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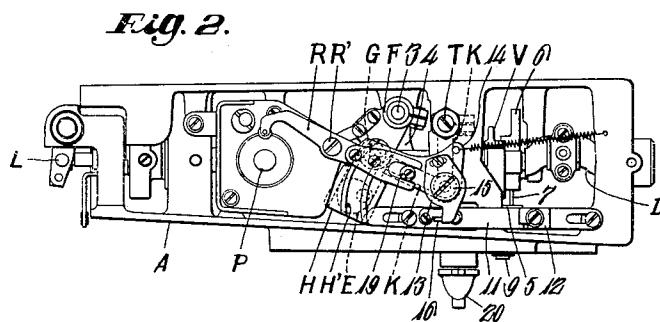
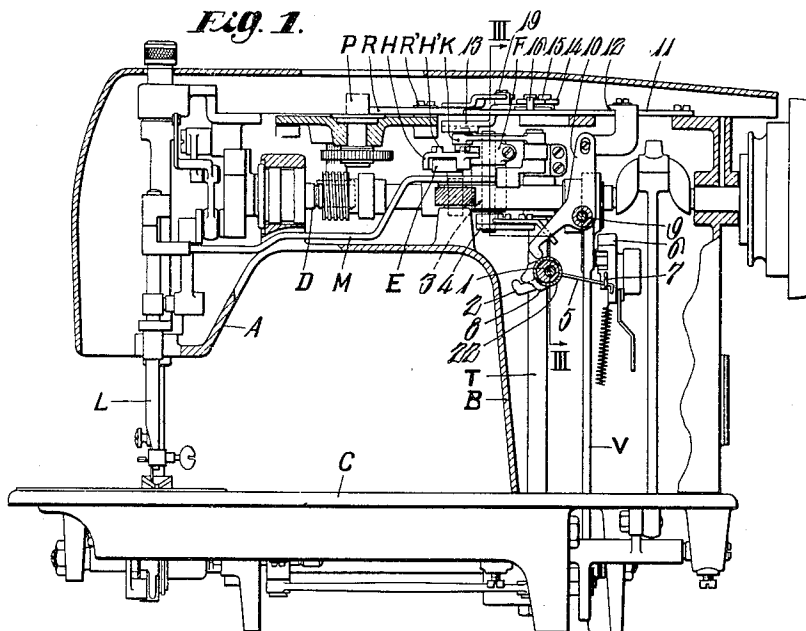
TAMOTSU KOJIMA ETAL

3,216,385

BUTTONHOLE SEWING MECHANISM IN ZIGZAG SEWING MACHINES

Filed Dec. 7, 1962

2 Sheets-Sheet 1



Nov. 9, 1965

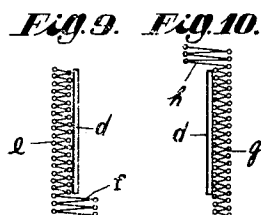
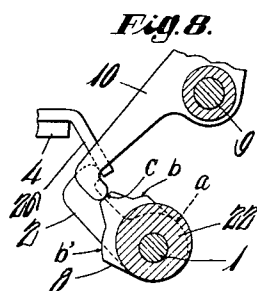
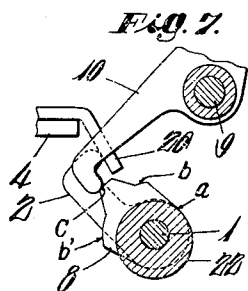
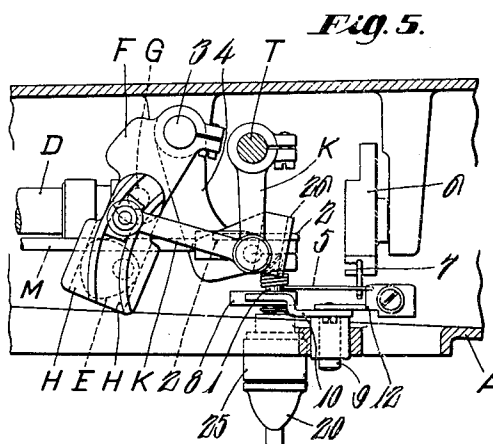
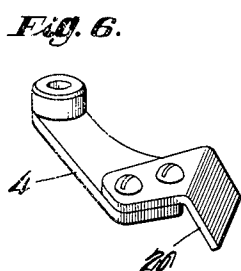
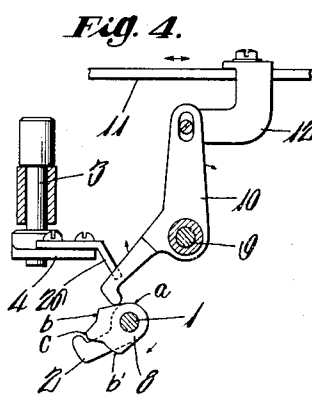
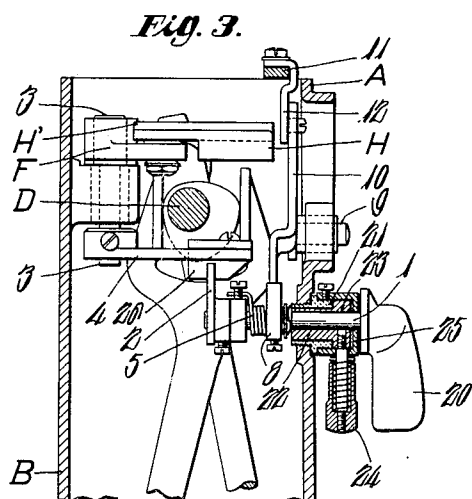
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Filed Dec. 7, 1962

