May 5, 1964 KEIZO YANAGIBAYASHI ETAL 3,131,658

DEVICE FOR UNIFORM REGULATION OF FORWARD AND REVERSE STITCHES IN AUTOMATIC BUTTON HOLE STITCHING BY MEANS OF A ZIGZAG SEWING MACHINE

Filed Nov. 14, 1960

5 Sheets-Sheet 1

Fig. 1

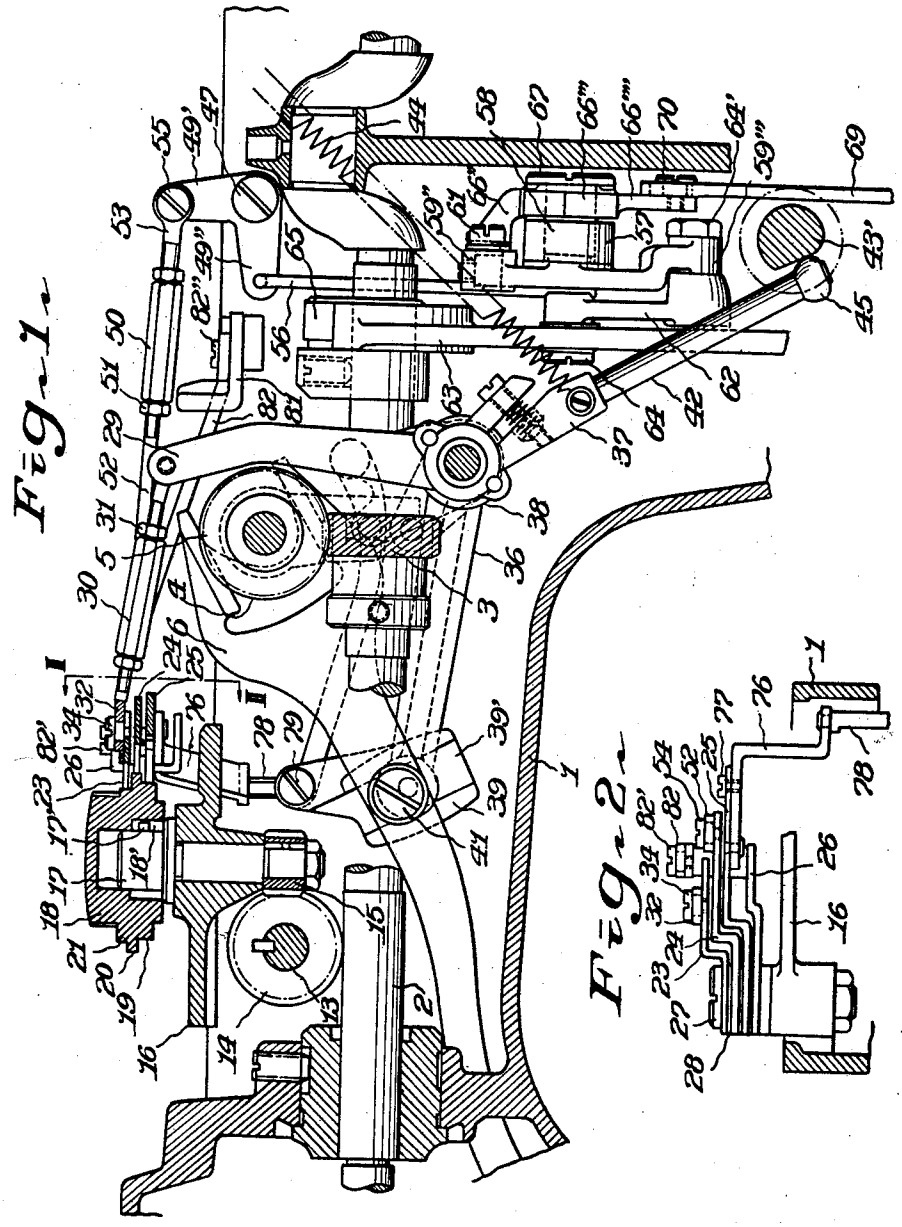


Fig. 2

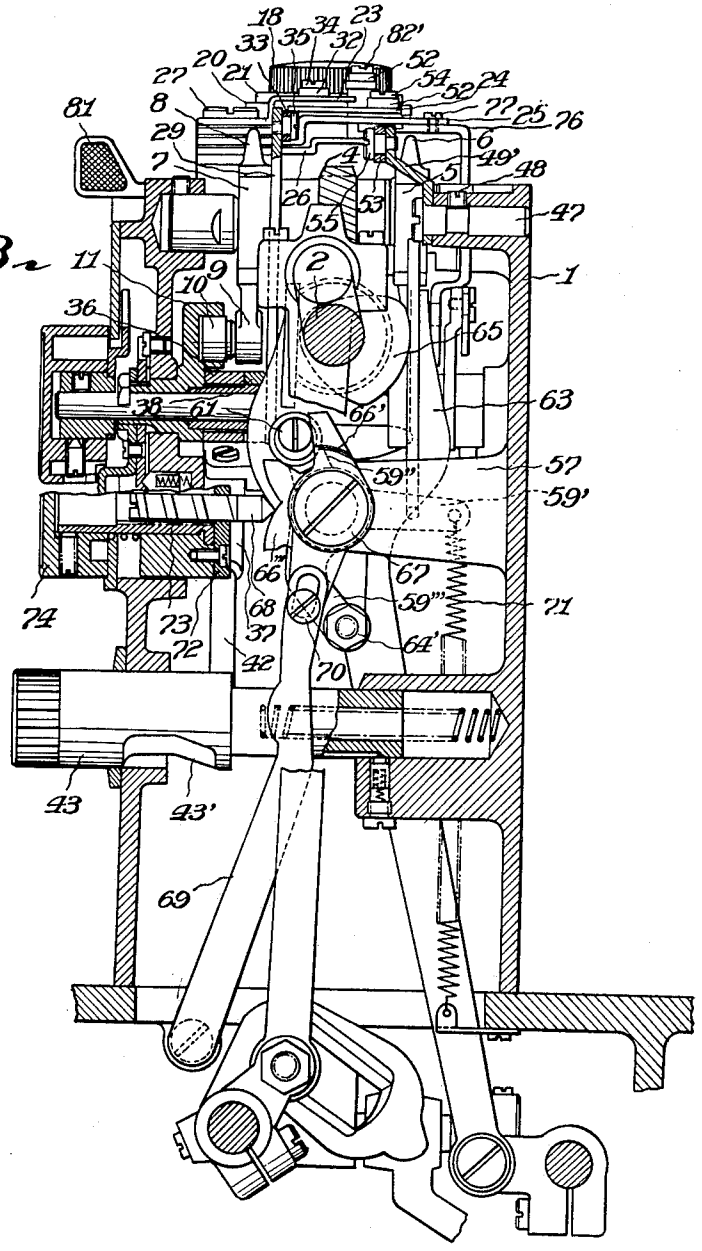
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Fig. 3

