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-clamp, feeding mechanism, buttonhole cutting mechanism adapted to act automatically to cut the buttonhole at the end of a stitching cycle, automatically actuated means for opening the work-clamp, and manually controlled means operable during a cycle of operations for preventing the action of the cutting mechanism and the opening of the work-clamp.

60. A buttonhole sewing machine comprising, in combination, stitch-forming mechanism, a stop-motion therefor, a work-holder, feeding mechanism for producing relative movement between said stitch-forming mechanism and the work-holder and including rapid actuating means, a readily removable and replaceable controlling wheel connected to said feeding mechanism, and means carried by said controlling wheel for tripping said stop-motion to start the stitch-forming mechanism and for substantially simultaneously rendering said rapid actuating means ineffective.

61. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-clamp comprising laterally separable devices for gripping the work at opposite sides of a buttonhole slit, and clamp-closing and spreading means comprising a rocking element fulcrumed upon a stationary support and acting during its movement in one direction to close said devices into gripping relation with the work, and means connected with said rocking element and deriving operative movements therefrom during the return motion of said rocking element for laterally separating said devices to spread the work.

In testimony whereof I have signed my name to this specification.

EDWARD B. ALLEN.