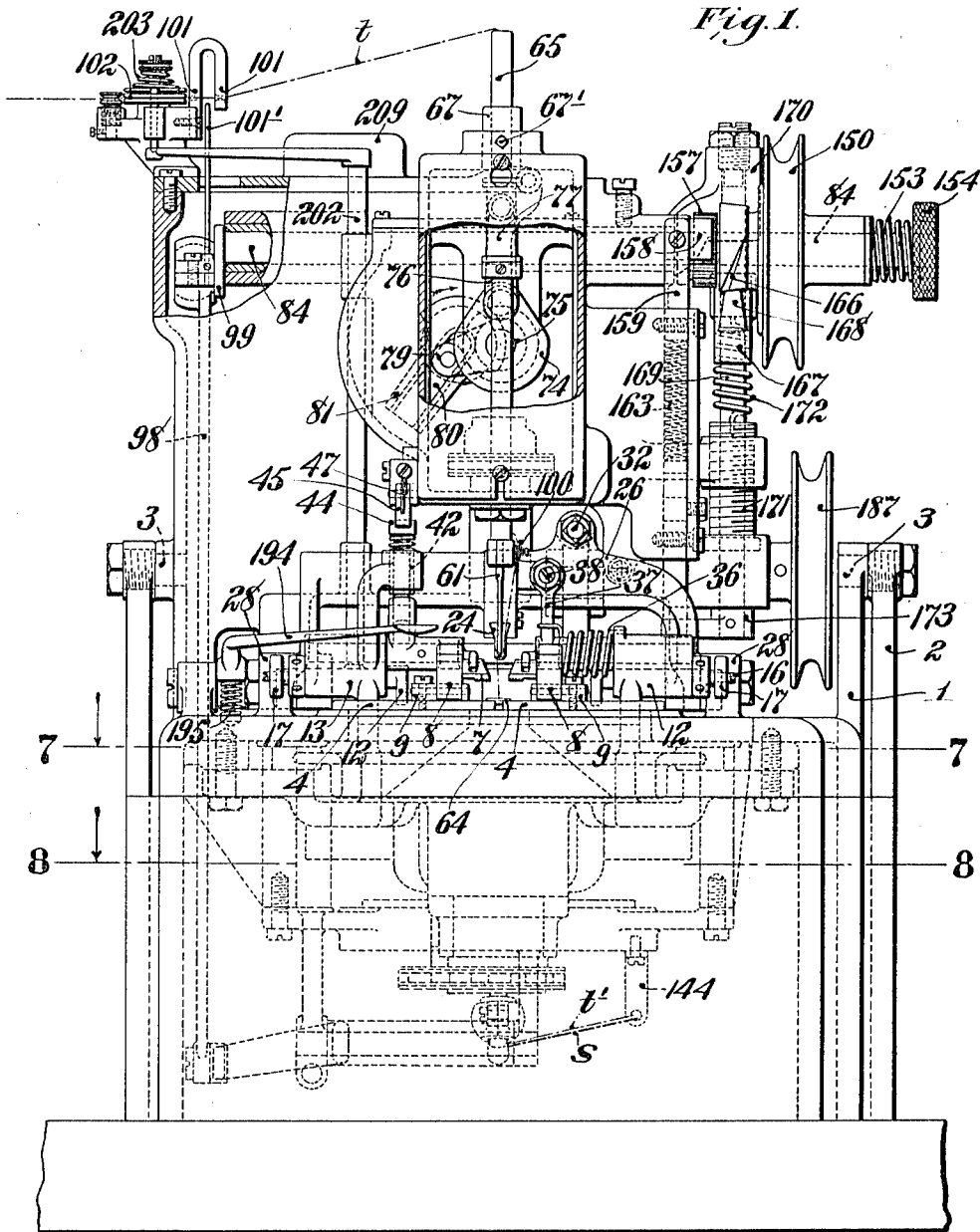


1,063,880.

Patented June 3, 1913.

14 SHEETS—SHEET 1.



Witnesses:

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1,063,880.

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14 SHEETS-SHEET 2.

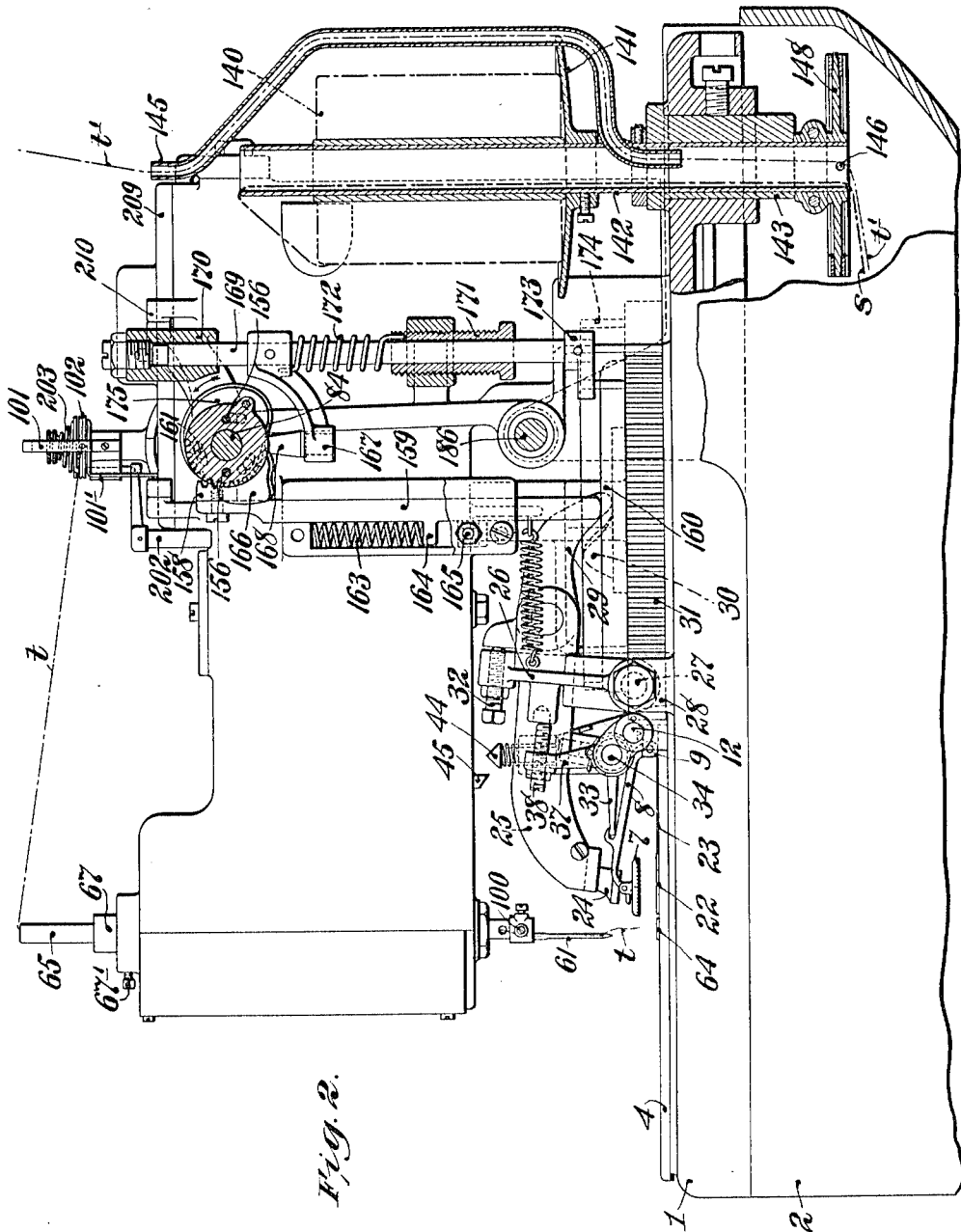


Fig. 2.

Witnesses:

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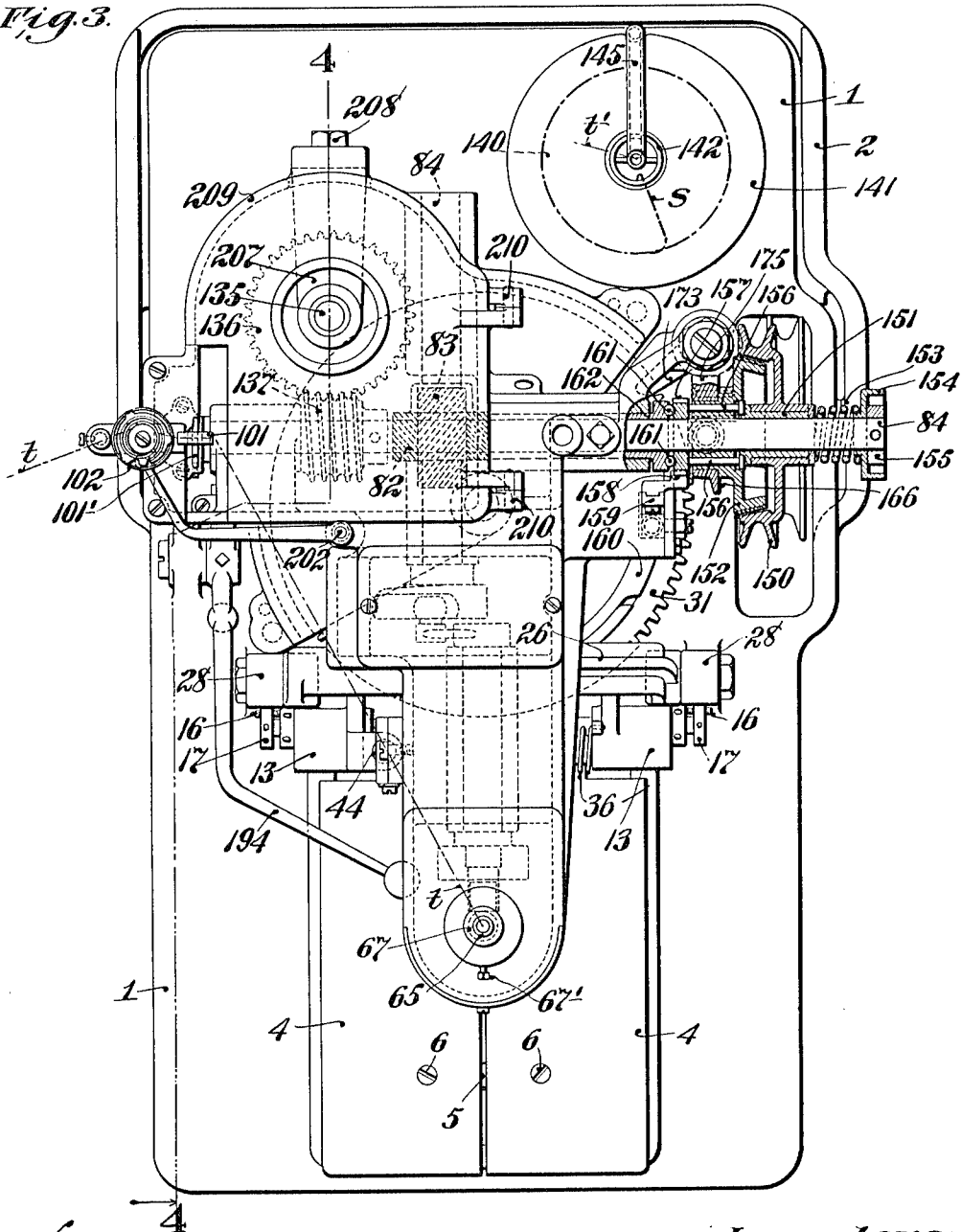
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1,063,880.

Patented June 3, 1913.

14 SHEETS—SHEET 3.

Fig. 3.



