May 8, 1962 TOSHIO TATEISHI 3,033,139

STITCH FORMING MECHANISM OF LOCK-STITCH SEWING MACHINE FOR ZIGZAG SEWING

Filed Oct. 24, 1958 6 Sheets-Sheet 1

Fig. 1.
PRIOR ART

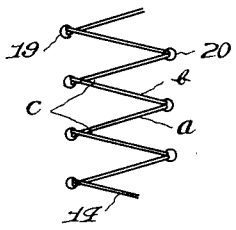


Fig. 2.
PRIOR ART

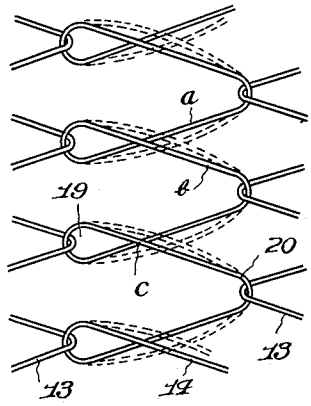


Fig. 3.
PRIOR ART

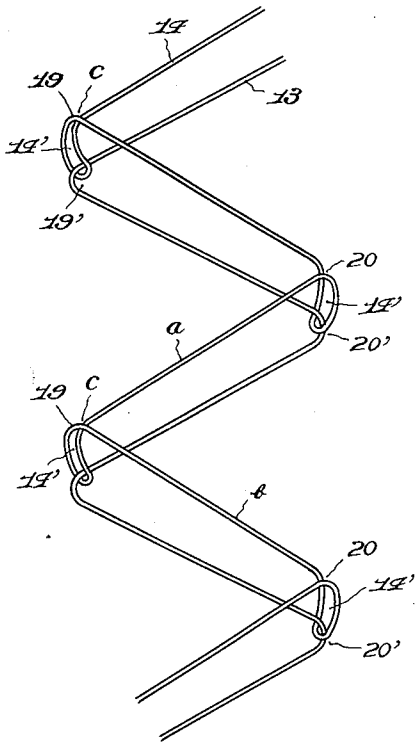
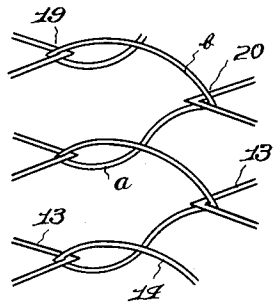


Fig. 4.
PRIOR ART



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STITCH FORMING MECHANISM OF LOCK-STITCH SEWING MACHINE FOR ZIGZAG SEWING

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Fig. 5.
PRIOR ART

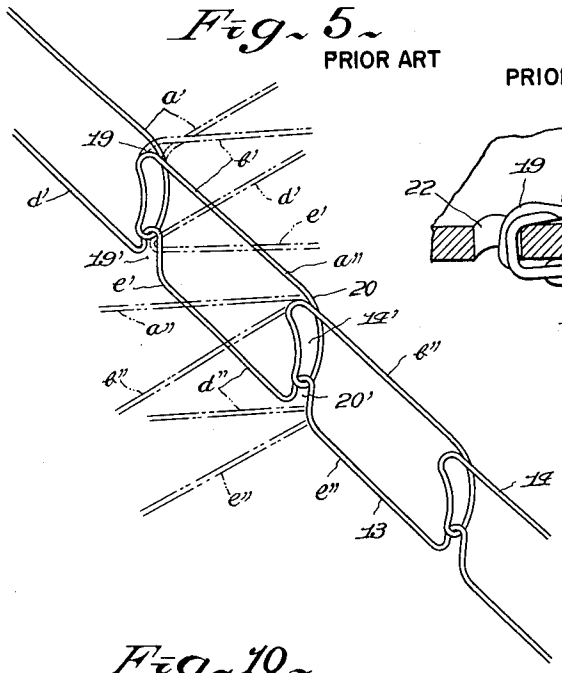


Fig. 6.
PRIOR ART

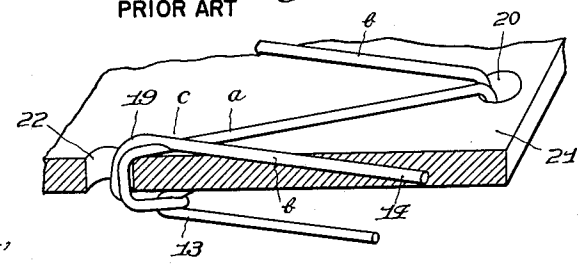


Fig. 7.

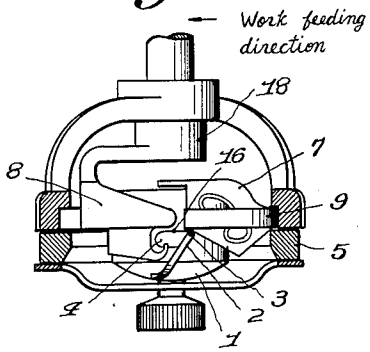


Fig. 10.

