United States Patent

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[54] **ZIGZAG SEWING MACHINE WITH A CONTROL DEVICE FOR VARYING THE OVERSTITCH WIDTH**

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[52] **U.S. Cl.**.....**112/158 R**

[51] **Int. Cl.**.....**D05b 3/02**

[58] **Field of Search**.....112/158 R, 158 A, 158 C, 158 B

[56] **References Cited**

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[57] **ABSTRACT**

In a zigzag sewing machine, the overstitch width is varied by a control device, the device includes a needle bar frame being oscillatable about an axis on the machine and reciprocably supporting a needle bar therein, a negative cam means is secured on the main drive shaft and engages said needle bar frame, a tape means running in the device has a number of series of variable number of perforations and a series of varying length follower means on said needle bar frame is engageable said series of perforations facing the follower means so that the fall of the needle bar frame is limited in proportion to the number of perforations in said series facing the follower means.

5 Claims, 6 Drawing Figures

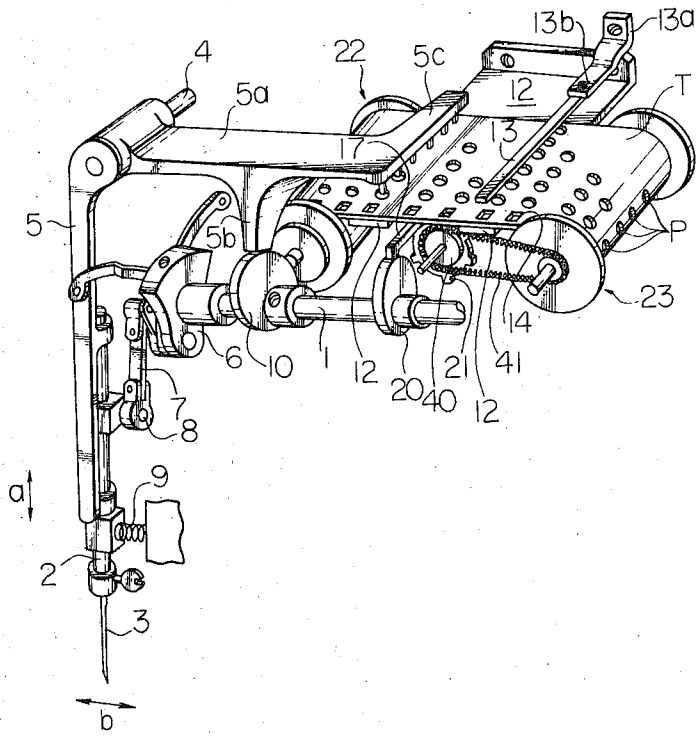


Fig. 1

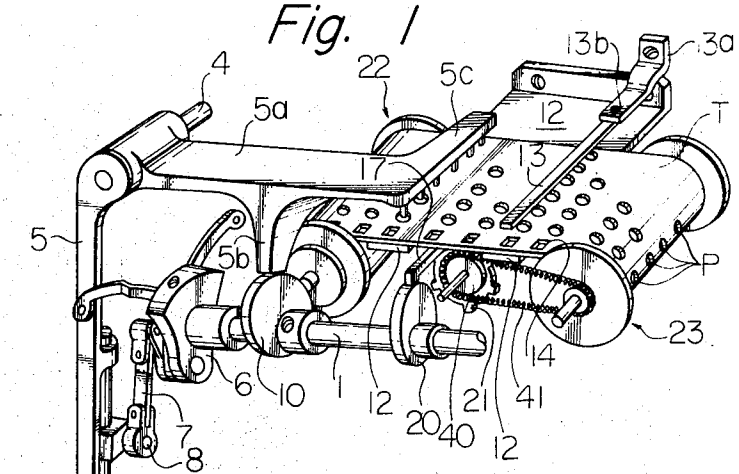


Fig. 3

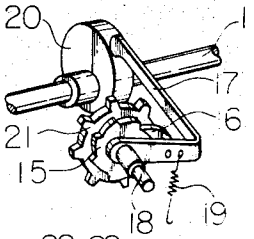


Fig. 2

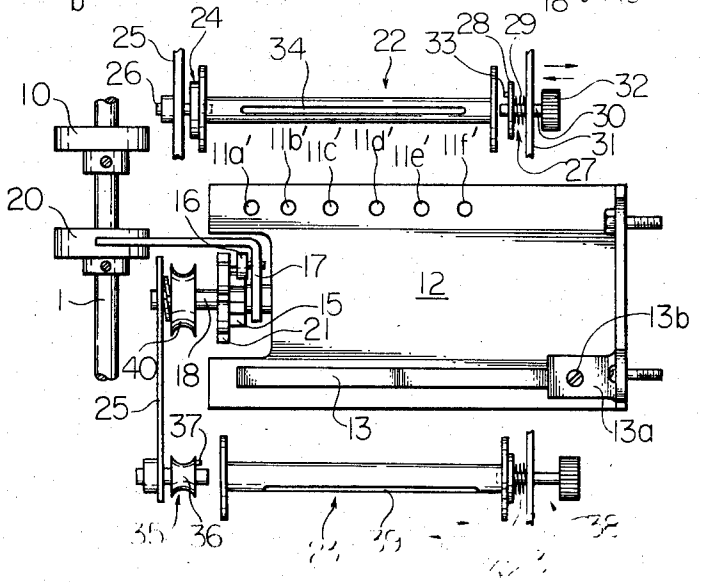


Fig. 4

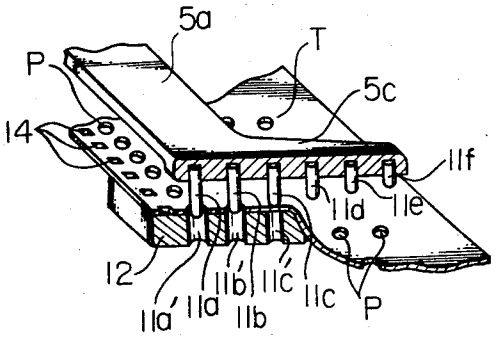

5a
T
P
5c
14
11f
11d
11e
12
11b'
11c'
11c
P
11a'
11a
11b

Fig. 5

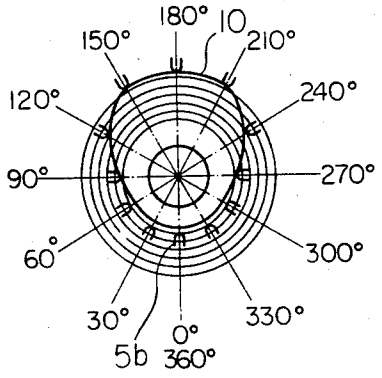
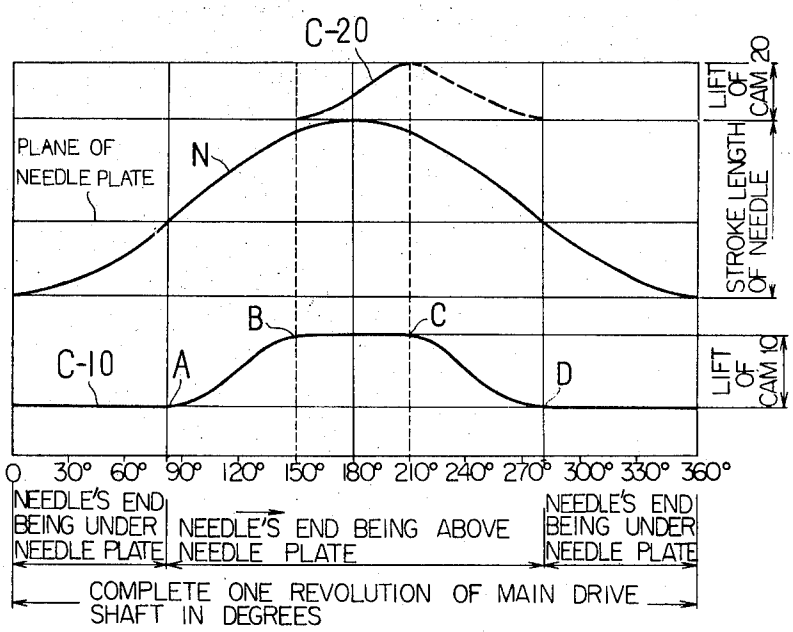

180°
10
150°
210°
120°
240°
90°
270°
60°
300°
30°
330°
0°
5b
360°

Fig. 6



CURVES WHICH SHOW THE RELATIONSHIP BETWEEN CAM 10, CAM 20 AND NEEDLE MOVEMENT

ZIGZAG SEWING MACHINE WITH A CONTROL DEVICE FOR VARYING THE OVERSTITCH WIDTH

BACKGROUND OF THE INVENTION

This invention relates to a control device of zigzag sewing machines and more particularly to a device for controlling the zigzag stitch oscillations of the sewing machines to vary the overstitch width.

