Feb. 28, 1967 J. SZOSTAK 3,306,242

BUTTONHOLE MECHANISMS FOR ZIGZAG SEWING MACHINES

Filed July 17, 1964

6 Sheets-Sheet 1

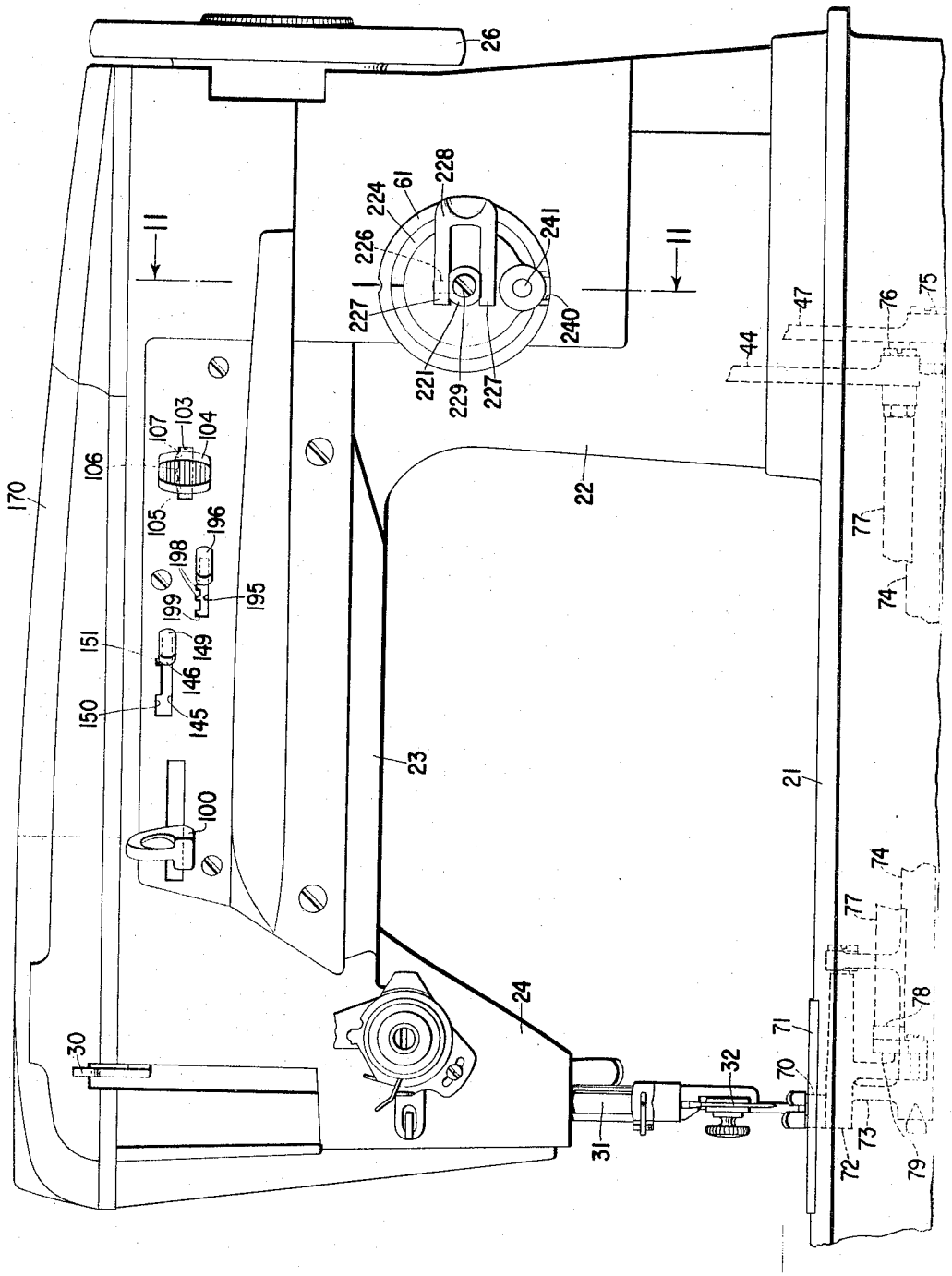

Fig. 1

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BUTTONHOLE MECHANISMS FOR ZIGZAG SEWING MACHINES

Filed July 17, 1964 6 Sheets-Sheet 2

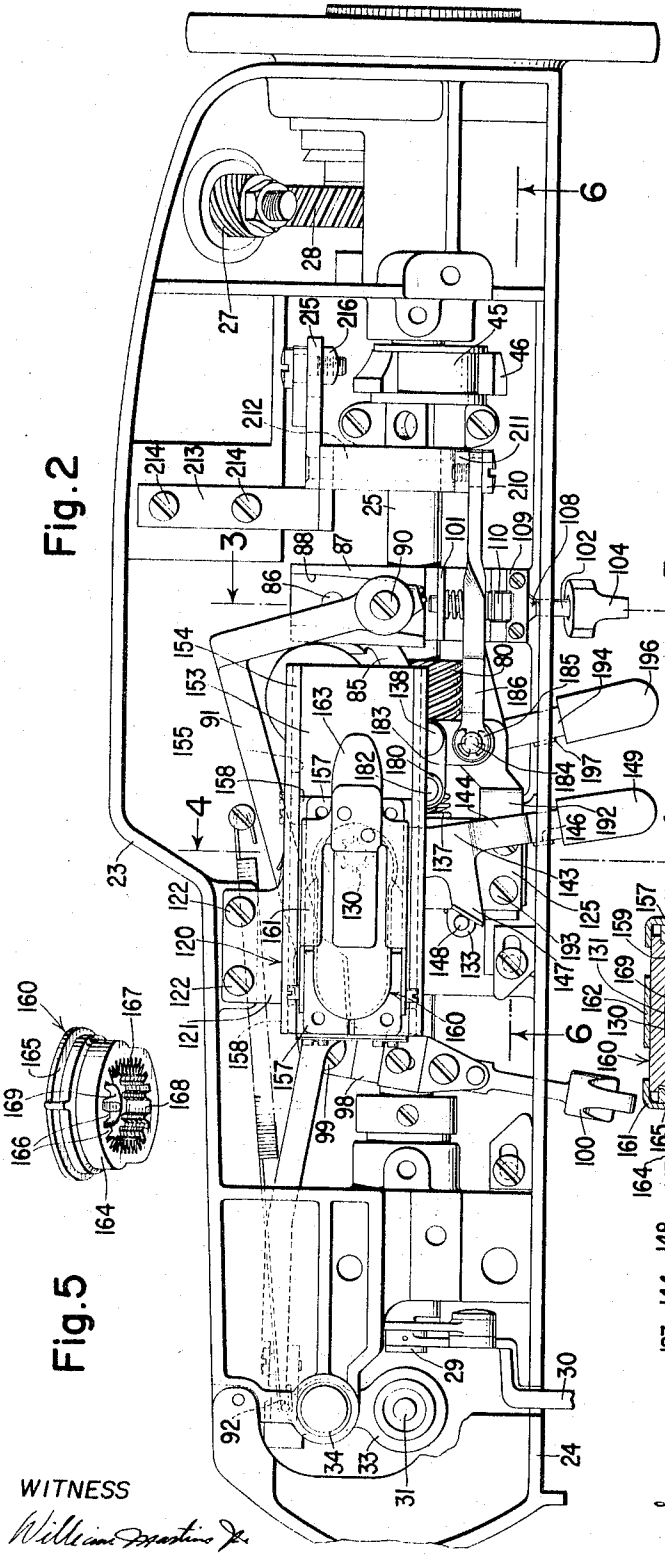

Fig. 2