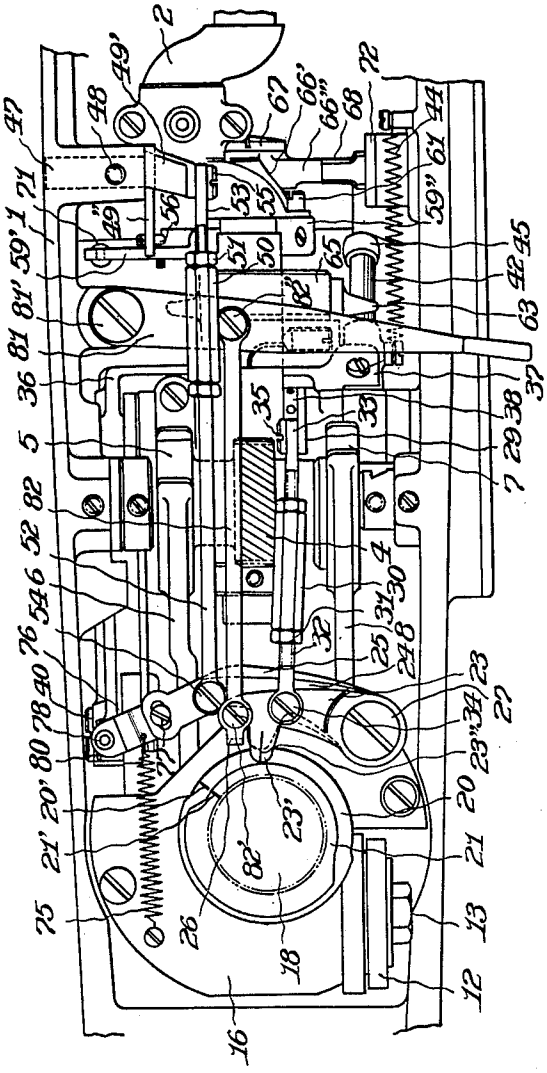


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Fig. 4



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Fig. 5

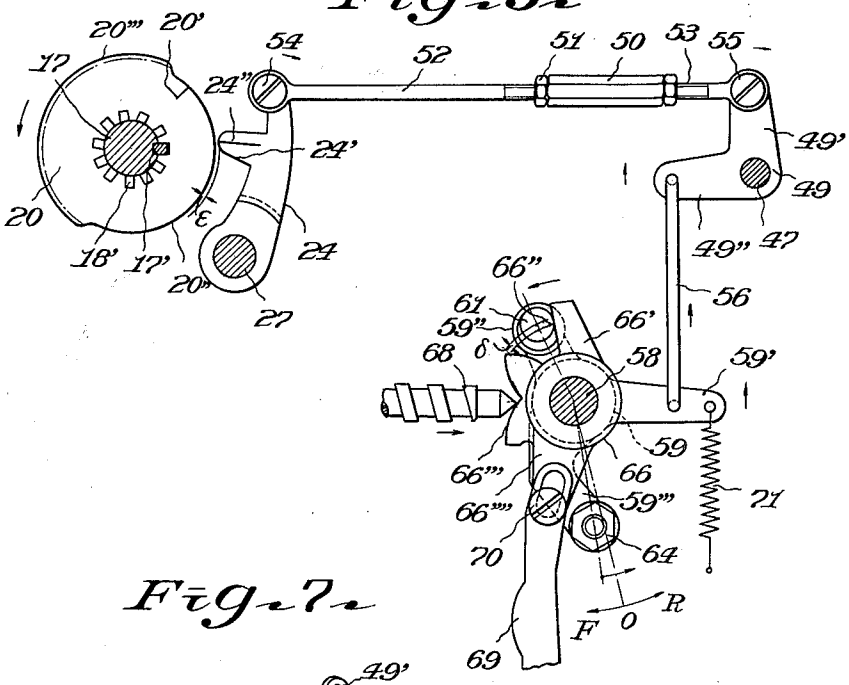
