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Tölle

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[54] **NEEDLE VIBRATING CONTROL MECHANISM FOR BUTTONHOLE SEWING MACHINES**

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

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

[58] **Field of Search** ..... 112/65, 66, 70, 73, 158 R, 112/158 B, 158 C

[56] **References Cited**

UNITED STATES PATENTS

1,466,154	8/1923	Sharaf	112/158
2,186,228	1/1940	Avis	112/70
2,193,344	3/1940	Reece	112/158 X
2,260,203	10/1941	Zablocki	112/158
2,329,681	9/1943	Zeier	112/158 X

Primary Examiner—Werner H. Schroeder
Attorney, Agent, or Firm—Marshall J. Breen; Chester A. Williams, Jr.; Robert E. Smith

[57] **ABSTRACT**

A mechanism for controlling the different zigzag stitches required along the sides and at the ends of a stitched buttonhole which may be operated at high speed and accommodated readily in the severely limited space available within the sewing machine frame. A primary crank mechanism provides the reciprocatory motion required for the zigzag side stitches along each side of the buttonhole. A sleeve in which the primary crank mechanism is journaled eccentrically provides a secondary crank mechanism which may also be rotated to augment the reciprocatory motion provided by the primary crank thus to produce the barring stitches at each end of the buttonhole. The sleeve may be stopped in positions angularly spaced one half revolution apart after each barring operation so as to locate the side stitches on opposite sides of the buttonhole.

7 Claims, 12 Drawing Figures

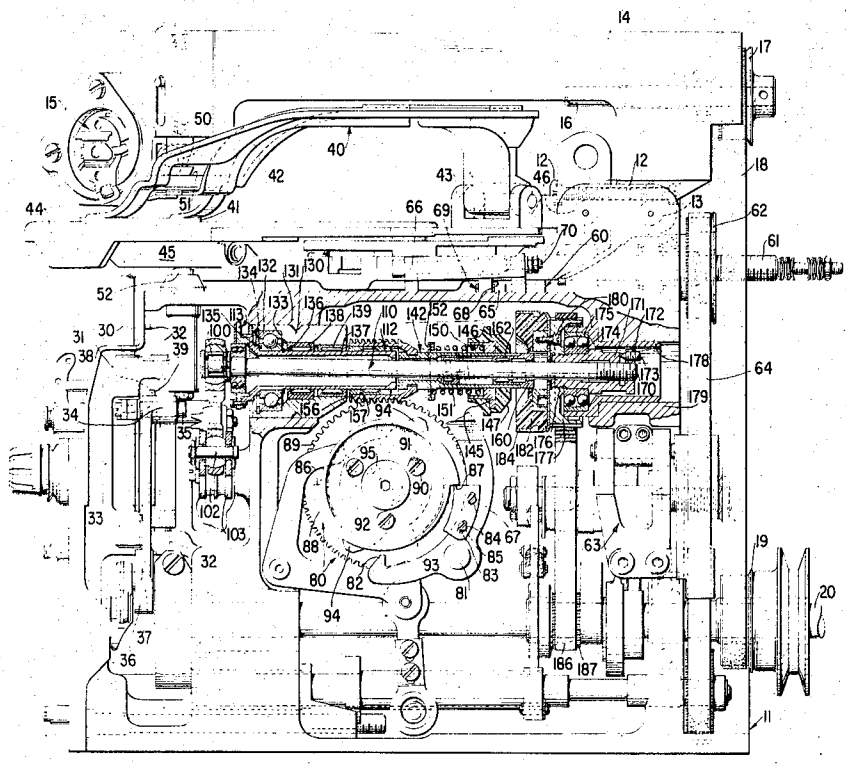
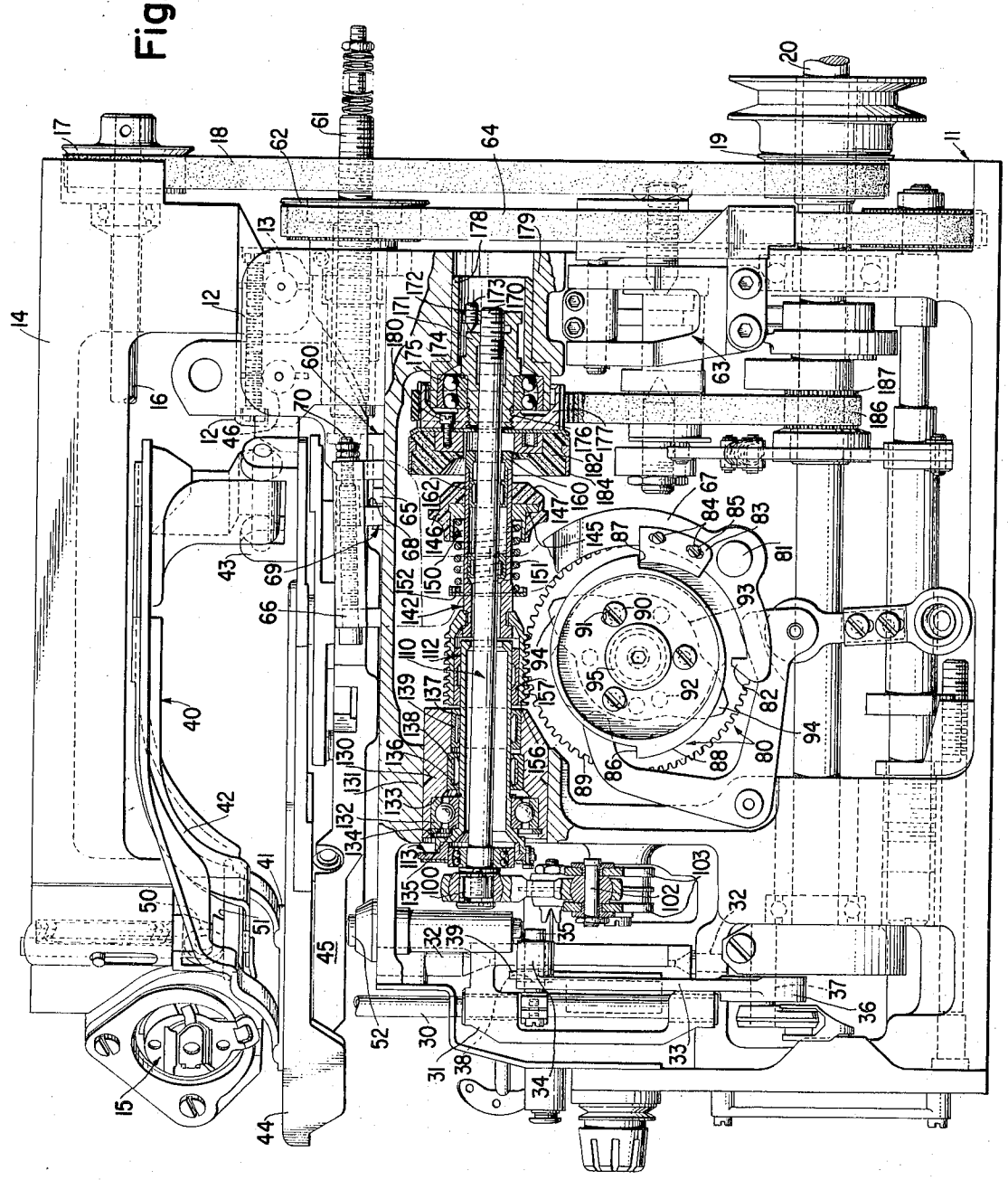