2 Sheets-Sheet 2



1

2

## 3,216,385 BUTTONHOLE SEWING MECHANISM IN ZIGZAG SEWING MACHINES

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Filed Dec. 7, 1962, Ser. No. 243,119

Claims priority, application Japan, Dec. 11, 1961,

36/45,149

1 Claim. (Cl. 112—158)

This invention relates to an improvement in zigzag sewing machines of the conventional type having a mechanism for zigzag sewing by means of transverse oscillations of the needle bar, a mechanism for adjusting the amplitude of lateral oscillation of the needle bar and a mechanism for reversing the direction of material feed, and more specifically, this invention has for an object to provide a buttonhole sewing means adapted for use on such type of zigzag sewing machines to permit the machines to perform not only zigzag sewing of various patterns but also buttonhole sewing by means of the manipulation of an operating lever.

The principal object of the present invention is to provide a unique buttonhole sewing mechanism whereby the length and width of a buttonhole seam can be adjusted freely according to the size of buttonhole. For example, for the sewing of a small buttonhole, the amplitude of the swinging movement of the needle bar is made small so that a seam of small width may be produced and for the sewing of a large buttonhole, the amplitude of the needle movement is made larger to produce a buttonhole seam of large width.

Another object of this invention is to provide a new buttonhole sewing means so devised that the length of the so-called barring stitches to be produced at the upper and lower terminal ends of a buttonhole can be adjusted according to the size of buttonhole and further that the distance from the edge of a seam on one side of a buttonhole to the edge of a seam on the opposite side can be made long or short as desired.

In order to permit a sewing machine of the type described to accomplish the aforementioned functions easily and accurately, a unique cam member, an arm piece and a spring means are mounted on a control shaft which is rotatably supported in the machine frame for buttonhole sewing operation. The said cam member is engaged by a lever in a zigzag-motion adjusting means connected with a zigzag-motion generating mechanism, the said arm piece being disposed to be engaged by an operating arm connected with a center-line shifting mechanism and the said spring means being linked to the feeding mechanism, while the said control shaft for buttonhole sewing operation is disposed in an eccentrically rotatable sleeve means. Under such arrangement, when the control shaft is rotated eccentrically by turning the sleeve means, the cam and arm piece mounted on the shaft are caused to change their operative positions to influence the movements of the zigzag-motion generating mechanism and the arm member for center-line shifting, thereby permitting the sewing of buttonholes of various sizes accurately and easily.

The nature of this invention will be more clearly understood by reference to the accompanying drawings, forming a part of the present application and illustrating unique elements and means employed to accomplish the functions of the present invention. In the drawings:

FIG. 1 represents a front elevation, in vertical section, of a sewing machine provided with the improved buttonhole sewing mechanism of my invention.

FIG. 2 represents a plan view, in cross-section, of the sewing machine shown in FIG. 1.

FIG. 3 represents a cross-sectional view of the mechanism on the section line III—III of FIG. 1.

FIG. 4 represents a front view, showing the connection of a control shaft for buttonhole sewing operation with a part of a zigzag-motion generating mechanism.

FIG. 5 represents a plan view, showing the connection of a lever for zigzag-motion adjustment with a center-line shifting mechanism.

FIG. 6 represents a perspective view of an operating arm for center-line shifting.

