Oct. 20, 1925. 1,558,118

B. F. SERAFINI

BUTTONHOLE MECHANISM FOR SEWING MACHINES

Filed Aug. 9, 1923 4 Sheets-Sheet 1

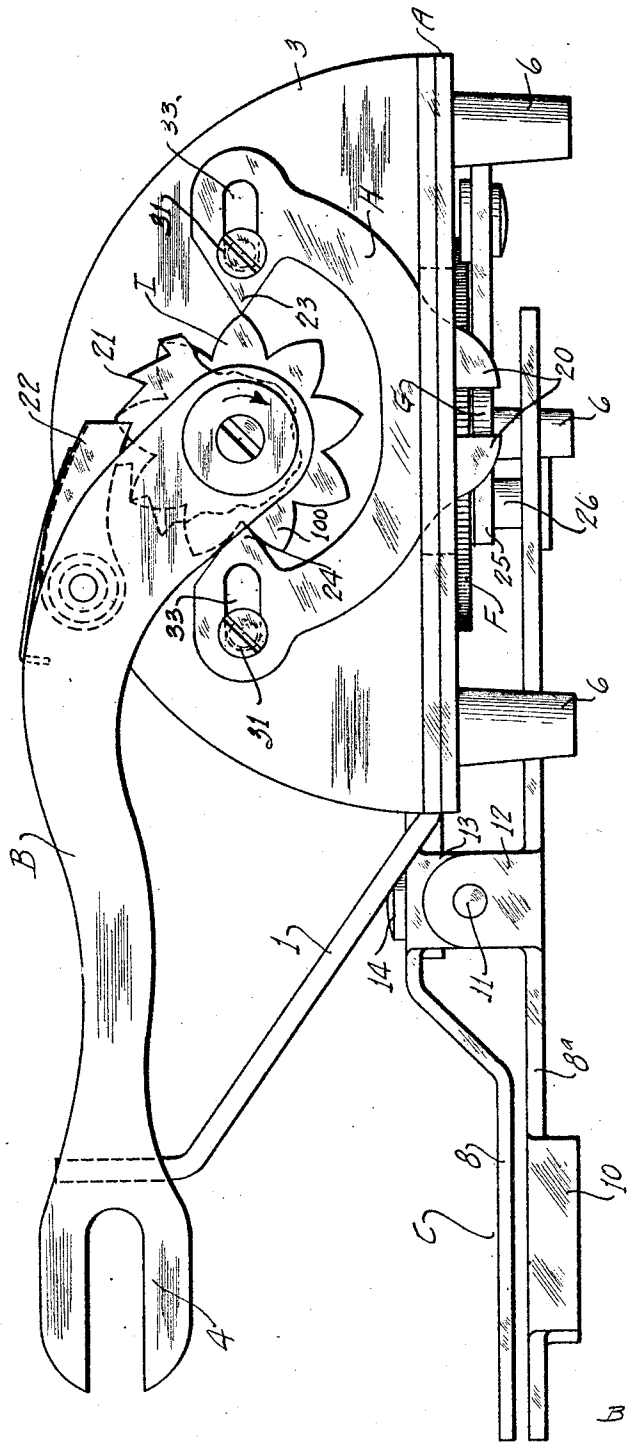


Fig. 1b.

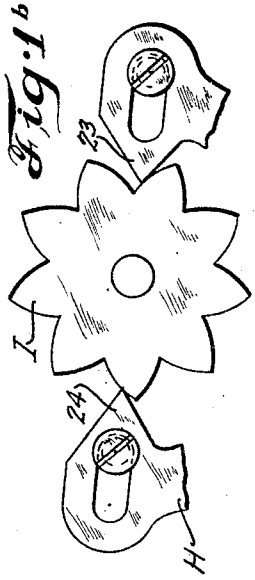
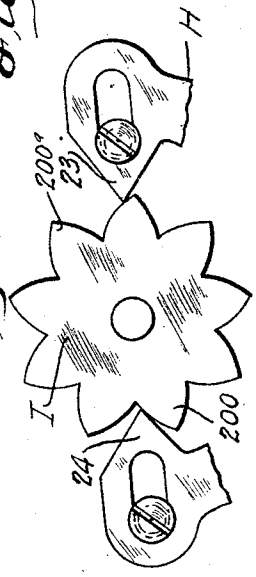


Fig. 1.

Fig. 1a.



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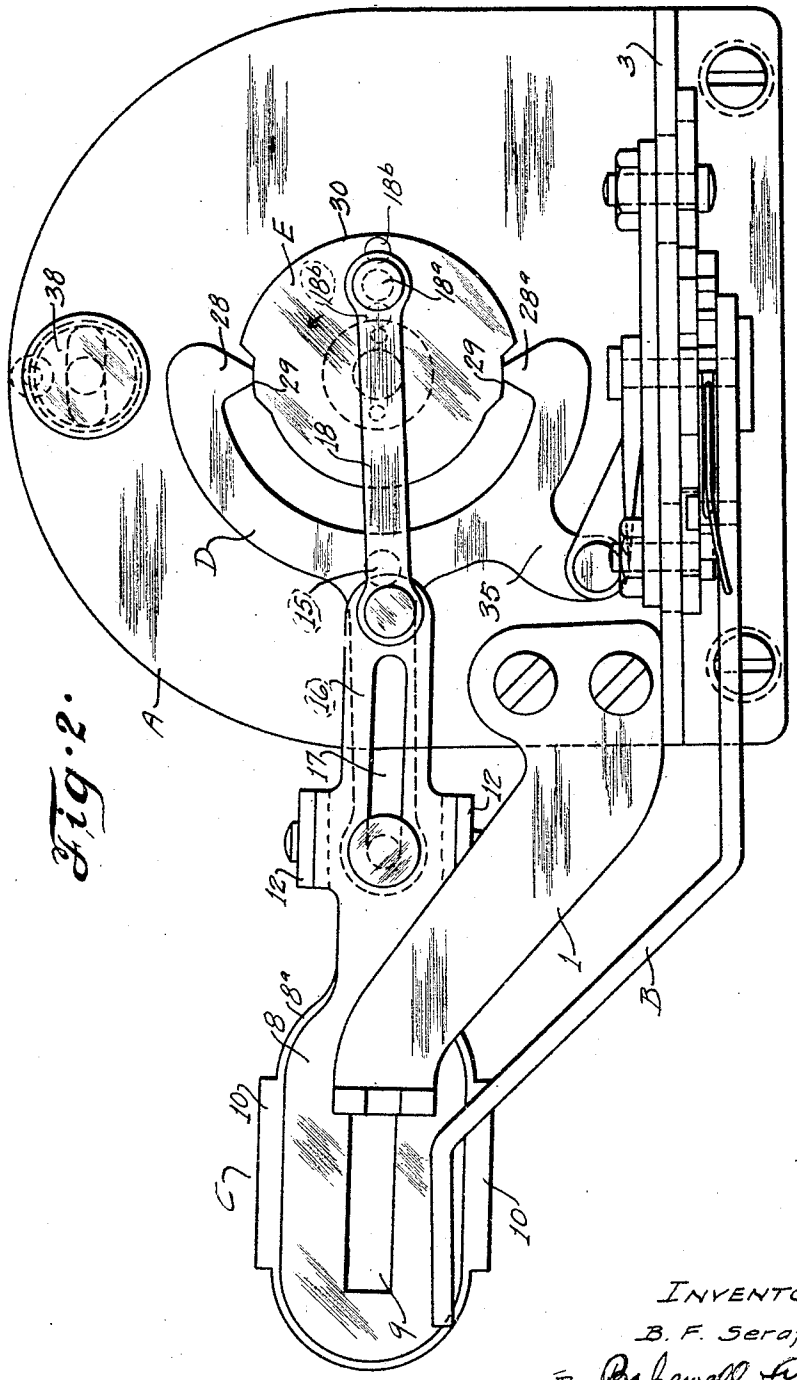


