A. H. DE VOE.

WORK SHIFTING MECHANISM FOR SEWING MACHINES.

APPLICATION FILED FEB. 21, 1917.

1,416,003. **Patented May 16, 1922.**

2 SHEETS—SHEET 1.

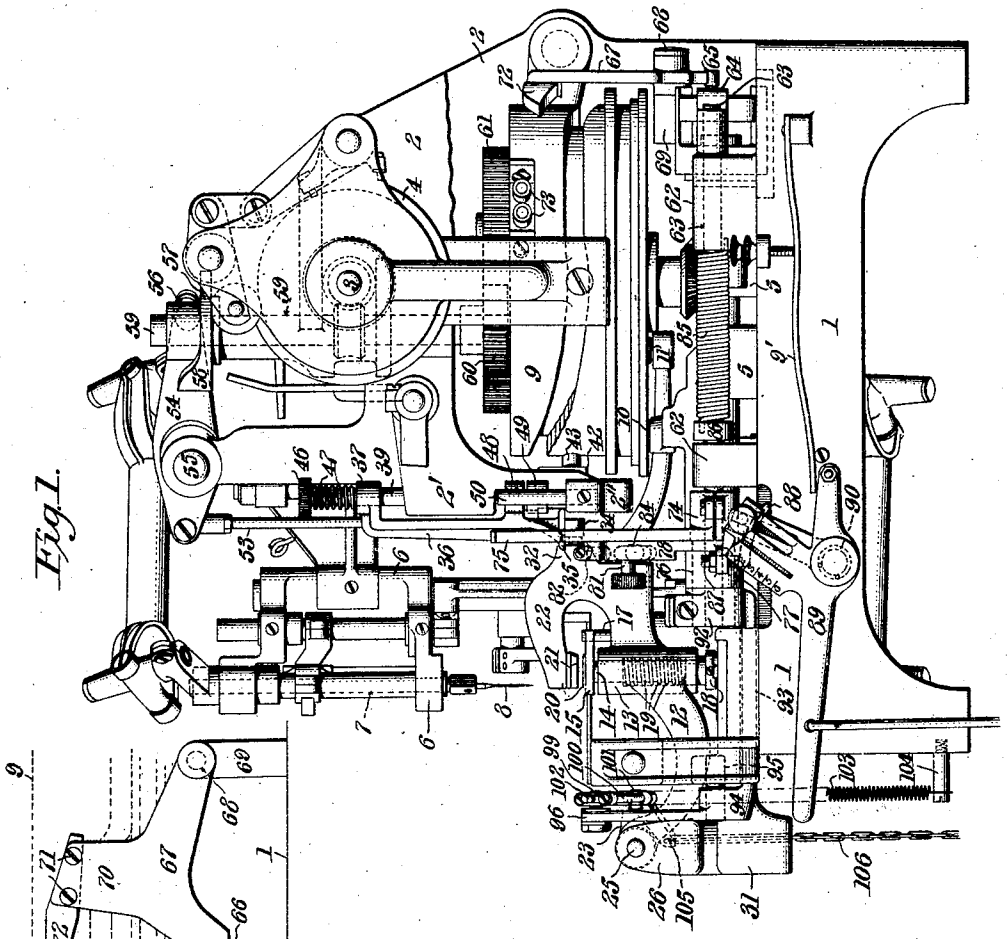


Fig. 1.

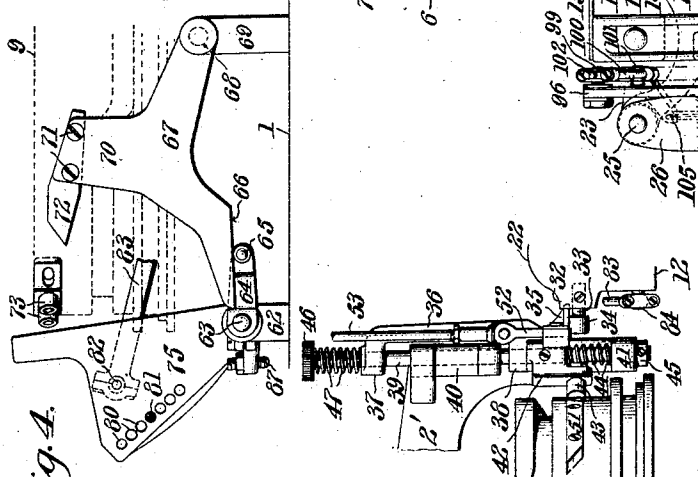


Fig. 4.

Fig. 5.

