

May 21, 1963

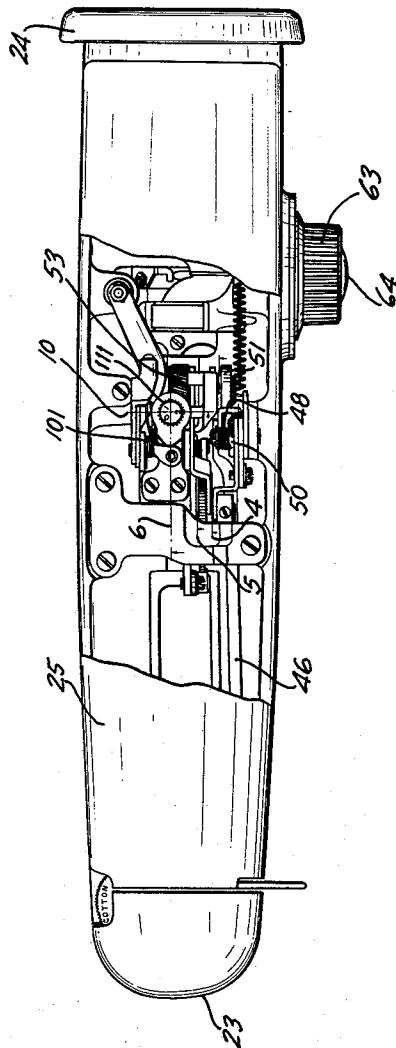
TADAO HAYASHI ETAL
SEWING MACHINE

3,090,334

Filed Nov. 12, 1959

14 Sheets-Sheet 1

FIG. 1



INVENTORS
TADAO HAYASHI
MUNEO ANDO
BY *Kane, Dolan*
and Kane
ATTORNEYS

May 21, 1963

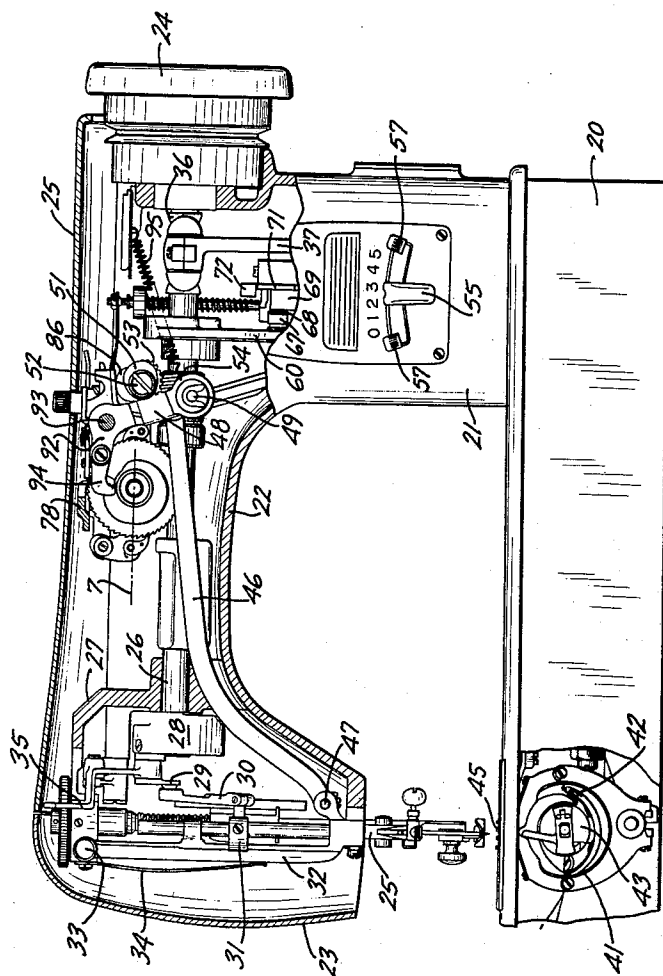
TADAO HAYASHI ETAL
SEWING MACHINE

3,090,334

Filed Nov. 12, 1959

14 Sheets-Sheet 2

FIG. 2



INVENTORS
TADAO HAYASHI
MUNEO ANDO
BY Kane, Dalimer
and Kane
ATTORNEYS

May 21, 1963

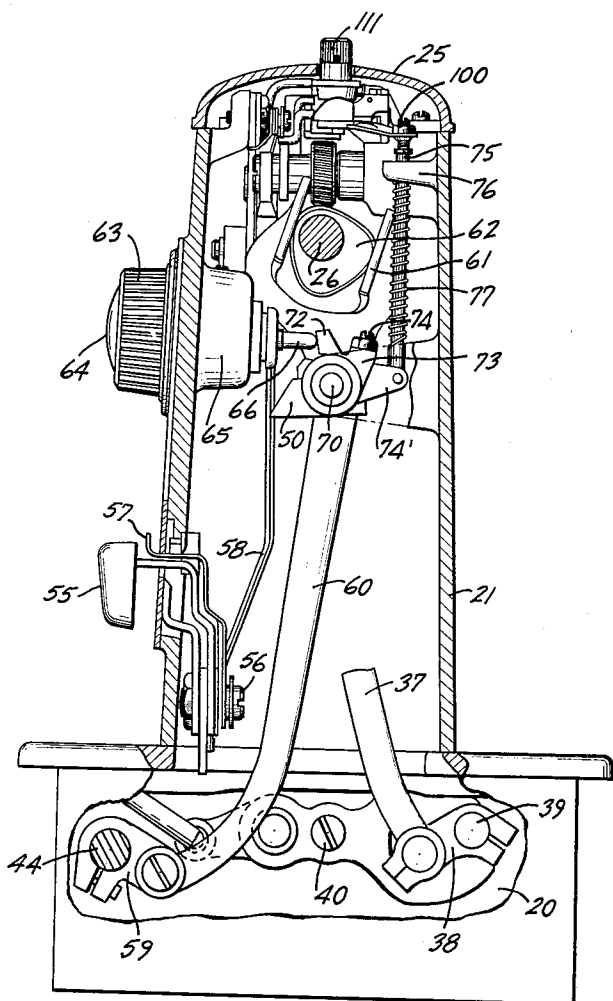
TADAO HAYASHI ETAL
SEWING MACHINE

3,090,334

Filed Nov. 12, 1959

14 Sheets-Sheet 3

FIG. 3



INVENTORS
TADAO HAYASHI
MUNEKO ANDO
BY *Kane, Dalsimer
and Kane*
ATTORNEYS

May 21, 1963

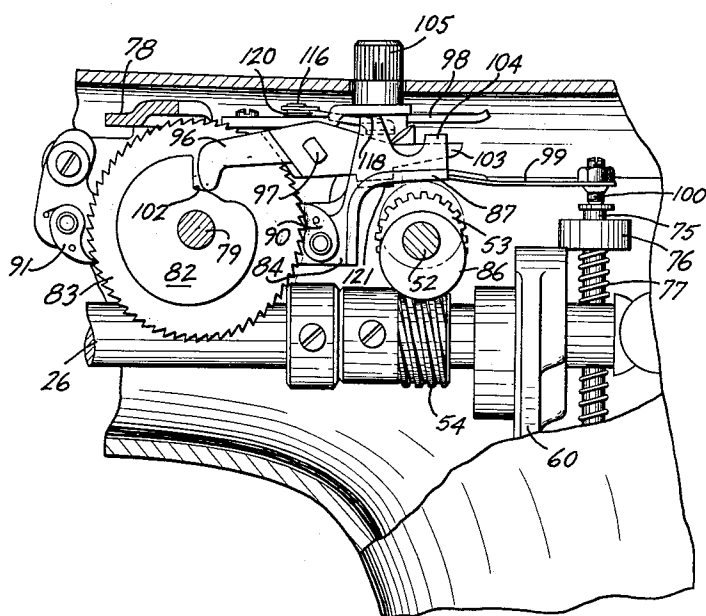
TADAO HAYASHI ETAL
SEWING MACHINE

3,090,334

Filed Nov. 12, 1959

14 Sheets-Sheet 4

FIG. 4



INVENTORS
TADAO HAYASHI
MUNEO ANDO

BY *Kane, Dalsimer
and Kane*
ATTORNEYS

May 21, 1963

TADAO HAYASHI ETAL