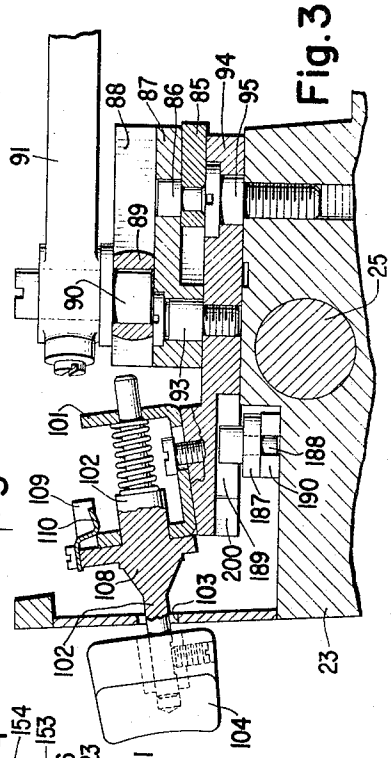

Fig. 3

Fig. 5

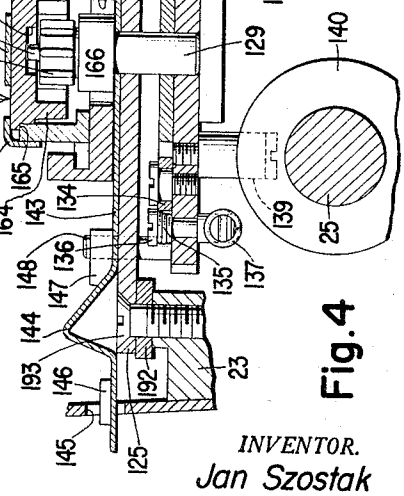

Fig. 4

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BUTTONHOLE MECHANISMS FOR ZIGZAG SEWING MACHINES

Filed July 17, 1964 6 Sheets-Sheet 3

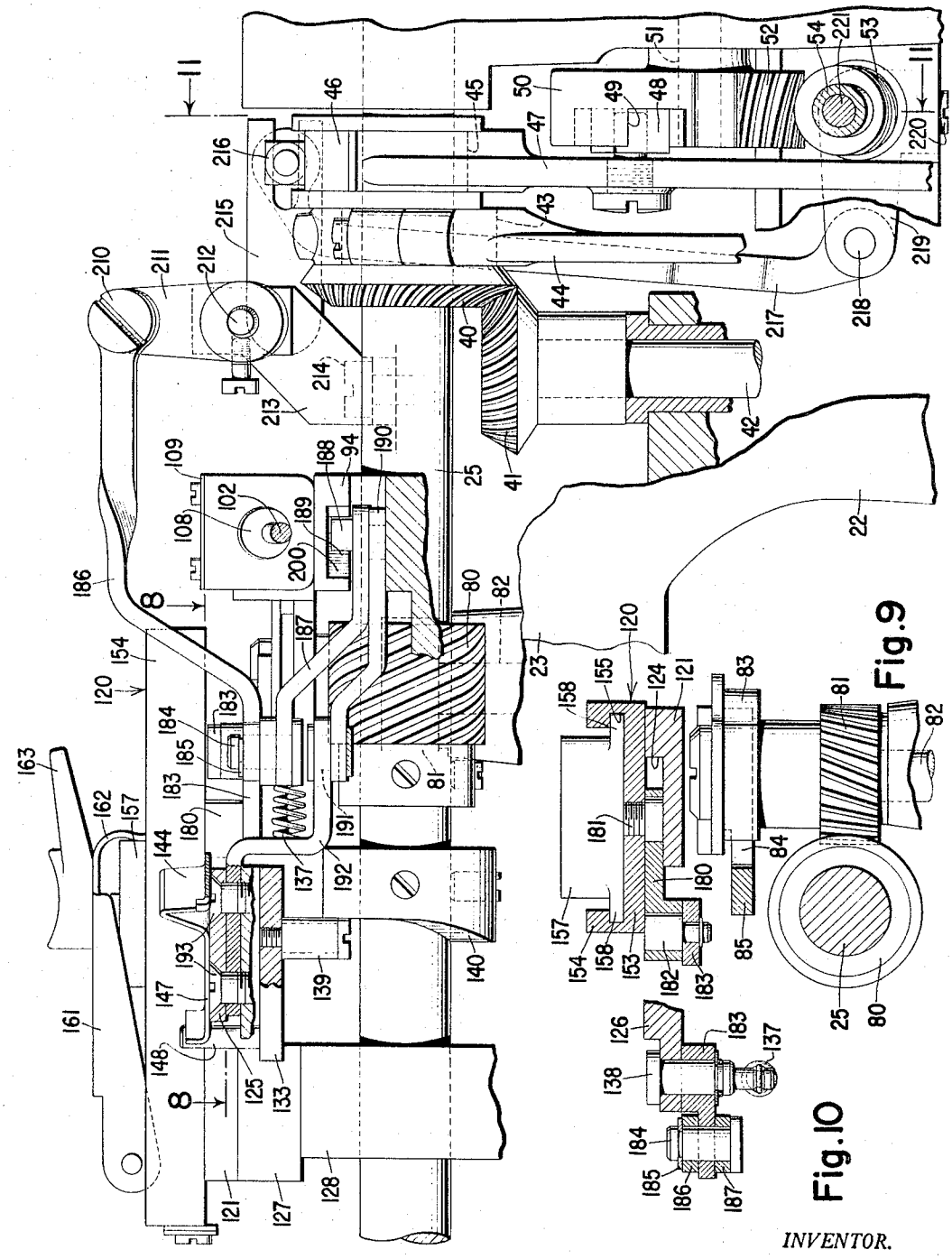

Fig.6

Fig.9

Fig.10

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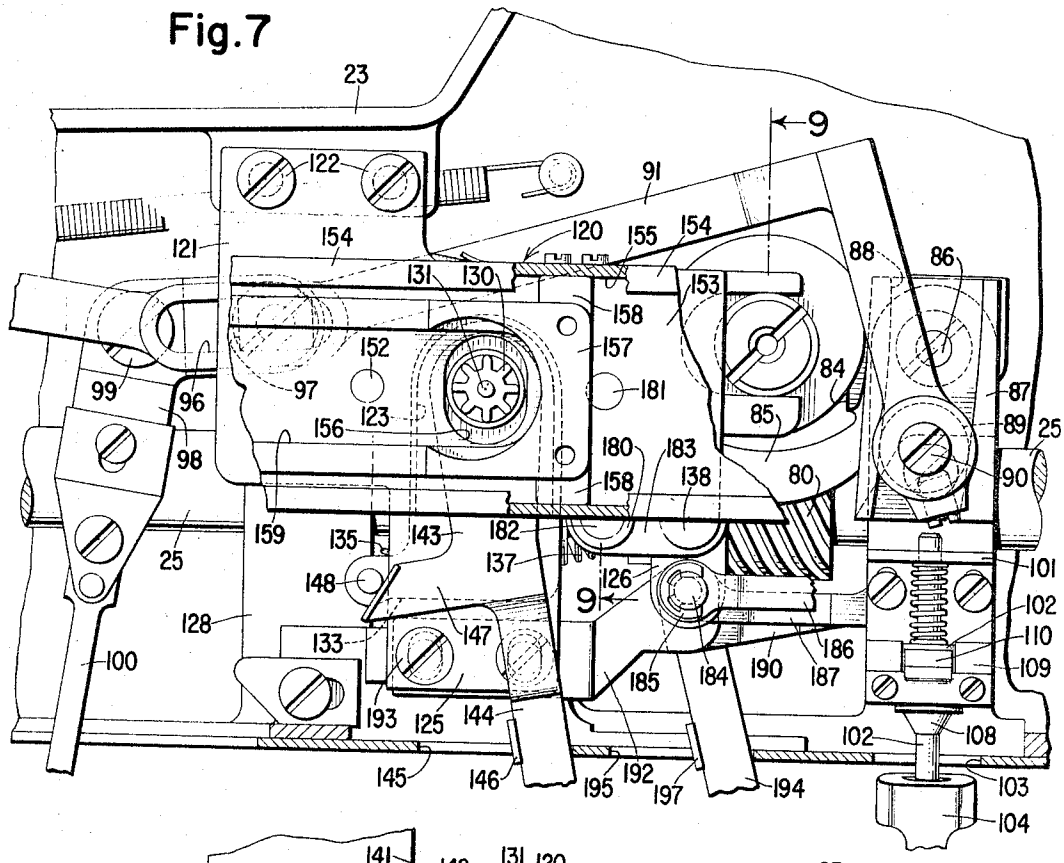