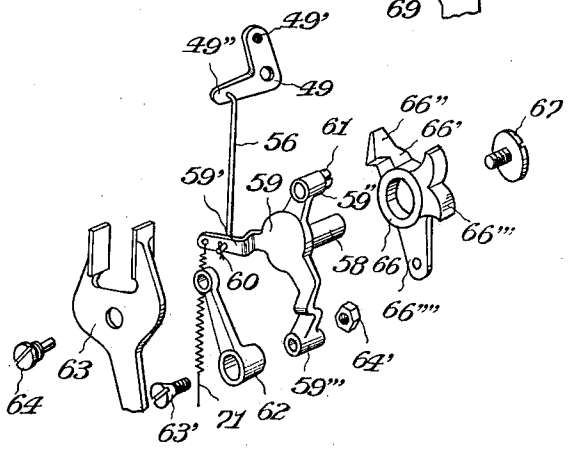


Fig. 7



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Fig. 6.

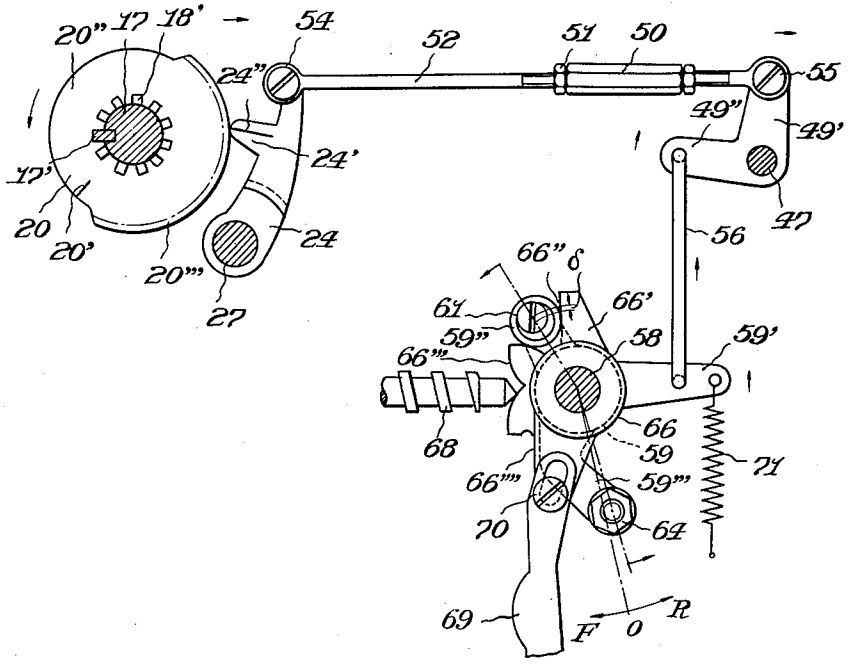
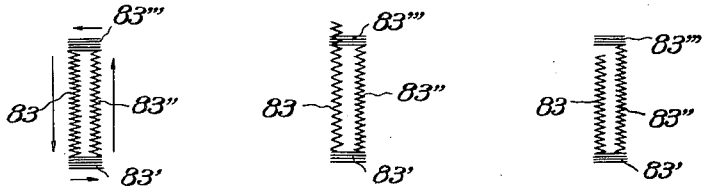


Fig. 8. Fig. 9. Fig. 10.



