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E. O. BENNETT.

BUTTONHOLE MECHANISM FOR SEWING MACHINES.

No. 553,639. Patented Jan. 28, 1896.

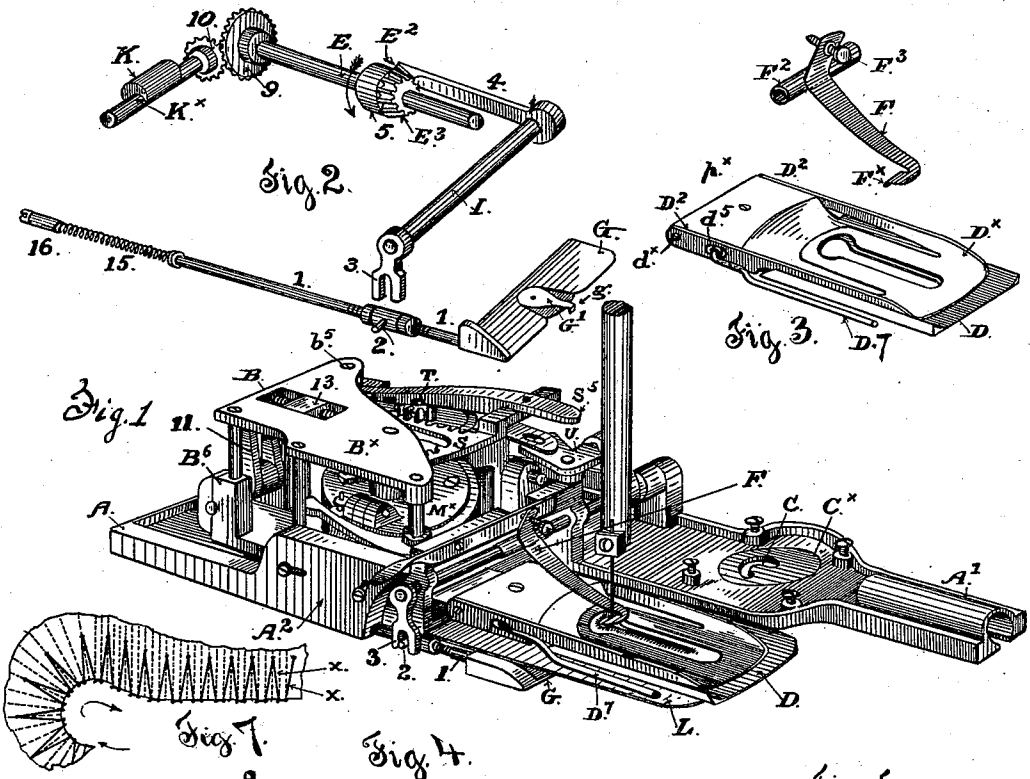

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 7.

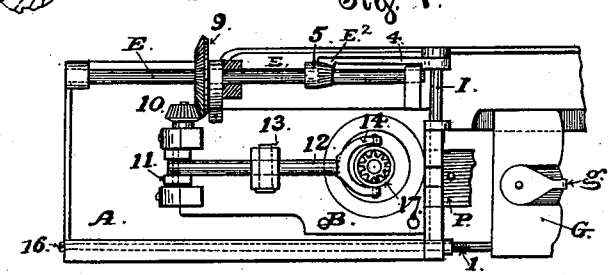

Fig. 4.

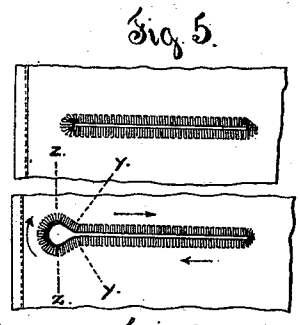

Fig. 5.

Fig. 6.

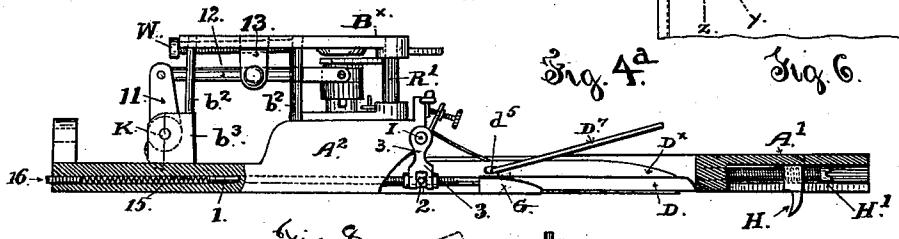

Fig. 4a.

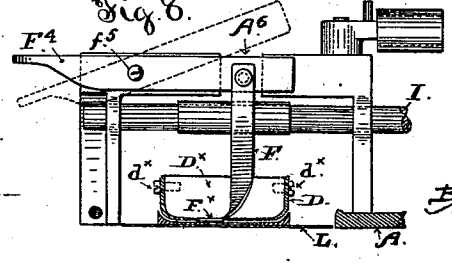

Fig. 8.

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(No Model.) 3 Sheets—Sheet 2.

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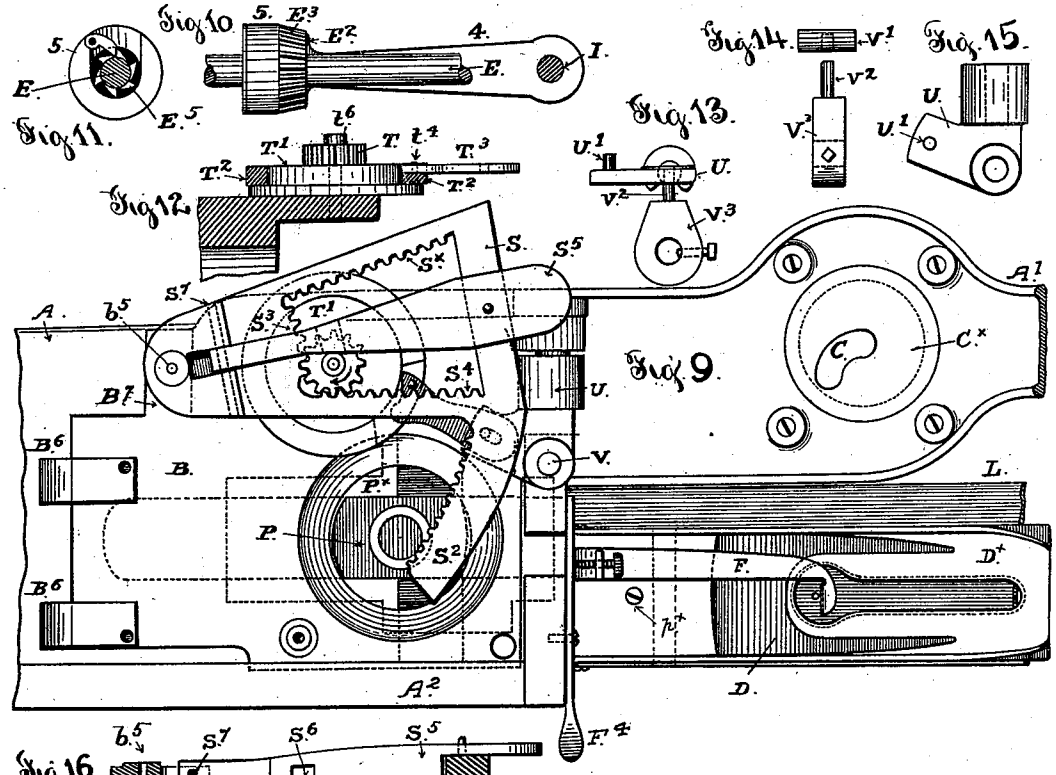

