

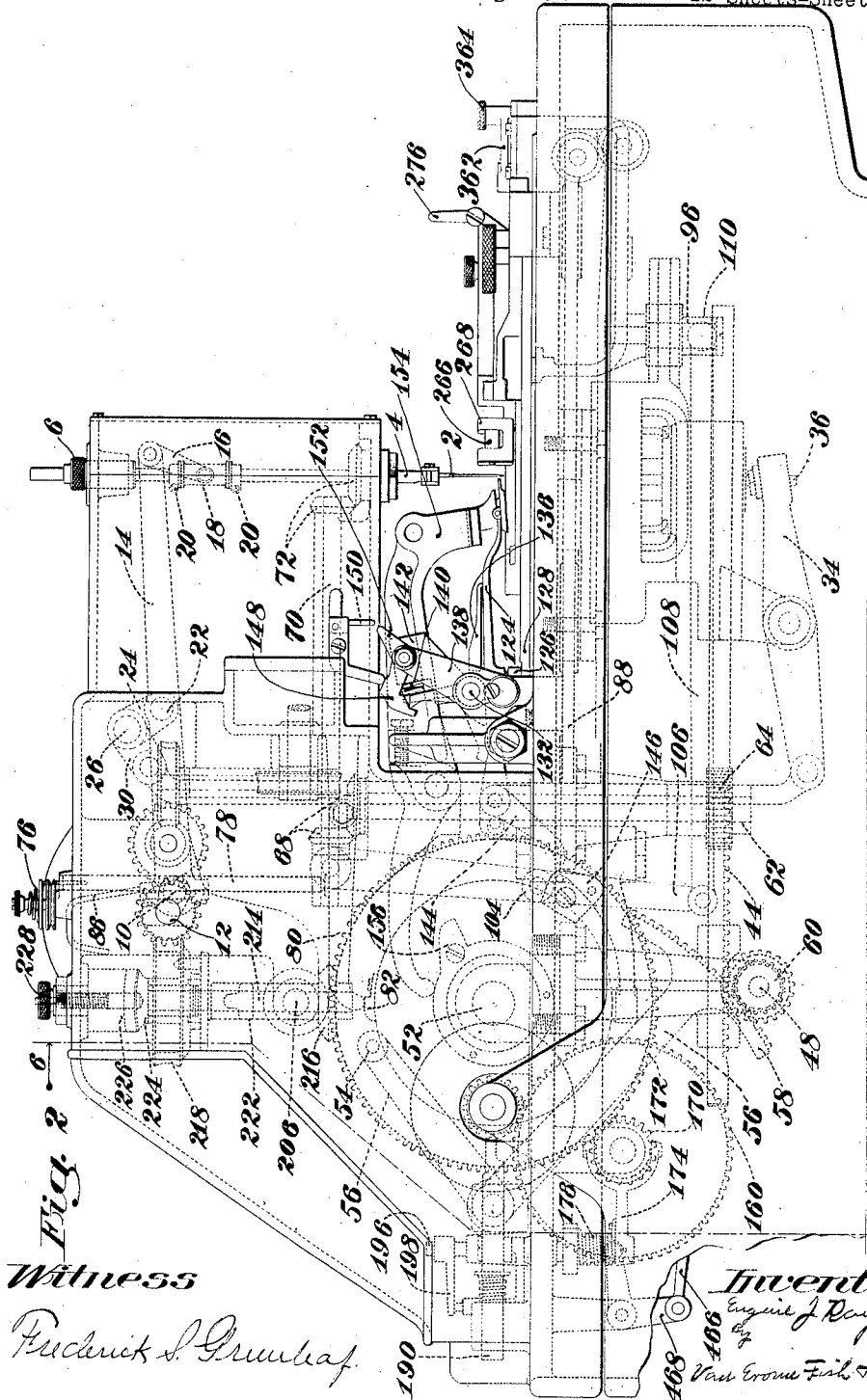
April 29, 1924.

E. J. RAY

1,492,084

BUTTONHOLE SEWING MACHINE

Filed Aug. 20, 1917. 12 Sheets-Sheet 2



Witness

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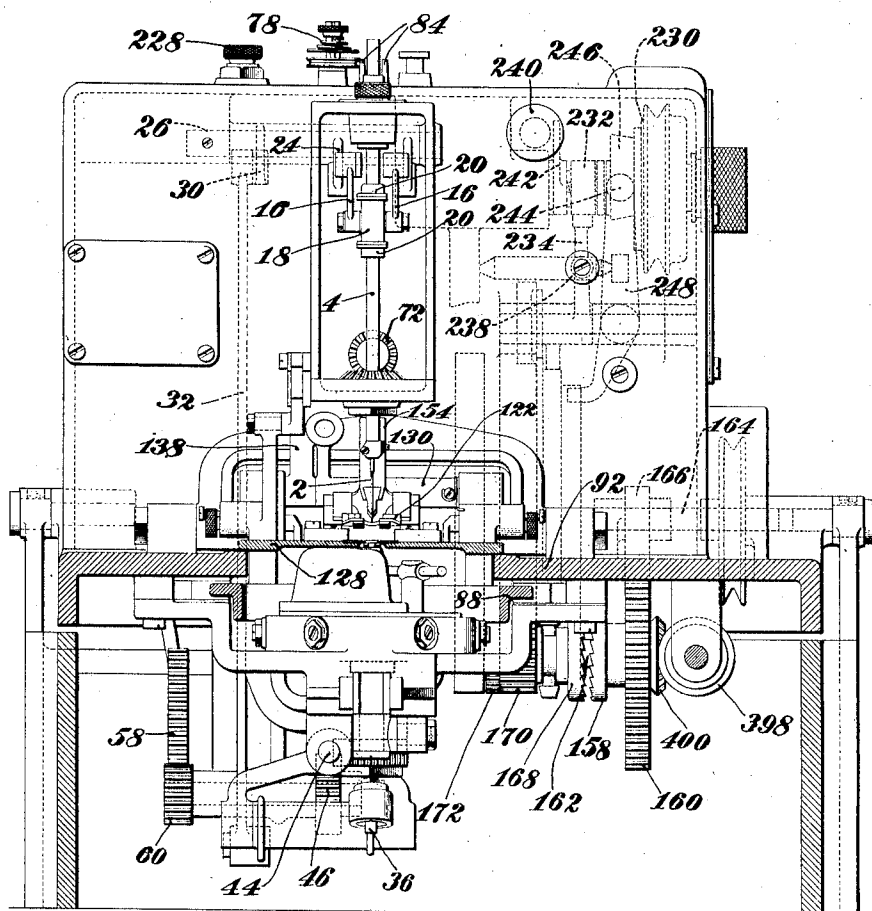
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BUTTONHOLE SEWING MACHINE

Filed Aug. 20, 1917

12 Sheets-Sheet 3

Fig. 3



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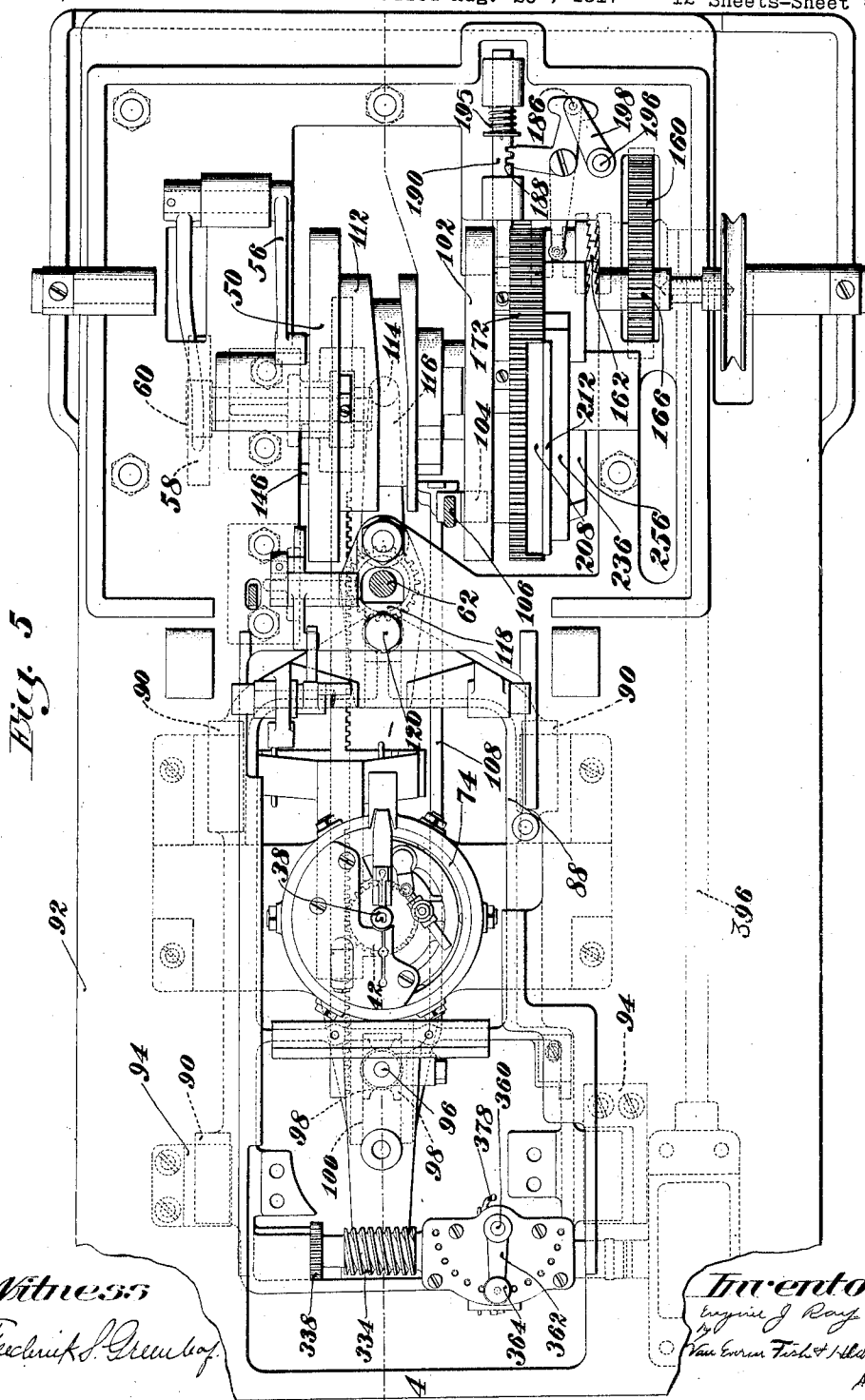
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BUTTONHOLE SEWING MACHINE