BUTTONHOLE MECHANISMS FOR ZIGZAG SEWING MACHINES

Filed July 17, 1964 6 Sheets-Sheet 4

Fig.7



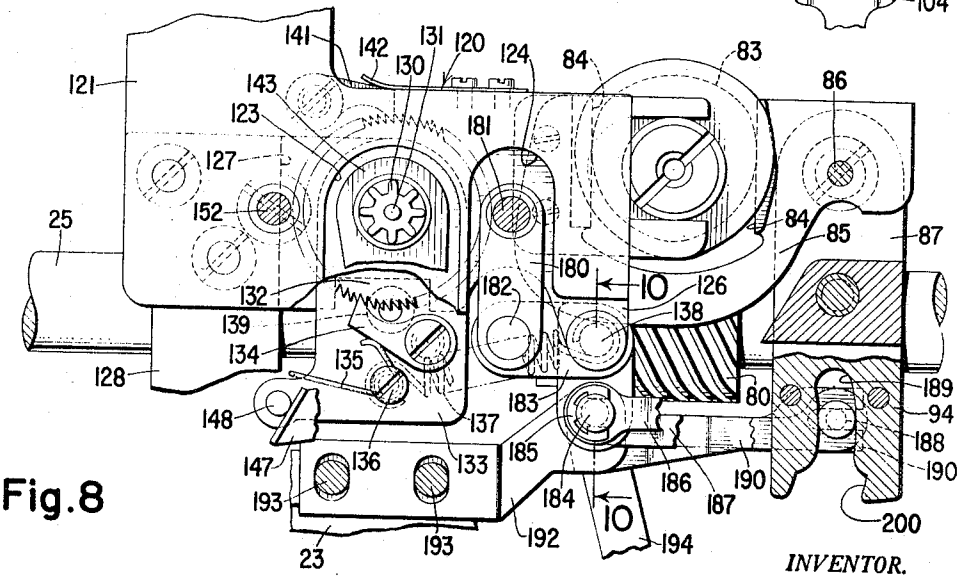


Fig.8

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BUTTONHOLE MECHANISMS FOR ZIGZAG SEWING MACHINES

Filed July 17, 1964

6 Sheets-Sheet 5

Fig. 11

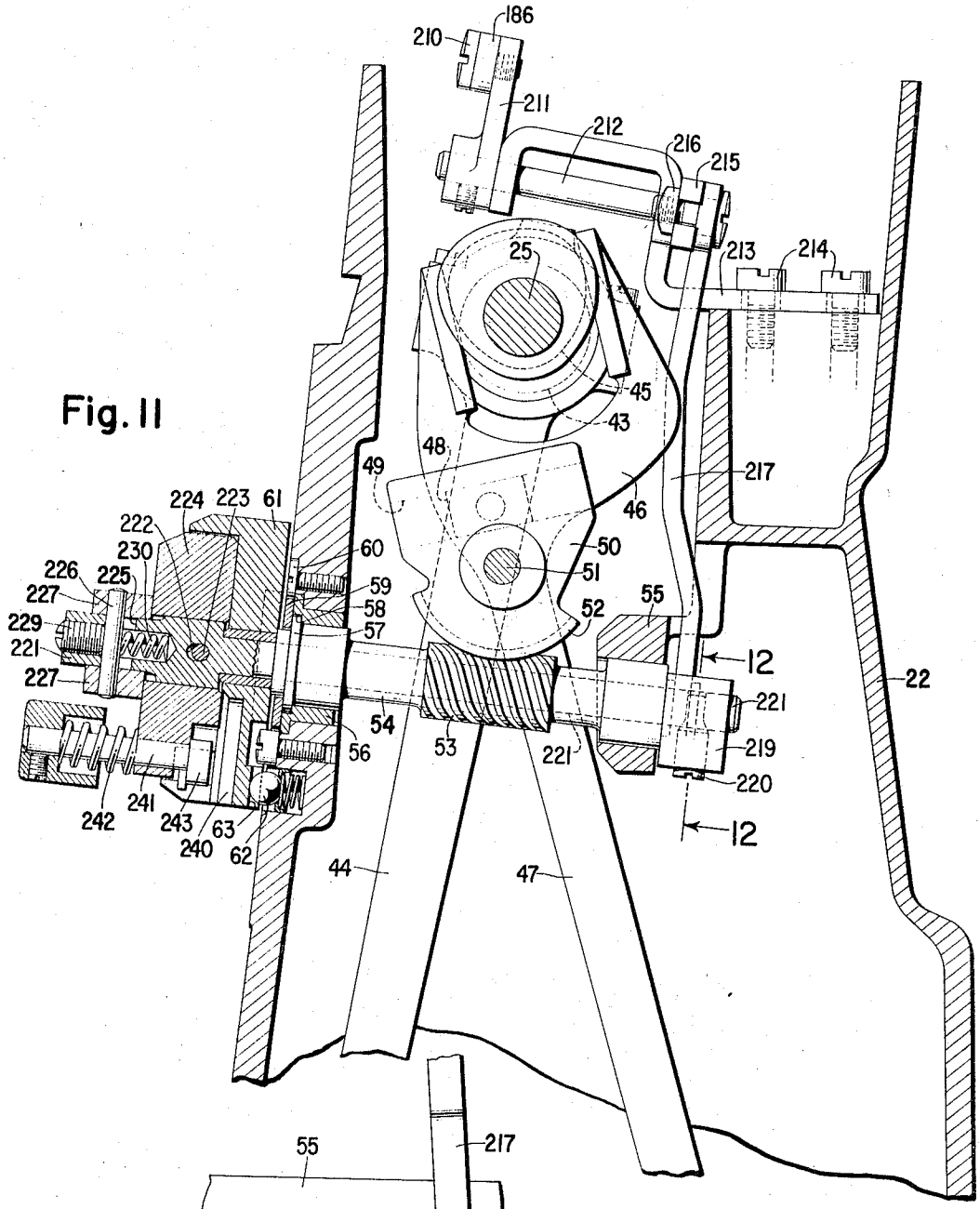
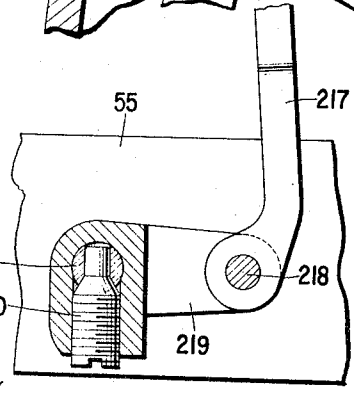