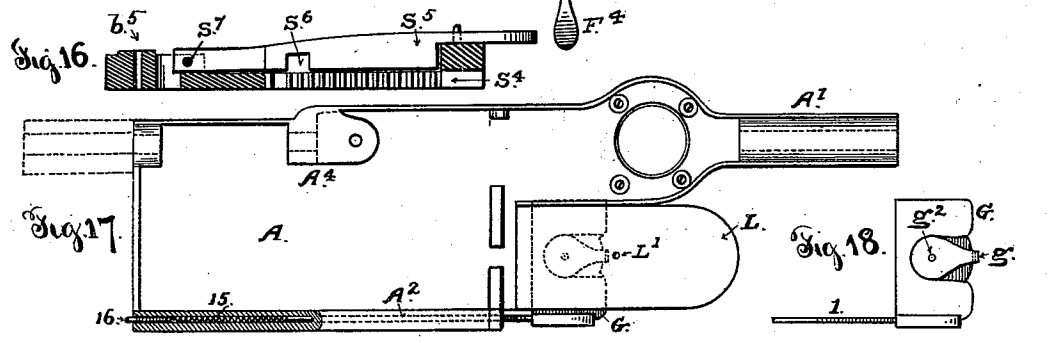

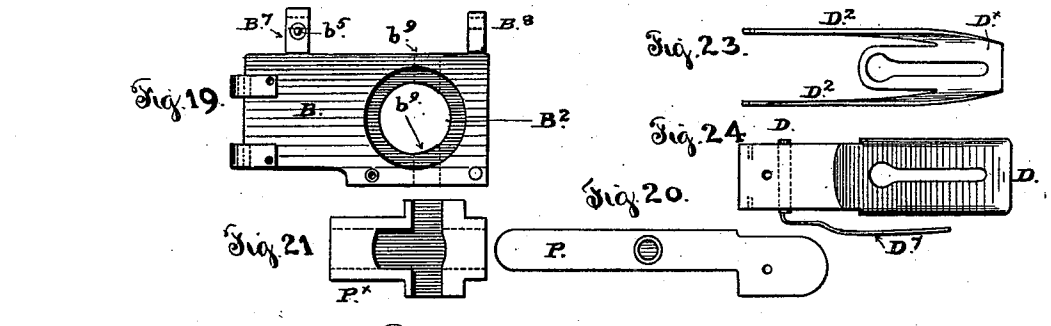

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(No Model.) 3 Sheets—Sheet 3

E. O. BENNETT.

BUTTONHOLE MECHANISM FOR SEWING MACHINES.

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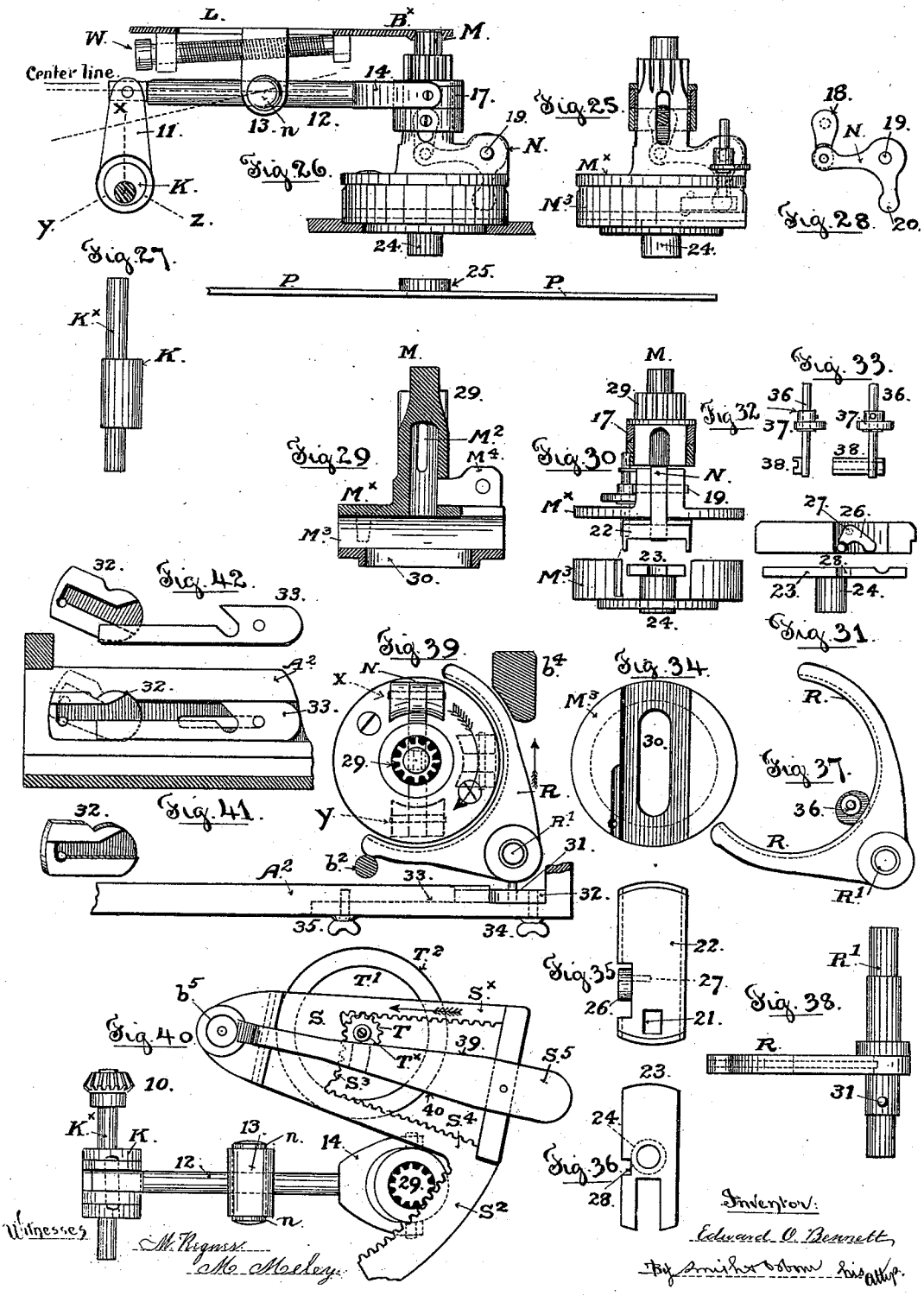

UNITED STATES PATENT OFFICE.