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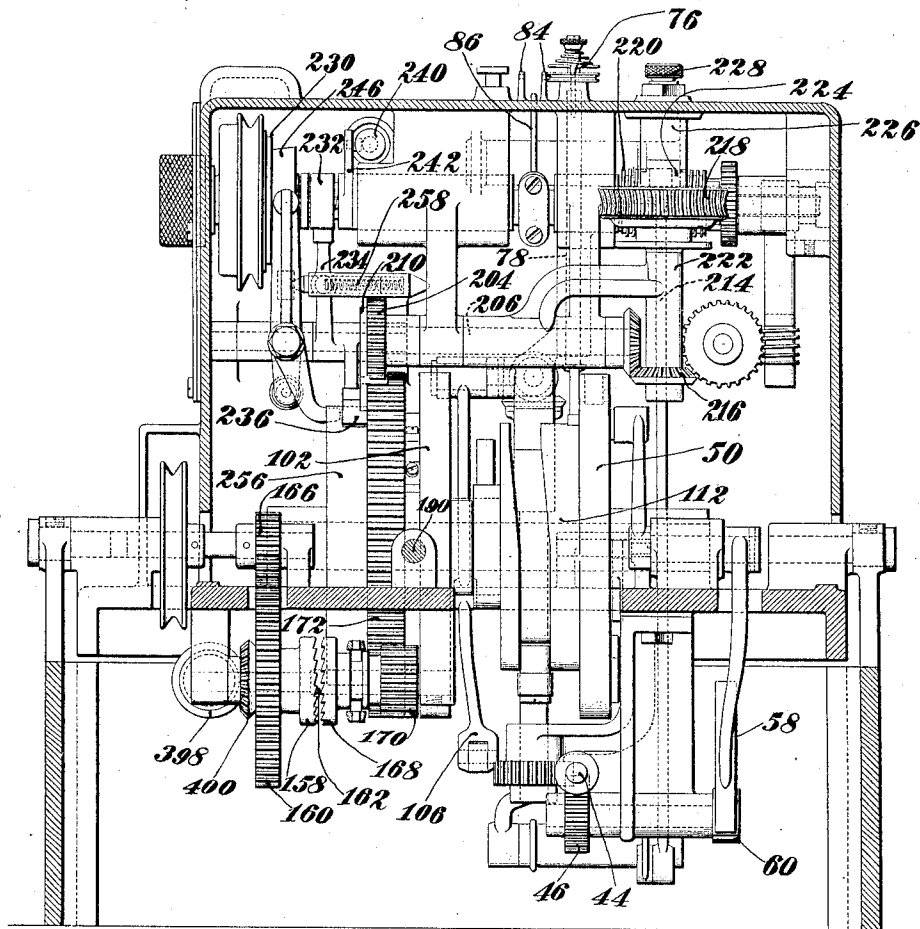
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BUTTONHOLE SEWING MACHINE

Filed Aug. 20, 1917

12 Sheets-Sheet 6

Fig. 6



Witness

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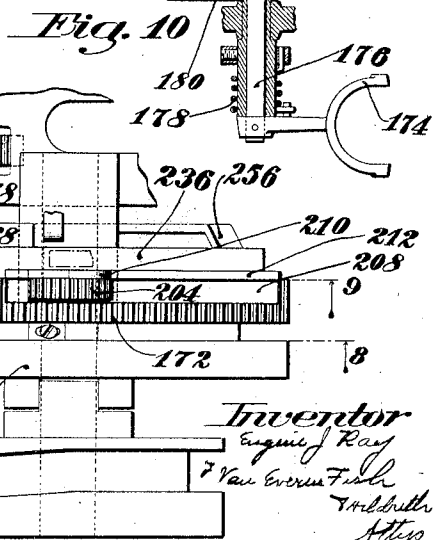
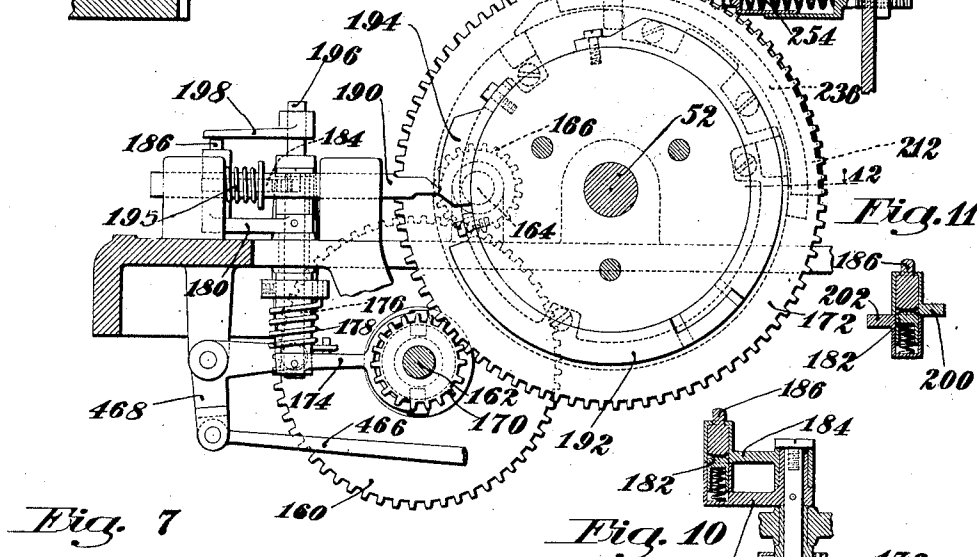
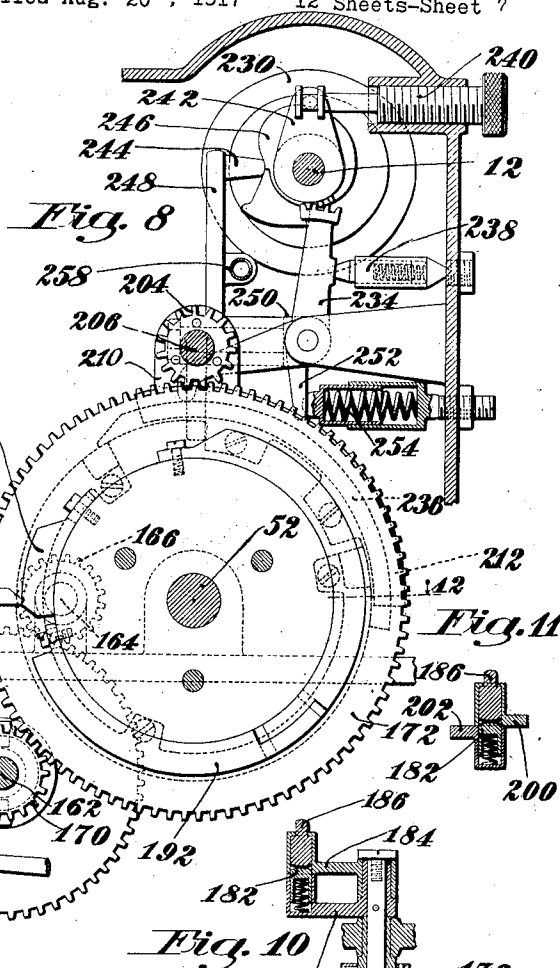
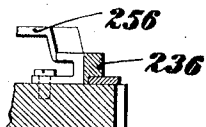
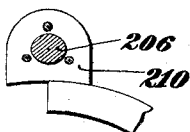
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BUTTONHOLE SEWING MACHINE

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Witness

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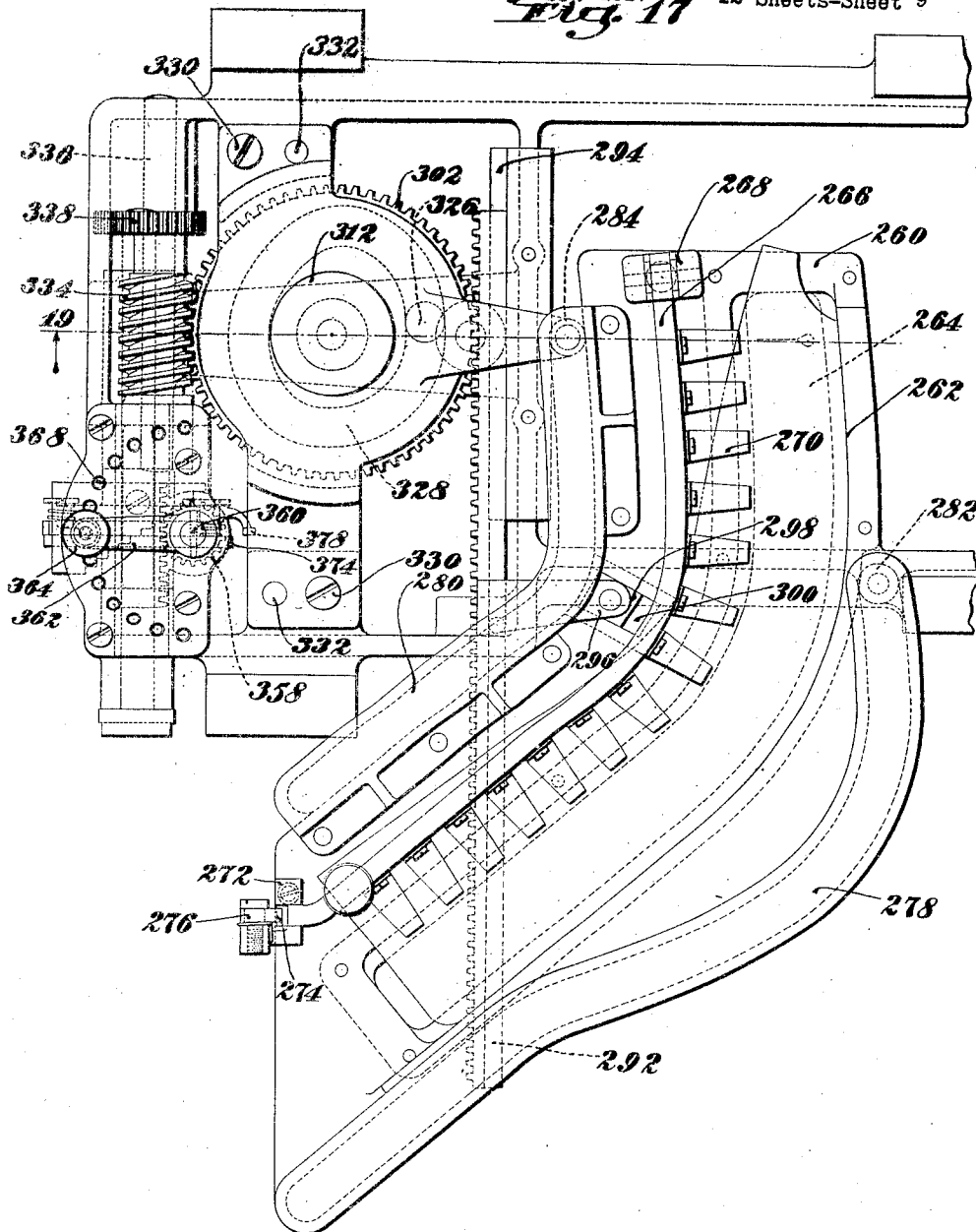
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BUTTONHOLE SEWING MACHINE

