

June 18, 1968

R. A. FRITTS ET AL

3,388,680

BUILT-IN AUTOMATIC BUTTONHOLING DEVICES

Filed April 7, 1966

3 Sheets-Sheet 1

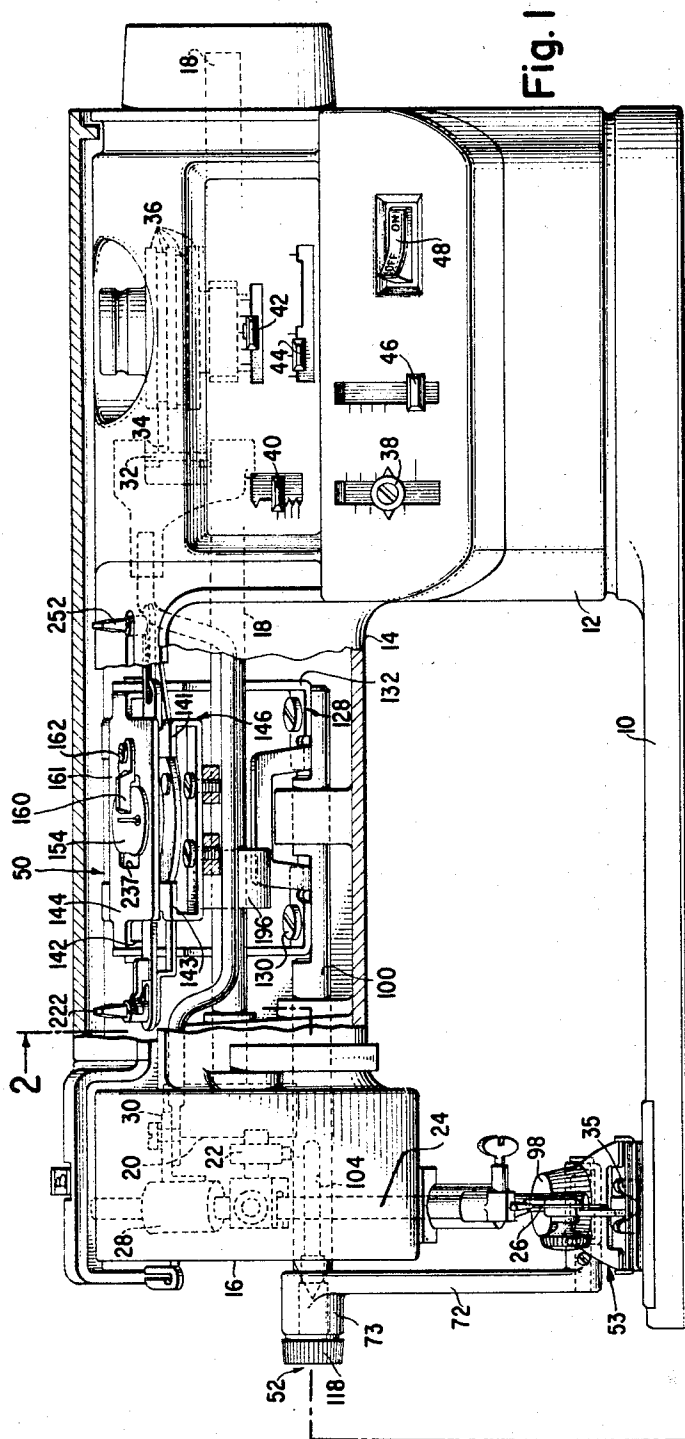


Fig. 1

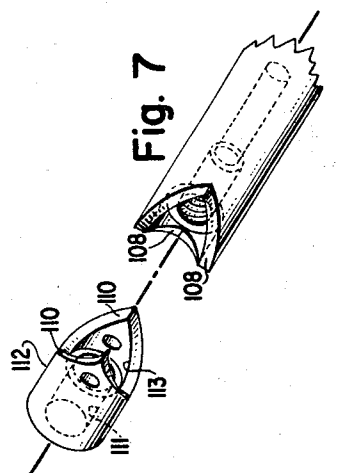


Fig. 7

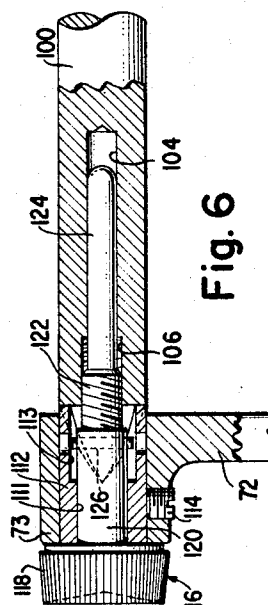


Fig. 6

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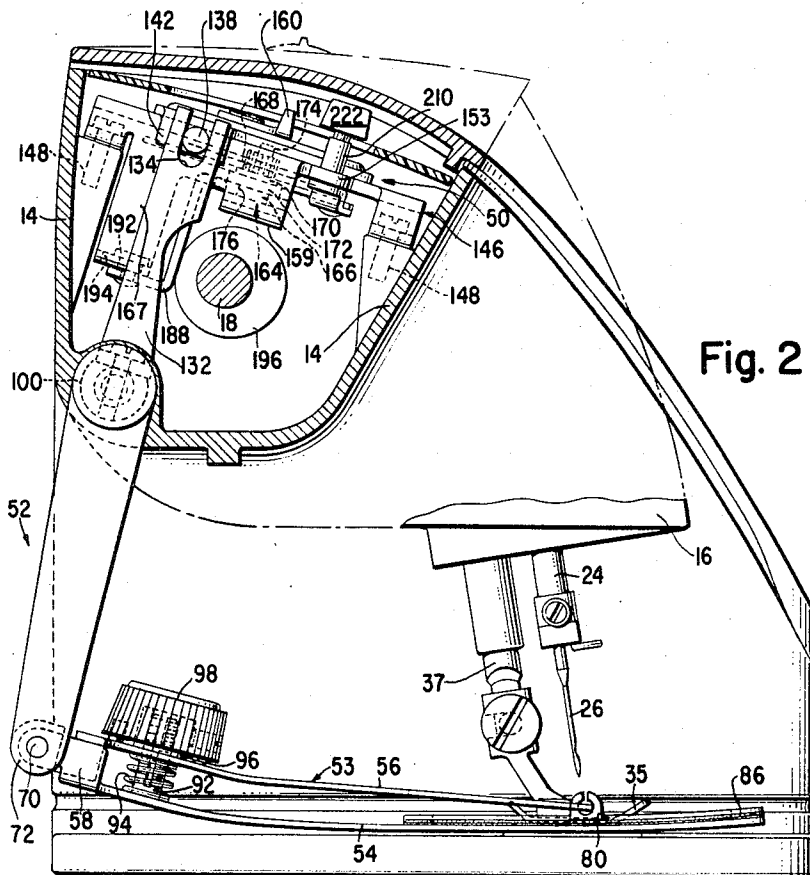