EDWARD O. BENNETT, OF HAYWARDS, CALIFORNIA.

BUTTONHOLE MECHANISM FOR SEWING-MACHINES.

SPECIFICATION forming part of Letters Patent No. 553,639, dated January 28, 1896.

Application filed September 26, 1893. Serial No. 486,511. (No model.)

To all whom it may concern:

Be it known that I, EDWARD O. BENNETT, a citizen of the United States, residing in Haywards, in the county of Alameda and State of California, have invented certain new and useful Improvements in Buttonhole Mechanism for Sewing-Machines, of which the following is a specification.

This invention relates generally to that class or description of sewing-machine attachments for stitching buttonholes in which the mechanism is actuated from the feed mechanism of the sewing-machine; and my invention embraces the mechanical structure of an attachment that is adapted for use on most all the different makes of family sewing-machines at the present time on the market and that has the capacity to produce a finished buttonhole either with or without an eye at one end and to work several different sizes of buttonholes.

Among the novel points and features in this mechanism attention is called, more particularly, to the construction of the work-carrying clamp and the means of vibrating or moving the same; to the mechanism by which the angular direction of the vibratory movements of the cloth-carrying clamp at the end of the buttonhole is changed on radiating lines to form the eye; also to the means for producing a buttonhole-stitch composed of two successive stitches or interlocking of the upper and lower threads upon the cut edge of the buttonhole-slit to one stitch or interlocking in the cloth back of the slit; also to the special mechanism for actuating all the working parts of the attachment from the feed-point or feed-bar of the sewing-machine.

These improvements and the manner in which I proceed to construct, combine, and embody them in an improved attachment for producing buttonholes with the sewing mechanism of a sewing-machine are fully explained in the following description, in which reference is had by figures and letters to the drawings that accompany and form a part of this specification.

In such drawings, Figure 1 is a perspective view of the complete attachment in position under the needle of a sewing-machine. Fig. 2 is a view in perspective of the main actuating-shaft and the parts connecting it with the feed mechanism of the machine. Fig. 3 is a detail view in perspective of the cloth-clamp and the stripper-foot removed from the machine. Fig. 4 is a top view of the principal part composing the bed-plate and the carriage of the attachment, the top plate of the carriage and some of the parts being removed. Fig. 4^a is a side elevation of the attachment with portions of its bed-plate at the front and rear shown in section. Figs. 5 and 6 are diagrams illustrating the two different styles of buttonholes made by this attachment. Fig. 7 is a diagram intended to illustrate the character of the stitch produced by this attachment. Fig. 8 is a front view on an enlarged scale showing the cloth-clamp and stripper-foot in cross-section on a vertical line just in front of the stripper-foot as it is seen in Fig. 1. Fig. 9 is a top view of the bed-plate and the carriage, with the top plate of the carriage removed, showing parts of the mechanisms that produce the progressive movement of the cloth-clamp and also the parts that change the angular direction of the vibrations. Figs. 10, 11, 12, 13, 14, 15, and 16 show such parts in detail. Fig. 17 is a plan of the bed-plates. Fig. 18 is a top view of the parts that connect the actuating-shaft of the attachment with the feed-bar of the machine. Fig. 19 is a top view of the carriage. Figs. 20 and 21 are details in top view of the compound slide or that part of the mechanism to which the cloth-clamp is connected and by which its several movements are produced. Fig. 22 shows one of the slides of this mechanism in perspective. Figs. 23 and 24 are top views of the parts composing the cloth-clamp. Figs. 25, 26, 27, and 28 are elevations, in detail and on an enlarged scale, of the parts that give vibratory movement to the cloth-clamp. Fig. 29 is a vertical section taken through the center of the turn-post M, with those parts omitted that are carried by the turn-post. Fig. 30 is a view of the turn-post M from the right-hand side of Fig. 25, with the parts thereof separated but in their relative positions. Figs. 31, 32, 33, 34, 35, and 36 are views in detail of the turn-post and the several parts that are mounted on and carried by it. Fig. 37 is a top view of the circular guide that produces and regulates the widening of the line of stitches along the curved edges of the buttonhole-slit. Fig.

38 is an elevation of the same part. Fig. 39 shows in top view the turn-post M, the circular guide, and parts of the stationary bed-plate with the switch-pieces or means that adjust and control the curved guide. Fig. 40 is a top view of the principal parts that feed or move the carriage progressively and also rotate the turn-post M to change the angular direction of the vibrations. Figs. 41 and 42 show in detail the parts of the switch-piece that control the circular guide and also regulate the length of travel of the carriage to produce buttonholes of different sizes.

The principal parts of the stationary bed-plate of the attachment consist of the flat base-plate A, the tubular projection A′ at the front and the perpendicular standing part A^2 at one side. This stationary part is secured on the bed of the sewing-machine in position under the needle-arm by means of the gage-screw that is used to hold in place the hemmer and other attachments of the sewing-machine. A hole or slot is provided for such screw in the front part A′; but as the position of the hole provided in the sewing-machine bed for this screw will be found to vary in different machines with relation to the needle-hole in the machine throat-plate the hole for such screw in my attachment would not, in some cases, lie in proper position if it were fixed or unchangeable, and therefore to furnish suitable scope or degree of adjustability in this respect I set in an opening in the part A′ a circular turn plate or disk $C^{\times}$, in which is a curved slot C for the fastening-screw, and thus by revolving such disk in the bed-plate its curved slot can be brought into a position wherein some portion of the slot will set directly over the screw-hole in the machine-bed beneath and the clamp-screw can be inserted and screwed down against the disk. In connection with this means of fastening the attachment in place I employ an adjustable clamping-dog H in the extension A′ to hold the bed-plate A down at the front. This part H is composed of a threaded nut fitted to move in the slotted recess provided for it in the under side of the part A′, and threaded to work on a screw-shaft H′ extending through the recess and exposed at the front end of the part A′, so that the screw-shaft can be turned from the outside to move the nut longitudinally in the slot. From the bottom of the nut projects the dog H, which being curved backward is made to engage the edge of the machine-bed by turning the screw-shaft. This fastening serves to hold the attachment against either lateral or perpendicular movement out of place under the needle.

An extension on the rear side of the bed-plate similar to the extension A′ at the front, with a slotted recess, a sliding dog and a setting-shaft of the same construction can be added to the attachment, as indicated by the dotted lines in Fig. 17 of the drawings; but for all ordinary sizes of these attachments which it may be practicable to manufacture I consider the single adjustable dog at the front of the bed-plate in connection with the clamp-screw a sufficient holding means.

