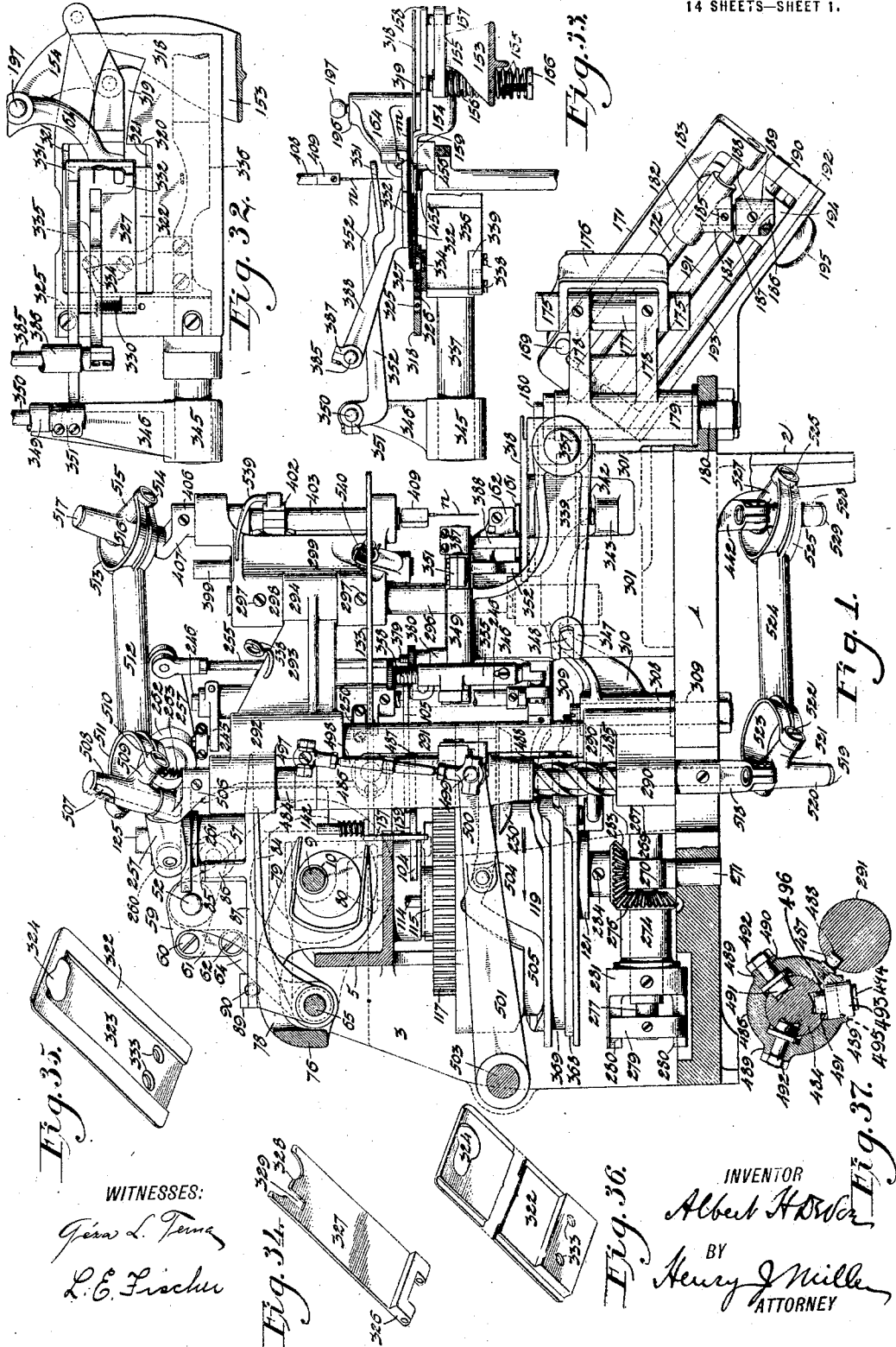


1,416,004.

Patented May 16, 1922.
14 SHEETS—SHEET 1.



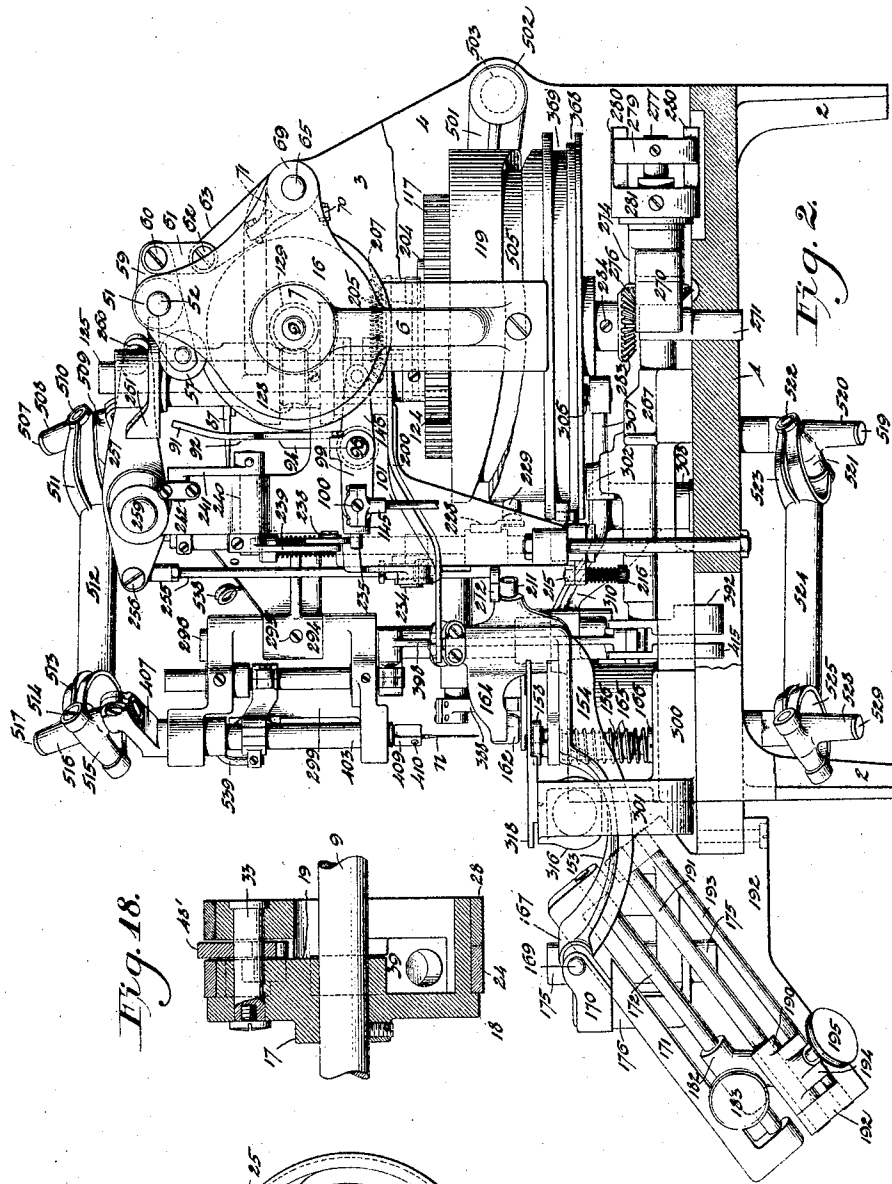


Fig. 18.

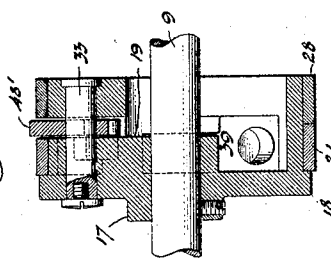
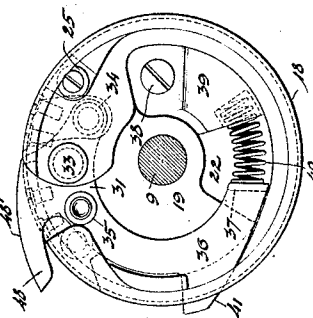


Fig. 17.



WITNESSES:
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 BUTTONHOLE SEWING MACHINE.

APPLICATION FILED DEC. 31, 1915. RENEWED JAN. 7, 1921.

1,416,004.

Patented May 16, 1922.

14 SHEETS—SHEET 3.

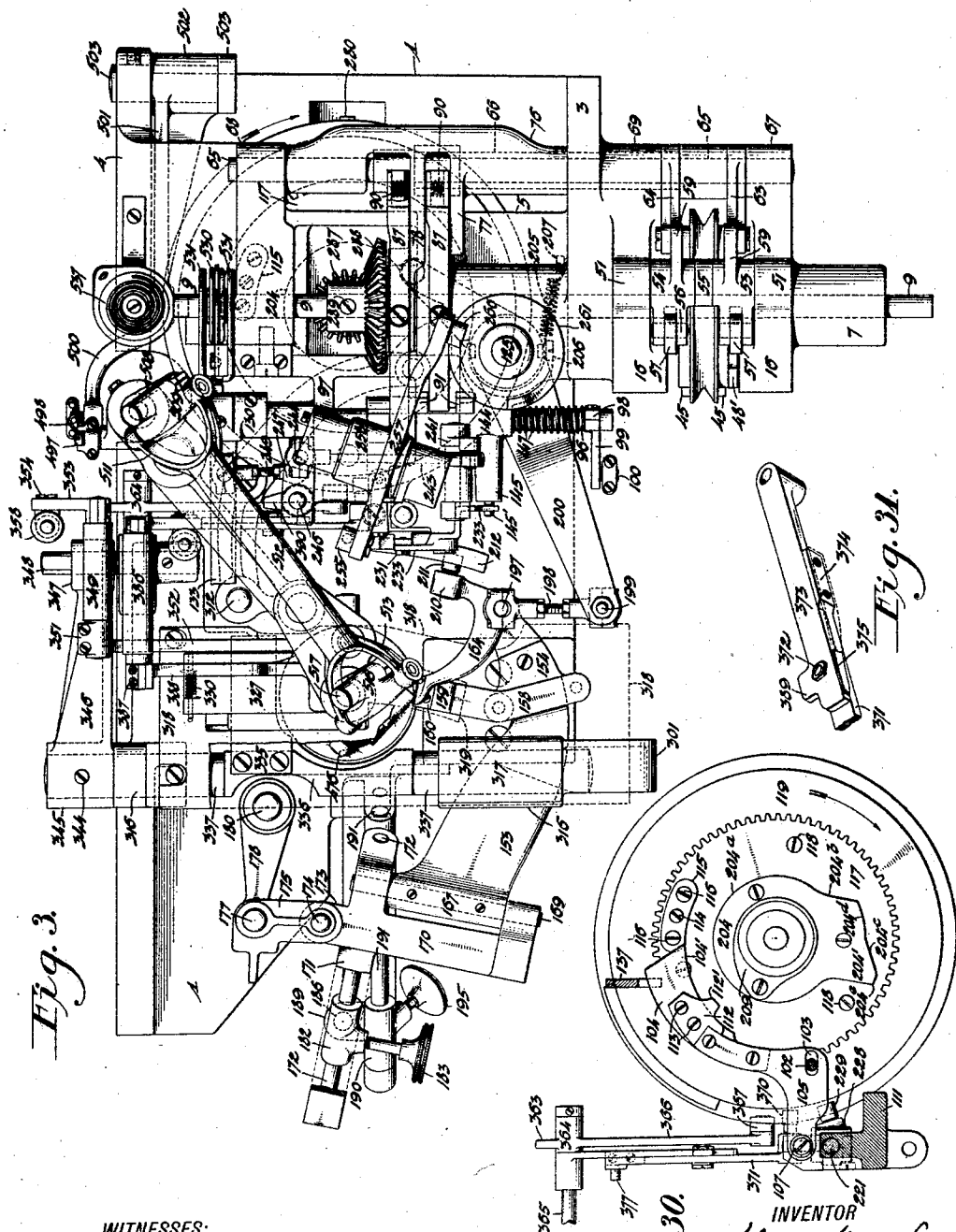


Fig. 3.

Fig. 31.

Fig. 30.

WITNESSES:

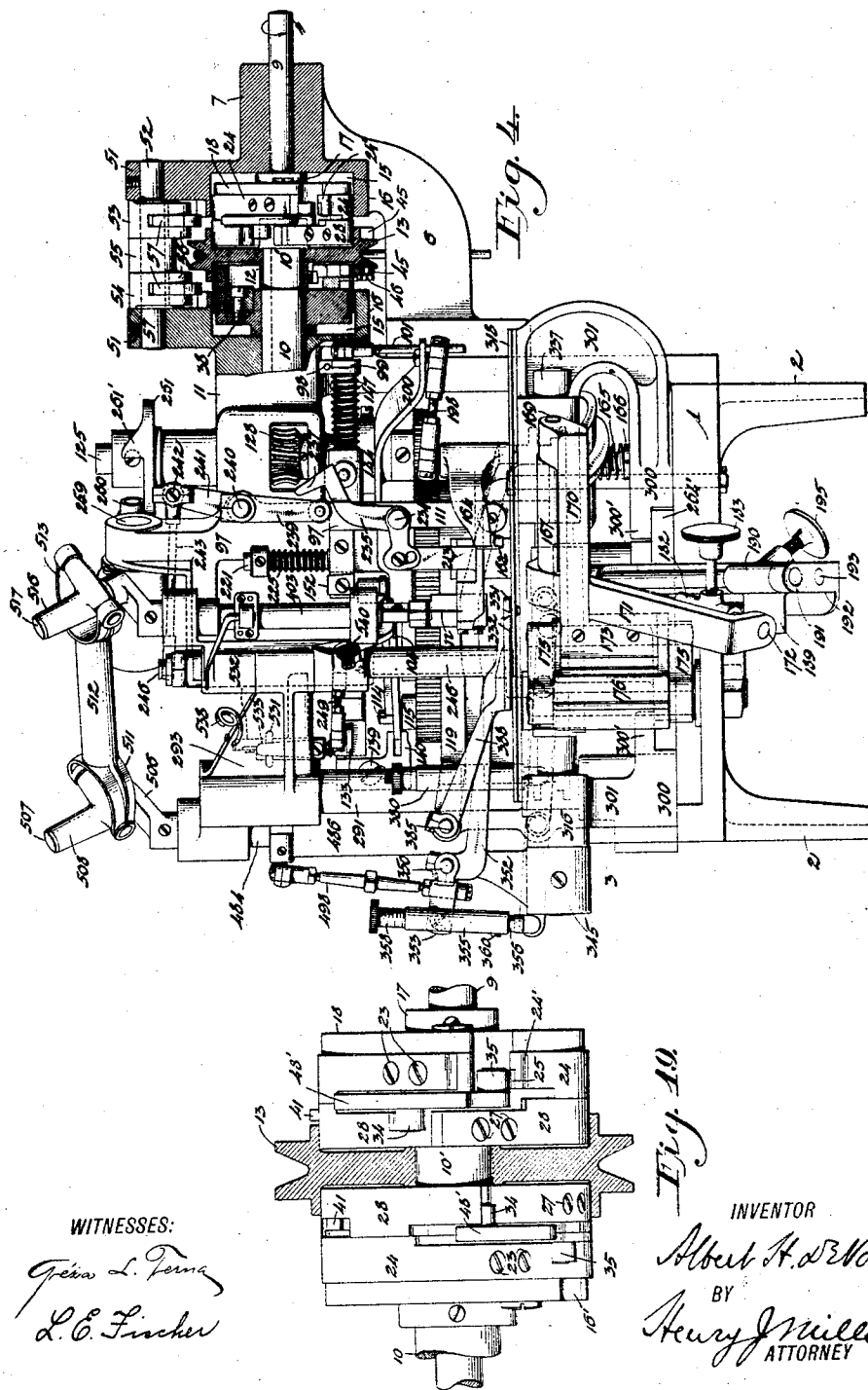
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Fig. 10.

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BUTTONHOLE SEWING MACHINE.

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14 SHEETS—SHEET 5.

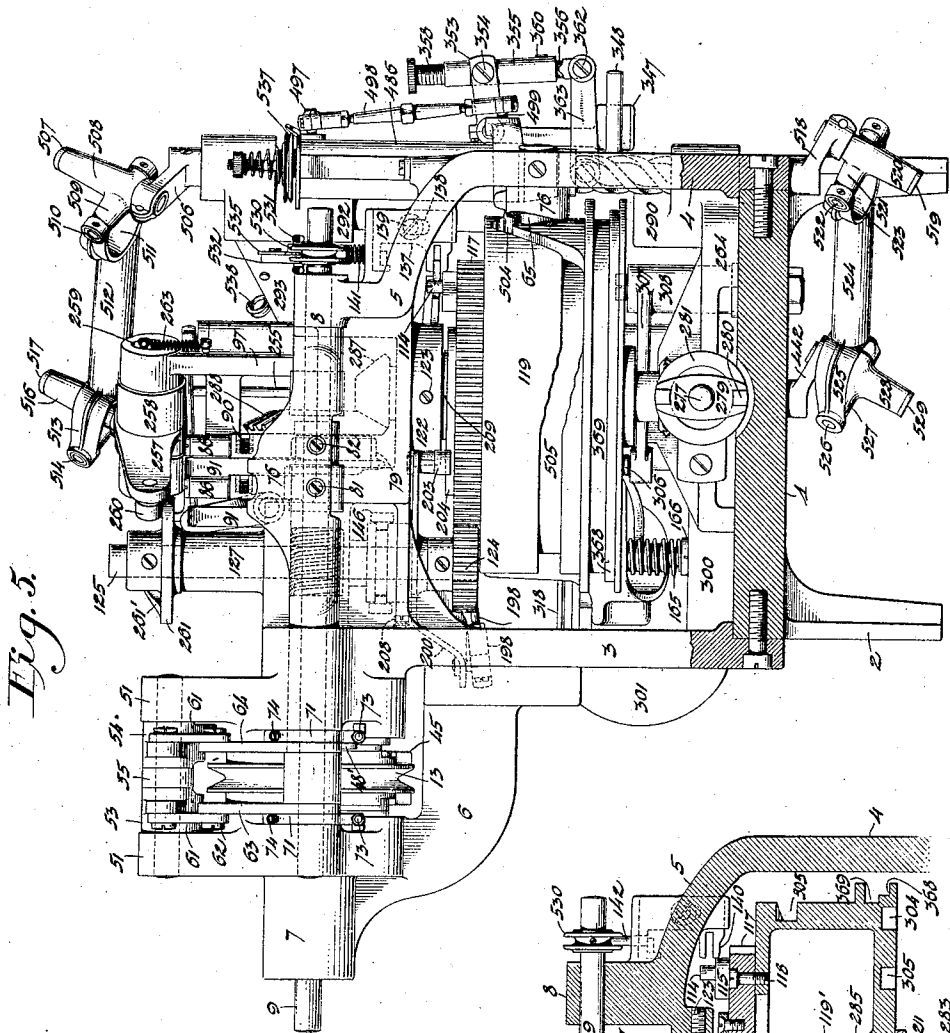


Fig. 5.