Fig. 2.

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BUTTONHOLE MECHANISM FOR SEWING MACHINES

Filed Aug. 9, 1923 4 Sheets-Sheet 3

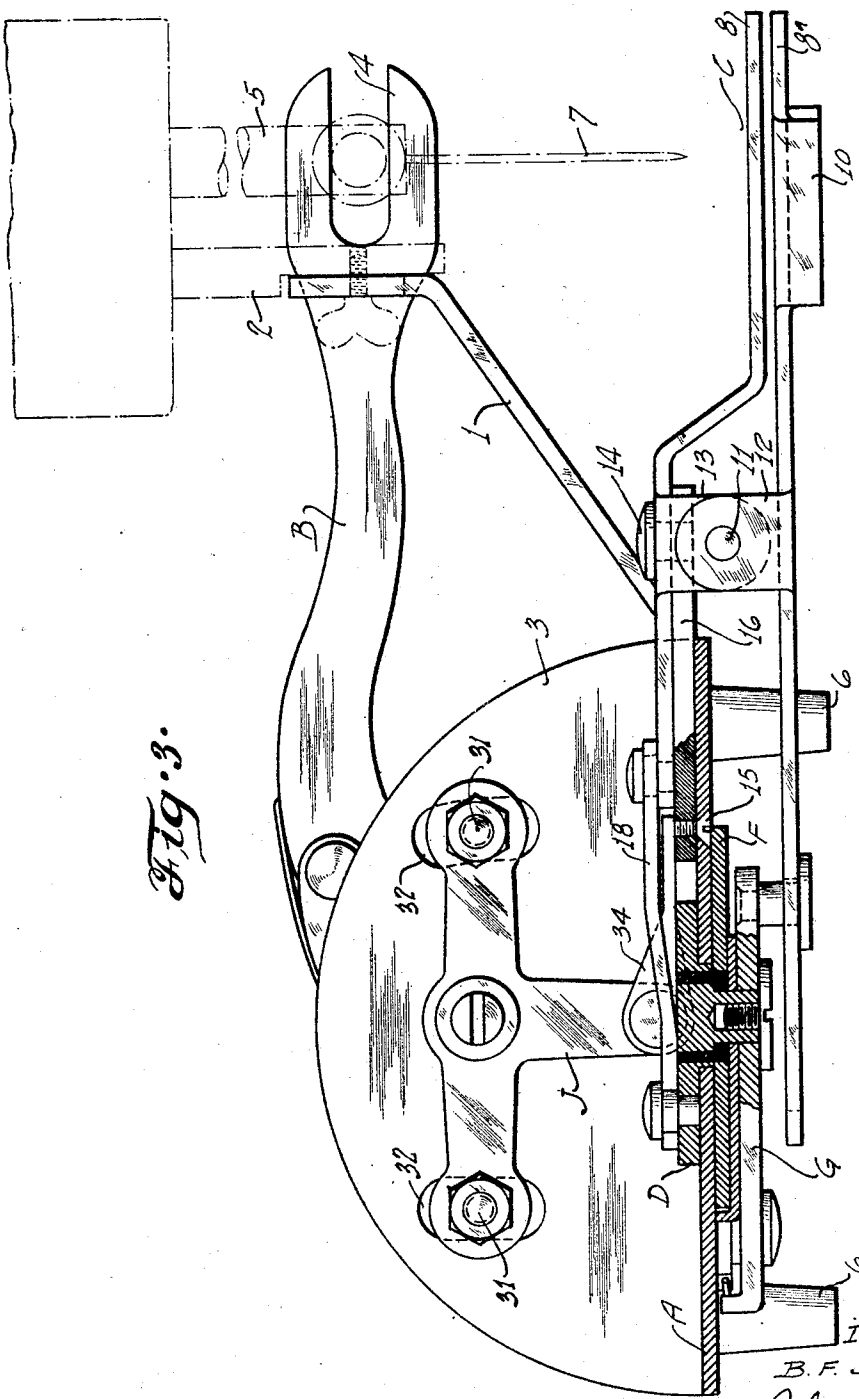


Fig. 3.