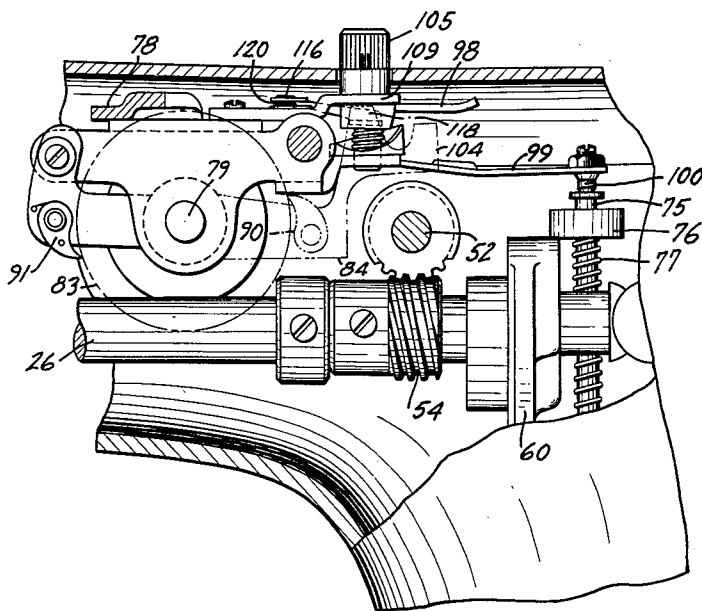
3,090,334

SEWING MACHINE

Filed Nov. 12, 1959

14 Sheets-Sheet 5

FIG. 5



INVENTORS
TADAO HAYASHI
MUNEO ANDO

BY
*Kane, Dalsimer
and Kane*
ATTORNEYS

May 21, 1963

TADAO HAYASHI ETAL
SEWING MACHINE

3,090,334

Filed Nov. 12, 1959

14 Sheets-Sheet 7

FIG. 7

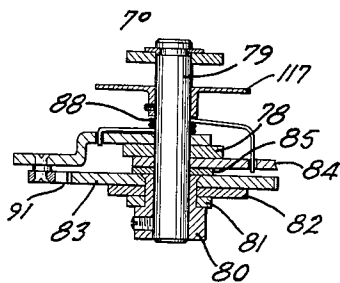


FIG. 15

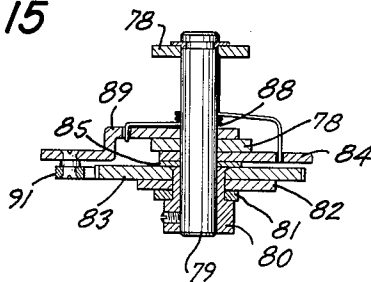
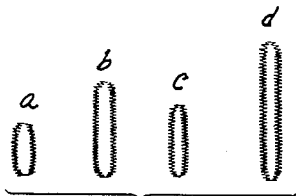


FIG. 16



INVENTORS
TADAO HAYASHI
MUNEO ANDO

BY
Kane, Dalsimer
and Kane
ATTORNEYS

May 21, 1963

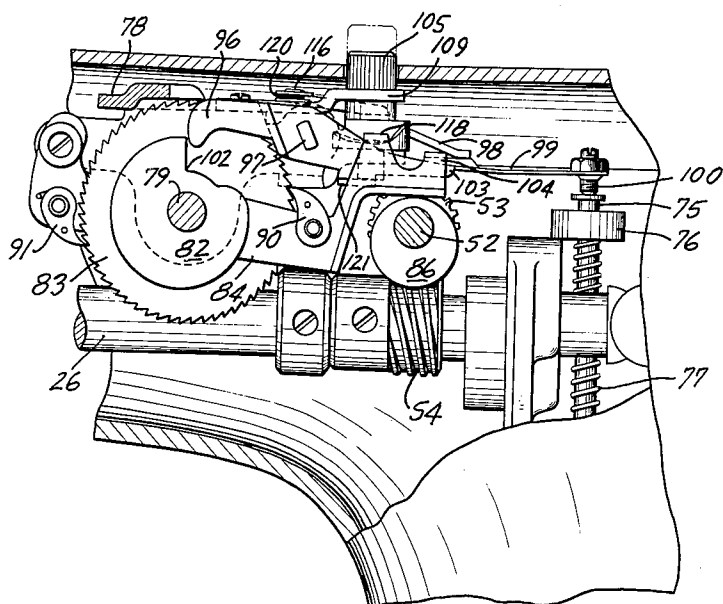
TADAO HAYASHI ETAL
SEWING MACHINE

3,090,334

Filed Nov. 12, 1959

14 Sheets-Sheet 8

FIG. 8



INVENTORS
TADAO HAYASHI
MUNEO ANDO
BY
*Kane, Dalsimer
and Kane*
ATTORNEYS

May 21, 1963

TADAO HAYASHI ETAL

3,090,334

SEWING MACHINE

Filed Nov. 12, 1959

14 Sheets-Sheet 9

FIG. 9a

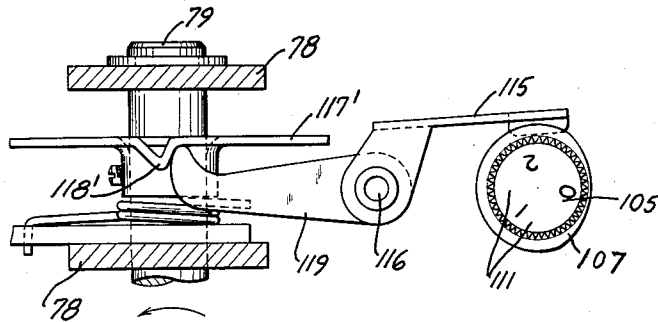
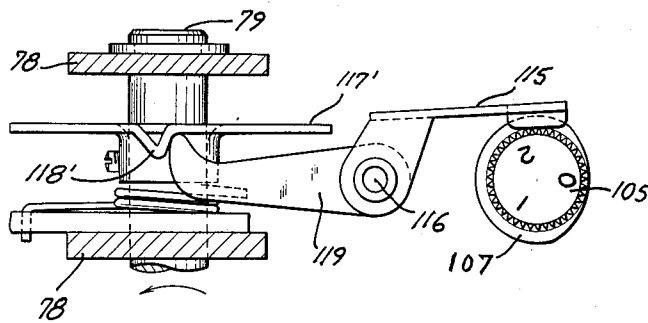