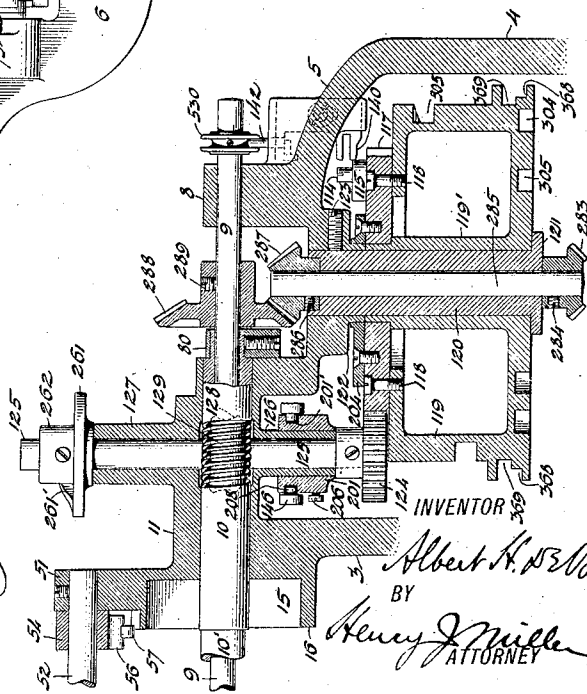


Fig. 6.

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BUTTONHOLE SEWING MACHINE.

APPLICATION FILED DEC. 31, 1915. RENEWED JAN. 7, 1921.

1,416,004.

Patented May 16, 1922.

14 SHEETS—SHEET 6.

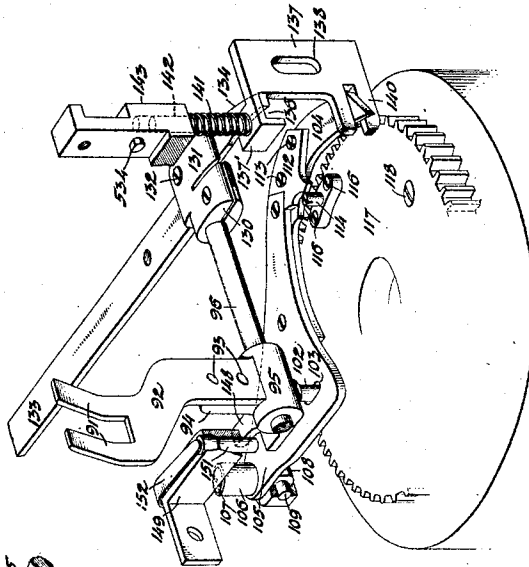


Fig. 8.

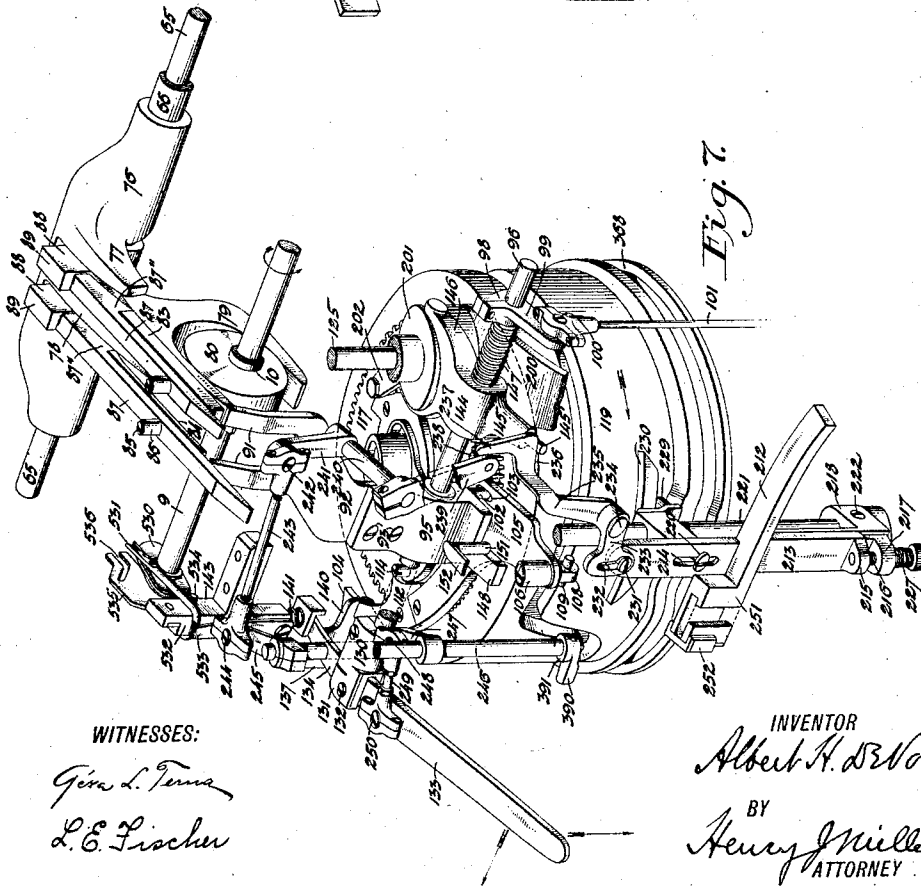


Fig. 7.

WITNESSES:

Gen. L. Tenna
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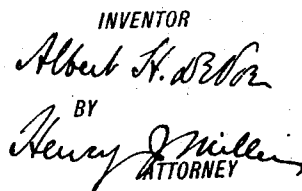
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APPLICATION FILED DEC. 31, 1915. RENEWED JAN. 7, 1921.

Patented May 16, 1922.
14 SHEETS—SHEET 7.



A. H. DE VOE.
 "BUTTONHOLE SEWING MACHINE."

APPLICATION FILED DEC. 31, 1915. RENEWED JAN. 7, 1921.

1,416,004.

Patented May 16, 1922.

14 SHEETS—SHEET 8.

Fig. 24.

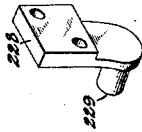


Fig. 22.

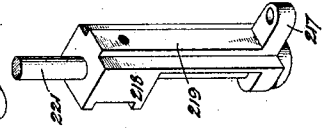


Fig. 23.

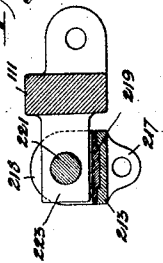


Fig. 20.

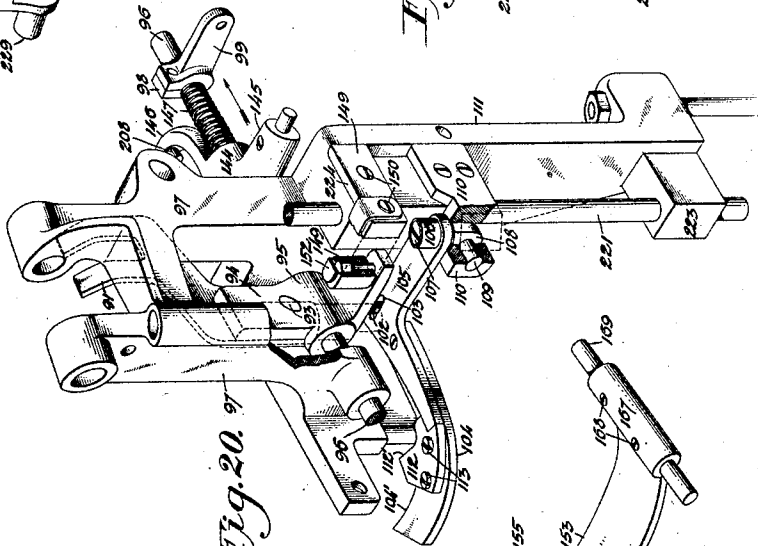
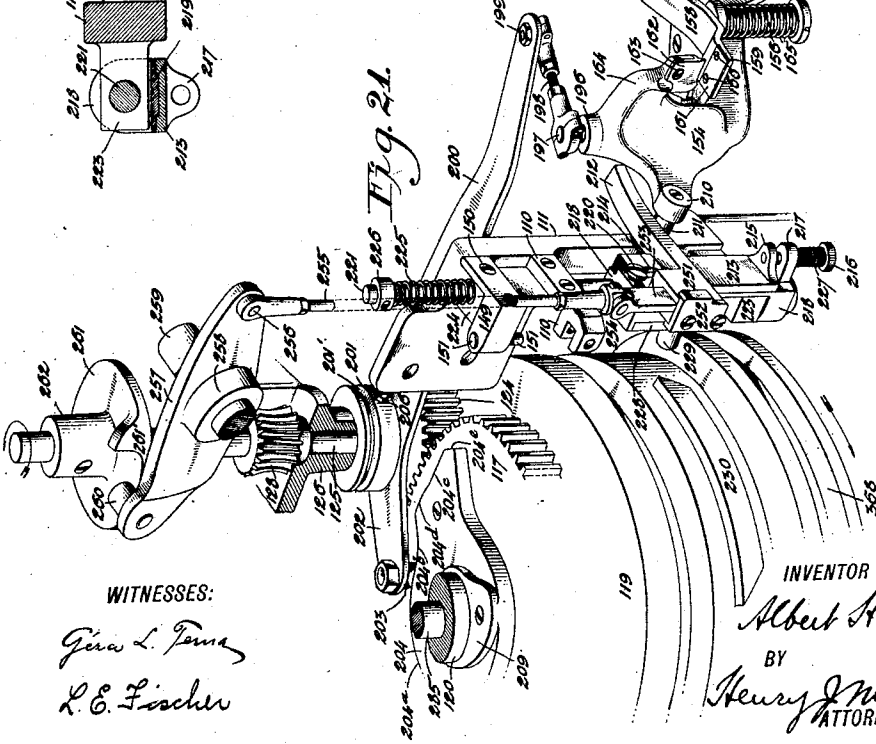


Fig. 21.



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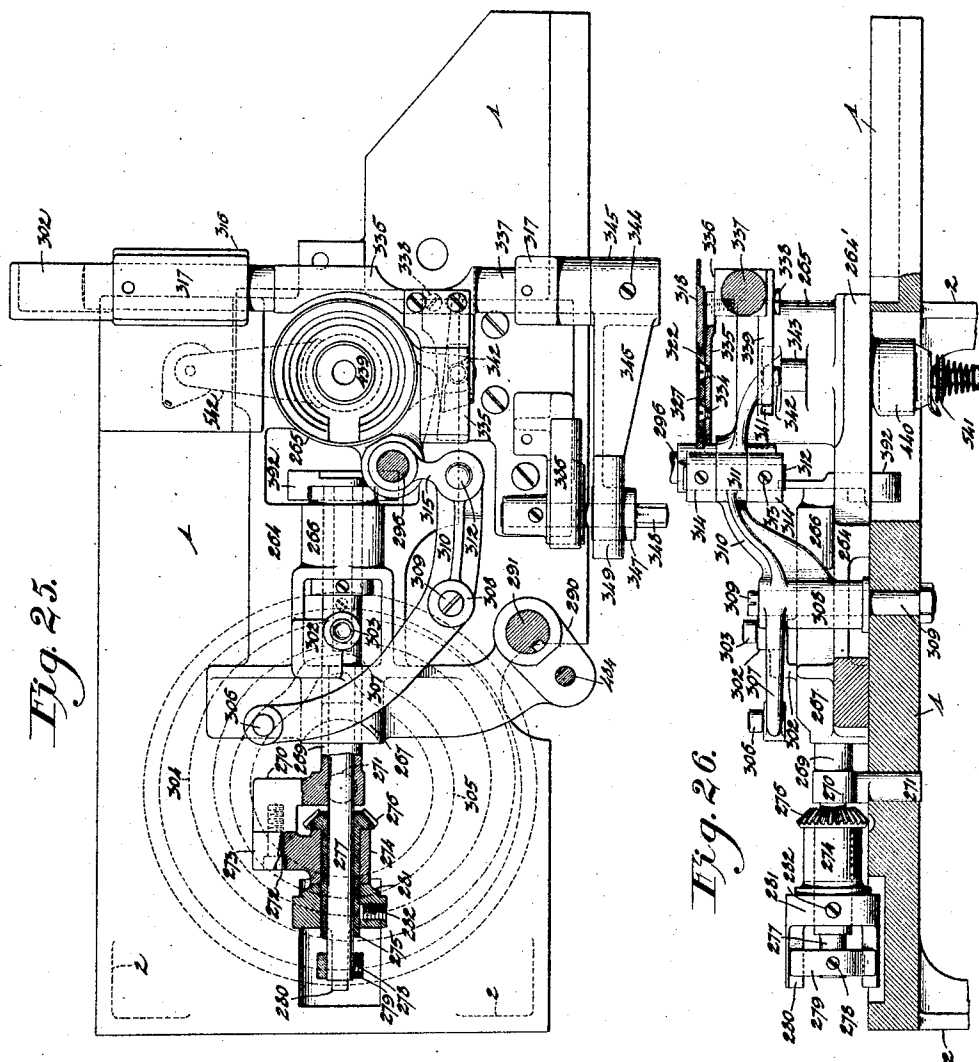


Fig. 25.

Fig. 26.

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1,416,004.

Patented May 16, 1922.

14 SHEETS—SHEET 10.

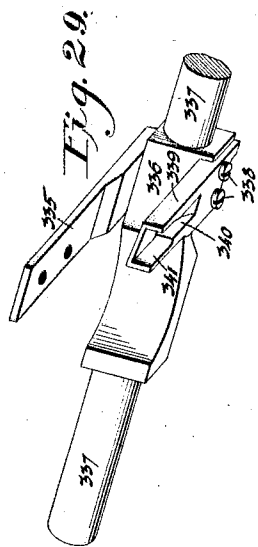


Fig. 29.

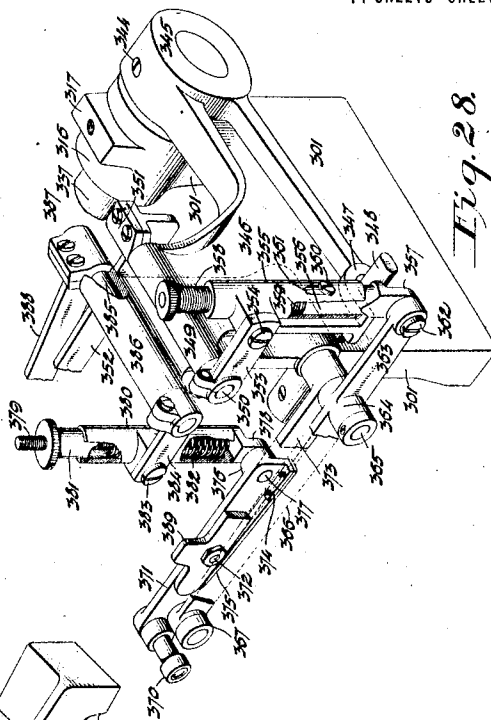


Fig. 28.

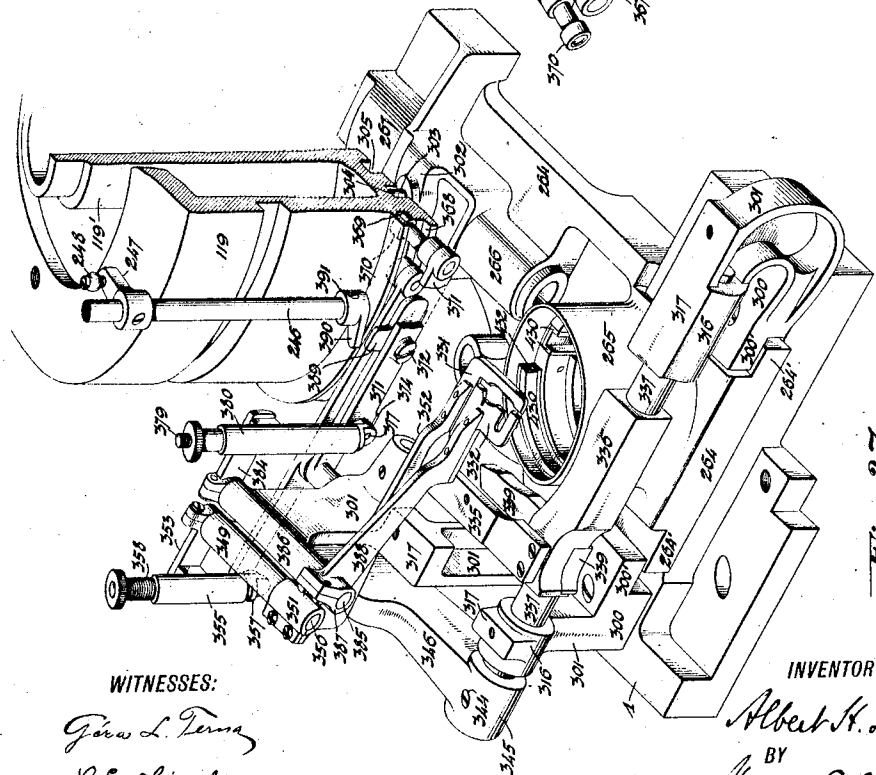


Fig. 27.