Witnesses:

E. C. Cardman
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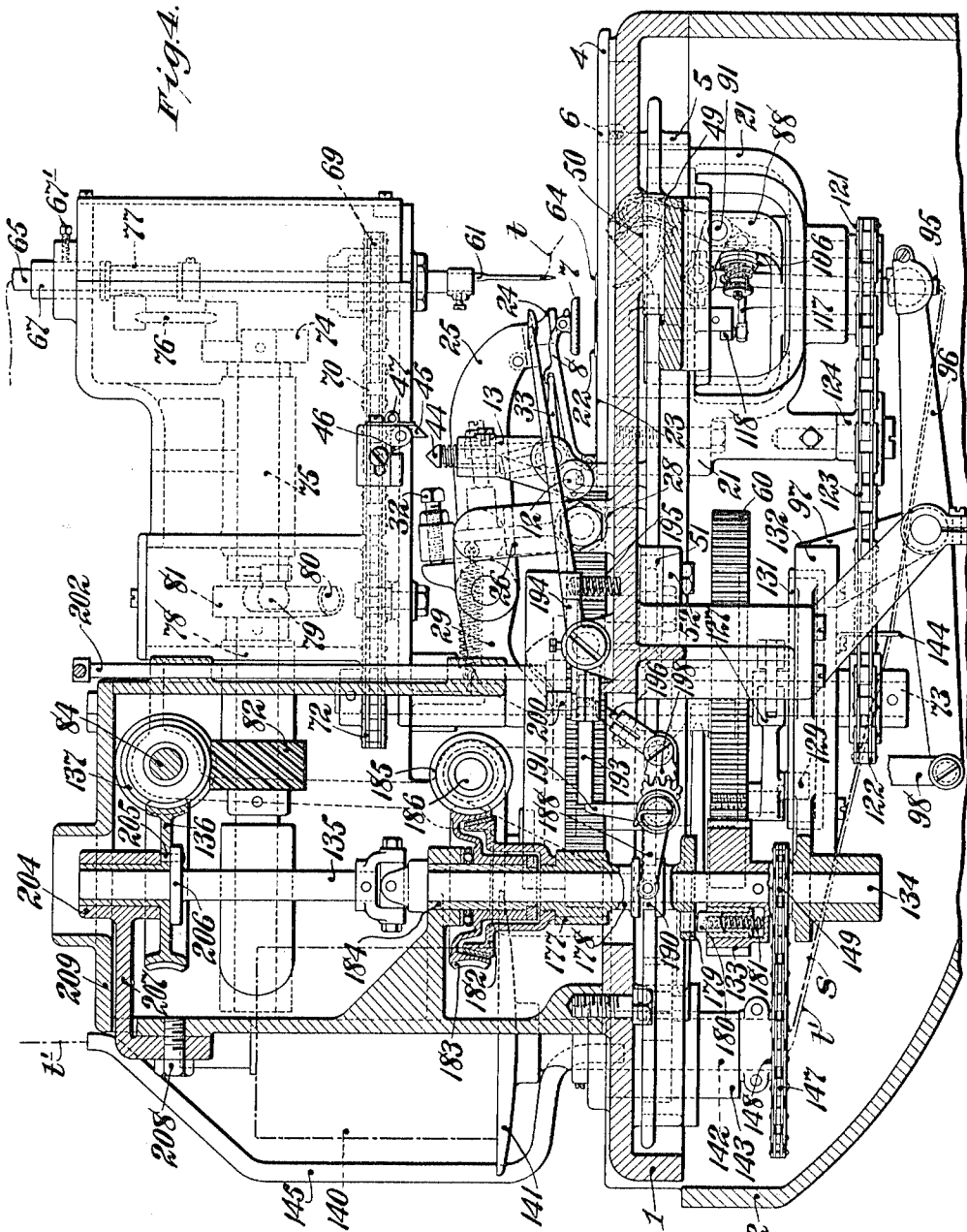
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1,063,880.

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14 SHEETS—SHEET 4.



Witnesses:

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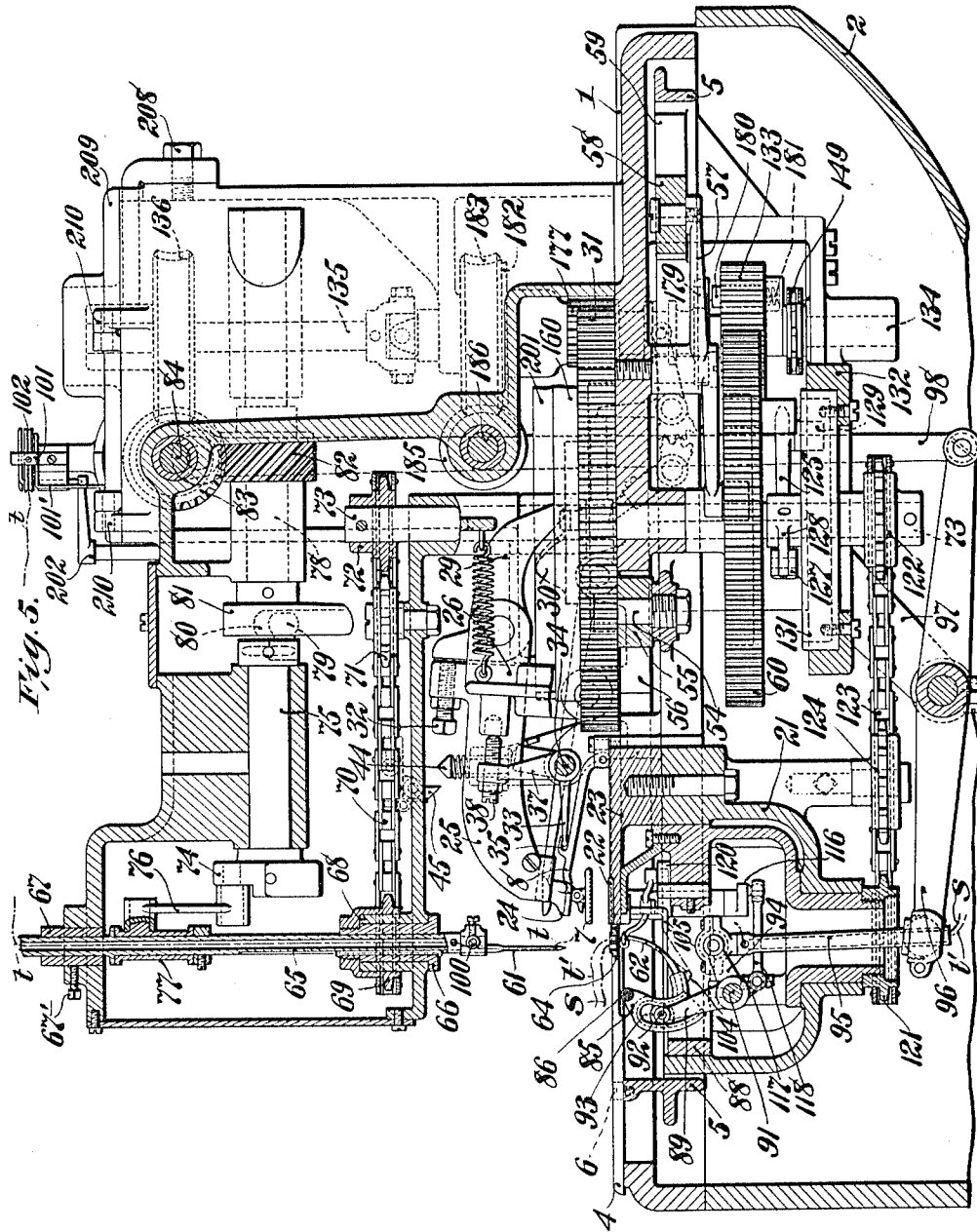
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1,063,880.

Patented June 3, 1913.

14 SHEETS-SHEET 5.



Witnesses:

E. C. Erdman
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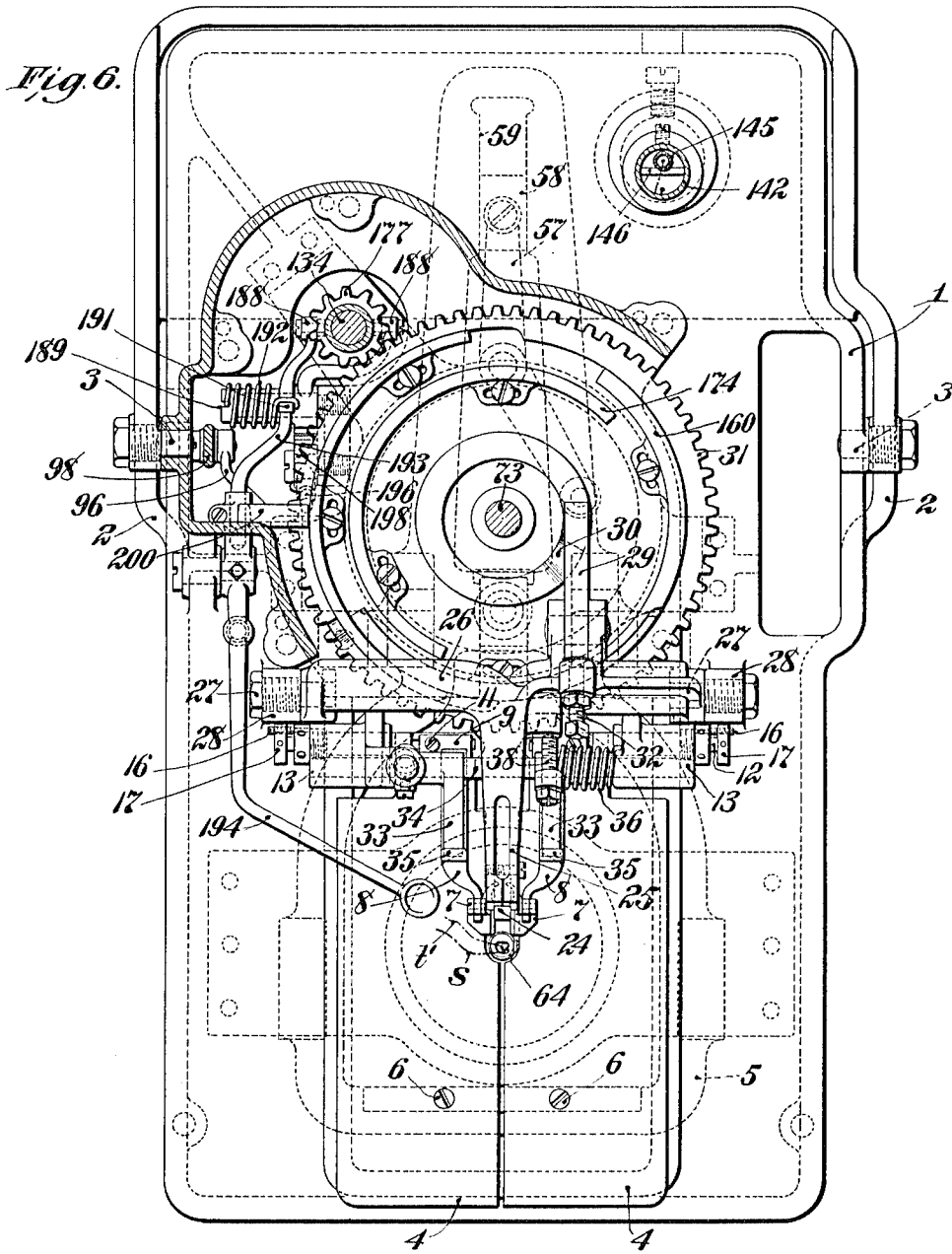
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Patented June 3, 1913.