WITNESS

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2 SHEETS—SHEET 2.

Fig. 2.

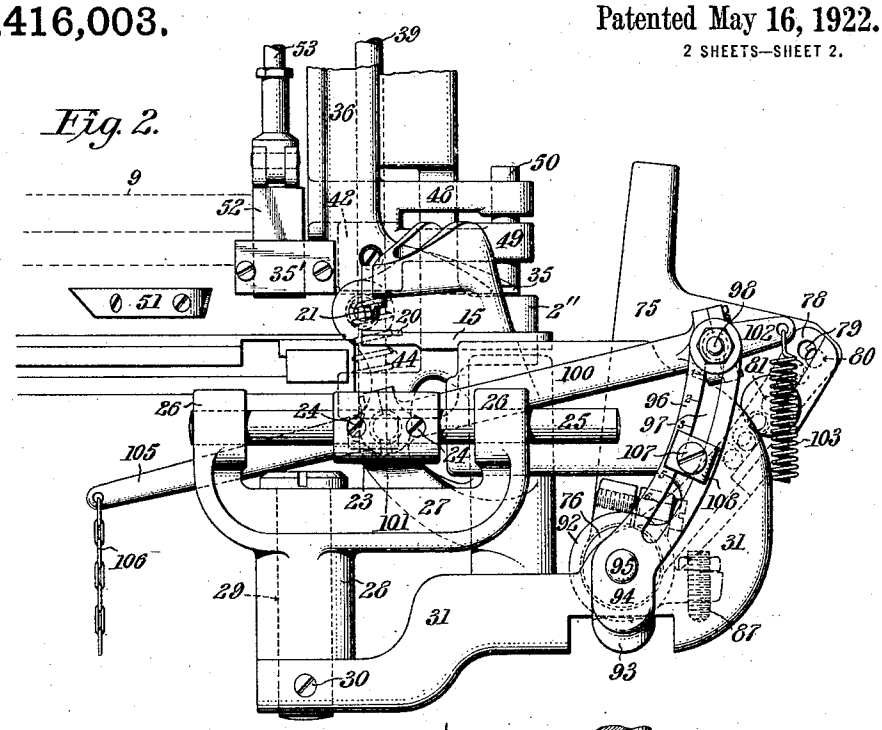
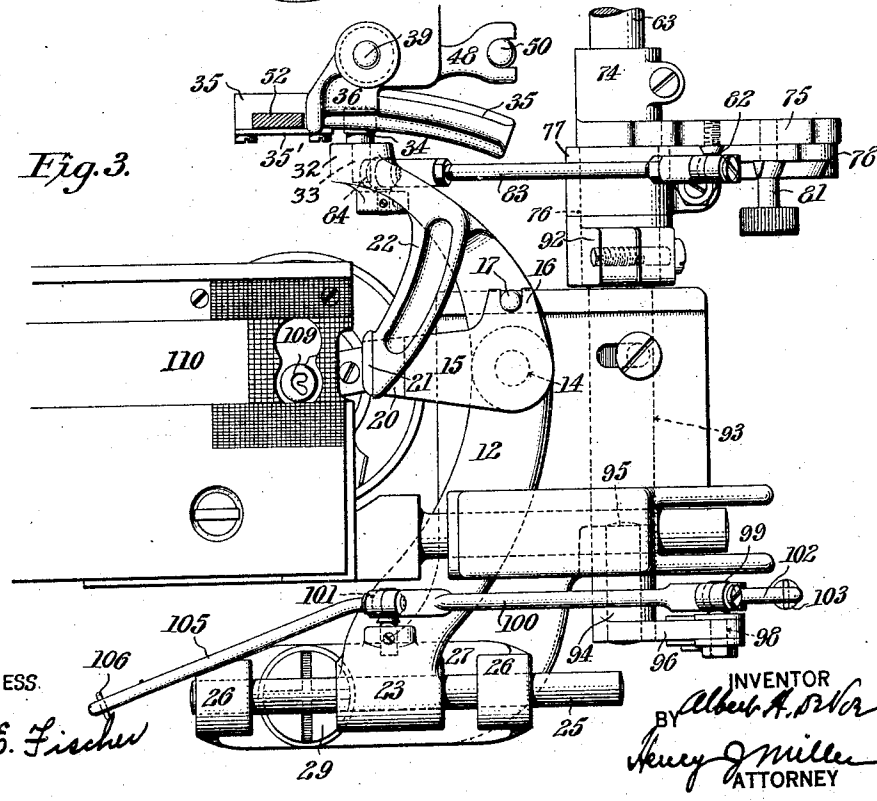


Fig. 3.