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BUTTONHOLE MECHANISM FOR SEWING MACHINES

Filed Aug. 9, 1923 4 Sheets-Sheet 4

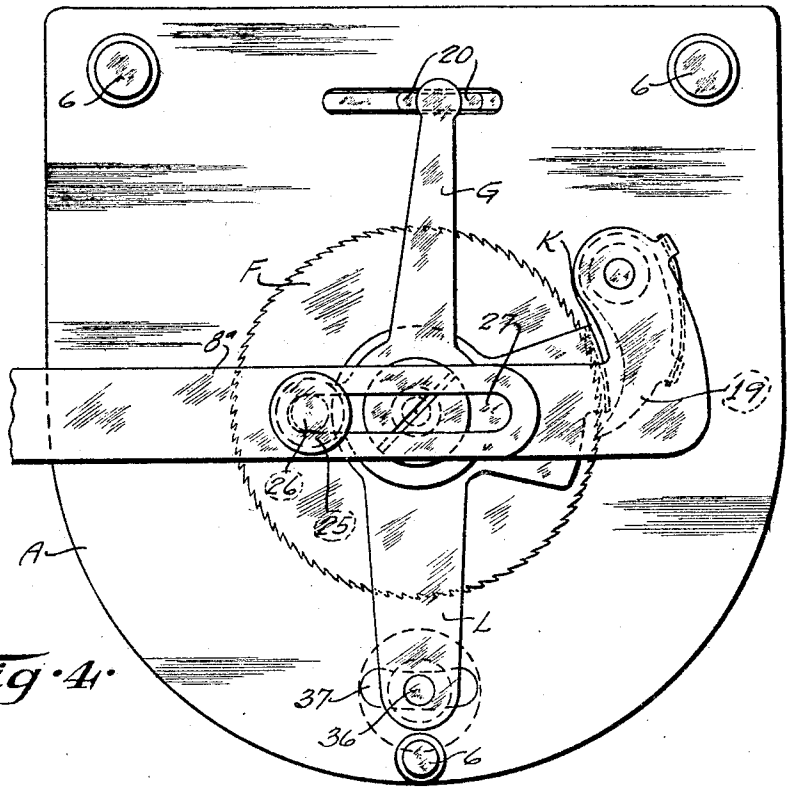


Fig. 4.

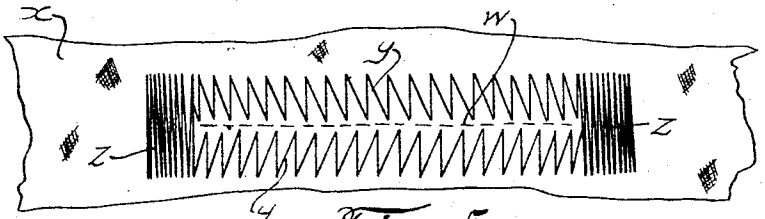


Fig. 5.

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UNITED STATES PATENT OFFICE.

BERNARD F. SERAFINI, OF ST. LOUIS, MISSOURI.

BUTTONHOLE MECHANISM FOR SEWING MACHINES.

Application filed August 9, 1923. Serial No. 656,602.

To all whom it may concern:

Be it known that I, BERNARD F. SERAFINI, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Buttonhole Mechanisms for Sewing Machines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention has for its main object to provide an efficient mechanism of simple design and inexpensive construction that is adapted to be used in conjunction with the stitch forming mechanism of a sewing machine to produce a strong and serviceable buttonhole.

Another object is to provide a mechanism for producing a reinforced buttonhole having rows of short stitches at its sides that are disposed at substantially right angles to the center line of the buttonhole and having groups of relatively long stitches at its ends that are disposed transversely of the buttonhole and which reinforce the ends of same and impart a neat and finished appearance to the buttonhole.

And still another object is to provide a practicable buttonhole attachment for sewing machines that is capable of use with many of the various standard makes of sewing machines now on the market.

Other objects and desirable features of my invention will be hereinafter pointed out.

To this end I have devised a buttonhole mechanism for sewing machines that comprises a work feeding element, and means operated by the needle bar or some other moving part of the sewing machine for causing said element to move the work relatively to the needle of the stitch forming mechanism in such a way that two rows of comparatively short stitches will be formed in the work at opposite sides of the center line of the buttonhole and two groups of comparatively long stitches will be formed in the work at the opposite ends of the buttonhole, the short stitches being disposed at substantially right angles to the center line of the buttonhole and the long reinforcing stitches at the ends of the buttonhole extending in the same general direction as the short stitches but being approximately double the length of said short stitches, thereby producing a buttonhole of neat and ornamental appearance whose ends are reinforced in such a way as to tend to reduce the liability of the material in which the buttonhole is formed from tearing at the ends of the buttonhole. The work feeding element can be constructed in various ways without departing from the spirit of my invention, but it is preferably composed of two gripping members between which the work is clamped and held securely enough to insure the work moving relatively to the needle of the sewing machine when said work feeding element is actuated. Various means can be used for actuating said element, but I prefer to use an operating mechanism which causes said element to move the work longitudinally in one direction so as to cause stitches to be inserted in the work at one side and at one end of the center line of the buttonhole, and then reverse the work and move it longitudinally in the opposite direction so as to cause stitches to be inserted in the work at the other side and at the opposite end of the buttonhole. While the work feeding element is traveling longitudinally, transverse movement is imparted to same so as to cause said element to travel in a zig-zag path and move the work relatively to the needle in such a way that a row of short stitches will be formed in the fabric in which the buttonhole is being made, at each side of the center line of the buttonhole and at substantially right angles to same, and groups of reinforcing stitches of approximately double the length of the short stitches will be inserted in the fabric at the opposite ends of the buttonhole and disposed transversely of the center line of the buttonhole. Various means can be used for effecting and governing the movements of the work feeding element, but I prefer to use a cam, as herein shown, for effecting the change from short stitches to long stitches, and vice versa, and also for governing the points at which the changes in the length of stitches are made, as such a controlling means is accurate and reliable, it is inexpensive to construct and not liable to get out of order when in use and it can be modified easily to vary the length of the buttonhole, to vary the length of the stitches and to vary the area of the reinforcing stitches at the ends of the buttonhole. In the mechanism herein shown the cam just referred to is also used for imparting longitudinal movement to the work feeding ele-

ment and to automatically reverse the direction of longitudinal movement of said element during the operation of forming the buttonhole.

I have herein illustrated my invention embodied in a buttonhole attachment for sewing machines that is capable of use with many of the standard makes of sewing machines now on the market, but I wish it to be understood that my invention is not limited to an attachment or accessory for a conventional sewing machine, but, on the contrary, is applicable to a sewing machine that is used solely for making buttonholes. Moreover, while I have herein illustrated the preferred embodiment of my invention, I wish it to be understood that various other means than those illustrated can be used for effecting the movement of the work relatively to the needle of the stitch forming mechanism of the machine without departing from the spirit of my invention.