14 SHEETS—SHEET 6.



Witnesses:

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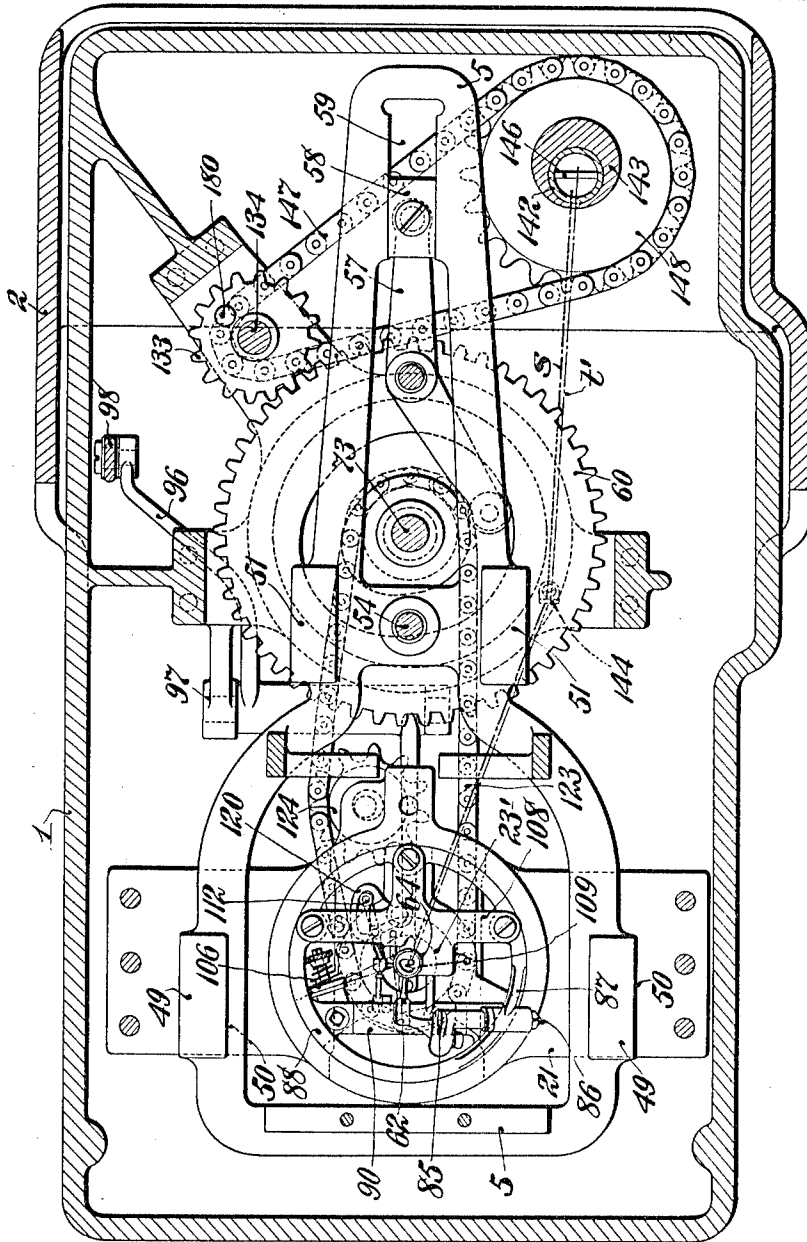
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1,063,880.

Patented June 3, 1913.

14 SHEETS—SHEET 7.

Fig. 2.



Witnesses:

E. W. Wurdeman
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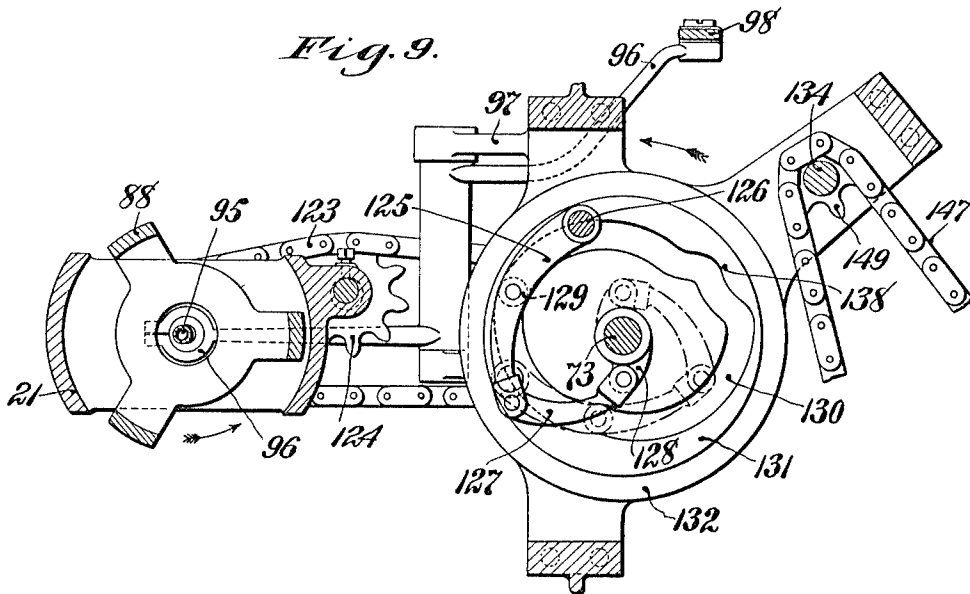
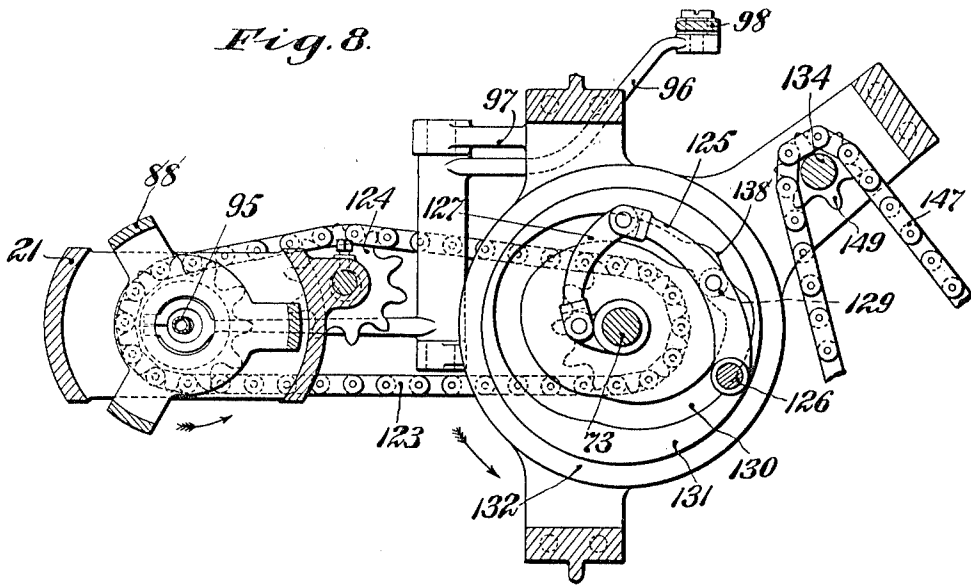
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1,063,880.

Patented June 3, 1913.

14 SHEETS—SHEET 8.



Witnesses:

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1,063,880.

14 SHEETS—SHEET 10.



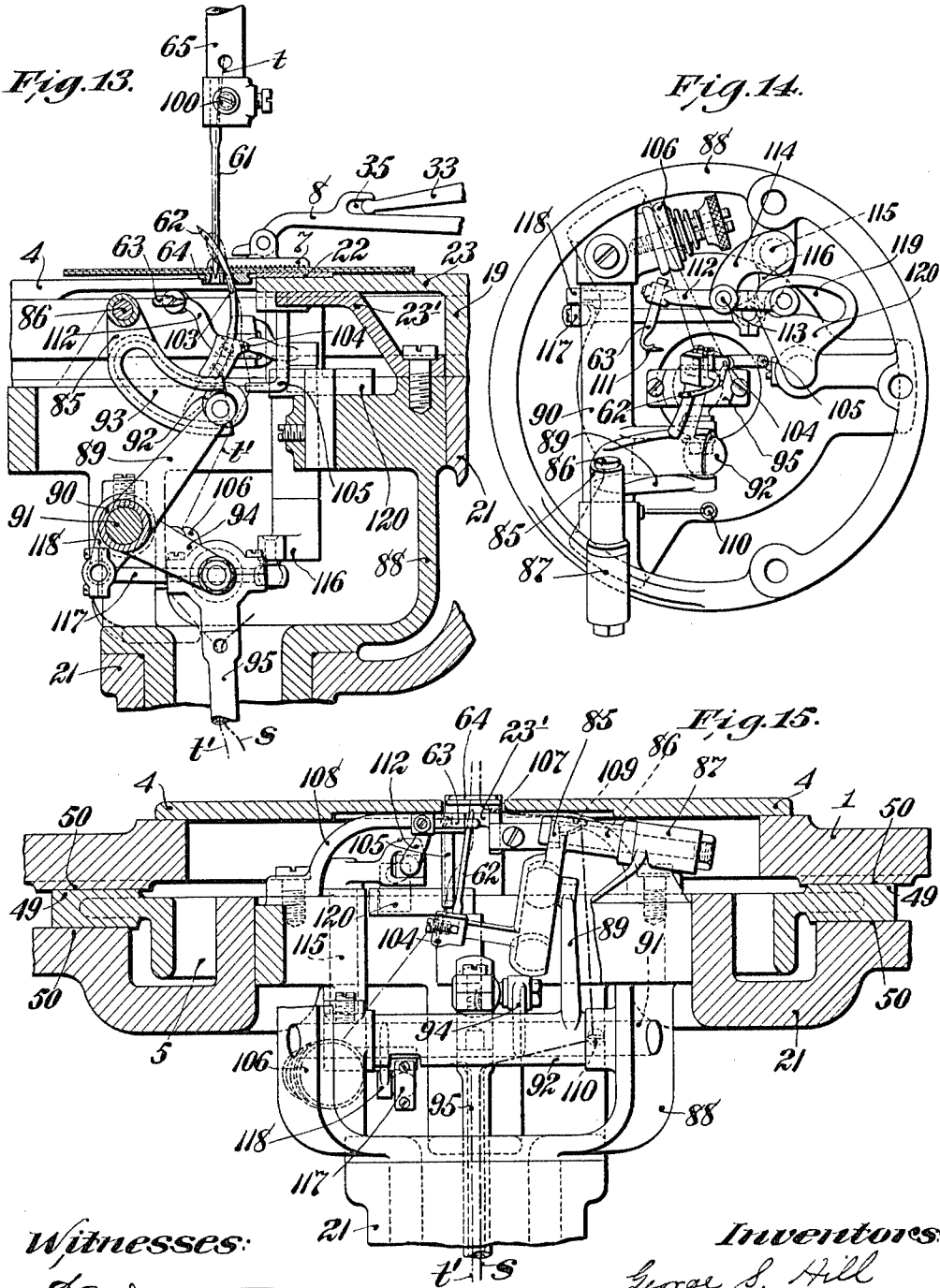
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1,063,880.

Patented June 3, 1913.

14 SHEETS—SHEET 11.



Witnesses:

E. J. Wurdeman
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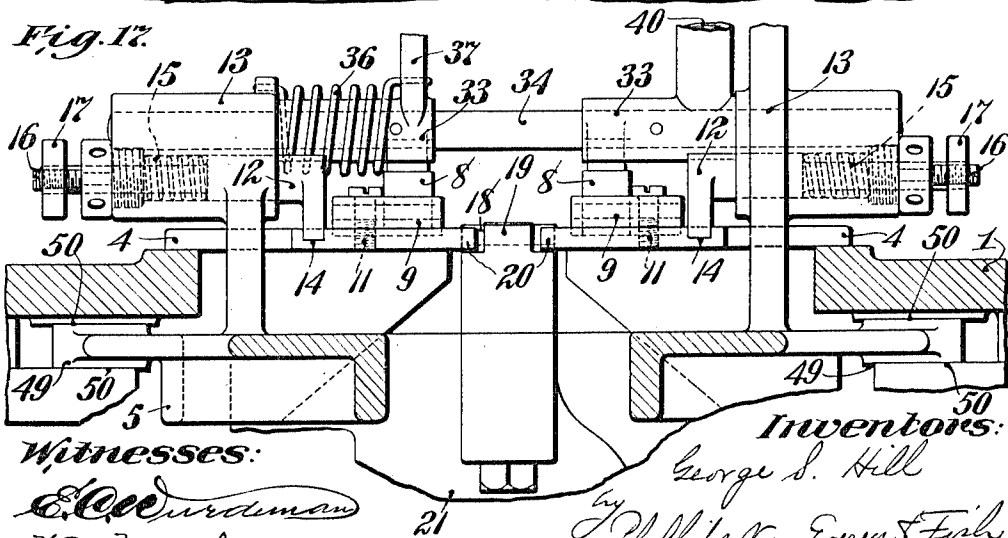
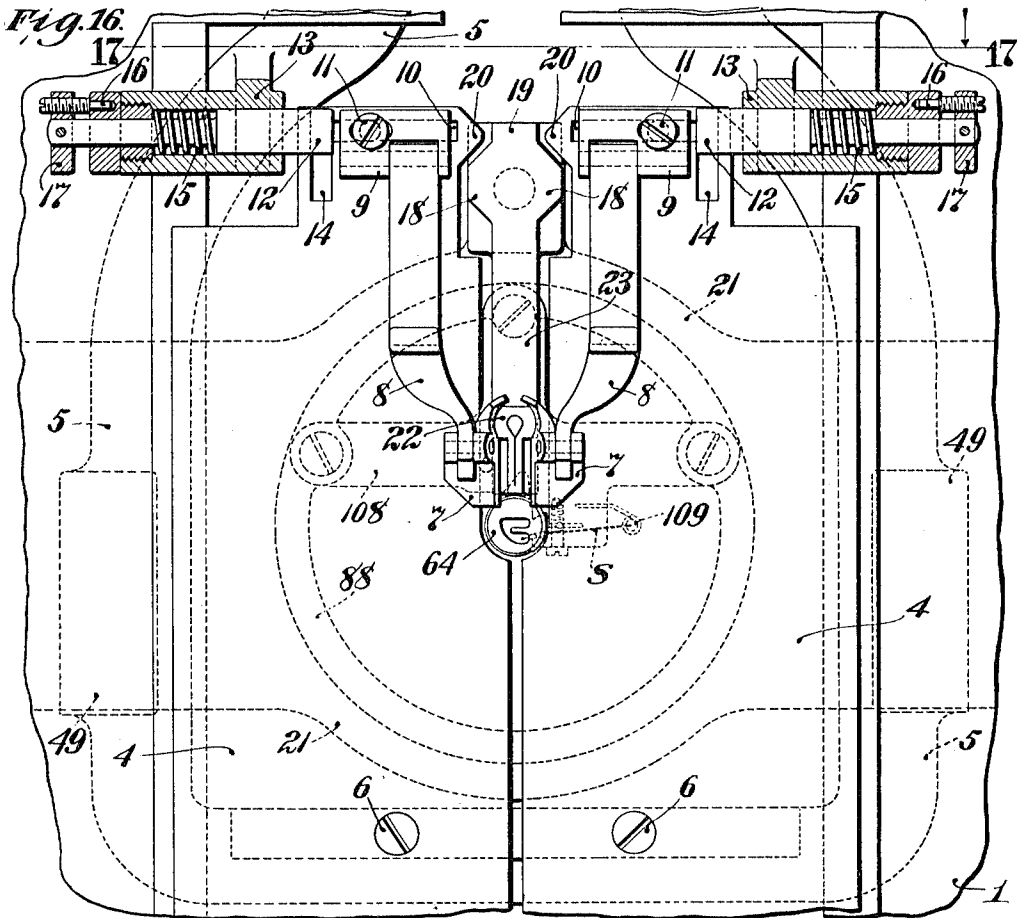
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Patented June 3, 1913.