B indicates a sliding carriage mounted on and movable in the bed-plate in a longitudinal direction only. In this movement it starts from the extreme position on the rear end of the stationary bed-plate A to the extreme forward position at the front, and thence back again to the starting-point. In this movement it carries the cloth-clamp D or that part in buttonhole attachments of this kind which grip or confine and move the cloth under the sewing mechanism with the progressive and vibratory movements. The step-by-step progressive movements of the carriage space the stitches along the slit, and the same are produced by the following parts, shown in detail in Figs. 2 to 16, inclusive.

The rock-shaft I is supported in bearings provided on the front end of the bed-plate, and at the left-hand side of the attachment the forked arm 3, secured on the end of the shaft, embraces a pin 2 on a horizontal slide-bar 1, extending forward at the side of the cloth-clamp. To the end of this bar 1 is connected the reciprocating slide-plate G, that engages with the feed-bar of the sewing-machine, and thereby produces reciprocations of the bar 1 from the feed mechanism of the machine. A coil-spring on the rod behind the slide-plate G acts to produce return movement of the plate after every throw produced by the feed-bar.

The pinion T is fixed on the top face of a horizontally-set disk T′, that is formed with a bottom flange, as seen in Fig. 12, and is mounted to rotate on the screw-stud t^6, fixed in the top of the support A^4 on the bed-plate, and on such flange is supported a ring T^2, loosely fitting and turning on the disk. To such ring is pivoted at t^4 a dog T^3, having a tooth or pointed end that sets against the rim of the disk and grips the same by friction when the opposite end of such dog is moved in one direction, but slips on the disk without biting when movement in the contrary direction takes place. The outer end of the dog is attached to the vibrating angle-piece U, which is centered to turn on an upright stud V on the top of the standing part of the bed-plate at the front, and to such piece U the end of the dog is attached by a stud U′ and a slot in the dog. The other arm or member of the part U is attached by means of a knuckle-joint or a ball-and-socket joint V′ V^2 to the end of the upright rocker-arm V^3, that is fast on the rock-shaft I. Thus the rock-shaft by its vibrations moves the piece U in a horizontal arc and throws the outer end of the dog T^3 first in one direction, whereby it grips and turns the disk T, and then in the opposite direction, when it slips and takes a fresh grip on the disk for the next step. The pinion rotated by these parts gives the carriage intermittent progressive movement through the medium of the rack S, which is

a frame having internal toothed portions $S^{\times}$ S^3 S^4 on the two sides and across one end, and having, also, a central guide-bar S^5 extending longitudinally across the top. The rack is pivoted at b^5 on the carriage B, and swings in an arc on that part as a center. The straight portions of the rack set at equal angles on both sides of the bar S^5, and each vertical face of that bar is parallel with the pitch-line of the rack opposite. In the space between such guiding edge of the bar and the teeth of the rack opposite the pinion T moves along in mesh with the rack, and a roller is set on the stud of the pinion to bear against and travel along the side of the bar S^5. The toothed portion S^3 at the end of the rack is struck on an arc from the pivot b^5 as the center, whereby the rack is moved over to the opposite side when the pinion leaves the straight portion S^4 and engages the curved portion. Thus the pinion T, starting at the outer end of the rack $S^{\times}$, will draw the carriage forward step by step to the front of the stationary bed-plate, and then being shifted over to the opposite side the pinion T will engage the opposite rack S^4 and draw the carriage back step by step to the starting-point. By these movements of the carriage the cloth-clamp is fed forward to lay the stitches along one side of the buttonhole-slit, and then back again to stitch the opposite side of the slit.

The function of the guide-bar S^5 is to hold the pinion in mesh with the racks on both sides, and the bar is cut away at S^6 on the under side to let the roller on the pinion-stud pass under the bar from one side to the other of the frame.

The guide-bar S^5 is hinged at S^7, Fig. 16, and is lifted at the outer end when a buttonhole is completed, in order to set the rack S back by hand and thus bring the pinion T into gear with the rack $S^{\times}$ in starting another buttonhole.

It should be noticed that the reverse movement of the rack-frame S takes place at the end of the buttonhole where the eye is formed, and consequently the carriage has no progressive movement at such time, and the cloth-clamp is acted on only by that part of the mechanism which gives the vibratory movements.

The cloth-clamp in attachments of this kind is composed generally of two jaws connected at the rear end and opening at the front end to receive and clamp the cloth between them, and having an open center for the needle to work in. These two parts should so coact, especially when the slit is cut in the cloth before the buttonhole is worked, that the cloth is firmly seized and confined all around the edges of the slit; and the best work is obtained when the upper jaw moves as nearly as possible parallel with the plane of the lower jaw under the cloth, and presses uniformly upon the cloth. It is also essential in the construction of these clamps that the cloth should lie as closely as possible to the surface of the needle throat-plate in the sewing-machine bed, in order to bring the interlocking of the two threads uniformly on the edges of the cloth and produce an even stitch. All these features and results are secured in and by my construction of cloth-clamp. Its bottom jaw is a plate D, with standing sides slightly curved on their inner face, and a flat cloth-carrying surface around a central opening for the needle to work in. This plate is considerably thicker at the back part than such cloth-supporting portion, and the sides are cut away, as shown in Fig. 3, to receive the side bars of the upper jaw, $D^{\times}$. The upper jaw is a plate of spring metal with an open center for the needle and a narrow rim or portion of metal extending around the sides and on the ends of such opening. Its side bars D^2 are cut integral with the metal of the bottom and bent up to form parallel arms standing backward, as shown in Figs. 3 and 22. Such arms are attached by screws $d^{\times}$ to the back end of the jaw D, so that the upper jaw opens and shuts on these screws as pivots. The lower jaw is formed of thin steel, and its opening conforms in outline to the shape of a buttonhole, but somewhat larger than the largest size which the attachment is capable of making. The edges of this opening should lie just outside of the line on which the needle enters the cloth, and the corresponding opening in the upper jaw should be somewhat smaller, so that its edges just overlap the edges of the lower opening. The side bars of the upper jaw are turned up on a curve where they join the body of the clamp near the front end, and from that point they are cut away to lie over the raised sides of the bottom plate, D, as seen in Figs. 1 and 3. These clamping-surfaces are flat and lie closely together around the buttonhole-opening; but along the sides of the clamp they extend upwardly in a curve, in consequence of which the cloth is firmly gripped lengthwise of the buttonhole along both sides, besides being held down smoothly around the opening in which the needle works. By virtue of this construction, also, the upper jaw presses firmly upon the cloth at the rear and front ends of the buttonhole-slit. This construction is especially adapted for the thinner kinds of fabrics, such as linen and muslin, which are found difficult to stretch smoothly and to clamp firmly. To open and close the upper jaw an eccentric d^5, turning freely in a recess in the thick portion of the lower jaw, is arranged to work at both ends in slots in the side bars of the upper jaw, Figs. 3, 4^a, 23, and 24, so that the eccentric when turned in these slots will move the jaw. The lever D^7 is fixed to one end of the eccentric for turning it.