Figure 1 of the drawings is a right hand side elevational view of a buttonhole attachment for sewing machines constructed in accordance with my invention.

Figures 1^a and 1^b are detail views of part of the means that is used for controlling the length of the stitches.

Figure 2 is a top plan view of the mechanism shown in Figure 1.

Figure 3 is a left hand side elevational view of said mechanism.

Figure 4 is a bottom plan view of said mechanism; and

Figure 5 is a top plan view of a buttonhole formed by my improved buttonhole mechanism.

Referring to the drawings, A designates a horizontally-disposed base plate provided with an upwardly-projecting arm 1 that is adapted to be connected to the presser foot bar 2 of a conventional sewing machine, as shown in Figure 3, and 3 designates a vertically-disposed wall or bracket on said base plate that carries a pivotally mounted operating lever B provided with a bifurcated portion 4 by which it can be connected to the needle bar 5 of the sewing machine, said base plate having legs 6 on the underside of same that rest upon the base plate (not shown) of the head of the sewing machine with which the mechanism is used. A work feeding element, designated as an entirety by the reference character C, is provided for moving the work or material x in which the buttonhole is to be formed, relatively to the needle 7 of the sewing machine in such a way that two parallel rows of short stitches y will be formed in the material x at opposite sides of the center line of the buttonhole and two groups of long stitches z will be formed in said material at the opposite ends of the buttonhole, as shown in Figure 5. Usually the stitches y and z will be formed in the material x at the sides and at the ends of an imaginary line, indicated by the dotted line w, in Figure 5, and the material thereafter slit or cut along the line w so as to form the opening of the buttonhole, but it will, of course, be obvious that the material could be slit to form the opening of the buttonhole and the stitches y and z thereafter inserted in the material without departing from the spirit of my invention.

The work feeding element C is preferably composed of two horizontally-disposed gripping members 8 and 8^a, arranged one above the other, and combined in such a way as to permit them to be separated sufficiently to enable the material to be introduced between same, said members having aligned elongated slots 9 in which the needle operates and the bottom gripping member 8^a being provided with depending feet 10 that rest upon the base plate of the head of the sewing machine and thus prevent the conventional serrated work feeding bars of the machine from striking against the work feeding element C of my mechanism. The gripping members 8 and 8^a that constitute the work feeding element C are preferably pivotally connected together by a horizontally-disposed pin 11 that passes transversely through upwardly-projecting ears 12 on the member 8^a that embrace depending ears 13 on the member 8, and said members 8 and 8^a are pivotally connected by a pivot pin 14 to a shiftable supporting member D arranged on the upper side of the base plate A and pivotally connected to same by a pivot pin 15, said member D being adapted to be maintained in three different positions,—one of which I will refer to as its center position, the other as its right hand position and the other as its left hand position. The shiftable supporting member D is of yoke form in general outline, as shown in Figure 2, and it is provided adjacent its pivot 15 with a horizontally-disposed, laterally-projecting arm 16 that carries the pivot pin 14 which constitutes the axis of movement of the work feeding element C when said element is moved transversely, as hereinafter described, the top gripping member 8 of said work feeding element resting upon the arm 16 and being provided with an elongated slot 17 that receives the pivot pin 14, thereby permitting the work feeding element to move longitudinally with relation to the arm 16 of the supporting member D and also swing laterally on said arm.

Longitudinal movement is imparted to the work feeding element C by a cam E rotatably mounted on the upper side of the base plate A and connected by means of a link 18 with the top gripping member 8 of the work feeding element. The cam E is rigidly connected to a ratchet wheel F arranged on

the underside of the base plate and a rock lever G is used to impart a step by step forward movement to said ratchet wheel and to the cam E when the needle bar of the sewing machine is in operation. As shown in Figure 4, the rock lever G is arranged parallel to the ratchet wheel F and is of bell crank shape in general outline, one arm of said lever carrying a pivotally-mounted, spring-pressed pawl 19, as shown in Figure 4, that is adapted to co-operate with the teeth on the ratchet wheel F, and the other arm of said rock lever G being arranged in engagement with a bifurcated portion 20 at the lower end of a horizontally-reciprocating actuating device H. The actuating device H is arranged on one side of the vertically-disposed bracket 3 on the base plate A, and is reciprocated back and forth by a rotatable star wheel I that operates in synchronism with the needle of the machine, said star wheel being rigidly connected to a ratchet wheel 21 which co-operates with a spring-pressed, pivotally-mounted pawl 22 on the operating lever B, previously referred to. The operating lever B rocks on the axis about which the star wheel I rotates, and accordingly, when the needle bar 5 of the machine is in operation, the lever B will turn the star wheel I forwardly with a step by step movement, thereby causing the teeth on said star wheel to co-operate with pointed projections 23 and 24 on the actuating device H to reciprocate said device horizontally. In view of the fact that the device H is operatively connected with the rock lever G that actuates the ratchet wheel F, the horizontal reciprocating movement of the device H causes the cam E to revolve and thus impart longitudinal movement to the work feeding element C by means of the link 18.

Each time the work feeding element C moves longitudinally, due to a forward step of the cam E, a transverse movement is imparted to said element so as to cause the work to move in a zig-zag path relatively to the needle 7, thereby resulting in stitches being inserted in the material x at substantially right angles to the center line of the buttonhole. The transverse movements or the transverse strokes that are imparted to the work feeding element are obtained or effected by an arm 25 on the rock lever G which is provided with a pin 26 that is arranged in an elongated slot 27 in the bottom gripping member 8^a of the work feeding element. When the lever G rocks forwardly during the operation of turning the cam E forwardly, the work feeding element will swing transversely in one direction, for example, to the right, about the axis formed by the pivot pin 14, and when said rock lever moves in the opposite direction preparatory to the next forward step of the cam E, the work feeding element will move transversely in the opposite direction, or to the left. In view of the fact that the work feeding element is moving in a longitudinal direction at the time the transverse strokes are imparted to said feeding element, it is obvious that the work will be moved in a zig-zag path relatively to the needle.