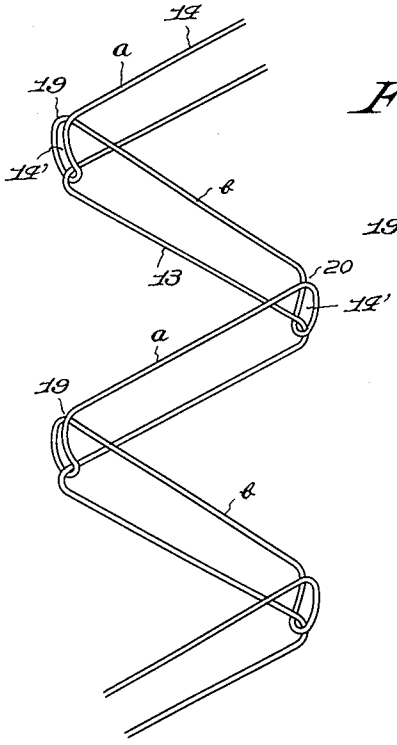


Fig. 9.

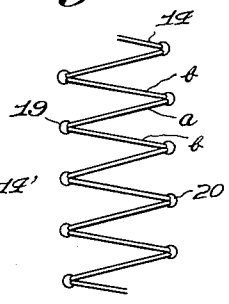
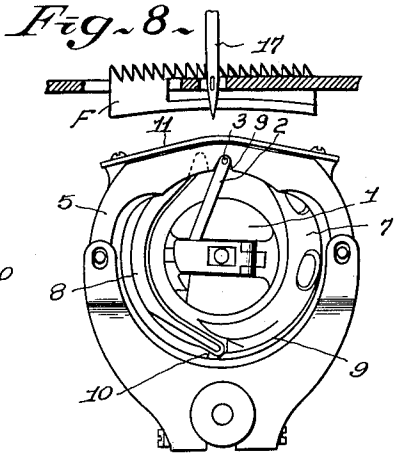


Fig. 8.



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STITCH FORMING MECHANISM OF LOCK-STITCH SEWING MACHINE FOR ZIGZAG SEWING

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Fig. 11(a)

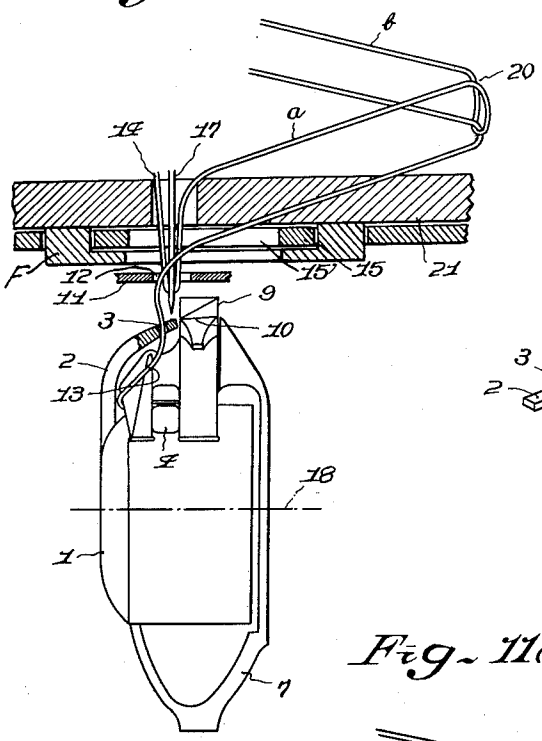


Fig. 11(b)

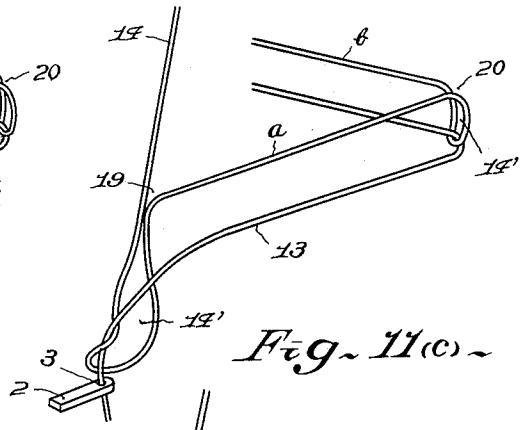


Fig. 11(c)

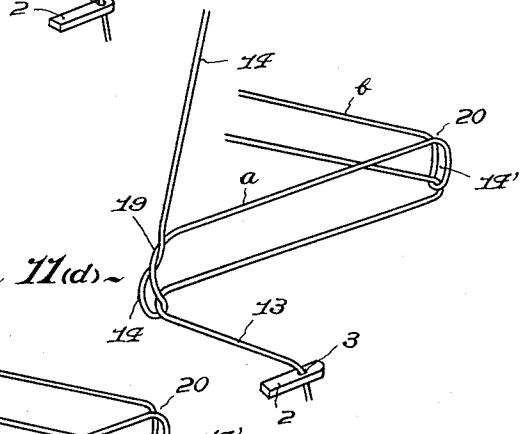


Fig. 11(d)