United States Patent Office 3,131,658 Patented May 5, 1964

3,131,658

DEVICE FOR UNIFORM REGULATION OF FORWARD AND REVERSE STITCHES IN AUTOMATIC BUTTON HOLE STITCHING BY MEANS OF A ZIGZAG SEWING MACHINE

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Claims priority, application Japan Nov. 17, 1959
4 Claims. (Cl. 112—158)

The present invention relates to the control of stitching pitch or spacing during button hole-stitching by a zigzag sewing machine, and more particularly it relates to an adjusting device for equalizing the forward and reverse stitching pitch in automatic button hole stitching by a zigzag sewing machine wherein the amplitude or width of stitch, forward and reverse stitching pitches, and the needle base line are controlled by means of automatic cams.

During button hole-stitching performed on a conventional zigzag sewing machine, such as an automatic zigzag sewing machine, which is not provided with a device for adjusting the forward and reverse stitching pitches, the forward stitching pitch and the reverse stitching pitch tend to differ, the lengths of the forward and reverse stitches tend to be uneven as illustrated in FIGS. 9 and 10 of the accompanying drawing, and it is impossible to obtain faultless automatic button hole-stitching. Furthermore, in the case of manual control of button hole-stitching cams by means of such mechanisms as levers, the procedure has entailed the first lever operation of sewing the upper bar stitch; the second lever operation of sewing the forward hole stitch; the third lever operation of sewing the lower bar stitch; and the fourth lever operation of sewing the reverse hole stitch in order to complete the button hole-stitching. This large number of separate operations has made the entire procedure complicated and inconvenient.

It is an essential object of this invention to provide a device which will enable, through the adjustment of only the forward stitching pitch by the simple rotation of a stitch adjusting knob, the forward and reverse stitching pitches to be exactly equal, whereby faultless automatic button hole-stitching as illustrated in FIG. 8 will become possible, and the abovementioned difficulties will be completely eliminated.

It will be appreciated that the effective value of such a device is extremely great and will greatly broaden the practical value of zigzag sewing machines for home use.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of a specific embodiment when read in connection with the accompanying drawings, which illustrate one example of the embodiment of this invention, and in which:

FIG. 1 is an elevational view, partly in section and with parts cut away, showing the arm portion of a sewing machine in which a device of this invention is installed, as viewed from the operator's side;

FIG. 2 is a side elevational view, partly in section with parts cut away, as viewed in the direction of the arrows II—II in FIG. 1;

FIG. 3 is a side elevational view, partly in section, showing the arm pedestal portion of the sewing machine, including the construction of the principal parts of the device of this invention;

FIG. 4 is a plan view, showing the mechanism in the central portion of the sewing machine arm;

FIG. 5 is a mechanical motion diagram, showing the mechanism of transmitting forward stitching regulation;

FIG. 6 is a mechanical motion diagram, similar to FIG. 5, showing the mechanism of transmitting reverse stitching regulation;

FIG. 7 is an exploded, perspective view, indicating the essential construction of the stitch regulating device;

FIG. 8 is a stitch diagram, in plan view, showing correctly sewn hole stitches;

FIGS. 9 and 10 are stitch diagrams, in plan views, showing incorrectly sewn hole stitches.

Referring to FIGS. 1 through 4, the rotational power from an upper shaft **2** supported horizontally on bearings in the sewing machine arm **1** is transmitted, through a gear **3** and a gear **4** which is meshed with said gear **3**, to a triangular cam **5** so as to rotate the cam **5**, which in turn causes an oscillating fork **6**, which is engaged with and follows the cam **5**, to oscillate. The resulting oscillatory motion is further transmitted through a suitable mechanism to oscillate the needle bar oscillating frame (not shown), thereby imparting a zigzag sewing motion to the needle bar.

The rotation of another triangular cam **7**, which rotates as a unit with aforesaid gear **4** and triangular cam **5**, causes an automatic fork **8**, which is engaged with and follows said cam **7**, to oscillate and, simultaneously, to undergo sliding motion along the direction of a slot of an adjusting box **11**, being guided in said sliding motion by the slot through a slide **10**, which is supported rotatably at the boss part **9** at the lower end of the cam **7**, and which slides in the slot. Due to the sliding motion of the automatic fork **8**, guided by the guide slot of the adjusting box **11**, the automatic fork **8** undergoes reciprocating motion and causes a plate **12** to oscillate. This motion is transmitted further through a freewheel and non-reversing freewheel (both not shown) to a shaft **13** so as to rotate it intermittently in a certain direction, and then the intermittent rotational motion of the shaft **13** is imparted through gears **14** and **15** to a cam shaft **17** supported rotatably by an automatic bedplate **16** fixed to the sewing machine arm **1**.