FIG. 9b



INVENTORS
TADAO HAYASHI
MUNEKO ANDO
BY Kane, Dalheimer
and Kane
ATTORNEYS

May 21, 1963

TADAO HAYASHI ETAL

3,090,334

SEWING MACHINE

Filed Nov. 12, 1959

14 Sheets-Sheet 10

FIG. 10a

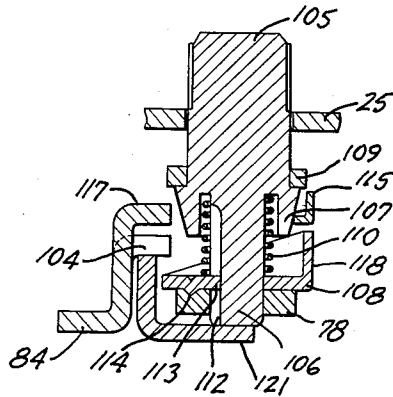
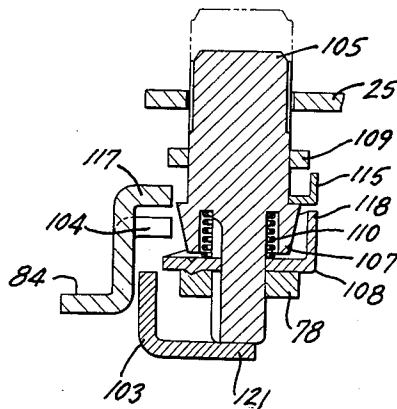