Fig. 12



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BUTTONHOLE MECHANISMS FOR ZIGZAG SEWING MACHINES

Filed July 17, 1964 6 Sheets-Sheet 6

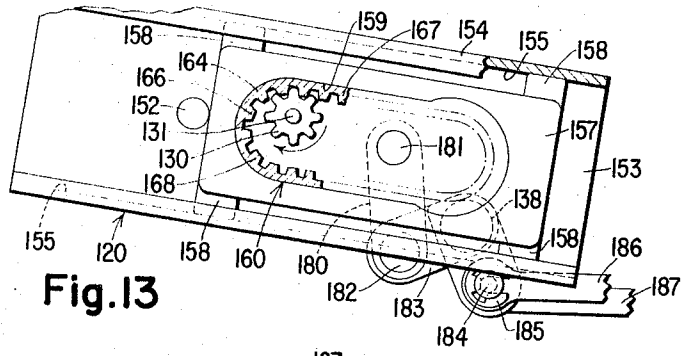

Fig.13

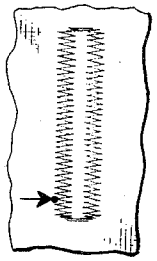

Fig.13a

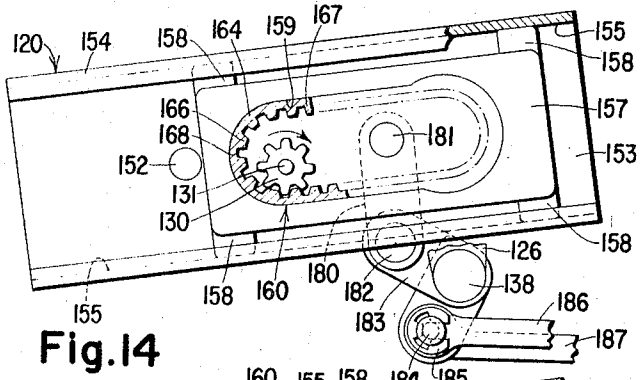

Fig.14

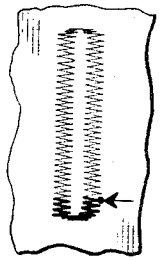

Fig.14a

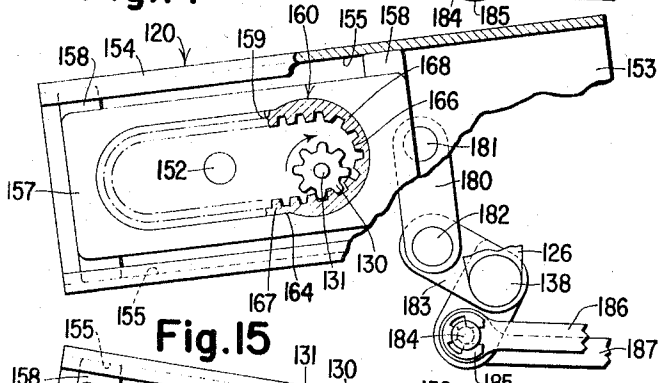

Fig.15

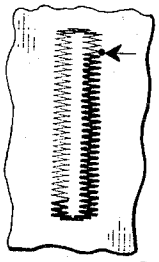

Fig.15a

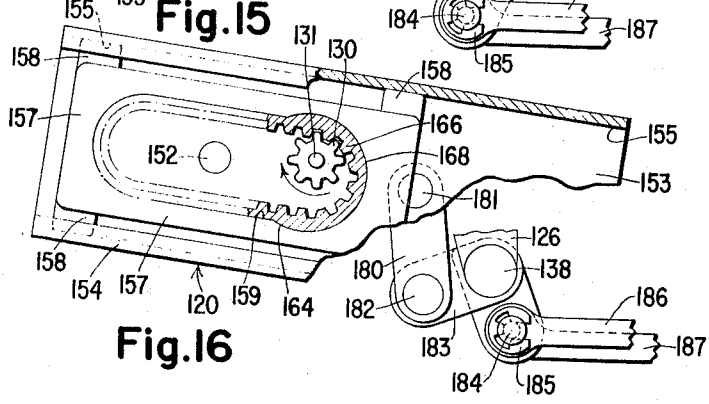

Fig.16

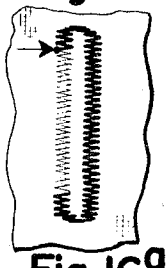

Fig.16a

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United States Patent Office 3,306,242 Patented Feb. 28, 1967

3,306,242

BUTTONHOLE MECHANISMS FOR ZIGZAG SEWING MACHINES

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Filed July 17, 1964, Ser. No. 383,411
8 Claims. (Cl. 112—158)

This invention relates to sewing machines capable of sewing zigzag stitches and, more particularly, to a novel device arranged to control the operation of a household zigzag sewing machine for the automatic stitching of buttonholes.

Heretofore, it has been known in the sewing machine art to produce buttonholes using a household zigag sewing machine by manually effecting adjustment of the machine controls at the various points of transition about the buttonhole. Such successive manual adjustments are not only tedious, but render the successive production of identically appearing buttonholes practically impossible.

There are also rotating cam devices known in the art which provide for programmed influence of the zigzag sewing machine stitch and work feed controls for the production of buttonholes. Since with these known rotating cam devices, the increment of cam rotation during each stitch regulates the length of the buttonhole, control definition becomes increasingly poorer as the length of the buttonhole is increased and the usefulness of these known rotating cam devices is therefore seriously limited.

This invention provides a control device for the stitching instrumentalities and the work feeding device of a sewing machine for the production of buttonholes with a zigzag sewing machine in which a control element is supported and driven by the sewing machine so as to partake of two different classes of motion, i.e., a translatory motion which does not influence a shift of the sewing machine controls, and an angular motion which is harnessed so as to effect modification of the sewing machine controls. With the present invention, the control element is exchangeable in the sewing machine and the length of the resulting buttonhole may be selected not by varying the increment of control element movement during each stitch, but by selection of an appropriately shaped control element. An advantage of the novel arrangement of this invention is that regardless of the length of buttonhole being stitched, the same optimum number of stitches can be placed at the critical buttonhole ends and the stitch spacing along each side of the buttonhole may be maintained uniform and therefore, the device of this invention serves equally satisfactorily for long as well as short buttonholes. Another advantage of this invention is that simply by the selection of control element, shape characteristics other than buttonhole length may be obtained, as for instance, either plain or eyelet end buttonholes may be stitched.