Fig. 1



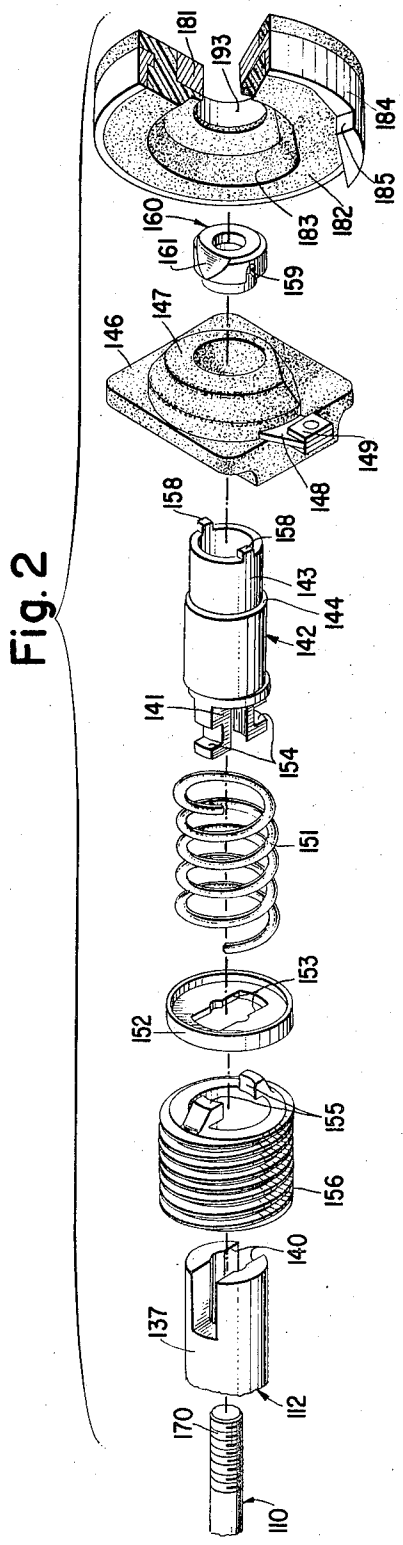


Fig. 2

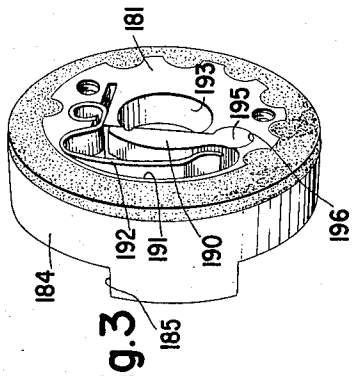


Fig. 3

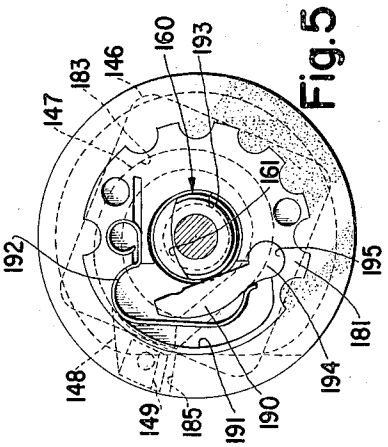


Fig. 5

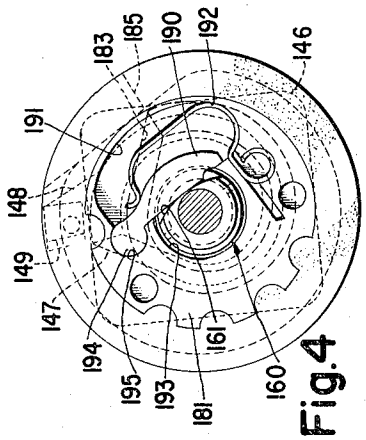


Fig. 4

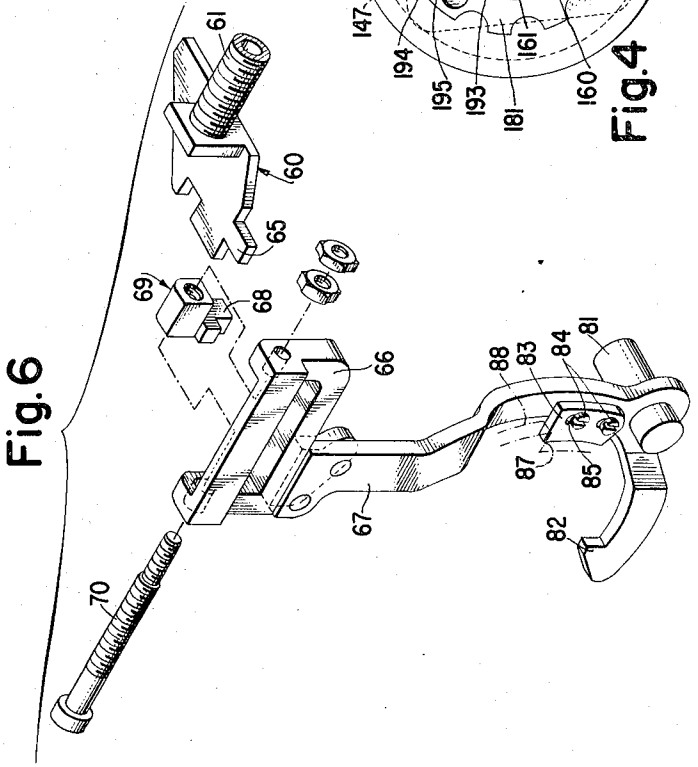


Fig. 6

Fig. 9A

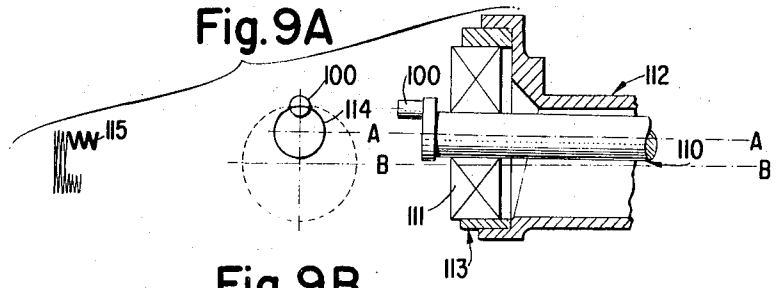


Fig. 9B

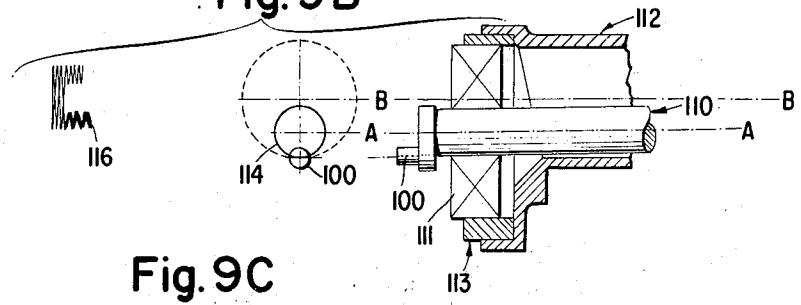
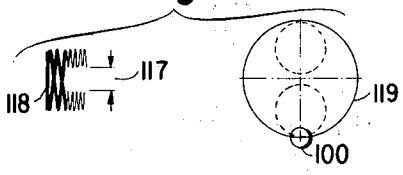