L is a thin metal plate, on which the bottom plate of the cloth-clamp slides smoothly when in motion. Such plate is fixed to the front of the bed-plate A to cover the feed-points of the sewing-machine, and it has a hole L′ for the needle. When the cloth is held in the clamp this plate is practically the

only thickness of metal that intervenes between the cloth and the surface of the needle throat-plate of the machine, and consequently the cloth in the clamp is not raised materially above the normal plane or position in which it would be if it were being sewed in the machine. This is an important point in the construction of these clamps, as the proper interlocking of the threads and the formation of the stitches are disturbed when the cloth is raised materially out of the plane in which it is intended to move under the needle.

F is a device which I term the "stripper-foot," the function of which is to prevent the cloth from rising with the needle and the cut edges of the buttonhole from being drawn up by the thread during the formation of the stitches on the edge. The foot of this piece is not allowed to rest directly upon the cloth, but sets in the opening of the clamp across the slit and in such close relation to the surface of the cloth and to the path of the needle that it strips the cloth from the needle and holds it down whenever there is any tendency to rise or be drawn up as the needle leaves the cloth and the stitch is tightened. It is adjusted therefore to hold the cloth down without actually pressing upon it during the movements of the cloth-clamp. The acting portion of the foot on the side next the needle has a turned-down lip $F^{\times}$, corresponding in breadth to the space between the edges of the opening on the upper jaw and setting in the opening between the edges, so that in the vibratory or sidewise movements it travels with the clamp; but it is not affected by the progressive movements of the clamp. It remains therefore in position in front of and close to the needle and bridges the opening in the clamp just at that point. This foot F is fixed to a sleeve F^2 fitted to slide on the rock-shaft I across the front of the frame, so that it moves sidewise with the clamp, but it is capable also of turning on the rock-shaft so that the foot can be raised up out of the way to inspect the work or to adjust the cloth in the clamp. A set-screw F^3 in the upper end of the foot bearing against the front cross-bar of the frame limits the upward movement of the stripper-foot, and by its adjustment serves to regulate the working position of the end $F^{\times}$ with reference to the thickness of the cloth in the clamp, and in such manner that the foot shall exert no pressure upon the work in the clamp, but shall prevent the cloth from rising with the needle. The screw therefore controls the length of such lifting movement of the foot. The cross-bar of the frame is cut away, as shown in Figs. 1, 8, and 17, to let the set-screw back into it, so that the foot can be turned up and thrown back out of the way when the needle is raised, and the bar F^4 that is pivoted at f^5 and turns up and down on that point can be set across the frame to close the opening A^6 and form a bearing for the set-screw F. By pressing on its outer end such bar F^4 is thrown above the slot in the frame, as indicated in dotted lines, Fig. 8, and the stripper-foot can be turned up out of the way. I do not confine myself to this manner of supporting the stripper-foot, however, as it may be found necessary in some cases to attach it to or support it from some other part of the attachment.

The cloth-clamp is attached to the carriage by the compound slide P $P^{\times}$, and such slide also connects the cloth-clamp with the mechanism that imparts the vibrations or sidewise movements, and by the combined action of one part on the other peculiar angular movements of the carriage are produced by which the stitches are laid substantially perpendicular at right angles to the cut edges of the buttonhole around the curved or circular portions as well as on the straight portions of the opening. All the vibratory movements of the clamp are produced from an eccentric K on a counter-shaft $k^{\times}$ mounted in bearings B^6 B^8 on the rear end of the carriage and geared into the principal shaft E by gears 9 10. Gear 9 has a bearing B^7 on the carriage, but it is fitted to slide on the shaft E and remains in gear with the wheel 10 while turning with the shaft.

The eccentric K operates a pivoted lever 12 through the medium of a strap or sleeve surrounding the eccentric and provided with arms 11 between which is pivoted one end of the lever 12. The inner end of the lever is forked at 14 to take a sliding collar 17 and is attached to that piece by screw-pivots. The collar 17 is fitted to slide upon an upright turn-post M, the upper end of which has a bearing in the top plate of the carriage, while a circular plate $M^{\times}$, formed integral with the lower end of the post, is secured to a circular block or turn-table M^3. Such part M^3 forming the bottom of the turn-post is fitted into a circular recess B^2 in the bed of the carriage, and the turn-post being centered in this manner in the top plate and in the bed of the carriage it turns smoothly on these bearings. The block M^3 is recessed horizontally from end to end, Figs. 29 and 34, and has also a long slot 30 in the bottom. In such recess is fitted a slide-plate 22 having a slot 21 in the top face near one end, and the oscillating motion of the lever 12 gives reciprocating movement to this slide 22 through the agency of the collar 17 and a pivoted lever N attached to the collar by a link 18. The lever N is pivoted at 19 between lugs M^4 on the top of plate $M^{\times}$, and its lower end sets into a slot 21 in a slide 22, so that the movement of the lever on its pivot 19 produces reciprocating movement of the slide in the guide-block M^3. A movable shoe 23, fitted into the grooved bottom face of the slide 22, is locked in that piece by a pivoted tumbler 26 and is carried by the slide. To this shoe or piece 23 the slide-plates P, that carry the work-clamp, are connected by a socket 25 on the plate and a stud 24 projecting from the bottom face of the shoe. This stud works through the slot 30. These parts connect part

P of the compound slide with the lever 12 and produce vibratory motions of the clamp by which the stitches are laid from the edge of the buttonhole backward into the cloth.

I use an eccentric to actuate the lever 12 and so adjust the lever that the forked ends shall vibrate in an arc of greater or less length the center of which is the fulcrum 13, (indicated in Fig. 26,) for the purpose of producing a peculiar buttonhole-stitch of the character illustrated in the diagram Fig. 7, Sheet 1. In this stitch the needle makes two stitches or interlocking of the threads in the slit to one stitch in the cloth back from the edge, thus forming a "pearl finish" directly on the edge of the slit around the buttonhole of a strong and substantial character that will not ravel when cut or worn at any point.

The shaft $K^{\times}$ is geared into the shaft E, and the eccentric is moved and timed with respect to the carriage-feed to produce two vibrations simultaneously with two progressive steps of the carriage followed by one progressive step without a vibration, so that while the eccentric is passing over the center the needle takes one stitch in the cloth and lays the threads *x x*, Fig. 7, from the edge of the slit into the cloth and back again; but while the eccentric is passing under the center no vibrations of the clamp are produced and the feeding movement above acts on the cloth-clamp during that time to cause the needle to make two stitches in the slit.