Referring to FIG. 5, an automatic cam **18** provided with an adjusting key slot **18'** is fitted fixedly to the cam shaft **17** by means of a key **17'**, the said cam **18** being provided with cam surfaces **19**, **20** and **21** (FIGS. 1 and 2) having, respectively, particular functions. The lower step automatic cam surface **19** governs the controlling of the stitching amplitude or width, the middle step automatic cam surface **20** governs the controlling of the forward and reverse stitch spacing, and the upper step automatic cam surface **21** governs the controlling of the needle base line. Four levers **23**, **24**, **25**, and **26**, FIGS. 1 and 2 with protruding fingers are supported pivotally on shaft **27** supported by the automatic bedplate **16**. Beginning at the top, these are: the needle base line lever **23**, stitch lever **24**, amplitude lever **25**, and the disconnecting lever **26**. Said levers are disposed in skewered arrangement with spacers **28** between each adjacent lever. The contactor **23'** of the needle base line lever **23** is opposite the needle base line cam **21** and has an index line punched on its surface. Referring to FIGS. 1 and 4 the ends of the lever **23** and a phase arm lever **29** are joined by threaded eye rods **32** and **33** held by a turnbuckle **30**, which has left-hand and right-hand internal threads on its ends, and which thereby can be adjusted in assembled length, and locked with nuts **31**. The rods **32**, **33** are pivotally connected to their respective levers by pin screws **34** and **35**. The base portion of the phase arm lever **29** is supported pivotally together with a phase regulating arm **37** by a shaft screw **38** on the center of rotation of a phase arm **36**. An amplitude regulating box **39** (FIG. 1) is supported

pivotally by a pin screw 40 on the end of the phase arm 36. The aforementioned oscillating fork 6 is supported, through a slide and pin 41, by the slide slot 39' of the regulating box 39. A phase arm bar 42 is embedded in the phase regulating arm 37, and a spherical follower 45 is fitted onto the end of the said phase arm lever 42 so that the follower is made to contact elastically by the force of a spring 44 to the cam surface 43' of a reverse stitching push button 43.

The contactor 24' of the stitch lever 24 is opposite the stitch cam surface 20 for automatic button hole stitching. The end of the lever 24 and the end of an upwardly disposed crank arm 49' of an intermediate crank 49, which is pivotally supported by a pin 47 and a screw 48 on a boss 46 extending out from a suitable portion of the sewing machine arm 1, are joined by an assembled, variable-length rod comprising end eye rods 52 and 53 (FIGS. 1 and 5) threaded into a turnbuckle 50 and locked by nuts 51, said eye rods 52 and 53 being connected to their respective lever ends by pin screws 54 and 55.

A connecting rod 56 (FIG. 7) is connected rotatably at its upper end in a simple manner to the other arm 49'' of the intermediate crank 49 and at its lower end to a rearwardly disposed crank arm 59' of a stitch bell crank 59, having a shaft 58, which is inserted so as to be freely rotatable in a hole in an extended bracket 57 (FIG. 1) of the sewing machine arm 1. The pin joints at the ends of said rod 56 are retained against slipping-out by cotter pins 60.

An eccentric pin 61 is disposed in a rotatably adjustable manner in an upwardly disposed arm (59'') of the bell crank 59, and a stitch link 62 (FIGS. 1 and 7) is connected pivotally by a screw 63' and a nut 64' to the end of a downwardly disposed arm 59'''. The other end of the link 62 is supported pivotally by a fork rod 63 and a pin 64, the fork portion of the rod being engaged about a feed cam 65 (FIG. 1) which is fixed to the upper shaft 2.

The bell crank shaft 58 protrudes from the hole of the extended bracket 57 and is inserted into the rotational hole of a feed regulating cam 66. The end face of the cam 66 is in contact with a holding screw 67, which is screwed into the bell crank shaft 58, and the cam 66 is clamped between the screw 67 and the extended bracket 57. The front end face of a protruding arm 66' of the feed regulating cam 66 forms a contact surface 66'' for elastically contacting the eccentric pin 61. The said cam 66 also has forward and reverse cam surfaces 66''', which confronts and contacts with a stitch adjusting screw 68 (FIG. 5). A downwardly disposed arm 66'''' is connected in a freely slideable manner to a reverse stitch transmitting link 69 by a pin 70.

A spring 71 is anchored at one end thereof to the end of the aforementioned rearwardly disposed arm 59' of the said bell crank, which is thus held elastically always in the direction tending to produce forward stitching (in the direction of F in FIG. 5).

The eccentric pin 61 can be rotated and adjusted in an extremely simple manner so as to adjustably set, by the amount δ of eccentricity, the zero-feed, inclination-angle position of the bell crank 59 corresponding to the zero-feed position of the feed regulating cam 66.