WITNESS.

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UNITED STATES PATENT OFFICE.

ALBERT H. DE VOE, OF WESTFIELD, NEW JERSEY, ASSIGNOR TO THE SINGER MANUFACTURING COMPANY, A CORPORATION OF NEW JERSEY.

WORK-SHIFTING MECHANISM FOR SEWING MACHINES.

1,416,003. Specification of Letters Patent. Patented May 16, 1922.

Application filed February 21, 1917. Serial No. 150,003.

To all whom it may concern:

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

This invention relates to an improvement in sewing machines for producing spaced groups or successions of stitches, and is directed particularly to means for producing relative shifting movements between the stitch-forming mechanism and the work intermediate stitching periods, with means of control whereby each group or succession of stitches relative to the preceding group may be positioned either uniformly within a series or arbitrarily at the will of the operator preparatory to the production of any individual group or succession of stitches.

While the present improvement is not limited to embodiment in machines of any one of various types, it has been designed particularly for use in connection with the buttonhole cutting and stitching machine forming the subject of my pending applications Serial No. 69,644, filed December 31, 1915, and Serial No. 135,154, filed December 5, 1916.

Heretofore, provision has been made in buttonhole machines for the automatic shift of the work between stitching positions to space the buttonholes, with the object of saving time by automatic control of the stich-forming and work-handling devices throughout a plurality of buttonhole-producing cycles; but the means to this end heretofore devised have been found impractical in commercial operation because of a lack of the necessary flexibility to adapt the machines for the varying conditions commonly encountered in the manufacture of garments.

The work-shifting means of my said application Serial No. 69,644 has for one of its important objects a capacity for variation, by predetermined adjustment, in the angular relation of successively produced buttonholes, while effecting a uniform spacing of the same apart; while the corresponding mechanism of my said application Serial No. 135,154 sought to further increase the flexibility of the mechanism to accommodate different working conditions by providing not only for the rendering of the same ineffective when required, but by making it controllable arbitrarily to vary the normal length of shift between stitching positions at any stage of a continuous series of buttonhole-producing cycles.

The present invention has for its object to still further increase the capability of this class of mechanism to accommodate itself to normal working conditions by not only increasing the range of adjustment in the angular relation of successive buttonholes of a series but by subjecting such adjustment to arbitrary manual control, so that the operator may determine precisely the position of any buttonhole both regarding its angular relation to and its spacing from the preceding buttonhole.

In its preferred embodiment, the improvement comprises suitable stitch-forming and work-feeding mechanisms in conjunction with a traveling work-gripping device, which latter may consist of the opposed cutting elements of a buttonhole cutting device with means for applying to said elements first a yielding work-gripping closing movement upon the work preparatory to a work-shifting movement, followed by a second stage or cutting movement for producing the buttonhole slit at its arrival in stitching position. The cutting device preferably comprises a travelling frame or carrier sustaining both of the cooperating cutting elements and having a transverse sliding connection at one point with a fulcrum-stud around which it has turning movements and relative to which it has bodily shifting movements. This carrier has independent connections at separated points by means of suitable pitmen with crank-arms upon an actuating rock-shaft of which that controlling the bodily transverse movement of said carrier relative to the fulcrum-stud is adjustable upon its respective crank-arm toward and from the rock-shaft for both uniform and arbitrary or manual control so as to vary or substantially prevent movement of the carrier transversely to its fulcrum-stud in conjunction with the turning movements imparted by the other of said link connections.

Further objects and constructive features of the present improvement will be understood by reference to the following detailed

description in connection with the accompanying drawings, in which—

Fig. 1 is a side elevation of a buttonhole cutting and stitching machine embodying the present invention. Fig. 2 is an enlarged front elevation and Fig. 3 a plan of the work-shifting and cutting mechanism detached from the other parts of the machine. Fig. 4 is an elevation representing the means for imparting operative movements to the actuating rock-shaft, and Fig. 5 is a rear side elevation representing the means for producing the work-gripping and cutting movements of the slit-cutting device.

As shown in the drawings, the machine is constructed with a frame comprising the base 1 from which rise the standards 2 sustaining in coaxial relation the main-shaft 3 and the constantly running driving pulley 4 imparting, through suitable clutch devices and other connections. operative movements to the several trains of mechanism.

Slidingly mounted upon the base 1 is the travelling stitch-frame 5 sustaining a bracket member 6 in which is journaled the reciprocating needle-bar 7 carrying the needle 8 cooperating in practice with loop-taking elements sustained by the frame 5. These stitch-forming elements are suitably mounted in their respective supports to perform partial rotations in buttonhole stitching cycles by means of an operative connection with the feed-cam 9 which derives its operative movements from connections with the main-shaft 3.