FIG. 7 represents a front view, showing a cam and an arm piece mounted on the control shaft in the upwardly adjusted positions as actuated by the eccentric movement of the control shaft.

FIG. 8 represents a front view, showing the elements in FIG. 7 in the downwardly adjusted positions as actuated by the reverse movement of the control shaft.

FIG. 9 represents diagrammatically a seam produced on the left border of a buttonhole.

FIG. 10 represents diagrammatically a seam produced on the right border of the buttonhole.

All of the drawings illustrate only those elements and devices that are essential to my invention and the other component elements not related to the present invention are omitted from the drawings. The same reference numerals and characters refer to the same parts in the drawings.

The bracket-arm A, hollow standard B and bed plate C are of the same shapes and constructions as those used in the conventional zigzag sewing machines and similarly, other component elements mounted inside those parts, such as a zigzag-motion generating mechanism in which a triangular cam E driven by the upper shaft D rocks an oscillator member H having its one end pivotally secured at the point G to a movable arm F for center-line shifting, the rocking motion of the said oscillator H being transmitted to the needle bar L through a connecting rod M which is operatively connected with the oscillator H by means of a linking lever K having its one end disposed in an arcuate groove H' of the oscillator H, a means for moving a shuttle in time with the lateral rocking movement of the needle bar, and an amplitude adjusting mechanism in which a cam shaft P driven by the upper shaft D carries thereon an assembly of cams of different shapes and the said cam unit is engaged by a cam-follower lever R which is pivotally secured at its midpoint R' for adjusting the width of zigzag seams to the desired degree, are the same as those in any conventional zigzag sewing machine.

Now, a movable arm F which supports at its end an oscillator H forming a part of the zigzag-motion generating mechanism, is pivotally secured to the upper end of an axis 3. Fixedly secured to the lower end of the axis 3 is an operating arm 4 provided at its end with a slope 26 which is engaged by the beaked end of an arm piece 2 carried by a control shaft 1.

Mounted on the control shaft 1 which is rotatably supported in the machine frame is a cam 8, the periphery of which comprises a low portion a, the first shoulder portion b which is substantially higher than the said lower portion a, a high portion c and the second shoulder portion b' which is also substantially higher than the said lower portion a. The cam 8 is constantly engaged by the beaked end (constituting a cam follower) of a lever 10 which is pivotally secured at its approximate midpoint 9 to a part of the machine frame and has its other end connected by means of a linking member 12 to a rod 11 slidably disposed on the machine frame.

The slidable rod 11 is operatively linked by means of a protrusion 16 carried thereon to a hooked member 14 which is pivotally secured by means of a screw 15 to

a swingable plate means 13 for zigzag amplitude adjustment. The swingable plate means 13 has its one end operatively connected with the oscillator H through the medium of a linking lever K which has its base end rigidly secured to a vertical shaft T and its other end disposed in an arcuate groove H' of the oscillator H. Provided on the upper surface of the swingable plate means 13 is a roller member 19 engaging in the forked end of a cam-follower lever R.

On the other hand, a spring means 5 is rigidly secured to the inner end of the control shaft 1 and the said spring 5 has its free end connected to a projection 7 provided on one side of a regulator member 6 provided on a bifurcated rod V for material feeding. The control shaft 1 carries at its external end a manipulating lever 20 which is supported in a hole 23 provided eccentrically in a bushing 2 rotatably interposed in a sleeve 21 secured to the machine frame by means of a screw. The rotatable bushing 22 carries at its external end a handle 24 which projects downwardly through a cap member 25 covering the end portion of the sleeve 21.

Under the arrangement thus described, as long as the beaked end of the lever 10 is held in contact with the lower portion *a* of the cam 8, a buttonhole sewing operation is rendered ineffective and only the sewing of decorative seams is performed by means of the zigzag sewing mechanism. For the switchover from ordinary zigzag sewing to buttonhole sewing operation, the cam unit mounted on the shaft P is released from engagement with the cam-follower lever R to render the lever R inoperative and thereafter, the manipulating lever 20 is rotated to bring the first shoulder portion *b* of the cam 8 into contact with the beaked end of the lever 10, whereupon the latter is caused to swing upwardly. This swinging motion of the lever 10 is transmitted by means of the slidable rod 11 operatively connected thereto and the hooked member 14 engaging the protrusion 16 of the rod 11 to the swingable plate means 13 to swing the latter slightly, thereby influencing the zigzag-motion generating mechanism to adjust the amplitude or volume of oscillation of the oscillator H to the desired degree for buttonhole sewing. The adjusted oscillating motion of the oscillator H will be transmitted to the needle bar L by means of a connecting rod M operatively connected with both the oscillator H and the needle bar L, to perform zigzag sewing of one border, for example, the left-hand border of a buttonhole.