In the design of mechanisms to obtain needle zigzag oscillations of the machines, cams are frequently employed. Even though the cams might make it possible to obtain an endless variety and irregularity of zigzag needle oscillations according to their inherent general function, a large number of types of cams are needed for the application of resultant stitch patterns which might vary in the commercial fields. This deficiency is considered as a great disadvantage, in that it is desired for most applications to easily vary the forms of resultant zigzag stitch patterns and problems arise when many types of cams are necessary to meet the requirements in commercial fields. Further each cam surface must be very accurately finished in its production. Still further, in case where a large number of different stitches are sewn in one cycle of an ornamental zigzag stitch pattern, the cam to be employed must be so designed as to have a larger diametrical size. There are, to be sure, difficulties in designing such sewing machine as would be capable of accepting a cam of large size within the space of the hollow arm of the sewing machine.

Solutions to overcome the foregoing disadvantages are contemplated by the present invention.

SUMMARY OF THE INVENTION

Accordingly it is a principal object of the present invention to provide a control device for zigzag sewing machines capable of automatic sewing of zigzag stitches no matter what number of different stitches may be desired in one cycle of zigzag stitch pattern. In the control device the cam mechanism is not used alone but is used with a tape or a series of cards or the like having a number of series of perforations of varying number, to control the needle zigzag oscillation; by which any number of different zigzag stitches may be obtained readily and even instantly whatever complicated stitch patterns may be required; and which is of simple structure as well as efficient resulting in substantially savings in the manufacturing cost.

Another object of the present invention is to provide a sewing machine for making ornamental zigzag stitches, in which the stitch formation is effected by simple, conveniently accessible, and easily adjustable parts.

With these and other objects in view, the control device of the present invention includes needle bar frame means mounted for oscillation at right angle to the work feeding direction about a fixed pivot or spindle supported by the frame of the machine, needle bar means carrying a sewing needle and mounted for reciprocation in said needle bar frame means, negative cam means mounted upon a main drive shaft and being in direct contact with said needle bar frame, so as to oscillate said frame toward the cam surface, device including tape means having series of perforations arranged and spaced in line substantially perpendicular to the lengthwise direction of said tape means, said series of perforations varying in number of perforations for varying the overstitch width, follower means so secured and arranged in a series on said needle bar frame means as to engage with the perforations in the series facing said follower means, and tape feeding means to intermittently advance said series of perforations to a position facing said follower means to effect limitation of returning movement of said needle bar frame means.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a control device for zigzag sewing machines, being constructed in accordance with the principles of the invention;

FIG. 2 is a fragmentary plan view illustrating the tape feeding means of the device of FIG. 1;

FIG. 3 is a fragmentary perspective view illustrating the tape feeding mechanism of the device of FIG. 1;

FIG. 4 is a detail fragmentary view and more clearly showing the follower means of the control device of FIG. 1;

FIG. 5 is a diagram of a cam used in the device of FIG. 1, showing construction or development of the motion of the follower means; and

FIG. 6 is a graph illustrating relationship between the cams and the motion of the needle of the machine in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention will be illustrated in the form it may take when applied to a well-known and conventional zigzag sewing machine.