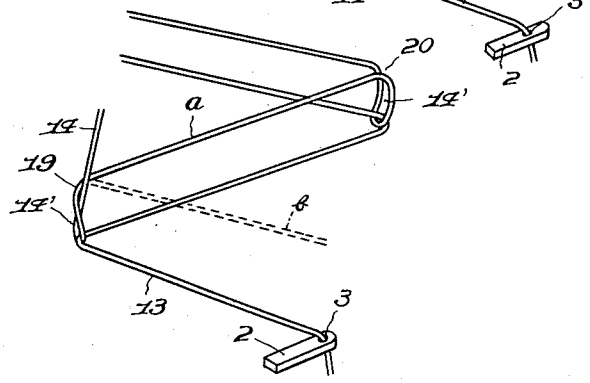
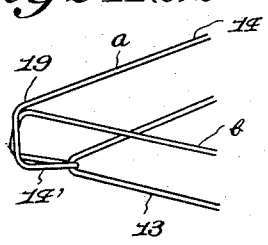


Fig. 11(e)



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STITCH FORMING MECHANISM OF LOCK-STITCH SEWING MACHINE FOR ZIGZAG SEWING

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Fig. 12 (a)

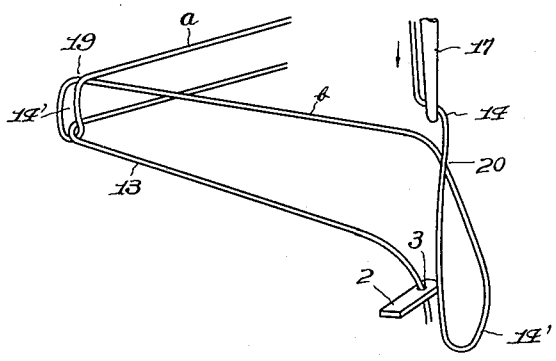


Fig. 12 (b)

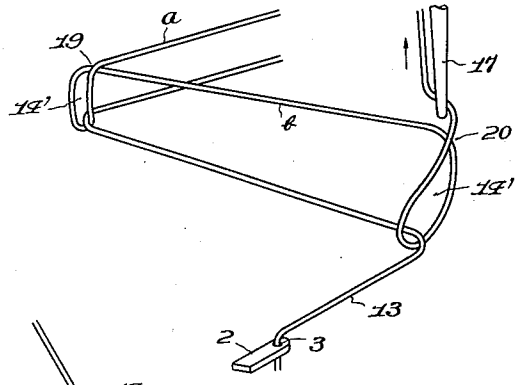
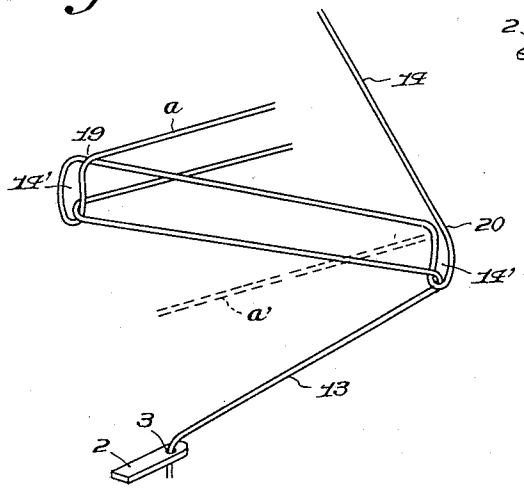


Fig. 12 (c)



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STITCH FORMING MECHANISM OF LOCK-STITCH SEWING MACHINE FOR ZIGZAG SEWING

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Fig. 13.

