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Tölle

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[54] **WORK CLAMP FEEDING MECHANISM FOR SEWING MACHINES**

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[52] **U.S. Cl.** **112/70**

[51] **Int. Cl.** **D05b 3/06**

[58] **Field of Search** 112/70, 73, 65, 71, 72, 112/74, 75, 76

[56] **References Cited**

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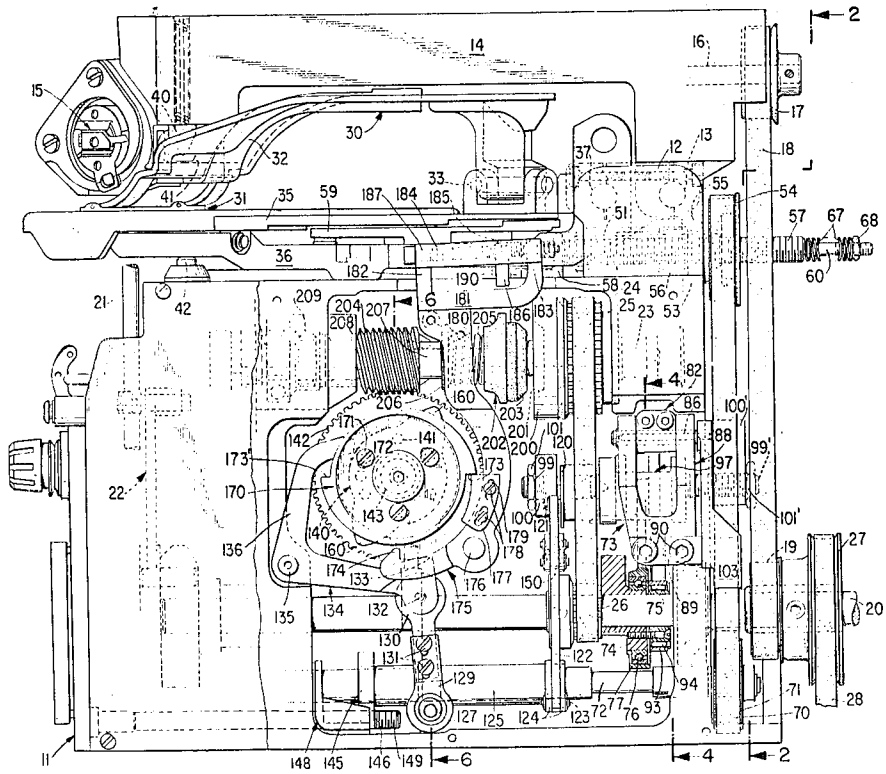
Primary Examiner—H. Hampton Hunter

Attorney, Agent, or Firm—McGlew and Tuttle

[57] **ABSTRACT**

A mechanism for shifting the work clamp of a buttonhole sewing machine relatively to the stitch forming mechanism back and forth along the length of the buttonhole in which the mechanism comprises a screw associated with the work clamp and in engagement with threads on a belt pulley constrained in the machine frame. The pulley is driven by an endless flexible belt that is turned intermittently by an oscillating belt gripper. The length of the active stroke of the belt gripper, as well as the phase relationship of the active and inactive strokes thereof, may be changed to influence the stitch density and the direction of feed of the work clamp.