Now referring to the drawing, FIG. 1, the numeral 2 denotes the needle bar of conventional zigzag sewing machine carrying a sewing needle 3 and mounted for reciprocation in the vertical direction in needle bar frame or holder 5, as indicated by the double arrow *a*, said frame being in turn mounted for oscillation at right angle to the work feeding direction about a fixed pivot or spindle 4 supported by the frame of the machine, as indicated by the double arrow *b* in the drawing. The reciprocation of the needle is effected in a known manner by coupling of the needle bar 2 with the main drive shaft or arm shaft 1 of the sewing machine via a crank 6, link 7 connected to a journal pin 8 afixed to the bar 2. The needle receives a thread from any suitable spool through the necessary tensions and feed pick-ups, which need not be specifically designated here. Anchored to the frame 5 is one end of a compressed spring 9 whose opposite end is in turn anchored to a suitable stationary part of the frame of the sewing machine. The bar frame 5 has an arm 5*a* extending at about right angles to the vertical frame 5 as illustrated. In the lower surface of the arm 5*a* is formed or secured a projection 5*b* normally urged by the spring 9 into contact with a cam 10 secured to the main drive shaft 1 of the sewing machine. As will be noted from the preceding, the frame 5 is oscillated as indicated by the arrow *b* by cam 10 and under the influence of the spring 9 as the main drive shaft 1 rotates in synchronism with the vertical reciprocation of the needle bar 2 which is effected by the driving shaft 1 via the crank 6, link 7 and the journal pin 8. The arm 5*a* has a portion 5*c* extend-

ing at right angles to the axis of the main drive shaft **1**. The portion **5***c* is provided on its lower surface with a plurality of pins, in this instance six pins, from **11***a* to **11***f* as clearly shown in FIG. **4**. The pins differ in length and are so arranged that the closer the pins are to the front edge of the tape T in FIG. **1**, the longer will be their length perpendicularly to the lengthwise direction of the tape. The first pin **11***a is longer than the next pin 11b*, the said next pin **11***b* longer than the third pin **11***c*, and so on, to the last pin **11***f*. All pins differ equally, in this instance, in length as compared with the preceding one. By this, the height of fall of the follower arm **5***a* is determined in every falling motion as will be described hereinbelow. A base plate **12** is mounted on a stationary part of the machine and is provided with a series of accurately spaced holes **11***a'* to **11***f'* Each hole a diameter large enough to permit the corresponding pin to pass therethrough without any frictional resistance against the pins. A tape T runs over two reels **22** and **23** in sliding relation with the surface of the base plate **12**.

A presser bar **13** is mounted so as to press the tape against the base plate **12** in a manner such that the tape can slide on the surface in feeding operation of the feed mechanism to be described. The presser bar **13** is bracket **13***a* secured to the frame of the machine with a set screw **13***b* or similar releaseable securing means for that purpose, so that the bar can be rocked sufficiently to permit the tape together with the reels to be moved into or withdrawn from the setting position. The bar serves to prevent the tape from disengagement from the sprocket wheel **21** during the operation as will be described as the description proceeds.

A tape feeding device shown in FIG. **3** consists of ratchet wheel **15**, a pawl **16**, and an arm or lever **17** to which the pawl is rotatively attached. The arm **17** is free to rotate on a shaft **18** through a fractional part of revolution with its angularly bent end urged by the spring **19** into engagement with the cam **20** secured on the main drive shaft **1**. The shaft **18** supports in integral relation therewith both the ratchet wheel **15** and sprocket wheel **21** having teeth which engage with accurately spaced perforations **14** at one side edge of the tape T. Any backward rotation of the ratchet wheel **15** is prevented by the presser bar **13** via the tape T when the pawl **16** simply lifts and slides over the point of the teeth without transmitting motion to the ratchet wheel. The pawl **16** may be held in engagement with the ratchet teeth either by the action of gravity alone or a conventional spring (not shown) may be used to increase the contact pressure. Just back of the sprocket wheel **21** in FIG. **3** is fastened a grooved pulley **40** shown in FIG. **1** integral with the sprocket wheel **21**.

The tape T advances from a let-off reel **22** over the base plate **12** to the take-up reel **23** to be wrapped thereon, as the sprocket wheel **21** intermittently rotates. As will be seen in FIG. **1**, the tape has a number of other series of perforations P, in each of which series the perforations are equally spaced on a straight line perpendicular to the lengthwise direction of the tape, and the perforations precisely correspond in position and in diametrical size to the holes **11***a'* to **11***f'* of the base plate **12**. The series of perforations P differ as to the number in dependency upon the variety of the overstitch width. However, the first perforation of each series is positioned axially in alignment with the first perforations of the other series, so that the last perforation of each series is not in alignment with the last perforations of all the other series.