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Fig. 17



Witness

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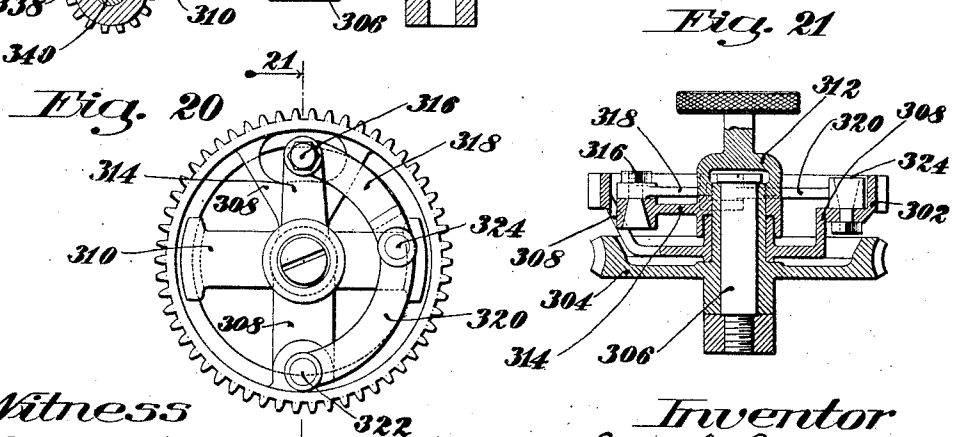
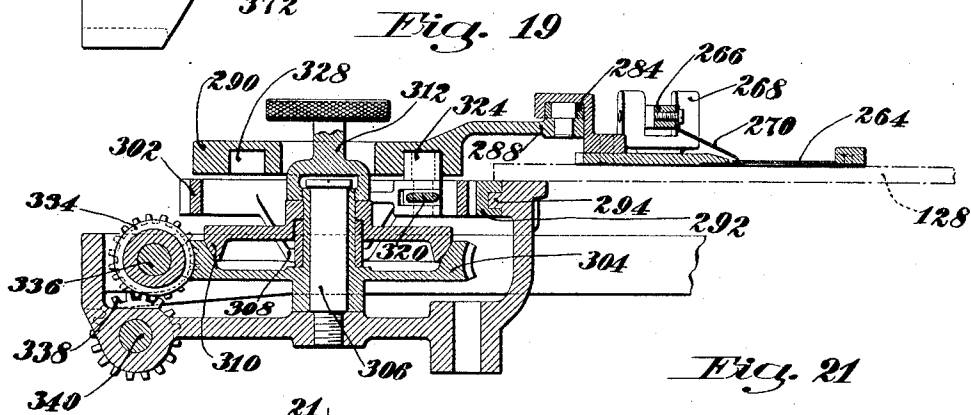
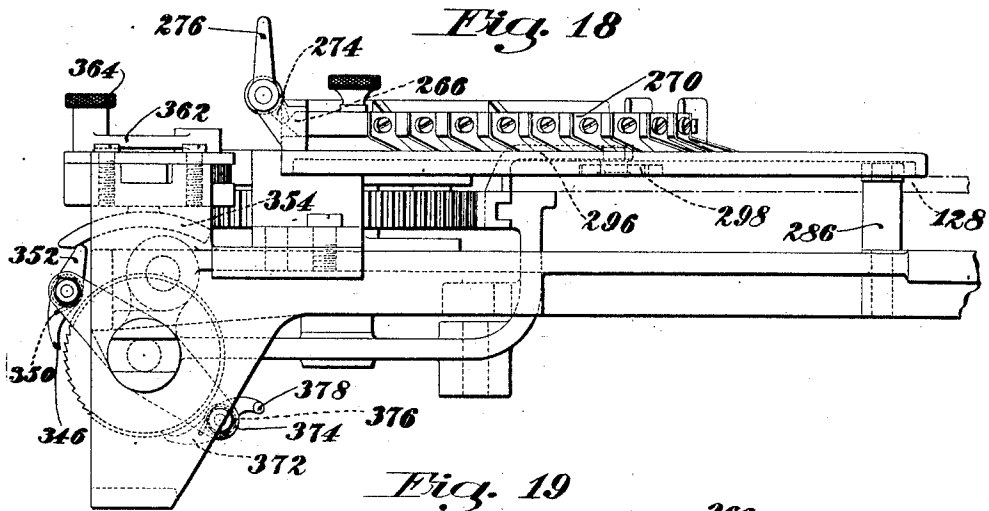
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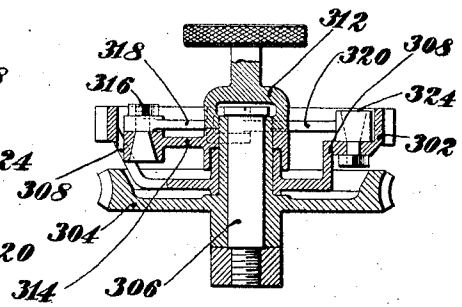
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Witness

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Fig. 21



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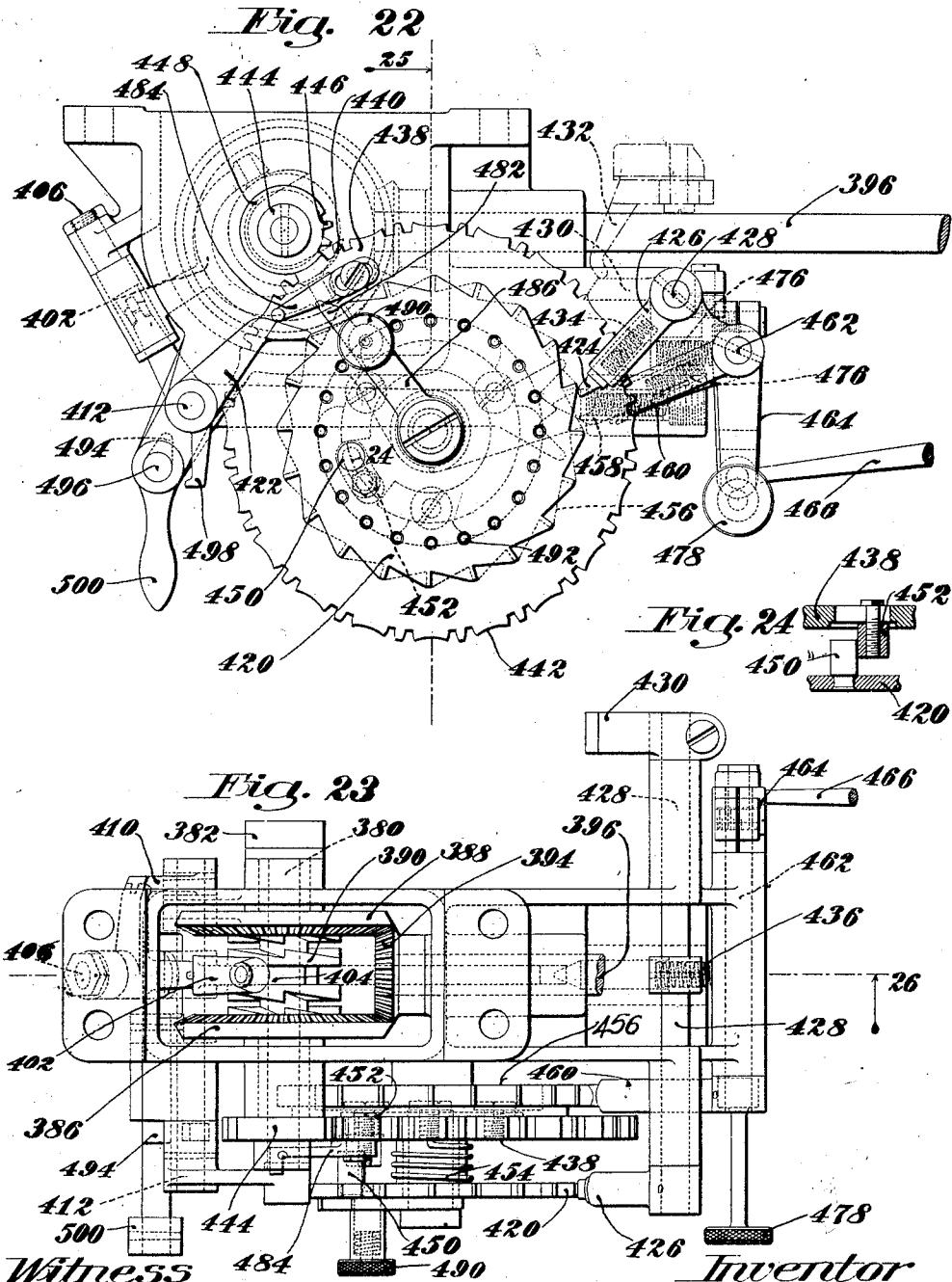
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BUTTONHOLE SEWING MACHINE