The longitudinal feeding or stitch-spacing movements and the lateral side-shift movements are imparted to the stitch-frame by connections with the feed-cam including roller-studs 10 and 11, respectively, entering suitable cam-grooves in the lower face of the feed-cam cylinder 9.

The non-travelling work-holder, in which the work is held during the successive stitching cycles, is not shown herein as it forms no material part of the present invention, but it may be constructed for cooperation with the buttonhole cutting mechanism as represented in my said pending applications.

As represented in the drawings, the travelling work-gripping and cutting device comprises a vertically and horizontally movable cutter-lever 12 having intermediate its ends a vertical tubular boss 13 in which is fitted the guide-stud 14 depending from the laterally extending thrust-plate 15 which has the forked lug 16 embracing the steady pin 17 carried by the cutter-lever 12. The collar 18 fixed upon the enlarged lower end of the guide-stud 14 rests upon a fixed part of the machine base 1, and between the shoulder afforded by the enlarged portion of said stud and the upper end of a socket surrounding the same within the boss 13 is interposed a spring 19 by means of which the cutter-lever is normally maintained yieldingly in upper or inoperative position.

Secured upon the free end of the thrust-plate 15 is the cutter-block or plate 20 disposed beneath and in operative relation with the relatively movable upper cutting knife 21 sustained by the overhanging member 22 of the cutter-lever or frame. The upper and lower cutting elements 21 and 20 are maintained normally separated by the previously described action of the spring 19.

The cutter-lever is formed at its forward end with a transverse apertured boss 23 in which is secured by set-screws 24 the slide-pin 25 mountd in alined transverse bearing apertures in the spaced members 26 of a yoke 27 having its hub 28 journaled upon the fixed headed fulcrum-stud 29 which is secured by the set-screw 30 within a vertical aperture of the bracket-member 31 sustained by the base 1. The cutting device, comprising the frame or carrier 12 with the cutting elements 20 and 21, is thus supported at its forward end upon the pivotally mounted yoke 27 and at a point intermediate its ends by means of the guide-stud 14 resting upon the base 1.

As set forth in my said applications, the cutter-lever has at its inner end adjacent the overhanging member 22 a boss 32 in which is secured a stud 33 carrying a roller 34 adapted for engagement with the lower operative face of the rail 35 sustained at the lower end of the slide-frame 36. The slide-frame 36 is formed with apertured upper and lower lugs 37 and 38 fitted upon the vertical push-rod 39 which is journaled in suitable bearing members 40 and 41 of the frame extension 2′.

The rod 39 has fixed thereon in its lower portion the collar 42 carrying the laterally extending roller-stud 43 and normally pressed upwardly by means of a spring 44 interposed between the same and the lower bearing 41, the elevated position of the rod 39 being determined by engagement of the collar 45 fixed upon its lower end with the bearing member 41. Interposed between the upper lug 37 of the slide-frame 36 and a thrust nut 46 applied to the threaded upper portion of the push-rod 39 is a spring 47 acting to press the slide-frame downwardly with its lug 38 seated upon the collar 42 (Fig. 5). Extending laterally from the lower portion of the frame 36 and the collar 42 respectively are the forked arms 48 and 49 embracing the steady pin 50 rising from a depending portion 2″ of the frame extension 2′, by means of which the parts are prevented from turning.

The roller-stud 43 normally lies within the path of movement of the cam-block 51 secured upon the periphery of the cam-cylinder 9 and provided with a backwardly and

downwardly inclined initial end which, in its encounter with the roller-stud 43 forces the same downwardly and with it the push-rod 39 and the slide-frame 36, thereby yieldingly depressing the rail 35. The rail carries with it the roller-stud 34 and cutter-lever 12 and thus causes the upper cutting element 21 to approach the lower cutting element 20 and yieldingly grip the work between them. The force of this gripping action is determined by the strength of the spring 47 under the normal tension placed thereon by the thrust-nut 46.