Fig. 2

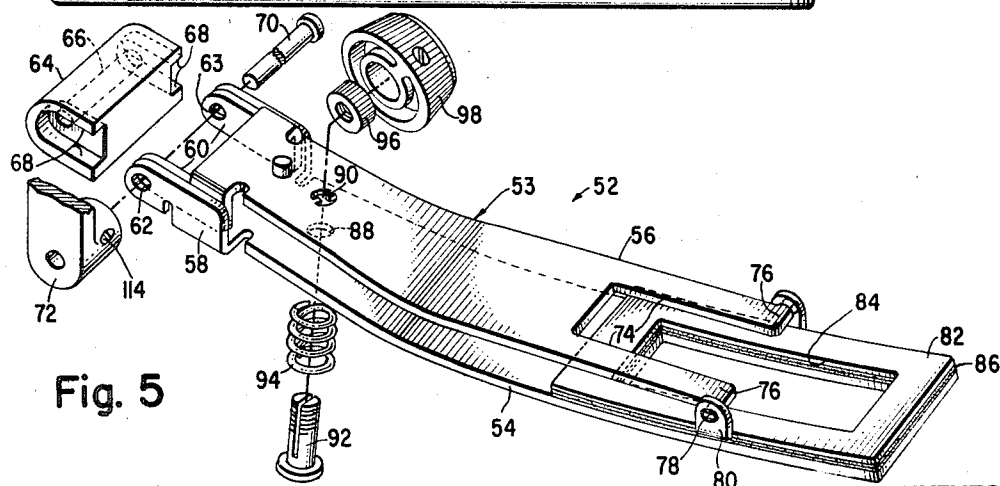


Fig. 5

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3 Sheets-Sheet 3

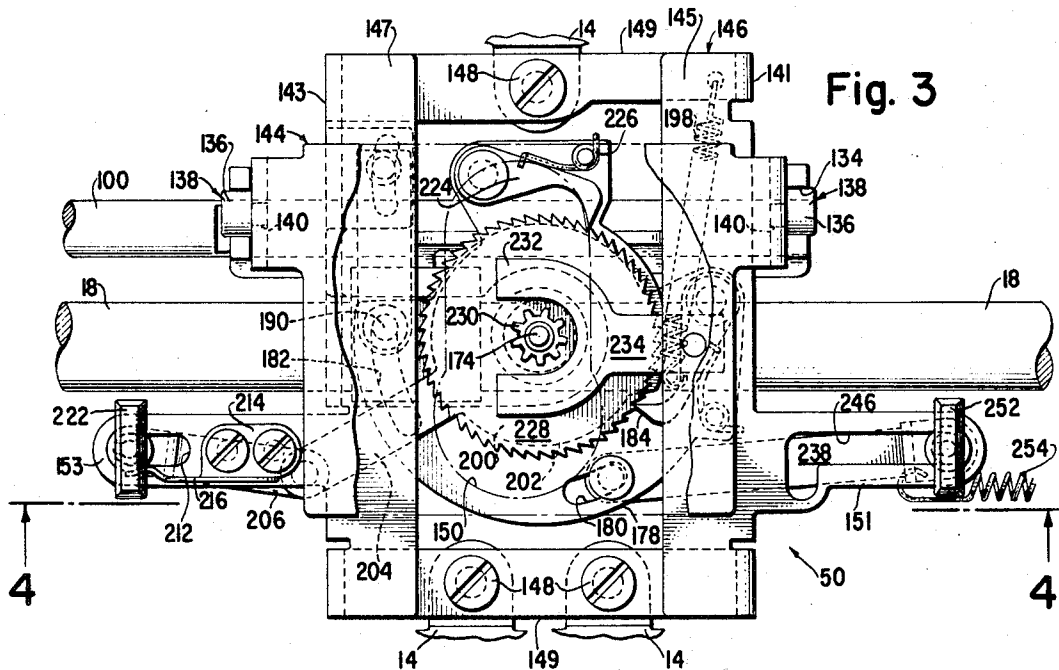


Fig. 3

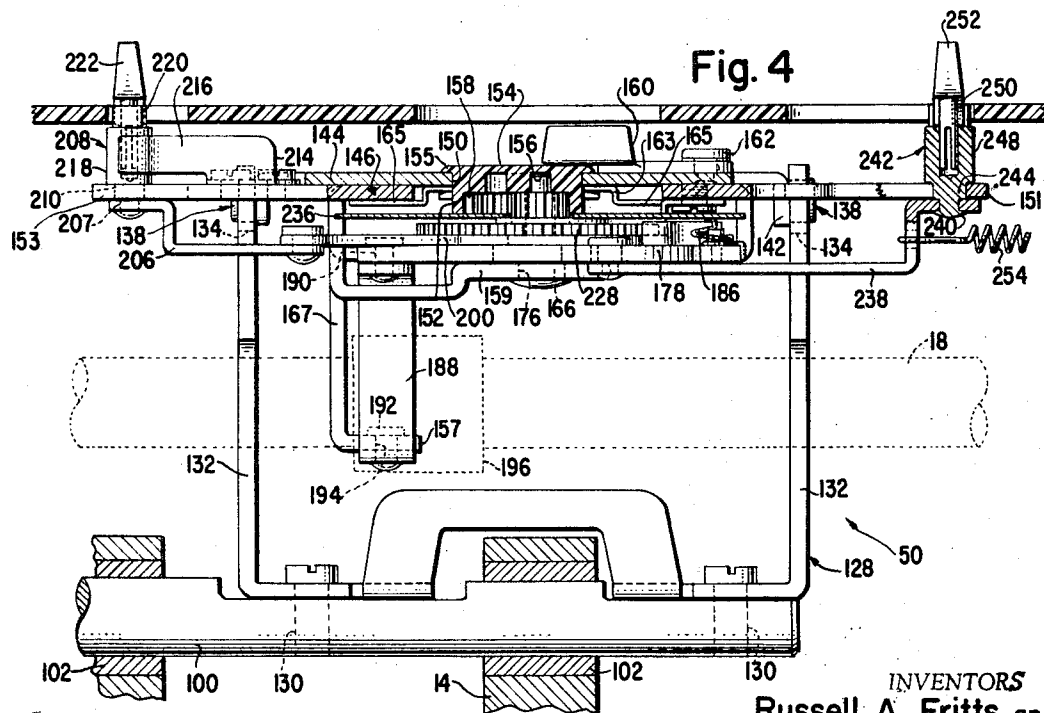


Fig. 4

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3,388,680

BUILT-IN AUTOMATIC BUTTONHOLING DEVICES

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4 Claims. (Cl. 112—73)

ABSTRACT OF THE DISCLOSURE

Apparatus for forming buttonholes including work shifting mechanism mounted in the bracket arm of a sewing machine and a work engaging foot unit carried externally of the bracket arm and detachably connected to the work shifting mechanism. The work shifting mechanism includes a rock shaft journaled in the bracket arm for oscillation about its longitudinal axis and for longitudinal movement, which rock shaft is detachably connected to the work engaging foot unit. The work shifting mechanism further includes apparatus for imparting endwise and oscillatory movements to the rock shaft in a predetermined sequence to drive the work engaging foot unit along a closed path parallel to the bed of the sewing machine.