FIG. 10b



INVENTORS
TADAO HAYASHI
MUNEO ANDO
BY *Kane, Dalzimer
and Kane*
ATTORNEYS

May 21, 1963

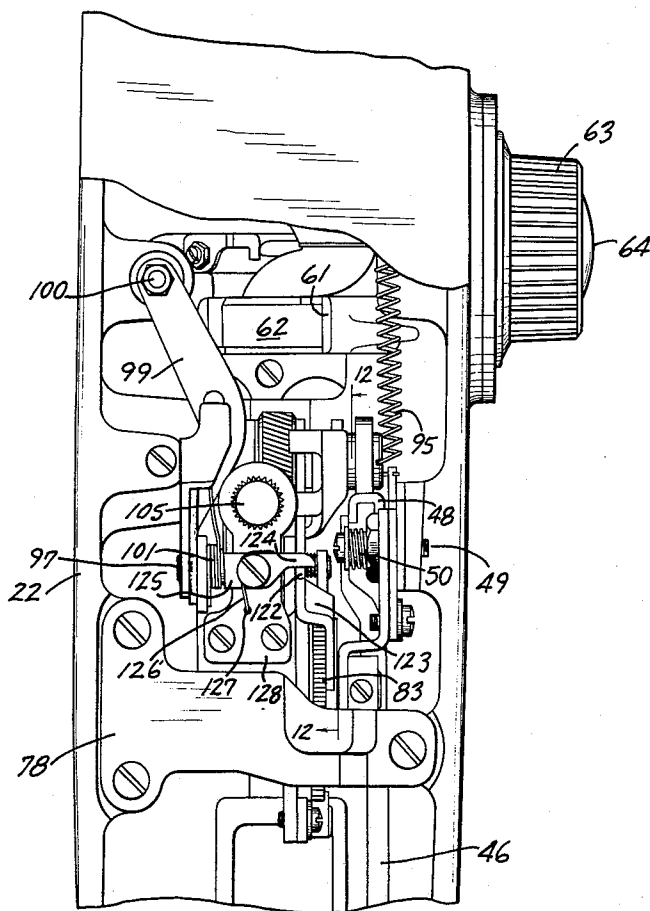
TADAO HAYASHI ETAL
SEWING MACHINE

3,090,334

Filed Nov. 12, 1959

14 Sheets-Sheet 11

FIG. 11



INVENTORS
TADAO HAYASHI
MUNEO ANDO
BY *Kane, Dalsimer
and Kane*
ATTORNEYS

May 21, 1963

TADAO HAYASHI ETAL

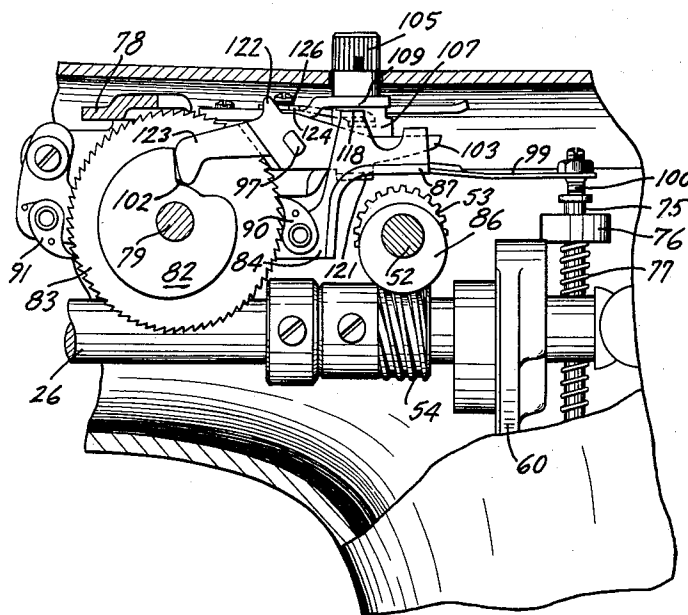
3,090,334

SEWING MACHINE

Filed Nov. 12, 1959

14 Sheets-Sheet 12

FIG. 12



INVENTORS
TADAO HAYASHI
MUNEO ANDO
BY Kane, Dalsimer
and Kane
ATTORNEYS

3,090,334

14 Sheets-Sheet 13

INVENTORS
TADAO HAYASHI
MUNE0 ANDO
BY *X*ane, Dalgimer
and *X*ane
ATTORNEYS

May 21, 1963

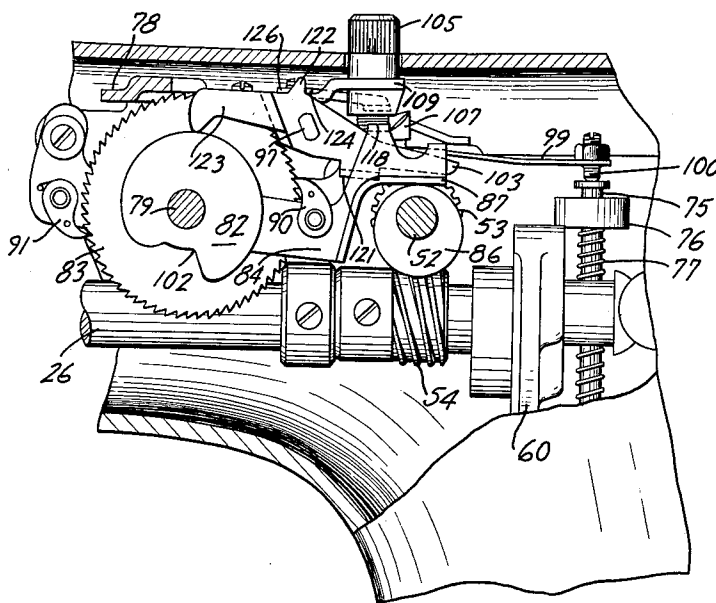
TADAO HAYASHI ETAL
SEWING MACHINE

3,090,334

Filed Nov. 12, 1959

14 Sheets-Sheet 14

FIG. 14



INVENTORS
TADAO HAYASHI
MUNEKO ANDO
BY
Kane, Dalsimer
and Kane
ATTORNEYS

1

3,090,334

SEWING MACHINE

Tadao Hayashi and Muneco Ando, Nagoya, Japan, assignors to Nikon Mishin Seizo Kabushiki Kaisha, Nagoya, Japan, a corporation of Japan

Filed Nov. 12, 1959, Ser. No. 852,244
10 Claims. (Cl. 112—158)

This invention relates to a structurally and functionally improved sewing machine, and in its more specific aspects aims to provide a mechanism capable of ready use by an unskilled operator in order to produce stitching suitable for the definition of a button hole.

It is a primary object of the invention to design a machine in which there will be present a grouping of mechanisms capable of being controlled by an unskilled operator so that a complete cycle of operations producing a stitching outline defining a complete buttonhole will result from the operation of a single manual control.

A further object is that of furnishing a mechanism of this character which may be applied to an already existing machine, or else may be included in a machine at the time of its manufacture; the mechanism embodying relatively few and simple parts capable of economical production and functioning over long periods of time with freedom from all difficulties.

A still further object is that of designing a machine in which the foregoing advantages will be included, and which machine will also include controls which may be manually and individually operated to govern the direction of movement of the material-feeding mechanism, as well as the speed of such movement, the position of the needle bar and its lateral movements as that bar is subjected to the conventional reciprocatory motions for effecting stitching.

With these and other objects in mind, reference is had to the attached sheets of drawings illustrating practical embodiments of the invention and in which:

FIG. 1 is a plan view of the machine, with certain of the casing portions broken away to disclose underlying constructions;

FIG. 2 is a partly sectional front view of the machine;

FIG. 3 is a similar view taken through one end of the assembly;

FIG. 4 is a fragmentary sectional view taken along the line indicated at 4 in FIG. 1;

FIG. 5 is a view corresponding to FIG. 4, but taken along the line indicated at 5 in FIG. 1;

FIG. 6 is a further similar view taken along the line 6 of FIG. 1;

FIG. 7 is a transverse sectional view in enlarged scale, taken along the line indicated by the reference numeral 7 in FIG. 2;

FIG. 8 is a view similar to FIG. 4, but showing the parts in different positions;

FIG. 9a is a partly sectional plan view of one detailed assembly of the mechanism;

FIG. 9b is a similar view thereof with the parts occupying different positions;

FIG. 10a illustrates the manual control and the associated parts in section;

FIG. 10b corresponds to FIG. 10a, but shows the elements shifted to occupy different positions;

FIG. 11 is a fragmentary plan view of a mechanism of alternative design;

FIG. 12 is a sectional side view taken along the line 12—12 in the direction of the arrows, as indicated in FIG. 11;

2

FIGS. 13 and 14 are views corresponding to FIG. 12, but showing the elements of the mechanism occupying different positions;

FIG. 15 is a view similar to FIG. 7, but showing the parts in different positions; and

FIG. 16, in *a*, *b*, *c* and *d*, illustrates examples of button-hole stitching which can be produced by means of the present mechanism.

Referring primarily to FIGS. 1, 2 and 3, the numeral 20 indicates the base or bed of the machine, from one end of which a standard or column 21 extends in an upward direction. This is continued in the form of an arm 22 terminating in a head 23. The foregoing is, of course, merely illustrative of a conventional design. Also in accordance with standard practice, a rotary wheel 24 may extend from an end of the assembly at the upper end of the column or standard 21. This wheel will conveniently include a pulley portion to receive a driving belt (not shown). The upper end of the casing may be closed by a cover plate 25. The machine will be additionally provided with other essential operating parts, such as a thread take-up, a spool mounting thread guides, etc. These have not been shown in the present drawings, in that they do not form parts of the teachings herein presented.

A main drive shaft 26 is rotatably supported by extensions of the casing or a suitable frame 27 forming a part of the machine. At its end, shaft 26 mounts a crank plate 28. This supports an auxiliary crank 29. A link 30 has its upper end connected to crank 29. Its lower end is connected, for example, by means of a collar 31 with needle bar 25. The connection between link 30, crank 29 and collar 31 is such that the link is capable of swinging movements axially of shaft 26 as well as laterally of that shaft. A guide 32 supports bar 25 for reciprocation. This guide is pivotally mounted as at 33. A spring 34 is supported adjacently and bears against the guide in order to urge the latter in a direction counterclockwise around its pivot 33. A suitable thread take-up mechanism 35 is conveniently operated by crank plate 28 through being secured to crank 29.

At its opposite end, drive shaft 26 supports the fly-wheel 24. At a point short of that member it is provided with a crank portion 36 to which the upper end of a connecting rod 37 is coupled. The latter extends downwardly through housing 21 and is connected by a crank 38 with a lower shaft 39 disposed below the bed plate of the machine. This shaft is operatively coupled to the feed lift rock shaft 40. Likewise, it is coupled to drive the shaft mounting the oscillating loop taker 41, which in conventional manner includes a hook 42 and a bobbin case 43. These are disposed adjacent the zone of needle bar 25 within the bed of the machine in accordance with conventional technique. Also housed within this bed is a feed advance rock shaft 44. The mechanism connected with this shaft in cooperation with the feed lift mechanism driven by shaft 39 serves to shift feed dog 45, in accordance with accepted practice.