14 SHEETS—SHEET 12.



Witnesses:

E. C. Erdman
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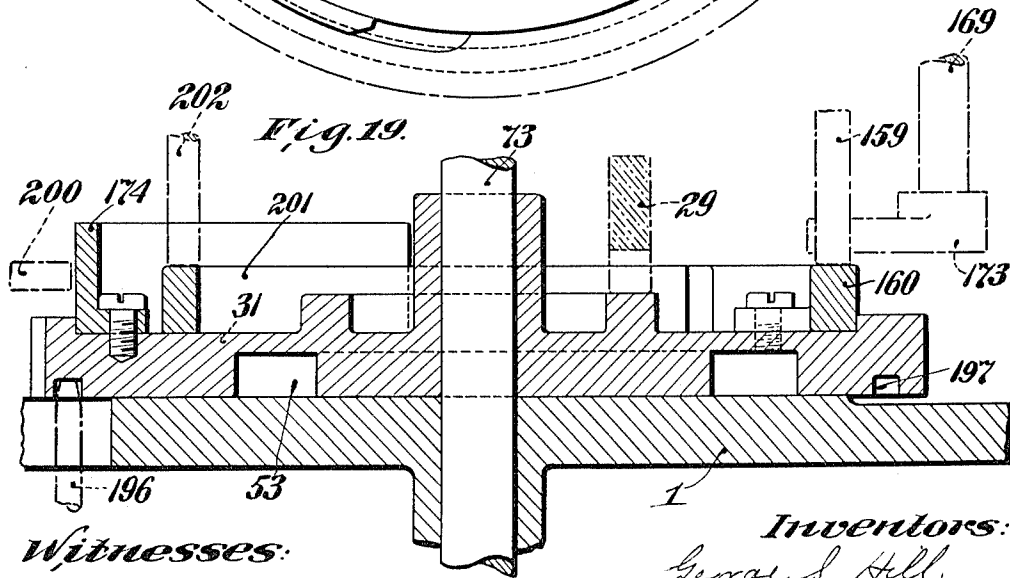
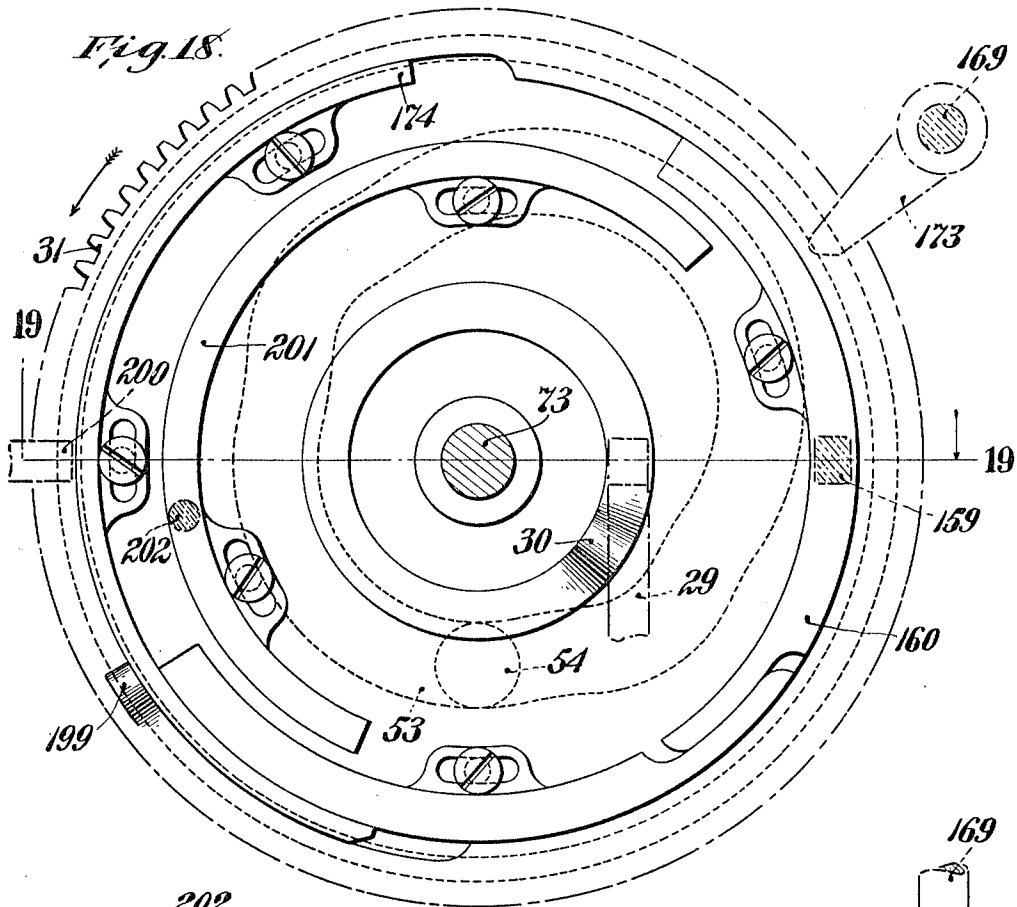
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1,063,880.

Patented June 3, 1913.

14 SHEETS—SHEET 13.



Witnesses:

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UNITED STATES PATENT OFFICE.

GEORGE S. HILL, OF STRAFFORD, NEW HAMPSHIRE, ASSIGNOR TO UNITED SHOE MACHINERY COMPANY, OF PATERSON, NEW JERSEY, A CORPORATION OF NEW JERSEY.

BUTTONHOLE-SEWING MACHINE.

1,063,880.

Specification of Letters Patent.

Patented June 3, 1913.

Application filed February 10, 1912. Serial No. 676,767.

To all whom it may concern:

Be it known that I, GEORGE S. HILL, a citizen of the United States, residing at Strafford, in the county of Strafford and State of New Hampshire, 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 of that class in which a work holding clamp and a stitch forming mechanism are relatively movable to form over-edge stitches extending along the sides and about the ends of the buttonhole.

The object of the invention is to produce a buttonhole sewing machine of this type having its various parts and mechanisms constructed and arranged in an improved and simplified manner, and having an improved mode of operation whereby the machine is adapted to cut and sew a buttonhole at a greater rate of speed and in a more uniformly reliable and satisfactory manner than the buttonhole sewing machines heretofore in use.

With these objects in view the invention comprises the features of construction and combination of parts hereinafter described and set forth in the claims.

The various features of the invention will be 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 front elevation of a buttonhole sewing machine embodying the features of the invention in their preferred forms; Fig. 2 is a right side elevation partly in section; Fig. 3 is a plan view partly in section; Fig. 4 is a vertical sectional view on line 4—4, Fig. 3; Fig. 5 is a central longitudinal sectional view looking from the right side of the machine; Fig. 6 is a sectional plan view, the section being taken below the head of the machine; Fig. 7 is a horizontal sectional view on line 7—7, Fig. 1; Fig. 8 is a detail sectional view on line 8—8, Fig. 1; Fig. 9 is a similar view showing the parts in a different position. Fig. 10 is a detail side elevation partly in

section showing the work holding clamp and cutter with the cutter in cutting position; Fig. 11 is a detail plan view of the turret carrying the under needle and co-operating looper, showing the looper in position to present the loop taken from the upper needle over the point of the under needle; Fig. 12 is a detail vertical sectional view showing the parts which operate upon the work; Fig. 13 is a longitudinal section of the turret carrying the under needle and looper showing the formation of the under loop by the needle; Fig. 14 is a plan view of the turret with the parts in a similar position; Fig. 15 is a front elevation partly in section of the turret and devices carried thereby; Fig. 16 is a detail plan view partly in section showing the work clamping devices; Fig. 17 is a sectional elevation on line 17—17, Fig. 16; Fig. 18 is a detail plan view of the gear which forms the carrier for various of the operating and controlling cams; Fig. 19 is a sectional elevation on line 19—19 Fig. 18; Fig. 20 is a sectional elevation showing the starting mechanism tripped to start the machine; Fig. 21 is a similar view with the parts in a different position; Fig. 22 is a sectional elevation showing the upper thread tension; and Fig. 23 is a diagram showing the arrangement of the stitches about the buttonhole.

The machine illustrated comprises generally a work clamp for holding the material to be operated upon, a cutter for cutting a buttonhole in the material, stitch forming mechanism comprising a straight-eye-pointed upper needle, a curved-eye-pointed under needle, and a coöperating looper, and mechanisms for operating the clamp, cutter, and stitch forming mechanism and for relatively moving them to properly position the material for cutting and then sewing the buttonhole, and for relatively feeding and turning the clamp and stitch forming mechanism during the operation of the stitch forming mechanism to form over-edge stitches extending along the sides and about the ends of the buttonhole. The relative movements referred to are secured in the machine illustrated by movement of the work clamp and by turning the stitch forming mechanism, although it will be understood that the mechanisms for effecting these relative movements are as well adapted for

moving the cutter and stitch forming mechanism, or turning the clamp, and may be embodied in machines in which the relative movements are thus secured.

5 The operative parts of the machine shown in the drawings are carried by a frame 1 supported on a base 2 to which the frame is connected by trunnions 3 so that it may be swung up to give access to the parts on its under side which are normally inclosed and protected by the base.

10 The work clamping devices comprise work supporting plates 4 arranged to pass on opposite sides of the stitch forming mechanism and connected to the clamp carriage 5 by the pivot screws 6 (Figs. 4, 5, 6, 16 and 17). The work is clamped on the plates 4 by clamping jaws 7 pivoted on the ends of the clamp carrying arms 8. The clamp arms are pivotally supported in blocks 9 which are provided with ribs engaging grooves 10 in the plates 4, and are held in adjusted position on the plates by the clamping screws 11 which pass through slots in the blocks.

20 The work supporting plates 4 are forced normally toward each other by the spring-pressed bars 12 which are mounted in supports 13 rising from the clamp carrier 5, and are provided with depending ends engaging grooves 14 in the plates. The bars 12 are forced forward by springs 15, and the forward position of the bars and connected work supporting plates is determined by adjustable stop screws 16 carried by collars 17 secured to the outer ends of the bars.