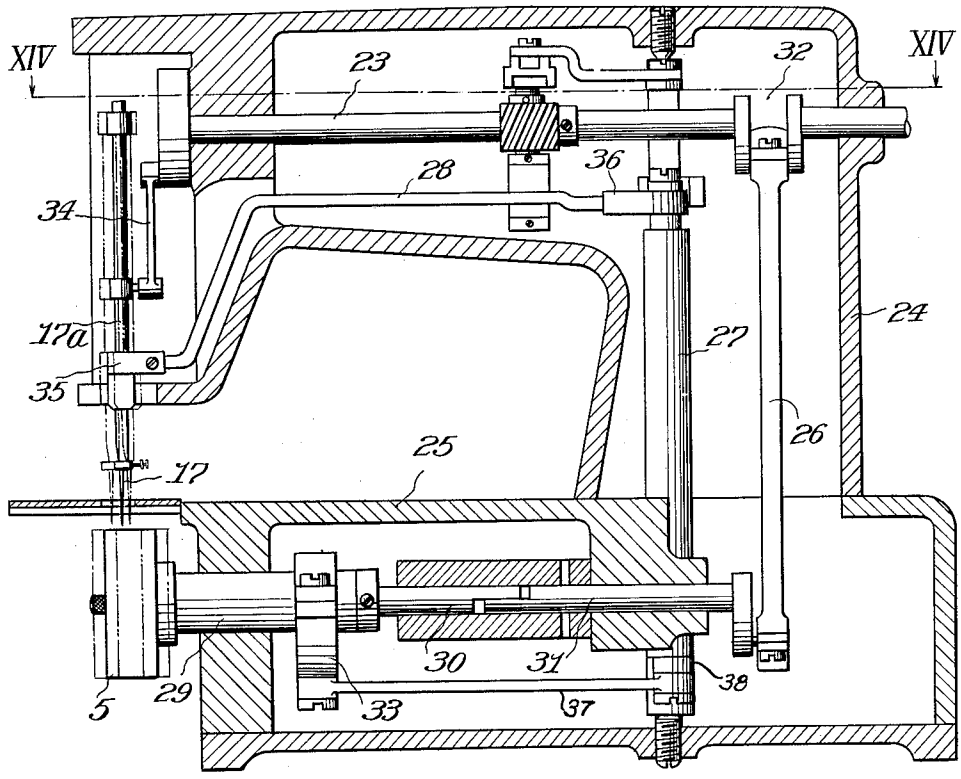
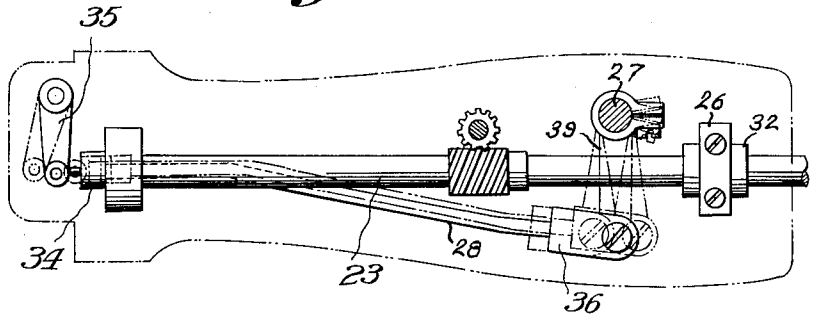


Fig. 14.



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STITCH FORMING MECHANISM OF LOCK-STITCH SEWING MACHINE FOR ZIGZAG SEWING

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Fig. 15(a)

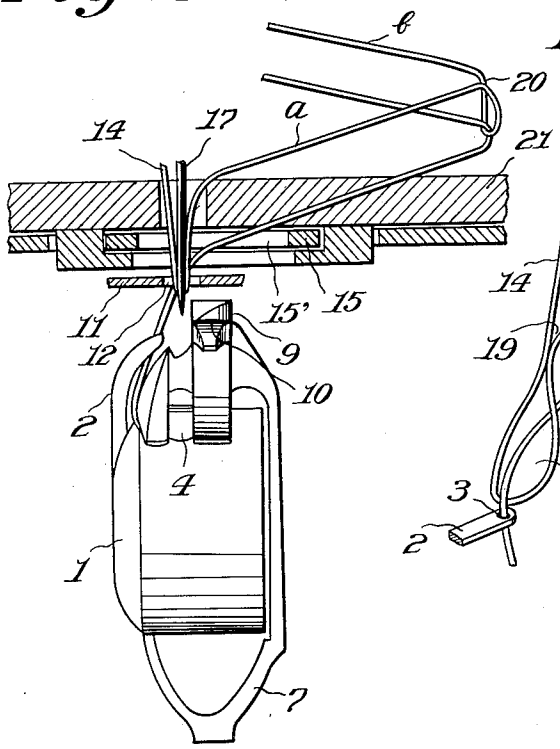


Fig. 15(b)

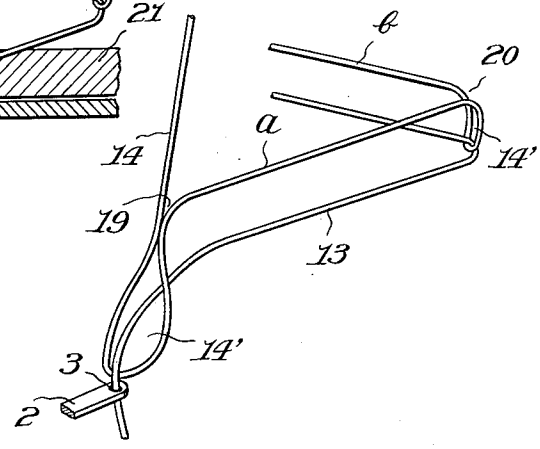


Fig. 15(c)

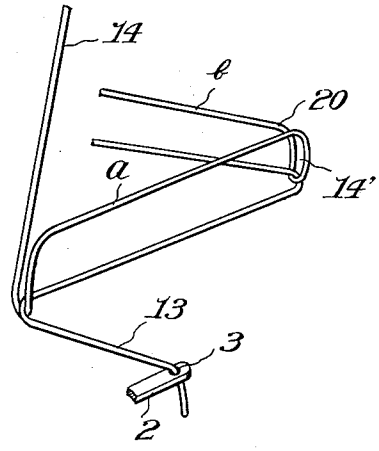
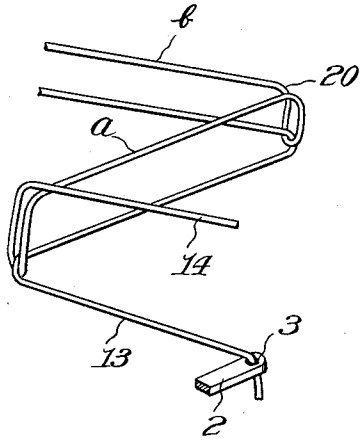