The positioning of the two surfaces of the stitch adjusting screws 68 (FIGS. 3 and 5) relative to cam surface 66''' is controlled by the guide cover 72 and the rotary guide cylinder 73. By rotating the stitch adjusting knob 74 (FIG. 3) which is fixed to the guide cylinder 73, the adjusting screw 68 is shifted in its axial direction to set the angle of inclination of the regulating cam surface 66''' and thereby to control the amount of forward feed.

The contactor 25' of the amplitude lever 25 is maintained in contact with the amplitude cam surface 19 by the elastic force of a spring 75 (FIG. 4). The end portion of the lever is connected adjustably by a screw 77 to the lever arm 76, and a lever pin 78 (FIG. 1) is affixed to tip of the said arm. The lower part of the lever pin

is inserted into a slot piece 80, which is pinned by a pin 79 to the arm of the amplitude regulating box 39. The oscillation of the amplitude lever 25 is transmitted through the lever pin 78 and slot piece 80 to cause oscillation of the amplitude regulating box 39, which has, as its center, the pin 40 at the end of the phase arm 36, and to effect automatic control of the amplitude through the slide slot 39' and oscillating fork 6.

The end portion of the disconnecting lever 26 is formed in the shape of a channel (E) and is so disposed as to contain and engage the ends of the aforementioned levers 23, 24, and 25. The upper end surface of the said lever 26 is connected by an eye rod 82 to the middle portion of a disengagement handle 81 (FIG. 3), which is installed at a suitable point on the machine arm 1 by a pin screw 81'. When the hole-stitching automatic cam is to be engaged or disengaged, such operation can be accomplished easily if the handle 81 is pushed to the right to cause the contactors of the levers 23, 24, and 25 to separate simultaneously from the maximum diameters of the automatic cam surfaces 19, 20 and 21.

The automatic control mechanism of the device of this invention for the needle base line, forward and reverse stitch, and stitch amplitude or width is constructed as described above. Its operation may be best understood by reference to the following description paying particular attention to the mechanism of equalizing regulation of forward and reverse stitches in the case of automatic hole-stitching.

The levers 23, 24, and 25 are opened by manipulating the disconnecting handle 26. Then a suitable key slot, from the several slots 18' of the automatic cam surface 18, is selected and fixed to the cam shaft 17 so that each of the index lines 21' and 20' for indicating the starting point of the automatic button hole-stitching cam coincides with the index line 23'' of the lever 23. Then, as the hole-stitching automatic cam 18 is rotated, by the rotation of the upper shaft 2, at reduced speed and intermittently in the arrow direction (FIGS. 5 and 6), the contactor 23' of the needle base line cam, the contactor 24' of the stitch cam, and the contactor 25' of the amplitude cam, which are in elastic contact with the cam surfaces 19, 20, and 21, respectively, follow their respective automatic cam curves and oscillate in correlated action, thereby causing the zigzag sewing and automatically controlling the needle bar motion to produce the automatic button hole stitching as illustrated in FIG. 8, the said stitching comprising: the forward hole-stitching 83; lower bar stitching 83'; reverse hole-stitching 83''; and upper bar stitching 83'''. When the upper bar stitching 83''' is completed, the cam index line 20' and the index line 23'' of the contactor coincide again, whereby one revolution of the cams is ended, and the automatic button hole-stitching operation is completed.

During this operation, the pitch of the reverse hole stitch 83'' is always maintained constant in the following manner. Since, as indicated in FIG. 6 the reverse lift cam part 20''' of the stitch automatic cam surface 20 is larger than the forward lift cam part 20'', the stitch lever 24 is lifted in the arrow direction by the following action of the contactor 24'. This motion is transmitted through the rod 52, turnbuckle 50, and rod 53, hence through the intermediate crank 49 and connecting rod 56, to force the eccentric pin 61 of the stitch bell crank 59 to rotate counter-clockwise against the force of the spring 71 and separate away from the contact surface 66'' of the feed regulating cam 66, whereby the said eccentric pin 61 becomes free and independent of the said feed regulating cam 66. At the same time, the downwardly disposed crank arm 59''' is caused to rotate in the reverse sewing direction R (the zero mark indicating the zero angle position of the stitch). This motion is transmitted through the stitch link 62 and forked rod 63 to govern the pitch of the stitches corresponding to the reverse lift circle 20''' always at a constant value.