30 The stop screws are provided with reduced ends engaging holes in the caps for the bar bearings, and with shoulders for engaging the caps and determining the inner position of the work supporting plates. When the machine is at rest the parts are in the position indicated in Figs. 16 and 17, with the plates 4 in their inner position and the clamps 7 open to receive the material and to position it in proper relation to the buttonhole cutting devices. After the material is placed between the clamps and the work supporting plates 4, and the machine is started, the cutting devices are operated to cut the buttonhole. The movement of the cutter is also utilized to close the work holding clamps, thus simplifying the clamp operating devices and reducing the number of operating cams. After the buttonhole is cut and the work clamped, the clamp carriage is moved forward to bring the buttonhole into proper relation to the stitch forming mechanism, and during this forward movement the plates 4 are swung away from each other to spread the buttonhole. The devices for thus moving the plates comprise the cam projections 18 formed on a block 19 and arranged to be engaged by the projections 20 on the plates. The block 19 is mounted upon a bracket 21 which is secured

to the under side of the frame 1, and also forms a support for the under needle turret and for the clamp carriage 5.

The devices for cutting the buttonhole comprise a lower cutter block 22 which is supported upon the front end of a tongue 23 projecting forward from the block 19, and a cutter blade or die 24 secured in the end of an arm 25 which projects forward from a yoke 26. The ends of the yoke are pivotally supported on trunnions 27 carried by lugs 28 rising from the frame 1 (Figs. 1 and 6). A lever 29 is pivoted to the rear side of the yoke, and one end of this lever is arranged to engage a cam 30 formed on the upper surface of the cam carrying gear 31. The other end of the lever bears against a set screw 32 on the yoke, which may be adjusted to bring the cutter into proper operative relation with the under cutter block when the end of the lever 29 rides on to the high part of the cam 30 (Fig. 10). The tongue 23 and cutter block 22 are firmly supported during the action of the cutter by a plate 23' which is secured to the top of the under-needle turret.

The devices for operating the work holding clamp comprise arms 33 carried by a rock shaft 34 and engaging slots 35 in the clamp arms 8 (Figs. 1, 6, 10 and 12). The rock shaft 34 is mounted in bearings formed in the supports 13 on the clamp carriage, and is forced in a direction to open the clamp by a torsional spring 36, one end of which is engaged with one of the supports 13, and the other end of which engages an arm 37 extending vertically from the rock shaft. The upper end of the arm 37 carries an adjustable screw 38 the end of which engages a bearing block 39 on the cutter yoke 26 when the work clamp is in position to receive the work. When the cutter is operated, the movement of the yoke 26 moves the arm 37 forward, thus rocking the rock shaft 34 in a direction to close the work clamp. After the work clamp has been thus closed it is held closed until the sewing of the buttonhole is completed and the clamp moved into position for the removal of the work preparatory to the next cycle of operations. The devices for holding the clamp closed comprise a spring-pressed latching pin 40 mounted in a vertical projection on the hub of one of the arms 33 and arranged to engage a shoulder 41 on one of the supports 13 (Fig. 12). The shoulder 41 is formed at the lower end of a bearing 42 in which a spring-pressed latch operating pin 43 is mounted to move vertically. The latch operating pin is provided at its upper end with a V-shaped head 44 arranged to cooperate with a stationary cam 45. The cam 45 is pivoted in a bracket secured to the head of the machine, and is provided with a tail piece 46 which prevents movement of the

cam toward the right in Fig. 12. The cam is held in normal position by a spring 47 which will yield to allow the cam to move toward the left. When the clamp is closed by the movement of the cutter in cutting the material, the latch 40 snaps up in front of the shoulder 41 and holds the clamp in closed position. During the forward movement of the clamp carriage the head of the latch operating pin rides under the cam 45, and the cam yields to allow the head to pass freely by it. After the head of the pin has passed the cam returns to its normal position. After the buttonhole has been sewed the clamp is returned to its initial position, and during this movement the cam 45 acts to press the latch operating pin downward, thus disengaging the latch pin from the shoulder 41 and allowing the spring 36 to open the clamp jaws. The opening movement of the clamp is limited by the engagement of the bearing for the pin 40 with a stop lug 48.

The clamp carriage 5 is in the form of a skeleton frame, as shown in Fig. 7, which is provided with bearing surfaces 49 arranged to move freely between bearing surfaces 50 formed on the under side of the frame 1 and on the upper side of the turret bracket 21. The carriage is also provided with bearing surfaces 51 which move freely between surfaces on the under side of the frame 1 and on supporting plates 52 secured to the frame (Figs. 10 and 12). The carriage is moved longitudinally or lengthwise of the buttonhole to shift the work from cutting to sewing position, to feed the work during the sewing, and to return the work to initial position after the buttonhole is completed, by a cam groove 53 formed in the under side of the cam carrying gear 31, which engages a roll carried on the upper end of a stud 54 secured in the carriage. The stud passes through a pivot block 55 arranged to slide in a slot 56 formed in the frame 1, and forms a pivot about which the carriage is swung to move the work clamp and work laterally in sewing along the sides of the eye of a buttonhole. The devices for swinging the clamp carriage laterally comprise a lever 57 mounted upon the frame 1 and having one end pivotally connected to a block 58 which engages a slot 59 in the rear end of the carriage, and the other end provided with a roll engaging a cam groove formed in the upper face of a gear 60.

The stitch forming devices comprise a straight-eye pointed upper needle 61 which is arranged to pass through the fabric at a certain distance from the edge of the buttonhole, a curved-eye pointed under needle 62 arranged to pass through the buttonhole slit, and a looper 63 for taking a loop of thread from the upper needle and passing it over the end of the under needle when it is

in its retracted position, so that the under needle will pass up through the loop when it is advanced. The needles are arranged to pass through a throat plate 64 which is arranged over the under needle as is usual in this type of buttonhole sewing machines. During the sewing operation the under needle is advanced through the loop of upper needle thread held by the looper, and after it has reached its upper or advanced position it is slightly retracted or dipped to form a loop through which the upper needle passes in its descent, and then the under needle is returned to its retracted position. During the sewing of a buttonhole the stitch forming devices are rotated or turned through a complete revolution, so that over-seam stitches are formed along the sides, about the eye, and across the end of the buttonhole. In order that the stitch forming mechanism may be thus rotated, the upper needle is eccentrically secured in a bar mounted to reciprocate through a rotary head or sleeve, and the under needle and looper are mounted in a rotary turret.

The upper needle 61 is secured at the lower end of a hollow needle bar 65 which is mounted to reciprocate through a sleeve 66 and an upper bearing 67. The needle bar is connected with the sleeve by a key and slot so that the bar will rotate with the sleeve while being free to reciprocate vertically through it. The sleeve is mounted to turn in a bearing 68, and a sprocket wheel 69 is secured to the sleeve and is rotated through a complete revolution during the sewing of each buttonhole by a chain 70 passing about the sprocket wheel, over the tightening sprocket 71, and about a sprocket wheel 72 secured to the upper end of a vertical shaft 73. The needle bar is reciprocated through a crank 74 secured to the front end of a crank shaft 75 and connected with the needle bar by a link 76, the upper end of which is pivoted to a sleeve 77 surrounding the needle bar. The crank shaft 75 is driven from a driving shaft 78 which is arranged out of axial alignment with the crank shaft, and is connected therewith by differential crank mechanism adapted to impart a slow movement to the needle bar during the first part of its downward movement, and a rapid movement to the bar during the lower part of its reciprocation. This crank mechanism comprises a crank pin 79 on the inner end of the crank shaft 75 which engages a radially extending slot 80 formed in an arm 81 which is secured to the forward end of the driving shaft 78. The shaft 78 carries a spiral or worm gear 82 which is engaged by a gear 83 carried by the driving shaft 84.

The under needle 62 is secured in a needle carrying arm 85 mounted upon an inclined stud 86 which is secured in a lug 87 on the upper edge of the turret 88. The needle

carrying arm is reciprocated by an arm 89 projecting upward from a sleeve 90 which is mounted to turn about a stud 91 supported in the turret. The connection between the
 5 needle carrying arm 85 and actuator arm 89 comprises a roll 92 mounted on the upper end of the arm 89 and engaging a slot 93 formed in the needle carrying arm. The
 10 actuator arm 89 and slot 93 are so arranged that the travel of the roll 92 along the slot as the actuator arm moves forward advances the under needle from its retracted to its advanced position and then slightly
 15 retracts or dips the needle to form a loop through which the upper needle may pass, as indicated in Figs. 5, 12 and 13. The slot 93 in the needle carrying arm is preferably curved as shown, since this reduces the
 20 throw of the arm 89 requisite for imparting the reciprocation and dip to the needle. The actuator arm 89 is oscillated during the formation of each stitch through an arm 94 projecting from the sleeve 90 and connected
 25 by means of a link 95 with one end of a lever 96. The lever 96 is pivoted upon a fixed bracket 97 which is secured to the frame of the machine, and the rear end of the lever is connected by a link 98 with a
 30 crank 99 on the end of the driving shaft 84 (Figs. 1, 5 and 12). This construction and arrangement of under needle carrier and driving connections enables the under needle to be reciprocated at a high rate of speed without strain or undue wear upon the
 35 parts.

The crank for actuating the under needle mechanism, and the differential crank mechanism for reciprocating the upper needle, are so arranged that both needles are with-
 40 drawn to their retracted position at substantially the same time, thus simultaneously tightening both the upper and under threads to set the stitches. This insures a uniform interlocking of the stitches and location of
 45 the purl. The slow movement imparted to the upper needle during the first part of its downward stroke, and the rapid completion of its reciprocation, enables the needles to be thus simultaneously moved to retracted
 50 position. The arrangement of the differential crank mechanism is such that during the half revolution of the driving shaft 84, which advances and dips the under needle, the movement of the upper needle is not sufficient to bring its point below the loop
 55 formed by the upper needle, and during the completion of the rotation of the shaft 84 which retracts the under needle the downward movement of the upper needle is completed, and the needle returned to its upper
 60 or retracted position.

The eye of the upper needle extends through the needle substantially parallel to the line of feed, and the upper thread t is
 65 threaded through the needle in the direction

of the feed so that the thread will draw freely through the eye during the sewing. The thread leads to the eye of the needle through a tension device 102, through the
 70 guides 101 of the slack thread controlling device, down through the needle bar, and through a light tension 100 on the lower end of the needle bar. As the needle bar rises it acts to draw the upper thread taut to tighten
 75 and set the stitch, and during the descent of the needle bar it gives up slack thread between its eye and the work. A part of this slack thread is required to form that side of the loop carried down through the work by
 80 the eye of the needle which extends from the previous stitch to the eye of the needle. The descent of the needle, however, gives up more slack thread than is required, and the surplus slack thread is taken up by the engagement of the thread with the upper bearing
 85 67 through which the upper needle reciprocates. This bearing is in the form of a sleeve, the upper end of which is so arranged that the upper end of the needle bar passes down within the sleeve during its descent,
 90 thus causing the thread to engage the upper end of the sleeve and be drawn back through the eye of the needle. The sleeve is mounted in the head of the machine so that it may be vertically adjusted, and is held in adjusted
 95 position by a set screw 67'. When the loop of thread carried through the work by the upper needle and held by the looper for the passage therethrough of the under needle is released by the looper, the slack thread in
 100 the loop is drawn up about the under needle by a vertically reciprocating thread finger 101' which coöperates with the thread guides 101. The thread finger is arranged to pass up between the thread guides 101 and
 105 is so arranged that it is somewhat below the thread when the upper needle is in its retracted position. As shown, the thread finger is secured to the crank 99 on the shaft 84 through which the under needle and
 110 looper are actuated. When the upper needle is in its upper position the looper holds a loop of upper needle thread in position over the upper end of the under needle. As the shaft 84 turns through a half revolution
 115 the under needle is advanced and the looper is retracted, and as the looper releases the loop the thread finger engages the thread between the guides 101 and withdraws the
 120 slack thread from the loop and draws the loop up about the under needle. During this time the upper needle has been moved slowly down through the first part of its stroke, and during the continued downward
 125 stroke of the upper needle the thread finger 101' is retracted and gives up the slack thread which it has drawn.