In order to impart lateral movements to needle bar 25 in properly timed relationship to the reciprocations of the needle, a link or connecting rod 46 has its lower end extending into the head 23 of the housing and is pivotally secured, as at 47, to the needle bar guide. The opposite end of this connecting rod extends into contact with the base of a groove defined by a member 48 rockingly supported as at 49. A spring 50 conveniently extends around the pin defining pivot 49 and acts against member 48 in order to maintain the latter in contact

with a cam 51. That cam is mounted by a shaft 52. Secured to the shaft is a worm wheel 53 in engagement with a worm 54 secured to drive shaft 26. Therefore, with the rotation of that shaft, cam 51 will turn. Member 48 will oscillate around its pivot 49. Link 46, engaging that member and being urged toward it by spring 34, will be reciprocated. Accordingly, carriage 32 will be oscillated around its pivot 33 to cause needle bar 25 to have lateral movements.

In order to provide for adjustment of the amplitude of these movements, a manually shiftable knob 55 conveniently extends beyond the forward face of the casing. This knob is mounted upon an arm supported by a pivot 56. The position of this arm may be shifted through a considerable range, as defined by the slot shown in FIG. 2. The range of this movement may be diminished or confined to a desired zone conveniently by providing stop members 57 movable by the operator to prevent shifting of control 55 to either side of desired limits. Conveniently by means of a crank connected to move with the arm mounting control 55, a link 58 is shifted upwardly and downwardly within column 21. This is achieved by having the lower ends of the link pivotally connected to such crank arm. The upper end of link 58 is coupled to the adjacent end of connecting rod 46. Therefore, as link 58 is raised and lowered, the position of this end of rod 46 will be moved farther away from or closer toward the point of pivotal mounting 49 of rocking member 38. The farther away rod 46 is shifted, the greater will be its range of reciprocation. The closer the end of this rod approaches pivot 49, the less will be amount of the reciprocation.

Connected to rock shaft 44 by means of a crank 59 is the lower end of a rod 60. The upper end of this rod extends into the zone of arm portion 22 and terminates in a fork or channeled member 61. Between the arms of the latter a cam 62 is disposed. That cam is secured to rotate with drive shaft 26. Therefore, with that shaft rotating, rod 60 will be reciprocated to oscillate shaft 44. That shaft being in turn connected with the advancing mechanism for feed dog 45, it follows that the latter, in conjunction with the presser foot, will function to shift material over the bed of the machine. Such feeding of the material may be for selected distances for each rotation of the drive shaft. Also, the feed may be in a forward or reverse direction, at the will of the operator.

Thus, referring to FIGS. 1 and 3, it will be seen that a knob 63 is conveniently mounted for rotation and extends beyond the forward face of housing or column 21. By rotating this knob, adjustment of the amount of feed may be achieved. An auxiliary control by means of which the direction of feed may be manually controlled may be furnished by a button or plate portion 64, around which the body of knob 63 extends. A casing 65 projects inwardly of column portion 21 in line with the knob; a pin 66 in turn extending rearwardly of this casing. Button or control 64 is urged outwardly by, for example, a suitable spring (not shown) and is connected with pin 66. Therefore, when the button or plate is pushed inwardly, that pin will be projected. Within casing 65, any satisfactory form of mechanism, such as a spiral groove and a cooperating pin or projection, is furnished. Therefore, as knob 63 is turned to correspondingly rotate desired parts with respect to each other, pin 66 will also be projected. When the knob is turned in a different direction, the pin will be retracted.

Intermediate the ends of rod 60 a slide block 67 is pivotally supported. This block rides within the groove 68 of a feed-adjusting member 69. That member is pivotally mounted upon a shaft or pin 70 secured to a suitable portion of the casing or frame. Also mounted for rocking movement upon this shaft is a feed-adjusting plate 71 having a contact portion 72 disposed in line with pin 66. A further projecting portion 73 of this plate carries a screw 74 contactable with a surface of the mem-

ber 50. By means of this screw, relative adjustment of the parts may be effected. A crank portion 74' extends from member 50 and has its outer end pivotally connected to a pin 75, which slidably extends through a guide 76 and is encircled by a spring 77 interposed between the guide and crank 74'. Therefore, the latter is urged in a clockwise direction, as viewed in FIG. 3. With the parts thus arranged and with the drive shaft rotating, the feed dog 45 will function to shift material over the bed plate of the machine in a forward direction. When button 64 is pressed inwardly, pin 66 will engage against the face of the projecting portion of plate 71 to rotate that plate in a clockwise direction, thereby changing the angle of the slide block 67 within the groove 68. Under these circumstances, a reverse feeding of the material is achieved by feed dog 45. When the pressure upon button 64 is released, spring 77 will return the parts to their normal positions, in which a forward feeding of the material obtains. As knob 63 is turned, pin 66 will be projected relatively slowly through a limited range, to cause a shifting of the parts such that the forward feeding of the material by dog 45 will be at a slower rate.

As will be apparent, an operator using a machine employing controls as aforescribed will be able to produce a great variety of stitching arranged in manner consistent with the ultimate results desired by the operator. By means of the present teachings, the operator may automatically produce stitching of the buttonhole type, including outlines and lengths such as are illustrated by way of example in FIG. 16. To this end, control mechanism as aforescribed, or its functional equivalent, will be caused to operate automatically in proper sequences without it being necessary for the operator to exercise any skill in controlling the mechanisms.

As especially shown in FIGS. 1 to 4, it is preferred to employ an auxiliary housing or mounting structure 78 for supporting the parts of the assembly governing the operation of the several mechanisms. That housing rotatably mounts a shaft 79 parallel to shaft 52. As shown especially in FIG. 7, it is preferred to fixedly mount a sleeve 80 upon shaft 79. This sleeve supports as a unit cams 81 and 82, as well as a ratchet wheel 83. Beyond the sleeve 80 shaft 79 mounts a washer 85 and a lever 84. As illustrated especially in FIGS. 2 and 4, shaft 52, in addition to mounting cam 51, mounts a cam 86 in line with the end of lever 84. Therefore, when this end portion is in operative association with cam 86, the latter will serve to rock lever 84 as the end of that lever is yieldingly urged into contact with such cam.

To achieve this result, and again referring especially to FIG. 7, shaft 79 is encircled by a spring 88. One end of this spring extends into an opening formed in lever 84. Its opposite end extends into an opening formed in plate 89, which is fixed with respect to the mounting or housing structure 78. To translate the rocking movements of lever 84 into rotation on the part of ratchet wheel 83, lever 84, as in FIG. 4, carries a spring-pressed pawl 90 adjacent the zone of the annular series of teeth presented by that wheel. A similar pawl 91, located at a point diametrically opposite pawl 90, engages these teeth to prevent a return movement of the ratchet wheel. Forward movement of the same obviously will occur as pawl 90, incident to a counterclockwise swinging of the lever 84, engages a tooth to move the wheel a predetermined arcuate distance. In the return movement of the lever, this pawl will simply override ratchet teeth.