This invention relates to sewing machines and more particularly to mechanism that is permanently installed in the bracket arm of a sewing machine and is adapted to drive a detachable work engaging unit which may be utilized at the discretion of the operator to automatically stitch buttonholes.

The prior art discloses numerous devices in the nature of attachments for shifting work fabrics in the production of buttonholes. One of the difficulties in the operation of such devices stems from the fact that the control mechanism is supported along with the work engaging foot at the end of the drive connection. This prior art arrangement adds substantially to the weight that must be moved about in the course of shifting the work area and also decreases access to and vision of the work material.

The present invention alleviates the above enumerated difficulties and also those raised by placing the control mechanism on the bed of the sewing machine where it decreases the space available for manipulation of work fabrics.

It is an object of this invention to provide for the accommodation of a control mechanism, including a template dictating the buttonhole size and shape, within the confines of a small space in the bracket arm of the sewing machine. This arrangement is made possible by the provision of a multiplication factor of greater than one between the longitudinal movement of the template and the longitudinal movement of the work engaging foot.

Prior art buttonhole mechanisms did not provide multiplication factors as high as that of this invention, it being pointed out that inaccuracies and the accumulation of tolerance are also multiplied by the same factor. It is an object of this invention to provide a work shifting control mechanism for a built-in buttonhole mechanism in which the connections to the work shifting foot are so direct and stable as to operate successfully with a multiplication factor greater than one between the longitudinal movement of the template and the longitudinal movement of the work engaging foot.

In addition the present invention does not take up space in the head of the sewing machine that is needed for the needle-bar, its actuating apparatus and other mechanisms normally mounted therein. Rather, in the present inven-

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tion a small but unused area of the bracket arm is utilized by the control mechanism and drive connecting elements with maximum efficiency.

Another object of this invention is to provide a work shifting mechanism for the production of buttonholes which with the exception of a conveniently detachable work engaging foot unit is permanently installed in the bracket arm of the sewing machine.

With the above and additional objects and advantages in view as will hereinafter appear, this invention comprises the devices, combinations, and arrangements of parts hereinafter described and illustrated in the accompanying drawings of a preferred embodiment in which:

FIG. 1 is a front elevational view, partially broken away, of a sewing machine including the buttonholing mechanism of this invention,

FIG. 2 is a vertical cross sectional view taken substantially along line 2—2 of FIG. 1,

FIG. 3 is an enlarged view of a portion of the buttonholing mechanism of this invention,

FIG. 4 is a sectional view taken along line 4—4 of FIG. 3,

FIG. 5 is an exploded perspective view of the work engaging foot of the present invention,

FIG. 6 is a vertical sectional view of a portion of the drive connection for the work engaging foot unit of the present invention, and,

FIG. 7 is a perspective view of a portion of the drive connection for the work engaging foot unit of the present invention.

The buttonholing mechanism of this invention is adapted for use with any conventional household sewing machine. In the preferred embodiment shown in the accompanying drawings, this invention is illustrated as applied to a zigzag sewing machine. The following is a brief description of those parts of the sewing machine which are necessary for an understanding of this invention.

The sewing machine frame includes a work supporting bed 10 from which rises a standard 12 sustaining a bracket arm 14 terminating in a sewing head 16 overhanging the work supporting bed. A main shaft 18 journaled in the bracket arm 14 carries a crank 20 connected by a drive link 22 to a needle-bar 24 which at its lower extremity carries a needle 26. The main shaft 18 thus imparts endwise reciprocation to the needle-bar 24 which is journaled for endwise reciprocation in a member 28. The member 28 is connected by linkage 30 to a wobble plate 32 engaged by cam followers 34 which selectively track cams 36 thereby imparting to the needle-bar 24 a jogging or zigzag motion laterally of the path of endwise reciprocating motion thereof. A presser-foot 35 is connected to the lower extremity of a presser-bar 37 mounted in the head 16. The zigzag mechanism for jogging the needle in response to rotation of the main shaft 18 is not disclosed in the accompanying drawings, nor is the feed and looper mechanisms, but they may be of any conventional design. The various control elements 38, 40, 42, 44, 46, and 48 provide the operator with a means for controlling the operation of the sewing machine.