The three acting points at which the stitches are formed in every complete revolution of the eccentric are indicated at *y x z*, Fig. 26. In passing from *y* to *x*, and then from *x* to *z*, the two long stitches on the cloth are made, but in passing from *z* to *y* the eccentric produces no vibration of the forked lever 12, and the short stitch is made in the slit while the eccentric is passing under the center between the two points *z y*. Thus the long stitches laid from the edge into the cloth being produced from the vibrations of the lever 12, the length of these stitches is determined by the length of the vibrations of the outer or forked end of the lever, and such vibrations are changed in length by shifting the fulcrum-block 13 nearer to or farther from the turn-post M. This block 13 slides in a slot in the top plate $B^{\times}$, and is threaded to work on a screw-shaft W, supported in lugs at the front and rear ends of a rectangular opening in the top plate, and provided with a capstan-head on the outer end. The fulcrum for the lever 12 in this block is formed of a cross-pin *n*, loosely fitting the block and having a transverse aperture through it for the lever, so that while the pin itself is confined in the block it is free to turn or rock in it, and at the same time the pin will slide along the lever when that part is being shifted forward or backward in the opening of the top plate to change the position of the lever's fulcrum.

It will be noticed that the screw-shaft W has an inclined position in the frame of the carriage and at the front end is higher than at the rear end instead of being horizontal. This is done for the purpose of making the forked end 14 of the lever start from the same point in beginning its downward stroke, at which time the opposite end of the lever is at the lowest point, of course, and the eccentric is passing from *z* to *y*, and during such time the needle is making the stitch in the slit of the buttonhole. If the fulcrum-block were shifted on a horizontal line it will be seen that the change in the position of the fulcrum would vary the length of throw of the end 14 of the lever in such manner that the starting-point at the top of the arc described by such end 14 would be changed as the length of the arc described was changed, and consequently the needle would not start always from the slit of the buttonhole in laying the long stitches into the cloth, such stitches as already before described being produced by the movements of the outer end of the lever 12 from *y* to *x* and from *x* to *z;* but by dropping the fulcrum 13 as it is moved back or raising it as it is moved forward in any change of position I am enabled to make the lever 12 start from the same point in beginning its downstroke in all adjustments of the fulcrum-block.

The slide P, as before described, sets in the part $P^{\times}$, Figs. 20, 21, and 22, in the longitudinal groove in that piece, and an intersecting groove crossing at a right angle in the same piece takes the guide-ribs $b^{\times}$ on the bottom of the carriage. The part $P^{\times}$ therefore can slide transversely on the carriage, but cannot move lengthwise, and the part P is free to move lengthwise only in the other part. The combined sliding movements of these two pieces acted on by the reciprocating shoe 22 control and change the angular direction of the vibrations according as the position of that piece 22 is changed by rotating its actuating-lever N above a vertical axis.

At the beginning of the operation to stitch a buttonhole the post M that forms such axis is set in the position represented in the top view, Fig. 39, the plane of oscillation of the lever N standing at a right angle to the line of the buttonhole-slit, so that the slide 22 reciprocates across the carriage and not lengthwise. In this position of the post M the slide P has no movement, but the other plate $P^{\times}$ being moved transversely on the guide-ribs gives lateral movement to the part P that rests in it, and consequently vibrations of the cloth-clamp are produced in the direction of the straight arrow, Fig. 30, at right angles to the buttonhole-slit and from one side of the center line of the slit outward and back again. By these vibrations the stitches are laid along one side of the buttonhole from the inner end to the eye, at which point the angular direction of the stitches are changed by the rotary movement of the post M in the direction of the curved arrow, Fig. 39, and the center 19 on which the lever N vibrates is

rotated about the post as a center until the same has made a complete half turn or revolution from x to y, Fig. 39. At such time the movements of the slide 22 act upon both parts of the compound slide P $P^{\times}$ and the combined movements of one slide in the other have the effect to lay the stitches radially around the circular edge of the eye into the cloth. When the lever N in its rotation comes to the opposite side of the center, as seen in Fig. 1 and indicated at y, Fig. 39, the vibrations will take place in a direction at right angles to the line of the buttonhole-slit, and the stitches will be laid along the opposite sides of the button-hole from the eye back to the starting-point.

By referring to Figs. 6 and 7 of the drawings it will be seen that in forming a buttonhole with an eye at one end the line of the slit where its straight edge joins the eye recedes gradually on a curve or widens on both sides to join the half-circle that completes the eye, so that it is necessary to shift the line of vibrations away from or back of the center line at these points. These two divergent lines of stitches, as from y to z, Figs. 6 and 7, on both sides are produced by simply moving the shoe 23 in the slide 22 a small amount to throw the stud 24 away from its normal center position under the center line of the turn-post, and by this means the starting-point of such vibratory movement of the slide P is shifted to one side of the center, while the length of the vibrations remains practically the same.

Referring to Figs. 30 to 36, it will be seen that the shoe 23 sets into the grooved bottom of the slide 22 and that piece in turn sets into the recessed block that forms the bottom of the turn-post M. Consequently the length of the vibrations of the slide produced by the lever N are not affected by shifting the shoe in the slide, although the starting-point of the cloth-clamp in each vibration will be set back from the center line to conform to the widening of the slit. The parts that shift the shoe to produce this widening of the buttonhole at the eye consist of the tumbler 26, the grooved keeper-plate 38 and the lifting-pin 36 mounted on the turn-post M, and the curved guide R mounted on the carriage.

The guide R embracing the base-block of the turn-post is fixed on a post R′ supported at top and bottom ends in the bed and top plate of the carriage and capable of limited vertical movement in its supports. The face of the curved guide next to the turn-post is grooved to receive a collar 37 fast on the lifting-pin 36. The guide R has limited vertical movement, but otherwise it is stationary in the carriage. Both the grooved plate 38 fixed on the end of the lifting-pin 36 and the tumbler 26 set in a recess in the side of the slide 22. The lifting-pin, which is supported in a socket in the block M^3 and is movable up and down therein, acts on the shoe 23 when moved up or down to shift that part in the slide 22 through the medium of the grooved plate and the tumbler 26 before mentioned, for the tumbler, which is pivoted at 27, connects the shoe 23 to the lifting-pin, and as that last-mentioned piece is raised or lowered by the curved guide R, before described, the tumbler is caused to set the shoe 23 either forward or backward in the slide 22. This last-mentioned piece is recessed for the tumbler and the grooved plate 38, as seen in Figs. 31 and 35 of the drawings.

The function of the curved guide R is to raise and depress the pin 36 and to hold it at rest when the turn-post is rotated on its center. When the guide is raised it moves the shoe to one side or backward from the center, or when it is lowered it brings the shoe back to the center again. Figs. 37, 38 and 39 show the shape and the position of this guide on the carriage.