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1,416,004.

Patented May 16, 1922.

14 SHEETS—SHEET 11.

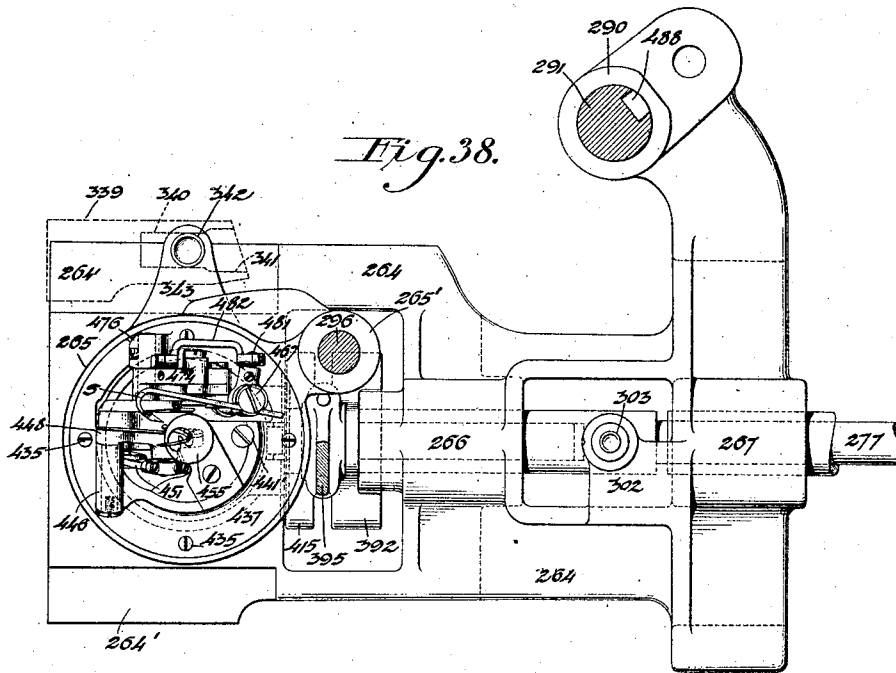


Fig. 38.

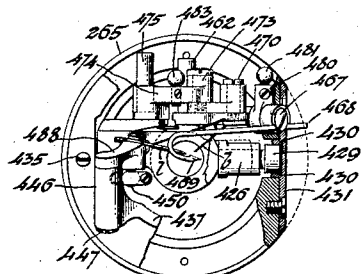


Fig. 40.

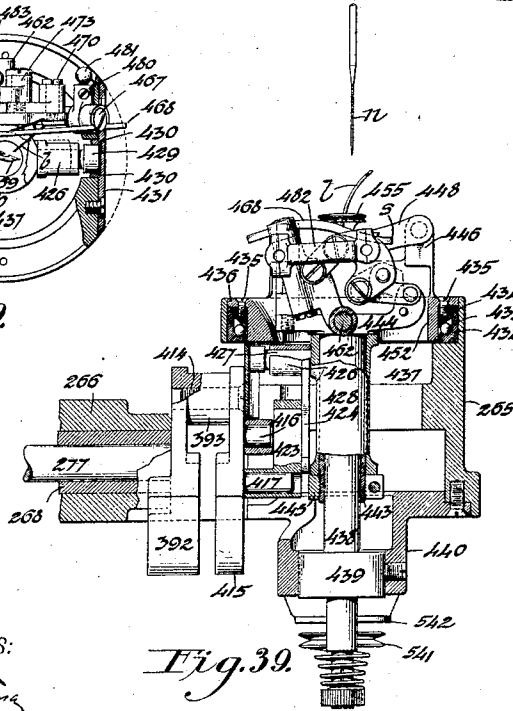


Fig. 39.

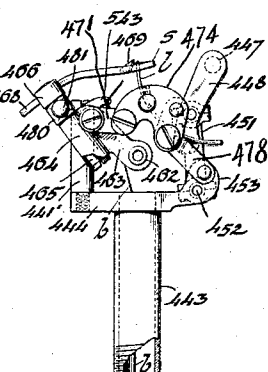


Fig. 41.

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·BUTTONHOLE SEWING MACHINE.

Patented May 16, 1922.

14 SHEETS—SHEET 12.

Fig. 42.

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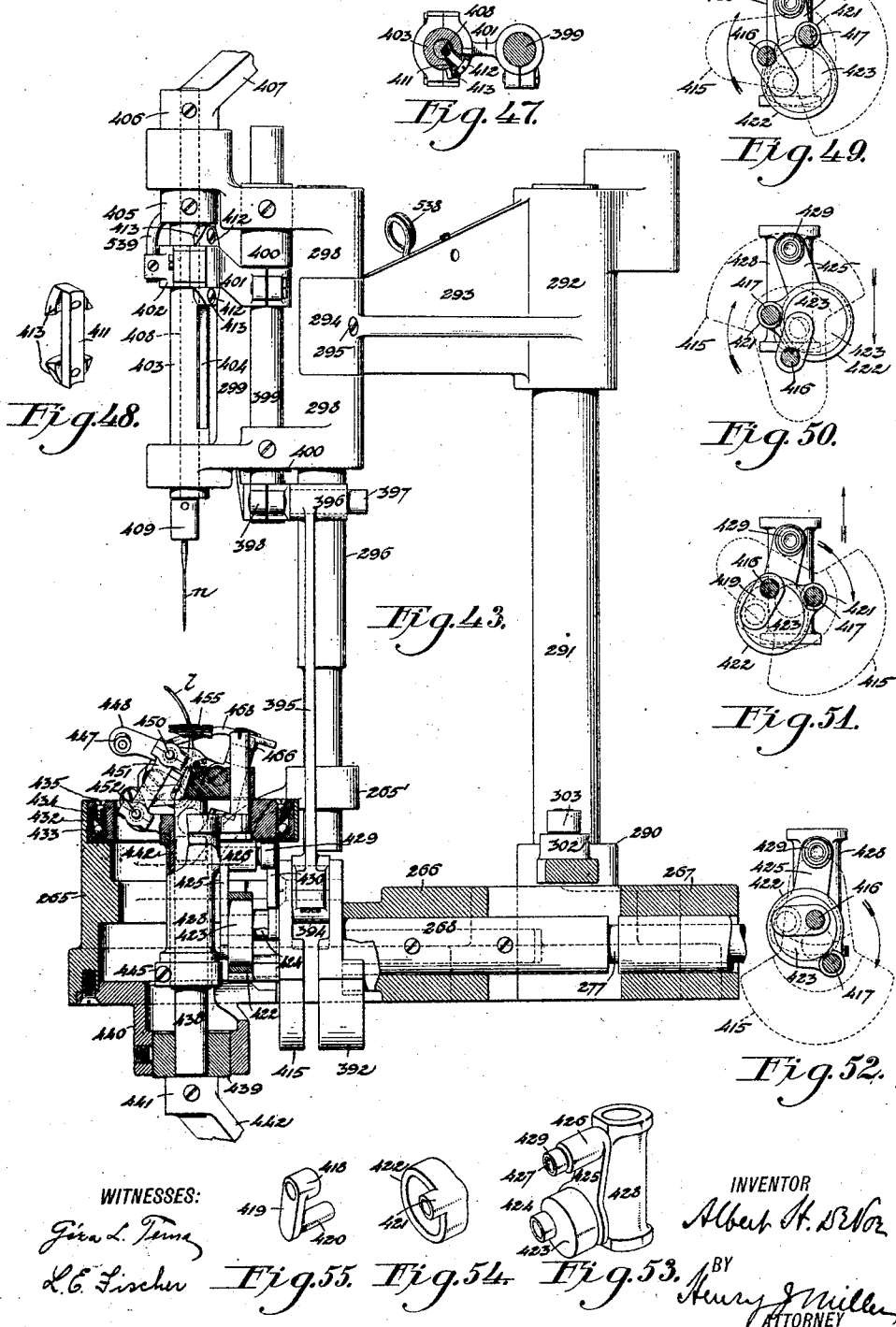
A. H. DE VOE.
BUTTONHOLE SEWING MACHINE.

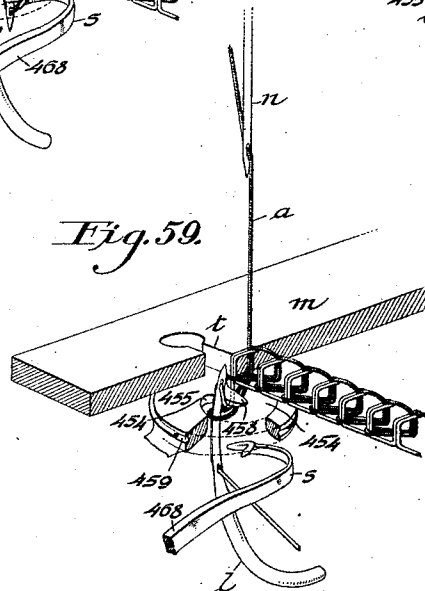
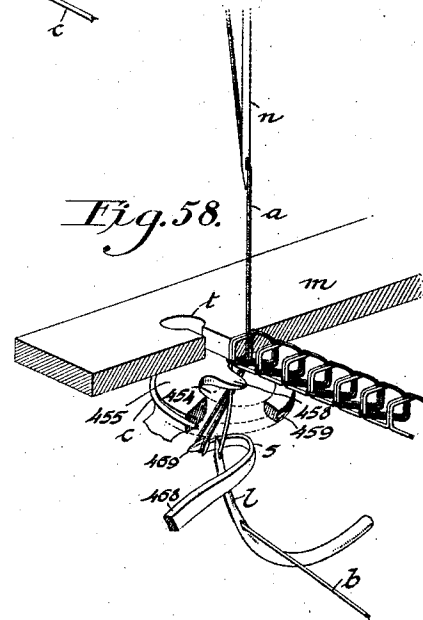
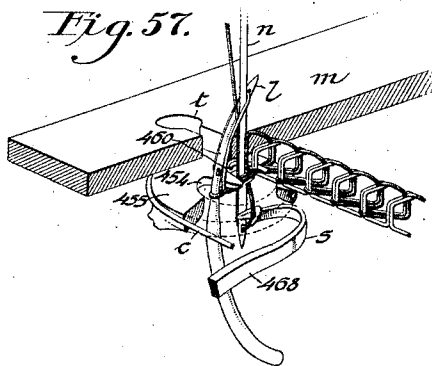
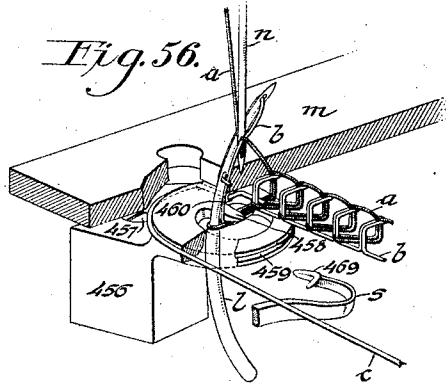
APPLICATION FILED DEC. 31, 1915. RENEWED JAN. 7, 1921.

1,416,004.

Patented May 16, 1922.

14 SHEETS, SHEET 13.





WITNESSES:
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UNITED STATES PATENT OFFICE.

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BUTTONHOLE-SEWING MACHINE.

1,416,004.

Specification of Letters Patent. Patented May 16, 1922.

Application filed December 31, 1915, Serial No. 69,644. Renewed January 7, 1921. Serial No. 435,761.

To all whom it may concern:

Be it known that I, ALBERT H. DE VOE, a citizen of the United States, residing at Westfield, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Buttonhole-Sewing Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an improvement more particularly in that class of buttonhole sewing machines employing stitching mechanism adapted to perform a semi-rotation for production of radial stitches at one or both ends of a buttonhole in conjunction with the usual straight line of side-stitches produced by the relative feed of the stitch-forming mechanism and the work; and it has for its primary object to increase the capacity of production as compared with buttonhole machines at present in commercial use, and also to facilitate the control of the machine under all conditions in the handling of the work by the operator.

In the preferred embodiment of the present invention, the control of the entire mechanism is centralized in a member of the starting device by which, not only are the starting and stopping of the several operative portions of the machine effected in the required order, but one or more of such portions of the machine may be stopped or otherwise rendered ineffective in suitable order in emergency, such, for instance, as the breaking of a stitching thread. The invention also preferably includes a special construction and arrangement of travelling buttonhole cutting device with actuating means whereby preparatory to its travel from retracted position it is caused to yieldingly nip the work and carry it bodily from one position to another relatively to the stitching mechanism for effecting the spacing apart and the required positioning of the buttonholes to be formed therein. The present invention further includes preferred novel constructions of the needle mechanism and loop-taking devices with the means whereby they are given their turning movements in the end stitching portions of a buttonhole-producing cycle. The invention further includes a preferred special construction of the work-clamp with its operating means designed for use particularly in con-

junction with the work-shifting buttonhole cutting mechanism.

The invention will be understood by reference to the accompanying drawings, in which—

Fig. 1 is an elevation taken from one side, and Fig. 2 an elevation taken from the opposite side of a buttonhole sewing machine embodying the present improvements. Fig. 3 is a plan, Fig. 4 a front end view and Fig. 5 a rear end view of the machine. Fig. 6 is a sectional elevation representing the feed-wheel and the cutter-actuating cam and portions of the mechanism associated therewith. Figs. 7 and 8 are perspective views representing the feed-wheel and portions of the mechanism for controlling the action of the same and other parts of the machine. Fig. 9 is a perspective view representing the clutch mechanism and its controlling devices whereby the operative parts of the machine are connected with the source of power; and Figs. 10, 11, 12, 13, 14, 15 and 16 are perspective views of detached parts of the clutch mechanism. Figs. 17 and 18 (sheet 2) are respectively a side elevation and a transverse sectional view of the operative parts of one of the clutches; and Fig. 19 (sheet 4) is an elevation, with the driving wheel in section, showing the relation of the operative parts of the two clutches through which power is transmitted from the driving wheel for actuation of the several groups of mechanism of the machine.

Fig. 20 is a perspective view representing a part of the controlling mechanism for the driving device. Fig. 21 is a perspective view of the buttonhole cutting mechanism, and Figs. 22, 23 and 24 are details of certain parts of said mechanism. Figs. 25 and 26 are respectively a plan and elevation, partly in section, representing the machine bed, the stitching frame and a portion of the feeding mechanism.

Fig. 27 is a perspective view representing the machine bed, the stitch-frame, and the work-clamp with its actuating means, and Figs. 28 and 29 are similar views showing parts of the work-clamp mechanism. Fig. 30 (sheet 3) is a plan of the feed-wheel and certain parts of the work-clamp mechanism and Fig. 31 is a perspective view of certain elements of the same. Figs. 32 and 33 (sheet 1) are respectively a plan and elevation of

the work-clamp and the buttonhole cutting device in cutting position. Fig. 34 is a perspective view, taken from the under side, of one of the lower work-clamp members, and Figs. 35 and 36 are perspective views taken respectively from the upper and lower sides, of the other lower work-clamp member. Fig. 37 is a detail sectional view of a part of the device for turning the stitch-forming mechanism.

Fig. 38 is a plan of the stitch-frame and the looper mechanism with its actuating means, and Fig. 39 a sectional elevation representing the looper mechanism. Fig. 40 is a plan of the looper mechanism and its supporting turret detached, and Fig. 41 an elevation of the same with certain parts omitted. Fig. 42 is an elevation taken from the front of the machine and representing the stitch-frame and the stitch-forming mechanism, and Fig. 43 is a similar view of the same parts taken from the same side of the machine as in Fig. 2. These figures are upon a larger scale than Figs. 1 to 6, and represent the stitch-frame partly in section. Figs. 44, 45 and 46 are perspective views respectively of the turret sustaining the looper mechanism, the lower thread carrying needle with its supporting and actuating means, and the spreader with its supporting and actuating means.

Fig. 47 is a cross-section of the needle-bar and needle-actuating bar with their connections, and Fig. 48 is a perspective view of certain parts of the latter. Figs. 49, 50, 51 and 52 are transverse sectional views showing certain parts of the looper-actuating mechanism in different operative positions, and Figs. 53, 54 and 55 are perspective views representing said parts detached.

Figs. 56, 57, 58 and 59 are perspective views showing diagrammatically the stitch-forming elements in different stages of a stitch-forming cycle and a portion of an edge-covering seam as applied to the margin of a buttonhole slit formed in the fabric.

The machine frame is constructed with the bed-plate 1 having the depending legs 2 and the standards 3 and 4 at opposite edges connected by the cross-member 5. The standard 3 is shown provided with a laterally extending bracket 6 formed with a bearing boss 7 in which and a bearing boss 8 is journaled the rotary shaft 9 which drives the stitch-forming mechanism and which is surrounded by a tubular shaft 10 for driving the feeding and buttonhole cutting mechanisms, which shaft is journaled in a bearing boss 11 of the cross-member 5.

Loosely mounted upon the reduced outer end portion 10' of the shaft 10 is the hub 12 of the peripherally grooved belt-wheel 13 formed in its opposite faces with annular clutch-cavities 14 each opposed to a similar brake cavity 15 of one of the hollow bosses 16

of the bearing bracket 6 and frame boss 11, respectively (Figs. 4 and 10).

The shafts 9 and 10 carry adjacent and upon opposite sides of the driving pulley 13 suitable clutching and braking devices which are similar in construction, except in being in right-and-left arrangement, and therefore a description of the one will apply equally to the other.

The shaft 9 is shown having fixed thereon within the brake-cavity 15 of the bracket 6 the hub 17 of a disk 18 formed upon its inner face with a boss 19 affording peripheral brake-band and clutch-band seats 20 and 21 and cut out at one side to form a segmental recess 22.