An object of this invention, therefore, is to provide a buttonholing unit for a sewing machine in which an exchangeable control element is operatively connected to shift the various regulators of the sewing machine to produce a buttonhole having a size dictated by the size of the control element.

As illustrated in the accompanying drawings, the exchangeable control element of this invention may take the form of a block which might be termed a template and which is formed with an endless toothed rack. While the control element does not serve directly as a template in the control of the buttonhole shape, it is an advantage of this invention that the devices for harnessing the control element motions are so arranged as to influence the stitching of buttonholes which have the length, proportion, and shape characteristics of the particular endless toothed rack which is inserted in the machine. This is advantageous

in that the control elements can provide a visual indication of the resulting buttonhole characteristics.

In the stitching of buttonholes by either manual or automatic control of the stitch and work feed regulating devices of a household zigzag sewing machine, it has heretofore been difficult to attain a like stitch spacing in the stitches along opposite sides of the buttonhole. Necessary tolerances in the work feed mechanism can result in different feeding action in forward as compared with reverse direction of feed; the feed dog work engaging points are commonly made asymmetrical to favor the more prevalent forward direction of feed used in regular sewing; and the feeding action in one direction or the other may vary disproportionately for different fabrics. This invention provides a novel means, compatible with the buttonhole programming control device, for balancing the effectiveness of the sewing machine work feeding mechanism in the forward and reverse directions of feed so that stitch spacing along opposite sides of the buttonhole may be maintained with a high degree of uniformity.

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

FIG. 1 represents a front elevational view of a sewing machine having the buttonholing device of this invention applied thereto,

FIG. 2 represents a top plan view of the bracket arm of the sewing machine of FIG. 1 with the top cover plate removed,

FIG. 3 is an enlarged vertical cross sectional view taken substantially along line **3—3** of FIG. 2,

FIG. 4 is a vertical cross sectional view taken substantially along line **4—4** of FIG. 2,

FIG. 5 is a perspective view of a buttonhole template,

FIG. 6 is an enlarged vertical cross sectional view taken substantially along line **6—6** of FIG. 2,

FIG. 7 represents an enlarged top plan view of a portion of the mechanism carried in the sewing machine arm with the buttonhole template and the hinged template retaining cover removed and with portions of the template guide lever broken away,

FIG. 8 is a horizontal cross sectional view of a portion of the mechanism carried in the sewing machine arm taken substantially along line **8—8** of FIG. 6,

FIG. 9 is a cross sectional view taken substantially along line **9—9** of FIG. 7,

FIG. 10 is a cross sectional view taken substantially along line **10—10** of FIG. 8,

FIG. 11 is a vertical cross sectional view taken substantially along line **11—11** of FIGS. 1 and 6, illustrating the work feeding mechanism regulator,

FIG. 12 is a cross sectional view taken substantially along line **12—12** of FIG. 11,

FIGS. 13 to 16 are diagrammatic top plan views of the control mechanism of this invention illustrating the operational sequence of the device and FIGS. 13*a* to 16*a* are representations of the various stages of buttonhole formation corresponding respectively to the control mechanism positional sequence illustrated in FIGS. 13 to 16.

Referring particularly to FIGS. 1, 2 and 6, the conventional elements will be briefly described of a zigzag sewing machine of a type to which this invention is adapted for use.

The sewing machine casing includes a bed **21**, a standard **22** rising from the bed, a bracket arm **23** cantilevered from the standard and overhanging the bed and terminating in a sewing head **24**. A main drive shaft **25** journaled in the bracket arm carries a handwheel **26** and may be driven as by a worm **27** and a worm wheel **28** from an electric motor (not shown). A crank **29**

on the main drive shaft in the sewing head **24** serves to actuate a needle thread take-up lever **30** and also serves to impart endwise reciprocatory movement to a needle bar **31** carrying a sewing needle **32**. In addition to endwise reciprocatory movement, the needle bar **31** is journaled in a gate **33** fulcrumed at **34** in the sewing head so as to be shiftable laterally for the sewing of zigzag stitches.

As illustrated in FIG. 6, a miter gear **40** fast on the main drive shaft meshes with a gear **41** carried on a shaft **42** in the standard. The shaft **42** is drivingly connected to the sewing machine loop taker (not shown) disposed beneath the bed **21** to drive the loop taker in timed relation with the endwise reciprocation of the needle in the formation of stitches. Adjacent to the miter gear **41** fast on the main drive shaft is a feed lift eccentric **43** embraced by a feed lift pitman **44** which extends downwardly through the standard. A feed advance cam **45** is fast on the mainshaft adjacent the feed lift eccentric and is embraced by the forked head **46** of a feed advance pitman **47** in the standard. Pivoted to the feed advance pitman is a slide block **48** which is constrained within a guide groove **49** cut in a block **50** which is pivotally supported on a pin **51** fixed in the machine frame. The angular position of the block **50** and particularly of the guide groove **49** therein with respect to the feed advance pitman will influence the amount and direction of work feeding motion, this type of feed regulation being well known in the art.

As illustrated in the drawings the mechanism for influencing the angular position of the block **50** includes a gear segment **52** formed as an integral part of the block **50**. Meshing with the gear segment **52** is a worm **53** fast on a hollow shaft **54** journaled in a web **55** formed within the standard and in a bearing **56** carried in the front wall of the standard. The hollow shaft **54** is formed with a flange **57** seated in a counterbore **58** in the bearing **56** and constrained therein by a keeper **59** secured by a screw **60** to the standard to limit axial movement of the hollow shaft **54**. A dial **61** secured to the hollow shaft exteriorly of the standard serves for manual adjustment of the angular position of the block **50** and a spring loaded detent ball **62** between a notched track **63** in the dial and the standard may be used to sustain the dial in any selected one of a multiplicity of regular increments of angular adjustment.

Referring to FIG. 1, work feeding is accomplished by a feed dog **70** which works upwardly through slots in a throat plate **71** carried on the bed beneath the needle. The feed dog is secured on a feed bar **72** which is pivoted to a rock arm **73** fast on a feed advance rock shaft **74** journaled beneath the bed. A rock arm **75** on the feed advance rock shaft is pivoted to the feed advance pitman **47**. The feed lift pitman **44** is pivoted to a rock arm **76** fast on a feed lift rock shaft **77** journaled beneath the bed. A rock arm **78** on the feed lift rock shaft is pivotally connected by means of a depending link **79** to the feed bar **72**.

The conventional mechanism for imparting and controlling the lateral jogging motion of the needle to produce zigzag stitches will now be described. Driven from a worm **80** on the main drive shaft is a worm wheel **81** fast on a vertical cam shaft **82** journaled on the bracket arm. A constant breadth cam **83** fast on the cam shaft which is thus turned at one half the speed of the main drive shaft is embraced by the forked head **84** of a follower lever **85** which is pivoted by a rivet **86** to a guide block **87**. As illustrated in FIGS. 2 and 3, the top of the guide block **87** is formed with a guide slot **88** which accommodates a roller follower **89** journaled on a pin **90** carried by one end of a needle jogging link **91** which link is pivoted at the other end on a pin **92** fixed in the needle bar gate **33**.