Fig. 9C



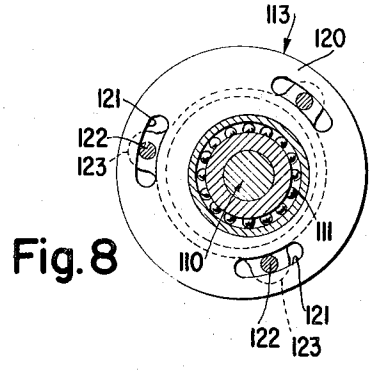


Fig. 8

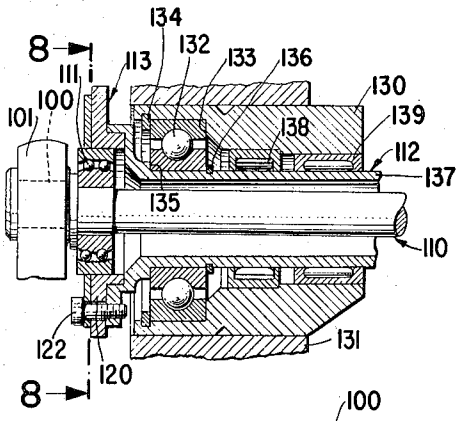


Fig. 7

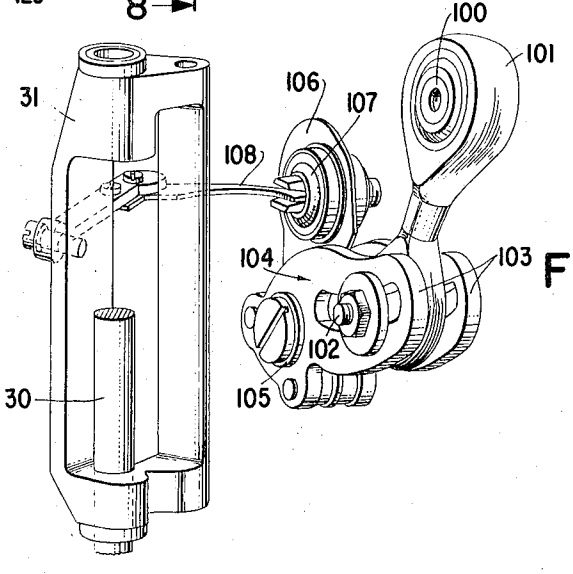


Fig. 10

NEEDLE VIBRATING CONTROL MECHANISM FOR BUTTONHOLE SEWING MACHINES

BACKGROUND OF THE INVENTION

Prior buttonhole sewing machines have been provided in which the different zigzag stitches required to form a buttonhole are produced by the operation of regulating mechanisms for changing the needle jogging motion. The U.S. Pat. No. 2,056,758 of E. B. Allen et al is representative of such prior buttonhole sewing machines. These known mechanisms require extensive needle jogging control linkages extending considerable distances through the machine frame from a number of different control devices such as cams or the like. Such extensive linkages are not conductive to high speed operation, nor are they adapted to inclusion in a sewing machine frame in which space is limited. a crank

The U.S. Pat. No. 2,983,340 May 9, 1961 of W. Engel discloses a needle vibrating control for buttonhole sewing in which a primary pattern cam for influencing the buttonhole side stitch zigzagging which is operated continuously is augmented by a periodically operating auxiliary pattern cam to produce the wide zigzag stitches of the buttonhole bars. This known construction thus requires separate spring loaded pattern cam follower mechanisms for the primary and auxiliary pattern cams and, therefore, is not only severely limited as to the speed at which it can be operated, but is not well adapted for use in a crowded sewing machine frame.

BRIEF SUMMARY OF THE INVENTION

It is an object of this invention to provide a needle vibrating control mechanism for a high speed buttonhole machine which is compact so that it can be accommodated readily in the severely restricted space within the frame of a sewing machine adapted to be ganged with other like machines simultaneously to sew adjacent buttonholes in a garment. This object of the invention is attained by the provision of a primary rotary drive capable, as by means of a crank mechanism, to impart zigzag motion for buttonhole side stitching; together with a sleeve eccentrically accommodating the primary rotary driver and capable of being rotated with the primary rotary device to augment the zigzag motion for formation of the barring stitches at the end of the buttonhole.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings this invention is illustrated in a preferred embodiment in which:

FIG. 1 is a side elevational view of a buttonhole sewing machine with portions broken away to illustrate this invention applied thereto,

FIG. 2 is disassembled perspective view of the clutch mechanism for providing the wide barring stitches at each end of the buttonhole with the clutch elements each positioned so as to expose the clutch faces,

FIG. 3 is a perspective view of the driving clutch element positioned so as to expose the face opposite the clutch face,

FIG. 4 is an elevational view of that face of the driving clutch element illustrated in FIG. 3 together with the driven clutch element shown held out of engagement of the clutch faces and in a position wherein clutch engagement can begin,

FIG. 5 is an elevational view similar to that of FIG. 4 but showing the clutch mechanism parts in a position of full clutch engagement,

FIG. 6 is a disassembled perspective view of the control lever and associated parts for influencing engagement of the clutch,

FIG. 7 is an enlarged vertical cross sectional view of that portion of the needle jogging mechanism of this invention adjacent to the needle jogging crank,

FIG. 8 is a cross sectional view taken substantially along line 8—8 of FIG. 7,

FIG. 9A is a set of three diagrammatic views depicting the needle jogging crank arrangement positioned for side stitching along one side of a buttonhole, a representation of the path of the crank pin, and a representation of the buttonhole portion produced thereby,

FIG. 9B is a set of three diagrammatic views similar to those of FIG. 9A but showing the needle jogging crank arrangement positioned for side stitching along the opposite side of a buttonhole,

FIG. 9C is a set of two diagrammatic views depicting the path of the crank pin when the outer eccentric rotates with the crank pin, and a representation of the barring stitches of the buttonhole produced thereby, and

FIG. 10 is a perspective view of the drive linkage connecting the needle jogging crank with the needle bar gate.

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 30 is journaled for endwise reciprocation in a swinging gate 31 supported on vertically spaced pintles 32 carried in the machine frame base 11. Endwise reiprocatory movement is imparted to the needle carrying bar 30 by means of a drive link 33 formed at the upper end with a boss 34 slidably embracing a stud 35 secured so as to extend laterally from the needle carrying bar. At the lower extremity the drive link 33 is formed with a boss 36 which engages a crank 37 carried by the main shaft 20. A slot 38 formed in the drive link boss 34 embraces a stabilizing bar 39 carried in the machine frame base to steady the drive link against lateral jogging movement of the stud 35.

A thread carrying needle (not shown) clamped in the upper extremity of the needle carrying bar 30 reciprocates upwardly through work fabrics held in a work clamp indicated generally at 40 for cooperation with the loop taker 15 in the formation of lockstitches.

Although this invention may 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 41 supported by an arched arm 42 pivoted as at 43 relatively to a lower jaw with which a work supporting plate 44 is associated. The pivotally connected jaws which can be opened by raising the upper jaw 41 to accept work fab-

rics therebetween, constitute a unit which is guided for linear movement relatively to a base plate **45** which is pivoted on a pivot pin **46** extending between the ears **12** of the machine frame base **11.** The base plate **45** may be swung up about the pivot pin **46** carrying the lower jaw and work supporting plate **44** 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 **50** carried by the bracket arm **14** and engaging a track **51** on the upper jaw **41** of the work clamp **40** 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 **45** engages a spring loaded plunger **52** in the machine frame base which biases the work clamp against the roller **50.**

The mechanism shown in the accompanying drawings for shifting the work clamp back and forth to define the length of the buttonhole is described in detail in my co-pending U.S. patent application Ser. No. 333,258 filed Feb 16, 1973 to which reference may be had.

Briefly, for a general understanding of this invention, it will be sufficient to understand that the work clamp is shifted by an angle bracket **60** secured to a threaded stud shaft **61** which engages a threaded bore formed in a sprocket wheel **62** supported for turning movement on the machine frame base. Intermittent turning movement is imparted to the sprocket wheel **62** by indexing mechanism indicated generally at **63** in the drawing which imparts step-by-step movements to the sprocket wheel **62** by way of a timing belt **64.**

The angle bracket **60** is formed with a lateral projection **65** which travels between one arm **66** of a control lever **67** and the depending lug **68** of an abutment member **60** on a threaded stud **70** carried in the control lever. The control lever **67** in response to movement of the work clamp **40** influences the operation of a quarter revolution clutch device indicated generally at **80.**

The control lever **67** is carried on a fulcrum pin **81** in the machine frame base **11,** and is formed with a stop finger **82** which is integral with the control lever and carries an adjustable stop finger **83** secured to the control lever by fastening screws **84** which pass through elongated apertures **85** in the stop finger **83.** The stop fingers **82** and **83** cooperate alternately with diametrically opposed radial abutment projections **86** and **87** of a stop cam **88** adjustably secured to a worm wheel **89** by screws **90** which pass through elongated arcuate slots **91** on the stop cam. Also secured as by locating pins **92** to the worm wheel **89** is a feed reversing cam **93** having diametrically opposed cam lobes **94.** The worm wheel **89** is freely journaled on a stud shaft **95** carried in the machine frame base **11.** The clutch device **80** is the control center for the operation of the buttonhole machine in that it changes the direction of feed of the work clamp; it influences the production of various different types of zigzag stitches produced by the machine during the course of the stitching of a buttonhole; and it can control many other functions of the machine which are not of direct concern to the present invention such as cutting, thread severing, and stopping at the conclusion of each sewing cycle.