In the case of forward sewing, the forward lift cam part 20'', as indicated in FIG. 5, is so formed that the stitching pitch obtained by the accurate follower action on the said lift circle will be greater than the aforesaid reverse stitching pitch. Then, if the stitch adjusting knob 74 is rotated to advance the stitch adjusting screw 68 so as to make the said forward stitching pitch become equal to the reverse stitching pitch, the forward cam surface 66''' will be pressed, whereby a force will be imparted through the contact surface 66'' on the eccentric pin 61 in contact therewith to rotate the bell crank 59 and the crank arm 59''' and rearwardly disposed crank arm 59' of the bell crank in the direction of the arrow R. The resulting motion is transmitted, in the same manner as described before, through the connecting rod 56, intermediate crank 49, and rods 53 and 52 to shift the stitch lever 24 to the right and cause an adjustment gap ϵ to be created between the forward lift circle 20'' and the contactor 24'.

In other words, the possibility of selecting at will the adjustment of the gap ϵ makes it possible to adjust the forward stitching pitch suitably by exactly the same operation as that for ordinary stitch adjustment. Accordingly, by shortening the forward stitching pitch if the forward hole stitches 83 are extended as in FIG. 9, and by lengthening the same if the forward hole stitches 83 are contracted as in FIG. 10, the forward and reverse stitching pitches can be made exactly equal in an extremely easy manner, and it is possible to obtain faultless, automatic button hole stitching as indicated in FIG. 8.

As is apparent from the above description, it is possible by means of the device of this invention to carry out faultless, automatic button hole stitching, even under such varying conditions as kind of fabric material being sewn and fabric thickness, by adjusting, in exactly the same manner as that for ordinary machine sewing, only the forward stitching pitch in a zigzag sewing transmitting mechanism wherein the sewing motions are due to the coordinated motions of the cam follower levers 25, 24, and 23 which are in contact, respectively, with the automatic cam surfaces 19, 21, and 22 which control, respectively, the amplitude or width, the forward and reverse stitch, and the needle base line of the hole stitching. It is possible, therefore, to greatly expand the practical value of zigzag sewing machines for home use.

While we have described a particular embodiment of our invention, it will, of course, be understood that we do not wish our invention to be limited thereto, since many modifications may be made and we, therefore, contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of our invention.

What we claim is:

1. In a zigzag sewing machine having an automatic cam and a cam follower, wherein hole stitching is carried out by one revolution of said automatic cam which automatically controls the amplitude, forward and reverse stitches and needle position line, said automatic cam having a forward stitch cam portion for controlling forward stitching and a reverse stitch cam portion for controlling reverse stitching, a stitch regulating mechanism comprising a forked feed rod, a manual feed regulating cam, and a stitch bell crank for transmitting a regulating motion to said forked rod in the stitch regulating mechanism, said manual feed regulating cam and stitch bell crank being separately arranged side by side in contact with each other, a common shaft mounting said feed regulating cam and said crank so that the regulated displacement of said manual feed regulating cam is transmitted to said forked rod, means to cause said stitch bell crank to contact under elastic pressure said manual feed regulating cam so as to be urged elastically in a forward sewing direction when the reverse stitch cam portion of said automatic cam and stitch cam follower are in contact with each other, a link

mechanism comprising an intermediate crank and two connecting rods for operating said stitch bell crank without being restrained by said manually operated stitch regulating cam thereby to control pitch of reverse stitching by said reverse stitch cam portion of the automatic cam; said automatic cam forward stitch cam portion being constructed so that when the forward stitch cam portion of the automatic cam and the stitch cam follower are in complete contact with each other the pitch of the forward stitching is always larger than that of the reverse stitching, a stitch adjusting knob rotatably mounted and operably connected elastically to said stitch bell crank through said manual feed regulating cam for adjusting the angle of inclination of said bell crank for forward stitching, whereby said angle of inclination is minutely adjusted through said manual feed regulating cam by rotating said knob without connection to said automatic cam thereby enabling freely increasing and decreasing of the forward stitch pitch to adjust the pitch of the forward stitching equal to the pitch of the reverse stitching and to adjust stitch lengths of the forward and reverse stitching for automatic button stitching to exactly equal lengths.