A changing lever 92 is pivotally supported, as at 93 in FIG. 2. This lever mounts a follower 94 in alignment with cam 81 controlling the change of position of the needle base or bar. A spring 95 has one of its ends connected to the lower arm of lever 92. Its opposite end is coupled to a fixed portion of the housing. Accordingly, lever 92 is urged in a counterclockwise direction, causing follower 94 to engage the operative edge of cam 81.

Referring to FIG. 4, a follower 96 cooperates with the

5

edge of the feed-changing cam 82. This follower is mounted upon a member 97 rockingly supported by the auxiliary housing 78. A feed-changing arm 98 is also connected to member 97 so that these parts move in unison. Additionally, a plate 99 is similarly coupled to member 97, and supports at its outer end an adjusting screw 100 contacting the upper end of pin or rod 75, which controls the direction of material feeding as governed by dog 45.

A spring 101 conveniently encircles member 97, as shown in FIG. 1. One end of this spring is anchored with respect to the auxiliary housing portion. The other end thereof bears against follower 96 to urge it into engagement with the operative periphery of cam 82. Accordingly, lever 92 will be rocked around its pivot 93 in accordance with the operative profile of cam 81 as the latter rotates. Also, the pivot 49, around which member 48 oscillates and which is carried by the lower arm of lever 92, will be shifted. As the feed-changing cam 82 rotates, follower 96 will rock and correspondingly move the pivoted member 97 upon which it is mounted. This movement will be in accordance with the profile of that cam. Arm 98 will be correspondingly moved, in that it will shift in synchronism with follower 96. Also, plate 99 will be shifted to cause pin or rod 75 to be depressed. Incident to the connection between this pin and rock shaft 44, the feeding movements achieved by dog 45 will serve to shift material upon the bed of the machine in a reverse direction. This shifting will be of a value equal to the forward feeding.

As will be noted, cam 82 is provided with a relatively recessed portion 102. Overlying the rear end 103 of follower 96 is a laterally extending portion 104 formed in the rear end of lever 84. Therefore, as follower 96 drops into the recess 102 incident to rotation of cam 84, its rear end will elevate lever 84 out of the zone of movement of cam 86. Accordingly, lever 84 will cease to rock, and the further rotation of ratchet wheel 83 and its associated parts will cease.

Attention is next invited to FIGS. 10a and 10b, in which the numeral 105 indicates a shaft or button having a reduced lower end portion or stem 106. The latter extends through an opening in a portion of the auxiliary housing structure 78. A plate 109 is affixed to this auxiliary housing and is formed with an opening through which the main portion of button 105 extends. Encircling the stem 106 is the base portion of a cam 108. Above this, the button or shaft is formed with an inverted frustoconical cam 107 terminating in a shoulder underlying the surface of plate 109. The functions of cams 107 and 108 will be hereinafter described, together with their detailed structure. It will be seen, however, that a spring 110 encircles stem 106 and has its lower end bearing against the base of cam 108, while its upper end bears against the surface of the button to force the shoulder defining the upper end of cam portion 107 against the lower surface of plate 109. This button is thus supported for both rotation around its axis and movement in the direction of that axis against the compressive force exerted by spring 110. Thus mounted, and as shown especially in FIGS. 2 and 3, the upper end of the button extends through an opening in cover plate 25. This plate, as well as the surface of the button or shaft, is provided with indicia, which have been indicated on the latter at 111. By suitably rotating the shaft, the elements of the indicia may be aligned so that functions as hereinafter brought out will be achieved.

In order to maintain button 105 in a position to which it has been adjusted by rotating it, a detent structure is provided. As shown especially in FIGS. 10a and 10b, stem 106 is conveniently provided with an axially extending groove 112. Riding within this groove is a projection 113 forming a part of cam 108. Thus, this cam will rotate with the button. The surface of the supporting or housing

6

structure 78 in contact with the base face of cam 108 is conveniently formed with a series of indentations. A projection is struck out of the base of this cam and rides within these indentations, as indicated at 114. Accordingly, while button 105 may be forcibly turned to disengage the cooperating detent structure, the latter will normally maintain the button in the position to which it has been adjusted.

Disposed adjacent cam 107 is a portion of a stop lever 115. This lever is pivotally supported, as at 116, upon the plate 109 (FIGS. 9a and 9b). As is apparent, when button 105 is depressed from the position shown in FIG. 10a to that illustrated in FIG. 10b, cam 107 will ride in contact with lever 115 and may be shifted to a position overlying the flange defined by this cam to retain the parts in position against the compression of spring 110. Cam 108 has disposed adjacent its edge a second overlapping or offset portion 117 corresponding to part 104 and also forming a preferably integral extension of lever 84. By turning the knob 105, it is apparent that cam 108 will be shifted to a point where its projecting portion 118 will underlie the extension 117. Under these circumstances, the cam portion 118 of unit 108 will prevent a lowering of the rear end of lever 84 beyond a predetermined point. Therefore, when cam 86 is rotated, that lever will have its rear end elevated through a relatively limited arc in comparison with the operation of the assembly when the projecting cam portion 118 does not obstruct the overlapping portion 117, as illustrated in FIG. 10a. Consequently, pawl 90 carried by lever 84 will advance ratchet wheel 83 and shaft 79 only a limited distance for each revolution of drive shaft 26, as compared with the rotational movement of shaft 79 when the outer or rear end of lever 84 may move downwardly a greater distance.

As shown particularly in FIGS. 9a and 9b, shaft 79 carries a plate 117' which rotates with it. This plate is formed with a cam or projecting portion 118' engageable with a follower 119 connected to lever 115. It is apparent that when cam portion 118' causes lever 119 to rock and thus causes a movement of lever 115 in a counterclockwise direction around pivot 116, the end of that lever will clear the base of cam portion 107. Thus, the parts will shift from the positions shown in FIG. 10b to those illustrated in FIG. 10a, in which, under the influence of spring 110, button 105 has been projected outwardly. Finally, with regard to this particular assembly, and as shown in, for example, FIG. 4, a spring 120 has one of its ends supported by plate 109, with its body coiled around the member defining pivot 116. The opposite end of this spring bears against stop lever 115, thus urging the same toward the axis of the button or shaft 105. As will also be observed in this figure, the rear end of the feed-changing follower or lever 96 is formed with a projecting portion 121, which, as in FIGS. 10a and 10b, underlies the stem 106 of the button or shaft 105.

Assuming that an operator has been using the machine in a conventional manner and desires to stitch a buttonhole, the knob 63 will be turned in order to adjust to the desired scope the length of the stitches produced as a consequence of the feeding of the material by the dog 45. Control 55 will be shifted to a position corresponding to the amplitude of lateral movements of which the needle bar 25 is to be capable during the defining of the buttonhole by the stitch pattern. To this end, stops 57 are shifted to positions beyond which control 55 may not move.