This invention relates to the control mechanism whereby lateral vibration of the needle is derived and regulated. Although not directly related to this invention, the mechanism for controlling the direction of feed of the work clamp is so closely associated with the present invention that it will be described in some detail herein to facilitate a clear understanding of the present invention.

Referring to FIGS. 7 to **10,** the manner in which lateral jogging movement is imparted to the needle bar can be explained and a general explanation can be given of the manner in which the various needle jogging motions are derived at the different stages of buttonhole production.

As shown in FIG. **7, 9A** and **9B,** a plain rotary driver in the form of a crank pin **100** serves to impart the lateral needle jogging motion. FIG. **10** illustrates the linkage connections between the crank pin **100** and the needle bar gate **31.** This needle jogging linkage forms the subject of a co-pending U.S. patent application Ser. No. 333,259 filed Feb. 16, 1973 to which reference may be had for a more detailed description. For comprehension of the present invention it will be sufficient to understand that a drive link **101** at one end embraces the crank pin **100** and at the other end embraces a pivot pin **102** which may be secured in selected position along a slotted lever arm **103** of a bell crank lever **104** supported on a fulcrum pin **105** in the machine frame base. The other lever arm **106** of the bell crank lever **104** is formed by a flat leaf spring which sustains a spherical connection **107** with a connecting link **108** to the needle bar gate. The connecting link **108** like the lever arm **106** is formed by a flat leaf spring, and the flexibility of these leaf springs each transversely of the directions in which they transmit forces to the needle bar gate reconcile without binding the slight differences between the arcuate and planar paths of motion of the various parts.

FIGS. **9A, 9B** and **9C** illustrate diagrammatically in a general way the derivation of the various needle jogging motions required in the production of a stitched buttonhole. The crank **100** is carried directly on a countershaft **110** which is journaled so as to rotate about an axis A—A in a bearing **111** supported in a sleeve **112.** The sleeve **112** constitutes a second shaft journaled on a fixed axis B—B in the machine frame as will be described in detail below. The bearing **111** is supported eccentrically of the axis B—B in the sleeve. An additional eccentric **113** is interposed between the bearing **111** and the sleeve **112** but this, as will be described in detail hereinbelow, simply provides for adjustment of the effective eccentricity of the bearing **111** relatively to the axis B—B of the sleeve **112.**

The countershaft **110** rotates constantly during operation of the machine and this rotation generates the small diameter paths of motion **114** of the crank pin **100** as illustrated in FIGS. **9A** and **9B.** The small diameter path of motion of the crank pin **100** produces the narrow zigzag side stitches of the buttonhole. In these FIGS **9A** and **9B,** the sleeve **112** is constrained in a position sustaining the countershaft in an extreme upper position so that the narrow zigzag stitches **115** along the right-hand side of the buttonhole will be produced. In FIG. **9B,** the sleeve **112** is constrained in a position one-half revolution beyond that of FIG. **9A** and as shown, the narrow zigzag stitches **116** along the left-hand side of the buttonhole will be produced.

The space **117** between the side stitches **115** and **116** provides cutting space for the buttonhole. A cutting space exists because the eccentricity of the bearing **111**

exceeds the eccentricity of the rotatable driver crank pin **100** and this may be regulated by selective adjustment of the additional eccentric **113** as will be explained hereinbelow.

When the sleeve **112** is rotated in synchronism with the countershaft **110** with the crank pin **100** in either the upper extreme position shown in FIG. **9A** or in the lower extreme position shown in FIG. **9B**, the crank pin will generate the large diameter path of motion **119** as shown in FIG. **9C** during which the wide zigzag stitches **118** will be formed providing the barring stitches at the ends of the buttonhole.

The adjusting eccentric **113** is formed with a radial flange **120** in which arcuate slots **121** are formed. The slots accommodate clamp screws **122** threaded each into a radial lug **123** protruding from the sleeve **112.** A cover plate **124** exteriorly of the eccentric flange **120** provides a surface which may be provided with indicia (not shown) cooperating with marks on the eccentric flange **120** to show the position of adjustment, for instance, to indicate the cutting space which will be provided in each possible position of adjustment.

Referring to FIGS. **1** to **5**, the mechanism for influencing constant rotation of the countershaft **110** and periodic rotation of the sleeve **112** with constraint thereof alternately in positions one-half revolution apart will now be described.