As illustrated in FIG. 3, the guide block **87** is pivoted by a shouldered screw **93** to an adjustng plate **94** fulcrumed on the machine frame by a shouldered screw **95**.

As illustrated in FIG. 7, the needle jogging link **91** between its ends is formed with an elongate slot **96** which embraces a slide block **97** pivoted on a bight adjusting bell crank lever **98** fulcrumed at **99** to the machine frame and having a handle **100** protruding outwardly through the bracket arm. By moving the handle **100**, the position of the roller follower **89** may be selected along the guide slot **88** to influence the magnitude of lateral jogging motion imparted to the needle. When the roller follower **89** is positioned along the guide slot **88** with its axis coinciding with that of the shouldered screw **93** no jogging motion will be imparted to the needle and the magnitude of lateral jogging motion will increase as the roller follower is shifted along the guide slot away from the shouldered screw **93**.

The field or neutral position of the needle jogging may be regulated left, right or center by swinging the plate **94** about its fulcrum screw **95**. For effecting neutral position adjustment a bracket **101** secured to the plate **94** carries a plunger **102** which protrudes through a slot **103** in the bracket arm and has a handle **104** affixed to its free extremity. The bracket arm slot **103** is formed with three notches **105**, **106** and **107** corresponding respectively to the left, center and right neutral positions of adjustment any one of which notches may be entered by a conical enlargement **108** on the plunger when the plunger is drawn outwardly. A spring clip **109** secured to the plunger **102** includes a tang **110** which engages the bracket **101** when the plunger is drawn outwardly so as to releasably constrain the plunger with the conical enlargement **108** in engagement with a selected one of the notches **105**, **106** or **107**. When the plunger is shifted inwardly into the position illustrated in FIG. 3, the adjusting plate **94** is free to be turned to effect a change in the neutral position adjustment.

The above described sewing machine is thus a conventional plain zigzag sewing machine in which the width or bight of zigzagging may be manually adjusted using the handle **100**, the neutral position needle jogging may be manually set at either left center or right using the handle **104** and the direction and extent of work feed may be regulated manually by turning the dial **61**.

In order to adapt the conventional manually controlled zigzag sewing machine for automatic production of buttonholes in accordance with this invention, a control device indicated generally as **120** is carried in the bracket arm of the sewing machine and is illustrated particularly in FIGS. 2 to 4 and 6 to 10. The control device **120** provides for utilization of the motion of the main drive shaft to provide a novel programmed control of the zigzag stitch and work feed controls to produce buttonholes. In accordance with this invention a horizontal support plate **121** is secured above the main drive shaft **25** within the bracket arm as by fastening screws **122**. The upper surface of the horizontal support plate **121** is formed with a pair of shallow recesses **123** and **124** illustrated clearly in FIG. 8. Protruding from beneath the recess **123** the support plate is formed with a lateral extension **125** and adjacent to the recess **124** the support plate is formed with a lateral extension **126**. An additional spacing block **127** may be inserted between the support plate **121** and a bearing web **128** in the bracket arm to provide increased stability for the support plate **121**. Journaled through the support plate **121** in the area of the recess **123** is a shaft **129** shown in FIG. 4 having a pinion **130** fixed thereto above the support plate and with the upper extremity **131** of the shaft **129** protruding above the pinion. A ratchet wheel **132** is fixed to the shaft **129** below the support plate **121**. As illustrated in FIGS. 6 and 8, an operating lever **133** is fulcrumed on the depending extremity of the shaft **129** and extends beneath the lateral extension **125** of the support plate. The operating lever **133** carries a pivoted pawl **134** which is biased into en-

gagement with the ratchet wheel **132** by a spring **135** carried on a screw **136** threaded through the operating lever and a coil spring **137** extending between the screw **136** and a pin **138** carried in the lateral extension **126** of the support plate urges the operating lever **133** in a counterclockwise direction as viewed in FIG. 8.

A roller follower **139** carried beneath the operating lever **133** bears against a face cam **140** fast on the main drive shaft so that as the main shaft turns, the action of the face cam **140** and the coil spring **137** will serve to vibrate the operating lever **133** to impart by way of the pawl **134** step-by-step increments of turning movement to the ratchet wheel and pinion **130**. A retrograde pawl **141** pivoted beneath the support plate and biased by a spring **142** against the ratchet wheel will insure motion of the pinion **130** only in a clockwise direction as viewed in FIGS. 2, 7 and 8.

A throw-out lever **143** is fulcrumed on the shaft **129** beneath the pinion **130** and within the recess **123**. An arched spring arm **144** formed on the throwout lever extends through a slot **145** in the bracket arm and is provided with an upturned tang **146** within the bracket arm slot **145**. The throw-out lever is formed with a lateral arm **147** upturned to abut a pin **148** extending upwardly from the operating lever **133**. By means of a finger grip **149** on the spring arm **144** outside the bracket arm, the throw-out lever may be turned clockwise as viewed in FIG. 7 so that the lateral arm **147** will engage the pin **148** to carry the roller follower **139** beyond the influence of the face cam **140**. The spring arm **144** will urge the tang **146** into a locking notch **150** in the bracket arm slot **145** to hold the lever **143** in the clockwise throw-out position, and a second locking notch **151** is provided into which the tank **146** will be urged to constrain the throw-out lever in an inoperative position.

Pivoted as at **152** atop the support plate **121** is a swinging guide member **153** formed with upstanding side flanges **154** which are undercut as at **155** as shown clearly in FIGS. 4 and 9. The guide member **153** is formed with a laterally elongate clearance hole **156** through which the pinion **130** extends so that the guide member may partake of limited swinging movement free of the pinion.

Slidably arranged in the guide member is a template carrier **157** formed with tangs **158** embraced within the undercut ways **155** of the guide member flanges **154**. The template carrier is formed with a central opening **159** adapted snugly to accommodate an exchangeable template **160** of the type illustrated in FIG. 5. A closure **161** hinged on the template carrier is formed with a spring finger **162** and with a finger grip **163** to constrain a selected template within the central opening of the template carrier.

Referring to FIG. 5, the exchangeable template **160** is formed with a body portion **164** which is accommodated snugly but freely within the opening **159** in the template carrier and suspended therein by a lateral flange **165** on the template which rests upon the template carrier **157**. The underface of the template body portion is formed with an endless series of rack teeth **166** in an oblong arrangement i.e., with straight rack portions **167** and with rounded end portions **168**. An oblong groove **169** is also formed in the under face of the template body within the series of rack teeth **166**.

For exchange of templates, a hinged cover **170** is provided at the top of the bracket arm exposing, when opened, the hinged closure **161** on the template carrier. When the hinged closure is turned upwardly, a template having the desired proportion of straight and rounded end portions **167** and **168** of rack teeth may be inserted into the opening **159** of the template carrier. When inserted, the rack teeth **166** of the selected template will mesh with the pinion **130** and the pinion shaft extremity **131** will seat within the oblong groove **169** of the template. The closure **161** when turned down into the position illustrated in FIG. 6 will constrain the template in place by engagement

of the spring finger **162** on the edge of the template carrier **157**.