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BUTTONHOLE SEWING MACHINE

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Fig. 25

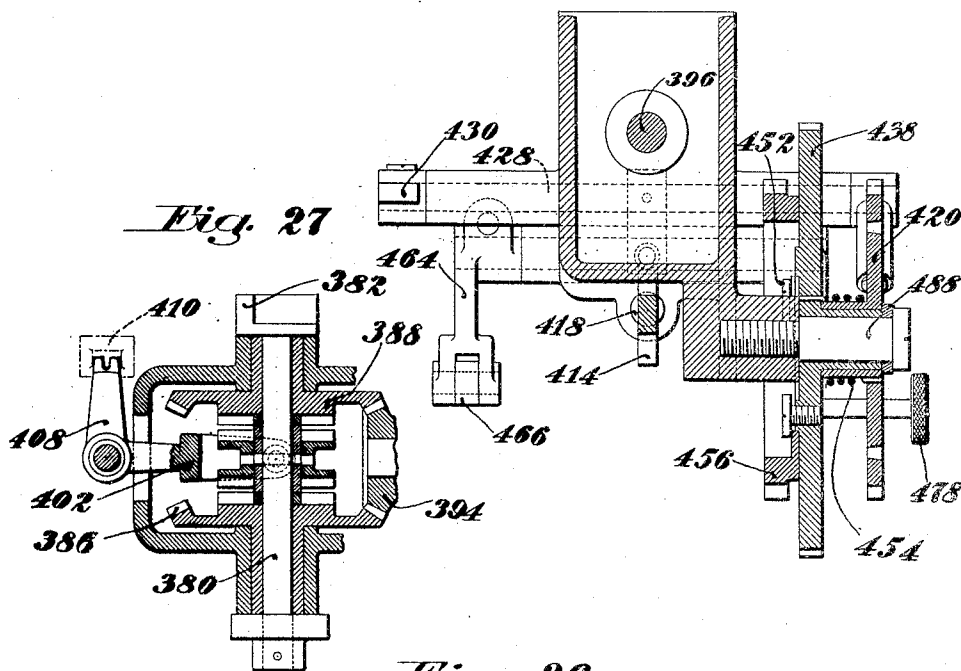
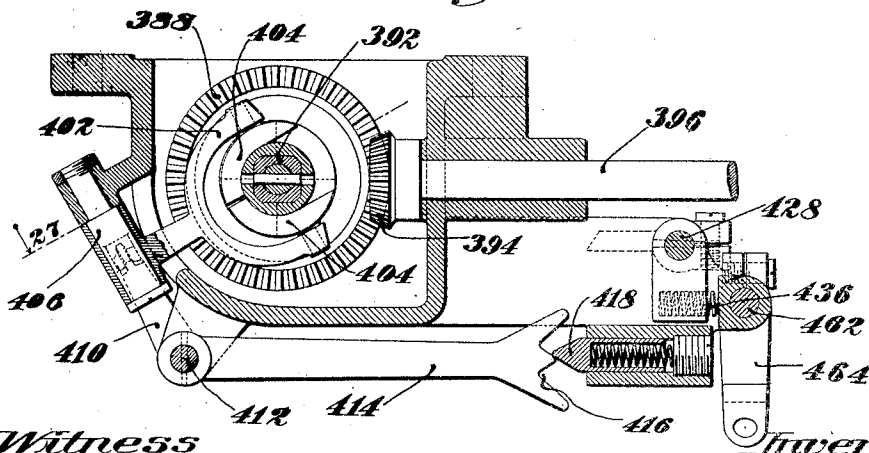


Fig. 26



Witness

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UNITED STATES PATENT OFFICE.

EUGENE J. RAY, OF BEVERLY, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO UNITED SHOE MACHINERY CORPORATION, OF PATERSON, NEW JERSEY, A CORPORATION OF NEW JERSEY.

BUTTONHOLE-SEWING MACHINE.

Application filed August 20, 1917. Serial No. 187,194.

To all whom it may concern:

Be it known that I, EUGENE J. RAY, a citizen of the United States, residing at Beverly, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Buttonhole-Sewing Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to buttonhole sewing machines in which a work holding clamp and a rotary stitch forming mechanism are relatively movable to form over-seam stitches along the sides and about one or both ends of an eye-ended buttonhole.

Machines of this type are extensively used in making buttonholes in the flies or uppers of button boots and shoes, the work being manually spaced and positioned in the work clamp by the operator between the successive buttonhole making cycles of the machine. It is the primary object of the present invention to provide a machine for automatically making a series of eye-ended buttonholes in shoe flies or analogous work, thereby avoiding the delay and inaccuracies incident to manually spacing the work and to manually starting the buttonhole making mechanisms after each cycle, with a resulting increase in the rapidity and accuracy with which the buttonholes are made and spaced, and a decrease in the skill and care required of the operator. To this end a feature of the invention contemplates the provision in a machine having a rotary stitch forming mechanism and a work clamp relatively movable to sew along the sides and about the eye of a buttonhole of work spacing mechanism co-operating therewith to automatically sew a series of buttonholes. In the more modern machines for doing the class of work referred to, the relative movement between the stitch forming mechanism and the work clamp lengthwise, or lengthwise and laterally of the buttonhole, is secured by movement of the work clamp, and another feature of the invention contemplates the provision in a machine of this type of means for automatically spacing or feeding the work from one buttonhole stitching position to another. This feature of the invention is not limited in its application to a

construction which automatically sews a series of buttonholes, although preferably embodied in a construction of this character.

The spacing of the buttonholes and their relative relation to each other and to the edge of the work usually varies with different styles and sizes of shoes, and further features of the invention relate to means by which the spacing or the spacing and positioning mechanisms may be readily set or adjusted by the operator to suit the piece of work to be operated upon.

In addition to the features outlined above, the invention also includes certain further features of construction and combinations of parts which contribute to the simplicity and efficiency of the machine, and which will be hereinafter described and set forth in the claims.

The various features of the invention will be readily understood from an inspection of the accompanying drawings and the following detailed description of the machine illustrated therein.

In the drawings, Figure 1 is a right-hand side elevation of a machine embodying the various features of the invention in their preferred forms; Fig. 2 is a left-hand side elevation of the machine; Fig. 3 is a front elevation, partly in section; Fig. 4 is a vertical section on line 4, Fig. 5; Fig. 5 is a sectional plan view on line 5, Fig. 1; Fig. 6 is a vertical section on line 6, Fig. 2; Fig. 7 is a detail plan view showing a part of the driving mechanism for the buttonhole making machine proper; Fig. 8 is a detail sectional elevation on line 8, Fig. 7; Fig. 9 is a detail section on line 9, Fig. 7; Fig. 10 is a detail section on line 10, Fig. 7; Fig. 11 is a sectional detail on line 11, Fig. 7; Fig. 12 is a sectional detail on line 12, Fig. 8; Fig. 13 is a sectional elevation on line 13, Fig. 1; Fig. 14 is a detail sectional view on line 14, Fig. 13; Fig. 15 is a detail plan view of a part of the spacing mechanism; Fig. 16 is a detail of the latch for holding the clamp of the work carrier in closed position; Fig. 17 is a detail plan view of the work carrier and a part of its operating mechanism; Fig. 18 is a detail side elevation of the parts shown in Fig. 17; Fig. 19 is a sectional elevation on line 19, Fig. 17; Fig. 20 is a detail plan view of a part of the spacing mechanism; Fig. 21 is a sectional view

on line 21, Fig. 20; Fig. 22 is a detail side elevation showing the counting mechanism for determining the number of buttonholes automatically sewn; Fig. 23 is a plan view of the parts shown in Fig. 22; Fig. 24 is a sectional detail on line 24, Fig. 22; Fig. 25 is a sectional view on line 25, Fig. 22; Fig. 26 is a sectional view on line 26, Fig. 23; and Fig. 27 is a sectional view on line 27, Fig. 26.

In the drawings the invention is shown embodied in a machine for making buttonholes in which the overseam stitches extend along the sides and about both ends of the buttonhole, the buttonhole slit being cut and spread before the sewing begins. The machine comprises in general a cutter for cutting the buttonhole slit, a traveling work clamp which is movable lengthwise and laterally of the buttonhole, and a stitch forming mechanism which is rotated during the sewing about the eye and about the opposite end of the buttonhole. The stitch forming mechanism comprises a straight eye-pointed upper needle which is arranged to penetrate the work a short distance from the edge of the buttonhole slit, a curved eye-pointed under needle which is arranged to pass up through the buttonhole slit, and which, at the upper end of its stroke, throws out a loop, down through which the upper needle passes, and a looper arranged below the work and operating to take a loop of upper needle thread and carry it into such position that the under needle will pass up through it during its up stroke.

As shown, the upper needle 2 is secured in the lower end of a hollow needle bar 4 which is mounted to reciprocate through a stationary upper bearing 6 and through a rotary head 8 with which the bar is so connected that it will rotate with the head while being free to reciprocate therethrough. The needle bar is reciprocated by a crank 10 formed on the sewing shaft 12 and engaging the rear end of a lever 14, the forward end of which is connected by links 16 with a sleeve 18 on the needle bar. The sleeve is confined between collars 20 which may be adjusted to determine the path of reciprocation of the needle. The lever 14 is pivotally supported at 22 on a link 24 which is free to swing about the shaft 26 as the lever is oscillated by the crank 10. The parts are so proportioned that the accurate timing of the upper needle with relation to the under needle and looper is secured through the combined oscillating and bodily swinging movements imparted to the lever 14 by the crank and lever supporting link 24, and the needle may be reciprocated at high speed without strain or undue wear on the parts.

The under needle and looper, which as shown are constructed and arranged like the needle and looper of Patent No. 1,134,046, dated March 30, 1915, are arranged upon

a turret 28 which is rotated in unison with the head 8 in sewing about the ends of a buttonhole. The under needle and looper mechanism is operated from the crank 10 through the oscillation of the lever supporting link 24, and thus the accurate timing of the parts is ensured when operating at high speed. As shown, the link 24 forms one arm of a bell crank lever, the other arm 30 of which is connected by a link 32 with the rear end of a rock lever 34. The forward end of the lever 34 is connected by a universal joint with a hollow link 36 which is arranged substantially in the axis of the turret, and is connected at its upper end with a lever on the turret through which the under needle and looper mechanism is actuated, as is more fully disclosed in the patent above referred to. In addition to the under needle and looper mechanisms the turret 28 carries the usual throat plate 38 provided with a needle opening and a guide for the stay cord.

The turret is rotated at the proper times through a rack bar 40 provided with rack teeth engaging a gear 42 on the lower end of the turret, and also provided with rack teeth 44 engaged by a gear 46 secured to a shaft 48. The shaft 48 is actuated from a cam 50 secured to the cam shaft 52, and engaging a roll 54 carried by one arm of a lever 56, the other arm of which is provided with a gear segment 58 engaging a pinion 60 on the end of the shaft 48. The head 8 is rotated in unison with the turret through a shaft 62, the lower end of which carries a gear 64 engaging rack teeth 66 on the rack bar 40, and the upper end of which is connected by bevel gears 68 with the rear end of a shaft 70, the forward end of which is connected by bevel gears 72 with the head 8. The turret may be and preferably is mounted to turn in ball bearings indicated at 74 in Fig. 5.

The under thread and stay cord are led to guides on the turret through the hollow link 36, and the upper thread is led to the upper needle through the hollow needle bar 4 and the usual light tension on the lower end of the needle bar. The upper thread leads to the needle bar through a tension device 76 which may be operated to release the tension at the completion of the sewing, and to re-apply the tension at the beginning of the sewing, through a vertically movable rod 78, the upper end of which acts on the tension device, and the lower end of which bears on a lever 80 which is operated by a cam lug 82 secured to one of the cam discs carried by the cam shaft 52. On its way to the needle bar the upper thread passes through two thread guides 84, and between these guides the thread is acted upon by a thread controller 86 carried by the rear end of the crank lever 14, and corresponding to

the thread controller shown and described in Patent No. 1,063,880, dated June 3, 1913.