During the above sewing operation, the feeding mechanism is set in a position for forward feeding, and as soon as the sewing of the left-hand border *e* is completed, the manipulating lever 20 is rotated to bring the high portion *c* of the cam 8 into contact with the beaked end of the lever 10, whereupon the latter is caused to swing largely. This swinging motion of the lever 10 is transmitted by means of the slidable rod 11 and the hooked member 14, as already described, to the swingable plate means 13 to swing the latter largely, influencing the zigzag-motion generating mechanism to adjust the volume of oscillation of the oscillator H to a large extent, the said adjusted motion being transmitted to the needle bar L, causing it to shift its position from the left-hand side of the buttonhole to the right-hand side, to effect a barring stitch *f* at the lower terminal end of the buttonhole. Since the material is being fed in forward direction, the barring stitching will be effected several times.

Upon completion of the barring stitches at the lower terminal end, the manipulating lever 20 is rotated again to bring the second shoulder portion *b'* of the cam 8 into contact with the beaked end of the lever 10 and at the same time, the spring means 5 presses the protrusion 7 of the feed regulator member 6 to rotate the latter, whereupon the bifurcated rod V is changed to its reverse feeding position. Simultaneously, the arm piece 2 provided on the control shaft 1 is moved to press the slope 26 of the operating arm 4 to swing the latter, where-

upon the movable arm F pivotally mounted on the axis 3 is caused to swing about the pivot axis 3, thereby shifting the pivot point G of the oscillator H at which it is pivotally secured to the movable arm F. By the shifting of the pivot point G which determines the center-line of zagzag seam, the center-line of zig-zag seam is shifted, which means that the needle bar L is shifted to the outer edge of the opposite side of the buttonhole.

With the material being fed in backward direction, the zigzag sewing of the right border of the buttonhole is performed in the same manner and in the same seam width as done before when the lever 10 was held in contact with the first shoulder portion *b* of the cam 8. Upon completion of zigzag seam *g* for the right border of the buttonhole the manipulating lever 20 is rotated in reverse direction to bring the high portion *c* of the cam 8 back into contact with the beaked end of the lever 10, whereupon the needle bar L is caused to effect several barring stitches *h* at the upper terminal end of the buttonhole in the same manner as done before for the lower terminal end, thus completing the whole buttonhole sewing operation.

According to the present invention, the width of buttonhole seam and the distance from the edge of a seam on one side of a buttonhole to the edge of a seam on the opposite side thereof can be adjusted, for the sewing of buttonholes of various sizes. This unique function is accomplished by first turning the handle 24 secured to the rotatable bushing 22. Upon rotation of the bushing 22, the control shaft 1 disposed eccentrically in the former is moved up and down, causing the cam 8 and arm piece 2 mounted thereon to move up or down, whereupon the position of the cam 8 in relation to the pivot axis 9 of the lever 10 is shifted farther or nearer, thereby varying the amplitude of the swinging motion of the lever 10 engaging therewith. The change in the amplitude of this swinging motion results in a variation in the amplitude of the operative motion of the zigzag-motion adjusting means and hence the amplitude of the swinging motion of the oscillator H forming a part thereof, whereupon the width of zigzag seam is adjusted to various degrees.

On the other hand, when the arm piece 2 is moved up or down, the position of its engagement with the operating arm 4 for center-line shifting is shifted up or down, varying the amplitude of the swinging motion of the operating arm 4, whereupon the amplitude of shifting of the centerline is adjusted accordingly.

I shall now describe in further detail the operations of the abovementioned elements. When the handle 24 is turned upward, the control shaft 1 and hence the cam 8 and the arm piece 2 move upward, whereupon the beaked end of the lever 10 is pressed upward. The swinging motion of the lever 10 in its upwardly adjusted position causes the slidable rod 11 to move backward by a long distance, which then actuates the swinging movement of the swingable plate means 13 by means of the hooked member 14 connected therewith. By the swinging motion of the plate means 13, the amplitude of the operative motion of the zigzag-motion generating mechanism is adjusted and the amplitude of the swinging motion of the oscillator H is made greater to produce a zigzag seam of large width.