The under thread t' leads from the eye of the under needle through a second eye or guide 103, through a guide eye 104 on the
 130

thread arm, thence through a fixed guide 105 carried on the turret, through a tension 106 on the turret, and thence through the hollow link 95. From the link 95 the thread leads through devices which are operated to prevent the twisting of the under and stay threads one about the other by the rotation of the turret, which devices will be more fully described hereafter. As the under needle is retracted the thread eyes in the needle and on the needle carrier coöperating with the fixed thread guide 105, draw up the slack in the under thread and tighten and set the stitch, without the aid or intervention of any additional takeup or thread tightening devices. The stay thread or cord *s* leads through the guide in the throat plate, through a guide 107 in the three-arm bracket 108 which supports the throat plate and plate 23', through guide eyes 109 and 110, through the hollow link 95, and thence to the guiding devices above referred to, which prevent twisting of the under and stay threads about each other. After the upper needle has passed down through the loop of under needle thread formed by dipping the under needle, and while the under needle is being retracted, the looper 63 engages the upper needle thread between the eye of the needle and the work, and during the movement of the needles to their retracted positions, carries the loop of thread thus taken over the end of the under needle, so that on the next upward stroke of the under needle it will pass up through this loop of upper thread. In the construction shown, the looper 63 is so operated that it passes the upper needle on the side opposite to that on which the under needle passes, *i. e.*, on the front side or side toward the direction of the feed, and is provided with a heel 111 which is arranged on the side of the looper away from the needle. The looper is provided with a laterally projecting shank by which it is adjustably secured in one end of the looper arm 112. The looper arm is mounted upon a vertical pivot 113 carried by the end of a horizontal arm 114. The arm 114 is secured to the upper end of a vertical rock shaft 115 which is mounted in the turret, and is provided at its lower end with a radially projecting arm 116. The arm 116 is connected by a link 117 with an arm 118 depending from the sleeve 90 which carries the needle actuating arm 89. When the sleeve is rocked to retract the under needle, the vertical shaft 115 is turned to swing the arm 114 and looper carrying arm 112 in a direction transversely of the direction of the feed to carry the point of the looper past the front side of the upper needle. As the looper carrying arm 112 is thus moved bodily in a horizontal plane it is also swung laterally in the direction of the feed about its vertical pivot

113, and as the looper arm completes its forward movement this lateral movement brings the loop carried by the looper over the end of the under needle. This position of the looper is indicated in Figs. 5 and 11. The devices for swinging the looper carrying arm laterally comprises a cam slot 119 formed in a stationary plate 120 and engaged by a roll carried by the looper carrying arm and arranged on the opposite side of the pivot 113 from the looper. The construction and arrangement of the looper supporting and actuating devices enables the looper to be maintained under positive control and to be actuated at a high rate of speed without strain or undue friction and wear upon the operating parts.

The turret 88 which carries the under thread mechanism and throat plate is mounted in bearings formed in the turret bracket 21, and is provided at its lower end with a sprocket wheel 121 which is connected with a similar sprocket wheel 122 on the lower end of the shaft 73 by a chain 123 which passes about the sprocket wheels and over an adjustable tightening sprocket 124. During the sewing of each buttonhole the shaft 73 is turned through a complete revolution, and through the sprocket wheels and chains described, turns the stitch forming mechanism through a complete revolution. In the construction shown, the rotation of the shaft 73 and of the stitch forming mechanism is always in the same direction, these parts being turned rotation after rotation during the sewing of successive buttonholes. The devices for thus rotating the shaft 73 and stitch forming mechanism comprise driving connections between the rotary gear 60 and the shaft 73, and a cam operating on these connections to vary the movement imparted to the shaft 73 and stitch forming mechanism by the rotation of the gear. As shown, the driving connections comprise an arm or link 125, one end of which is pivotally connected to a pin 126 on the gear 60, and the other end of which is connected by a link 127 to an arm 128 secured to the shaft 73 (Figs. 4, 5, 8 and 9). The link 125 carries a roll 129 which travels in a cam groove 130 formed in a disk 131 which is secured in a bracket 132. During the operation of the stitch forming mechanism the gear 60 is driven through a single revolution by a pinion 133 secured to a vertical shaft 134. The upper end of the shaft 134 is connected by a universal joint to a shaft section 135, the upper end of which carries a worm wheel 136 engaged by a worm 137 on the driving shaft 84. Through these connections a uniform and continuous movement is imparted to the gear 60 during the operation of the stitch forming mechanism. The cam groove 130 and the arms and links connecting the gear and the shaft 73 are so proportioned

and arranged, however, that the stitch forming mechanism is held stationary or moved at varying speeds during the sewing about the buttonhole, according to the part of the buttonhole at which the stitch forming mechanism is operating. In the machine shown, the parts are so proportioned and arranged that the first stitch in a buttonhole is formed at the end of the buttonhole slit, and the last stitch is completed in the same needle hole in which the first stitch was begun, as indicated in Fig. 23. The position of the parts when the sewing mechanism is started and stopped is indicated in Fig. 8. During the first advance stroke of the needles the cam roll 129 moves in the part 138 of the cam groove 130, which is so shaped that no rotary movement is imparted to the stitch forming mechanism until after the needles have passed through the work. After the first stitch is formed, the roll travels in a part of the cam groove which accelerates the movement transmitted to the stitch forming mechanism from the gear 60 so that the stitch forming mechanism is rotated at a comparatively rapid speed in forming the stitches across the lower end of the buttonhole. The rotation of the stitch forming mechanism is then retarded in sewing along the sides of the buttonhole, is accelerated in sewing about the eye of the buttonhole, is again retarded in sewing along the opposite side of the buttonhole, and is again accelerated in passing from the side to the end and sewing across the end of the buttonhole. In forming the last stitch the needles pass through the material at the same point they passed in forming the first stitch, and thereafter the cam roll travels in the part 138 of the cam groove so that no rotary movement is imparted to the stitch forming mechanism during the last retracting movement of the needles, and the stitch forming mechanism is stopped in proper position for the sewing of the next buttonhole. By the mechanism described the rotation of the stitch forming mechanism may be accurately and uniformly controlled while the actuating mechanism is operated at a high rate of speed.

As has been stated, the under thread t' and stay thread s are led through the hollow link 95 forming a part of the driving connections for the under thread mechanism.

This link rotates with the turret carrying the under thread mechanism, and the lower end of the link is provided with a pin 139 which lies between the under and stay threads and provides two guides for the threads at the lower end of the link. Since the turret is turned rotation after rotation in the same direction, the stay and under threads would be twisted one about the other below the lower end of the link 95 if means were not provided to avoid such twisting to-

gether of the threads. In the construction shown, such twisting together of the threads is avoided or counteracted by providing guides for the threads which are given a rotation for each rotation of the turret, and by providing a support for one or both of the thread supplies which turns with these guides. As shown, one of the thread supplies 140, preferably that of the stay thread, is carried by a support 141 secured to a vertical tube 142 which is mounted to turn in an eccentric adjustable bearing 143. The stay thread is led from the thread supply 140 down through the guiding tube 142 and thence through a guide eye 144 to the guides at the lower end of the link 95. The under thread is led from its supply through a guide tube 145 which directs the thread from a point in line with the axis of the guide tube 142 down about the thread supply 140 and into the guide tube 142 below the stay thread supply. The thread leads from the lower end of this tube over a guide pin 146 which divides the lower end of the guide tube 142 into two guides similar to the guides at the lower end of the hollow link 95. The guide tube 142 is given a rotation for each rotation of the turret, and in an opposite direction, so that the twisting action of the turret is nullified and the twisting together of the threads is avoided. The means for thus turning the guide tube 142 comprises a sprocket chain 147 passing over a sprocket wheel 148 secured to the lower end of the tube, and over a sprocket wheel 149 secured to the shaft 134 through which the stitch forming mechanism is rotated.

The mechanism for driving and stopping the shaft 84 which actuates the stitch forming mechanism and the mechanism for turning the stitch forming mechanism and under thread guides, comprises a continuously rotating driving pulley 150 which is loosely mounted on a sleeve 151 surrounding the shaft (Figs. 1, 2 and 3). The pulley is provided with an internal clutch face adapted to cooperate with a clutch disk 152 which is keyed on the shaft. The pulley carrying sleeve 151 is forced in a direction to engage the members of the clutch by a spring 153 interposed between the end of the sleeve and a disk 154 held on the end of the shaft by a collar 155. The pulley is moved against the tension of the spring to disengage the clutch members by pins 156 which pass through the hub of the clutch member 152, and are interposed between the end of the sleeve 151 and an actuator pinion 157. The actuator pinion is rocked in one direction or the other at proper intervals by a rack 158 secured to the upper end of a vertical actuator bar 159, the lower end of which rides on a cam rib 160 secured to the upper face of the cam carrying gear 31. A series of balls 161 are arranged between the face of the pinion 157

and the end of a fixed bearing sleeve 162 and engage inclined cam surfaces formed on the pinion and sleeve. When the actuator bar 158 is in its upper position the cam surfaces are so related that the pinion acting on the ends of the pins 157 holds the clutch members out of engagement against the tension of the spring 153. When the actuator bar moves downward the pinion 157 is rocked to allow the clutch members to engage so that the shaft 84 is driven from the pulley 150. The actuator bar 159 is forced downward by a spring 163, and its downward movement when released by the cam rib 160 is limited by the engagement of a lug 164 on the bar with an adjustable stop 165.

When the actuator bar rides off the end of the cam rib 160 the driving clutch for the shaft 84 is engaged, the operation of the stitch forming mechanism and the other devices driven from the shaft is started, and these devices continue in operation until the actuator bar is again raised by the cam rib and the driving clutch disengaged. When the driving clutch is disengaged, the shaft 84 is brought to rest with the needles of the stitch forming mechanism in their retracted positions, and the mechanism for turning the stitch forming mechanism in its initial position by stopping devices which are controlled by cams on the cam carrying gear. These devices comprise a positioning and stop cam 166 which is secured to the hub of the clutch member 152, and a yielding stop arm 167 carrying a roll 168 for cooperating with the cam. The stop arm is secured upon a vertical shaft 169 mounted to rock and move vertically in an upper bearing 170 and a lower bearing sleeve 171. The upper end of the shaft is held against a stop in the upper bearing by a spring 172, one end of which is connected to the hub of the arm 167, and the other end of which is connected to the adjustable bearing sleeve 171. This spring is a torsional as well as a compression spring, and not only acts to yieldingly support the stop arm, but also tends to swing the arm in a direction to bring the roll carried thereby into the path of the cam 166. The lower end of the shaft 169 carries an arm 173 the end of which projects into the path of a cam 174 on the cam carrying gear 31. Just before the driving clutch is engaged the cam 174 engages the end of the arm 173 and swings the stop roll out of the path of the cam 166, and the cam continues to hold the stop arm in this position until the clutch is to be disengaged and the shaft 84 arrested. At this time the arm 173 rides off the end of the cam 174, so that the stop arm is swung by its spring 172 in a direction to bring the upper end of the roll 168 into the path of the cam 166. This swinging movement of the arm is controlled by

an inclined cam 175 arranged in advance of the cam 166, and so shaped that the roll rides against the side of this cam and is brought gradually into the path of the cam 166. After the clutch is disengaged, the momentum of the parts tends to continue the rotation of the shaft 84 in the direction of the arrow in Fig. 2, and the cam 166 acting on the upper end of the roll 168 forces the stop arm down against the tension of the spring 172, thus overcoming the inertia of the parts. If the shaft has moved slightly beyond its stopping position, the pressure of the roll against the cam 166 will move the shaft back into the stopping position indicated in Fig. 2.