A permanently mounted buttonholing mechanism is indicated generally by the numeral 50 and will be described in detail below. The buttonholing mechanism 50 operates a detachable work engaging unit 52 comprising a work engaging foot 53 including a lower arm 54 and an upper arm 56 having, respectively, ears 58 and 60 which ears include, respectively, axially aligned pin holes 62, 63. The ears 58 and 60 are received by a block 64 that includes a bore 66 which is aligned axially with the pin holes 62 and 63. The block 64 also includes grooves 68 which receive and embrace the ears 58 and 60, thereby to align the ears and also provide the strong support necessary for

the ear end of the work engaging foot 53. The work engaging foot 53 pivots on the shank of a pin 70 which pin is secured to the lower extremity of a drive link 72 having a collar 73 formed on its upper extremity.

The upper arm 56 of the work engaging foot 53 includes at its free end portion a mouth 74 and a pair of forwardly extending fingers 76 outturned as illustrated in FIG. 5. The outturned fingers 76 enter apertures 78 formed on the side flanges 80 of a plate 82 having a clearance aperture 84. Between the plate 82 and the lower arm 54 there is sandwiched two apertured cork pads 86, one cork pad being glued or cemented to the underside of the plate 82 and the other to the top side of the lower arm 54. The lower arm 54 and the upper arm 56 include, respectively, orifices 88 and 90 which receive a split, threaded pin 92. Mounted about the shank of the threaded pin 92 between arms 54 and 56 is a coil spring 94 and a knurled nut 96 threadably engages the pin 92 while a knurled knob 98 in turn engages the nut 96.

The drive link 72 is detachably secured at its upper end to a rock shaft 100 journaled in bearings 102 in the bracket arm 14. The rock shaft 100 is adapted to oscillate about its longitudinal axis and move endwise of its longitudinal axis. The head end portion of the rock shaft 100 has formed therein an axial guide bore 104 (FIG. 6) and a threaded countersink 106 and includes opposite hand indents 108 (FIG. 7) cut out of the end of the shaft. The indents 108 are adapted to receive tongues 110 of a sleeve 112 which is encompassed by the collar 73. The sleeve 112 has formed therein a bore 111 and a countersink 113. The drive link 72 may be adjusted about the sleeve 112 by loosening a screw 114. The guide bore 104, countersink 106, and the sleeve 112 receives a stepped connecting pin 116 having a knob 118, sleeve shank 120, threaded shank 122, and guide shank 124.

The sleeve shank 120 receives a transverse locking pin 126 that serves to lock the sleeve to the connecting pin 116. To detach the work engaging foot unit 52 when it is not in use, the operator need only unscrew the connecting pin 16 and pull the pin and attached sleeve away from the rock shaft 100. Since the entire work engaging unit 52 remains connected together, the operator does not have to concern himself with loose parts that are apt to fall when he is detaching the unit or become separated and misplaced during the storage of the unit.

The buttonholing mechanism 50 is mounted in the bracket arm 14 and includes the rock shaft 100 to which is secured, by screws 130, a substantially U-shaped rock frame 128. The rock frame 128 includes two upstanding legs 132 having stud grooves 134 formed in the upper ends thereof. The stud grooves 134 receive the elongated head 136 of studs 138 while the shank 140 of the studs 138 is received by apertures in depending ears 142 (FIG. 2) of a slide plate 144. The slide plate 144 rests upon and is slidable over a fixed, substantially rectangular support bracket 146. The support bracket 146 is formed with elongated parallel side plates 141 and 143 having, respectively, flat sliding surfaces 145 and 147. The bracket 146 also includes a pair of elongated parallel end plates 149 which are secured to the sewing machine bracket arm 14 by screws 148. The bracket 146 is further formed with a slotted arm 151 extending outwardly at right angles from the side member 141, a slotted arm 153 extending outwardly at right angles from the side member 143, a depending leg 167 integrally formed with side member 143 and including a flat foot 157, and a depending support arm 159 that bends inwardly of the side member 143. The slide plate 144 includes a pair of parallel end plates 161 to the underside of which are secured a pair of brackets 163 (FIG. 4) shaped in the form of a winged-U, the wings 165 of the brackets and the underside of the slide plate forming a groove which tracks the side plates 141 and 143 of the fixed bracket 146.