A bushing **130** fixed in a web **131** of the machine frame base **11** accommodates an anti-friction bearing **132** in fixed position therein between a shoulder **133** and a split locking ring **134.** The bearing **132** is similarly locked in place between a shoulder **135** and a locking clip **136** on a shank portion **137** of the sleeve **112.** The sleeve **112** is thus carried for rotation but constrained against endwise shift in the machine frame. Also interposed between the bushing **130** and the sleeve shank **137** is a one-way roller clutch **138** and an anti-friction needle bearing **139.**

The free extremity of the sleeve shank **137,** as best shown in FIG. **2,** is formed diametrically with a slot **140** which slidably accommodates a diametrically slabbed key **141** formed on a hollow driven clutch hub member **142** of which the exterior **143** is formed with a step **144.** Force fit or otherwise rigidly secured to the exterior **143** of the driven clutch hub member **143** against the step **144** is a metal core **145** on which is molded a synthetic plastic driven clutch shoe **146** which includes a tapered non-circular clutch face **147.** Projecting from the metal core **145** is a radial arm **148** to which a block **149** is secured.

The core **145** is formed with a counterbore **150** which accommodates one end of a compression spring **151** of which the opposite end abuts a stop washer **152** formed with a slot **153** snugly accommodating the slabbed key **141.** The washer, therefore, abuts the free extremity of the sleeve shank **137** so that the spring **151** will urge the driven clutch shoe **146** toward the right as viewed in FIG. **1.**

The slabbed key **141** of the clutch hub is formed with notches **154** accommodating inwardly extending lugs **155** formed on a hollow worm **156** which is fitted internally with a bearing **157** upon which the worm can slide relatively to the sleeve shank **137.** The worm **156** and the driven clutch shoe **146** are thus permanently interlocked for rotation and axial sliding movements as a unit.

At the extremity of the clutch hub **142** opposite the worm **156,** the hub is formed with securing tangs **158** which are clinched into locking engagement with mating recesses **159** in a pilot nose element **160** formed with an inclined slabbed portion **161.** Internally in the driven clutch hub member **142** adjacent to the pilot nose element **160** as shown in FIG. **1,** a needle bearing **162** is provided between the clutch hub member and the countershaft **110.** The countershaft **110** at the extremity opposite the crank pin **100** is threaded as at **170** to accommodate a driving clutch hub member **171.** A split threaded portion **172** of the hub member **171** is provided with a set screw **173** by which the split portion may be deformed to secure the hub member fast in selected angular position on the countershaft **110.** The driving clutch hub member **171** is formed with an exterior step **174** against which an anti-friction bearing **175** is seated. The hub member is exteriorly threaded as at **176** to accommodate a threaded belt pulley **177** which locks the bearing **175** in place against the step **174.** The anti-friction bearing **175** is supported in a hollow bushing **178** seated in a web **179** in the machine frame base **11.**

Secured by screws **180** to the pulley **177** is a metal core **181** on which a synthetic plastic driving clutch shoe **182** is molded. The clutch shoe **182** includes a tapered non-circular clutch face **183** which is complemental to the driven clutch face **147** on the driven clutch shoe **146.** The metal core **181** also supports a metalic outer ring **184** formed with a lateral driving lug **185** adapted to cooperate with the block **149** on the driven clutch core during disengagement of the clutch as will be described below.

A timing belt **186** operably connects the belt pulley **177** on the countershaft with a driving pulley **187** on the main shaft **20.** The countershaft **110,** therefore, will be rotated continuously during the operation of the sewing machine main shaft. The driving clutch shoe **182** similarly will be rotated continuously. Because of the meshing arrangement of the worm **156** with the worm wheel **89,** the sleeve **112** will be rotated periodically in synchronism with the countershaft **110** and will be alternately stopped in diametrically opposite positions in a manner which will now be described.

When either the fixed stop finger **82** or the adjustable stop finger **83** on the control lever **67** engages one of the radial projections **86** or **87** on the stop cam **88,** turning of the worm wheel **89** will be stopped and the worm **156,** as it continues to be driven by the engaged clutch shoes **146, 182,** will move axially to the left as viewed in FIG. **1** continuing to turn the sleeve **112** but drawing the clutch faces **146, 182** apart into the declutched position as shown in FIG. **1.**

When the clutch faces are fully engaged, as shown in FIG. **5,** the block **149** and driving lug **185** will be separated and the non-circular clutch faces **147, 183** fitting one within the other will transmit all of the motion to the sleeve **112.** As disengagement of the clutch begins, the block **149** will immediately shift into engagement with the driving lug **185** to maintain driving relation between the clutch path until they are shifted completely apart as shown in FIG. **1.**

The one-way clutch **138** will prevent retrograde movement of the worm **156** and the restrained stop cam **88** will prevent retrograde movement of the worm wheel **89** so that, in turn, the worm **156** will be prevented from sliding axially along the sleeve shank and

as a result, the sleeve will be held stationary in a very accurately oriented position of eccentricity of the bearing **111.** Each of the two alternate stopped positions of the sleeve **112** moreover, can be adjusted independently. Positioning of the stop cam **89** relatively to the worm wheel **89** by virtue of the screws **90** effects adjustment of one stopped position; and positioning of the adjustable stop finger **83** by the screws **84** effects adjustment of the other stopped position.