The cam carrying gear is driven through a single revolution for each cycle of operations performed by the machine. During the operation of the stitch forming mechanism it is connected with the mechanism for actuating and turning the stitch forming mechanism, so that the longitudinal movement of the work clamp may be properly and accurately timed with relation to the reciprocating and turning movements of the stitch forming mechanism. It is independently driven, and preferably at a higher rate of speed, to actuate the cutter and to move the work clamp from cutting to sewing and back to cutting position while the stitch forming mechanism and the mechanism for turning it are at rest. The mechanism for thus rotating the cam carrying gear comprises a pinion 177 formed on a sleeve 178 which is loosely mounted on the shaft 134 (Figs. 4, 6, 20 and 21). A flange 179 is formed on the lower end of the sleeve and is provided with a hole adapted to be engaged by a clutch pin 180 mounted in the pinion 133 and supported by a spring 181. The upper end of the sleeve is provided with a clutch member 182 adapted to engage an internal clutch surface formed on a worm wheel 183. The worm wheel is loosely mounted on the upper bearing sleeve 184 for the shaft 134, and is engaged by a worm 185 secured to a shaft 186 which is continuously driven through a pulley 187 (Fig. 1). When the clutch members at the upper end of the driving sleeve are engaged, the cam carrying gear is independently driven at a comparatively high rate of speed. When the clutch members at the lower end of the sleeve are engaged, the cam carrying gear is driven from the shaft 84 at a slower rate of speed and in unison with the stitch forming mechanism. The sleeve 178 is moved to engage and disengage the clutches through a yoke 188 mounted on a stud 189 and provided with arms the ends of which carry rolls engaging an annular groove 190 formed in the sleeve. The yoke is provided with a vertical arm 191 and is forced in a direction to engage the clutch members at the upper

end of the driving sleeve by a torsional spring 192. When the machine is at rest the driving sleeve is held in neutral position with both clutches out of engagement by a latch 193 secured in the rear end of a starting lever 194. The latch is held in active position by a spring 195 underlying the starting lever. When the starting lever is depressed the yoke 188 is released and the spring 192 shifts the driving sleeve to engage the clutch members at the upper end of the sleeve. The cam carrying gear will now be driven at a comparatively high rate of speed through a partial revolution. During this partial revolution of the gear the cutter will first be operated to close the work clamp and cut the buttonhole, and then the work clamp will be moved forward to bring the end of the buttonhole into proper relation to the needles of the stitch forming mechanism. During this movement of the cam carrying gear the driving clutch for the shaft 84 will be held out of action by the cam 160 which supports the clutch actuating bar 159. After the buttonhole has been brought into sewing position the cam 174 will swing the stop arm out of active position, and the clutch actuating bar 159 will ride off the end of the cam 160, thus starting the shaft 84 which actuates the stitch forming mechanism. At this time the driving sleeve 178 will be shifted to engage the clutch members at the lower end of the sleeve by a lever 196 one end of which engages a cam groove 197 formed in the under face of the gear 31, and the other end of which is provided with a gear segment 198 engaging a similar segment on the yoke 188 (Fig. 21). The cam carrying gear will now be driven from the shaft 84 and will be rotated through a further part of its revolution in unison with the stitch forming mechanism and with the actuator gear 60 which turns the stitch forming mechanism, and also moves the work clamp laterally during the sewing. After the sewing of the buttonhole is completed the clutch actuating bar 159 will be raised by the cam 160, thus disengaging the driving clutch of the shaft 84, and at the same time the cam 174 will release the arm 173, so that the stop arm will be moved into the path of the stop cam on the shaft 84, and will bring the shaft to rest in proper position. The cam 197 will operate the lever 196 to shift the driving sleeve 178 and reengage the clutch members at the upper end of the sleeve. At this time the latch 193 on the starting lever must be out of the path of the operating arm 191, and the gear 31 therefore carries a cam lug 199 which rides under an arm 200 on the starting lever, and holds the latch in inactive position until the arm 191 has passed under it, and then releases the latch and starting lever. After the clutch members at the

upper end of the sleeve have been thus re-engaged, the cam carrying gear is driven through the remainder of its revolution at the high speed, and moves the work holding clamp back to its initial position, thus opening the clamp and bringing it into position ready for the cutting of the succeeding buttonhole. As the cam carrying gear moves to its initial position, the cam 197 operates the lever 196 and shifts the driving sleeve sufficiently to disengage the clutch members at the upper end of the sleeve and to bring the arm 191 back of the latch 193. The movement of the parts after the clutch is disengaged is sufficient to carry the cam 197 into such position that it will not interfere with the engagement of the clutch members at the upper end of the sleeve when the starting lever is again tripped.

In addition to the cams already referred to the cam carrier gear 31 also carries a cam rib 201 for raising and lowering a tension release rod 202. During the operation of the stitch forming mechanism the cam does not underlie the rod, and the spring 203 of the tension device 102 forces the disks of the tension device together (Fig. 22). When the operation of the stitch forming mechanism ceases, and during the time that the mechanism is out of operation, the rod rides on the cam 201 and raises the rod, so that the pressure of the spring on the disks is released.

The number of stitches formed in sewing about the buttonhole will depend upon the relative speeds of the shaft 84 which reciprocates the needles, and the shaft 134 which actuates the cams and devices for feeding the work clamp and turning the stitch forming mechanism, and for controlling the starting and stopping of the stitch forming mechanism. In order to provide for conveniently varying the number of stitches about the buttonhole, the worm gear 136 is so connected with the shaft section 135 that it may readily be removed and a gear of a different size secured in its place. The universal joint between the shaft section 135 and the shaft 134 enables different sizes of worm gears to be used with the same worm on the shaft 84. As shown, the hub of the worm gear 136 is mounted in a removable bearing 204 and is detachably connected with the shaft section 135 by a pin 205 adapted to enter a hole formed in the flange 206 near the upper end of the shaft section. The bearing 204 is formed in an arm 207 which is connected to the frame of the machine by a bolt 208. The cap plate 209 which covers the driving mechanism is hinged as indicated at 210 (Fig. 3), so that it may be readily swung up out of the way when the worm gear 136 and bearing arm 207 are to be changed.

While the various features of the inven-

tion have been shown and described as embodied in a machine in which the overedge stitches are formed by an upper needle and complementary under thread mechanism consisting of an under needle and looper, and certain features of the invention relate more particularly to this type of stitch forming mechanism, the other features of the invention are not limited in their application to machines embodying this type of stitch forming mechanism, but may be embodied with advantage in machines provided with other forms of complementary under thread mechanism coöperating with an upper needle or provided with other forms of stitch forming mechanism. It will also be understood that the specific construction and arrangement shown and described is not essential, and may be modified and changed as found desirable or best suited to the construction and mode of operation of the parts and mechanisms of the machine in which any or all of the features of the invention are embodied.

Certain features of invention relating to the work clamp and means for operating and controlling it are claimed in a division of the present application, No. 764,377, filed April 29, 1913.

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

1. A buttonhole sewing machine, having, in combination, upper and under needles, a shaft connected to reciprocate the upper needle, a driving shaft out of axial alinement therewith, and differential crank mechanism connecting the shafts and arranged to impart a comparatively slow movement to the needle during the first part of its downward movement and a rapid movement during the lower part of its reciprocation, substantially as described.

2. A buttonhole sewing machine, having, in combination, upper and under needles, a shaft connected to reciprocate the upper needle, a driving shaft out of axial alinement therewith, and a crank carried by one shaft and having a radially sliding connection with the other shaft, the crank and sliding connection being arranged to rotate the driven shaft one revolution for each revolution of the driving shaft and at a slow speed during the first part of the downward movement of the needle and at a high speed during the lower part of the reciprocation of the needle, substantially as described.

3. A buttonhole sewing machine, having, in combination, upper and under needles, a vertically reciprocating needle bar carrying the upper needle, a crank shaft provided with a crank connected to the needle bar, a driving shaft out of axial alinement with the crank shaft, and a differential crank

connection for driving the crank shaft through a revolution for each revolution of the driving shaft comprising a crank pin on the end of one shaft and an arm on the other shaft provided with a radial slot engaged by the crank pin, substantially as described.

4. A buttonhole sewing machine, having, in combination, a straight upper needle, a curved under needle, mechanism for reciprocating and dipping the under needle, mechanism for advancing the upper needle to a position to enter the loop formed by dipping the under needle while the under needle is being advanced from its retracted position and dipped, and for completing the advance and return movement of the upper needle while the under needle is returning to its retracted position, substantially as described.

5. A buttonhole sewing machine, having, in combination, a straight upper needle, a curved under needle, and mechanism for reciprocating the needles to form over-edge stitches and for bringing them simultaneously to their retracted positions to set the stitches, substantially as described.

6. A buttonhole sewing machine, having, in combination, upper and under needles, an oscillating carrier for the lower needle, and an oscillating arm having a sliding connection with the needle carrier arranged to oscillate and dip the needle, substantially as described.

7. A buttonhole sewing machine, having, in combination, a straight upper needle, a curved under needle, a pivoted needle carrying arm for the under needle, an actuating arm, a guideway on the needle carrying arm engaged by the actuator arm and arranged to cause the needle to be advanced and dipped by the forward stroke of the actuator arm, substantially as described.

8. A buttonhole sewing machine, having, in combination, an upper needle, a curved under needle, a pivoted carrier arm for the under needle provided with a slot, a pivoted actuator arm 89 provided at its upper end with a roll engaging the slot, and means for oscillating the actuator arm to oscillate and dip the needle carrier, substantially as described.

9. A buttonhole sewing machine, having, in combination, a curved under needle, a pivoted arm 85 for oscillating the needle provided with a slot 93, an actuator arm 89 pivoted below the arm 85 and provided at its upper end with a roll engaging the slot, and means for oscillating the actuator arm to reciprocate and dip the needle, substantially as described.

10. A buttonhole sewing machine, having, in combination, upper and under needles and mechanism for actuating the under needle comprising a pivoted arm connected to oscillate the needle, an oscillating actua-

tor arm, and a sliding connection between the arms arranged to cause the needle to be advanced and dipped by the forward stroke of the actuator arm.

- 5 11. A buttonhole sewing machine, having, in combination, an upper needle, a curved under needle, a pivoted arm connected to oscillate the under needle, an actuator arm, and a guideway on the pivoted arm engaged
10 by the actuator arm and arranged to cause the needle to be advanced and dipped by the forward stroke of the actuator arm.

12. A buttonhole sewing machine, having, in combination, an upper needle, a curved
15 under needle, a pivoted arm connected to oscillate the under needle provided with a slot, a pivoted actuator arm provided at its upper end with a roll engaging slot, and means for oscillating the actuator arm to
20 oscillate and dip the needle.

13. A buttonhole sewing machine, having, in combination, an upper needle, an under needle, a looper 63, a looper arm 112, a horizontal arm 114 upon which the looper arm
25 is pivoted, a rock shaft 115 carrying the arm 114, a fixed cam 119, and a roll on the looper arm engaging the cam, substantially as described.

14. A buttonhole sewing machine, having,
30 in combination, upper and under thread handling mechanisms, rotary supports for said mechanisms, sprocket wheels on the supports, a shaft carrying corresponding sprocket wheels, chains connecting the
35 sprocket wheels, and mechanism for actuating the shaft to rotate the supports during the sewing of a buttonhole, substantially as described.

15. A buttonhole sewing machine, having,
40 in combination, upper and under needle mechanisms, rotary supports therefor, a shaft, sprocket chains connecting the shaft and supports, a uniformly rotating driving member, and means for transmitting a variable motion from the driving member to
45 the shaft and support, substantially as described.

16. A buttonhole sewing machine, having, in combination, stitch forming mechanism
50 including upper and under thread handling devices, mechanism for rotating the stitch forming devices in the same direction rotation after rotation in sewing about successive buttonholes, stay thread guiding devices
55 rotating with the stitch forming devices, guiding devices for the stay and under threads, a support for a thread supply, and mechanism for rotating said guiding devices for the stay and under threads and said support in a direction opposite to that in which
60 the stitch forming devices are rotated to avoid twisting of the threads about each other by the rotation of the stitch forming mechanism, substantially as described.

17. A buttonhole sewing machine, having, 65 in combination, stitch forming mechanism including upper and under thread handling devices, mechanism for rotating the stitch forming devices in the same direction rotation after rotation when sewing about
70 successive buttonholes, stay thread guiding devices rotating with the stitch forming devices, a rotary support for a thread supply, guides on the support over which the thread from the thread supply and
75 an additional thread are led to the under and stay thread guiding devices, and mechanism for rotating said support in a direction opposite to that in which the stitch forming devices are rotated to avoid twist-
80 ing of the threads about each other by the rotation of the stitch forming mechanism, substantially as described.

18. A buttonhole sewing machine, having, in combination, stitch forming mechanism 85 including upper and under thread handling devices, mechanism for rotating the stitch forming devices in the same direction rotation after rotation in sewing about successive buttonholes, guides for the under and
90 stay threads rotating with the stitch forming mechanism, a vertical tube provided with guides from which the under and stay threads are led to the guides on the stitch forming mechanism, means for rotating the
95 tube in a direction opposite to that in which the stitch forming mechanism is rotated, and a thread supply support rotating with the tube, substantially as described.

19. A buttonhole sewing machine, having, 100 in combination, stitch forming mechanism including upper and under thread handling devices, a turret in which the under devices are mounted, mechanism for rotating the upper devices and the turret in the same direction
105 rotation after rotation in sewing about successive buttonholes, guiding devices on the turret for the under thread and a stay thread, a vertical guide tube provided with guides at its lower end for the under and
110 stay thread, a thread supply support on the tube, a guide carried by the tube for leading one of the threads about the thread supply, and means for rotating the tube in a direction opposite to that in which the turret is
115 rotated, substantially as described.