The slide plate 144 has formed therein an aperture 150 adapted to accommodate the shank 152 of a template 154,

best illustrated in FIG. 4. The template 154 is supported on the slide plate 144 by a support ledge 155 extending outwardly of the template and completely around its periphery. The template 154 is formed with an endless groove 156 in the shape of the tack of stitches to be formed. Encompassing the groove 156, and of the same general shape, is an endless rack 158 formed in the template. The template 154 is held secure in its seat by a locking lug 160 pivotally mounted on the shank of a stud 162 secured to the slide plate 144.

The mechanism for shifting the slide plate 144 includes a composite bearing member, as best seen in FIG. 2, indicated generally as 164, comprising a series of vertically stacked coaxially arranged cylindrical portions. At the base of the bearing member 164, a post 166 is separated from a cylindrical post 168 by an upper cylindrical flange bearing 170 and a lower cylindrical flange bearing 172. Rising from the post 168 is a guide pin 174.

The composite bearing member 164 is mounted on the support arm 159 of the support bracket 146, an aperture 176 in the support arm serving to receive the post 166 of the bearing member. Journaled on the lower cylindrical flange bearing 172 is an apertured pawl carrier plate 178, formed with slots 180 and 182, as best seen in FIG. 3, on which a pawl 184 is pivoted. The pawl 184 is biased inwardly by a spring 186 acting between the pawl and the pawl carrier plate. The pawl carrier plate 178 is oscillated in timed relation with the endwise reciprocation of the sewing needle 26 by means of a cam follower 188 mounted at one end on a pin 190 that slidably engages the slot 182 in the carrier plate 178 and at the other end on a pin 192 that slidably engages an elongated slot 194 formed in the foot 157 of the depending leg 167 of the fixed bracket 146. The cam follower 188 is slidably engaged, as best seen in FIG. 2, by an eccentric cam 196 mounted on the main shaft 18. The pawl carrier plate 178 is biased in a counterclockwise direction (FIG. 3) by a coil spring 198 acting between the pawl carrier plate and the fixed support bracket 146. Thus, as the main shaft 18 rotates, the pawl carrier plate 178 is oscillated between a clockwise direction by means of the eccentric cam 196 and the cam follower 188 and a counterclockwise direction by means of the spring 198.

Journaled on the upper cylindrical flange bearing 170 is a pawl stroke adjustment plate 200 formed with a pawl engaging flange 202 and a leg 204 pivotally connected to one end of a link 206 whose other end is pivotally connected to the bottom portion 207 of a composite knob post 208 formed with a series of vertically stacked coaxially arranged cylindrical portions. Above bottom portion 207 is a cylindrical bearing 210 which slidably engages an elongated slot 212 in arm 153 of the fixed support bracket 146. The arm 153 supports a fixed latch 214 formed with a leaf spring 216 adapted to be slidably engaged by a bored cylinder 218 of the knob post 208. Rising from the cylinder 218 is a hollow stem 220, the cylinder 218 and stem 220 being adapted to receive the shank of a knob 222. Pivoted on the pawl stroke adjustment plate 200 is a pawl 224 biased inwardly by a spring 226.

Journaled on the cylindrical post 168 of the composite bearing member 166 above the pawl stroke adjustment plate 200 is a ratchet wheel 228 integrally formed with a small pinion 230. The ratchet wheel 228 is engaged by the arms 232 of an arched leaf spring 234 secured to the fixed support bracket 146, thus, the ratchet wheel is pressed firmly downwardly against the pawl stroke adjustment plate 200. It is noted that a substantially rectangular shield plate 236 is mounted to the end plates 149 of the fixed support bracket 146 and extends above the ratchet wheel 228 and serves to block from the view of an observer looking down at the buttonholing mechanism 50 the machine parts beneath the plate, thereby presenting a more pleasing appearance to the observer. When the template 154 is properly positioned on the slide plate 144, the pinion 230 will be in mesh with the endless

rack 158 of the template and the guide pin 174 of the composite bearing member 164 will be disposed in the endless groove 156 of the template. The template may be readily removed and exchanged since the pinion 230 and guide pin 174 may be separated from the template simultaneously by a vertical movement of the template. The slide plate 144 is preferably formed with enlarged portions 237 at each side to admit an operator's finger tips at each side of the template for convenient removal and replacement of templates.

The pawl 184 on the pawl carrier 178 and the pawl 224 on the pawl stroke adjustment plate 200 are both disposed in operative engagement with the ratchet wheel 228 and each is arranged to override the other in turning of the ratchet wheel in one direction, thus providing clutch means effective operatively to interconnect the oscillatory pawl carrier plate 178 to the pinion 230 in only one direction of turning movement of the pawl carrier plate.