After one row of short stitches y have been formed in the material at one side of the buttonhole, a group of long stitches z are formed in the material at one end of the buttonhole. The change from the long to the short stitches is effected automatically and is obtained by shifting the axis 14 about which the work feeding element turns when it moves transversely and by changing the position of the reciprocating actuating device H relatively to the star wheel I. As previously stated, the shiftable supporting member D has three different positions,—a center position, a right hand position and a left hand position. Likewise, the actuating device H has a center position, a right hand position and a left hand position. The cam E controls the position of the member D and the device H, due to the action of said cam on lugs 28 and 28^a arranged at the opposite ends of the yoke-shaped portion of the supporting member D. When the lugs 28 and 28^a are in engagemnt with surfaces 29 on the cam E that have a very slight curve, as shown in Figure 2, the member D and the device H will be maintained in their center positions, when the lug 28^a is in engagement with a curved, concentric surface 30 on the cam E, the member D and device H will be maintained in their right hand positions, and when the lug 28 is in engagement with the surface 30 on the cam, said member D and device H will be maintained in their left hand position. The surfaces 29 are arranged at the ends of the curved surface 30 just referred to, and in view of the fact that said surfaces 29 are arranged diametrically opposite each other and are substantially straight I will refer to the surfaces 29 as straight, parallel surfaces. When the member D and the device H are in their center positions, the transverse movements of the work feeding element are so timed that the needle will penetrate the material at the ends of the transverse strokes of said feeding element, thereby causing long stitches z to be inserted in the material. At such times, namely, when the long stitches are being inserted, the reciprocating actuating device H occupies such a position with relation to the star wheel I that the apex of one tooth of said star wheel is positioned directly opposite one of the pointed projections on the device H and the inner end of the diametrically-opposed valley in the star wheel is positioned directly opposite the other

pointed projection on the device H at the time the needle penetrates the material in which the buttonhole is being formed. Assuming that the star wheel I and device H are in the position shown in Figure 1 and that the needle is penetrating the material a certain distance at one side of the center line of the buttonhole, the upward movement of the needle bar causes the lever B to rock upwardly, thereby moving the star wheel I forwardly in the direction indicated by the arrow in Figure 1. This movement of the star wheel causes the tooth on said wheel that is located at the rear of the valley previously referred to, which tooth I have designated by the reference character 100 in Figure 1, to move upwardly into engagement with the pointed projection 24 on the actuating device H, thereby causing said device H to reciprocate to the left and move the rock lever G forwardly, which operation causes the pin 26 in the arm 25 on said rock lever to move the work feeding element C transversely into such a position that the needle will penetrate the material on its next downward stroke at a point located the same distance from the center line of the buttonhole but at the other side of said center line. It is only when the long stitches *z* are being formed that the shiftable supporting member D and the actuating device H occupy their center positions, as shown in Figures 2 and 1. At other times, namely, when the short stitches *y* are being formed, the member D and device H will occupy either their right hand position or their left hand position. By referring to Figures 1[a] and 1[b] which show the actuating device H arranged in its right hand position and left hand position, it will be noted that in these positions of said device it is tilted slightly from its center position, shown in Figure 1. I have not illustrated the right hand and left hand positions of the supporting member D that swings the work feeding element C to the right and to the left, but it will be obvious from Figure 2 that when the member D is swung on its pivot 15 in one direction, the work feeding element C will be moved bodily to the right, and when said member D is swung on its axis in the opposite direction, the work feeding element will be moved bodily to the left. When the actuating device H is arranged in its right hand position, as shown in Figure 1[a], the pointed projection 23 on said device will be positioned above or at the rear of the apex of one tooth on the star wheel I and the projection 24 on said device H will be positioned slightly in advance of or above the apex of a different tooth on said star wheel when the needle is penetrating the material. Assuming that the supporting member D is in its right hand position, that the actuating device H is in the position shown in Figure 1[a] and that the needle is penetrating the material at one side of the center line of the buttonhole, the upward stroke of the needle bar to withdraw the needle from the material causes the pawl 22 on the lever B to turn the star wheel I forwardly. The first portion of this movement of the star wheel causes the tooth on said wheel, which I have designated by the reference character 200 in Figure 1[a], to engage the projection 24 on the device H and move said device to the left, looking at Figure 1[a], the continued movement of said star wheel causing the tooth of said wheel, which I have designated by the reference character 200[a] to engage the projection 23 on the device H and move said device to the right immediately after the apex of the tooth 200 has passed out of engagement with the projection 24. This movement of the device H causes the material to assume such a position with relation to the needle that at the next downward stroke of the needle bar the needle will penetrate the material at the same side of the center line of the buttonhole, thus forming a short stitch on the right hand side of the buttonhole. On the succeeding upward stroke of the needle bar the work feeding element C will make a full lateral stroke in the opposite direction, for example, to the left, and then will move to the right, reaching such a position when the needle again penetrates the material that the end of the next stitch that is to be inserted will be on a line with one end of the preceding short stitch. From the foregoing it will be understood that the degree of transverse movement imparted to the work feeding element C is not changed to vary the length of the stitches during the operation of inserting long and short stitches in the material, but on the contary, the variation in the length of the stitches is obtained by bodily shifting the work feeding element C and varying the time at which the work feeding element C is moved transversely relatively to the time at which the needle penetrates the material. When the long stitches are being inserted the actuating device H and the supporting member D are in their central positions, thus causing the work feeding element to finish its lateral strokes at the same time the needle penetrates the material, and when the short stitches are being inserted, the work feeding element finishes its lateral strokes before and after the needle penetrates the material. Stated in another way, the needle may be said to penetrate the material at the ends of the transverse strokes of the work feeding element, when long stitches are being inserted, and penetrates the material intermediate the ends of the transverse strokes of the work feeding element when short stitches are being inserted.