20. A buttonhole sewing machine, having, in combination, stitch forming and stay
120 thread guiding devices, mechanism for rotating said devices in the same direction rotation after rotation in sewing about successive buttonholes, and independently actuated devices for carrying the stay and under threads one about the other to avoid twisting of these threads about each other by the
125 rotation of the stitch forming and stay thread guiding devices, substantially as described.

21. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, a cutter, a cam carrier, cams on the carrier for operating the cutter and relatively moving the clamp, cutter and stitch forming mechanism, a rotary actuator for rotating the stitch forming mechanism, connections between the actuator and motion transmitted to the stitch forming mechanism, mechanism for rotating the cam carrier and actuator during the sewing to sew about a buttonhole, and mechanism for independently rotating the cam carrier to relatively move the clamp, cutter and stitch forming mechanism alternately into cutting and sewing relations while the stitch forming mechanism and actuator are at rest, substantially as described.

22. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, a cutter, a cam carrier which makes one revolution for each cycle of the machine, cams on the carrier for operating the cutter and for relatively moving the clamp, cutter and stitch forming mechanism lengthwise of the buttonhole, a rotary actuator for rotating the stitch forming mechanism which makes one revolution for each buttonhole, connections between the actuator and stitch forming mechanism for varying the motion transmitted from the actuator to the stitch forming mechanism, and mechanism for rotating the cam carrier through a partial revolution during a complete rotation of the actuator and for independently rotating it during the remainder of its revolution, substantially as described.

23. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, a cutter, a cam carrier which makes one revolution for each cycle of the machine, cams on the carrier for operating the cutter and for relatively moving the clamp, cutter and stitch forming mechanism lengthwise of the buttonhole, a rotary actuator for rotating the stitch forming mechanism which makes one revolution for each buttonhole, connections between the actuator and stitch forming mechanism for varying the motion transmitted from the actuator to the stitch forming mechanism, mechanism for rotating the cam carrier through a part of a revolution and the actuator through a complete revolution during the sewing of a buttonhole, and mechanism for independently rotating the cam carrier at a higher speed through the other part of its revolution to operate the cutter and relatively move the parts into cutting and sewing relations, substantially as described.

24. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, a cutter, a cam carrier, cams

on the carrier for operating the cutter and for relatively moving the clamp, cutter and stitch forming mechanism, a rotary actuator for rotating the stitch forming mechanism which makes one revolution for each buttonhole, connections between the actuator and stitch forming mechanism for varying the motion transmitted from the actuator to the stitch forming mechanism, mechanism for rotating the cam carrier and actuator during the operation of the stitch forming mechanism to sew about a buttonhole, and mechanism for independently rotating the cam carrier to operate the cutter and bring the clamp and stitch forming mechanism into sewing relation before the operation of the stitch forming mechanism is started and to bring the clamp and cutter into cutting relation after the operation of the stitch forming mechanism, substantially as described.

25. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, a cutter, a cam carrier, cams on the carrier for operating the cutter and for relatively moving the clamp, cutter and stitch forming mechanism, a rotary actuator for rotating the stitch forming mechanism which makes one revolution for each buttonhole, connections between the actuator and stitch forming mechanism for varying the motion transmitted from the actuator to the stitch forming mechanism, mechanism for rotating the cam carrier and actuator during the operation of the stitch forming mechanism to sew about a buttonhole, mechanism for independently rotating the cam carrier to operate the cutter and bring the clamp and stitch forming mechanism into sewing relation before the operation of the stitch forming mechanism is started and to bring the clamp and cutter into cutting relation after the operation of the stitch forming mechanism is arrested, driving mechanism for the stitch forming mechanism, and cams on the carrier for throwing said driving mechanism into and out of operation, substantially as described.

26. A buttonhole sewing machine, having, in combination stitch forming mechanism, a work clamp, a cutter, a cam carrying gear, cutter operating and clamp feeding cams on the cam carrier, a second gear, and connections for imparting a variable rotary movement to the stitch forming mechanism, a pinion engaging the cam carrying gear, mechanism for driving the pinion, a second pinion engaging the second gear, mechanism for driving the stitch forming mechanism and the second pinion, and devices for connecting the pinions during the sewing and for disconnecting the pinions and connecting the first pinion with its driving mechanism during the operation of the cutter and the

feed of the clamp from cutting to sewing and from sewing to cutting position, substantially as described.

27. A buttonhole sewing machine, having, in combination, a cam carrier, cutter operating and clamp feeding cams on the carrier, a rotary actuator which makes one revolution for each buttonhole and connections for varying the movement transmitted to the stitch forming mechanism from the actuator, independent driving mechanism for the cam carrier, cams on the cam carrier for throwing the independent driving mechanism into operation to drive the cam carrier through a partial revolution to operate the cutter and feed the work clamp to sewing position, for then throwing in the driving mechanism for the stitch forming mechanism and actuator, throwing out the independent driving mechanism and connecting the cam carrier with the actuator driving mechanism, for throwing out the driving mechanism for the stitch forming mechanism and actuator after the completion of the sewing about the buttonhole and reconnecting the cam carrier with its independent driving mechanism, and for throwing out the independent drive when the cam carrier has reached its initial position, substantially as described.

28. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a turret carrying part of the stitch forming mechanism, a cutter, a cooperating cutter block, and a fixed plate carried by the turret underlying and supporting the cutter block during the cutting, substantially as described.

29. A buttonhole sewing machine, having, in combination, a work clamp, stitch forming mechanism comprising upper and under needles and a looper, two adjacent thread guides for the upper needle thread, a thread engaging finger, mechanism for intermittently advancing and retracting the finger between the guides to draw the upper needle thread about the under needle when released by the looper, and mechanism for actuating the stitch forming mechanism and work clamp to sew about a buttonhole.

30. A buttonhole sewing machine, having, in combination, a work clamp, stitch forming mechanism comprising upper and under needles and a looper, thread guides for the upper needle thread, a thread finger, means for actuating the finger to intermittently engage the thread and draw the upper needle thread about the under needle when released by the looper, and mechanism for actuating the stitch forming mechanism and work clamp to sew about the buttonhole.

31. A buttonhole sewing machine, having, in combination, a work clamp, stitch forming mechanism comprising upper and under

needles and a looper, mechanism for actuating the under needle including a crank, guides for the upper needle thread, a cooperating finger carried by the crank and arranged to draw the upper needle thread about the under needle when released by the looper, and mechanism for actuating the stitch forming mechanism and work clamp to sew about a buttonhole.

32. A buttonhole sewing machine, having, in combination, a work clamp, stitch forming mechanism comprising upper and under needles and a looper, guides for the upper needle thread, a crank, a thread engaging finger carried by the crank and arranged to cooperate with the guides in drawing the upper needle thread about the under needle when released by the looper, and mechanism for actuating the stitch forming mechanism and work clamp to sew about a buttonhole.

33. A buttonhole sewing machine, having, in combination, stitch forming mechanism, work holding clamps, a clamp carriage on which the clamps are mounted, supporting guideways in which the carriage is freely movable in a horizontal plane, a pivot stud on the carriage, a feed cam operating on the stud to move the carriage longitudinally, a longitudinal slot in the carriage, a block in the slot, a lever engaging the block, and a cam for operating the lever to swing the carriage laterally, substantially as described.

34. A buttonhole sewing machine, having, in combination, stitch forming and work holding mechanisms, a feed cam for relatively moving said mechanisms, a shaft and gearing for rotating the cam, a shaft section, a universal joint connecting the shaft and shaft section, a removable worm gear on the end of the shaft section, and a driving shaft having a permanent worm engaging the worm gear, substantially as described.

35. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a clamp carriage, work supporting plates pivoted on the carriage, cooperating clamp carrying arms, spring pressed bars arranged on the carriage and engaging the plates to force them toward each other, adjustable stops for the bars, mechanism for relatively actuating the clamp carriage and stitch forming mechanism to sew about a buttonhole, and means for closing the clamp carrying arms and spreading the plates before the sewing.

36. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a clamp carriage, work supporting plates pivoted on the carriage, cooperating clamp carrying arms, bearings on the carriage, spring pressed bars in the bearings for forcing the plates toward each other, adjustable stops on the bars engaging the ends of the

- bearings, mechanism for relatively actuating the clamp carriage and stitch forming mechanism to sew about a buttonhole, and means for closing the clamp carrying arms and spreading the plates before the sewing.
37. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a clamp carriage, work supporting plates pivoted on the carriage, cooperating clamp carrying arms, a pivot stud carried by the carriage, a guideway for the stud, a feed cam for moving the carriage longitudinally, a longitudinal slot in the carriage, a lever carrying a stud working in the slot, a cam operating the lever to swing the carriage laterally, and means for closing the clamp carrying arms and spreading the work supporting plates.
38. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a clamp carriage, work supporting plates pivoted on the carriage, supporting guideways in which the carriage is freely movable in a horizontal plane, a pivot stud on the carriage, a guideway for the stud, a feed cam for moving the carriage longitudinally, a longitudinal slot in the carriage, a lever provided with a stud engaging the slot, and a cam for operating the lever to swing the carriage laterally.
39. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a turret carrying part of the stitch forming mechanism, a stationary cutter block overlying the turret, a cooperating cutter, and a plate secured to the turret underlying and supporting the cutter block during the cutting.
40. A buttonhole sewing machine, having, in combination, stitch forming mechanism comprising an upper needle and a pivoted under needle, a turret carrying the under needle, a stationary cutter block overlying the turret, a cooperating cutter, and a plate on the turret arranged to underlie and support the cutter block during the cutting.
41. A buttonhole sewing machine, having, in combination, stitch forming mechanism comprising upper and under needles, a turret carrying the under needle, a pivotal support for the under needle on one side of the sewing point, a plate on the turret on the opposite side of the sewing point, a cutter block under which the plate and pivotal support for the needle travel during the rotation of the turret arranged to be supported by the plate, and a cutter cooperating with the block.
42. A buttonhole sewing machine, having, in combination, a work clamp, stitch forming mechanism comprising a hollow reciprocating needle bar through which the upper needle thread passes and supplementary under thread handling devices, a stationary vertically adjustable thread engaging sleeve at the top of the needle bar above and below which the upper end of the needle bar passes during its reciprocation, and mechanism for actuating the stitch forming mechanism and work clamp to sew about a buttonhole.
43. A buttonhole sewing machine, having, in combination, a work clamp, stitch forming mechanism comprising upper and under needles and a looper, thread guides for the upper needle thread, a rotary shaft, a thread engaging finger eccentrically mounted on the shaft and having a thread engaging surface arranged to be advanced and retracted between the guides by the rotation of the shaft to draw the upper needle thread about the under needle when released by the looper, and mechanism for actuating the stitch forming mechanism and work clamp to sew about a buttonhole.
44. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, a feed cam for relatively moving the clamp and stitch forming mechanism, a rotary actuator for rotating the stitch forming mechanism, connections between the actuator and stitch forming mechanism for varying the motion transmitted to the stitch forming mechanism, mechanism for rotating the feed cam and actuator during the sewing to sew about a buttonhole, and mechanism for independently rotating the feed cam to relatively move the clamp and stitch forming mechanism while the stitch forming mechanism and actuator are at rest.
45. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, a feed cam which makes one revolution for each cycle of the machine for relatively moving the clamp and stitch forming mechanism lengthwise of a buttonhole, a rotary actuator for rotating the stitch forming mechanism which makes one revolution for each buttonhole, connections between the actuator and stitch forming mechanism for varying the motion transmitted to the stitch forming mechanism, mechanism for rotating the feed cam through a part of a revolution and the actuator through a complete revolution during the sewing of a buttonhole, and mechanism for independently rotating the feed cam at a higher speed through the other part of its revolution while the stitch forming mechanism and actuator are at rest.
46. A buttonhole sewing machine, having, in combination, stitch forming mechanism, a work clamp, a feed cam for relatively moving the stitch forming mechanism and clamp, a rotary actuator for rotating the stitch forming mechanism which makes one revolution for each buttonhole, connections between the actuator and stitch forming

mechanism for varying the motion transmitted to the stitch forming mechanism, mechanism for rotating the feed cam and actuator during the operation of the stitch forming mechanism to sew about a button-hole, and mechanism for rotating the feed cam independently of the actuator to relatively move the stitch forming mechanism

and clamp before the operation of the stitch forming mechanism is started and after the operation of the stitch forming mechanism is completed. 10

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Witnesses:

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."