Fig. 15(d)



United States Patent Office

3,033,139

Patented May 8, 1962

3,033,139

STITCH FORMING MECHANISM OF LOCK-STITCH SEWING MACHINE FOR ZIGZAG SEWING

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Filed Oct. 24, 1958, Ser. No. 769,508
Claims priority, application Japan Oct. 31, 1957
5 Claims. (Cl. 112—159)

This invention relates to an improved stitch forming mechanism of a lock-stitch sewing machine for zigzag sewing.

An essential object of this invention is to provide a lock-stitch sewing machine for zigzag sewing which can carry out effective zigzag sewing without forming unsightly cross points between the needle thread and bobbin thread.

With the above and other objects in view, as will hereinafter appear, the invention comprises the devices, combinations and arrangements of parts hereinafter set forth in connection with the accompanying drawings from which the working of a preferred embodiment of this invention and the advantages attained thereby will be readily understood by those skilled in the art.

Referring to the drawings, the same or similar parts are indicated by the same reference characters and in which:

FIG. 1 is a plan view of zigzag seams obtained by a conventional sewing machine;

FIG. 2 is an exaggerated view of the seams shown in FIG. 1;

FIG. 3 is an enlarged perspective view of the conventional zigzag seams;

FIG. 4 is an enlarged view showing the curved portions of a needle thread at the left and right turning points of completed seams;

FIG. 5 is a perspective view showing the right twisting type sewn seams;

FIG. 6 is a perspective view showing the formation of the seams at the left turning points in a conventional zigzag sewing machine;

FIG. 7 is a plan view illustrating the loop-taker in which a stitch forming mechanism of this invention is incorporated;

FIG. 8 is a side view of the mechanism shown in FIG. 7;

FIG. 9 is a plan view of the zigzag seams obtained by a sewing machine provided with an improved stitch forming mechanism of this invention;

FIG. 10 is an enlarged perspective view of the seams in FIG. 9;

FIG. 11(*a*)–(*e*) are perspective views showing the steps of forming the left side seams in FIGS. 9 and 10;

FIG. 12(*a*)–(*c*) are perspective views showing the steps of forming the right side seams in FIGS. 9 and 10;

FIG. 13 is an elevational view, partly in cross-section, showing the main components of a zigzag sewing machine to which the invention is applied, but with the feeding device being omitted;

FIG. 14 is a view taken along line XIV—XIV of FIG. 13; and

FIGS. 15(*a*)–15(*d*) are perspective views showing the steps of forming the left side turning points of zigzag seams by the conventional zigzag sewing machine in which the seams are formed by reciprocating the needle and loop taker in a lateral direction relative to the work.

In the conventional lock-stitch sewing machine provided with a loop-taker which rotates around a transversal axis which is perpendicular to the work feeding direction or reciprocates around said axis, zigzag sewing is usually carried out by oscillating the loop-taker together with the needle or by shifting the work right and left.

When the seams obtained by said zigzag sewing are viewed from the topside, it will be found that there are cross points *c* which are formed, as shown in FIG. 1, between the inclined portions *a* and *b* of the needle thread 14 at the positions near the left turning points 19, with said thread portion *a* advancing obliquely from a left turning point 19 to the adjacent right turning point 20 and said thread portion *b* advancing obliquely from a right turning point 20 to the adjacent left turning point 19. Such cross points *c* as described above present a very unsightly appearance, as shown exaggerated in FIG. 2. Accordingly, ideal zigzag seams having left and right turning points of regular V-form can not be obtained.

In the so-called satin-stitch, the cross points *c* of the needle thread appear noticeably in the left side seam line of the sewn width, thus reducing materially the value of the so-called embroidering seams.

As a result of my study relating to the cause of the abovementioned cross points of the needle thread, I have come to the following conclusion.

That is to say, in the favorably controlled seams of a straightaway sewing, a loop of the needle thread formed by the loop-taker is first enmeshed with the bobbin thread, and then the needle thread is brought to cross perpendicularly the bobbin thread by the tightening action of said loop caused by the thread drawing action of the take up device as well as by the tension caused by tightening action of the bobbin thread enmeshed with said loop. However, as shown in FIG. 5, loop 14′ of the needle thread 14 formed by the loop-taker is formed in the direction displaced by 90° relative to the sewing direction and the bobbin thread 13 is enmeshed with said loop so as to pass through said loop 14′. Moreover, the thread drawing action of the take up device occurs substantially upward, so that said loop 14′ is tightened without being given any opportunity for displacing toward the direction which is parallel to the sewing direction, whereby such right twisting type seams due to perfect-stitch as shown in FIG. 5 are continuously obtained.