The front side face of the rail 35 is formed in the end portion farthest from the cutter-lever with a vertical channel laterally closed by a cap-plate 35′ to afford a guideway for the vertically reciprocating plunger-bar 52 pivotally connected at its upper end with the lower extremity of the pitman 53 whose opposite end is pivotally attached to the shorter arm of a rock-lever 54 mounted upon the fixed fulcrum-pin 55 and having its other arm provided with the lateral roller-stud 56 (Fig. 1). The roller-stud 56 is normally maintained by means of a suitable spring (not shown) resting upon the upper face of the cutter-actuating cam-disk 57 formed with the actuating projection 58 by means of which the rock-lever 54 is tilted for reciprocation of the plunger-bar 52. The cam-disk 57 is fixed upon the vertical shaft 59 having speed-reducing worm-and-worm wheel connection with the main-shaft 3, as represented in dotted lines in Fig. 1, and carries a driving pinion 60 meshing with a gear-wheel 61 secured to the cam-wheel 9 and from which the latter derives its operative movements.

With its connections with the main-shaft represented in the drawings, the cutter-actuating shaft 59 performs several rotations in each button-hole-producing cycle, and the plunger-bar 52 performs a like number of reciprocations, all but one of which are idle or ineffective. As the cutting device, with the work gripped between its cutting elements, reaches stitching position in a work-shifting movement, the roller-stud 34 assumes a position beneath the end of the then retracted plunger-bar which in its next descent thrusts such roller-stud positively downward and thereby depresses the cutter-lever 12 and forces the upper cutting element through the work to cut the buttonhole slit. At this point in the cycle of the machine, the until-then open work-clamp is closed upon the work, the cutting elements separated and the cutting device withdrawn laterally into retracted position and the stitching of the buttonhole is performed as usual.

Journaled in bearings 62 upon the base 1 is a rock-shaft 63 provided upon its rearward end (Figs. 1 and 4) with a crank-arm 64 carrying a roller-stud 65 extending beneath the straight lower operative edge 66 of a lever 67 fulcrumed at 68 upon the post 69 rising from the base 1. The lever 67 has at its upper edge intermediate its ends the extension 70 to the face of which is secured by means of screws 71 the angular tappet member 72, the opposite end portions of whose upper edge are downwardly inclined for successive engagement with the roller-studs 73 projecting from the periphery of the cam-cylinder 9. The engagement of the tappet-member 72 by the studs 73 causes first the gradual depression of the lever 67, then the maintenance of the same in depressed position and the final gradual release of the same to permit it to return to initial elevated position, the rock-shaft 63 performing corresponding rocking movements by reason of the described connections.

The rock-shaft 63 has secured thereon the split hub 74 of an upwardly extending arm 75 which is provided with the forwardly extending sleeve 76. Upon this sleeve and adjacent the hub 74 is loosely mounted the hub 77 of a lever 78 having therein a series of apertures 79 disposed in slightly angular and intersecting relation with a corresponding series of holes 80 in the lever 75. These overlying levers are adapted to be coupled together in different angular relations by means of the pin 81 entering registering holes at the crossing of the two series, as represented in dotted lines in Fig. 2. The lever 75 carries a ball-stud 82 embraced by a strap at one end of a pitman 83 whose opposite end is provided with a similar strap embracing a ball-stud 84 carried by the cutter-lever 12 adjacent the roller-stud 34 (Fig. 5).

Surrounding the rock-shaft 63 is the spring 85 having one end fixed to the rearward bearing 62 and the opposite end secured to a collar 86 fixed upon said rock-shaft and acting upon the latter to yieldingly maintain a stop-screw 87 carried by the hub 77 of the lever 78 in contact with a stop-plate 88 which is sustained by an arm of the plural-armed treadle-actuated lever 89 fulcrumed at 90 and having a lateral arm adapted for engagement with the stop-spring 9′ (Fig. 1).

Secured upon the forward end of the sleeve 76 is a split collar 92 at one end of a forwardly extending bar 93 formed at the other end with a hub 94 carrying a steady pin 95 entering an aperture of the machine frame. Extending upwardly from the hub 94 is a segmental crank-arm 96 formed with a curved slot 97 which is entered by a stud-pin 98 movable within said slot toward and from the steady pin 95 upon the axis of the rock-shaft 63. The stud-pin 98 is formed at one end with a ball 99 embraced by a strap at the end of a pitman-lever 100 formed intermediate its ends with a second strap embracing a ball-stud 101 sustained by the boss 23 of the cutter-lever 12.

The pitman-lever 100 has adjacent the stud-pin 98 an extension 102 apertured to receive one end of a spring 103 whose opposite end is connected to a stud 104 sustained by the bed 1. The pitman-lever 100 has an oppositely directed extension 105 apertured to receive a treadle connection represented in the form of a chain 106. The crank-arm 96 has adjustably secured thereon by means of the clamp-screw 107 passing through the slot 97 a divided stop-block 108 adapted to arrest the pitman-lever 100 in a predetermined initial position of adjustment under the action of the spring 103, while permitting such pitman-lever to be moved by the operator in opposition to said spring under the action of the treadle connection 106.