On the other hand, by the simultaneous upward movement of the arm piece 2, the position of the contact of the said arm piece 2 with the spread-out slope 26 of the arm 4 is shifted upward, thereby swinging the arm 4 largely about the axis 3, whereupon the movable arm F rigidly fixed to the upper end of the axis 3 is caused to swing largely about the axis 3. With the swinging movement of the movable arm F, the position of the pivot point G at which the oscillator H is pivotally secured to the arm F is shifted and thus, the center-line of zigzag movement is shifted by a long distance from the left-hand side of the buttonhole to the right-hand side. Herein lies the reason

5

why the present improved mechanism is suitable for the sewing of large buttonholes.

Next, when the handle 24 is turned downward, the control shaft 1 and hence the cam 8 and the arm piece 2 mounted thereon move downward as shown in FIG. 8, whereupon the lever 10 cooperable with the cam 8 and also the operating arm 4 contacted by the arm piece 2 are caused to move in a manner opposite to that when the handle 24 was turned upward, thereby contracting the amplitude of zigzag motion and also the amplitude of center-line shifting motion, which naturally results in a diminution of the distance from the edge of a seam on one side of a buttonhole to the edge of a seam on the opposite side. Herein lies the reason why the present improved mechanism is suitable also for the sewing of small buttonholes.

Regarding the shifting of the center-line of a seam in the above operation, since the slope 26 of the operating lever or arm 4 engaged by the arm piece 2 is widened towards its lower end, the amplitude of the swinging movement of the operating arm 4 when the arm piece 2 engaged the lower portion of the slope 26 differs from that when the tip of the arm piece 2 engaged the upper portion of the slope 26. In other words, the volume of the swinging movement of the operating arm 4 varies exactly according to the difference in height between the upper and lower portions of the slope 26 where the tip of the arm piece 2 contacts. It will thus be known that the volume of the shifting of the center-line varies by the difference in height between the upper and lower portions of the slope 26.

As described herein, by the manipulation of the handle 24, which actuates the rotation of the rotatory bushing 22, the control shaft 1 supported in the hole provided eccentrically in the said bushing 22 is moved up or down, actuating similar movements of the cam 8 and the arm piece 2 mounted on the shaft 1 to enlarge the width of zigzag seam and the distance from the seam on one side to the seam on the opposite side for the sewing of large buttonholes and to diminish the seam width and distance for the sewing of small buttonholes. This unique function makes the present invention the most ideal of all for buttonhole sewing operation.

Having thus described the nature of my invention, what I claim herein is:

In a zigzag sewing machine of the type having a frame, a reciprocating and swingable needle bar, a reversible material feeding means, a drive shaft for reciprocating said needle bar and driving said feeding means, mechanism driven by said drive shaft for swinging said needle bar to provide a zigzag stitch and means to adjust the amplitude of swinging movement of said needle bar to vary the width of the stitch, a buttonhole sewing device

6

comprising an eccentric bushing rotatably mounted on said frame, a finger-engaging knob on said bushing, a control shaft rotatably mounted in said bushing, a cam fixed on said control shaft, first, second, third and fourth lobes on said cam, a finger engaging knob fixed to said control shaft, a cam follower lever engaging said cam, linkage means connecting said lever and said amplitude adjusting means, an arm fixed to said control shaft, a second lever having a beveled surface thereon disposed in the path of movement of said arm, means connecting said second lever and said swinging mechanism, whereby upon rotation of said bushing to move the axis of said control shaft, the effective length of said follower lever will be varied to vary the degree of adjustment of stitch width and the point of engagement of said arm with said beveled surface will be changed to vary the degree of change of the stitch center line upon rotation of said control shaft to certain positions to change the stitch center line, and means connecting said control shaft and said feeding means to reverse the direction of feed upon rotation of said control shaft to certain positions, whereby with said follower lever engaging said first lobe said machine will sew a conventional zigzag stitch, upon rotation of said control shaft to engage said follower lever with said second lobe said machine will sew a wider zigzag stitch for one side of a buttonhole seam, upon rotation of said control shaft to engage said follower lever with said third lobe and change the stitch center line said machine will sew a still wider zigzag barring stitch at one end of said button hole seam, upon rotation of said control shaft to engage said follower lever with said fourth lobe, reverse the direction of feed and further change the stitch center line said machine will sew a zigzag stitch corresponding to said first mentioned wider stitch in the reverse direction for the opposite side of said buttonhole seam and upon reverse rotation of said control shaft to again engage said follower lever with said third lobe and change the stitch center line to the first changed position said machine will sew a zigzag barring stitch at the opposite end of said buttonhole seam corresponding to said first mentioned barring stitch.

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