Referring to FIG. **2**, let-off reel generally indicated by the reference character **22** is supported at its ends by a pair of retainers **24** and **27**. The retainer **24** is rotatively supported on the stationary part **25** of the frame of the machine, the shaft **26** of which slightly extends beyond a flange of the reel into the hollow axis of the reel. The opposite retainer **27** is of well known construction somewhat like that of popular film reeling mechanism of the usual camera. The flange **28** secured on the shaft **30** of the retainer **27** bears on one side face against a compressed spring **29**, the other end of which bears the wall of the frame **31** of the machine. The shaft extends beyond the wall of the frame **31** and carries at its end a knob **32** to manually rotate or pull the retainer to the right against the spring **29** when the reel is to be engaged with or withdrawn from the retainers. The shaft **30** also slightly extends in its operative position into the hollow shaft of the reel so that the reel **22** is free to rotate relative to the frame under frictional force derived from the spring **29**. The reel **22** can be withdrawn from the retainer by pulling the knob **32** to the right as indicated by the arrow in FIG. **2**. The projection **33** formed in the flange **28** of the retainer **27** is normally urged into engagement with a recess or small hole (not shown) formed in the flange of the reel by the spring **29** so that the reel may be rotated by manually rotating the knob **32** to adjust the tension of the tape T. When the knob **32** is pulled toward the right as indicated by the arrow in FIG. **2**, against the spring **29**, the retainer **27** disengages from the reel and the reel can be drawn out of the two retainers. The numeral **34** refers to a well known slot used in this type of reel for inserting the end of the tape.

Other retainers **35** and **38** are provided to retain the take-up reel **23**. The retainer **35** is of the same construction except grooved pulley **36** and a pin **37** are secured thereon. The other retainer **38** is of identical construction with that of the retainer **27**. The reel **23** can be set into or drawn out of the two retainers **35** and **38** in the same manner as the reel **22**. The numeral **39** also refers to a slot similar to that of the reel **22**. The projection of pin **37** of the grooved pulley **36** normally engages with a recess (not shown) in the flange of the reel **23** by the action of spring **42** so that the reel may be rotated when the grooved pulley **36** is driven. When the reel is pulled to the right against the spring **42**, the reel may be disengaged from the recess and the recess may be adjusted relative to the projection **37**. The grooved pulley **36** is mounted on the shaft of the retainer **35** and the other grooved pulley **40** is mounted on the shaft **18** of the tape feeding device and rotates together with the sprocket wheel **21** so as to transmit rotation to the pulley **36** through a spring belt **41** running over the two pulleys. The two pulleys differ as to their diametrical size. As will be seen, the pulley **40** is diametrically greater than the pulley **36**. Although the tape is fed a predetermined amount each time it is moved by the sprocket wheel **21** its accurately spaced perforations **14** meshed with the teeth of the sprocket wheel **21**, the coil on the take-up reel increases its diametrical size as the operation proceeds. While upon the other hand, the spring belt **41** travels a predeter-

mined amount each time it is moved, in synchronism with the tape, regardless of the diametrical enlargement of the coil. It will be noted that the diametrical sizes of the two pulleys must be so designed that the amount the belt is moved each time is always greater than the amount of surface movement of the grooved pulley **36**. By this design, the tape T is always held in tensioned condition during the operation between the presser bar **13** and the take-up reel **23** as the frictional force of the belt enables slipping of the belt on the pulleys.

During operation of the sewing machine, the needle **3** is vertically reciprocated by the main drive shaft **1** via the crank **6** and the needle bar **2**. The frame **5** is given positive motion by the cam **10** to the right in FIG. **1**, While it returns to the left relying upon the spring **9**. The term "negative cam" used herein refers to the cam by which its follower member is positively moved toward the cam surface but returns in the reverse direction relying upon gravity alone or a spring. The returning motion is governed by the number of perforations P in a series which may have been positioned just under the series of the pins of the portion *5c*. It will be noted that returning movement of the needle bar is governed thus by the number of perforations P in a series which may have been positioned just under the series of the pins. The overstitch width of the resultant ornamental stitch pattern is thus controlled by the perforations in such series. It will otherwise be noted that indentation of the end of each series of perforations will be just reflected in the resultant zigzag stitch pattern.