The work clamps are mounted upon a clamp carriage 88 provided with side flanges 5 having bearing surfaces 90 which fit between bearing surfaces formed on the under side of the base plate 92, and formed on the upper side of the turret bracket and brackets 94 secured to the under side of the base plate, as indicated in Figs. 3 and 5. Near 10 its forward end the clamp carriage is connected by a pivot bolt 96 with a fulcrum block 98 mounted to slide lengthwise of the buttonhole in a guideway 100 formed in 15 the turret bracket. The clamp carriage is moved longitudinally or lengthwise of the buttonhole by a feed cam 102 secured to the cam shaft 52, and provided with a cam groove engaging a roll 104 carried by a lever 20 106, the lower end of which is connected by a link 108 with a sleeve 110 mounted on the lower end of the pivot stud 96. The clamp carriage is moved laterally during the sewing about the eye of the buttonhole by a 25 cam 112 secured to the cam shaft 52, and provided with a groove engaging a roll 114 on the rear end of the lever 116. The forward arm of the lever 116 is slotted to receive a pivot block 118 which is connected 30 to the rear end of the clamp carriage by a pivot bolt 120 (Figs. 4 and 5).

The upper work clamping jaws 122 are carried in the forward ends of clamp arms 124 which are pivoted on blocks 126 adjustably secured on the work supporting 35 plates 128, which are in turn pivoted upon the work carriage, so that they may be separated to spread the buttonhole. The devices for retaining and positioning the 40 plates, and for separating the plates to spread the buttonhole, are the same in construction as the corresponding devices shown and described in Patent No. 1,063,880. The means for closing the clamp is substantially 45 the same in construction as the mechanism shown and described in application Serial No. 125,948, filed October 16, 1916, and comprises a sleeve 130 secured to a rock shaft 50 132 and carrying a yoke 134 which is pivotally mounted on the sleeve and is provided with arms 136 bearing on the clamp arms 124. The sleeve is rocked to close the clamp through a rock lever 138 mounted to turn on the shaft 132, and having a vertical 55 arm arranged to engage a spring 140 which is interposed between the arm and an arm 142 rising from the sleeve. The horizontal arm of the rock lever 138 is arranged to overlie the forward end of a lever 144 when 60 the clamp carriage is in its retracted position, as indicated in Fig. 2. The rear end of the lever 144 is arranged to be acted upon by a cam 146 secured to the cam disc 50, and operating to rock the lever to close the clamp 65 when the cam shaft is started. The move-

ment of the lever 144 is transmitted to the rock shaft 132 and yoke 136 through the lever 138 and spring 140, and the pivoted yoke 136 acts to equalize the pressure on the clamp arms. The clamp is held closed 70 during the cutting and sewing by a latch 148 arranged to engage the lever 138. The latch is operated to release the lever and allow the clamps to open as the clamp carriage is moved back into its retracted position by 75 a dog 150 arranged to engage the arm 152 of the latch during the backward movement of the carriage.

The buttonhole slit is cut while the clamp carriage is in its retracted position by a 80 cutter carried on the forward end of a cutter lever 154, the rear end of which is arranged to be engaged by a cam 156 secured to the cam shaft. The buttonhole slit is spread 85 during the forward movement of the clamp carriage from cutting to sewing position by a spreader cam such as shown and described in Patent No. 1,063,880.

The cam shaft 52 is given a single revolution during each cycle of the machine. It 90 is driven at a comparatively high speed when the machine is started to close the clamp, to operate the cutter, and to move the clamp carriage forward from cutting to sewing position, is then driven at a compara- 95 tively slow speed through connections with the sewing shaft 12 during the sewing of the buttonhole, and is then again driven at comparatively high speed through the remainder of its revolution to return the 100 clamp carriage to cutting position, to open the clamp, and to turn the sewing mechanism back towards initial position, the return movement being completed during the 105 first part of the rotation of the cam shaft when the machine is started in forming the succeeding buttonhole. The mechanism for driving the cam shaft at comparatively high speed before and after the sewing comprises 110 a high speed driving clutch member 158 formed on the hub of a gear 160 which is mounted on the shaft 162 and is continuously driven from a driving shaft 164 through a pinion 166. The clutch member 115 is provided with clutch teeth adapted to be engaged by corresponding teeth on a driven clutch member 168 formed on one end of a sleeve which is mounted to slide on the shaft 162, and is provided at the other end 120 with a pinion 170 engaging a gear 172 secured to the cam shaft. The clutch members are engaged and disengaged at the proper times through a yoke 174 secured to a vertical rock shaft 176 and carrying rolls 125 at the ends of its arms which engage an annular groove in the clutch sleeve (Figs. 3, 5, and 7 to 10). The clutch member 168 is forced in a direction to engage the clutch members by a spring 178 surrounding the bearing for the shaft 176 and acting on the 130

yoke 174 (Figs. 8 and 10). The rock shaft 176 is actuated to engage and disengage the clutch through an arm 180 secured to the upper end of the shaft, and carrying a spring pressed pin 182 which engages a recess in one arm of a bell crank lever 184 loosely mounted on the hub of the arm 180. An unlatching pin 186 is arranged in the lever 184 above the pin 182 for a purpose to be described. The other arm of the bell crank lever 184 is provided with a gear segment 188 engaging rack teeth formed in a bar 190, the inner end of which is arranged to be engaged by cam ribs 192 and 194 which are secured on the hub of the gear 172. A spring 195 forces the rack bar 190 toward the cams. So long as the arm 180 and bell crank lever 184 are connected together by the pin 182, and the bar 190 is in engagement with either the cam 192 or the cam 194, the clutch member 162 will be held in disengaged position. When the machine is to be started the tripping pin 186 is depressed by the downward movement of a rod 196, the upper end of which carries an arm 198 overlying the pin. The depression of the pin 186 forces the latching pin 182 out of the recess in the bell crank lever 184, so that the arm 180 is disconnected from the bell crank lever, thus allowing the spring 178 to rock the shaft 176 and engage the clutch members. During this movement of the rock shaft the latch pin 182 rides under a flange 200 on the side of the bell crank lever 184, while the pin 186 is supported on a similar flange 202 projecting from the opposite side of the arm 180 (Fig. 11). When the bar 190 rides off of the cam 194 during the rotation of the cam shaft, the bell crank lever 184 is swung into position over the arm 180, so that the latch pin 182 re-engages the recess in the bell crank lever. This re-connects the bell crank lever and arm 180, so that the clutch members will be disengaged when the bar 190 rides up on to the cam rib 192, as it does at the beginning of the sewing, and as the bar rides up on to the cam 194, as it does after the clutch members have been reengaged at the completion of the sewing and are to be disengaged to stop the machine.

The cam shaft 52 is driven during the sewing through a pinion 204 secured to a shaft 206 and engaging the gear 172. During the time that the gear is being driven both before and after the sewing the pinion 204 registers with a blank space 208 formed on the gear 172, and the pinion and connected mechanism is locked against displacement during this period by a locking plate 210 secured to the side of the pinion and arranged to engage a segmental locking plate 212 secured to the side of the gear. The shaft 206 is driven from the sewing shaft 12 through

a vertical shaft 214, the lower end of which carries a bevel gear 216 engaging a similar gear on the shaft 206, and the upper end of which carries a worm wheel 218 engaging a worm 220 on the sewing shaft. In order that the speed of the cam shaft with relation to the sewing shaft may be readily changed to vary the number of stitches in the buttonholes, the shaft 214 is mounted in a bearing 222 which is supported to turn on the shaft 206, and the worm wheel 218 is so mounted on the upper end of the shaft that it may be readily removed and another wheel substituted. A removable bearing block 224 is arranged above the worm wheel and engages a retaining block 226 within which it may be locked by a locking bolt 228.

The driving and stopping mechanism for the sewing shaft comprises a clutch indicated at 230, which is the same in construction as the clutch shown and described in Patent No. 1,212,486, dated January 16, 1917, and is engaged and disengaged by the rocking of a cam sleeve 232 corresponding to the rocking cam sleeve of said patent. The sleeve is rocked to engage and disengage the clutch through a bell crank lever 234, one arm of which is provided with a gear segment engaging a gear segment on the cam sleeve, and the other arm of which is arranged to be engaged by a cam rib 236 secured to the side of the gear 172. The bell crank lever is forced in a direction to engage the clutch by a spring operated strut 238 (Fig. 8). The timing of the clutch disengaging mechanism may be adjusted by the operator through an adjusting screw 240, the inner end of which is connected with the cam plate 242 with which the cam sleeve 232 co-operates.

A stop pin 244 which co-operates with a stop cam 246 on the sewing shaft is carried on the upper end of a lever 248. The lever is pivoted on a rocking support 250, which is provided with a depending arm 252 acted upon by a spring 254 which tends to force the stop pin against the periphery of the stop cam. The lower end of the lever 248 is arranged to be engaged by a cam 256 which rocks the lever on the support 250 to move the stop pin out of the path of the cam, the lever being rocked to carry the pin into the path of the cam by a spring operated strut 258.

The mechanisms thus far described are adapted to automatically cut and sew a buttonhole and then come to rest in initial position whenever the starting mechanism is tripped, the mode of operation being in general the same as the mode of operation of the machines in commercial use for making eye-ended buttonholes in the flaps of button shoes. In operating machines of this type as heretofore constructed, the operator shifts

the work in the work clamp from one buttonhole sewing position to another, and trips the starting mechanism after the work has been shifted and positioned in the clamp.