When the control lever **67** is swung to disengage and free the stop cam **88,** the worm wheel **89** is released and the worm **156** becomes free to shift axially toward the right as viewed in FIG. **1** under the action of the spring **151** toward engaged position of the clutch faces **147, 183.** Clutch engagement is purposely delayed, however, in order to provide gradual clutch engagement over the largest possible angular interval. Because of this gradual engagement of the clutch faces, the clutch becomes operable at far higher speeds than would be possible if sudden engagement were to be attempted. The gradual engagement minimizes rebound. Delayed clutch engagement is provided by means of a blocking lever **190** which is arranged in a cutout **191** of the metal core **181** of the driving clutch shoe and urged by a spring **192** into a position traversing a portion of a bore **193** in the core **181** into which the nose element **160** is accommodated. The blocking lever **190** may be formed with a rounded fulcrum projection **194** constrained in a mating seat **195** in the core **181** pivotally to support the lever thereon. Until the inclined slabbed portion **161** of the nose element **160** moves into registry with the blocking lever **190,** the driven clutch shoe **146** will be prevented from moving toward the driving clutch shoe **182.** As shown in FIG. **4,** this position of registry occurs when the block **149** first clears the lug **185** thus allowing the greatest angular increment for gradual engagement of the clutch faces **147, 183.**

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

1. In a buttonhole sewing machine in which the needle is carried in a gate laterally shiftable in the sewing machine frame and connected by a linkage to a rotatable drive, a mechanism for imparting to the needle lateral jogging movements of a narrow width along each side of the buttonhole and of a wide width at the ends of the buttonhole, comprising a first shaft having an axis of rotation and carrying said rotatable driver eccentrically of said axis of rotation thereon, a second shaft journaled on a fixed axis in said sewing machine frame, a bearing for said first shaft supported eccentrically of said fixed axis on said second shaft, the eccentricity of said bearing exceeding the eccentricity of said rotatable driver, continuously operative drive mechanism for rotating said first shaft during operation of said sewing machine to generate lateral jogging movements of a narrow width along each side of the buttonhole as a result of the eccentricity of said rotatable driver, and periodically operative drive mechanism for rotating said second shaft in synchronism with said first shaft to generate lateral jogging movements of a wide width at the ends of the buttonhole as a result of the sum of the eccentricities of said rotatable driver and of said bearing.

2. A needle jogging mechanism as set forth in claim **1** in which means is provided for adjusting the difference by which the bearing exceeds the eccentricity of the rotatable driver so that the buttonhole cutting space between the buttonhole side stitches may be regulated.

3. A needle jogging mechanism as set forth in claim **2** in which said adjusting means comprises an additional eccentric interposed between said second shaft and said bearing and a clamping device for securing said additional eccentric in selected angular position relatively to said second shaft.

4. A needle jogging mechanism as set forth in claim **1** in which the periodically operative drive mechanism for the second shaft comprises a driving clutch element fixed on said continuously driven first shaft, a driven clutch element rotatably interlocked with said second shaft, mechanism for axially shifting said driven clutch element into and out of engagement with said driving clutch element, and means for restraining said driven clutch element in diametrically opposite positions of rotation on alternate shifts out of engagement with said driving clutch element.

5. A needle jogging mechanism as set forth in claim **4** in which said means for restraining said driven clutch element in diametrically opposite positions of rotation comprises a worm secured for turning and axial shifting with said driven clutch element, a worm wheel journaled in said sewing machine and meshing with said worm, abutments secured to said worm wheel and cooperable with stop fingers on said sewing machine frame for selectively arresting rotation of said worm wheel, and retrograde clutch means continuously effective between said second shaft and said sewing machine frame.

6. A needle jogging mechanism as set forth in claim **5** in which tripping mechanism is provided responsive to the operation of the buttonhole sewing machine for releasing said stop fingers to re-establish the periodically operative drive for said second shaft at each end of a buttonhole.

7. A needle jogging mechanism as set forth in claim **4** in which said driving and said driven clutch elements are formed with non-circular complemental clutch faces which in fully engaged condition establish a predetermined angular relationship between said driving and driven clutch elements, and in which said driving and driven clutch elements include blocking means effective when the clutch elements are disengaged to permit axial movement of the clutch faces toward full engagement to begin in only that one angular relationship between said driving and driven clutch elements which is substantially one full revolution in advance of said predetermined angular relationship which is established in fully engaged condition of said clutch elements.

* * * * *