The operator will now turn button or shaft 105 to a position at which the indicia indicates a length corresponding to that desired in the buttonhole to be formed. In this connection, it will be understood that by so turning this member, different portions of the revolution-ratio-controlling cam 118' are brought to underlie the inwardly extending portion 117 of lever 84. Under one condition, this will limit the rocking movement of that lever to, for example, an arc wherein pawl 90 will advance ratchet

wheel 83 only one tooth for each complete rocking cycle of the lever. In another position of the parts, such advance may be, for example, two teeth. Depending upon this feed, shaft 79 will be rotated at a greater or lesser speed, even with constant speed of rotation on the part of drive shaft 26. Therefore, a relatively elongated buttonhole outline will be produced. This has been shown comparatively in FIG. 16, attention being invited to views "b" and "d" in comparison with views "a" and "c."

Operating button or knob 105 is now depressed, as shown in FIG. 8. Under these circumstances, projection 121 extending outwardly from the lower rear edge of feed-changing lever or follower 96 is depressed. With such depression, the follower portion of this lever is elevated above the surfaces defining recessed portion 102 of cam 82. Simultaneously, lever 84 will be rocked by cam 86, resulting in a rotation of shaft 79. As the button 105 is shifted axially from the position shown in FIG. 10a to that illustrated in FIG. 10b, stop lever 115 will be engaged by the side face of cam 107 and finally will assume a position beyond the base of that cam, thereby retaining the button or shaft 105 in its depressed position. This position of the parts will be maintained for an entire operating cycle.

During the initial stage of this cycle the material is moved by the feed dog in a forward direction. Simultaneously, and as illustrated in FIG. 16, the rocking range of the needle bar is gradually shifted from a central base position to one side of that position. Thereupon, the stitching continues along a straight zone. Following this, the base position of the needle bar will again gradually approach the center line as cam 81 controls this operation. As the stitching reaches this center line, the feed direction will be changed to reverse the movement of the material. This is accomplished by the control exercised through cam 82. Again, the zone of stitching will diverge from the center line in a direction opposite that of its initial divergence. Finally, after this stitching traverses a straight zone parallel to and suitably spaced from the first straight zone, the stitching will converge back toward the center line to join with the stitching formed in the initial stage of the cycle.

During the foregoing operation, shaft 79 is rotating, carrying with it the disk 117'. At the completion of the cycle, projection or cam portion 118' of that disk will cause a rocking of arm 119 to correspondingly shift arm 115, which is the stop lever. As that lever or arm clears cam 107, spring 110 will return the button or shaft 105 to its initial position. Also, with the needle bar reaching a central position at the completion of the cycle, the rotation of cam shaft 79 will cease, as the follower portion of lever 96 enters the recess 102 of cam 82.

In view of the fact that the operating shaft or button 105 will remain depressed throughout an entire cycle involving the formation of stitching in a buttonhole outline, the operator need feel no uncertainty as to the continued functioning of the mechanism in this manner. As aforebrought out, by turning this control, shorter or longer outlines of buttonholes may be created. If it is desired to reinforce the stitching outline of the buttonhole, then immediately upon the completion of the cycle, button 105 may be again depressed, and a zone of stitching superimposed upon the initial zone will be created. When a suitable mark of the indicia 111 (such as, for example, an O) is aligned with a predetermined point of the cover plate 25, a depression of button 105 may be resorted to without initiating a cycle, in view of the fact that the stop lever 115 will not maintain the operating shaft 105 in depressed position. Rather, the latter will immediately return to projected position under the influence of spring 110 when finger pressure is released. Under these conditions, cam shaft 79 will not be operatively coupled to drive shaft 26.

As will be observed, the mechanism controlling the production of stitching in a buttonhole outline is relatively

quite simple. It may be the main part be assembled as a unit with the auxiliary housing part 78. It will in no wise detract from the appearance of the machine, having in mind that only the operating button or shaft 105 extends beyond the housing; all control of this mechanism being achieved by the manipulation of that shaft. As will additionally be noted, an operator may change the characteristics of a buttonhole outline in many ways. This is accomplished by, for example, readjusting the control 55 and its stops 57. Also, by shifting the position of knob 63, the amount of movement imparted to the material by feed dog 45 is changed for each reciprocating cycle of the needle bar with respect to both forward and reverse feeds.

The same results are achieved generally by the mechanism illustrated in FIGS. 11 to 15 inclusive. In those views it will be seen that the same reference numerals heretofore employed to designate corresponding parts in earlier views have again been used. Also, it will be seen that the control lever 119, as well as the plate 117' and its cam portion 118' have been dispensed with. However, the manual control shaft or button 105 is nevertheless maintained in its depressed or operating position and returned to its initial position at the end of a cycle. This is achieved by means of the following structure, attention being invited primarily to FIGS. 11 and 12:

A projection 122 is formed in the upper edge of the follower or lever 123 operated by cam 82. A projection 124 forms a part of stop lever 125, which corresponds to stop lever 115 as aforedescribed. This lever is acted upon by a spring 126, which has one of its ends bearing against the lever edge, is conveniently coiled around the pivot for the lever, and has its opposite end extending into an opening 127 forming a part of fixed plate 128. In this manner the stop lever is urged in the direction of the axis of button 105. As is clear from FIG. 12, when the end of follower 123 is disposed within the recess 102 of feed-changing cam 82, driving connection between main shaft 26 and cam shaft 79 is interrupted.

When it is desired to initiate a buttonhole-stitching cycle, then operating shaft or button 105 is depressed from the position shown in FIG. 12 to that shown in FIG. 13. It will be maintained in this position incident to stop lever 125 riding in contact with the surface of cam 107 and coming to lie in a position beyond the base portion of that cam, as aforedescribed in connection with FIG. 10b. Simultaneously with the depression of button 105, lever 123 is elevated out of notch or recess 102. With the lowering of the rear end of this lever or follower, the end of driving lever 84 is brought into cooperative contact with cam 86. Therefore, cam shaft 79 will be rotated. Simultaneously, the projection 124 of stop lever 125 will be disposed adjacent the projection 122 of feed-changing lever or follower 123. This condition of the parts has been illustrated in FIG. 13.

As shown in FIG. 14, when shaft 79 rotates and the contact portion of feed-changing lever 123 lies in a position to the rear of the notch 102, the projection 122 of that lever will act against projection 124 of the stop lever 125. Accordingly, the latter will rotate around its pivot against the action of the spring 126 (FIG. 11). This will result in disengagement of projection 124 of lever 125 from the base of cam 107. Accordingly, the actuating button or shaft 105 will return to its original position. Even with the stop lever disengaged from cam 107 and with actuator 105 returned to its initial position, the projection 124 of the stop lever is controlled in its movements by the extended portion 122 of lever 123. Therefore, if actuator 105 is depressed while in a position where its zero indication is registered, it will immediately return to its original position. Accordingly, no difficulty will be experienced in determining whether the buttonhole-stitching mechanism is operating.