5 The proper and accurate spacing of the buttonholes depends, therefore, upon the skill and care of the operator, and the production of a machine is to a large extent dependent upon the dexterity of the operator. In the
10 machine illustrated, the accurate spacing of the buttonholes is ensured, and the production of the machine increased, by providing means for automatically feeding the work from one buttonhole sewing position to another, and by so constructing and operating
15 these means that a series of buttonholes is automatically cut and sewed. In the construction shown the means for spacing or feeding the work from one buttonhole sewing position to another comprises a work
20 carrier which is mounted on the clamp carriage and is operated to shift the work and position it in the work clamp between successive cycles of the buttonhole making mechanisms. The work carrier is one form of
25 work spacing means which is constructed to act on the work adjacent to the sewing point and is, therefore, well adapted for spacing comparatively small pieces of work such as this type of machine usually operates on.
30 The work carrier is designed for spacing and positioning buttonhole flies of shoe uppers either before or after they are secured to the uppers, and as shown comprises a base plate 260 provided with a curved edge gage 262
35 corresponding substantially to the curvature of the buttonhole fly, and with a slot 264 extending parallel and adjacent to the edge gage, and registering with the buttonhole zone of the fly when in position against the edge gage. The carrier plate is arranged to move over the upper surface of the
40 work supporting plate 128 of the work clamp and the base plate of the carrier between the edge gage 262 and the slot 264 and along the opposite edge of the slot is very thin, so that the work when in position on the carrier is close to the upper surface of the work supporting plates, and may be
45 firmly clamped by the work clamping jaws. The work carrier is provided with means for clamping or holding the work in position which as shown comprises a clamp bar 266 having one end pivoted to a pivot block 268
50 which is mounted on the upper side of the carrier, and provided with a series of spring clamping fingers 270 which are arranged to engage the work and press it against the upper surface of the carrier along the outer edge of the slot 264. When the clamp bar 266 is swung down into work holding position its free end passes between two positioning lugs 272 and is latched in position by a
55 yielding latch finger 274. The latch finger may be operated to release the bar by a

handle 276 (Fig. 16). In order that the buttonholes may be properly positioned with relation to the edge of the work, the path of movement of the carrier transversely of the clamp carriage and of the buttonholes is determined by two guideways 278 and 280 formed on the carrier and engaged by guide rolls 282 and 284. The shape and curvature of the guideways will depend upon the curvature of the edge gage 262 and upon the relation which the buttonholes are to bear to the edge of the work. As shown in Fig. 17, the guideways are shaped and arranged to so position the work in the work clamps that the buttonholes will be formed substantially at right angles to the edge gage 262 and to the edge of the buttonhole fly held in the carrier. The roll 282 is mounted upon the upper end of a post 286 which rises from the clamp carriage and projects through a slot formed in one of the supporting plates 128. The guide roll 284 is carried on the end of an arm 288 projecting from a cam plate 290 which is mounted upon the clamp carriage, and will be again referred to. The means for actuating the work carrier to space the buttonholes comprises a rack 292 mounted to reciprocate on a guide rib 294 which is formed on the clamp carriage (Figs. 17, 18 and 19). The rack bar is provided with an arm 296
70 75 80 85 90 95

The rack is engaged by a gear 302 which is driven from a worm wheel 304 through mechanism which varies the movement imparted to the gear in accordance with the path of movement of the work carrier, so that the requisite movements are given to the carrier to equally space the buttonholes along the irregularly curved edge of the work. The connections between the uniformly moving worm wheel 304 and the gear 302 are also so constructed that they may be uncoupled or disconnected to permit the movement of the work carrier into position to properly locate the first buttonhole in the series to be sewed. As shown in Figs. 17 to 21, the worm wheel 304 is mounted upon a stud 306 secured in the clamp carriage, and the gear 302 is provided with a hub loosely mounted on the hub of the worm wheel and connected with the rim of the gear by the arms 308. The connections between the worm wheel and gear comprise a coupling or clutch member 310 in the form of a bar mounted on the hub of the worm wheel and provided at its ends with conical clutch faces adapted to engage a conical clutch face in the upper side of the worm wheel. The clutch bar is normally forced into engagement with the worm wheel by a clamping nut 312 screwed on to the upper end of the worm wheel hub and projecting up through the cam plate 290. The upper end of the
100 105 110 115 120 125 130

clamping nut is provided with a knurled head by which it may be manipulated in clamping and releasing the clutch bar. The clutch bar is provided with a laterally projecting arm 314, the upper end of which carries a crank pin 316 which is connected by two arms or links 318 and 320 to a crank pin 322 on one of the arms 308 of the gear 302. The pivot pin 324 which connects the links 318 and 320 carries a roll 326 which engages a cam groove 328 formed in the under side of the cam plate 290. Motion is transmitted from the worm wheel 304 to the gear 302 through the links 318 and 320, and this movement is varied by the action of the cam groove 328 on the links to increase or diminish the movement imparted to the gear in accordance with the curvature of the path of movement of the work carrier. In case carriers having different paths of movement to suit work of widely varying curvature are to be used, the cam plate 290 must be changed so that the cam groove 328 will correspond to the curvature of the path of movement of the carrier. To permit the cam plate to be readily changed it is secured upon the clamp carriage by the screws 330 and dowel pins 332.

The worm wheel 304 is intermittently rotated through a worm 334 secured to a shaft 336 which is connected by gears 338 with a shaft 340. The shaft 340 is mounted on the clamp carriage, and is driven from a shaft 342 which is also mounted on the clamp carriage and is given a single rotation between successive buttonhole making cycles by mechanism mounted on the machine frame and connected with the shaft through a coupling to be hereinafter described. In order that the movement imparted to the work carrier, and therefore the spacing of the buttonholes, may be varied to suit the piece of work being operated upon, the mechanism through which motion is transmitted from the shaft 342 to the shaft 340 is so constructed that it may be readily adjusted by the operator to vary the movement given to the shaft 340 by each complete rotation of the shaft 342. As shown, this mechanism comprises a ratchet wheel 344 secured to the end of the shaft 340, and a feeding pawl carried by an arm 348 secured to the end of the shaft 342 and arranged to be held in engagement with the ratchet wheel by a spring 350. The pawl is provided with a tail piece 352 which is arranged to ride over a controller plate 354 during a part of the revolution of the shaft 342, the controller plate being arranged to hold the pawl out of engagement with the ratchet wheel. The controller plate is provided with a series of pawl-engaging surfaces which are of different lengths, and the plate is so mounted that it may be adjusted to bring any required pawl-engaging surface into the path of the

tail piece 352. As shown in Figs. 13 to 18, the controller plate is carried upon a rack bar 356 which is engaged by a pinion 358 secured to a shaft 360. The shaft 360 is provided at its upper end with an arm 362, the outer end of which is provided with an operating handle 364 attached to a locking pawl 366 which may be engaged with any one of a series of holes 368 formed in the upper surface of the plate overlying the rack bar. The operating handle 364 is within convenient reach of the operator, so that the controller plate may be readily and quickly adjusted to bring any desired pawl-engaging surface into the path of the feeding or spacing pawl. The holes may be graduated to indicate the spacing corresponding to any adjustment if found desirable.

In the machine illustrated the work carrier is automatically returned to initial position after the completion of a series of buttonholes, and this movement is effected by a reverse rotation of the shaft 342 through a number of revolutions corresponding to the number of buttonholes which have been automatically sewn. The mechanism through which the reverse rotation of this shaft is transmitted to the shaft 340 comprises a second ratchet wheel 370 secured to the shaft 340 at the side of the spacing ratchet wheel 344, and a returning pawl 372 mounted upon an arm 374 secured to the end of the shaft 342 and held normally in engagement with the ratchet wheel 370 by a spring 376. In order that the same movement may be imparted to the shaft 340 and to the work carrier during both the feeding and reverse rotations of the shaft 342, the returning pawl 372 is provided with a tail piece 378 arranged to travel in the same path through which the tail piece 352 of the spacing pawl travels. During the reverse rotations of the shaft 342 therefore, the returning pawl travels over the same pawl-engaging surface on the controller plate which was engaged by the pawl 346 during the spacing of the buttonholes. Both pawls therefore have the same extent of idle travel during each rotation of the shaft 342 in either direction, and the return movement of the carrier will therefore be the same as the spacing movement in sewing a series of buttonholes.

The mechanism for automatically actuating the work spacing means, and for controlling the buttonhole making mechanisms to sew a series of buttonholes and then return the work carrier to initial position, is mounted on the machine base and comprises a shaft 380 which is so arranged that it is in line with the shaft 342 on the clamp carriage when the clamp carriage has been moved to its retracted position at the completion of the buttonhole

making cycle (Figs. 1, 3, 13, and 22 to 26). At this time the shaft 380 is coupled to the shaft 342 by a coupling comprising a tongue 382 secured on the end of the shaft 380, and engaging a slot 384 formed in a sleeve secured to the end of the shaft 342, the tongue and slot being arranged to be engaged and disengaged by the travel of the clamp carriage lengthwise of the buttonhole. The mechanism for rotating the shaft 380 to feed and return the work carrier comprises two reversely rotating bevel gears 386 and 388 loosely mounted on the shaft 380 and provided with two clutch members adapted to be engaged by a clutch 390 arranged between the gears. The clutch is connected with the shaft by a polygonal sleeve 392 which is pinned to the shaft so that the shaft will rotate with the clutch while the clutch is free to move into engagement with either of the gears. The gears 386 and 388 are continuously driven in opposite direction through a bevel pinion 394 secured to the forward end of a shaft 396, the rear end of which carries a gear 398 engaging a gear 400 which is secured to the constantly running gear 160. The mechanism for shifting and controlling the clutch comprises a yoke 402, the arms of which carry shoes 404 engaging an annular groove in the clutch (Figs. 23, 26 and 27). The yoke is mounted upon a stud 406, and is provided with a laterally projecting arm 408, the outer end of which is toothed to engage corresponding teeth in an arm 410 secured to the end of a rock shaft 412. The rock shaft carries an arm 414, the end of which is provided with two V-shaped notches 416 adapted to be engaged by a spring-pressed pawl 418 which tends to shift the clutch in either direction, according to the notch with which the end of the pawl happens to be in engagement. Normally the pawl tends to shift the clutch into engagement with the gear 386 which is driven in the proper direction to advance or feed the work carrier. The clutch is controlled by a counting mechanism which determines the number of buttonholes which shall be automatically sewn before the buttonhole making mechanism stops and the work carrier is returned to initial position. This counting mechanism comprises a toothed wheel 420 which is provided with a number of teeth corresponding to the greatest number of buttonholes which the machine is adapted to sew. The counting wheel is so arranged that the teeth on the wheel engage the end of an arm 422 secured on the rock shaft 412 and normally hold the clutch in neutral position against the pressure of the spring pawl 418, the end of the arm normally resting on the high part of a tooth, as indicated in Fig. 22. The toothed wheel 420 is moved sufficiently to release the arm 422 so that the clutch may be engaged with the spacing gear wheel 386 by a pawl 424 arranged to engage a tooth of the wheel, and actuated by the movement of the clamp carriage into its retracted position. As shown in Figs. 1, 22 and 23 the pawl 424 is mounted in an arm 426 secured to the end of a rock shaft 428, the opposite end of which carries an arm 430 arranged in the path of a finger 432 which is secured to the clamp carriage. The pawl is mounted to slide in the arm 426 and is held in active position by a spring 434. When the clamp carriage is advanced at the beginning of a buttonhole making cycle, the finger 432 moves to the left in Figs. 1 and 22 and disengages the arm 430, so that the shaft 428 may be rocked by a spring 436 which acts upon an arm depending from the shaft. This movement of the rock shaft carries the pawl 424 over the end of a tooth in the wheel 420 and into active position in front of the tooth. When the clamp carriage returns to its initial position at the completion of a buttonhole making cycle, the finger 432 engages the arm 430 and rocks the shaft 428 into the position indicated in Fig. 22, thus actuating the pawl 424 to slightly advance the toothed wheel 420. This movement of the wheel carries the tooth which has been supporting the arm 422 from under the end of the arm, so that the work spacing clutch is engaged to effect the spacing of the work. When the spacing clutch is engaged it remains in engagement during a single revolution of the shaft 380, and is then disengaged by a forward movement of the toothed wheel 420 sufficient to bring the high part of another tooth under the end of the arm 422, the tooth acting to swing the arm and return the spacing clutch to initial position. The revolution of the shaft 380 not only spaces the work, but it also actuates the mechanism which, as the spacing is completed, automatically trips the high speed clutch of the buttonhole making mechanisms, so that after the work is spaced the work clamp is automatically closed and the succeeding buttonhole cut and sewed. The mechanism through which this is accomplished comprises a wheel 438 which is connected with the toothed wheel 420 and is provided with a series of toothed portions 440 separated by locking segments 442, the series of toothed portions and the series of locking segments corresponding in number to the number of teeth in the toothed wheel 420. The wheel 438 is advanced a step as the shaft 380 completes each revolution through a disc 444 secured to the end of the shaft 380, and provided with teeth 446 for engaging the toothed portions of the wheel 438, and with a locking seg-