8 Claims, 9 Drawing Figures



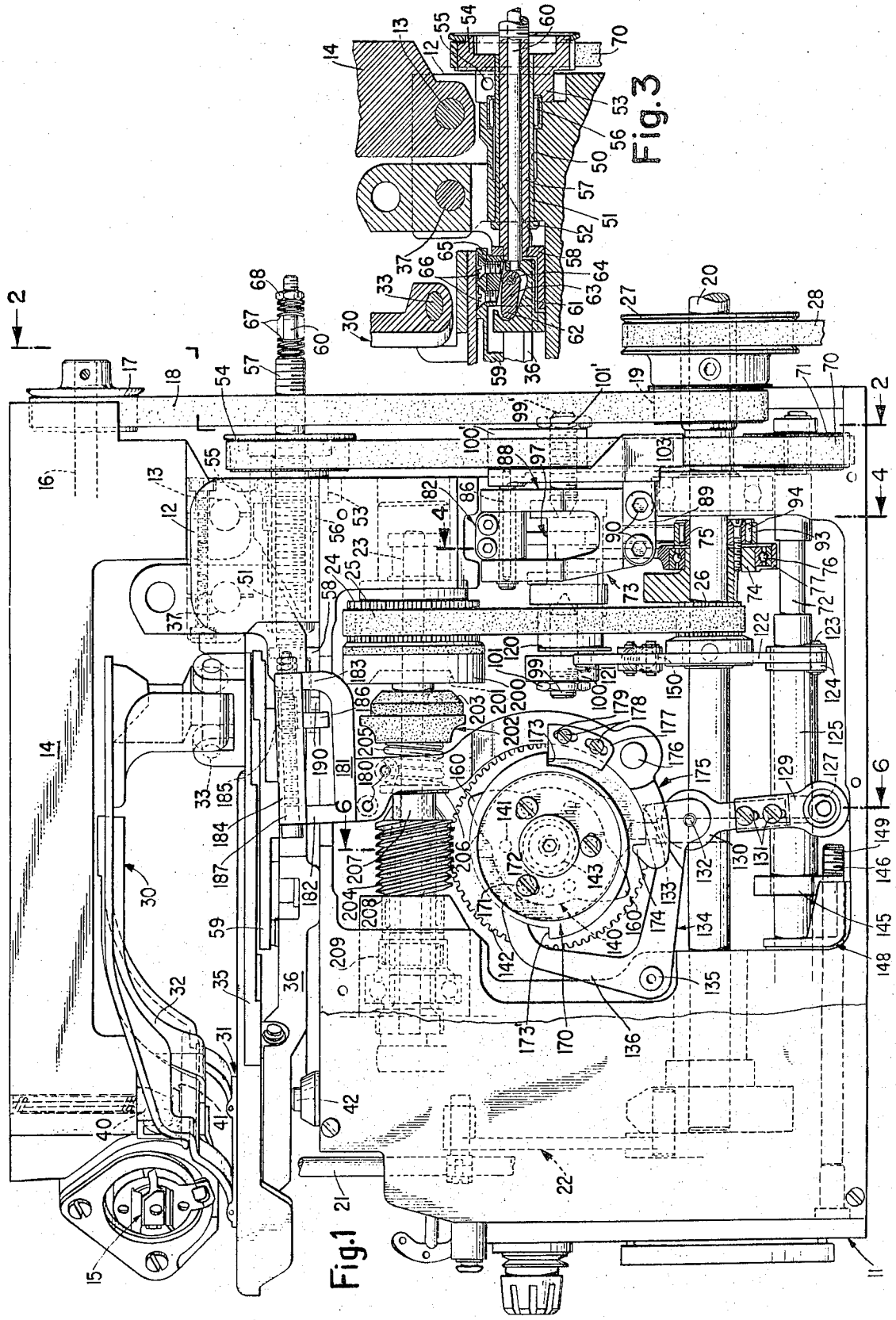


Fig.1

Fig.3

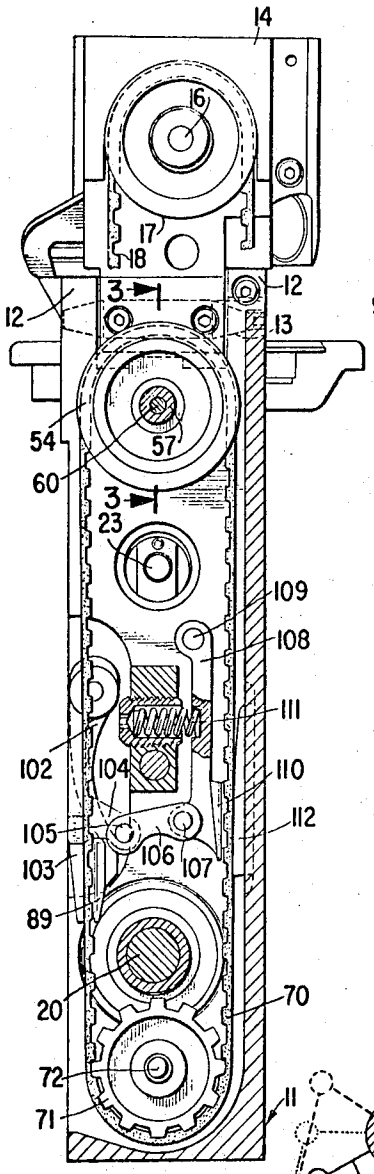


Fig. 2

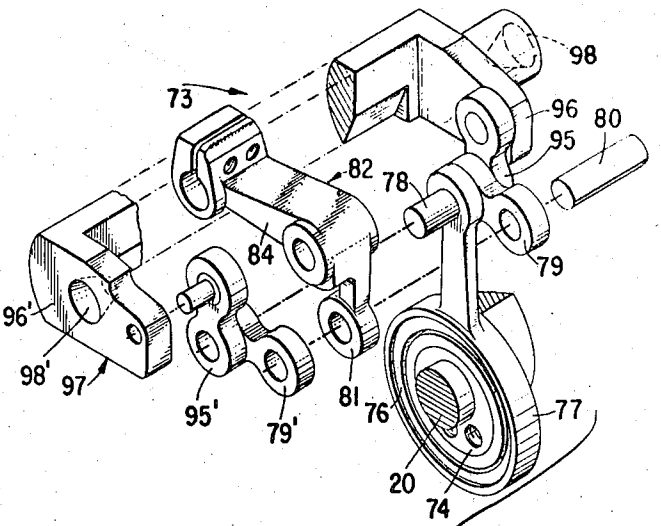


Fig. 7

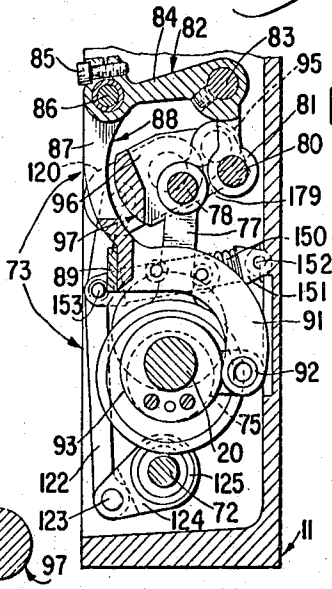


Fig. 4

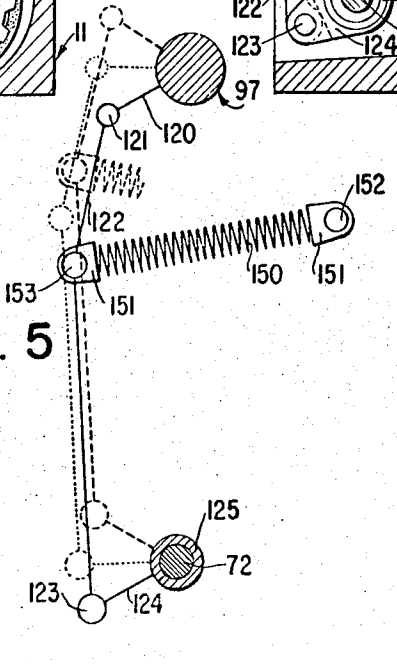


Fig. 5

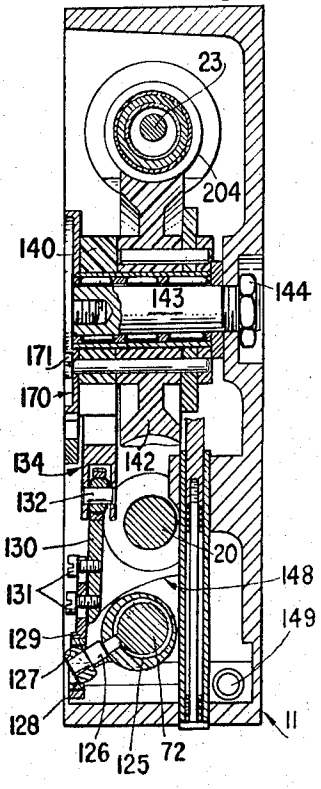


Fig. 6

Fig. 8

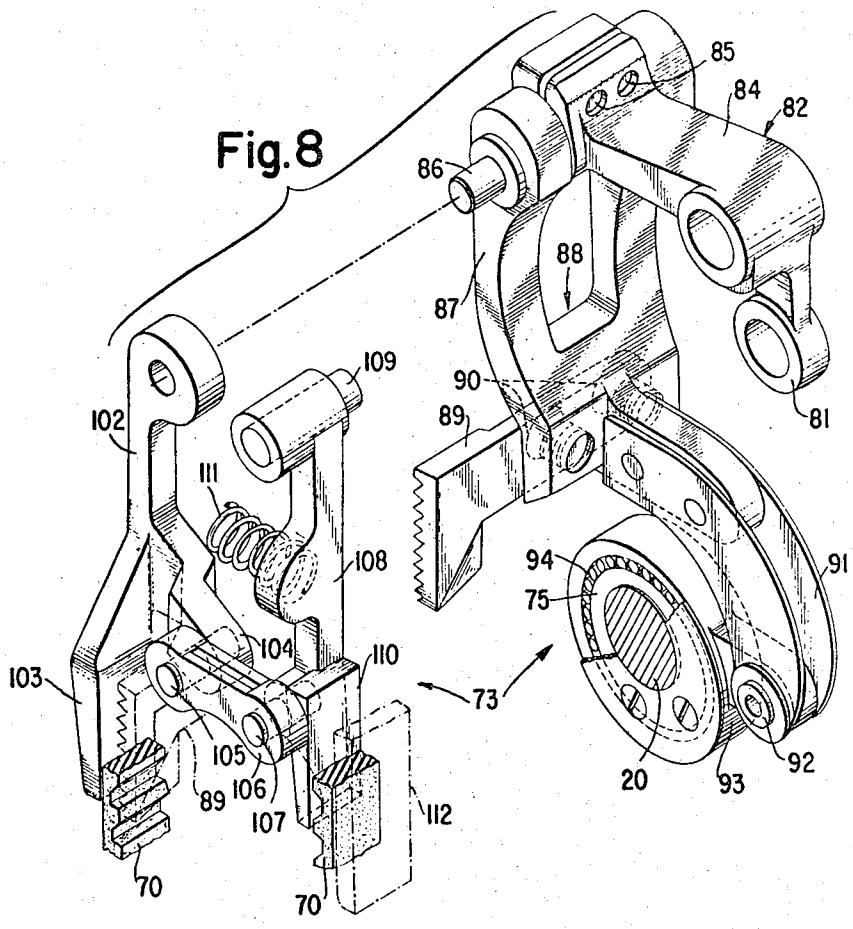

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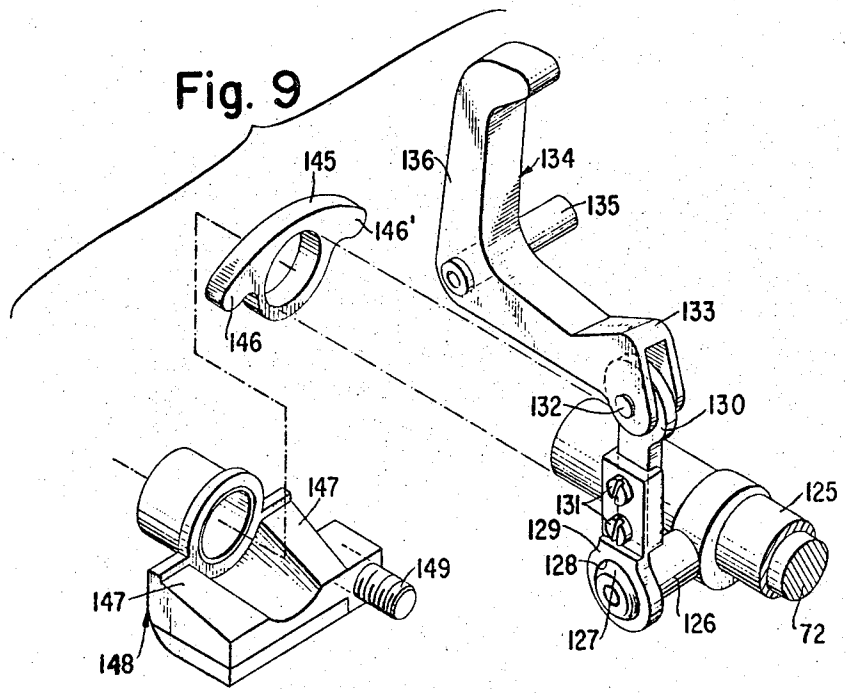
Fig. 9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WORK CLAMP FEEDING MECHANISM FOR SEWING MACHINES

BACKGROUND OF THE INVENTION

The work clamp shifting mechanisms of known buttonhole sewing machines are not conducive to incorporation within the small confines of a buttonhole sewing machine which can be ganged with other like machines simultaneously to sew adjacent buttonholes on a garment. Moreover, in a sewing machine which is organized with the needle and associated control mechanisms beneath the work and the loop taker above the work, the space problems become even more acute because of the necessity to preserve room for the operator to be seated in front of the machine so that the known work clamp shifting mechanisms are to a greater degree inadequate.

BRIEF SUMMARY OF THE INVENTION