The pawl engaging flange 202 of the pawl stroke adjustment plate 200 is arranged so as to force the pawl 184 out of engagement with the ratchet wheel 228 for a portion of travel of the pawl. By shifting the knob 222 and connected post 208 from one end of the elongate slot 212 in the arm 153 to the other end of the slot the portion of the pawl engaging flange 202 that contacts the pawl 184 is varied thereby varying the number of teeth of the ratchet wheel 228 that is indexed at each revolution of the main shaft 18 and thus at each needle penetration. The post 208 is held in position at either end of the elongate slot 212 by means of the leaf spring arm 216.

Apparatus is provided to deactivate the ratcheting mechanism at will and also provides for manual ratcheting. Thus, a manual ratcheting lever 238 is pivotally connected at one end to the pawl carrier 178 by means of a pin captured by the elongated slot 180 in the pawl carrier. The other end of the lever 238 is connected to the bottom cylindrical portion 240 of a composite knob post 242 formed with a series of vertically stacked coaxially arranged cylindrical portions including the portion 240. Above bottom portion 240 is a cylindrical bearing 244 which slidably engages an elongated slot 246 in the arm 151 of the fixed support bracket 146. Above the bearing 244 is formed a bored cylindrical portion 248 from which rises a hollow cylindrical stem 250, the portion 248 and stem 250 serving to securely carry a knob 252. The lever 238 is biased into a retracted position against one end of the slot 246 by a spring 254 secured at one end to the lever and at the other end to the standard 14.

With the lever 238 in the position shown in FIG. 3, the ratcheting mechanism is in its activated mode and will operate upon rotation of the main shaft 18. This can be understood by reference to FIGS. 3 and 4 where it is seen that when the cam follower 188 is moved by the cam 196 the pin 190 will be brought up against the farther end (FIG. 3) of the pawl carrier slot 182 thereby moving the pawl carrier plate 178 in a clockwise direction. However, when the lever 238 is moved all the way to the left as viewed in FIG. 3 the pawl carrier plate 178 is rotated in a clockwise direction placing the pin 190 at the near end of the pawl carrier slot 182. Thereafter, movement of the pin 190 by the cam follower 188 will not bring the pin into engagement with the far end of the slot 182, thus, the pawl carrier plate 178 will not be oscillated when the shaft 18 is rotated. Since at every stroke of the lever 238 the pawl carrier plate 178 is oscillated it can be understood that the above described activating apparatus may also serve as a manual ratcheting means.

In operation the work engaging foot 53 will be shifted progressively in a closed path by the rotation of the main shaft 18 which also drives the needle-bar 24, the whole being synchronized to impart to the foot 53 on increment of movement at each stroke of the needle-bar. The work engaging foot 53 partakes only of progressive movement about a closed path as determined by the shape of

the endless groove 156 and rack 158 of the template 154, the zigzag stitches being performed and controlled by other separate apparatus in the sewing machine. It is here noted that the presser-foot 35 is adapted to act as an anti-flogging means thereby preventing the lifting of the work material on each upstroke of the needle.

To prepare the buttonhole mechanism for buttonholing operations the operator must connect the work engaging foot unit 52 to the rock shaft 100 as described above and place the template 154 in its seat and secure the same thereto with the locking lug 160. The operator must then place the work material between the cork pads 86 and position the area of the work material to be sewn within the aperture 84 and thereafter clamp the work material tightly between the pads by turning the knurled knob 98 clockwise, as viewed from above. The operator may then set whichever of the conventional sewing controls is necessary to obtain the desired stitches.

Thereafter, when the drive mechanism for the sewing machine is actuated the stitch forming instrumentalities begin to function in the usual manner and in addition the composite bearing member 164 is rotated by the pawl 184 which in turn is oscillated by the pawl carrier plate 178. The pawl carrier plate 178 is oscillated in timed relation with the endwise reciprocation of the needle 26 by means of the cam follower 188 which in turn is slidably engaged by the eccentric cam 196. The eccentric cam 196 rocks the cam follower as it is rotated by the shaft 18 upon which it is secured. As the composite bearing member 164 is rotated the template 154 is driven by the pinion 230, which forms part of the composite bearing member. As the template is driven by the pinion 230 it in turn drives the slide plate 144, in which the template is seated, along a substantially rectangular path as determined by the shape of the endless groove 152. Since the work engaging unit 52 is operatively connected to the slide plate 144 through the U-shaped rock frame 128 and the rock shaft 100, the foot 53, carrying the work material, will follow a path as determined by the groove in the template. The buttonholing apparatus disclosed above provides only for work shifting motion in the buttonhole shaped path, the stitch by stitch zigzag motion necessary to provide a covering stitch along each side of the buttonhole being provided by the zigzag mechanism of the sewing machine.