With a template in place and the face cam **140** on the sewing machine main drive shaft operative to impart step-by-step turning movement to the pinion **130**, the pinion when in mesh with a rounded end potrion **168** of the rack will shift the template carrier **157** and the guide member **153** laterally of the sewing machine bracket arm and cause the guide member to partake of a gradual turning movement about the axis of the pivot **152** for the guide member. This angular motion of the guide member is harnessed as will be described herebelow to effect a gradual change of the ordinarily manual stitch and work feed regulators from settings appropriate for the sewing of one side of a buttonhole to settings appropriate for the sewing of the other side, and during this gradual transition an end of the buttonhole will be produced. While the pinion meshes with a straight rack portion **167**, the template carrier will slide along the ways **155** of the guide member imparting no motion to the guide member and the sewing machine controls will be maintained for a period of sewing machine actuation which is proportional to the length of the straight rack portions and thus the length of the buttonhole may be influenced by the selection of a template having a requisite length straight rack portion **167**.

The mechanism for harnessing the angular motion of the guide member **153** for influencing the stitch and work feed regulating devices of the sewing machine comprises a link **180**, FIGS. 6, 8 and 9 are arranged in the recess **124** of the support plate **121** and pivoted at **181** to the guide member **153** at a point spaced from the fulcrum pivot **152** for the guide member. The link **180** is pivoted at **182** to one arm of a bell crank **183** fulcrumed on the pin **138** carried in the support plate extension **126**. The other arm of the bell crank **183** carries a pivot pin **184** secured by a spring keeper **185** which pin is embraced by a link **186** for controlling the work feed regulating means and by a link **187** for controlling the neutral position of needle zig-zagging motion.

The link **187** influences neutral position of needle zig-zag motion by way of a pin **188** fixed transversely through the link **187**, the upper extremity of which pin enters an arcuate slot **189** formed beneath the neutral position adjusting plate **94**. The lower extremity of the pin **188** is embraced by the bifurcated arm **190** of a bell crank fulcrumed on a pin **191** FIG. 6 carried in a bracket arm **192** fixed by screws **193** to the lateral extension **125** of the support plate **121**. The other arm **194** of the bell crank is a spring arm which extends through a slot **195** formed in the sewing machine bracket arm and is fitted exteriorly of the machine frame with a handle **196**. A tang **197** formed on the spring arm **194** can cooperate with any one of a series of locking notches **198** formed in the slot **195** to position the pin **188** in different positions along the arcuate slot **189**; by this means the angular motion of the guide member **153** can be made to have more or less of an influence upon the setting of the neutral position control plate **94**. A locking notch **199** formed in the slot **195** serves to lock the bell crank **190**, **194** with the pin **188** positioned out of the arcuate slot **189** and into an adjoining widened portion **200** in which position the angular motion of the guide member **153** can have no influence upon the setting of the neutral position control plate **94**.

The link **186** for influencing the setting of the work feeding device is pivotally connected by the shouldered screw **210** to a rock arm **211** fixed to a rock shaft **212** journaled in a bracket **213** secured by screws **214** within the sewing machine bracket arm. As illustrated in FIGS. 6, 11 and 12 a bifurcated rock arm **215** fast on the rock shaft **212** embraces a threaded clamp fastener **216** which may be secured in selected position along the bifurcated rock arm **215** and provides a pivotal connection between the rock arm **215** and a link **217** which depends within

the standard 22 and is pivoted at 218 to a rock arm 219 secured by a setscrew 220 to a rod 221 journaled within the hollow feed regulating shaft 54.

The rod 221 is in the usual condition freely journaled within the hollow shaft 54 and extends outwardly beyond the feed adjusting dial 61 on the hollow shaft 54. The rod 221 is formed with a transverse slot 222 elongate lengthwise of the rod to accommodate a pin 223 slidably but non-rotatably securing to the rod 221 a dial 224. The rod 221 is also formed with a transverse slot 225 elongate lengthwise of the rod to accommodate a fulcrum pin 226 fixed in bifurcated arms 227 of a locking lever 228. The fulcrum pin 226 is fixed asymmetrically in the bifurcated arms 227 so that when the locking lever is turned to the right as viewed in FIG. 1, the arms 227 will urge the dial 224 toward the rock arm 219 and will thus clamp the rod 221 to the hollow shaft 54 so that the two will turn as a unit. A stop screw 229 threaded into the free extremity of the rod 221 and abutting the fulcrum pin 226 in the clamped position of the parts may be used to attain a micrometer control of the clamping effect attained by the locking lever 228. When the locking lever is turned to the left as viewed in FIG. 1, the rod 221 will be freed to turn relatively to the hollow shaft 54 and a spring 230 in an axial bore 231 in the rod and abutting the fulcrum pin 226 will serve to deter accidental turning movement of the locking lever.

In the automatic production of buttonholes it is necessary that the angular motion of the guide member 153 at the ends of the buttonhole change the setting of the work feed regulating device from one direction of work feed to the opposite direction. To insure that the locking lever 228 may be turned to effect locking of the rod 221 relatively to the hollow shaft 54 in a position of the parts which will effect a feed reversal in response to the angular guide member motion, a radial slot 240 is formed in the feed regulating dial 61 opposite a plunger 241 slidable in the dial 224 on the rod 221. A retracting spring 242 on the plunger urges the plunger in a direction away from the feed regulating dial 61 and an eccentric 243 is formed on the extremity of the plunger which is continguous to the dial 61 and of a diameter slightly smaller than the width of the radial slot 240. The plunger 241 is arranged in that angular position on the dial 224 relatively to the radial slot 240 that when the eccentric 243 is brought opposite the radial slot 240 midway about the end of a buttonhole being formed under the control of the guide member 153, the stitch length of the work feeding mechanism will be substantially reduced to zero. When the plunger 241 is depressed seating the eccentric in the radial slot 240 and the locking lever 228 is turned to free the rod 221 in the hollow shaft 54, the plunger may be turned to effect a micrometer adjustment of the angular position of the rod 221 relatively to the hollow shaft to favor to a selected degree either the forward or the reverse direction of feed. When the feed is properly balanced using this micrometer adjustment so as to be equally effective in the forward and reverse directions when influenced by the control device 120 to suit the specific conditions encountered, the locking lever 228 may be turned to the right as viewed in FIG. 1 to lock the parts in the adjusted position.

Operation

To ready the sewing machine for automatic production of buttonholes using the control device of this invention, a selected template 160 is first positioned in the template carrier 157. Referring to FIG. 1, the width or bight adjusting handle 100 is set to a position corresponding to slightly less than half the maximum permissible width of zigzag stitch; the feed regulating dial 61 is turned until the radial slot 240 is aligned with the eccentric 243 and the plunger 241 may be depressed and turned to effect the desired micrometer adjustment and then the locking lever 228 is turned to the right into the position illustrated in FIG. 1. The neutral position handle 104 is depressed until the spring tang 110 locks the conical portion 103 of the plunger 102 out of the range of the notches 105, 106 and 107 and frees the neutral position influencing plate 94 for automatic control.

The handle 196 is shifted to move the tank 197 out of the locking notch 199 into one of the notches 198 thus carrying the pin 188 into the arcuate slot 189 and rendering the connection from the control device 120 to the neutral position regulating plate 94 effective. The greater the distance that the handle 196 is shifted from the locking notch 199 the smaller will be the total width of the buttonhole and of the cutting space between the stitches at each side of the buttonhole.

The handle 149 is shifted to the right as viewed in FIG. 1 and the tang 146 seated in the notch 151 to lock the handle 149 in a position in which the ratcheting device for the pinion 130 will be operative thus completely readying the sewing machine for the automatic sewing of buttonholes.