It is an object of this invention to provide a work clamp shifting mechanism for a buttonhole sewing machine which occupies a small space and of which the parts may be positioned with regard to space limitations without adversely influencing the functioning of these parts in the determination of buttonhole shape and stitch density.

The object of this invention is attained by the provision of a threaded stud operatively connected to impart lengthwise movement to the work clamp. Screw threads formed on a belt pulley in the machine frame engage the threaded stud and a belt engaging the pulley is driven by an oscillating gripper device which engages and intermittently shifts the belt. The problem of limited space within the frame of the buttonhole sewing machine and particularly the limited width of a machine intended to be ganged with other like machines, is accommodated by this arrangement since the belt may be directed in any desired path and the location of the belt gripper mechanism is not critical to the proper operation of this device.

DESCRIPTION OF THE DRAWINGS

With the above and additional objects and advantages in view as will hereinafter appear, this invention is illustrated in the accompanying drawings of a preferred embodiment in which:

FIG. **1** is a side elevational view of a buttonhole sewing machine having portions of the machine frame and parts of the machine broken away to expose the mechanism of this invention for shifting the work clamp,

FIG. **2** is an end elevational view of the sewing machine of FIG. **1** with the lower portion broken away and illustrated in vertical cross section taken substantially along line **2—2** of FIG. **1**,

FIG. **3** is an enlarged cross sectional view taken substantially along line **3—3** of FIG. **2** and showing the connection between the work clamp and the threaded stud which drives the work clamp back and forth,

FIG. **4** is a cross sectional view taken substantially along line **4—4** of FIG. **1**,

FIG. **5** is an enlarged diagrammatic view of the control linkage for the belt feeding mechanism showing the control linkage in solid lines in a position corresponding to that for shifting the work clamp in one direction, in dashed lines in a position for shifting the work clamp in the opposite direction, and in dotted lines in a position midway therebetween,

FIG. **6** is a cross sectional view taken along line **6—6** of FIG. **1**,

FIG. **7** is a perspective disassembled view of the feed regulating toggle mechanism including the pitman which imparts working feeding movements to the belt,

FIG. **8** is an assembled perspective view of the belt feeding linkage including the pitman for alternately causing the belt to be gripped and released, and

FIG. **9** is a perspective view of the cam follower mechanism for causing the direction of belt feed to be reversed.