The seat 20 has secured thereon by screws 23 one end, suitably apertured, of the brake-band 24, having an enlarged opposite extremity 24' recessed to receive the anti-friction roller 25 mounted upon the bearing stud 26 tapped into the part 24', which lies normally within and in braking relation with the inner wall of the surrounding brake-band cavity 15. The seat 21 has secured thereon by screws 27 one apertured extremity of the similarly formed clutch-band 28 having its opposite end 28' recessed in its inner face to receive the anti-friction roller 29 journaled upon the bearing stud 30 tapped into said end of the clutch-band, this clutch-band being normally embraced by but maintained out of contact with the walls of the adjacent clutch-cavity 14 of the belt-wheel 13.

The boss 19 of the disk 18 is cut away upon the side opposite the recess 22 to receive the angular clutch-lever 31 having an aperture 32 to receive a fulcrum-stud 33, by means of which it is pivotally mounted within a slot of said boss between the seats 20 and 21. The lever 31 carries upon opposite faces and at opposite sides of the fulcrum-aperture 32 the laterally projecting roller-studs 34 and 35, the former working in the radial slot 18' of the disk 18 and being adapted to contact with the roller 25 of the brake-band and the latter to engage the roller 29 of the clutch-band.

That arm of the clutch-lever 31 carrying the roller-stud 35 has a substantially segmental extension 36 formed at its extremity with an inwardly extending lug 37 entering the cavity 22 of the disk 18 in which latter is secured by means of a screw 38 a thrust-block 39. Between the bottom of a cavity in the thrust-block 39 and the lug 37 is interposed a spring 40 which acts upon the clutch-lever to force the stud 35 into engagement with the clutch-band roller 29 and to retract the stud 34 from contact with the brake-band roller 25.

The clutch-lever extension 36 is formed with an outwardly projecting portion 41 passing through the clearance notch 42 of the clutch-band seat 21 and the notch 43 of the

clutch-band 28 and affording an inclined bearing shoulder for engagement with the similarly inclined edge of an inwardly extending lug 44 of one of the segmental thrust-blocks 45 secured by means of screws 46 upon opposite sides of the rim of the driving pulley 13. When the clutch-lever 31 is free to turn upon its fulcrum-stud 33 under the action of the spring 40, the projection 41 rests upon the inner wall of the clutch-cavity 14 of the driving wheel until it comes into register with the clearance notch 47 therein (Fig. 15), through which it emerges to permit a clutching action of the lever 31 which is thus caused to thrust the stud 35 into engagement with the roller 29 to expand the clutch-band 28 into gripping relation with the wall of the clutch-cavity. The initial slip of the clutch-band upon the driving wheel is arrested by the engagement of the projection 41 with the lug 44 extending into the notch 47, whereby, not only is the clutch-lever thrust still more forcibly into clutching relation, but a positive coupling is insured between the driving and driven members.

The clutch-lever arm sustaining the roller-stud 35 has a second outwardly projecting portion 48 which extends through notches 49 and 50 in the adjacent edges of the brake and clutch-bands 24 and 28 and between the adjacent edges of the rims of the bosses 16 and the driving wheel 13 beyond which latter it presents an eccentrically arranged segmental bearing surface 48' to provide for actuation of the clutch-lever from the exterior of the clutch device.

The bosses 16 containing the brake-band cavities are provided each with an upwardly extending lug 51 in which is mounted the rock-shaft 52 having journaled thereon for independent movement the hubs 53 and 54 of two rock-levers spaced apart by means of the intermediate collar 55. These rock-levers each comprise a tappet-arm 56 forked at its outer extremity to embrace a roller 57 sustained therein upon the journal-pin 58. The rollers 57 are disposed each above one of the spaces between the driving wheel and one of the bosses 16, (Fig. 4) and therefore above the paths of movement of the clutch-lever extensions 48 into and out of engagement with which they are designed for movement. These rock-levers are provided with oppositely extending arms 59 each pivotally connected by means of a pin 60 with one end of a link 61 having its opposite end connected by a pin 62 with one of the levers 63 and 64, the former being fixed upon an inner rock-shaft 65 and the latter upon a tubular rock-shaft 66 surrounding the same.

The inner rock-shaft 65 is journaled at its opposite ends within a bearing 67 extending from the outer brake-band boss 16 and a bearing 68 of the frame cross-member 5

(Fig. 3), and the tubular rock-shaft 66 is journaled internally upon the rock-shaft 65 and externally within a bearing 69 extending laterally from the inner brake-band boss 16 and the frame standard 3. The links 61 and the arms 63 and 64 form between the rock-levers 54, 56 and 59 and their respective rock-shafts toggle devices of which the extreme operative positions are determined by the angularly arranged stop-arms 70 and 71 (Figs. 9 and 10) each secured to and movable with its respective toggle arm by means of a screw 72. Each of the arms 70 and 71 carries a stop-screw 73 and 74, respectively, adapted to contact with the exterior of the boss 16 for determining the throw of the link 64.

When either toggle is bent under the action of the spring 75 interposed between the stop-arm 70 and the adjacent boss 16, the roller 57 is retracted, and its respective clutch-lever is permitted to revolve with the driving wheel unobstructedly; but when the toggle is straightened as represented particularly in Figs. 9 and 10, the roller 57 is moved inwardly into the peripheral clearance notch 16' of the boss 16, and into the path of movement of the extensions 48 of its respective clutch-lever, thereby thrusting the same inwardly to shift the clutch-lever for uncoupling its respective shaft from the driving wheel and applying the brake in the manner before described.

As the outer end portion of the bearing face 48' of the clutch-lever extension 48 extends slightly beyond the roller 57 even when the roller-stud 34 engages the brake-band roller 25 (Fig. 16) it is evident that the roller 57 imposes a positive barrier to the continued rotation of the clutch-lever with its connected shaft, and therefore positively brings the latter to rest always in the same position, so that the positions of rest of the moving parts are invariably the same. It is also evident that, although the shafts 9 and 10 are adapted to be coupled independently to the common driving wheel 13, the clutching devices act, as previously described, to couple them to the driving member in such manner that they invariably assume a fixed relation during a working cycle, which is a matter of importance in buttonhole sewing machines involving the action of different work-engaging elements upon the fabric in succession in substantially the same working position.

Loosely journaled at one end upon the tubular rock-shaft 66 and at the other end upon the concentric inner shaft 65 is a rocking sleeve 76 provided intermediate its ends with the spaced laterally projecting tappet-arms 77 and 78, the arm 78 having an extension formed with a yoke 79 which embraces an actuating cam or eccentric 80 fixed upon and rotating with the tubular shaft

10. The sleeve 76 is cut away on one side intermediate its ends to expose the inner end of the tubular rock-shaft 66 and the adjacent portion of the rock-shaft 65, which have
 5 secured thereon by means of set-screws 81 and 82 the hubs of two laterally extending arms 83 and 84 each disposed adjacent one of the tappet-arms 77 and 78.

Each of the arms 83 and 84 has tapped
 10 into its upper face a shouldered stud-screw 85 entering the apertured boss 86 of a laterally movable latch-lever 87. Each lever 87 has its end portion adjacent the sleeve 76 notched in one side and the reduced portion 87' thus formed extended within a
 15 housing afforded by a lug 88 and overhanging lip 89 formed upon the adjacent tappet-arm, a spring 90 being interposed between the parts 87' and 88 to normally maintain
 20 the latch-lever in superposed relation and alinement with its supporting arm, and with a depending stop-flange 87'' thereof in contact relation with the edge of said supporting arm which is notched to receive the
 25 same.

Under the action of their respective springs 90, the latch-levers are normally maintained out of the range of action of the adjacent tappet-arms 77 and 78, and the
 30 arms 83 and 84 may assume their lower positions in which the toggles 61 and 64 are bent; but when the latch-levers 87 are shifted laterally in opposition to such springs, as represented at the left in Fig. 9, they are
 35 caused to project above the respective tappet-arms, which perform constant rising and falling movements during the operation of the machine, and are thereby lifted so as to straighten said toggles and tilt the rock-
 40 levers 56 59 into stopping position.

The ends of the latch-levers 87 opposite their notched extremities project in different degrees beyond the corresponding ends of the arms 83 and 84, the one sustained by the
 45 arm 83 being the shorter of the two. In the elevated positions of the said arms assumed while the machine is at rest, the overhanging portions of the levers 87 rest upon the ends of the spaced members of a yoke 91 at
 50 the upper end of a detaining arm 92 secured by screws 93 upon a plate 94 extending upwardly from a collar 95 fixed upon the endwise movable starting rock-shaft 96 in the bearing bracket 97 secured to the front side
 55 of the frame cross-member 5.

The rock-shaft 96 is shown having secured upon one end the split hub 98 of a lateral crank-arm 99 carrying a crank-pin 100 embraced by a strap at the upper end of a
 60 treadle-rod 101, by which the rock-shaft may be rocked in starting the machine to retract the detaining yoke 91 for disengagement of one of its members with the shorter of the latch-levers 87 to permit its carrying arm
 65 83 to descend for bending the inner toggle

to effect the coupling of the tubular shaft 10 with the driving pulley. A subsequent endwise movement of the shaft 96 causes the edgewise shifting of the detaining yoke and consequent disengagement of the other member thereof from the longer latch-lever 87 to
 70 effect the coupling of the shaft 9 with the driving pulley.

The collar 95 carries a depending pin 102 which enters an elongated aperture 103 in a
 75 substantially segmental cam-lever 104 having at one end a lateral extension 105 formed with an apertured boss 106 entered by the fulcrum stud-screw 107 which is tapped into the depending block 108 carrying the trans-
 80 verse fulcrum-pin 109 (Figs. 8 and 20) which is journaled in a suitably apertured bracket-piece 110 secured to the standard 111 which depends from the bearing bracket 97. The angularly arranged fulcrum-pins 107
 85 and 109 form a universal-joint connection of the cam-lever 104 with its supporting frame whereby such lever is adapted for movement both horizontally and vertically.

The concave edge 104' of the cam-lever
 90 and the overhanging angular edge 112' of the cam-plate 112 secured by screws 113 thereon are adapted for engagement by a stud 114 upon a block 115 secured by screws
 95 116 upon the upper face of a gear-wheel 117 which is in turn secured by screws 118 upon the upper face of the feed cam-cylinder 119. The cam-cylinder 119 is formed with a hub 119' fitted upon a tubular bushing 120 having at its lower end the flange 121 to sup-
 100 port the weight of the cam and secured within a hub 122 of the frame cross-member 5 by means of set-screws 123, of which only one is shown in Fig. 6.

Meshing with the gear-wheel 117 is a driv-
 105 ing pinion 124 secured upon the lower end of the cutter-actuating shaft 125 journaled in the bearing bosses 126 and 127 having fixed thereon the worm-wheel 128 meshing with the worm 129 formed in the tubular
 110 shaft 10. By the means described the shaft 10, which rotates in unison with the driving pulley 13, turns the cutter-shaft 125 at a reduced speed through the described worm and worm-wheel connection and the feed-
 115 cam is driven at a still slower speed by its speed-reducing gear connection with the cutter-shaft.

The starting rock-shaft 96 has secured upon its end opposite the crank-arm 99 the
 120 split hub 130 of a block 131 having a transverse slot in which is secured by means of the pivotal screw-pin 132 the forwardly extending starting lever 133 having a rearward extension 134 of reduced width. The
 125 hub 130 is formed with a socket between the bottom of which and the adjacent edge of the lever 133 is interposed a spring 135 (Fig. 9) by which the edge of the lever is yieldingly maintained in contact with the inner
 130

end of the embracing slot of the block 131 (Fig. 7).

The extension 134 of the starting lever enters and engages the upper wall of a recess 5 136 of a lifting slide-plate 137 formed with a slot 138 to receive a screw 139 by which it is slidably sustained upon an upright seat upon the frame-member 5. The plate 137 is formed with a forked lateral extension 140 10 embracing the free end portion of the cam-plate 104 (Fig. 8). The lifting plate is normally pressed downwardly by means of a spring 141 surrounding a pin 142 entering a socket in a frame-member 143 between 15 which and the lifting plate the spring is interposed.

The rock-shaft 96 has loosely mounted thereon the hub 144 of a rock-lever having a lateral arm 145 and an oppositely extending arm formed with a yoke 146. The hub 20 of this lever rests against the adjacent member of the bearing bracket 97, and has interposed between it and the hub 98 of the crank-arm 99 a spring 147 by means of 25 which the rock-shaft 96 is pressed endwise in the direction indicated by the arrow in Fig. 20, and through the pin-and-slot connection 102 103 the cam-lever 104 is yieldingly maintained within the range of movement of the stud-pin 114 moving with the 30 cam-wheel 119.

The collar 95 is formed with a laterally notched and forwardly projecting finger 148 which, under the normal action of the 35 spring 141 upon the extension 134 of the starting lever, is normally pressed upwardly in contact with the bottom of the angle-piece 149 secured upon the standard 111 by screws 150, (Figs. 8 and 20). The operative end of this angle-piece is formed with 40 a socket containing the headed plunger-pin 151 with its lower end normally projecting below the bottom of the angle-piece under the action of the flat spring 152 overlying 45 the angle-piece and pressing upon the head of the plunger-pin.

When the starting rock-shaft 96 is in initial position in which the yoke 91 detains the clutch-controlling levers 83 and 84 in elevated position, the finger 148 occupies the position beneath the angle-piece 149 represented in Fig. 20, the lower end of the plunger-pin resting upon such finger. When, 50 however, the rock-shaft 96 performs its two-step endwise operative movement under the action of the stud-pin 114 successively upon the cam edges 104' and 112', the finger 148 is moved edgewise in a direction opposite to that indicated by the arrow in Fig. 20, and 60 the plunger-pin 151 descends under the action of its spring 152 into latching relation with the finger, as indicated in Fig. 7.

The finger 148 remains in engagement with the detaining plunger-pin 151 until the 65 shaft 96 is rocked by means of the treadle-

rod 101 or the finger-lever 133 at the beginning of a succeeding working cycle, when the finger 148 becomes disengaged from the plunger-pin 151 and is permitted under the action of the spring 147 to reassume its initial position beneath the same. 70

The rocking of the starting shaft 96 by depression of the crank-arm 99 or finger-lever 133 not only causes the disengagement of the yoke 91 from one of the latch-levers 87 75 to effect the starting of the tubular shaft 10 which drives the cam-wheel 119, but acts through the extension 134 of the lever 133 to raise the lifting plate 137 in opposition to its spring 141, thereby lifting the 80 cam-plate 112 out of engagement with the stud-pin 114 with which it remains in engagement at the completion of a working cycle, thereby permitting the starting shaft 96 to perform one step of its operative 85 movement under the action of the spring 147 and bring the operative edge of the cam-lever 104 into engagement with the stud-pin 114.

In this position of the shaft 96, the second 90 of the yoke-members 91 is still beneath the longer of the latch-levers 87, but as the stud-pin 114 performs its travel with the supporting cam-wheel, it rides off the end of the cam-lever 104 and thereby further removes the restraint upon the shaft 96 against 95 the second stage of its endwise clutch-controlling movement under the action of the spring 147. In performing the second stage of its movement, the shaft 96 carries the 100 yoke 91 from beneath the latch-lever 87, thereby permitting the arm 84 to descend and thus effect the coupling of the shaft 9 with the driving pulley to set the stitch-forming mechanism in operation. 105

The starting lever extension 134 normally rests against the body of the lifting plate 137, as indicated in Fig. 8, not only when the parts are in stopping position but after the initial actuation of the starting rock-shaft 110 96. The second stage of endwise movement of the shaft 96 carries the lever 133 bodily with it to bring the extension 134 into contact relation with the depending lip 137' affording the opposite wall of the recess 136 115 where it remains during the stitching operation.

In order to stop one or both trains of mechanism actuated by the shafts 9 and 10 during a working cycle of the machine, the 120 starting lever 133 may be manually shifted edgewise in the direction of the arrow (Fig. 7) to move the rock-shaft 96 toward initial position in opposition to its spring 147. This movement of the shaft acts, similarly 125 to the corresponding movement automatically effected by means of the stud-pin 114 and the cam-lever 104, to bring the edge of the appropriate member of the yoke 91 against the adjacent edge of the longer latch- 130

lever 87 to laterally shift the same into engagement with the tappet-arm 78 for lifting the arm 84 to uncouple the shaft 9 from the driving pulley, the raising of the latch-lever 5 87 with its supporting arm permitting it when in its highest position to snap into initial position above its actuating yoke-member under the action of the spring 90.

A continued movement of the starting lever 10 133 in the same direction produces a like engagement of the other detaining yoke-member 91 with the shorter latch-lever 87 for uncoupling the shaft 10 from the driving pulley. It is evident that the elements 87 15 and 91 are spaced apart sufficiently and are of the requisite width to permit the described successive control of the clutch-controlling arms 83 and 84.

As represented in the drawings, the cutting device is mounted to perform travelling 20 movements from retracted position into and out of the range of operation of the stitch-forming mechanism which preferably includes a reciprocating eye-pointed upper 25 needle *n*, a reciprocating curved and eye-pointed lower needle or looper *l*, and a spreader *s* for seizing thread-loops from the upper needle and holding them below the work for passage of the lower needle which presents 30 loops of its own thread above the work for passage of the upper needle. In the present embodiment of the invention, the stitch-forming elements are sustained by a travelling stitch-frame adapted to be shifted out 35 of its normal working position to permit the cutting of a buttonhole slit in stitching position.

The cutting device comprises a vertically and horizontally movable cutter-lever formed 40 in two rigidly connected sections 153 and 154 with an intermediate raised seat 155 apertured to receive and guide a stud 156 and a steady pin 157 depending from a plate 158 having an upwardly offset lateral extension 45 159, (Figs. 21 and 33). Secured upon the extension 159 by means of screws 160 is the cutter-block or plate 161 disposed beneath and in operative relation with the relatively movable upper cutting knife 162 secured by 50 a screw 163 upon an overhanging member 164 of the cutter-lever arm 154.

The cutting elements 161 and 162 are normally maintained separated by means of a spring 165 surrounding the stud 156 and 55 interposed between the head of a screw 166 tapped therein and the lower face of the member 155 of the cutter-lever.