In the case of zigzag-sewing, however, the needle thread 14 and bobbin thread 13 creep at a sharp angle relative to the sewing direction, so that the enmeshing manner of the seams is very different from that of the straightaway sewing. That is, as shown in FIG. 5, the left turning points 19 and 19′ in FIG. 3 correspond, respectively, to the cases in which the portions *a′* and *b′* of the needle thread 14, and the portions *d′* and *e′* of the bobbin thread 13 are, respectively, crossed over each other so as to form such an extremely sharp angle as shown by dot and dash lines between the portions *a′* and *b′* and between the portions *d′* and *e′*. Similarly, the right turning points 20 and 20′ of FIG. 3 correspond, respectively, to the cases in which the portions *a″* and *b″* of the needle thread 14, and the portions *d″* and *e″* of the bobbin thread 13 are, respectively, crossed over each other so as to form such an extremely sharp angle as shown by dot and dash lines between the portions *a″* and *b″* and between the portions *d″* and *e″*. The actual seams formed as described above are shown exaggerated in FIG. 4. Accordingly, the state in which the needle thread 14 creeps without being tightened at its turning points is represented by a curve as shown by dotted lines in FIG. 2. However, in the actual operation, each seam at the left turning point 19 is completed by tensioning the loosened inclined thread portion *a* coming from the right turning point 20. In the same manner as above, each seam at the right turning point 20 is completed by tensioning the loosened inclined thread portion *b* coming from the left turning point 19. These operations are repeated, so that the inclined thread portion *b* having been inserted into the right turning point 20 by the needle guide after completion of the seam at the left turning point 19 and having not

yet been tightened by the take up device and bobbin thread, and the inclined thread portion *a* having been transferred from the right turning point **20** to the left turning point **19** and having the same state as the above thread portion *b* are made to advance while forming such curve as shown exaggerated in FIG. 4.

Since, in practice, regular seams of V-shape are formed at the right turning point **20**, a detailed description thereof is not necessary. However, at the left turning point **19**, the inclined thread portion *b* advancing toward the right turning point **20** from said point **19** stretches over the inclined thread portion *a* before the completion of the right seam of said thread portion *b* and moreover, said thread portions *a* and *b* are positioned side by side in such a manner that the forward end of the thread portion *b* is brought in engagement with the part of the thread portion *a* at the position near the left turning point **19** in the edge of needle aperture **22** of the work **21** as shown in FIG. 6, so that said forward end can not be disengaged from said part of the inclined thread portion *a* so as to be able to slide toward this side by the action tensioning the needle thread even when the inclined thread portion *b* is tightened owing to the complete formation of the right seam, whereby formation of the cross points *c* can not be avoided. The sharper the turning angle of the thread portions *a* and *b*, the nearer the cross points *c* displace to the center of the seam width.

As a result of the above-mentioned consideration, I have found that when a loop having no such curved portion crossing the inclined thread portion *a* as shown in FIGS. 2 and 4 is formed on the inclined thread portion *b* of the needle thread **14** at the left turning point **19** and the bobbin thread **13** is enmeshed with said loop in such a manner that the so-called left twisting type hitch-stitch which occurs during reverse feeding of the work in the normal sewing machine is formed, and such disadvantage of the zigzag sewing as described above will be avoided.

However, in the present technical level or in the conventional sewing machines, it is impossible to form the right turning point as the perfect stitch and to form the left turning point as the hitch-stitch so as to form alternately different seams.

This invention is based on the above-mentioned results of my studies and characterized by the stitch forming mechanism which is constructed so that the final holding point of the bobbin thread to be forwarded toward the formed seams of the work may be positioned in a left-rear quadrant plane viewed from the operator side, with such plane having a center point just under the needle end and being defined at its front by the center line of the transversal axis which is perpendicular to the advancing direction of the work. whereby hitch-stitch and perfect stitch are, respectively and alternately, formed at the left turning points and right turning points of the zigzag sewing.

This invention will be described in connection with FIGS. 6–11, 13 and 14.

With particular reference to FIGS. 13 and 14, there is shown a sewing machine incorporating the features of this invention and which may well include a base **25** which is hollow and serves to support an upwardly projecting hollow overhanging arm **24** having means on the outer end thereof for slidably supporting a needle bar **17***a*. Rotatably mounted in the overhanging arm **24** is a main drive shaft **23** provided with a crank mechanism having a connecting rod **34** connected to the needle bar **17***a* for reciprocating the same upon rotation of the drive shaft **23**, and the needle bar **17***a* serves to carry a conventional needle **17**. A vertically disposed rock shaft **27** may be oscillated by suitable mechanism from the main drive shaft **23** and the rock shaft **27** may be connected through a lever arm with the fitting **36** which in turn is connected to a rod **28** connected through an arm **35** with the needle bar **17***a* or needle bar guide in such a manner as to oscillate the same for the production of zig-zag stitches.