Referring to the drawings, the buttonhole sewing machine in which this invention is embodied includes a base **11** formed with spaced upstanding ears **12.** Swingable on a pivot pin **13** extending between the ears **12** is a bracket arm **14** carrying a loop taker **15** which may take the form of a rotary hook or any other known lockstitch loop taker. The loop taker may be actuated by suitable operative connections with an arm shaft **16** journaled in the bracket arm **14** and carrying a sprocket **17** on which a timing belt **18** is entrained. The timing belt extends in mesh with a driving sprocket **19** fast on a main shaft **20** journaled in the base **11.** A needle carrying bar **21** is reciprocated upwardly into cooperation with the loop taker by a mechanism indicated generally at **22** and actuated by the main shaft **20** but not shown in detail in the drawings since it does not form a direct part of this invention. A countershaft **23** journaled in the base carries a sprocket **24** driven by a timing belt **25** from a sprocket **26** on the main shaft **20.** The countershaft **23** serves to impart lateral jogging movement to the needle bar **21** in a manner which is not specifically related to the present invention and, therefore, not disclosed herein in detail. For producing the zigzag movement of the needle, however, the countershaft **23** is preferably driven at half the speed of the main shaft **20.**

A driven pulley **27** is secured to the main shaft **20** and is engaged by a drive belt **28** from a power transmitter (not shown) which may be of any known construction for actuating the sewing machine of this invention.

The work fabrics in which a buttonhole is to be stitched by the machine of this invention are gripped beneath the loop taker by a work clamp, indicated generally at **30.** This invention provides a novel and improved mechanism for shifting the work clamp back and forth so as to determine and form the length of the buttonhole. This invention may thus be used with work clamps having any known configuration and arrangement. As shown in the drawings, the work clamp may comprise a work engaging upper jaw **31** supported by an arched arm **32** pivoted as at **33** relatively to a lower jaw with which a work supporting plate **35** is associated. The pivotally connected jaws which can be opened by raising the upper jaw **31** to accept work fabrics therebetween, constitute a unit which is guided for linear movement relatively to a base plate **36** which is pivoted on a pivot pin **37** extending between the ears **12** of the machine frame base **11.** The base plate **36** may be swung up about the pivot pin **37** carrying the lower jaw and work supporting plate **35** of the work clamp upwardly with it to provide access to the needle bar as for threading of the needle or the like.

A roller 40 carried by the bracket arm 14 and engaging a track 41 on the upper jaws 31 of the work clamp 30 maintains a uniform distance between the work clamp jaws and the loop taker, and when the bracket arm 14 is turned down into operative position, as shown in the drawings, the base plate 36 engages a spring loaded plunger 42 in the machine frame base which biases the work clamp against the roller 40.

For shifting the work clamp 30 lengthwise back and forth relatively to the base plate 36 to define the length of the buttonhole, there is journaled in a bore 50 in the upper portion of the machine frame base 11 a sleeve 51 formed at one end with a head 52 and having a split hub 53 of a sprocket wheel 54 clamped at the other end by a clamp screw 55. As best shown in FIG. 3, a needle bearing 56 may be interposed between the sleeve and the machine frame base 11 to minimize friction and binding. The sleeve 51 is formed internally with screw threads which preferably are multiple threads with an appreciable lead, and are arranged in mesh with multiple threads formed externally on a hollow stud shaft 57 to which an angle bracket 58 is rigidly secured.

The angle bracket 58 is guided for rectilinear movement by sliding contact with the top of the machine frame base 11 and also by the guiding action of the hollow shaft 57 within the sleeve 51. It is the rectilinear movement of the angle bracket which shifts the work clamp 30 back and forth along the length of the buttonhole to be stitched. Any suitable connection such as a sliding plate 59 may be provided between the angle bracket 58 and the work clamp 30 since this specific connection does not form a direct part of this invention.

Since the base plate 36 of the work clamp may be turned about the pivot pin 37 while the angle bracket 58 is constrained against the machine frame base, it is necessary that a connection therebetween be provided which is sufficiently flexible to accommodate the differences in paths of motion when the work clamp base plate is lifted to expose the needle. FIG. 3 illustrates a construction for accomplishing this flexibility in the connection.

A rod 60 which is slidable within the hollow stud shaft 57 has a block 61 secured thereto and arranged in the angle bracket 58. The block 61 is formed with a depression 62 accommodating a finger 63 which is pivoted as at 64 to a bracket 65 attached by screws 66 beneath the sliding plate 59. When the base plate 36 is swung up, the pivotally supported finger 63 is free to shift in the depression 62 thus to avoid binding of the parts. The block 61 is also resiliently sustained in the angle bracket 58 by means of spring washers 67 held on the rod 60 against the free end of the hollow stud shaft 57 by a nut 68.