The cutter-lever arm 153 is formed with a transverse boss 167 in which is secured by 60 set-screws 168 the pivotal pin 169 which is journaled in the spaced members of a transverse yoke 170 of a swinging frame 171 carrying the guide-rod 172. The frame 171 is formed with a depending boss 173 embraced 65 between and pivotally connected by means

of the pin 174 with the spaced arms 175 of a link member which arms are rigidly connected together by a tie-piece 176. The arms 175 embrace between them and are pivotally 70 connected by means of the pin 177 with the spaced lateral arms 178 of a swing-bracket having a tubular hub 179 journaled upon the fulcrum-stud 180 which is sustained by the bed-plate 1 (Fig. 1).

By the means described, the swinging 75 frame 171 is supported for movement in any direction horizontally around the pivotal pins 174, 177 and 180 and is restrained against movement in other directions. The cutter-lever, while having a pivotal connec- 80 tion with said frame transverse to the pins upon which it moves, is sustained in a horizontal position by reason of the screw 166 resting upon the top of the foot 300 of a bracket 301 secured upon the bed-plate 1 85 (Figs. 2, 4 and 5).

Slidably mounted upon the guide-rod 172 is a sleeve 182 adapted to be secured there- 90 on in the desired position of adjustment by means of the clamp-screw 183 and provided with a laterally extending and apertured boss 184 in which is secured by means of the set-screw 185 the fulcrum-pin 186 which en- 95 ters a bushing 187 secured by means of the set-screw 188 in a lateral socket 189 of the sliding sleeve 190 (Fig. 1). The sleeve 190 is fitted upon a guide-rod 191 of the rigid bracket 192 provided with a parallel rod 193 100 embraced by the wings 194 of the sleeve 190 to prevent the latter from turning, a clamp-screw 195 being applied to the sleeve 190 to secure it in the desired position of adjustment.

The bracket 192 is shown secured to the front end of the bed-plate 1 with the paral- 105 lel rods 191 and 193 inclined to the vertical pivotal pins 174, 177 and 180, the rod 172 being so sustained by its swinging frame 171 that it assumes a position in parallel- 110 ism with the rods 191 and 193 when directly above them corresponding with the cutting position of the cutting elements.

The vertically arranged pin 186 obviously affords a fulcrum upon which the swinging 115 frame 171 and the connected cutter-lever move to confine the bodily travel of the cutting elements to a circular path with a degree of curvature determined by the distance of its fulcrum-pin from cutting position with which it is maintained in aline- 120 ment in its adjustment along the fixed guide-rod 191. By simultaneous adjustment of the sleeves 182 and 190 lengthwise of their respective supporting rods, the radius of curvature of the travelling movements of the 125 cutting elements may be correspondingly varied.

The position of the fulcrum-pin 186 relative to cutting position might be suitably 130 varied if the guide-rods 172 and 191 were

arranged horizontally, but in such case there would be nothing to prevent the endwise displacement of the swinging frame 172 relatively to the fixed guide-rod 191, so as to correspondingly shift the operative position of the cutting elements, but by inclining the rods 191 and 172 to the pivotal supports 174, 177 and 180 of the frame 171, this frame is not permitted to shift endwise relatively to the fixed guide-rod 191 in the simultaneous adjustment of the sleeves 190 and 182, so that in any position of adjustment of the fulcrum-pin 186 to vary the curvature of movement of the cutting elements, their cutting position remains permanently fixed.

The cutter-lever arm 154 is shown provided (Fig. 21) with an upwardly extending boss 196 carrying a ball-stud 197 which is embraced by a strap at one end of a link 198 having at its opposite end a similar strap embracing a stud 199 upon a lateral arm 200 of an angle-lever having a hub 201 at the junction of its arms slidably journaled upon the bearing boss 126 of the cutter-shaft 125. This angle-lever has a second arm 202 carrying a roller-stud 203 normally engaging the operative edge of the cam-disk 204 secured upon the upper face of the gear-wheel 117. The stud 203 is maintained in contact with the cam 204 by means of a spring 205 having one end secured by a screw 206 to the hub 201 and the opposite end connected by a screw 207 to a fixed part of the frame, as shown in dotted lines in Figs. 2 and 3.

As represented in Fig. 30, the periphery of this cam has a portion 204^a constituting about three-quarters of a circumference and a projection 204' having two active portions 204^b and 204^c with adjacent concentric portions 204^d and 204^e. During the greater part of a buttonhole producing cycle, the stud 203 rests upon the inner cam portion 204^a, and the cutter-lever 153, 154, is maintained in extreme retracted position through the described connections with the angle-lever 200, 202. As the cam-wheel continues its rotation, the stud 203 engages successively the cam portions 204^b, 204^c, 204^d and 204^e, whereby the cutting device is advanced about two-thirds of the distance to cutting position where it remains at the completion of the buttonhole-producing cycle, after which it advances to cutting position where it remains sufficiently long for the cutting of the buttonhole slit and then retires to initial retracted position as the stud 203 again engages the concentric cam-portion 204^a.

The hub 201 is formed with an annular groove 201' entered by inwardly extending pins 208 of the yoke 146 (Figs. 6 and 20). When it is desired to prevent the travel of the cutting device between retracted and cutting positions, the rock-lever 145, 146,

may be manually rocked through a connection with the starting lever 133 to bodily lift the lever 200, 202, sufficiently to lift the roller-stud 203 above the cam-disk 204, thereby permitting the spring 205 to retain the cutting device in retracted position. To automatically return the cutter-shifting lever to operative relation with its actuating cam, the disk 204 is provided upon its upper face with a pear-shaped cam projection 209 having an outer portion merging into the periphery of the cam 204. As the cam-wheel 119 rotates, the roller-stud 203 is forced outwardly by the cam-projection 209 until it comes into register with the main cam 204, when it descends by gravity into initial position for normal operation in a succeeding buttonhole producing cycle.

The cutter-lever is formed at the end which carries the boss 196 with a lateral boss 210 in which is mounted a roller-stud 211 adapted to engage the lower face of a transverse rail 212 sustained by a vertical slide-bar 213. The slide-bar is provided above the rail 212 with a longitudinal slot 214 and at its lower end with a lateral ear 215 into which is tapped from below the screw-stud 216 which passes through an apertured lug 217 of a block 218 formed with a longitudinal tongue 219 entering a corresponding channel of the slide-bar 213. The slot 214 is entered by the shank of a stud-screw 220 tapped into the block 218 to assist the screw-stud 216 in holding the slide-bar 213 to its seat upon the block 218. The block 218 is cut out intermediate its ends upon the side opposite the tongue 219, and its end portions are apertured to fit the reciprocating rod 221 to which it is secured at the lower end by means of the set-screw 222 (Fig. 7).

The rod 221 is journaled in lateral bearing lugs 223 and 224 of the standard 111 with the lug 223 entering the cut out portion of the block 218 which latter is maintained in raised position by a spring 225 interposed between the top of the bearing lug 224 and a collar 226 fixed upon the upper end of the rod 221. Interposed between the head of the screw-stud 216 and the lug 217 is a spring 227 adapted to draw the slide-bar 213 downwardly and to yieldingly maintain it in lowered position upon the block 218.

To the upper member of the block 218 is secured a bearing plate 228 carrying the laterally extending roller-stud 229 adapted to engage the lower edge of the cam-rib 230 upon the periphery of the cam-wheel 119, this cam-rib being provided with downwardly and convergently inclined opposite ends (Figs. 7 and 21). In the rotation of the cam-wheel, the encounter of the roller-stud 229 by the inclined advance end of the cam-rib 230 causes the depression of the

block 218 in opposition to the action of the spring 225. At this time, the slide-bar 213 is prevented from full downward movement, and the spring 227 is accordingly compressed for subsequent action upon the slide-bar and the parts connected therewith.

The slide-bar 213 carries a stud-pin 231 entering a segmental slot 232 in the lateral arm 233 of an angle-lever fulcrumed by means of the stud 234 upon the standard 111 and provided with an angular upwardly projecting arm 235 having in its outer portion a straight lower edge 236 and an upwardly extending finger 237. The cam edge 236 is adapted for engagement by a pin 145' sustained by the rock-lever arm 145, and the edge of the finger 237 is adapted for engagement with a lateral pin 238 upon the depending arm 239 fixed upon a rock-shaft 240 which is journaled in the bracket 97 and carries an upwardly extending crank-arm 241 provided with a ball crank-stud 242.

The stud 242 is embraced by a strap at one end of a pitman 243 having at its opposite end a strap embracing a similar stud 244 sustained by a lateral crank-arm 245 of a vertical rock-shaft 246 which is also journaled in a bearing of the bracket 97. The rock-shaft 246 carries a second lateral crank-arm 247 carrying a ball-stud 248 which is embraced by a strap at one end of the link 249 having at the opposite end a strap embracing the ball-stud 250 secured upon the starting lever 133.

When the parts are in the positions which they assume at the completion of a buttonhole producing cycle, the stud 238 is maintained forcibly in engagement with the finger 237 of the angle-lever 233, 235, and the stud-pin 231 rests upon the lower end-wall of the slot 232 to sustain the slide-bar 213 against the downward thrust imposed by the block 218 through the spring 227. When, however, the machine is started for a new buttonhole producing cycle, the first endwise movement of the starting rock-shaft 96 under the action of its spring 147 moves the lever 133 bodily in a direction opposite that indicated by the arrow at the left in Fig. 7, thereby causing the rocking of the shaft 246 and through it the shaft 240 to disengage the stud 238 from the finger 237, whereby the restraining influence of the angle-lever 233, 235, is removed from the slide-bar 213 which now descends under the action of the spring 227.

The slide-bar 213 in descending carries downwardly the rail 212 which acts through the roller-stud 211 to depress the cutter-lever for closing the upper cutting element upon the work and nipping it between itself and the lower cutting element. The strength of the spring 227 is such as to counteract the stress of the cutter-separating

spring 165 and to apply a suitable nipping force to the upper cutting element without producing an actual cutting impulse upon the work, so that in the subsequent movement of the cutter-lever toward stitching position, the work is shifted correspondingly to space the previously made buttonhole from that about to be cut and stitched in the work.

The rail 212 is shown formed at one end with an integral socket 251 closed at one end by the cap 252 and serving as a guide to which is fitted the plunger-bar 253. This plunger-bar has at its upper end a fork in which is pivotally secured by the pin 254 the lower end of a connecting rod 255 having its suitably eyed upper end attached by a pivotal pin 256 to one arm of a rock-lever 257 having its hub 258 fixed upon a rock-shaft 259 which is journaled in suitable bearing bosses of the bracket 97.

An oppositely extending arm of the rock-lever 257 carries a roller-stud 260 resting upon the upper face of the cutter-actuating cam-disk 261 formed with the cam projection 261' and having its hub 262 secured upon the cutter-shaft 125. The roller-stud 260 is maintained in operative relation with the cam 261 by means of a spring 263 (Fig. 5) connected at one end to the bracket 97 and at its opposite end to a screw-pin tapped eccentrically into the end of the rock-shaft 259. The operative connection between the cutter-shaft and the cam-wheel 119 is such that the former performs several rotations to one of the latter, but as the plunger 253 reciprocates idly excepting when the cutter is in cutting position and the stud 211 assumes a position in register with the socket 251, a cutting action can take place by engagement of the plunger 253 with the stud 211 only once in each buttonhole-producing cycle, it being understood that in each rotation the cam-wheel 119 effects, in its present embodiment, only a single cycle of operation of each of the parts which it actuates.

By employing the travelling cutting device for engaging and shifting the work between buttonhole stitching positions, in its travel into and out of the normal range of action of the stitch-forming mechanism, not only is the operator relieved of the necessity of shifting the work by hand, but the period of time in which the stitching mechanism is idle is reduced to a minimum, and the production of the machine is correspondingly increased as compared with the methods of handling the work heretofore in practical use.

As in a certain well-known type of buttonhole sewing machine, the present machine is constructed with a travelling stitch-frame sustaining the stitch-forming devices and comprising the base-plate 264 having

at one end the upwardly extending cylindrical curb or casing 265 for the looper mechanism and rearward thereof the longitudinally extending bearings 266 and 267.

- 5 The bearing 266 is provided with the bushing 268, and the bearing 267 has fitted within it the tubular bearing boss 269 of a bracket 270 which is formed with a depending fulcrum-stud 271 journaled within a
10 suitable bearing aperture in the bed-plate 1 (Figs. 25 and 26). The bracket 270 has secured to it by the screw 272 an arm 273 of a bearing sleeve 274 in which is journaled the tubular hub 275 of a bevel pinion 276.
15 Journaled within the bushing 268 and the bearing boss 269 is the crank-shaft 277 which drives the stitch-forming mechanism, this shaft passing through the hub 275 of the gear 276 and having secured upon its
20 end by the set-screw 278 the cross-bar 279 notched in its ends to fit the diametrically opposite and parallel guiding pins 280 formed upon the collar 281 which is secured by means of the set-screw 282 upon the gear
25 hub 275 and with the gear 276 embraces the bearing sleeve 274 to confine the gear against axial movement while the shaft 277 is permitted to move endwise freely. The collar 281 and cross-bar 279 obviously provide a
30 sliding driving connection between the gear hub and the shaft.

- Intermeshing with the bevel pinion 276 is a similar pinion 283 having its hub secured by the set-screw 284 upon the lower end of
35 an intermediate shaft 285 journaled in the bearing bushing 120 of the feed-wheel (Figs. 1 and 6) and having secured upon its upper end by the set-screw 286 the hub of a bevel pinion 287 which meshes in turn with a
40 larger bevel-wheel 288 having its hub secured by the set-screw 289 upon the rotary shaft 9. The shaft 277 is thus driven through the described connections with the shaft 9 at twice the speed of the latter, and
45 is permitted to travel with the stitch-frame independently of its driving connections.

- Rigidly secured in a boss 290 of the base-plate 264 is a standard 291 having secured upon its upper end the hub 292 of an over-
50 hanging bracket-arm 293 formed at its free end with a boss 294 in which is secured by a set-screw 295 the depending post 296 with its reduced lower portion entering an apertured bearing boss 265' sustained by the casing 265. Secured upon the post 296 by set-
55 screws 297 upon opposite sides of the hub 294 are the spaced hubs 298 of the needle-bar frame 299 sustaining the needle mechanism.

- 60 The base-plate 264 rests upon the smooth face of the bed-plate 1 and has at its forward end the lateral flanges 264' extending beneath the overhanging lips 300' of the feet 300 of the bearing brackets 301 rising from
65 opposite sides of the bed-plate. The base-

plate 264 is provided intermediate its ends with an upwardly extending member 302 sustaining a roller-stud 303 entering the feed cam-groove 304 formed in the lower face of the cam-cylinder 119. The side-shift cam 70 groove 305 of said cam-wheel is entered by a roller-stud 306 upon one arm 307 of a bell-crank-lever having its hub 308 mounted upon a fulcrum-stud 309 fixed in the bed-plate 1 and formed with a second arm 310. 75 A boss 311 of the lever-arm 310 is entered by a pivotal pin 312 which is secured by set-screws 313 in the spaced members 314 of a fork embracing the boss 311 at one end of a swinging link 315 which has its opposite end 80 journaled upon the post 296 (Figs. 25 and 26).

The stitch-frame thus receives through the stud 303 from the cam-groove 304 travelling movements lengthwise of the shaft 277, and 85 swinging side-shift movements upon the fulcrum-stud 271 from the cam-groove 305 through the stud 306 and its connections with the rigid post 296 of the stitch-frame. In performing these movements, the stitch- 90 frame is guided at one end by the journal of the shaft 277 within the bearing sleeve 269, and near the opposite end by the described connection, including the swinging link 315 between the side-shift cam groove 305 and 95 the rigid post 296.

The bearing brackets 301 are formed with transverse and alined bearing bosses 316 each surmounted by a flat seat 317 (Fig. 27) upon which is secured the work-plate 318. 100 The work-plate is shown (Figs. 3, 32 and 33) formed with a segmental slot 319 to accommodate the laterally moving cutting elements, this slot communicating at one end with a rectangular opening 320 formed along 105 the opposite sides with bearing ribs 321.

Fitted within this aperture is the slide-plate 322 having its side edges notched in the lower face to fit the bearing ribs 321 and 110 formed in its upper face with a shallow channel 323 (Figs. 35 and 36). Near one end the slide-plate 322 is formed with a transverse needle-aperture 324 of the general shape of a buttonhole and adapted to receive the stitch-forming mechanism in the 115 stitching operation.

Pivotaly mounted by means of a pin 325 within a recess at the end of the opening 320 in the work-plate is the forked hub 326 of a thin plate 327 (Fig. 34) fitted to and 120 normally lying within the channel 323 of the slide-plate 322, and having its outer extremity 328 notched to conform with one side of the needle-aperture 324 in the latter and also provided with a slot 329 extending in- 125 wardly therefrom. The pin 325 is surrounded within the fork of the boss 326 with a spring 330, by means of which the plate 327 is pressed within its housing channel 323, so that its upper face is normally flush 130

with that of the slide-plate 322. The upper faces of the plates 322 and 327 at opposite sides of the needle-aperture afford the lower clamping jaws of the work-holder of which the upper jaws are provided by the feet 331 and 332 similarly formed in the work-engaging portions adjacent the needle-aperture.

A thickened portion of the slide-plate 322 at the end opposite the needle-aperture is provided with countersunk screw-holes 333 to receive fastening screws 334 by means of which it is secured upon a transverse holding plate 335 which is sustained by the angular middle portion 336 of a slide-bar 337 journaled for endwise movement within the bearing bosses 316 of the brackets 301. The portion 336 of the slide-bar has secured within a seat in its lower side by screws 338 a rigid arm 339 which is formed with a groove 340 having a flared outer end portion 341 affording a guideway to receive a roller-stud 342 sustained by a lug 343 projecting laterally from the casing 265.

The contracted portion of the groove 340 closely embraces the stud 342 so as to cause the bar 337 to follow the sidewise movements of the stitch-frame in the initial and final stages of a buttonhole-producing cycle, while being unaffected by the sidewise movements of the stitch-frame during the stitching of the eyelet-end of the buttonhole. The enlargement of the outer end portion of the groove 340 is therefore provided for clearance.