A sleeve **29** is rotatably and slidably mounted in the base **5** and the sleeve **29** serves to support a shuttle **5** disposed in an appropriate location below the needle **17**. A shaft **30** connected to the sleeve **29** is connected by a slidable coupling with a shuttle drive shaft **31** rotatably mounted in the base **25**. The shaft **31** as well as the shaft **30** and sleeve **29**, together with the shuttle **5** carried thereby may be oscillated by a connecting rod **26** connected to a crank **32** on the main drive shaft **23**. Since it is necessary to reciprocate the shuttle **5** transversely to the longitudinal axis of the needle **17**, there is provided a fitting **33** on the sleeve **29** and such fitting **33** is connected through a link **37** to an arm **38** fixed to the rock shaft **27** and accordingly, upon oscillation of the rock shaft **27**, the shuttle **5** will reciprocate with respect to the needle **17**.

It will, therefore, be seen that rotation of the drive shaft **23** results in reciprocating the needle bar **17***a* and needle **17** carried thereby to provide a stitching movement and also oscillation of the rock shaft **27** from the drive shaft **23** will, through the arm **39** attached thereto and the bar **28**, oscillate the needle bar **17***a* transversely to the path of movement thereof in order to provide zig-zag stitches. Likewise as a result of the rotation of drive shaft **23**, the shuttle **5** will be oscillated from the crank **32** and connecting rod **26** and at the same time will be reciprocated transversely to the path of movement of the needle **17** by means of the arm **38** and link **37**. This mechanism provides all of the necessary movements to accomplish the sewing operation of this invention.

Referring to FIGS. 7 and 8, the end of restraining arm **2** of bobbin case **1** is extended inward more than is the case of the conventional machine so as to be positioned above thread aperture **4**, and said end being provided with a thread guide aperture **3**. Cover plate **5** of the shuttle race body is provided with a slot **6** for engagement with the restraining arm **2**. A shuttle **7** is adapted to move in said shuttle race. The slot **6** is displaced more closely toward the operator than such slot of any conventional cover plate of the shuttle race body as shown by dotted line. The relative position of the thread guide aperture **3** to the loop-taker is exaggeratedly shown in FIG. 7. That is to say, said position is selected so as to be near the side edges of driver **8** and hook piece **9** of the shuttle **7** between the operator side and drop point **16** of needle **17**. In other words, said position exists in the left-rear quadrant plane viewed from the operator side, with said plane having its center at point **16** and being defined at its front by the center line of transversal axis **18**. In FIG. 8, member F is a feed dog for holding cloth from the rear surface thereof and for oscillating the cloth therewith.

Referring to FIG. 11(*a*), the bobbin thread **13** is led out of the thread aperture **4** of the bobbin case **1** and is caused to pass through the thread guide aperture **3**, and then is led through aperture **12** of upper spring plate **11** of the shuttle race body and hole **15'** of needle plate **15**. The thus passed thread is led toward the already formed seams of work **21**. The loop-taker in this example is of the type which is reciprocably rotated around the transversal axis perpendicular to the forward direction of the work **21** while being oscillated right and left together with the needle.

Referring to FIGS. 11(*a*)–(*e*), when the bobbin-thread case illustrated in FIGS. 7, 8 and 11(*a*) is used for the zigzag sewing, and the seam at the left turning point **19** is to be formed, the bobbin thread **13**, the bobbin side final holding point of which is positioned at the thread guide aperture **3** is led out in such a manner that said thread **13** advances toward the right turning point **20** of the already formed seam from the operator side over the upper portion of the hook piece **9**. In this situation, when the needle **17** moves down, a small loop of the needle thread **14** is formed by the needle end by lowering of the take up device while the shuttle **7** achieves its forward rotation so that said loop may be seized on the hook end **10** and may pass through the position under the bobbin

thread **13**. Accordingly, the loop **14'** formed by said operation, after having been detached from the loop-taker, is enmeshed with the bobbin thread **13** is such a counterclockwise direction as shown in FIG. 11(*b*), so that when said loop is drawn upward by the thread drawing caused by the take up device, it is brought into the position shown in FIG. 11(*c*) after revolution thereof around the bobbin thread **13**. Next, the final tightening action of the bobbin thread **13** is exerted to said loop **14'**, whereby the threads **13** and **14** tend to cross each other perpendicularly at the cross point, but the loop **14'** is further twisted, because the bobbin thread itself has no revolvable loop. Accordingly, the threads are perfectly tightened at the position shown in (FIG. 11(*d*) to form a complete seam. Of course, when the stretching of the needle thread is relatively loose, the tightening of the loop **14'** is imperfect and takes a position as shown in FIG. 11(*e*).

In the above-mentioned finished seam at the left turning point, the left side end of the inclined thread portion *b* protrudes into the position under the left side end of the thread portion *a* at the needle aperture, whereby such a regular V-shaped seam as shown in FIG. 9 will be obtained and the defects in the conventional machine completely removed.

At the right turning point **20**, the seam is formed in accordance with the steps shown in FIGS. 12(*a*), (*b*), and (*c*). The formation of said seam is approximately the seam as that of the conventional machine, so that a detailed description relating to the formation of said seam is omitted. The above-mentioned description is applied to the machine of the type in which the loop-taker rotates around the transversal axis and to the machine of the type in which the work advances while being oscillated left and right.