The guide R is raised and depressed by a pin 31, fixed in the post R′, and a slotted switch-piece composed of two grooved or slotted plates 32 33, Figs. 41 and 42, in a recess in the standing sides A^2 of the bed-plate. The end of the pin 31 travels in the slot formed by the switch-piece for the entire movement of the carriage, from its extreme position at the back to its farthest position forward on the bed, and controls the length of movement of the carriage and also lifts and depresses the circular guide. The two parts 32 33 of the switch-piece on the stationary frame A^2 are adjustable to form a guide-slot of greater or less length and either with or without a rise or upward inclination at the front end. One piece 33 is movable horizontally in the recess and is held by a clamp-screw 34, working through a slot in the part A^2. The other piece 32 is movable in an arc in the recess in such part A^2 and is held by a clamp-screw 35. Its inner face is grooved or recessed, as shown in Figs. 41 and 42, so that in all positions its slot is a continuation of the slot formed by the piece 33. The pin 31 traveling along these pieces is guided by and necessarily follows the direction of the slot which they form, and the guide R is held at rest by the straight portions of the slot and is either elevated or depressed by the inclines at the ends of the slot during the travel of the carriage in the bed. As I have before described, the office of the guide R is to raise and lower the lifting-pin 36 and by moving that piece up or down it throws the stud 24 on the bottom of the reciprocating piece 22 either away from or back to the center line of the turn-post, and thus shifts the starting-point of the vibrations either away from or toward the straight line of the buttonhole-slit. This divergence of the line of stitching in sewing from the end of the buttonhole toward the eye must begin when the straight line meets the curve, as at x, Fig. 6, and must continue until the line has widened sufficiently to form the eye, and then from that point z the stitches are laid in a semicircle around to the opposite side. That point

z is the point, therefore, at which the circular guide ceases to move the sliding shoe 23 and the turn-post M begins to turn on its center, making a half-revolution. The change in the angular vibrations thus produced has the effect to lay the stitches around the half-circle to the point z, and when that point is reached the turn-post has carried the lever N around to the outer side, as shown in Fig. 1 and by broken lines in Fig. 39. In this position the turn-post then remains while the carriage moves back step by step to finish the other side of the buttonhole. The rotation of the turn-post M is produced by the pinion 29 on the upper part of the post and the curved rack S^2, which is a part of the carriage-moving rack S, the curved rack being always in mesh with the pinion 29. These parts are so adjusted that when the driving-pinion T engages the teeth S^3 at the end of the frame and swings the frame on its pivot b^5 the carriage has completed its forward travel and one side of the buttonhole from the end to the half-circle of the eye has been finished, and then the turn-post is rotated by the movement of the rack-frame S on its pivot, but the carriage itself has no progressive movement while that takes place. Before this rotative movement of the turn-post begins, however, the pin 31 has reached the end of the inclined groove in the piece 32 and has elevated the guide R, throwing the shoe 23 off the center and thereby shifting the starting-point of the vibrations back of the center line. After this, the extreme front end of the slot having been reached by the pin 31, the carriage has no farther movement forward, and the rack S^3 turns the post M around one half-revolution step by step to lay the stitches in radial lines around the half-circle of the eye. At the completion of the half-circle the carriage begins to feed backward step by step and the pin 31 moves backward and down the incline until it strikes the straight portion of the guide-slot in the piece 33. The line of stitching is then converged or thrown in from the end of the half-circle by the gradual drawing down of the guide R in the same manner as it was thrown out during the divergence or widening of the line by the lifting of the guide R, and the stitches are laid in the cloth and on the straight line of the buttonhole-slit.

In the operation of stitching a buttonhole the length of the slot formed by the switch-piece 32 33 determines the length of the buttonhole, and the pitch of the incline at the front end determines the form of the buttonhole at the end. Therefore these pieces are made adjustable, as described, to enable several different sizes and styles of buttonholes to be made in the same attachment. The straight piece 33 sliding in the frame A^2 is set forward or back according to the length of the buttonhole to be made, and the piece 32 is turned to set its slot at greater or less pitch above the horizontal according to the size of the eye to be formed in the buttonhole. If a buttonhole without an eye is to be stitched the piece 32 is set straight, as shown by the full lines, Fig. 41.

It will be noticed that the groove of the switch-piece is inclined downwardly at the rear end, in which the pin 31 rests when the carriage begins to move forward. The purpose of this incline is to depress the curved guide R and thereby set the starting-point of the lateral vibrations directly upon the center line of the slit as the work begins, and then throw several stitches gradually back from the line on an angle until the slit in the cloth is reached. This incline on the rear end of the piece 32 therefore gradually elevates the guide R and causes the shoe 23 to draw toward the center axis of the turn-post, gradually shifting outward the starting-point of the vibrations in the cloth-clamp. Several stitches are thus laid at the inner end of the buttonhole, as indicated in Fig. 5, to stay the end of the slit. As the pin 31 leaves the incline and runs into the straight portion of the switch-piece it holds the guide R stationary until the straight line of the slit is finished and the incline at the front end is reached. In the return movement of the carriage the pin 31 controls and moves the guide R in the same manner, and the inner end of the buttonhole is finished with several stitches laid gradually inward by the depression of the guide R on the carriage. Both ends of the buttonhole are stitched and finished, therefore, by shifting the starting-point of the vibrations of the cloth-clamp away from the center line of the buttonhole-slit for one side, and toward such center line for the opposite side of the buttonhole.

By referring to Figs. 2, 4 and 4^a, it will be seen that all the movements of the carriage and the cloth-clamp attached to the carriage are obtained from the rock-shaft I, which may be termed, therefore, the "principal shaft," and that the other shafts deriving their movement from it thus have motion of rotation in one direction, and there are no abrupt reversing movements in these drivers. This has the effect to produce smooth, even and uniform vibrations of the cloth-clamp, and enables short or fine stitches to be sewed successfully especially in thin fabrics. The shaft I is actuated directly from the feed-bar of the sewing-machine itself through the medium of the reciprocating plate G and the spring-rod 1 that causes the plate to follow the movements of the feed-bar backward as well as forward. The plate G is fitted to slide in the bed-plate A and has a catch g that engages the front end of the feed-bar; but as the position of the feed-bar is found to vary sometimes in machines of different makers it is necessary to change this catch g to accommodate the feed-bar. For this purpose I form the catch g in one piece with a disk G′ centered on a pivot g^2 in the plate and movable on that point as a center. This allows sufficient lateral adjustment of the

catch *g* to meet any variation in the position of the feed-bar. The rod 1 plays in a long recess in the bed-plate and a coil-spring 15 sets behind it to hold the slide-plate G in contact with the feed-bar in such manner that when in operation the plate is practically connected to the feed-bar and does not break or separate from it during its reciprocations. The force of the spring is regulated by a set-screw 16 placed behind the rear end, as shown in Figs. 2 and 8.

The parts that operate the eccentric K consist of the rock-shaft I, the rocker-arm 4, and the toothed segment E^2 on the end of that arm, the shaft E, which is geared into the eccentric-shaft by the bevel-gears 9 10 and the ratchet-drum 5 on the shaft E. The toothed segment E^2 engages a bevel-gear E^3 on the drum, and that part, being fitted to turn loosely on the shaft E, surrounds the ratchet-tooth portion E^5 formed on that part of the shaft E which is covered by the drum. That part which I have termed the "ratchet-drum" has a recess in one end containing a pivoted pawl, Fig. 11, that engages the ratchet-teeth on the shaft, and thus as the arm 4 is vibrated by its shaft I the drum is turned on the shaft F alternately forward and back, producing intermittent rotary motion of the shaft E, and through that movement turning the eccentric-carrying shaft in one direction with intermittent motion. The gear 9 is mounted on the carriage, and the shaft E is mounted on the stationary frame, but is fitted to slide through that gear to which it is connected by a groove and feather. The shaft E also forms a guide for the carriage in its movements backward and forward in the stationary frame. The two blocks or posts B^7 B^8 slide on the shaft and are a part of the carriage.