In forming a buttonhole, one row of short stitches *y* is first inserted in the material at one side of the buttonhole, and when one end of the slit in the material or one end of the imaginary line *w* in the material is reached, the length of the stitch is increased so as to cause a series of long stitches *z* to be inserted in the material transversely of the center line of the buttonhole and extending a considerable distance beyond the end of the buttonhole. Thereafter another series of long stitches are inserted in the material over the first series of long stitches that were inserted, and when the end of the slit in the material or the end of the imaginary line *w* is reached, the length of the stitch is then reduced and another row of short stitches *y* is inserted in the material at the other side of the buttonhole, the length of the stitch being increased when the opposite end of the buttonhole is reached and the material being moved in such a way with relation to the needle that two series of long stitches *z* are inserted in the material at the opposite end of the slit or imaginary line *w*. Preferably, the top series of reinforcing stitches *z* at each end of the buttonhole are interlapped with the bottom series of reinforcing stitches so as to insure the material being reinforced and strengthened sufficiently at the ends of the buttonhole to prevent it from tearing when the buttonhole is subjected to rough usage. In the form of my invention herein shown the shifting of the actuating device H from its center position into its right hand position and into its left hand position is produced by the rocking movement of a shifting lever J that is pivotally mounted on the bracket 3 on the base plate A and provided with horizontally-disposed guide pins 31 on which the actuating device H slides horizontally. As shown in Figure 3 the shifting lever J is of T-shape in general outline and the horizontal arm of same is provided at its ends with guide pins 31 that project through elongated slots 32 in the bracket 3. The actuating device H is provided at its upper end with horizontally-disposed slots 33 that receive the guide pins 31 and the depending, vertical arm of said lever J is connected by a link 34 or in any other suitable way, to an arm 35 on the supporting member D that carries the work feeding element C. Accordingly, the actuating device H may be said to be carried by the shifting lever J, but mounted on said lever in such a way that it can reciprocate horizontally relatively to said lever J to actuate the rock lever G without affecting or disturbing the position of the shifting lever J, the horizontal reciprocating movement of said device H being made possible by the elongated slots 33 that receive the guide pins 31 on the shifting lever. When the shifting lever J is in its central position, shown in Figure 3, the actuating device H will be maintained in its center position, and when the vertical arm of said lever J is moved to the right or to the left, due to a change in the position of the supporting member D, the relative position of the actuating device H and the star wheel I will be changed.

When the lug 28 on the supporting member D is in engagement with the curved surface 30 on the cam E the reciprocating movements of the needle bar of the sewing machine causes a row of short stitches *y* to be inserted in the material *x* along one side of the slit or imaginary line *w* in the material, and when the straight parallel surfaces 29 on said cam move into engagement with the lugs 28 and 28ª on the member D, the parts of the mechanism will move automatically into such a position that a series of long stitches *z* will be inserted in the material at one end of the buttonhole, beginning at the end of the slit or imaginary line *w* in the material and terminating at a point some distance beyond the end of said imaginary line. Thereafter the direction of movement of the material is reversed so as to cause a second series of long stitches to be inserted in the material over the series of long stitches previously inserted. This is obtained by reversing the longitudinal movement of the work feeding element C while the lugs 28 and 28ª on the member D are in engagement with the straight surfaces 29 on the cam E so as to cause the work feeding element to start to move longitudinally in the opposite direction. When the lugs 28 and 28ª on the member D first engage the surfaces 29 on the cam, the pin 18ª that joins the cam to the top gripping member 8 of the work feeding element is approaching its dead center position, shown in Figure 2. During this time the under series of long stitches at one end of the buttonhole are being inserted in the material, and after the pin 18ª of the link 18 passes its dead center position, thus reversing the longitudinal movement of the work feeding element C, the top series of long stitches are inserted. Thereafter, when the surface 30 of the cam E engages the lug 28ª on the member D, the work feeding element C and the actuating device H will be shifted into their left hand positions, thereby resulting in a row of short stitches *y* being inserted in the material at the left hand side of the buttonhole. When the other end of the buttonhole is reached the straight surfaces 29 on the cam E again engage the lugs 28 and 28ª on the member D and restore said member D and the actuating device H to their center positions, thereby causing an under series and an upper series of long stitches to be formed at the opposite end of the buttonhole. Due to the fact that

the longitudinal movement of the work feeding element C is produced by a rotating part, namely, the cam E, which is connected with said work feeding element by a link 18, the movement which the link 18 imparts to the work feeding element at each forward step of the cam E will be less when the connecting pin 18ª of said link is adjacent its dead center position, or, in other words, when the ends of the buttonhole are being approached, than when said pin 18ª occupies an intermediate position, or in other words, when the short side stitches *y* are being inserted in the material adjacent the middle of the buttonhole. This causes the short stitches *y* to be arranged closer together as the ends of the buttonhole are approached and results in a stronger and more serviceable buttonhole. due to the fact that it has a greater number of stitches at the points where great strength is required, namely, the zones adjacent the ends of the buttonhole. In order to prevent the needle from penetrating the material at the same points during the operation of inserting the top series of long reinforcing stitches that the needle penetrated the material during the operation of inserting the under series of reinforcing stitches, the pivot pin 18ª which joins the link 18 to the cam E is set a little off of 90°, or, in other words, is set slightly nearer to one of the straight surfaces 29 of the cam than to the other straight surface 29, so as to insure the top series of reinforcing stitches interlapping or lying between the bottom series of reinforcing stitches.

In order to vary the number of stitches per inch that are inserted at the sides and at the ends of the buttonhole, I have equipped the mechanism with an adjustable shield K arranged at the periphery of the ratchet wheel F in proximity to the pawl 19, as shown in Figure 4, said shield being carried by a substantially bell-crank-shaped lever L arranged between the ratchet wheel F and the rock lever G and provided in its long arm with a screw-threaded projection 36 that projects upwardly through an elongated slot 37 in the base plate A, a nut 38 being mounted on said screw-threaded projection, as shown in Figure 2, so as to hold the lever L in adjusted position. If it is desired to have the stitches arranged comparatively close together, the arm L is set in such a position that the pawl 19 will travel on the shield K during a large portion of the forward stroke of the rock lever G, thus causing a relatively slight forward movement to be imparted to the ratchet wheel F and to the cam E at each forward stroke of the rock lever G, and if it is desired to have the stitches spaced comparatively far apart, the lever L is set in such a position that the pawl 19 will travel on the shield K during only a small portion of the forward stroke of the rock lever G.