When the buttonholing operation is complete the operator may detach the work engaging unit 52 merely by unscrewing the connecting pin 116 and pulling the pin and attached sleeve away from the rock shaft 100. The operator may then actuate the lever 238 thereby to deactivate the ratcheting mechanism.

It is noted that each of the legs 132 of the U-shaped rock frame 128 is longer than the distance between the pivot points of the drive link 72. Thus, while the endwise motion of the template 154 is multiplied by a factor less than one in the process of being converted to the oscillatory motion of the rock shaft, due to the lever action of the legs 132, the resultant oscillatory motion of the rock shaft is multiplied by a factor sufficiently in excess of one, due to the greater length of the drive link 72, that the resultant endwise motion of the foot 53 is greater than the endwise motion of the template 154.

What is claimed herein is:

1. A sewing machine having in combination, a frame formed with a flat work supporting bed, a standard rising from said bed, an overhanging bracket arm terminating in a head and supported by said standard, stitch forming instrumentalities and actuating mechanism therefor carried in said frame, a buttonholing device comprising a work shifting mechanism carried within said bracket arm, a detachable work engaging foot unit carried externally of said bracket arm and including a work engaging foot adapted to overlie said flat work supporting bed, said work shifting mechanism including a rock shaft substantially parallel with said flat work supporting bed and journaled in said bracket arm for oscillation about its longi-

tudinal axis and for endwise movement, said work engaging foot unit including a connecting arm depending from said rock shaft and means detachably connecting the upper extremity of said arm to one extremity of said rock shaft, the lower extremity of said arm being connected to said work engaging foot, means operatively connected within said bracket arm to said rock shaft for imparting endwise and oscillatory movements to said rock shaft in a predetermined sequence, said means for imparting endwise and oscillatory movements to said rock shaft including a member mounted in said bracket arm above said rock shaft and connected to said rock shaft, pattern means mounted in said bracket arm for imparting to said member movements which are transmitted by said member to said rock shaft to provide said rock shaft endwise and oscillatory movements, the movements imparted to said member by said pattern means including movements along a first path which provides said oscillatory rock shaft movements and movements along a second path transversely of said first path to provide said endwise rock shaft movements, said movements serving to drive said work engaging foot along a closed path parallel to said flat work supporting bed, said oscillatory movements of said rock shaft providing said work engaging foot with endwise movements greater than the movements of said member along said first path and said endwise movements of said rock shaft providing said work engaging foot with movements transversely of the endwise movements of said work engaging foot.

2. A sewing machine as in claim 1 wherein said means detachably connecting the upper extremity of said connecting arm to one extremity of said rock shaft includes a connecting pin received by a bore in said rock shaft and removably secured thereto, one end of said connecting arm and said one extremity of said rock shaft being formed with mating non-planar surfaces held in contiguous interlocking relationship by said connecting pin.

3. A sewing machine having, in combination, a frame formed with a flat work supporting bed, a standard rising from said bed, an overhanging bracket arm terminating in a head and supported by said standard, stitch forming

instrumentalities and actuating mechanism therefor carried in said frame, a buttonholing device comprising a work shifting mechanism carried within said bracket arm, a detachable work engaging foot unit carried externally of said bracket arm and including a work engaging foot adapted to overlie said flat work supporting bed, said work shifting mechanism including a rock shaft journaled in said bracket arm for oscillation about its longitudinal axis and for endwise movement, said work engaging foot unit being detachably connected to one extremity of said rock shaft, means operatively connected within said bracket arm to said rock shaft for imparting endwise and oscillatory movements to said rock shaft in a predetermined sequence, said last named means being driven by said sewing machine actuating mechanism whereby said work engaging foot is driven along a closed path parallel to said flat work supporting bed, said sewing machine actuating mechanism including a rotary shaft journaled in said bracket arm, a needle-bar journaled for endwise reciprocation in said head and operatively connected to said rotary shaft, and in which said means for imparting movement to said rock shaft includes an eccentric cam mounted on said rotary shaft, a cam follower in operative engagement with said eccentric cam whereby the rotation of said rotary shaft serves to drive said rock shaft in timed relation with endwise reciprocation of said needle-bar so as to impart to said work engaging foot an increment of movement for each reciprocation of said needle-bar.

4. A sewing machine as set forth in claim 1 including a depending rod connecting said member to said rock shaft, the length of said depending rod being less than that of said connecting arm.

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