FIGS. 13 to 16 are diagramatic top plan views of the pinion 130, template 160, template carrier 157 and guide member 153 and including fragments of the linkage 180, 183, 186 and 187 connecting tht guide member 153 with the work feed and neutral position regulating mechanisms of the sewing machine. These figures illustrate the sequence of operation in the formation of a buttonhole and for this purpose each is accompanied by a representation, FIGS. 13*a* to16*a*, in fine lines of the buttonhole stitching ultimately to be performed with those portions of the buttonhole illustrated in heavy lines which have been thus far stitched in the sequence of operation and including an arrow indicating the position of the sewing machine needle.

Stitching of the buttonhole may be initiated as illustrated in FIG. 13 with the pinion 130 about to mesh with the curved rack portion 168 at one end of the template. With the pinion turning in step-by-step fashion in the direction illustrated by the curved arrow in FIG. 13 meshing of the pinion with the curved rack portion 168 will cause the guide member 153 to be shifted angularly about the pivot 152 from the position illustrated in FIG. 13 to that illustrated in FIG. 14 with a consequent gradual shift of both links 186 and 187 to reverse the direction of feed and transpose the neutral position of needle vibration. The result in the buttonhole stitching as illustrated in FIG. 14*a* is the production of one end of the buttonhole.

Continued operation of the sewing machine gives rise to tracking of the pinion 130 along one of the straight rack portions 167 of the template 160 during which, the guide member 153 remains in the position illustrated in FIGS. 14 and 15, since the template carrier 157 partakes only of translatory motion along the ways 155 of the guide member 153. The links 186 and 187 will remain motionless during the period and as illustrated in FIG. 15*a* one side of the buttonhole will be stitched. It will be appreciated, therefore, that the length of the straight rack portion 167 of the template 160 serves as a timing device to dictate the length of the resulting buttonhole. It is pointed out that the kinematics of the linkage 211–219 for controlling the work feed regulating mechanism may be arranged to provide for stitching of buttonholes closely approximating the length of the rack portions 167 of the template and that the clamp fastener 216 provides for a fine adjustment of buttonhole length whereby a visual correlation may be established for the operator's benefit between the size of the template rack and the size of the buttonhole to be produced.

Comparison of FIGS. 15 and 16 will illustrate diagrammatically the result of combined sewing machine operation during which the pinion 130 tracks the opposite curved rack portion 168 to complete the opposite end of the buttonhole as illustrated in FIG. 16*a*. Continued sewing machine operation then serves to complete the

sewing of the other side of the buttonhole to conclude the buttonhole sewing sequence.

The total width of the buttonhole produced by the device of this invention as well as the cutting space between rows of stitches at each side of the buttonhole may be regulated by either or both of two adjustments, i.e., either by the setting of the bight of zigzag stitching using handle **100** or by using handle **196** and selecting one of the locking notches **198** to influence the degree of control which the template **160** will exert upon the neutral position variation during buttonhole sewing.

While the clamp fastener **216** in providing a fine adjustment of buttonhole stitch spacing may be used to influence accurate correlation of the buttonhole length with that of the rack in the template, the clamp fastener **216** may also be used to provide for a regulation of the buttonhole length larger or smaller than the template rack should buttonholes be desired of length slightly different from that of the available template rack.

Having thus described the nature of the invention, what I claim herein is:

1. A buttonholing device in a sewing machine having a frame, an endwise reciprocating and laterally jogging needle and a work feeding device carried in said frame, actuating mechanism in said frame for operating said needle and said work feeding device, a first shiftable regulator in said frame operatively connected to said needle actuating mechanism for controlling the lateral position of needle jogging, and a second shiftable regulator in said frame operatively connected to said work feeding actuating mechanism for controlling the direction and magnitude of said work feeding device, said buttonholing device comprising an exchangeable template carried in said sewing machine frame, and means operatively connecting said template with said first and second shiftable regulators to produce automatically a buttonhole having a size dictated by the size of the template.

2. A buttonholing device in a sewing machine having a frame, an endwise reciprocating and laterally jogging needle and a work feeding device carried in said frame, actuating mechanism in said frame for operating said needle and said work feeding device, a first shiftable regulator in said frame operatively connected to said needle actuating mechanism for controlling the lateral position of needle jogging, and a second shiftable regulator in said frame operatively connected to said work feeding actuating mechanism for controlling the direction and magnitude of said work feeding device, said buttonholing device comprising an exchangeable template shiftably supported in said sewing machine frame, drive means operated by said sewing machine actuating mechanism for imparting step-by-step movement to said template in a closed path, and linkage in said frame connectable to said first and second shiftable regulators and responsive to movement of said template to shift said regulators for the automatic production of a stitched buttonhole.

3. A buttonholing device in a sewing machine having a frame, an endwise reciprocating and laterally jogging needle and a work feeding device carried in said frame, actuating mechanism in said frame for operating said needle and said work feeding device, a first shiftable regulator in said frame operatively connected to said needle actuating mechanism for controlling the lateral position of needle jogging, and a second shiftable regulator in said frame operatively connected to said work feeding actuating mechanism for controlling the direction and magnitude of said work feeding device, said buttonholing device comprising a lever, means defining a fulcrum for said lever in said sewing machine frame, a track formed on said lever radially of said fulcrum, linkage in said frame responsive to angular movement of said lever about said fulcrum, means for at will connecting said linkage to said first and said second shiftable regulators, a pinion journaled in said sewing machine frame, drive means operated by said actuating mechanism for imparting step-by-step rotary motion in one direction to said pinion, a template formed with an endless rack, and means supporting said template for translatory sliding movement along said track in said lever and with said template rack in mesh with said pinion.

4. A buttonholing device as set forth in claim **3** in which said drive means for said pinion includes a manually operable throw-out element in said frame effective at will to render said drive means for said pinion ineffective.

5. A buttonholing device as set forth in claim **3** in which said means connecting said linkage to said first shiftable regulator includes an element adjustable exteriorly of said frame for varying the motion imparted to said first shiftable regulator by said linkage.

6. A buttonholing device as set forth in claim **3** in which said means connecting said linkage to said second shiftable regulator includes a clamping device adjustable exteriorly of said frame for effecting said connection of said linkage with said second shiftable regulator in any initial position of adjustment of said second shiftable regulator.

7. A buttonholing device as set forth in claim **6** in which said second shiftable regulator includes a hollow rotatable adjusting shaft for said work feeding device and in which said clamping device includes a rod connected to said linkage and journaled within said hollow feed adjusting shaft and means for at will rotationally interlocking said rod and said feed adjusting shaft, and manually operable means interposable between said rod and said feed adjusting shaft in a limited range of positions of said feed adjusting shaft which range includes a position corresponding to zero stitch length for providing a fine adjustment of the angular relation of said rod relatively to said feed adjusting shaft.

8. A buttonholing device as set forth in claim **3** in which said endless rack in said template is formed with straight rack portions disposed substantially parallel to said track when said template is sustained in said supporting means, and in which said means connecting said linkage to said second shiftable regulator is adjustable to provide for that stitch length while said pinion is in mesh with said straight rack portions as will produce a stitched buttonhole having a length substantially equal to the length of said straight rack portions in said template.

No references cited.

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