In the rocking of the shaft 63 under the action of the cam-wheel studs 73 upon the tappet-member 72, the crank-arms 75 and 96 are moved in the direction of the stitch-forming mechanism, thereby acting through the pitmen 83 and 100 to move two spaced portions of the cutter-lever 12 defined by the ball-studs 84 and 101 in the same direction but in extent corresponding with the distances of the ball connections 82 and 99 from the axis of the shaft 63.

Obviously the crank-arm 75 imparts to the cutter-lever a turning movement about the fulcrum-stud 29 while the crank-arm 96 is adapted to impart to the opposite end of the cutter-lever a bodily movement upon the slide-pin 25 transversely of such fulcrum-stud. These independent movements derived from the actuating rock-shaft are thus adapted to produce a resultant curvilinear movement of the intermediately disposed cutting elements (Fig. 3) of which the curvature is determined by the relative amplitudes of the component movements.

The length of the crank-arm 96 is so proportioned relatively to the pitman connection of the crank-arm 75 that when the stud 98 is in its highest position, as represented in Fig. 2, the effective lengths of said crank-arms are the same, and in the actuation of the rock-shaft 63 its described connections with the cutter-lever 12 act as a parallel-motion device of which the cutter-lever is a member, whereby the latter is caused to move rectilinearly, every point in such lever performing a rectilinear movement of the same extent as every other point. The release of the treadle connection and adjustment of the stop-block 108 to any position intermediate the outer end of the crank-arm 96 and its axis of movement permits the connection between the pitman-lever 100 and said crank-arm to assume such a position that the pivotally mounted end of the cutter-lever will perform a bodily movement transverse to the fulcrum-pin of less extent than the opposite end of the cutter-lever, thereby imparting to the cutting elements a movement in a substantially circular path of a degree of curvature determined by said adjustment.

It is of course obvious that the adjustment of the pitman-lever connection with its respective crank-arm may be adjusted within the limits for which the machine is designed so as to determine the exact angular relation between the initial or retracted position and final or stitching position of the cutting elements, and that it is not essential that their path of movement intermediate these positions should be precisely circular.

In the machine represented in the drawings, provision is made for temporary displacement of the upper and lower stitch-forming elements, as also the needle-throat 109 and a section 110 of the work-plate, to enable the cutting elements to move into stitching position in shifting the work between buttonhole positions and cutting the same to form each buttonhole-slit preparatory to a stitching operation.

In the use of the machine as thus described, the coupling pin 81 is adjusted within the requisite registering apertures 79 and 80 to determine the normal retracted position of the crank-arm 75, and the stop-block 108 is set to produce the requisite effective length of the crank-arm 96 for movement of the cutting elements 20 and 21 in a path of the desired curvature. The machine being set in motion and the cutting elements having been lightly pressed upon the work to grip the same, the cam-wheel studs 73 act upon the lever 67 to effect the rocking of the shaft 63 by means of which the opposite ends of the cutter-carrier are moved backwardly to carry the cutting elements into stitching position in a curved path at the end of which the cutting knife 21 invariably assumes a position in parallelism with the direction of feed and in fixed relation with the stitch-forming elements. The cutting elements having performed their second or cutting stage of movement to produce the buttonhole slit in cutting position, the work is clamped in the work-holder and the cutting elements separated and returned to initial retracted position, the stitching succeeding the cutting operation in the usual manner.

In operation upon the buttonhole flap of a shoe upper, the buttonholes should not maintain their parallelism throughout the series, but their angular relation as well as their spacing apart requires modification, depending upon the class of work operated upon. In the machine of the present improvement, the angular relation of the knife 21 in its initial retracted and final positions may be varied by the manual tilting of the pitman-lever 100 so as to vary its point of connection with the crank-arm 96, and this change may be effected in any degree between the normal position determined by the

stop-block 108 and extreme straight-line position, as represented in Fig. 2, depending entirely upon the will of the operator. As described in my said application Serial No. 135,154, the spacing apart of the buttonholes may be changed arbitrarily without disturbing the normal adjustment of the machine by the manual operation of the stop-plate carrying lever 89 so as to change the initial retracted position of the crank-arms 75 and 96. Thus, the present machine provides means for changing, both normally and arbitrarily on the part of the operator, both the initial position and the angular relation of the cutting elements in respect to their position at the button hole cutting point. It will be observed that the capacity of the present mechanism for variation of its effect upon the work is due to the provision for adjustment which is constantly under the control of the operator throughout substantially the entire cycle of operation of the machine, or at all times at which the cutting device is retracted from cutting position. Under such condition, changes in the path or direction of travel of the cutting device may be made arbitrarily by the operator for any individual buttonhole of a connected series of which the component buttonholes are adapted to be automatically produced and spaced in sequence in each cycle of operation of the machine. The manual control of the relative location of the buttonholes of the series obviously produces no effect upon the automatic action of the machine which invariably effects the operation of the actuating rock-shaft 63 at predetermined intervals governed by the speed of rotation of the controlling cam-cylinder 9.