A timing belt 70 engaged with the sprocket wheel 54 and extending about an idler sprocket 71 rotatable on a trunnion stud 72 in the machine frame base 11 is influenced intermittently by an indexing mechanism indicated generally at 73 to turn the sprocket wheel 54 in increments first in one direction and then in an opposite direction in order to shift the work clamp along the length of a buttonhole being stitched.

The indexing mechanism 73 is driven by two eccentrics 74 and 75 arranged side-by-side each fast on the main shaft 20. The eccentric 74 provides motion for shifting the timing belt 70 to impart the work feed motion; while the eccentric 75 serves alternately to cause the indexing mechanism to grip and to release the timing belt.

The feed driving eccentric 74 carries a ball bearing 76 embraced by a pitman 77 connected by a pivot pin 78 to a pair of links 79, 79' which are in turn pivoted by the pin 80 to the depending arm 81 of a bell crank lever 82 fulcrummed on the fulcrum pin 83 in the machine frame base. The other arm 84 of the bell crank lever 82 is clamped by screws 85 to a stud 86 which is freely journaled in bifurcated arms 87 formed on the top of a feed bar 88 to which a belt indexing shoe 89 is secured by screws 90. The shoe 89 is preferably serrated and positioned so as to engage the inside of the timing belt 70. The feed bar 88 at the bottom carries a downturned extension 91 which is pivoted as at 92 to a pitman 93 embracing a needle bearing 94 arranged on the eccentric 75 on the main shaft 20.

The pivot pin 78 of the pitman 77 is also embraced by a pair of toggle links 95, 95' pivoted in turn to opposing arms 96, and 96' of a feed frame 97. The feed frame 97 is formed with bearing sockets 98, 98' by which it is journaled in the machine frame base on opposing pintles 99, 99' each threaded through an ear 100, 100' in the machine frame base 11 and held by a lock nut 101, 101' so that a precise adjustment may be maintained. As can be seen in FIGS. 4 and 7, the angular position of the feed frame 97 influences by way of the toggle links 79, 95 the magnitude and the phase relationship of turning movement of the bell crank lever 82 in response to turning of the feed drive eccentric 74.

Pivoted on the stud 86 is a depending lever 102 formed with an abutment shoe 103 disposed, as shown in FIGS. 2 and 8 at the opposite side of the timing belt 70 from the belt indexing shoe 89. The lever 102 is also formed with a lateral arm 104 carrying a pivot pin 105 embraced by a connecting link 106 which embraces a pivot pin 107 carried by a belt lever 108. The brake lever 108 is pivoted on a fulcrum pin 109 carried in the machine frame base 11 and formed with a brake shoe 110 which is biased toward the timing belt 70 by a heavy coil spring 111. At the opposite side of the timing belt 70 from the brake shoe 110, an abutment shoe 112 may be fixed to the machine frame base.

The eccentric 75 thus alternately shifts the belt indexing shoe 89 into and out of engagement with the belt. By way of the abutment shoe 103, the lever 102, the connecting link 106, and the brake lever 108, the brake shoe 110 is moved out of engagement with the belt whenever the belt indexing shoe 89 moves into engagement with the belt, and the brake shoe 110 is rendered effective each time the belt indexing shoe 89 is retracted. The feed eccentric 74 moves the belt indexing shoe 89 in one direction along the belt while the belt indexing shoe is in engagement with the belt, and in the opposite direction when the belt indexing shoe is out of belt engagement. The angular position of the feed frame 97 regulates not only the magnitude of belt indexing movement of the belt indexing shoe 89 but also the phase relationship thereof, i.e., the direction along the belt which the belt indexing shoe 89 will partake while the shoe occupies a position in engagement with the belt.

For controlling the angular position of the feed frame 97, a rock arm 120 which is clamped on the feed frame adjacent to the bearing socket 98 is pivoted as at 121 to one end of a link 122 which is pivoted at 123 at the

opposite end to a rock arm 124 extending from a sleeve 125 freely journaled on the trunnion stud 72.

A second rock arm 126 on the sleeve 125 is formed with a spherical extremity 127 embraced by a socket 128 formed on the lower portion 129 of a split link. The lower portion 129 of the split link and an upper portion 130 are secured together by clamp screws 131. The upper portion 130 is pivoted at 132 to one arm 133 of a bell crank cam follower lever 134. The bell crank follower lever 134 is fulcrummed at 135 in the machine frame base 111 and is formed with a second arm 136, each of the bell crank follower arms 134 and 136 being arranged to extend into the path of and subject to the influence of a feed reversing cam 140 which is made fast by a locking pin 141 to a worm wheel 142 journaled on a stud shaft 143 fixed in the machine frame base by a nut 144.