2. In combination in a zigzag sewing machine a cam follower; an annular cam having a center, a continuous peripheral cam surface comprising unequal camming arcs of unequal radii subtended by equal center angles, said camming arcs being connected at their ends; and means for equalizing the effective travel of the cam follower over said unequal camming arcs comprising, a bell crank having a plurality of radial arms and a center shaft normal to said radial arms, said bell-crank being mounted to rotate around the center axis of said shaft, an eccentric pin rotatably mounted in one of said radial arms, transverse thereto and approximately parallel to said center shaft, said eccentric pin being rotatably adjustable circumferentially with respect to said radial arm, cam means mounted on said shaft side-by-side with said bell crank and having a plurality of radially extending cam arms, one of said cam arms having an axially extending cam surface for engaging and disengaging with said eccentric pin, another of said cam arms having dual peripheral cam surfaces intersecting and extending radially and circumferentially from said intersection to oppositely disposed cam-surface ends, biasing means mounted to bias said bell crank to pivot about said center axis and engage said eccentric pin with the axially extending cam surface of said one cam arm, screw means having external threads and means having complementary screw threads mounting said screw means, said screw means having a pointed end cam surface and disposed in rotary engagement with said complementary screw threads and with said point end cam surface opposed to and in contact with one of said dual peripheral cam surfaces of said cam means, knob means for rotating said screw means relative to said complementary screw threads whereby said pointed end cam surface engaged with one of said dual peripheral cam surfaces pivots said cam means around said shaft to thereby engage the axially extending cam surface of said one cam arm with the eccentric pin of said bell crank and rotate said bell-crank with said cam means against said biasing means, linkage means operably connecting said cam follower with another of said radial arms of said bell-crank whereby when said cam follower engages the camming arc having the shortest of the unequal radii, rotation of said knob means pivots said cam means around said shaft and said bell-crank around its center axis against said biasing means by means of said eccentric pin biased into engagement with said axially extending cam surface of said one cam arm, thereby actuating said linkage means traveling over said camming arc with the shortest radii to cause lifting of said follower to follow the mean circle path of the camming arcs having the longest and shortest radii and causing said bell crank to be pivoted against said biasing means by said connecting linkage when said

cam follower engages the camming arc having the longest of the unequal radii thereby to rotate said eccentric pin clear of said axially extending cam surface of said cam means, said eccentric pin being rotatably mounted adjustable circumferentially with respect to said supporting arm of said bell crank as said cam follower is displaced from said mean circle path thereby to equalize the effective travel of said cam follower over said continuous peripheral cam surfaces.

3. A device for microregulation of stitches of a zigzag sewing machine comprising, a stitch regulating mechanism having a forked feed rod, a manual feed regulating cam, and a stitch bell crank for transmitting a regulating motion controlled by said feed regulating cam to said forked rod in said stitch regulating mechanism, a common shaft mounting said manual feed regulating cam and said stitch bell crank side-by-side, an eccentric pin mounted on one arm of said stitch bell crank for engaging said manual feed regulating cam, means comprising elastic means biasing said eccentric pin for causing said stitch bell crank to elastically contact said manual feed regulating cam and urge said crank in a forward sewing direction, said eccentric pin being disposed rotatably and adjustably mounted in said arm of the said bell crank to adjustably set a relative phase angle between said stitch bell crank and said stitch feed regulating cam freely by rotating said eccentric pin, thereby enabling easy adjustment of the angle of inclination of the said bell crank for zero feeding.

4. In a zigzag sewing machine having an automatic cam and a cam follower wherein button hole stitching is carried out by one revolution of said automatic cam which automatically controls the amplitude, forward and reverse stitches and needle position line, said automatic cam having a forward stitch cam portion for controlling forward stitching and a reverse stitch cam portion for controlling reverse stitching, a device for micro-uniform regulation of forward and reverse stitches comprising a stitch regulating mechanism comprising, a forked feed rod and a manual feed regulating cam, a stitch bell crank for transmitting a regulating motion of said feed regulating cam to said forked rod in the stitch regulating mechanism, a common shaft for mounting said manual feed regulating cam and said stitch bell crank separately arranged side-by-side, an eccentric pin mounted on one arm of said stitch bell crank for engaging said manual feed regulating cam so that the regulated displacement of said manual feed regulating cam is transmitted to said forked rod, elastic means biasing said eccentric pin for causing said stitch bell crank to make contact under elastic pressure with said manual feed regulating cam and to be urged elastically in a forward sewing direction, said eccentric pin being disposed rotatably and adjustably mounted in one arm of said bell crank for freely adjusting a relative phase angle between said stitch bell crank and stitch feed regulating cam by rotating said eccentric pin, thereby enabling easy adjustment of the angle of inclination of said bell crank for zero feeding when said reverse stitch cam portion of said automatic cam and said stitch cam follower are in contact with each other, a link mechanism for operating said stitch bell crank without restraint by said manual operated stitch regulating cam to control the pitch of reverse stitching by said reverse stitch cam portion of said automatic cam, said automatic cam forward stitch cam portion being constructed so that when the forward stitch cam portion of the automatic cam and the stitch cam follower are in complete contact with each other the pitch of the forward stitching is always larger than that of the reverse stitching; a rotatable stitch adjusting knob elastically connected to said stitch bell crank through said manual feed regulating cam for minutely adjusting the angle of inclination of said bell crank for forward stitching through said manual feed regulating cam by rotating said knob without connection to said automatic cam, thereby enabling freely increasing and decreasing the forward stitch pitch, whereby the pitch of forward stitching can be made equal to the pitch of reverse stitching and stitch lengths of the forward and reverse stitching for automatic button hole stitching can be made exactly equal.

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