Thus, among others, the several objects of the invention as specifically aforenoted are achieved. Obviously,

numerous changes in construction and rearrangements of the parts may be resorted to without departing from the spirit of the invention as defined by the claims.

We claim:

1. A buttonhole stitching mechanism for zigzag sewing machines of the type provided with an amplitude adjusting device for controlling lateral motion of a needle bar, a needle base position adjusting device for changing the range of motion of said needle bar and a feed adjusting device for reversing feed direction and for adjusting feed amount, comprising in combination a cam shaft rotatably supported in the machine frame, a drive cam for driving said cam shaft operatively connected with the main shaft of the machine, a first lever oscillatably supported on said cam shaft, a first spring biasing one end of said first lever against said drive cam, means for converting the motion imparted to said first lever by rotation of said drive cam into intermittent rotary motion of said cam shaft, a feed reversing cam for said machine, a needle base position changing cam for said machine, said feed reversing and needle base position cams being secured to said cam shaft, a second lever pivotally supported on said frame, a second spring biasing one end of said second lever against said needle base position changing cam, means for connecting the remaining end of said second lever to said needle base position adjusting device, whereby said adjusting device is actuated according to the outline of said needle base position changing cam and the range of motion of needle bar is automatically changed, a third lever pivotally supported on said frame, a third spring biasing one end of said third lever against said feed reversing cam, means connecting the other end of said third lever to said feed adjusting device, whereby said feed adjusting device is actuated according to the outline of said feed reversing cam and feed direction is automatically reversed, one of said feed reversing and needle base position cams having a recessed portion, for receiving the contact portion of one of said second or third levers associated therewith, means for disengaging said first lever from said drive cam, a manual operating device and means for withdrawing the contact portion of the one of said second or third levers from the recess so as to engage said first lever with said drive cam by the operation of said manual operating device in order to operatively connect said cam shaft with said main shaft.

2. In a button hole stitching mechanism for zigzag sewing machines as claimed in claim 1, means for maintaining said manual operating device at its manual operating position until at least the contact portion of said lever corresponding to said cam having said recess is withdrawn from said recess and faces to a normal operating portion subsequent to the recess of said cam in accordance with the rotation of said cam.

3. In a buttonhole stitching mechanism for zigzag sewing machines as claimed in claim 2, means for returning said manual operating device from its operating position to its original position so that the contact portion of said lever faces again to the recess of said cam.

4. In a buttonhole stitching mechanism for zigzag sewing machines of the type provided with an amplitude adjusting device for controlling lateral motion of a needle bar, a needle base position adjusting device for changing the range of motion of said needle bar and a feed adjusting device for reversing feed direction and for adjusting feed amount, comprising in combination a cam shaft rotatably supported in the machine frame, a drive cam for driving said cam shaft operatively connected with the main shaft of the machine, a first lever oscillatably supported on said cam shaft, a first spring biasing one end of said first lever against said drive cam, means for converting the motion imparted to said first lever by rotation of said drive cam into intermittent rotary motion of said cam shaft, a feed reversing cam for said machine, a

needle base position changing cam for said machine, said feed reversing and needle base position cams being secured to said cam shaft, a second lever pivotally supported on said frame, a second spring biasing one end of said second lever against said needle base position changing cam, means for connecting the other end of said second lever to said needle base position adjusting device, whereby said adjusting device is actuated according to the outline of said needle base position changing cam and the range of motion of needle bar is automatically changed, a third lever pivotally supported on said frame, a third spring biasing one end of said third lever against said feed reversing cam, means connecting the other end of said third lever to said feed adjusting device, whereby said feed adjusting device is actuated according to the outline of said feed reversing cam and feed direction is automatically reversed, a recess formed in said feed reversing cam, means for disengaging said first lever from said drive cam, a manual operating shaft supported on said frame and shiftable in axial directions, means for withdrawing the contact portion of said third lever from said recess whereby said first lever and said drive cam are capable of being engaged by the axially shifting of said manual operating shaft and the operatively connecting of said cam shaft with said main shaft.

5. In a buttonhole stitching mechanism for zigzag sewing machines as claimed in claim 4, means for maintaining said manual operating shaft at its manual operating position until at least the contact portion of said third lever is withdrawn from said recess.

6. In a buttonhole stitching mechanism for zigzag sewing machines as claimed in claim 5, means for returning said manual operating shaft, from its operating position to its original position.

7. In a buttonhole stitching mechanism for zigzag sewing machines as claimed in claim 4, said manual operating shaft being axially rotatable, a spring urging said manual operating shaft always in one direction along its axis, an inverted frustoconical cam mounted on said manual operating shaft, to move with the same, and a further lever pivotally supported on the frame, spring biasing said further lever against said inverted frustoconical cam, said further lever being constructed to engage with the base of said inverted frustoconical cam in order to maintain said manual operating shaft at a selected rotation position upon said shaft being shifted in an axial direction.

8. In a buttonhole stitching mechanism for zigzag sewing machines as claimed in claim 7, a projection forming a part of the third lever means for disengaging the further lever from the base of said inverted frustoconical cam in order to return said manual operating shaft to its original position by said projection when the contact portion of said third lever withdraws from the recess of said feed reversing cam.

9. In a buttonhole stitching mechanism for zigzag sewing machines as claimed in claim 7, a disk secured to said cam shaft, a projection extending from said disk for disengaging said further lever from the base of said inverted frustoconical cam to allow return of said manual operating shaft.

10. In a buttonhole stitching mechanism for zigzag sewing machines as claimed in claim 7, in which one end of the manual operating shaft projects beyond the machine frame, an axially elongated groove formed in said manual operating shaft, a revolution ratchet control cam provided with a projection engaging with said elongated groove for rotating said shaft therewith, said manual operating shaft and said revolution ratchet control cam being relatively shiftable axially of said shaft, a spring urging said manual operating shaft in one axial direction, means for maintaining said revolution ratchet control cam together with said manual operating shaft at a desired position, a projection forming a part of said first lever to engage with said revolution ratchet control cam, and

said revolution ration control cam controlling the amplitude of motion of the first lever according to the outline of said revolution ration control cam.

References Cited in the file of this patent

UNITED STATES PATENTS

2,301,797	Spaine	Nov. 10, 1942
2,682,845	Casas-Robert et al.	July 6, 1954
2,905,119	Bono	Sept. 22, 1959

5

2,966,868
2,979,002
2,983,240

525,946
552,428
792,784
219,620

Theenhausen et al. Jan. 3, 1961
Casas-Robert et al. Apr. 11, 1961
Engel May 9, 1961

FOREIGN PATENTS

Italy Mar. 12, 1955
Italy Dec. 3, 1956
Great Britain Apr. 2, 1958
Australia Jan. 14, 1959