By taking in consideration differences of the number of perforations between the series, any number of different combinations of the series may be obtained whatever the requirement may be. Simplicity of construction without use of the cam mechanism and a large number of possible forms of ornamental stitch are the advantages of the invention. When possibility of combination of the varied series of perforations is considered, it will be apparent that the total number resulting is very large.

By using a suitable punching machine somewhat like the so-called "piano machine" customarily used in the textile weaving art, the tape may readily be prepared. This punching machine is not for the contemplation of the present invention and therefore will not be described so much.

Referring to the FIG. **5**, the cam **10** is so designed that there are alternately one stop and one feed of the tape per revolution of the main drive shaft. The feeding means is so timed that the tape advances by one pitch of the perforations **14** for every vertical reciprocation of the needle. The construction or development of the motion of the arm *52* is worked out in FIG. **5**. The method is based upon keeping the cam **10** stationary and revolving the projection *5b* about it, as in planetary gearing, determining the relative progress of the extremity end of the projection *5b* by plotting the corresponding positions located 30° apart which thus outline the proper shape of the cam **10**.

FIG. **6** is a graph illustrating the relationship between cam lifts of the cam **10** and cam **20** and the motion of the needle, in which one complete turn of 360°, of the main drive shaft is plotted as the abscissa and the stroke of the needle and lifts of the two cams **10** and **20** are all plotted as the same ordinate but in different positions respectively. As will be seen, the lifts of the cams **10** and **20** are respectively illustrated along the line C-**10** and line C-**20** and the stroke of the needle along the line N. The rise of the arm *5a* is commenced at the point A just corresponding to the retraction of the needle from the fabric. Between the point B and the point C the arm *5a* is maintained at a position above the tape T to keep the lower end of the longest pin **11**a above the plane of the tape T. During such dwell of the pins, the tape feeding mechanism operates to advance the tape by one pitch of the series of perforations **14**. The rise of the lever **17** must be defined between also the point A and point B. The point D, bottom of the rise of the arm *5a*, corresponds to the position of the needle just prior to penetrating the fabric. With aid of marks located onto abscissa at regular intervals of 30°, the relationship can be seen between the revolution of the main drive shaft and the movements of the arm *5a* and the arm **17**.

The cam **20** will be found from the preceding capable of being designed in a similar manner to that of the cam **10** and need not be specifically described here.

What is claimed is:

1. In a zigzag sewing machine including controlling means to vary the width of overstitch comprising in combination, a fixed pivot, needle bar frame means mounted on said pivot for oscillation at right angles to the work feeding direction, needle bar means mounted for reciprocation in said needle bar frame means, a sewing needle mounted on said needle bar means, a main drive shaft for reciprocating said needle bar means, a negative cam means mounted on said drive shaft for oscillating said needle bar frame means, tape means having a plurality of series of perforations each series having at least one perforation and each series of perforations being substantially perpendicular to the lengthwise direction of said tape means, a plurality of follower means of different length mounted on said needle bar frame means over said tape means to engage with that series of perforations in said tape means located under said follower means to limit the oscillation of said needle bar frame means, and means for intermittently advancing said tape means to successively position each series of perforations under said follower means whereby the return oscillating movement of said needle bar frame means is limited thus controlling the width of the overstitch.

2. A zigzag sewing machine as claimed in claim **1** wherein said needle bar frame means includes an arm extending therefrom, said follower means being mounted on the underside of said arm for engagement with that series of perforations disposed immediately under said follower means.

3. A zigzag sewing machine as claimed in claim **1** wherein said means for intermittently advancing said tape means includes a cam mounted on said main drive shaft, a lever actuated by said cam, a pawl means rotatably mounted on said lever, a ratchet wheel cooperating with said pawl for intermittent rotation thereby, a sprocket wheel rotatable with said ratchet wheel, said tape means having spaced perforations at the edge thereof meshing with said sprocket wheel for intermittently advancing said tape means when said cam is rotated by said main drive shaft.

4. A zigzag sewing machine as claimed in claim 1 wherein said plurality of follower means includes a series of pins arranged in a line substantially perpendicular to the lengthwise direction of said tape means.

5. A zigzag sewing machine as claimed in claim 1 and further comprising a let-off reel and a take-up reel for said tape means, retainer means for each reel and means cooperating with each retainer means for permitting manual rotation of each reel to adjust the position of said tape means.

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