One end of the bar 337 has secured thereon by set-screws 344 the hub 345 of a bracket-arm 346 having in its opposite end a fork 347 which embraces a flattened guide-stud 348 by which the bracket-arm and its supporting slide-bar are prevented from turning, while free to slide transversely of the machine frame. The arm 346 has an upwardly extending portion terminating in a bearing boss 349 in which is journaled a rock-shaft 350 having secured upon one end the split hub 351 of a laterally extending clamp-arm 352 to the outer end of which is secured the angularly disposed shank of the clamping foot 331.

The rock-shaft 350 has secured upon its opposite end the split hub of a lateral crank-arm 353 to which is connected by the screw-pin 354 the tubular outer member 355 of a telescopic link of which the inner member 356 constitutes a plug fitted within the lower end of the member 355 and is provided at the lower end with an apertured lug 357. Between an externally threaded bushing 358 entering the internally threaded upper end of the link section 355 and the body of the plug 356 is interposed a spring 359 which maintains the link yieldingly in elongated condition in which a stop-screw 360 tapped into the plug 356 rests against the lower end of a slot 361 formed in the tubular section 355.

The lug 357 carries a screw-stud 362 which is embraced by an apertured arm 363 of a rock-lever having a hub 364 journaled upon a fulcrum-pin 365 sustained by the bearing bracket 301 and an oppositely extending arm 366 carrying upon its outer end a roller-stud 367 which enters a peripheral cam-groove 368 of the cam-wheel 119 by means of which the vertical position of the clamping foot 331 is controlled. In the bottom of the cam-groove 368 is a narrower cam-groove 369 which is entered by a roller-stud 370 upon one arm of a rock-lever 371 mounted intermediate its ends upon a fulcrum-stud 372. The fulcrum-stud 372 is carried at the outer end of a lever 373 having its hub journaled upon the fulcrum-pin 365. The rock-lever 371 has formed upon its other arm a lateral lip 374 extending beneath the lever 373 and affording a seat for a flat spring 375 of which the outer end bears upon the lever 373 adjacent the fulcrum-stud 372 so as to maintain the two levers yieldingly in alinement.

The arm of the rock-lever 371 to which the spring is attached is formed with an apertured hub 376 entered by a lateral stud 377 upon the angular head 378 of a pin 379 having a threaded upper portion and forming one member of a yielding link of which the other member is a surrounding tube 380 entered by a bushing 381 applied to the threaded pin 379. A spring 382 surrounding the pin 379 and interposed between the end of the bushing 381 and the lower end of the cylinder 380 holds the sectional link in contracted condition with the end of the section 380 pressed yieldingly upon the head 378. The link section 380 carries a screw-pin 383 by which it is pivotally connected with a lateral arm 384 upon one end of the rock-shaft 385 which is fulcrumed in a bearing member 386 of the bearing bracket 301. Secured upon the opposite end of the rock-shaft 385 is the split hub 387 of a clamp-arm 388 to the outer end of which is secured the clamping foot 332.

The lever 373 is shown provided adjacent its outer end with an upwardly extending lug 389 which is unobstructed in its upward movement with the lever 373 in the normal actuation of the mechanism under the action of the cam-groove 369; but at certain times it is adapted for engagement with a stop-finger 390 having its hub 391 fixed upon the lower end of the rock-shaft 246 (Fig. 27) whereby the rise of the lever 376 is resisted. In such case, the fulcrum-stud 372 is prevented from rising, and the lifting of the roller-stud 370 causes an idle rocking movement of the lever 371 with a mere drawing down of the inner section 379 of the sectional link connection without the normal lifting of the clamping foot 332.

In the lateral displacement of the stitch-

ing elements carried by the laterally moving stitch-frame to permit the advance of the cutting device into cutting position for a new buttonhole-producing operation, the slide-bar 337 is moved endwise correspondingly and carries with it the upper and lower clamping elements 322 and 331 beyond the path of movement of the cutting elements and while they are separated to release the work, the clamping foot 331 being lifted sufficiently high to clear the top of the knife-carrying member of the cutter-lever. In the side movement of the slide-plate 322, the clamp-plate 327 is slightly lifted by the engagement of its upwardly inclined forward extremity with the corresponding end of the channel 323 of the slide-plate. While the cutting elements are still in cutting position, the clamping foot 332 descends and clamps the work in position upon the clamp-plate 327, after which the cutting device recedes to extreme retracted position and the temporarily displaced work-clamping members 331 and 322 perform their return to operative position simultaneously with the stitch-forming devices. As soon as the clamping foot 331 clears the foot 332 over which it has moved in its recession from operative position, and while performing the latter part of its lateral return movement, it descends to grip the work upon the slide-plate 322, thereby performing a spreading movement to stretch the work previously gripped upon the opposite side of the slit by the clamping elements 332 and 327.

The crank-shaft 277 carries at its forward end the crank-plate 392 formed with the crank-stud 393 which is embraced by a strap 394 at the lower end of a pitman-rod 395 having at its upper end the apertured boss 396 entered by a stud 397 projecting from a split collar 398 which is clamped upon the reciprocating bar 399 journaled in suitable bushings 400 of the needle-frame 299. Secured upon the bar 399 is the split hub at one end of a rigid lateral arm 401 having upon its opposite end a split boss 402 loosely embracing a rotary tubular bushing 403 formed in one side with a longitudinal slot 404 and journaled within bearing bosses of the needle-frame parallel with the bar 399. The bar 403 is confined against endwise movement by a collar 405 secured thereon below its upper bearing boss and the hub 406 of an inclined crank-arm 407 secured thereon above said bearing boss.

Journaled within the bushing 403 is the reciprocating needle-bar 408 carrying at its lower end the needle-clamp 409 in an eccentrically disposed socket of which is secured by the clamp-screw 410 the eye-pointed needle *n*. Fitted within the longitudinal slot 404 of the bushing 403 is a spline 411 secured to the needle-bar by screws 412 and provided upon the outer face with projecting

lugs 413 embracing between them the collar 402. Through the described connections, the rotation of the crank-stud 393 with the crank-shaft 277 effects the reciprocation of the needle-bar and needle which are caused to turn with the surrounding bushing 403. As will be observed by reference to Fig. 43, the connections between the intermediate bar 399 and the needle-bar and the pitman-rod, respectively, are upon opposite sides of the intermediate bar and extend laterally to such extent that a sufficient clearance is provided between the needle and the pitman-rod to accommodate the margin of the work in which the buttonholes are formed.

Secured to the crank-stud 393 by the screw 414 (Fig. 39) is a second crank-plate 415 adapted to rotate with the crank-shaft 277 and provided upon its forward end with the looper-actuating crank-pins 416 and 417 arranged nearly diametrically apart (Figs. 49 to 52 inclusive). The crank-pin 416 enters an aperture in the boss 418 at one end of a link 419 having at its opposite end the stud 420 (Fig. 55) and the crank-pin 417 enters an aperture in the boss 421 at one side of the eccentric strap 422. The eccentric strap and its apertured boss together constitute a short link.

The eccentric strap 422 is fitted upon a boss 423 having the apertured boss 424 entered by the stud 420 of the link 419, said boss being formed upon the lower end of a pitman 425 having at its opposite end the apertured boss 426. The boss 426 is entered by a stud 427 extending laterally from the upper end of a sleeve 428 and carrying an anti-friction roller 429 which enters a guideway between two parallel ribs 430 upon a plate 431 affording a closure for the vertically slotted inner side of the casing 265 (Fig. 40). By the movement of the roller 429 within its guideway the upper end of the pitman 425 is movable only in a rectilinear path and the sleeve 428 is prevented from turning upon its axis.

The upper end of the casing 265 is cut out to form an annular seat in which is introduced a ring 432 formed with an annular race to receive the antifriction balls 433 upon which rests the conical face of a wearing ring 434 which is secured by screws 435 to the peripheral flange 436 of the rotary turret 437 from which depends the axial shaft 438 (Figs. 39, 42 and 44) journaled near its lower end in the bushing 439 secured in the depending boss 440 of the casing 265. Secured to the reduced lower end of the shaft 438 is the hub 441 of an inclined crank-arm 442 by which the turret is confined to its bearing.

Slidably mounted upon the shaft 438 is a tubular actuating rod 443 provided with a transverse head 444 carrying a guide-pin 444' entering an aperture 437' of the turret.

The sleeve 428 is loosely fitted upon the rod 443 and is confined between its head 444 and a split thrust-collar 445 applied to its threaded lower end, whereby the reciprocatory movements of the sleeve derived from the crank-shaft 277 are communicated to the tubular rod 443. The turret 437 is provided at one side with an upwardly extending bearing boss 446 having a slight downward inclination to receive the fulcrum-stud 447 of the vibrating lower needle-arm 448 which is formed in one face at its free end with a groove in which is clamped by means of the head 449 of a fastening screw the shank of the curved lower needle 7 which is shown provided near its point and intermediate the same and the shank with thread-eyes (Fig. 45).

The needle-arm 448 is provided intermediate its ends with a lateral ball-stud 450 which is embraced by a strap at the upper end of a pitman 451 having at its opposite end a similar strap which embraces a ball-stud 452 sustained by an upwardly extending lug 453 upon the head 444 of the actuating rod 443, the vertical movements of which communicate to the lower needle endwise movements in a circular path and in a plane slightly inclined to the path of movement of the upper needle *n*. The lower needle reciprocates through the U-shaped needle-aperture 454 of the needle-throat 455 which is upwardly and inwardly offset from a block 456 secured by means of a screw 457 upon a flat seat upon the top of the turret. The U-shaped form of the aperture produces a tongue 458 serving as a loop-detainer for the upper-thread loops around the lower needle.

The needle-throat is shown formed with a peripheral groove 459 to receive a cord which is led to the needle-aperture through a transverse hole 460 extending from the periphery into one end of the needle-aperture (Figs. 56 and 57).

Journalled within a bearing boss 461 extending inwardly from the rim of the turret is a stud 462 projecting laterally from a swinging arm 463 having at one edge the tubular socket 464. Journalled within this socket is a pin 465 formed with a head 466 having a transverse seat upon which is secured by means of the head of the clamp-screw 467 the shank 468 of the spreader *s* having its outer portion U-shaped and provided at its extremity with the shouldered loop-seizing beak 469.

The arm 463 carries a screw-stud 470 embraced by one end of a link 471 carrying at its opposite end a screw-stud 472 which is embraced by an apertured boss 473 upon one arm of an elbow-lever 474 fulcrumed upon the stud-pin 475 which is secured in the suitably apertured bearing boss 476 of the turret. Another arm of the elbow-lever is piv-

otally connected by means of the screw-pin 477 with one end of a link 478 having upon its opposite end the screw-stud 479 which is journaled within a second bearing aperture of the boss 453 of the head 444 of the actuating rod 443.

The pin 465 has secured thereon adjacent the head 466 a collar 480 having a crank-arm carrying a ball-stud 481 which is embraced by a strap at one end of a bent link 482 (Fig. 38) which has at its opposite end a strap embracing a ball-stud 483 carried by the lateral arm of the elbow-lever 474 intermediate the screw-stud 472 and the fulcrum-stud 475. In the rectilinear reciprocation of the actuating rod 443, the elbow-lever 474 receives rocking movements through the link 478. These movements are communicated to the spreader-carrying arm 463 through the link 471 which, with the connected arm of the elbow-lever forms a toggle device which is straightened as the spreader approaches advance position, where it is given a dwell in contrast with the rapid reversal of its movement when in retracted position.

By reason of the described link-and-crank connection between the rocking spreader carrying pin 465 and the elbow-lever, the continued movement of the latter during the dwell of the vibratory movement of the former produces an oscillatory movement of such pin, and hence a lateral movement of the spreader upon the pin 465 as a fulcrum to bring the blade thereof immediately behind its loop-restraining shoulder close to the path of movement of the lower needle (Figs. 58 and 59), in order to hold the loop for passage of the lower needle (Fig. 59). As the needle-thread loop is carried by the spreader beneath the needle-throat loop-stripping tongue 458, it is detained against being carried frictionally upon the needle-blade 7 through the buttonhole slit, and being thereby restrained against excessive distension in the stitch-forming operation.

Journalled in suitable bearing bosses sustained by the base-plate 264 and the needle-bar frame 292 is an oscillatory shaft 484 formed intermediate its ends with a screw threaded portion 485 to which is slidably fitted the endwise movable sleeve 486 which is prevented from turning by the provision of a roller-stud 487 projecting from its periphery and into a guiding groove 488 of the standard 291 (Figs. 1, 37, 38 and 42). The sleeve 486 is provided near its lower end with the apertured bosses 489 arranged equi-distantly around its circumference, in two of which are introduced the flanged bolts 490 having upon their inner ends adjacent their flanges the anti-friction rollers 491 entering the spiral grooves between the threads of the sleeve and provided with nuts 492 by which said bolts are secured in posi-

tion. The third of the bosses 489 is formed with a seat for a block 493 which is secured in position thereon by a screw 494 and provided upon its inner face with a boss 495
 5 extending into an aperture 496 of the sleeve and carrying a roller 491 entering another groove between the screw-threads of the sleeve.

The sleeve 486 carries at its upper end
 10 the ball-stud 497 which is embraced by a strap at one end of a pitman 498. The opposite end of said pitman is similarly provided with a strap which embraces a ball-stud 499 upon the outwardly offset extension 500 of a lever 501 having its hub 502
 15 journaled upon a fulcrum-stud 503 sustained by the frame-member 4. The lever 501 carries a roller-stud 504 which enters a cam-groove 505 in the periphery of the cam-wheel 119 (Figs. 1 and 3). Through the described connections, the sleeve 486 derives from the cam-wheel vertical movements which are transmitted to the shaft 484 in oscillatory movements.

The shaft 484 has secured upon its upper end the hub of an inclined crank-arm 506 carrying a reversely inclined crank-pin 507 upon which is mounted a sleeve 508 provided with a cross-bar 509. The ends of this cross-bar are embraced by and pivotally secured by means of a cross-pin 510 between the spaced members of a yoke 511 formed at one end of a pitman-bar 512 having a similar yoke 513 at its opposite end. Within the yoke 513 are similarly pivoted by
 35 a cross-pin 514 the ends of a cross-bar 515 upon a sleeve 516 which is fitted upon an inclined crank-pin 517 carried by the crank-arm 407 of the needle-bar bushing 403.

Secured upon the lower end of the shaft 484 is the hub of an inclined crank-arm 518 carrying a reversely inclined crank-pin 519 upon which is mounted a sleeve 520 provided with a cross-bar 521. The ends of this cross-bar are embraced by and pivotally secured by means of a cross-pin 522 between the spaced members of a yoke 523 formed at one end of a pitman-bar 524 having a similar yoke 525 at its opposite end. Within the yoke 525 are similarly pivoted by a cross-pin 526 the ends of a cross-bar 527 upon a sleeve 528 which is fitted upon an inclined crank-pin 529 carried by the crank-arm 442 fixed upon the shaft 438 of the looper-carrying turret.

Through the described connections, the oscillatory shaft 484 imparts to the needle-bar and the turret carrying the lower loop-taking elements the requisite turning movements in unison for the stitching of a buttonhole.

The inclined-crank and pitman-bar connections of the shaft 484 with the needle-bar bushing 403 and the turret 437 embody the improved driving device forming the
 65 subject of my patent No. 1,201,026, issued

October 10, 1916, and, in their broader aspect, as a mechanical movement, form no part of the present invention.

The present machine is shown provided with a rotary take-up device of well-known
 70 form for the needle-thread. This comprises the spaced cam-disks 530 fixed upon the rotary shaft 9 and embraced by the thread-guiding arms 531 of a yoke sustained within a suitable seat of the upright bracket-member 532 by means of a flat spring 533 normally maintaining it yieldingly in operative position with one of said arms resting upon the stop-pin 534 (Fig. 7). Secured upon the bracket-member 532 is a
 80 throw-off arm 535 disposed intermediate the disks 530 and formed in its outer end portion with the angular slot 536. As the stitch-forming implements perform two operative cycles for each rotation of the shaft 9, the take-up cams 530 are formed with opposite active portions which are adapted each to produce thread-drawing actions once for each rotation of said shaft.

In threading the machine for operation, the needle-thread *a* is led from the source of supply through the main tension-device 537, and thence through the eyes of the guide-arms 531, and thence across the ranges of movement of the take-up cams 530, from which it is led through the guide-eye 538 upon the bracket-arm 293. From the guide-eye 538 it is passed through an eye in the outer end of the take-up arm 539 secured upon the boss 402 of the reciprocating needle-bar actuating arm 401, from which it is led downwardly through the thread-controlling tension device 540 and thence to the needle *n* preferably through a guide-eye of the needle-clamp.

The lower-thread *b* is led from the source of supply through the tension device 541 carried by a bracket 542 secured to the boss 440, from which it is passed upwardly through the bore of the tubular shaft 438 from which it is threaded through the eye of a take-up arm 543 and thence through the middle eye of the needle from which it is led through the eye adjacent the needle point.

When the machine is at rest preparatory to an initial buttonhole-producing operation of a series, both clamp-arms are raised, the stitch-forming mechanism is in a position which it occupies in forming the last stitch of the previously stitched buttonhole, and the buttonhole cutting elements are disposed at one side thereof in work-nipping position, a distance from cutting position equal to the normal spacing apart of the buttonholes in the work, but the cutting elements are slightly separated to permit the insertion and gripping of the work for an initial buttonhole.

The machine is started by depressing the treadle-actuated crank-arm 99 or pressing
 130

down the starting lever 133 to rock the shaft 96 which first disengages the fork 91 from the latch-lever 87 of the arm 83 to set in motion the cutter-shaft and the feed-wheel, the rocking of the shaft 96 at the same time releasing it from the latch-pin 151 and lifting the cam-block 112 clear of the stud-pin 114 to effect the first endwise shift of the shaft 96. This causes the rocking of the arm 239 to permit the nipping of the work *m* by the cutter which is immediately shifted by means of the lever 200 202 into cutting position while the laterally moving upper and lower clamping members 331 and 322 are simultaneously moved into laterally retracted position, as well as the stitch-forming mechanism, all of which are connected with and movable simultaneously with the stitch-frame.