The length of feed or longitudinal movement of the carriage B to which the cloth-clamp is attached is varied by changing the throw of the lever T^3 that rotates the disk T', Figs. 9 and 12, and thus the number of stitches produced by the mechanism in any given length of buttonhole is increased or reduced by changing the feed or length of movement that takes place at every stroke of the needle. The length of stroke of the lever T^3 is regulated by changing the throw of the pivoted piece U, and that is done by loosening the set-screw in the piece V^3, which is held by the screw on the rock-shaft I and then shifting that piece longitudinally on the rock-shaft either toward or away from the center of vibration of the piece U, which is on the post or stud V on the frame. As before mentioned the pin V^2 of the piece V^3 sets into the slot in the lower side of the lateral arm of the piece U, the lever T^3 being attached to the rearwardly-extending arm of that piece, and therefore by shifting the piece V^3 farther from the center V the length of vibrations of the arm moving the lever T^3 will be increased while a contrary adjustment of the piece on the rock-shaft will reduce the vibrations.

Referring to Figs. 9 and 17, it will be seen that the cloth-clamp sets and is moved upon a thin plate instead of setting directly upon the cloth-plate of the machine. This plate prevents the feed-bar from acting on the cloth and forms a smooth level surface for the cloth-clamp to work on. It also supports the cloth directly around the needle in the open part of the clamp. The slide G that connects with the feed-bar is located beneath this plate, as shown in Fig. 17.

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

1. In an attachment for sewing-machines the combination of a stationary bed-plate, a carriage having longitudinal movement therein, a cloth-clamp receiving longitudinal movement from said carriage, and mechanism mounted on the carriage for vibrating the cloth-clamp, consisting, essentially, of the pivoted lever N, eccentric and eccentric shaft K $K^\times$ means connecting such shaft with the feed-bar of the sewing machine to rotate said eccentric intermittently, means connecting the lever N with said eccentric whereby the same is vibrated from the feed-bar of the machine, and the compound slide composed of the parts P $P^\times$ connecting the cloth-clamp to the carriage, and the carriage with said lever *k*, constructed for operation as described.

2. The combination, with the cloth-clamp, of the carriage having longitudinal movement to space the stitches, the compound slide connecting the cloth clamp with the carriage, and mechanism for vibrating said slide, consisting essentially of a pivoted lever moving in a vertical plane and having vibratory movement on its center and means for turning said center of vibration around a vertical axis to change the angular direction of the vibrations without affecting the length of such vibrations.

3. The combination, with the cloth-clamp, of the compound slide consisting of the sliding-piece having longitudinal movement, and the sliding piece having transverse movement only, a lever vibrating in a vertical plane and capable of rotation about a central axis to change the angular direction of such vibrations, and means connecting said lever with one sliding-piece, the other sliding-piece being attached to the carriage.

4. The combination, with the cloth-clamp, of the compound slide P $P^\times$, the turn-post M, the pivoted vibrating lever N mounted in the turn-post, the reciprocating slide 22, the shoe 23, tumbler 26, keeper-plate 38, lifting-pin 36, curved guide R and means of elevating and depressing such curved guide, constructed for operation as described.

5. The combination, with a cloth-clamp, of the eccentric K, pivoted vibrating lever N capable of rotation about a vertical axis, the le-

ver 12 connecting said vibrating lever with the eccentric and having an adjustable fulcrum for varying the length of stroke of the lever, and means connecting the vibrating lever with the cloth-clamp; the said eccentric being connected and timed with relation to the step by step progressive movement of the cloth-clamp as described to produce one complete vibration of the cloth-clamp forward and back again when passing over the center, and none while passing under the center.

6. In a button-hole attachment the combination, of a cloth-clamp, a carriage to which said clamp is attached having longitudinal movement only that feeds the cloth-clamp under the needle from end to end of the button-hole, and means producing said movement step by step from the sewing mechanism of the machine consisting of the slide-plate G adapted to engage the feed-bar of the machine, the spring rod, rock-shaft I connected with said rod, swinging rack-frame S attached to the carriage having toothed portions along two sides and across one end, guide-bar S^2 pinion T and means connecting said pinion with the rock-shaft and producing intermittent rotative movement of the pinion from the vibrations of the rock shaft, constructed for operation as described.

7. In a button-hole attachment, the reciprocating plate G having an adjustable catch-piece *g* to engage the feed-bar of a sewing machine and a spring to hold the same against the feed-bar, said catch piece being adjustable laterally on its plate, constructed for operation as described.

8. In a button-hole attachment the combination, of a stationary bed-plate principal shaft I, counter-shaft E, the carriage B movable on said bed-plate, means for imparting step-by-step movement to the carriage from the movements of the rock-shaft E, the eccentric shaft geared into the shaft and receiving rotative movement therefrom in one direction, the eccentric K, cloth-clamp D compound slide P $P^\times$ and mechanism connecting one of the parts of said slide with the eccentric, comprising a rocking-lever B and a pivoted lever N vibrating in a vertical plane which is rotatable about a central axis to change the angular position of said plane with respect to the longitudinal movement of the carriage in the bed-plate, and means connecting said rotatable vibrating lever with one part of the compound slide, the other part of the said slide being arranged to slide on the carriage in a direction at right angles to the movement of the other part to which said vibrating lever is attached.

9. The combination with the turn-post M, reciprocating plate 22, shoe 23 and vibrating lever N, of the lifting-pin 26 means connecting said pin with the shoe 23, the adjustable switch-piece 32 33 curved guide R having a pin engaging the switch-piece and means for rotating the turn-post.

10. The combination, with the vibrating lever N capable of rotative movement about a vertical axis to change the angular direction of its vibrations, of the slide 22, shoe 23, stud 24 adapted to connect the shoe with the part to be vibrated by the lever, and means for shifting the shoe in the slide and thereby changing the starting points of its reciprocating movements without affecting the length of such movements.

11. The combination, with the cloth-clamp having vibratory movements under the needle of the machine, of the stripper-foot F having the foot-piece $F^\times$, the slide F^2 fitted to turn and slide on the shaft I whereby the foot can be turned up clear of the work in the cloth-clamp, and the adjustable stop adapted to limit the upward movement of the foot when at work.

In testimony that I claim the foregoing I have hereunto set my hand and seal.

EDWARD O. BENNETT. [L. S.]

Witnesses:
EDWARD E. OSBORN,
CHAS. E. KELLY.