According to this invention, as clear from the above-mentioned description, the final holding point of the bobbin thread is positioned, at the bobbin side, in a left-rear quadrant plane having a center at the drop point of the needle and defined at its front by the axial line of the loop-taker, with the seam at the left turning point of the zigzag stitch being formed by leading the bobbin thread toward the right turning point from said final holding point over the hook piece of the cover plate of the shuttle race body and by enmeshing the loop of the needle thread formed by the loop-taker with the bobbin thread in the counterclockwise direction to form a hitch-stitch, and the seams at the right turning point of the zigzag stitch being formed by leading the bobbin thread toward the left turning point from said final holding point without passing over said hook piece and by enmeshing the loop of the needle thread formed by the loop-taker with the bobbin thread in the clockwise direction to form such a perfect stitch as in the case of the conventional zigzag sewing machine. Accordingly, very simple constructional members can be used as the device forming the final holding point of the bobbin thread at the bobbin side and moreover the zigzag seams consist of a series of regular V-shaped seams, thus avoiding such unsightly seams as in the case of the conventional sewing machine.

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

1. A lock-stitch sewing machine comprising a reciprocably supported stitching needle, a loop-taker adapted to move along a circular path having a horizontal axial center line to form seams together with said needle, a bobbin case mounted stationarily in said loop-taker, work feeding means for feeding the work in a direction perpendicular to the horizontal axial center line of said loop-taker, and means adapted to reciprocate said needle and loop-taker relative to the work in the same direction as said horizontal axial center line of said loop-taker to form zigzag seams, stitch-forming means in which the bobbin thread final holding point of said bobbin case being positioned at a left-front quadrant plane viewed from the work feeding side, with said plane having a center at the drop point of the needle and being defined by a vertical plane parallel to said horizontal axial center line and another vertical plane perpendicular to the first-named vertical plane so that when the seam at the left side turning point is to be formed, the needle drops through the work feed off side of the bobbin thread, thus forming a lock-stitch having one knot at each left side turning point and forming a normal lock-stitch without a knot at each right side turning point.

2. Stitch forming mechanism as claimed in claim 1, wherein the loop-taker is constructed to be reciprocated along the circular path having a horizontal center axial line.

3. A lock-stitch sewing machine comprising a reciprocably supported stitching needle, a loop-taker adapted to move along a circular path having a horizontal axial center line to form seams together with said needle, a lower thread feeding bobbin case mounted in said loop-taker, said case being provided with an upper projection means for stopping the rotation thereof, said projection having at its end a hole for holding the bobbin thread, work feeding means for feeding the work in the direction perpendicular to the horizontal axial center line of the movement of said loop-taker, and means adapted to reciprocate said needle and loop-taker relative to the work in the same direction as the axial line of the movement of said loop-taker, the end of said projection means having the hole and used for holding the bobbin thread being positioned at a left-front quadrant plane viewed from the work feeding side, with said plane being defined by a vertical plane parallel to the axial line of the movement of said loop-taker and by another vertical plane intersecting with the first-named vertical plane at an angle 90° at the drop point of the needle so that when the seam at the left side turning point is to be formed, the needle drops through the work feed off side of the bobbin thread, thus forming a lock-stitch having one knot at each left side turning point.

4. In a lock-stitch sewing machine comprising a reciprocably supported needle, a loop-taker adapted to reciprocably rotate around a horizontal axial center line to form seams together with said needle, a bobbin case mounted concentrically in said loop-taker, said case being provided with an upper projection means for stopping rotation thereof, said projection having at its end a hole for holding the bobbin thread, work feeding means for feeding the work in a direction perpendicular to the axial line of the movement of said loop-taker, means adapted to reciprocate said work relative to said needle and loop-taker in the same direction as the axial line of the rotation of said loop-taker to form zigzag seams, the end of said projection means having the hole and used for holding the lower bobbin thread being positioned at a left-front quadrant plane viewed from the work feeding side, with said plane being defined by a vertical plane parallel to the axial line of the movement of said loop-taker, and another vertical plane which intersects perpendicularly said first-named vertical plane at the drop point of the needle so that when the seam at the left side turning point is to be formed, the needle drops through the work off side of the bobbin thread, thus forming a lock-stitch having one knot at each left side turning point.

5. In a lock-stitch sewing machine comprising a reciprocably supported stitching needle, a looptaker adapted to move along a circular path having a horizontal axial center line to form seams together with said needle, a bobbin case held in said loop-taker, said case being provided with an upper projection means for stopping the rotation thereof, said projection means being provided at its end with a hole for holding the bobbin thread, work feeding means for feeding the work in the direction perpendicular to the horizontal axial center line of the

movement of said loop-taker, the hole of said projecting means being positioned at a left-front quadrant plane viewed from the work feeding side, with said plane being defined by a vertical plane parallel to the axial line of the movement of the loop-taker and by another vertical plane which perpendicularly intersects the first-named vertical plane at the drop point of the needle, so that the needle drops through the work off side of the bobbin thread only when a seam is to be formed at the left side

turning point, thus forming lock stitch having one knot at each left side turning point.

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