The upper cutting element having received its second-stage cutting movement from the reciprocating plunger-bar 253, the cutting device moves to extreme retracted position and the laterally movable clamping members and the stitch-forming mechanism simultaneously follow the same to their respective operative positions, the upper clamping member 331 closing upon the work just prior to the completion of its return movement to stretch the material previously gripped upon the opposite side of the buttonhole-slit *t* by the clamping foot 332 substantially coincidentally with the cutting action. During its return to stitching position, the stitch-forming mechanism is given a complete rotation in a direction opposite to that in which it had been turned in the previous buttonhole stitching operation, and is therefore positioned in readiness for a new stitching cycle.

During these several operations, the stud-pin 114 continues in engagement with the operative edge of the cam-lever 104, but just as the parts resume stitching position under the action of the cam-wheel 119, the stud-pin rides off the end of the cam-lever 104 thereby permitting the shaft 96 to perform its second-stage endwise movement by which the shaft 9 is connected with the driving pulley through its respective clutch and the stitch-forming mechanism is caused to perform its cycle of operation in stitching along the sides and around the ends of the buttonhole slit.

When the machine stops at the completion of a buttonhole, the turret is turned in such position that the block 456 is located immediately beneath the extension 159 of the cutter-block carrying plate 158 (Fig. 33). By this means the thrust of the cutter-knife 162 upon the cutter-block 161 is effectively sustained in the buttonhole cutting operation.

While the construction and means of actuation of the stitch-forming elements of the present machine are deemed new and pat-

entable, their mode of cooperation in the production of stitches is similar to that of the stitch-forming mechanism disclosed in the United States patent to G. S. Hill & D. A. Hitchcock, No. 642,122, dated January 30, 1900.

At the beginning of the stitching operation, the stitch-forming elements are positioned to lay the initial stitch crosswise of the slit and at the opposite side thereof from the initial side to be stitched, and the stitching proceeds continuously around the narrow end of the slit and along the first side, then around the eye and along the second side and again around the narrow end to a point opposite the initial stitch. The stitches are laid throughout preferably perpendicular to the edge of the straight sides of the slit and radially in the curved end portions, and the overlapping of the initial and final stitches at the narrow end of the slit thus effectively reinforces that end of the buttonhole.

When it is desired to stitch a series of buttonholes in the buttonhole fly of a shoe, for instance, without stopping the machine after each buttonhole, the crank-arm 99 may be held down continuously by the operator throughout a plurality of consecutive buttonhole-producing cycles, in which case the yoke 91 is maintained retracted beyond the end of the shorter latch-lever 87 and the cam-lever 104 remains lifted sufficiently for the stud-pin 114 to pass beneath the cam-block 112, thereby causing the control of the endwise positions of the rock-shaft 96 to be effected solely by the cooperation of the stud-pin 114 with the operative edge 104' of the lever 104. By this means, the shaft 96 is caused to move during the period referred to between its second and third endwise positions without assuming its initial stopping position, whereby the clutch connection between the driving wheel and the shaft 10 is caused to remain effective throughout a plurality of buttonhole-producing cycles.

In the operation of the machine under such control, the operative parts perform their functions in the order and in the timing before described, excepting that the nipping of the work by the cutting elements for advancing it between stitching operations is not temporarily prevented by the action of the angle-lever 233 235, the amplitude of movement of the crank-arm 239 under the limited endwise movement of the rock-shaft 96 having no effect upon such angle-lever.

The cam-rib 230 is so positioned upon the cam-wheel 119 that it acts initially to depress the rail 212 just as the cutting device reaches its work-nipping position in which it pauses preparatory to shifting the work, and the automatic spacing of the buttonholes apart is therefore uniform in the continuous

operation of the machine for a plurality of buttonhole-producing cycles as well as in detached cycles at the end of each of which the machine comes to rest. It is evident that the

5 release of the crank-arm 99 in a final buttonhole-producing cycle will permit the machine to come to rest at the completion of the last buttonhole, as previously described.

In case the thread should break, or in
10 other emergency, the machine may be manually stopped by pressing the supporting lever 133 in the direction indicated by the arrow at the left in Fig. 7, thereby prematurely shifting the rock-shaft 96 in oppo-
15 sition to its spring 147, and with it the yoke 91, the degree of movement of the lever 133 determining whether only the stitch-forming mechanism be arrested or the entire mechanism.

20 By pressing downwardly and shifting the said lever in the same direction beyond its normal range of movement, the crank-arm 239 is given an abnormal movement in the opposite direction whereby the angle-lever
25 arm 239 is caused to engage the pin 145' of the rock-lever 145 146 for lifting the cutter shift-lever 200 202 above the range of action of the cam 204, with its stud 203 within the field of action of the restoring cam 209, and
30 at the same time turning the rock-shaft 246 sufficiently to bring the stop-finger 390 into restraining position above the lever 373 to prevent the lifting of the clamping foot 332 under the normal action of the cam 369. As
35 the rocking of the shaft 96 under such actuation of the starting lever 133 retracts the yoke 91 out of tripping relation with the shorter latch-lever 87, the cam-wheel 119 is permitted to complete its rotation then in
40 progress and to perform that part of a succeeding rotation sufficient to feed the work, still clamped in the work-holder, into a position to receive the remaining edge-covering
45 stitches of the until then incomplete buttonhole. The release of the lever 133 by the operator at such instant permits the spring 147 to shift the yoke 91 out of engagement with the longer latch-lever 87, whereby the
50 stitching mechanism is immediately thrown into action for completion of the buttonhole.

The present improvement is believed to be the first instance in which a buttonhole cutting device is employed to shift the work to
55 space successive buttonholes. Of the various advantages derived from this feature, an important one is the facility with which the work may be located to accurately position the buttonhole therein, the vision of the
60 operator being entirely unobstructed by a surrounding work-clamp to conceal any position-marks made upon the work. As will be readily understood, according to the present improvement the cutting knife is not
65 only exposed at the beginning of a button-

hole-producing cycle detached from all other parts of the machine, including the work-clamp, but the cutting elements are partially closed so that the upper element is closely
70 adjacent to the face of the work which may be readily placed to cause the production of the slit exactly upon a mark which may have been previously made to determine the required position.

It has been customary heretofore to con-
75 struct a buttonhole machine with a bodily travelling stitch-frame carrying a controlling cam for timing and actuating the operation of the various parts. According to the present invention, the controlling cam-wheel 80
80 and all the heavier parts of the machine are mounted upon a stationary main frame, and the movable stitch-frame has therefore a minimum weight whose inertia and momentum only are required to be overcome in per-
85 forming the feeding and side-shifting of the stitch-forming elements for spacing the stitches.

From the foregoing description, it is evident that the machine herein specifically
90 shown and described contains many features which are more or less broadly new and patentable, and that these features are susceptible of embodiment in widely different
95 forms and arrangements of their component parts and that they may be employed either separately or combined, within the scope of the present invention. It is also to be understood that all features of novelty of the present improvement as herein shown and
100 described are of my invention, both in details of construction and principles of operation.

Having thus set forth the nature of the invention, what I claim herein is:— 105

1. In a buttonhole sewing machine, in combination, stitch-forming mechanism, buttonhole cutting mechanism, and means including a common element which is normally
110 subjected in each period of operation of the machine to successive manual and automatic control for setting said mechanisms successively in operation.

2. In a buttonhole sewing machine, in combination, stitch-forming mechanism, button-
115 hole cutting mechanism, means including a common element for controlling said mechanisms, and manually and automatically actuated elements normally acting in succession in each cycle of operation of the
120 machine and having independent operative connections with said common element for effecting the successive operation of the cutting and stitch-forming mechanisms.

3. In a buttonhole sewing machine, in
125 combination, stitch-forming mechanism, buttonhole cutting mechanism, manually actuated means including an operative element for setting the cutting mechanism in operation, and automatically actuated means con- 130

nected with said element for setting the stitch-forming mechanism in operation.

4. In a buttonhole sewing machine, in combination, stitch-forming mechanism, buttonhole cutting mechanism including a controlling cam-wheel and actuating means independent thereof for effecting the closing of the cutting elements upon the work, means for setting in operation the said cam-wheel and actuating means, and means connected with said cam-wheel for setting in operation the said stitch-forming mechanism.

5. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism including a feed-wheel, a cutting device, cutter-actuating means movable differentially of the feed-wheel, operative connections between the cutting device and said feed-wheel and actuating means mutually cooperating to effect the actuation of the cutting device, and means for simultaneously setting in operation said feed-wheel and actuating means and for thereafter setting in operation the stitch-forming mechanism.

6. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism including a work-holder and a feed-wheel for producing relative feeding movements between the stitch-forming mechanism and the work, a buttonhole cutting device sustained independently of the work-holder, an actuator therefor independent of the stitch-forming mechanism, and means connected with said feed-wheel for shifting said cutting device relatively to said work-holder into and out of the range of action of said actuator.

7. In a buttonhole sewing machine, in combination, stitch-forming mechanism including a reciprocating needle-bar carrying a needle, feeding mechanism including a work-holder and a feed-wheel for producing relative feeding movements between the stitch-forming mechanism and the work, a buttonhole cutting device sustained independently of the work-holder, a reciprocating actuator therefor movable independently of the needle-bar, and means connected with said feed-wheel for shifting said cutting device relatively to said work-holder into the range of action of said actuator.

8. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism including a work-holder and a feed-wheel for producing relative feeding movements between the stitch-forming mechanism and the work, a buttonhole cutting device including cooperating cutting elements normally retracted from cutting position and restrained against participation in said feeding movements, an actuator having a range of action from which the cutting device is normally retracted, and means connected with said feed-wheel for bodily shifting

said cutting device within the range of action of said actuator and its cooperating cutting elements into cutting position.

9. In a buttonhole sewing machine, in combination, stitch-forming mechanism, means for producing relative feeding movements between the stitch-forming mechanism and the work, a cutter actuator operative independently of the stitch-forming mechanism, a cutting device normally retracted from the range of action of said actuator and restrained against participation in said feeding movements, and means for shifting said cutting device within the range of action of said actuator.

10. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism including a rotary feed-wheel, means for imparting to said feed-wheel operative movements uniformly throughout a buttonhole producing cycle, and cutting mechanism, including cutting elements maintained in predetermined position relative to and during the operation of the stitch-forming mechanism, with means controlled by the feed-wheel but independently actuated for operating said cutting mechanism while the feed-wheel continues in motion.

11. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism including a feed-wheel, a cutting device normally occupying a predetermined position in relation to the stitch-forming mechanism throughout a stitching period, a reciprocating actuator operative independently of the stitch-forming mechanism, and means connected with the feed-wheel for bodily shifting the cutting device into and out of cutting position and into and out of the range of action of said actuator.

12. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism including a feed-actuating member, a cutting device normally occupying a predetermined position in relation to the stitch-forming mechanism throughout a stitching period, an actuator therefor, a connection between said member and the cutting device for shifting the latter into and out of the range of action of said actuator, and means for interrupting said connection.

13. In a buttonhole sewing machine, in combination, a cutting device, an actuator therefor, means for shifting the cutting device into and out of the range of action of said actuator, and means operative at the will of the operator to prevent said shifting action.

14. In a buttonhole sewing machine, in combination, a cutting device, an actuator therefor, means for shifting the cutting device into and out of the range of action of

the actuator, manually controlled means for rendering the shifting means ineffective, and automatically controlled means for restoring said shifting means to operative condition.

15. In a buttonhole sewing machine, in combination, a cutting device, an actuator therefor, means including a cam and connections with the cutting device for shifting the latter into and out of the range of action of said actuator, manually controlled means for interrupting the connection between said cam and the cutting device, and means including another cam for restoring said connection between the first-named cam and the cutting device.

16. In a buttonhole sewing machine, in combination, stitch-forming mechanism, including cooperating upper and lower thread-engaging elements, feeding mechanism, actuating means for said mechanisms, means for controlling the normal periods of operation of said mechanisms, and means under the control of the operator for arresting the operation of each of said cooperating thread-engaging elements within the period of normal operation of the stitch-forming mechanism while the feeding mechanism continues in operation.

17. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, buttonhole cutting mechanism, actuating means for said mechanisms, means for controlling the normal periods of operation of said mechanisms, and means for arresting the operation of the stitch-forming mechanism and rendering the cutting mechanism ineffective within and before the end of a stitching period and while the feeding mechanism continues in operation.

18. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, buttonhole cutting mechanism, means for controlling the period of action of the feeding and cutting mechanisms, means for controlling the normal period of action of the stitch-forming mechanism, and means for arresting the operation of the stitch-forming mechanism within a stitching period and while the feeding and cutting mechanisms remain operative.

19. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, including a feed-wheel, actuating means therefor, buttonhole cutting mechanism connected with and controlled by said feeding mechanism, actuating means for said cutting mechanism, including an operative element mounted independently of said feed-wheel, means for controlling the normal periods of operation of the said mechanisms, and means under the control of the operator for arresting the operation

of the stitch-forming mechanism within its respective period of normal operation while the feeding mechanism continues in operation.

20. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, buttonhole cutting mechanism connected with and controlled by said feeding mechanism, actuating means for said mechanisms, means for controlling the normal periods of operation of the said mechanisms, and means operable within the normal stitching period for independently arresting the stitch-forming mechanism and the feeding and cutting mechanisms.

21. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, buttonhole cutting mechanism connected with and controlled by said feeding mechanism, actuating means for said mechanisms, means for controlling the normal periods of operation of said mechanisms, and means including a common element manually operable at will within a normal stitching period for arresting either the stitch-forming mechanism or both the stitch-forming and feeding mechanisms.

22. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, buttonhole cutting mechanism, actuating means for said mechanisms, means including a common controlling element for starting said feeding mechanism and through it the cutting and stitch-forming mechanisms and for automatically stopping said mechanisms, and means for manually operating said controlling element to render said mechanisms ineffective before the completion of their respective periods of normal operation.

23. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, buttonhole cutting mechanism ineffective during each stitching period, a shaft operable only during each stitching period and with which the stitch-forming mechanism is operatively connected, a second shaft deriving its movements throughout each buttonhole-producing cycle independently of the first-named shaft, and a driving connection uninterrupted during stitching periods between the second-named shaft and the feeding and buttonhole cutting mechanisms.

24. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, buttonhole cutting mechanism, a shaft with which the stitch-forming mechanism is operatively connected, a second shaft with which the feeding and buttonhole cutting mechanisms are operatively connected, a common driving element for said shafts, and independent coupling means for connecting and disconnecting said

shafts from said driving element, means being provided whereby said shafts are arrested in initial relation.

25. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, buttonhole cutting mechanism ineffective during a stitching period, a shaft with which the stitch-forming mechanism is operatively connected, a cutter actuating shaft deriving independently of the first-named shaft operative movements throughout and subsequently to each buttonhole stitching period, and a driving connection, uninterrupted throughout a buttonhole-producing cycle, between said cutter shaft and the cutting and feeding mechanisms.

26. In a buttonhole sewing machine, in combination, stitch-forming mechanism, feeding mechanism, a travelling buttonhole cutting device, a shaft with which the stitch-forming mechanism is operatively connected, a second shaft provided with a cutter-actuating cam, a speed-reducing driving connection between the second shaft and the feeding mechanism, and an operative connection between the feeding mechanism and the cutting device whereby the latter is shifted into and out of cutting position.

27. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a buttonhole cutting device comprising cooperating cutting elements, means for producing relative travelling movements between the stitch-forming mechanism and the cutting device while the stitch-forming mechanism is idle, means for producing a partial closing of the cutting elements before the completion of a relative travelling movement, and means for completing said closing movement at the completion of said travelling movement.

28. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a buttonhole cutting device comprising cooperating cutting elements, means for producing relative travelling movements between the stitch-forming mechanism and the cutting device while the stitch-forming mechanism is idle, means for producing a partial closing of the cutting elements before the completion of a relative travelling movement, and means brought into operation only at the completion of said travelling movement for completing said closing movement to produce a buttonhole slit.

29. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a buttonhole cutting device comprising cooperating cutting elements, means for producing relative travelling movements between the stitch-forming mechanism and the cutting device while the stitch-forming mechanism is idle, yielding acting means

for producing a partial closing of the cutting elements before the completion of a relative travelling movement, and means for completing said closing movement at the completion of said travelling movement.

30. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a travelling buttonhole cutting device comprising cooperating cutting elements, means for imparting to the cutting device travelling movements from retracted position into and out of cutting position, means acting while the cutting device is retracted from cutting position for partially closing the cutting elements to nip the work between them, and cutter-actuating means arranged to act upon the cutting device only when in cutting position for completing the closing of the cutting elements to cut a buttonhole.

31. In a buttonhole sewing machine, in combination, a work-holder, feeding mechanism comprising a feed-wheel, a cutting device comprising cooperating cutting elements, means connected with said feed-wheel for producing a relative travel of the cutting device and work-holder into and out of operative relation, means operatively connected with the feed-wheel for partially closing the cutting elements to nip the work preparatory to a travelling movement, and means for completing the closing of the cutting elements to cut a buttonhole.

32. In a buttonhole sewing machine, in combination, a work-holder, feeding mechanism comprising a feed-wheel, a cutting device comprising cooperating cutting elements, means connected with said feed-wheel for producing a relative travel of the cutting device and work-holder into and out of operative relation, means operatively connected with the feed-wheel for partially closing the cutting elements to nip the work preparatory to a travelling movement, means for completing the closing of the cutting elements to cut a buttonhole, a starting device for setting the machine in motion, and a connection between said starting device and the initially acting cutter-closing means for effecting the action of the latter.