ment 448 co-operating with the locking segments 442. In order that the toothed wheel 420 may be slightly advanced by the pawl 424 in the manner above described, while the wheel 438 is locked by the locking segment on the end of the shaft 380, the wheel 420 is mounted to turn on the hub of the wheel 438, as indicated in Fig. 25, and is provided with a stud 450 arranged to be held in engagement with an adjustable stud 452 on the wheel 438 by a spring 454. The means for automatically tripping or starting the buttonhole making mechanism at the completion of the spacing of the work comprises a toothed wheel 456 secured to the rear side of the wheel 438 and arranged to act upon a pawl 458 which is connected to actuate the tripping rod 196. The pawl 458 is mounted in an arm 460 secured to one end of a rock shaft 462, the other end of which carries an arm 464 which is connected by a link 466 to one arm of a bell crank lever 468. The other arm of the bell crank lever carries a roll 470 engaging a slot 472 in the lower end of the tripping or starting rod 196 (Figs. 1, 7 and 8). The tripping or starting rod and the pawl carrying arm 460 are held in normal position by a spring 474 which supports the rod in its raised position with its arm 198 above the tripping pin 186 heretofore described. The pawl 458 is mounted to slide in the arm 460, and is held yieldingly in its advance or active position by a spring 476. The pawl normally stands in the position indicated in Fig. 22 with its outer end in the path of the teeth on the toothed wheel 456, the teeth of which are arranged to face in a direction opposite to that in which the teeth of the wheel 420 face. During the latter part of the advance movement of the wheel 438, which occurs as the spacing shaft 380 completes its revolution, one of the teeth on the wheel 456 engages the end of the pawl 458, and as it passes the end of the pawl, rocks the shaft 462 to depress the starting rod 196 and thereby engage the high speed clutch 162 of the buttonhole making mechanisms. The shaft 462 is rocked to depress the starting rod 196 in starting the machine to make the first buttonhole through a handle 478 which projects from the arm 460 on the end of the shaft, and is in convenient position to be manipulated by the operator.

After the machine is started by the operator, as above indicated, the controlling mechanism operates in the manner above described to throw the spacing mechanism into operation after each buttonhole is completed, and to throw the buttonhole making mechanisms into operation after the spacing

has been completed, the actuating wheel 438 and the two controlling toothed wheels 420 and 456 being advanced a step between successive buttonhole making cycles. The advance movements of these wheels continue until a stopping and reversing cam or tooth 482 engages the clutch controlling arm 422 and swings the arm beyond the neutral position indicated in Fig. 22, thus rocking the shaft 412 so that the arm 414 is raised sufficiently for the spring pawl 418 to engage the lower notch in the arm and thus shift the clutch 390 into engagement with the reversing gear 388. This discontinues the spacing and also the advance of the controlling disk 456, thereby stopping the automatic throwing into operation of the buttonhole making mechanism. The shaft 380 will then be driven in a reverse direction to return the work carrier to its initial position, and during this reverse rotation the controlling wheels will be rotated step by step in a reverse direction to initial position, which is indicated in Fig. 22. As the wheels come into this position an arm 484 which is adjustably secured to the wheel 438 engages the upper side of the clutch controlling arm 422, swinging the arm into neutral position and thus disengaging the clutch 390 from the reversing gear and shifting the arm 414 so that the spring pressed pawl 418 again engages the upper notch in the arm, the clutch controlling arm 422 being arrested and retained in neutral position by the engagement of its end with the high point of the initial tooth on the toothed wheel 420.

In order that the number of buttonholes which are automatically made before the work carrier is returned to initial position may be varied as found desirable, the reversing cam tooth 482 is so mounted that it may be adjusted into position to follow any one of the teeth on the toothed wheel 420. As shown, the cam tooth is formed on an arm 486 which is mounted to turn on the stud 488 upon which the controller wheels are mounted. The arm is provided with a spring pressed locking pin 490 which may be engaged with any one of a series of holes 492 formed in the outer face of the toothed wheel 420 and corresponding to the teeth of the wheel. The locking pin is provided with a head which is within convenient reach of the operator, and by which the operator may conveniently adjust and position the reversing tooth to determine the number of buttonholes which are to be automatically made in the work carried in the work carrier. The positioning holes are so arranged that the reversing tooth will be held in position directly following one of the teeth on the wheel 420, so that when this wheel is given its slight forward movement by the action of the pawl 424 as the clamp carriage comes

into its initial and stopping position after the final buttonhole has been completed, the reversing tooth will act upon the clutch controlling arm to reverse the spacing mechanism and return the work carrier to its initial position preparatory to the removal of the finished piece of work and the introduction of a new piece. The spacing clutch may be locked in neutral position to permit manual adjustment or manipulation of the controlling mechanism when desired by a locking lug 494 formed on a rock shaft 496 and arranged to engage an arm 498 depending from the rock shaft 412. The shaft 496 may be operated to throw the locking lug into and out of active position by a handle 500 arranged within convenient reach of the operator.

While it is preferred to employ the specific construction and arrangement of parts shown and described, especially in embodying the invention in a machine in which the buttonhole making mechanisms have the general construction and mode of operation of the mechanisms shown and described, it will be understood that this construction and arrangement is not essential to the broader features of the invention, and may be varied or modified as found desirable or best suited to the construction or mode of operation of the machine in which it is to be embodied.

The upper needle mechanism shown and described is covered by the claims of the divisional application Serial No. 337,147, filed Nov. 11, 1919.

Having explained the nature and object of the invention, and specifically described one form of machine in which it may be embodied, what is claimed is:—

1. A buttonhole sewing machine, having, in combination, stitch forming mechanism, mechanisms for reciprocating the work lengthwise of the buttonhole and for relatively actuating the stitch forming mechanism to sew about the buttonhole, and work spacing means acting on the work adjacent to the sewing point and mounted for bodily movement crosswise of the buttonhole.

2. A buttonhole sewing machine, having, in combination, stitch forming mechanism, mechanisms for rotating the stitch forming mechanism, for feeding the work to sew about a buttonhole and for moving the work to space the buttonholes, and mechanism for controlling said mechanisms to automatically sew a series of buttonholes and to stop at the end of the series.

3. A buttonhole sewing machine, having, in combination, stitch forming mechanism, mechanisms for rotating the stitch forming mechanism, for feeding the work to sew about a buttonhole and for moving the work to space the buttonholes, mechanism for con-

trolling said mechanisms to automatically sew a series of buttonholes, and means for adjusting the controlling mechanism to vary the number of buttonholes in a series.

4. A buttonhole sewing machine, having, in combination, stitch forming mechanism, mechanisms for rotating the stitch forming mechanism and relatively feeding the work and stitch forming mechanism to sew about a buttonhole and for moving the work to space the buttonholes, and mechanism for controlling said mechanisms to automatically sew a series of buttonholes and to stop at the end of the series.

5. A buttonhole sewing machine, having, in combination, stitch forming mechanism, mechanisms for rotating the stitch forming mechanism and relatively feeding the work and stitch forming mechanism to sew about a buttonhole and for moving the work to space the buttonholes, mechanism for controlling said mechanisms to automatically sew a series of buttonholes, and means for adjusting the controlling mechanism to vary the number of buttonholes in a series.

6. A buttonhole sewing machine, having, in combination, stitch forming mechanism, work holding means, and mechanism for rotating the stitch forming mechanism and for relatively moving the stitch forming mechanism and work holding means to automatically sew a series of buttonholes and then stop.

7. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, mechanism for rotating the stitch forming mechanism and relatively moving the work clamp and stitch forming mechanism to sew about a buttonhole, and mechanism for automatically spacing and positioning the work to sew a predetermined number of buttonholes.

8. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, mechanisms for reciprocating the work clamp lengthwise of the buttonhole and for rotating the stitch forming mechanism to sew about the buttonhole, and mechanism arranged to act on the work adjacent to the sewing point for automatically spacing the work for successive buttonholes.

9. A buttonhole sewing machine, having, in combination, a rotary stitch forming mechanism and a work clamp relatively movable to sew about a buttonhole, a buttonhole cutter, mechanism for actuating these parts to cut and sew a buttonhole, and mechanism arranged to act on the work adjacent to the sewing point for automatically spacing the work between successive buttonhole making cycles.

10. A buttonhole sewing machine, having, in combination, a rotary stitch forming mechanism, a work clamp, a buttonhole cut-

ter, mechanism for actuating these parts to cut and sew a buttonhole, mechanism for spacing the work, and mechanism for controlling the buttonhole making and spacing mechanisms to automatically cut and sew a predetermined number of buttonholes.

11. A buttonhole sewing machine, having, in combination, a rotary stitch forming mechanism, a work clamp, a buttonhole cutter, mechanism for actuating these parts to cut and sew a buttonhole, mechanism for spacing the work, mechanism for controlling the buttonhole making and spacing mechanisms to automatically cut and sew a series of buttonholes, and means for adjusting the controlling mechanism to vary the number of buttonholes in a series.

12. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a reciprocating work clamp, a buttonhole cutter, work spacing means movable in a curved path, and mechanism for actuating these parts to automatically cut and sew a predetermined number of buttonholes along a curved buttonhole zone.

13. A buttonhole sewing machine, having, in combination, a rotary stitch forming mechanism, a work clamp, a buttonhole cutter, work spacing means, mechanism for actuating these parts to automatically cut and sew a predetermined number of buttonholes, and means for adjusting the actuating mechanism to vary the number of buttonholes.

14. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, mechanism for rotating the stitch forming mechanism and for relatively reciprocating the stitch forming mechanism and clamp to sew about a buttonhole, a buttonhole cutter, a work carrier, and means for moving the carrier to space the work and position it in the work clamp after said relative reciprocation.

15. A buttonhole sewing machine, having, in combination, stitch forming mechanism, an intermittently reciprocating clamp carriage, work clamps on the carriage, a work carrier mounted on the carriage, and means for moving the carrier to space the work between reciprocations of the clamp carriage.