The sleeve 125 on the trunnion stud 72 also has fixed thereto an abutment block 145 formed with diametrically opposed radial arms 146, 146' each arranged for engagement with one tapered ramp 147, 147' of a bifurcated stop block 148 which straddles the sleeve 125 and is threadedly engaged by an adjusting screw 149 constrained axially in the machine frame base 11. By means of the adjusting screw 149, the stop block 148 may be shifted axially of the sleeve 125 so as to vary the total permissible angular shift which the sleeve 125 and the rock arm 126 thereon can partake. Because of the symmetry of the abutment block radial arms 146, 146', and the tapered ramps 147, 147' of the bifurcated stop block 148, opposite extreme angular positions of the feed frame 97 may be adjusted simultaneously and the magnitude of work clamp feed in each direction can thus be regulated with a single adjustment. A coil spring 150 to which a clevis 151 is secured at each end, is arranged in tension between a pivotal connection 152 with the frame base 11 at one end and a pivotal connection 153 with the link 122 at the other end. The spring 150 is preferably arranged substantially perpendicular to the link 122 and substantially parallel to the rock arms 120 and 124 as shown in FIG. 5. Because the length of the spring 150, i.e., the distance between the pivotal connections 152 and 153, is considerably longer than either of the rock arms 120 and 124, the spring 150 is flexed most in the intermediate position of the link and the spring will bias the link into that extreme position toward which the link is shifted slightly beyond the mid-position. The reversing cam 140 and the bell crank follower arms 133, 136 need only be arranged to shift the feed frame 97 slightly over the center, the spring 150 will complete the movement of the feed frame to the extent dictated by the radial arm 146, 146' and the tapered ramps 147, 147'. In this way, the cam 140 needs never operate in conflict with the stop block 143.

It will be noted in FIG. 1 that the follower arms 133 and 136 of the bell crank 134 terminate in positions spaced angularly 90° apart about the axis of the stud shaft 143 on which the feed reversing cam 140 is journaled. The feed cam 140, moreover, is formed with diametrically opposed lobes, 160, 160' and as a result each quarter revolution increment of turning of the feed reversing cam 140 will cause one of the cam lobes 160 or 160' to engage one of the bell crank follower arms 133 or 136 to effect a reversal of the feed direction. A total of one-half revolution of the feed reversing cam 140, therefore, causes two feed direction reversals which is sufficient for the formation of a buttonhole.

For metering quarter revolution increments of rotation of the feed reversing cam 140, a stop cam 170 is made fast to the worm wheel 142 by the screws 171 which pass through slightly elongated slots 172 in the stop cam to provide for limited angular adjustment of the stop cam. Diametrically opposite radial projections 173, 173' are formed on the stop cam 170 which cooperate either with a stop finger 174 formed directly on a control lever 175 pivoted on a fulcrum pin 176 in the machine frame base 11 or with a stop finger 177 which is adjustably secured to the control lever 175 by fastening screws 178 passing through elongate apertures 179 in the stop finger 177. The stop fingers 174 and 177 are spaced angularly approximately 90° apart about the axis of the stud shaft 143.

Secured to the control lever 175 by screws 180 is a sensing head 181 bifurcated to define spaced arms 182, 183. A threaded stud 184 captive between the spaced arms 182 and 183 carries a nut 185 having a depending lug 186 which is constrained against rotation by a member 187 spanning the spaced arms 182, 183.

The angle bracket 58, sliding movement of which gives rise to movement of the work clamp 30, is formed with a lateral projection 190 which extends between one of the arms 183 of the sensing head and the depending lug 186 thereon. As the angle bracket 58 shifts toward the left as viewed in FIG. 1 to move the work clamp, therefore, it will strike the lug 186 and turn the control lever counterclockwise as viewed in FIG. 1 thus to move the stop finger 174 radially away from the stop cam 170 and to move the stop finger 177 radially toward the stop cam. This will release the stop cam 170 for one quarter turn after which the stop finger 177 will engage one of the stop cam projections 173 as shown in FIG. 1, and again arrest movement of the stop cam. In the quarter turn of the stop cam, the movement of the associated feed reversing cam 140 will change the direction of work feed as explained above.

As the angle bracket 58 shifts toward the right as viewed in FIG. 1 it will strike the arm 183 of the sensing head 181 and shift the control lever 175 in a clockwise direction. This will move the stop finger 177 radially outward out of engagement with the projection 173 of the stop cam and it will simultaneously move the stop finger 174 toward the stop cam 170 into a position of readiness to engage the projection 173 after one quarter turn of the stop cam 170.

While any suitable drive may be utilized to turn the cams 140, 170 in quarter revolution increments whenever the stop cam 170 is released, the mechanism illustrated in FIG. 1 will be described by way of an example.