A buttonhole mechanism of the character above described is of such simple design that it is inexpensive to manufacture and is not liable to get out of order when in use; it can be used with various standard makes of sewing machines now on the market by simply changing the form and arrangement of the arm 1 that connects the base plate A of the mechanism to the presser foot bar of the sewing machine, and it can be adjusted easily to vary the number of stitches per inch that are inserted in the material in which the buttonhole is being formed. Owing to the fact that the cam E governs the longitudinal movement and the transverse movement of the work feeding element and also effects the change from long stitches to short stitches, and vice versa, the length of the buttonhole produced by the mechanism can be varied by changing the point of connection between the cam E and the link 18 that actuates the work feeding element C. One convenient way of accomplishing this is to provide the cam E with a plurality of holes 18ᵇ located at different distances from the axis of movement of the cam E, as shown in Figure 2, for receiving the stud or pin 18ª that connects the link 18 to said cam. My invention is not limited, however, to this particular means for adjustably connecting the work feeding element C to the means that actuates same, as it is obvious that various other means could be used for this purpose. As the area of the reinforced portions at the ends of the buttonhole is governed by the length of the sraight surfaces 29 on the cam E, it is possible to vary the length of said reinforced portions by substituting a cam E having straight surfaces 29 of different length. In addition to being reliable, easy to operate and inexpensive to manufacture, a mechanism of the construction above described produces a strong and serviceable buttonhole that presents a neat and ornamental appearance, the sides of the buttonhole being finished by rows of short sitches that are disposed at substantially right angles to the center line of the buttonhole and the the ends of the buttonhole being reinforced by long stitches of substantially double the length of the short stitches that are disposed transversely of the center line of the buttonhole and extend a sufficient distance beyond the ends of the opening in the buttonhole to prevent the material from tearing at the ends of the buttonhole.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A means for forming buttonholes, comprising a stitch forming mechanism, a work feeding element, means for causing

said element to travel longitudinally in a zig-zag path forwardly and backwardly, and means whereby the needle of the stitch forming mechanism will be caused to penetrate the material at a different period with respect to the transverse movement of the work feeding element during the operation of inserting stitches at the ends of the buttonhole than said needle penetrates the material during the operation of inserting stitches at the sides of the buttonhole.

2. A means for forming a buttonhole, comprising a stitch forming mechanism, a work feeding element, means for causing said element to move longitudinally in opposite directions, and means for moving said element transversely during its longitudinal movement, constructed in such a way that the transverse strokes of said element will terminate substantially coincident with the penetration of the material by the needle during the operation of finishing the ends of the buttonhole and will terminate intermediate the periods at which the needle penetrates the material during the operation of finishing the sides of the buttonhole, whereby the stitch forming mechanism will be caused to insert long stitches at the ends of the buttonhole and short stitches at the sides of the buttonhole.

3. A buttonhole mechanism for sewing machines, comprising a work feeding element, means for imparting a longitudinal zig-zag movement to said element in opposite directions so as to cause the needle of the machine to insert stitches in the material at the sides and at the ends of the buttonhole, and means for changing the period at which the work feeding element shifts transversely relatively to the penetration of the needle, during the operation of inserting the stitches at the sides of the buttonhole so as to diminish the length of said side stitches.

4. A buttonhole mechanism for sewing machines comprising a work feeding element, means for causing said element to move longitudinally forwardly and backwardly so as to cause the needle of the machine to act on the portions of the material at the sides and at the ends or the buttonhole, and means for shifting said element transversely when it is moving longitudinally in such a way that the transverse strokes of said element will terminate substantially at the time the needle penetrates the material during the operation of inserting stitches at the ends of the buttonhole, thereby forming stitches of maximum length, and will terminate intermediate the periods at which the needle penetrates the material during the operation of inserting stitches at the sides of the buttonhole, thereby producing side stitches of less length than the end stitches.

5. A buttonhole mechanism for sewing machines, comprising a work feeding element, means for moving said element longitudinally first in one direction and then in the opposite direction, means for moving said element transversely in opposite directions when it is moving longitudinally, and means for varying the termination of the transverse strokes of said element relatively to the operation of the needle of the sewing machine so as to vary the length of the stitches that are inserted in the material.

6. A buttonhole mechanism for sewing machines composed of a work feeding element, a rotatable member that operates in synchronism with the needle of the machine, means for causing said work feeding element to travel forwardly and backwardly in a zig-zag path comprising an actuating device operated by said rotatable member, and means for changing the position of said actuating device relatively to said rotatable member at different periods in the cycle of operations of the mechanism so as to cause short stitches to be inserted in the material at the sides of the buttonhole and long, transversely-disposed stitches to be inserted in the material at the ends of the buttonhole.

7. A buttonhole mechanism for sewing machines composed of a work feeding element, a rotatable member that operates in synchronism with the needle of the machine, means for causing said work feeding element to travel forwardly and backwardly in a zig-zag path comprising an actuating device operated by said rotatable member, and means for bodily shifting said actuating device relatively to said rotatable member during certain periods in the cycle of operations of the mechanism so as to vary the length of the stitches used to finish different portions of the buttonhole.

8. A buttonhole mechanism for sewing machines composed of a work feeding element, a rotatable member that operates in synchronism with the needle of the machine, means for causing said work feeding element to travel forwardly and backwardly in a zig-zag path comprising an actuating device means whereby said actuating device will be arranged in such a position with relation to said rotatable member at certain periods in the cycle of operations of the mechanism that stitches of one length will be inserted in the material at the sides of the buttonhole and will be arranged in such a position with relation to said rotatable member at other periods in the cycle of operations of the mechanism that stitches of a different length will be inserted in the material at the ends of the buttonhole.

9. A buttonhole mechanism for sewing machines, comprising a work feeding element, a rotatable cam for imparting longitudinal movement to said element in opposite directions, a rock lever for moving said ele-

ment transversely when it is moving longitudinally, a rotatable member that operates in synchronism with the needle of the machine, an actuating device that co-operates with said rotatable member to transmit movement to said rock lever and cam, and means that co-operates with said cam to bodily shift said work feeding element at certain periods in the cycle of operations of the mechanism and to change the position of said actuating device relatively to said rotatable member each time said work feeding element is shifted bodily so as to vary the length of the stitches used to finish different portions of the buttonhole.