33. In a buttonhole sewing machine, in combination, a work-holder, a travelling cutting device comprising cooperating cutting elements, a fulcrum for said cutting device upon which its cutting elements are movable in unison in a curved path, shifting means for moving the cutting device into and out of operative relation with the work-holder, and means for closing the cutting elements upon the work.

34. In a buttonhole sewing machine, in combination, a work-holder, a travelling cutting device comprising cooperating cutting elements, an adjustable fulcrum for said cutting device upon which its cutting elements

are movable in unison in a curved path preparatory to each cutting action, shifting means for moving the cutting device into and out of operative relation with the work-holder, and means for closing the cutting elements upon the work.

35. In a buttonhole sewing machine, in combination, a work-holder, a travelling cutting device comprising cooperating cutting elements, a fulcrum for said cutting device upon which its cutting elements are movable in unison in a curved path, shifting means for moving the cutting device into and out of operative relation with the work-holder, means acting preparatory to a travelling movement of the cutting device for partially closing the cutting elements to nip the work, and means acting at the end of said travelling movement for completing the closing of the cutting elements to cut a buttonhole.

36. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a travelling cutting device, means for shifting said cutting device in a curved path toward and from stitching position, means for effecting the engagement of the cutting device with the work to shift the latter to space the buttonholes apart, and means connected with the shifting means for varying the degree of curvature of said path of movement.

37. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a travelling cutting device, a fulcrum about which said cutting device is movable, means for bodily shifting said cutting device upon its fulcrum toward and from stitching position, means for adjusting said fulcrum toward and from stitching position, and means for effecting the engagement of the cutting device with the work for shifting the latter to space the buttonholes apart.

38. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder, means for producing feeding movements between the stitch-forming mechanism and the work-holder, a buttonhole cutting device normally retracted from stitching position, means for actuating the same to cut a buttonhole, and means connected with said cutting device for shifting the work to space the buttonholes apart.

39. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder comprising work-gripping elements confined permanently within stitching position, means for producing feeding movements between the stitch-forming mechanism and the work-holder, a travelling buttonhole cutting device normally retracted from stitching position, means for actuating the same to cut a buttonhole, and means connected with said cutting device for shifting the work to space the buttonholes apart.

40. In a buttonhole sewing machine, in

combination, stitch-forming mechanism, a work-holder comprising work-gripping elements confined permanently within stitching position, means for producing feeding movements between the stitch-forming mechanism and the work-holder, a travelling button hole cutting device normally retracted from stitching position, means for effecting the engagement of said cutting device with the work preparatory to a cutting movement, means for bodily shifting said cutting device toward the work-holder, and means for actuating the cutting device to cut a buttonhole at the end of said shifting movement.

41. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a travelling cutting device comprising separable cutting elements, means for imparting to the cutting device travelling movements toward and from the stitch-forming mechanism, and means for closing the cutting elements upon the work preparatory to said travelling movements.

42. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a travelling cutting device comprising separable cutting elements, means for imparting to the cutting device travelling movements toward and from the stitch-forming mechanism, and means acting intermediate the extremes of travel of the cutting device for closing the cutting elements upon the work.

43. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a travelling cutting device comprising separable cutting elements, means for imparting to the cutting device travelling movements toward and from the stitch-forming mechanism with a pause intermediate the extremes of said travel in one direction, and means for closing the cutting elements upon the work during said pause.

44. In a sewing machine, in combination, stitch-forming mechanism, a supporting frame therefor mounted for longitudinal and lateral movements, a main frame, an actuating cam mounted for rotation in fixed relation with the main frame, and operative connections between said cam and the supporting frame for producing between said frames relative longitudinal travelling and lateral side-shift movements.

45. In a sewing machine, in combination, stitch-forming mechanism, a supporting frame therefor mounted for longitudinal and lateral movement, a main frame movably sustaining said supporting frame, an actuating cam sustained by said main frame independently of said supporting frame, and operative connections between said cam and the supporting frame for imparting to the latter longitudinal travelling and lateral side-shift movements.

46. In a sewing machine, in combination,

stitch-forming mechanism comprising co-operating upper and lower stitch-forming elements with means for turning them upon a common axis, a supporting frame carrying the stitch-forming mechanism, a main frame, an actuating cam mounted for rotation in fixed relation with the main frame, and operative connections between said cam and the supporting frame for producing between said frames relative travelling movements.

47. In a sewing machine, in combination, a main frame, a stitch-frame movably mounted thereon, stitch-forming mechanism mounted in the stitch-frame, a shaft journaled in bearings of both frames, a cam rotating in fixed relation with the main frame, and an operative connection between said cam and the stitch-frame for producing between said frames step-by-step travelling movements lengthwise of said shaft.

48. In a sewing machine, in combination, a main frame, a shaft-bearing swiveled upon the same, a stitch-frame sustained by the main frame and carrying a shaft bearing stitch-forming mechanism mounted in said stitch-frame, a rotary shaft journaled in said bearings and operatively connected with the stitch-forming mechanism, a cam rotating in fixed relation with the main frame, and an operative connection between said cam and the stitch-frame for producing between said frames travelling movements lengthwise of said shaft and lateral movements crosswise thereof.

49. In a sewing machine, in combination, a main frame and a stitch-frame relatively movable and of which one is sustained by the other, stitch-forming mechanism mounted in the stitch-frame, a cam movable upon an axis in fixed relation to the main frame, a shaft-bearing fulcrumed in the main frame coaxially with said cam, a shaft-bearing in the stitch-frame, an actuating shaft journaled in said bearings and operatively connected with the stitch-forming mechanism, and operative connections between said cam and the stitch-frame for producing between said frames relative travelling movements along said shaft and lateral movements transverse thereof.

50. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a movable stitch-frame for supporting the same, a work-holder comprising work-gripping elements, a support for said work-gripping elements movable relatively to the stitch-frame, means for producing relative feeding movements between the stitch-frame and the work-holder, means for imparting side-shift movements to the stitch-frame, and connecting means between said support and the stitch-frame whereby they are caused to move in unison in the side-shift of the stitch-frame at one end of its travel and the stitch-frame moves independently of the

work-clamp elements at the other end of its travel.

51. In a buttonhole sewing machine, in combination, a work-holder comprising independent clamping feet with a needle-aperture between them, and independently and automatically acting means for lifting said feet in succession.

52. In a buttonhole sewing machine, in combination, a work-holder comprising independent clamping feet with a needle-aperture between them, means for laterally moving one of said feet toward and from the other, and means for restraining the other of said feet against lateral movement.

53. In a buttonhole sewing machine, in combination, a work-holder comprising independent clamping feet with a needle-aperture between them, a travelling cutting device having cutting elements movable into and out of register with the initial position of said needle-aperture, and means for laterally shifting the adjacent clamping foot out of the range of movement of the cutting device in its travel while the other clamping foot remains laterally immovable.

54. In a buttonhole sewing machine, in combination, a work-holder comprising independent clamping feet with a needle-aperture between them, a travelling cutting device having cutting elements movable into and out of register with the initial position of said needle-aperture, and means for lifting the adjacent clamping foot above the range of movement of the cutting device.

55. In a buttonhole sewing machine, in combination, a work-holder comprising independent clamping feet with a needle-aperture between them and relatively movable lower clamping elements opposed to said feet, respectively, a cutting device, and means for separating the adjacent clamping members and shifting them laterally beyond the range of action of the cutting device.

56. In a buttonhole sewing machine, in combination, stitch-forming mechanism, clamping feet sustained for relative lateral movement and relatively movable lower clamping elements opposed respectively to said clamping feet, a travelling cutting device having cutting elements movable laterally into and out of the normal operative position of the stitch-forming mechanism, means for imparting lateral movements to the cutting device, and means for laterally displacing the stitch-forming mechanism and the adjacent clamping foot and opposed lower clamping element when the buttonhole cutter moves into operative position.

57. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a laterally movable stitch-frame in which said stitch-forming mechanism is mounted, relatively movable clamping feet and relatively movable lower clamping elements opposed

respectively to said clamping feet, a fixed support sustaining one of said clamping feet and the opposed clamping element, a movable support sustaining the other of said clamping feet and the opposed clamping element, an operative connection between said movable support and the stitch-frame, a travelling cutting device having cutting elements movable laterally into and out of the normal operative position of the stitch-forming mechanism, means for imparting lateral movements to the cutting device, and means connected with the stitch-frame for shifting the stitch-forming mechanism and the movable elements of the work-holder from operative position out of the range of movement of the cutting device.

58. In a buttonhole sewing machine, in combination, stitch-forming mechanism, relatively movable clamping feet and relatively movable lower clamping elements opposed respectively to said clamping feet, a travelling cutting device having cutting elements movable laterally into and out of the normal operative position of the stitch-forming mechanism, means for imparting lateral movements to the cutting device, means for laterally displacing the stitch-forming mechanism when the cutting device moves into operative position, and means for laterally shifting and separating the adjacent clamping foot and its opposed clamping element to embrace the other clamping elements when the stitch-forming mechanism is displaced.

59. In a buttonhole sewing machine, in combination, a work-holder comprising independent clamping feet with a needle-aperture between them, lower clamping elements opposed respectively to said clamping feet, a travelling cutting device having cutting elements movable into and out of register with an initial position of said aperture, means for lifting the adjacent clamping foot out of the range of travel of the cutting device, and means for laterally shifting the corresponding lower clamping element out of the range of travel of the cutting device.

60. In a buttonhole sewing machine, in combination, a work-holder comprising pairs of separable clamping feet and opposed lower clamping elements which are relatively movable laterally, a travelling cutting device having cutting elements movable into and out of operative position adjacent one of said clamping feet and the opposed lower clamping element, actuating means for operating said cutting device when in operative position to cut a buttonhole, means for laterally displacing the other of said clamping feet and the opposed lower clamping element beyond the range of travel of the cutting device and for restoring them to operative position, means for closing the first-named foot upon the work at the time said cutting action is performed, and means for

closing the other clamping foot upon the work after a cutting action.

61. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder comprising separable clamping elements, means for closing them upon the work for a stitching operation and for opening them thereafter to release the work, work-shifting means operative upon the work while the work-holder is open, and manually controlled coacting means for rendering the work-shifting means ineffective and for simultaneously preventing the opening of the work-holder.

62. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder comprising separable clamping elements, means including a yielding element for closing them upon the work for a stitching operation and for opening them thereafter to release the work, work-shifting means operative upon the work while the work-holder is open, and manually controlled coacting means for rendering the work-shifting means ineffective and for simultaneously preventing the opening of the work-holder.

63. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder comprising separable clamping elements, means for closing them upon the work for a stitching operation and for opening them thereafter to release the work, a travelling cutting device having cutting elements movable laterally into and out of operative relation with said clamping elements and while the latter are open, means for closing the cutting elements upon the work preparatory to a travelling movement, means for rendering the cutting device ineffective, and means acting upon the work-holder to prevent the release of the work while the cutting device is ineffective.

64. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a work-holder comprising separable clamping elements, means for closing them upon the work for a stitching operation and for opening them thereafter to release the work, feeding mechanism for producing relative feeding movements between the stitch-forming mechanism and the work-holder, a travelling cutting device having cutting elements movable laterally into and out of operative relation with said clamping elements and while the latter are open, means for closing the cutting elements upon the work preparatory to a travelling movement, means for rendering the cutting device ineffective, and means acting upon the work-holder while the feeding mechanism continues in operation to prevent the release of the work while the cutting device is ineffective.

65. In a sewing machine, in combination, stitch-forming mechanism, a work-holder

comprising separable clamping elements, feeding mechanism for producing relative feeding movements between the stitch-forming mechanism and the work-holder, a travelling cutting device movable into operative position in register with the work-holder, and means for actuating the cutting device while in operative position, an operative connection between the feeding mechanism and the cutting device for imparting travelling movements thereto, an operative connection between the feeding mechanism and the work-holder whereby it is normally closed and opened, respectively, preparatory and subsequent to a buttonhole-producing cycle, and means operative intermediate the ends of a buttonhole-producing cycle for rendering ineffective the stitch-forming mechanism and buttonhole cutting device and for preventing the opening of the work-holder while the feeding mechanism continues in operation through successive cycles.

66. In a buttonhole sewing machine, in combination, a stitch-frame and a main frame, the one movable relatively to the other, stitch-forming mechanism rotatably mounted in the stitch-frame, a cam sustained by and movable in a position fixed relatively to the main frame, and an operative connection between said cam and the stitch-forming mechanism whereby the latter is turned in a stitching operation.

67. In a buttonhole sewing machine, in combination, a stitch-frame and a main frame, the one movable relatively to the other, stitch-forming mechanism rotatably mounted in the stitch-frame, a cam sustained by and movable in a position fixed relatively to the main frame, an oscillatory shaft mounted in the stitch-frame and connected with the stitch-forming mechanism, a lever fulcrumed on the main frame and deriving operative movements from said cam, and an operative connection between said lever and the oscillatory shaft.

68. In a buttonhole sewing machine, in combination, a stitch-frame and a main frame, the one movable relatively to the other, stitch-forming mechanism rotatably mounted in the stitch-frame, a cam sustained by and movable in a position fixed relatively to the main frame, an oscillatory shaft mounted in the stitch-frame and formed with a spiral groove, a connection between said shaft and the stitch-forming mechanism, a reciprocating sleeve slidably fitted upon said shaft and provided with a stud entering said spiral groove therein, a lever fulcrumed on the main frame and deriving operative movements from said cam, and an operative connection between said lever and said sleeve.

69. In a buttonhole sewing machine, in combination, a driving member, a plurality of braking members, a plurality of driven

members, stitch-forming mechanism operatively connected with one of said driven members, feeding mechanism operatively connected with another of said driven members, and means for effecting independently the coupling of said driven members with said driving member in fixed circular relation and for operatively connecting said driven members with said braking members also in fixed circular relation.

70. In a buttonhole sewing machine, in combination, a driving member, a plurality of braking members, a plurality of driven members, stitch-forming mechanism operatively connected with one of said driven members, feeding mechanism comprising a controlling cam-wheel operatively connected with another of said driven members, and means including a common element controlled successively by manual actuation and through a connection with said cam-wheel for effecting independently the coupling of said driven members with said driving member in fixed circular relation and for operatively connecting said driven members with said braking members also in fixed circular relation.

71. In a buttonhole sewing machine, in combination, a work-holder comprising independent clamping feet with a needle-aperture between them, a laterally shiftable cutting device, means for lifting said feet in succession, and means for moving said cutting device into and out of operative position across the normal operative position of one of said feet.

72. A buttonhole sewing machine having, in combination, stitch-forming devices, stopping means therefor, a work-clamp, means for relatively moving the stitch-forming devices and work-clamp to sew about a buttonhole, and automatic buttonhole spacing means including a reciprocating work-engaging feeder and mechanism for imparting a to-and-fro cycle of movement to the feeder per buttonhole producing cycle of the machine to shift the work relative to the work-clamp between sewing periods.

73. A buttonhole sewing machine having in combination, stitching devices and a work-clamp relatively movable to sew about a buttonhole, a gripper, mechanism for closing the gripper on the work, for advancing it to feed the work while the clamp is open and thus space the buttonholes, for opening the gripper, and for returning it to initial position before the completion of the succeeding buttonhole making cycle.

74. A buttonhole sewing machine having, in combination, stitch-forming devices, rotary supporting means therefor, a work-clamp, a cam-shaft making one rotation per buttonhole producing cycle, a pair of cam elements carried by said shaft and connections for relatively moving the stitch-form-

ing devices and work-clamp laterally and longitudinally of the button-hole during the sewing, a third cam element carried by said shaft and connections for rotating the stitch-forming devices in sewing around the end of the buttonhole and for reversely turning such devices to initial position after the buttonhole has been stitched, a work-gripper adapted to advance the work to the work-clamp between sewing periods and return to initial position prior to the completion of the next sewing operation and cam means on said shaft and connections for so operating the gripper.

75. A buttonhole sewing machine having, in combination, stitch-forming devices, a work-clamp, means for relatively moving the stitch-forming devices and work-clamp to sew a buttonhole, clamp-opening and closing mechanism, a work-gripper including opposed work-gripping elements adapted to advance the work to the work-clamp between sewing periods, and mechanism for imparting feed-and-return movements to said work-gripper.

76. A buttonhole sewing machine having, in combination, stitch-forming devices, a work-clamp, means for relatively moving the stitch-forming devices and work-clamp to sew a buttonhole, clamp-opening and closing mechanism, coacting work-gripping elements adapted to advance the work to the work-clamp between sewing periods, means for relatively moving said work-gripping elements to grip and release the work, and means for imparting feed-and-return movements to said work-gripping elements.

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

78. A buttonhole sewing machine having, in combination, stitch-forming mechanism, a work-clamp, mechanism for relatively reciprocating the stitch-forming mechanism and clamp lengthwise of the buttonhole, and a work carrier movable crosswise of the buttonhole to space the work between buttonhole making cycles.

79. A buttonhole sewing machine having, in combination, stitch-forming mechanism, a work-clamp, mechanism for relatively moving them to sew about a buttonhole, mechanism for opening and closing the clamp, and

a work spacing gripper mounted to reciprocate transversely of the buttonhole.

80. A buttonhole sewing machine having, in combination, stitch-forming mechanism, a work-clamp, mechanism for relatively moving them to sew about a buttonhole, means for cutting the buttonhole slit, mechanism for opening the clamp at the end of the buttonhole making cycle, and a gripper reciprocating transversely of the buttonhole to space the work in the clamp between successive buttonhole making cycles.

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

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

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

84. A buttonhole sewing machine, having, in combination, stitch-forming mechanism, a work clamp, mechanism for relatively moving them to sew about a buttonhole, means for cutting the buttonhole slit, mechanism for opening the clamp at the end of the buttonhole making cycle, a gripper reciprocating transversely of the buttonhole to space the work in the clamp between successive buttonhole making cycles, and means for actuating the gripper to engage and release the work.

85. A buttonhole sewing machine having, in combination, buttonhole sewing mechanism, work spacing means, and adjusting means for varying the direction of the work spacing movements.

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

ALBERT H. DE VOE.

Witness:

HENRY J. MILLER.