The sprocket 24 for driving the countershaft 22 carries an enlarged hub 200 formed with a clutch face 201. Slidable along the countershaft 22 and freely journaled thereon is a driven element 202 formed with a clutch face 204 complemental to the clutch face 201. A worm 204 is secured to or locked with the driven element 202 so as to rotate with and slide axially therewith. A coil spring 205 biases the driven element 202 toward the right as viewed in FIG 1, i.e., toward engagement of the clutch faces. The spring 205 may bear against a washer 206 which abuts a tang 207 which extends internally of the worm 204 from a rotatable sleeve element 208 which is constrained against axial

movement relatively to the machine frame base **11** but which is interlocked rotationally with the worm **204** and the driven element **202.** Between the rotatable sleeve **208** and the machine frame base **11** is interposed a roller clutch **209** which permits turning of the worm only in the direction of rotation of the sprocket wheel **24.**

When the stop cam **170** is prevented from turning by engagement of either stop finger **174** or **177** with a stop cam projection **173, 173'**, the worm wheel **142** attached to the stop cam will also be held against rotation. Continued driving impetus imparted to the worm **204** through the clutch faces **201** and **203** will cause the worm **204** to shift axially to the left as viewed in FIG. **1** relatively to the now stationary worm wheel **142** with which it remains in mesh, and this axial movement of the worm will separate the clutch faces **201** and **203.**

The roller clutch **209** which prevents turning of the worm **204** and the stop cam **170** which locks the worm wheel **142** and prevents axial sliding of the worm **204** thus combine to hold the clutch faces out of engagement until the stop cam **170** is next released.

By adjustment of the captive threaded stud **184,** the distance between the arm **183** and the depending lug **186** may be regulated for control of the length of work clamp feed and, therefore, the length of the resulting buttonhole.

Having set forth the nature of this invention, what is claimed herein is:

1. A work clamp feeding mechanism for a buttonhole sewing maching having a frame, a work clamp, and guide means constraining said work clamp to move in a predetermined path relatively to said frame, said work clamp feeding mechanism comprising a work clamp shifting member supported in said frame and formed with screw threads, means operatively connecting said work clamp shifting member with said work clamp to impart movement to said work clamp along said predetermined path, a belt pulley journaled in said frame, said belt pulley formed with screw threads arranged in meshing relation with the screw threads of said work clamp shifting member, a flexible belt arranged in driving engagement with said belt pulley, and belt indexing mechanism operated by said sewing machine for imparting lengthwise movement to said flexible belt selectively in either direction.

2. A work clamp shifting mechanism as set forth in claim **1** in which an idler pulley journaled in said frame engages and directs said flexible belt into a portion of said frame remote from said work clamp, and in which said belt indexing mechanism is driven in timed relation with stitch forming mechanism of said buttonhole sewing machine and is arranged for operative engagement with said flexible belt in a portion of said frame remote from said work clamp.

3. A work clamp shifting mechanism as set forth in claim **1** in which said belt indexing mechanism includes a reciprocating element constrained to move back and forth along said flexible belt, a rotary actuator driven one rotation during each stitch forming cycle of said buttonhole sewing machine for imparting to said reciprocatory element motion in opposite directions during successive half revolutions of said rotary actuator, and means for rendering said reciprocating element effective to index said flexible belt during reciprocatory movement in only one direction along said flexible belt.

4. A work clamp shifting mechanism as set forth in claim **3** in which said means for rendering said reciprocating element effective to index said flexible belt during reciprocatory movement in only one direction along said flexible belt comprises a second rotary actuator driven one revolution during each stitch forming cycle of said buttonhole sewing machine, and mechanism driven by said second rotary actuator and effective during alternate half revolutions thereof for rendering said reciprocating element effective to index said flexible belt.

5. A work clamp shifting mechanism as set forth in claim **4** including means for selecting the direction of reciprocation of said reciprocating element during that half revolution of said second rotary actuator in which said reciprocatory element is rendered effective to index said flexible belt.

6. A work clamp shifting mechanism as set forth in claim **5** in which said means for selecting the direction of reciprocation of said reciprocating element comprises a reversing mechanism effective upon each actuation to change by 180° the phase relationship of said first rotary actuator with respect to the direction of movement of said reciprocatory element, and sensing means responsive to the travel of said work clamp for actuating said reversing mechanism.

7. A work clamp shifting mechanism as set forth in claim **2** in which said belt indexing mechanism comprises a belt engaging shoe supported relatively to said frame for reciprocatory movement in a first path substantially along a length of said flexible belt and for reciprocatory movement in a second path substantially normal to said first path into and out of engagement with said belt, a first and a second eccentric for imparting movement to said belt engaging shoe in said first and second paths, respectively, and control means included in that mechanism which is responsive to said first eccentric for varying the amplitude of reciprocatory movement of said belt engaging shoe in said first path as well as for changing the phase relationship of said first and second paths of movements.

8. A work clamp shifting mechanism as set forth in claim **7** in which said control means comprises a toggle linkage interposed between said first eccentric and said belt engaging shoe, said toggle linkage beging shiftable to vary both the direction and the amplitude of reciprocatory motion imparted to the belt engaging shoe from said first eccentric, cam means for shifting said toggle linkage between extreme positions thereof, and means responsive to movement of said work clamp for actuating said cam means.

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