10. A buttonhole mechanism for sewing machines, comprising a work feeding element, a rotating cam, means for utilizing the rotary movement of said cam to move said work feeding element longitudinally in opposite directions, a shiftable supporting member on which said work feeding element is mounted, means whereby the cam will co-operate with said supporting member to maintain the work feeding element in a central position and in a right hand and left hand position during different periods in the cycle of operations of the mechanism, an operating means for said cam that comprises a rotatable member which operates in synchronism with the needle of the machine, an actuating device operated by said rotatable member, and means controlled by said cam for effecting a change in the position of said actuating device relatively to said rotatable member each time the work feeding element is moved from one position to another by said shiftable supporting member.

11. A buttonhole mechanism for sewing machines, comprising a base plate, a rotatable cam mounted on said base plate, a supporting member on said base plate adapted to be shifted by said cam into different positions, a work feeding element carried by said supporting member, a link that joins said cam to said work feeding element, a rock lever for turning said cam forwardly with a step by step movement, means on said rock lever for moving the work feeding element transversely when it is moving longitudinally, a star wheel that operates in synchronism with the needle of the machine, and an actuating device for transmitting movement from said star wheel to said rock lever.

12. A buttonhole mechanism for sewing machines, comprising a base plate, a rotatable cam mounted on said base plate, a supporting member on said base plate adapted to be shifted by said cam into different positions, a work feeding element carried by said supporting member, a link that joins said cam to said work feeding element, a rock lever for turning said cam forwardly with a step by step movement, means on said rock lever for moving the work feeding element transversely when it is moving longitudinally, a star wheel that operates in synchronism with the needle of the machine, an actuating device for transmitting movement from said star wheel to said rock lever, and means whereby said actuating device will be shifted into a different position relatively to said star wheel each time said supporting member is shifted into a different position by said cam.

13. A buttonhole mechanism for sewing machines, comprising a base plate, a rotatable cam mounted on said base plate, a supporting member on said base plate adapted to be shifted by said cam into different positions, a work feeding element carried by said supporting member, a rock lever that moves said cam forwardly with a step by step movement, means for transmitting longitudinal movement to said work feeding element from said cam, means on said rock lever for moving the work feeding element transversely when it is moving longitudinally, a star wheel that operates in synchronism with the needle of the machine, an actuating device operated by said star wheel for imparting movement to said rock lever, a shiftable member that carries said actuating device, and a connection between said shiftable member and said supporting member for effecting a change in the position of said actuating device relatively to said star wheel each time the cam moves said supporting member to bodily shift the work feeding element.

14. A buttonhole mechanism for sewing machines, comprising a base plate, a rotatable cam on the upper side of said base plate, a ratchet wheel on the underside of the base plate rigidly connected to said cam, a rock lever provided with a pawl that co-operates with said ratchet wheel to impart a step by step forward movement to said cam, a work feeding element, means operated by said cam for moving said work feeding element longitudinally, and means operated by said rock lever for imparting transverse movement to said work feeding element.

15. A buttonhole mechanism for sewing machines, comprising a base plate, a rotatable cam on the upper side of said base plate, a ratchet wheel on the underside of the base plate rigidly connected to said cam, a rock lever provided with a pawl that co-operates with said ratchet wheel to impart a step by step forward movement to said cam, a work feeding element, means operated by said cam for moving said work feeding element longitudinally, means operated by said rock lever for imparting transverse movement to said work feeding element, a shiftable supporting member on the base plate provided with a pivot about which said work feeding element swings when it is moved trans-

versely, means whereby the rotary movement of said cam automatically effects a change in the condition of said supporting member during the operation of finishing different portions of the buttonhole, a star wheel that operates in synchronism with the needle of the machine, an actuating device operated by said star wheel that transmits movement to the rock lever, and means for effecting a change in the position of said actuating device relatively to said star wheel each time the supporting member for the work feeding element is shifted.

16. A buttonhole mechanism for sewing machines, comprising a base plate provided with means for connecting it to the presser foot bar of the sewing machine, a vertically-disposed bracket on said base plate, a cam and ratchet wheel arranged above and below the base plate, respectively, and rigidly connected together, a pivotally mounted, yoke-shaped supporting member on the upper side of the base plate provided with an arm and with portions that co-operate with said cam to cause said supporting member to shift into different positions when the cam is in operation, a work feeding element provided with an elongated slot that receives a pivot pin on the arm of the supporting member, a link that joins said cam to said work feeding element, a rock lever on the underside of the base plate provided with a pawl that co-operates with said ratchet wheel to turn the cam forwardly with a step by step movement, means on said rock lever for imparting transverse movement to said work feeding element, a rotatable star wheel on said bracket, an operating lever on said bracket actuated by the needle bar of the machine for turning said star wheel forwardly, a pivotally mounted shifting member on said bracket operatively connected with said supporting member in such a way that the position of same will change when said supporting member is shifted from one position to another, and a reciprocating actuating device carried by said shifting member and adapted to be moved by said star wheel to cause said rock lever to swing forwardly and rearwardly.

17. A bottonhole mechanism for sewing machines, comprising a base plate provided with supporting feet, a vertically-disposed bracket on said base plate, means for enabling said base plate to be connected to the presser foot bar of the machine, a pivotally mounted operating lever on said bracket adapted to be connected to the needle bar of the machine, a rotatable star wheel on said bracket adapted to be actuated by said operating lever when the needle bar is in operation, a cam and ratchet wheel arranged above and below the base plate, respectively, at and rigidly connected together, a pivotally mounted, yoke-shaped supporting member on the base plate provided with opposed lugs that bear on the periphery of said cam, an arm on said supporting member provided with a pivot pin, a work feeding element composed of two gripping members pivotally connected together, one of said gripping members having an elongated slot that receives the pivot pin on the arm of the supporting member, a link pivotally connected to the cam and to one of said gripping members, a rock lever on the underside of the base plate provided with an arm equipped with a pin that is arranged in an elongated slot in the bottom gripping member of the work feeding element, a pivotally mounted pawl on said rock lever that is adapted to co-operate with said ratchet wheel to feed the cam forwardly, an adjustable shield for controlling the degree of movement imparted to the cam by said ratchet wheel, a shiftable member pivotally mounted on said bracket and operatively connected with the yoke-shaped supporting member, a reciprocating actuating device carried by said shiftable member and provided with pointed projections that co-operate with the teeth in the star wheel, and means for transmitting movement from said actuating device to said rock lever.

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