From the foregoing description, it is evident that the present invention is susceptible of widely different embodiments, depending largely upon the type of machine to which it may be applied; and it is therefore evident that the invention is not limited to the construction and arrangement of parts herein shown and described.

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

1. In a sewing machine, in combination, stitch-forming and feeding mechanisms for producing within a stitching cycle stitching upon the work in a defined pattern, and means acting upon the work and adapted to shift beyond the normal range of action of the stitch-forming mechanism that portion of the work last within such range in the stitching of said pattern, and comprising a work-gripping device, and shifting means for moving it in a predetermined path and provided with adjusting means whereby said gripping device may be caused to travel either in a rectilinear or a curvilinear path.

2. In a sewing machine, in combination, stitch-forming and feeding mechanisms for producing within a stitching cycle stitching upon the work in a defined pattern, and work-shifting means acting upon the work intermediate stitching cycles and comprising a work-gripping device, and shifting means adapted to move the same in a curved path and provided with adjusting means whereby the degree of curvature of said path may be varied at will between a predetermined maximum degree and a straight line.

3. In a sewing machine, in combination, stitch-forming mechanism, feeding mechanism for effecting the spacing of the stitches in the work, and work-shifting means acting independently of the feeding mechanism and comprising a work-gripping device, a fulcrum, and connected means for shifting said gripping device respectively about and bodily transversely of said fulcrum.

4. In a sewing machine, in combination, stitch-forming mechanism, feeding mechanism for effecting the spacing of the stitches in the work, and work-shifting means acting independently of the feeding mechanism and comprising a work-gripping device, a fixed support, a fulcrum sustained thereby, and means for imparting to said gripping device compound shifting movements relatively to said fixed support about and transversely of said fulcrum.

5. In a sewing machine, in combination, stitch-forming mechanism, feeding mechanism for effecting the spacing of the stitches in the work, and work-shifting means acting independently of the feeding mechanism and comprising a work-gripping device comprising opposed gripping elements and a carrier therefor, means connected to said carrier at spaced points for shifting the same, and means for varying the effective action of the respective carrier-shifting means.

6. In a sewing machine, in combination, stitch-forming mechanism, feeding mechanism for effecting the spacing of the stitches in the work, and work-shifting means acting independently of the feeding mechanism and comprising a work-gripping device, a fixed fulcrum, and means for turning said gripping device upon and for shifting it bodily transversely of said fulcrum.

7. In a sewing machine, in combination, stitch-forming mechanism, feeding mechanism for effecting the spacing of the stitches in the work, and work-shifting means acting independently of the feeding mechanism and comprising a work-gripping device, a fixed fulcrum, a transverse guide-element mounted upon said fulcrum with which said gripping device has a sliding connection, and means for turning said gripping device upon and for shifting it bodily transversely of said fulcrum.

8. In a sewing machine, in combination, stitch-forming mechanism, feeding mecha-

nism for effecting the spacing of the stitches in the work, and work-shifting means acting independently of the feeding mechanism and comprising a work-gripping device, a fixed fulcrum, means for turning said gripping device upon and for shifting it bodily transversely of said fulcrum, and adjusting means for relatively changing the extent of said turning and bodily shifting movements.

9. In a sewing machine, in combination, stitch-forming mechanism, feeding mechanism for effecting the spacing of the stitches in the work, and work-shifting means acting independently of the feeding mechanism and comprising a work-gripping device, a fixed fulcrum, means for turning said gripping device upon and for shifting it bodily transversely of said fulcrum, and adjusting means connected with said bodily shifting means and adapted to vary the extent of said bodily shifting movements.

10. In a sewing machine, in combination, stitch-forming mechanism, feeding mechanism for effecting the spacing of the stitches in the work, and work-shifting means acting independently of the feeding mechanism and comprising a work-gripping device, a fixed fulcrum, means for turning said gripping device upon and for shifting it bodily transversely of said fulcrum, and adjusting means constantly under the control of the operator connected with said bodily shifting means and adapted to vary the extent of said bodily shifting movements.