16. A buttonhole sewing machine, having, in combination, a rotary stitch forming mechanism, a work clamp, a buttonhole cutter, a work carrier, means for moving the carrier to space the work and position it in the work clamp, and means for returning the carrier to initial position after a predetermined number of spacing movement.

17. A buttonhole sewing machine, having, in combination, stitch forming mechanism, an intermittently reciprocating clamp, and means moving with the clamp for spacing the work between reciprocations of the clamp.

18. A buttonhole sewing machine, hav-

ing, in combination, buttonhole cutting and sewing mechanisms, a work carrier movable in a variable curved path, spacing mechanism for intermittently moving the carrier including a uniformly moving driver, and connections between the driver and carrier for varying the movement transmitted to the carrier to equally space the buttonholes.

19. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp reciprocating lengthwise of the buttonhole, a buttonhole cutter, a work carrier, and mechanism for moving the carrier between buttonhole making cycles to space the buttonholes including means permitting relative movement of the carrier to position it for the initial buttonhole of the series.

20. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp reciprocating lengthwise of the buttonhole, a buttonhole cutter, a work carrier, mechanism for moving the carrier between buttonhole making cycles to space the buttonholes including a coupling which may be disengaged to permit movement of the carrier to position it for the initial buttonhole of the series.

21. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanism, a work carrier having an edge gage curved to correspond to the edge of a shoe fly, guides for causing the carrier to move in a correspondingly curved path, spacing mechanism including a normally engaged clutch, and means for temporarily disengaging the clutch to permit movement of the carrier to position it for the initial buttonhole of the series.

22. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier having an edge gage curved to correspond to the edge of the shoe fly, guides for causing the carrier to move in a correspondingly curved path, spacing mechanism including an intermittently and uniformly moving wheel, connections between the wheel and carrier, a cam acting on the connections to vary the movement transmitted to the carrier to equally space the buttonhole, a normally engaged clutch between the connections and wheel, and means for temporarily disengaging the clutch to permit movement of the carrier to position it for the initial buttonhole of a series.

23. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier movable in a variable curved path, mechanism for intermittently moving the carrier including a uniformly moving driver, connections between the driver and carrier for varying the movement transmitted to the carrier to equally space the buttonholes, and means for disconnecting the driver to permit rela-

tive movement of the carrier to position it for the initial buttonhole of a series.

24. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier movable in a variable curved path, spacing mechanism for moving the carrier to space the buttonhole including an intermittently and uniformly moving driver, connections for transmitting movement from the driver to the carrier, and a cam acting on the connections to vary the movements transmitted to the carrier.

25. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier movable in a variable curved path, spacing mechanism for moving the carrier to space the buttonholes including an intermittently and uniformly moving crank, a crank geared to the carrier, links connecting the cranks, and a cam acting on the links to vary the movement transmitted to the carrier.

26. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier, spacing mechanism for moving the carrier to space the buttonholes including a spacing pawl having an intermittent and uniform feeding movement, and an adjustable controller for varying the active period of each feeding movement.

27. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier, spacing mechanism for moving the carrier to space the buttonholes comprising a feeding member having a uniform feeding movement, and an adjustable controller for varying the period in each movement during which motion is transmitted to the carrier.

28. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier, a ratchet wheel through which motion is transmitted to the carrier to space the buttonholes, a one-revolution feeding pawl, and an adjustable controller plate having surfaces of varying length for holding the pawl out of engagement with the wheel during part of each revolution.

29. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier, oppositely arranged ratchet wheels through which motion is transmitted to the carrier to space the buttonholes and to return the carrier to initial position, feeding and return pawls for engaging the ratchets, and an adjustable controller plate having surfaces of varying length for preventing engagement of the pawls with the wheels during part of each revolution of the active pawl.

30. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing

mechanisms, a work carrier, mechanism for moving the carrier to space the buttonholes and for returning it to initial position after the completion of a series of buttonholes.

31. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier, carrier spacing mechanism, carrier returning mechanism, and mechanism for controlling the spacing and returning mechanisms.

32. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier, carrier spacing mechanism, carrier returning mechanism, and counting mechanism for controlling said mechanisms to cut and sew a series of buttonholes and then return the carrier and counting mechanism to initial positions.

33. A buttonhole sewing machine, having, in combination, buttonhole cutting and sewing mechanisms, a work carrier, carrier spacing and returning mechanisms including a clutch, a controlling wheel operated by the spacing mechanism and having a series of teeth for controlling the engagement and disengagement of the clutch to space the buttonholes, and an adjustable tooth for shifting the clutch to return the carrier and controlling wheel to initial positions.

34. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a clamp carriage, a work carrier having an edge gage curved to correspond to the edge of a shoe fly, a slot in the carrier to register with the buttonhole zone of the fly and leave the same unobstructed, work holding means on the carrier, means for guiding and moving the carrier to space the buttonholes, and means on the carriage registering with the slot for clamping the work during the sewing.

35. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp comprising work supporting plates and upper clamping jaws, a work carrier plate mounted to move over the work supporting plates and provided with an edge gage and a slot to register with the buttonhole zone of a piece of work on the carrier and leave the same unobstructed, and spacing mechanism for moving the carrier between buttonhole making cycles.

36. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a clamp carriage, a work carrier having an edge gage of varying curvature, a slot adjacent the gage to register with the buttonhole zone of the piece of work on the carrier, carrier guides for maintaining the edge of the work at the point of operation in predetermined relation to the stitch forming mechanism, a vertically movable clamping bar for holding the work on the carrier, and

mechanism for moving the carrier to space the buttonholes.

37. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a clamp carriage, a work carrier comprising a base plate, an edge gage of varying curvature, a slot to register with the buttonhole zone of the piece of work on the carrier, means for holding the work on the carrier, guideways of varying curvature on the carrier, co-operating guides on the carriage, and connections for moving the carrier to space the buttonholes.

38. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a traveling work clamp carriage, and work spacing mechanism thrown into action by the travel of the clamp carriage at the completion of a buttonhole making cycle.

39. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a traveling work clamp carriage, work spacing mechanism thrown into action by the travel of the clamp carriage at the completion of a buttonhole making cycle, and actuating mechanism for the stitch forming mechanism and carriage thrown into action at the completion of the spacing.

40. A buttonhole sewing machine having, in combination, buttonhole sewing mechanism, including a rotary stitch forming mechanism and means for feeding the work lengthwise of the buttonhole, and work spacing means arranged to act on the work adjacent to the sewing point.

41. A buttonhole sewing machine having, in combination, stitch forming mechanism, a work clamp, mechanism for relatively reciprocating the work clamp and stitch forming mechanism lengthwise of the buttonhole, a work spacer mounted for bodily movement crosswise of the buttonhole, and mechanism for actuating the spacer to space the work after said relative reciprocation.

42. A buttonhole sewing machine having, in combination, stitch forming mechanism, a traveling work clamp carriage, work spacing mechanism thrown into action at the completion of the buttonhole making cycle, and actuating mechanism for the stitch forming mechanism and carriage thrown into action at the completion of the spacing.

43. A buttonhole sewing machine having, in combination, buttonhole making mechanism, stop mechanism therefor, work spacing mechanism rendered active at the end of each buttonhole making cycle, counting mechanism operated from the spacing mechanism for stopping the machine after a pre-determined number of buttonholes has been sewed.

44. A buttonhole sewing machine having, in combination, buttonhole making mechanism, stop mechanism therefor, work spac-

ing mechanism thrown into operation by the buttonhole making mechanism at the end of each buttonhole making cycle, a counting mechanism advanced a step to start the buttonhole making mechanism at each operation of the spacing mechanism, and means operated by the final movement of the counting mechanism for discontinuing the spacing.

45. A buttonhole sewing machine having, in combination, buttonhole making mechanism, stop mechanism therefor, work spacing mechanism thrown into operation by the buttonhole making mechanism at the end of each buttonhole making cycle, a counting mechanism advanced a step to start the buttonhole making mechanism at each operation of the spacing mechanism, means operated by the final movement of the counting mechanism for discontinuing the spacing, and means for returning the counting mechanism to initial position.

46. A buttonhole sewing machine having, in combination, buttonhole making mechanism, stop mechanism therefor, a work carrier, a one-revolution work spacing clutch thrown into operation by the buttonhole making mechanism at the end of each buttonhole making cycle, and a counting mechanism operated by the spacing mechanism for discontinuing the spacing at the completion of a pre-determined number of buttonholes.

47. A buttonhole sewing machine having, in combination, stitch forming mechanism, a clamp carriage mounted to reciprocate lengthwise of the buttonhole, a work carrier mounted on the carriage, and means for moving the carrier to space the work between buttonhole making cycles.

48. A buttonhole sewing machine, having, in combination, a rotary stitch-forming mechanism and a work-clamp relatively movable to sew about a buttonhole, a carrier on which the work is held mounted to move in a variable curved path and means for advancing the carrier step-by-step to space the buttonholes.

49. A buttonhole sewing machine, having, in combination, a stitch-forming mechanism, a work-clamp, mechanism for relatively reciprocating the work-clamp and stitch-forming mechanism lengthwise of the buttonhole, a buttonhole cutter, a separate work-carrier mounted for movement crosswise of the buttonhole, and mechanism for actuating the carrier to space the work in the clamp after said relative reciprocation.

50. A buttonhole sewing machine, having, in combination, a stitch-forming mechanism, a work-clamp, mechanism for relatively reciprocating the stitch-forming mechanism and clamp lengthwise of the buttonhole, a work-carrier upon which the work is held movable crosswise of the buttonhole, and

mechanism for advancing the carrier step-by-step between the buttonhole making cycles.

5 51. A buttonhole sewing machine, having, in combination, a stitch-forming mechanism, a work-clamp, mechanism for relatively moving them to sew about a buttonhole, mechanism for opening and closing the clamp, means for cutting the buttonhole
10 slit, and an additional work-spacing gripper mounted to reciprocate transversely of the buttonhole.

52. A buttonhole sewing machine, having, in combination, a stitch-forming mechanism,
15 a work-clamp, mechanism for relatively moving them to sew about a buttonhole, mechanism for opening the clamp at the end of the buttonhole making cycle, means for

cutting the buttonhole slit, and an additional gripper reciprocating transversely of
20 the buttonhole to space the work in the clamp between successive buttonhole making cycles.

53. A buttonhole sewing machine, having, in combination, a stitch-forming mechanism, 25 a work-clamp, means for relatively moving the stitch-forming devices and work-clamp to sew a buttonhole, clamp opening and closing mechanism, a buttonhole cutter, an additional work-gripper including opposed
30 work-gripping elements adapted to advance the work to the work-clamp between the sewing periods, and mechanism for imparting feed and return movement to said work-gripper.

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