11. In a sewing machine, in combination, a work-gripping device, a fixed fulcrum, means for turning said gripping device upon and for shifting it bodily transversely of said fulcrum, adjusting means for determining normally the relative extent of said turning and bodily shifting movements, and additional shifting means constantly under the control of the operator for temporarily varying such normal adjustment.

12. In a sewing machine, in combination, stitch-forming and feeding mechanisms, and work-shifting means acting independently of said feeding mechanism and comprising a work-gripping device, a fulcrum therefor, a reciprocating actuating member, and independent connections between said work-gripping device and said actuating member for shifting said gripping device respectively about and transversely of said fulcrum.

13. In a sewing machine, in combination, stitch-forming and feeding mechanisms, and work-shifting means acting independently of said feeding mechanism and comprising a work-gripping device, a fulcrum therefor, an actuating rock-shaft, and independent connections between said work-gripping device and said rock-shaft for shifting said gripping device respectively about and transversely of said fulcrum.

14. In a sewing machine, in combination, a work-gripping device, a fulcrum therefor, an actuating rock-shaft provided with crank-arms, independent connections including links pivotally attached to said crank-arms for shifting said gripping device respectively about and transversely of said fulcrum, and means whereby one of said connections may be adjusted upon its respective crank-arm toward and from the rock-shaft.

15. In a sewing machine, in combination, a work-gripping device comprising opposed gripping elements and a carrier therefor, means for opening and closing said gripping device upon the work, a parallel motion device comprising said carrier as a member, and adjusting means for a member of said parallel motion device for varying the extent of relative travel of different portions of said carrier.

16. In a sewing machine, in combination, a work-gripping device, shifting means for imparting thereto movements of a predetermined range, means for adjusting both the extent and direction of said movements, and means constantly under the control of the operator for further varying the direction of movement of said gripping device.

17. In a sewing machine, in combination, a work-gripping device, shifting means for imparting thereto movements of a predetermined range, means for adjusting both the extent and direction of said movements, and means constantly under the control of the operator for further varying both the extent and the direction of movement of said gripping device.

18. In a sewing machine, in combination, feeding mechanism, a work-gripping device, shifting means operable in alternation with the feeding mechanism for imparting to the work-gripping device movements of a predetermined range, means for adjusting both the extent and direction of said movements, and means constantly under the control of the operator for further varying either the extent or direction of movement of said gripping device.

19. In a sewing machine, in combination, stitch-forming mechanism, a work-gripping device, and shifting means operable intermediate operative periods of the stitching-forming mechanism for producing between them relative travelling movements in a predetermined path, said shifting means being provided with adjusting means whereby said path of relative travel may be rectilinear or curvilinear in form.

20. In a sewing machine, in combination, stitch-forming mechanism, a work-gripping device, shifting means for producing between them relative travelling movements in a predetermined path, adjusting means for the shifting means whereby said path of relative travel may be rectilinear or curvi-

linear in form, and means constantly under the control of the operator for further varying said path of relative travel.

21. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a travelling work-cutting device comprising opposed work-engaging elements, means for imparting to said cutting elements in successive stages nipping- followed by cutting-movements, and shifting means connected with said cutting device and adapted to move the same while its cutting elements are in nipping relation in a curved path toward the stitch-forming mechanism, said shifting device being provided with adjusting means whereby the degree of curvature of said path may be determined between a predetermined maximum of curvature and a straight line.

22. In a buttonhole sewing machine, in combination, stitch-forming mechanism, a travelling work-cutting device comprising opposed work-engaging elements, means for imparting to said cutting elements in successive stages nipping- followed by cutting-movements, shifting means connected with said cutting device for movement thereof in a curved path toward the stitch-forming mechanism while its cutting elements are in nipping relation, adjusting means for said shifting means whereby the degree of curvature of said path may be determined between a predetermined maximum of curvature and a straight line, and means constantly under the control of the operator for further varying the degree of curvature of said path.

23. In a sewing machine, in combination, stitch-forming mechanism, feeding mechanism for imparting thereto travelling movements in a defined path during the sewing periods, and shifting means acting upon the work between sewing periods and adjustable to move it in paths respectively of different character in relation to the path of travel of the stitch-forming mechanism.

24. A buttonhole sewing machine, having, in combination, a rotary stitch forming mechanism and a work-clamp relatively movable to sew about a buttonhole, and means for moving the work in a variable curved path to space the buttonholes.

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

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

ALBERT H. DE VOE.