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Adams et al.

[11] **3,795,210**

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[54] **CAM SELECTION MODULE**

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

[51] **Int. Cl.** **D05b 3/02**

[58] **Field of Search** .. 112/65, 158 R, 158 A, 158 B, 112/158 C, 158 D

[56] **References Cited**

UNITED STATES PATENTS

3,054,368	9/1962	Bono	112/158 R X
3,081,724	3/1963	Bono	112/158 A
3,091,200	5/1963	Fukunaga	112/158 A
3,177,835	4/1965	Tanaka et al.	112/158 A
3,696,768	10/1972	Torii	112/158 R

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Attorney, Agent, or Firm—Marshall J. Breen; Chester A. Williams, Jr.; Robert E. Smith

[57] **ABSTRACT**

A cam selection module for the positioning of five cam followers, used for controlling needle position, needle field and feed motion, which effects the positioning of the followers over four distinct modes of sewing machine operation by manipulation of a first control means. The first control means operates directly on a first cam follower for tracking pattern cams to determine needle position over a first portion of its operating range. Over a second portion of its operating range, the first control means actuates a second control means which positions a second cam follower for tracking feed cams to determine feed motion while also positioning the first cam follower, resulting in cam controlled feed patterns. Over a third portion of its operating range, the first control means actuates a third control means for positioning a third cam follower to track a pattern cam surface of a replaceable cam, or a fifth cam follower ganged with the third cam follower to track a needle position cam of a closed pattern unit mounted adjacent the replacement cam. Concurrently, the first control means actuates a fourth control means for positioning a fourth cam follower to track a feed cam surface of either the closed pattern unit or the replaceable cam. Provision is made to place the cam followers in ineffective positions when not in use.

11 Claims, 7 Drawing Figures

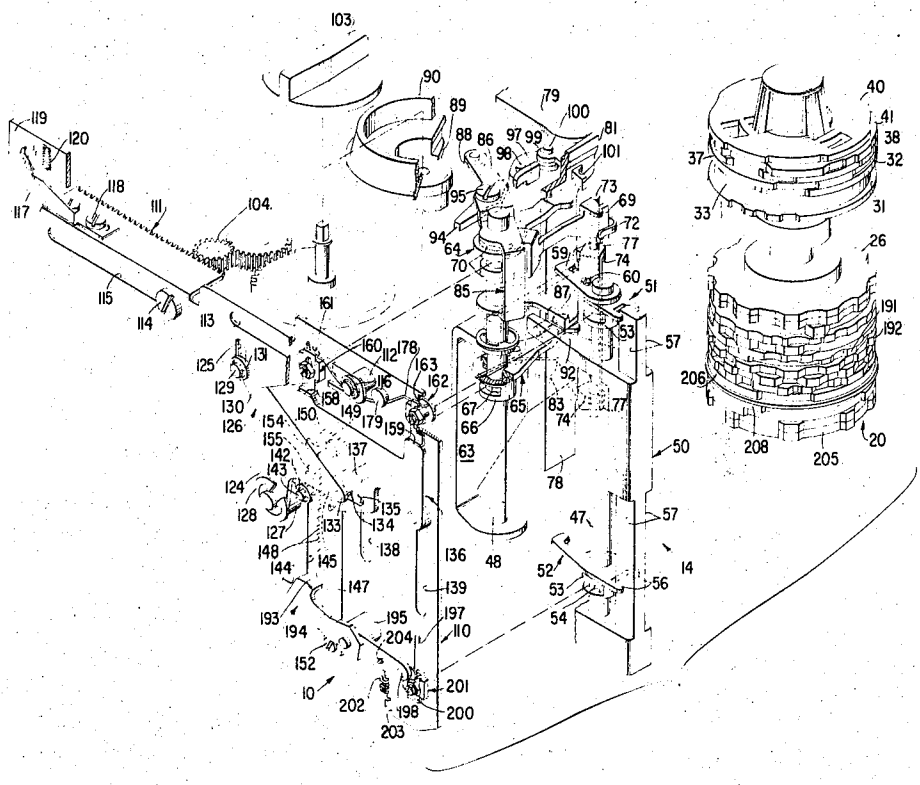
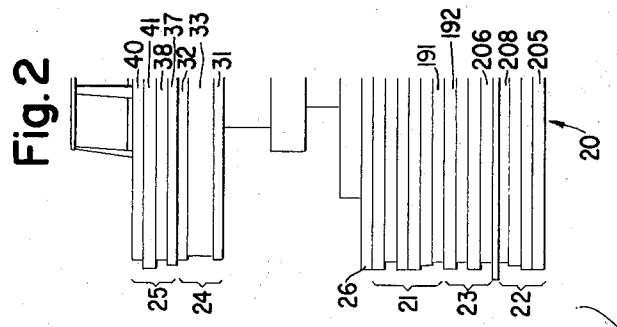


Fig.2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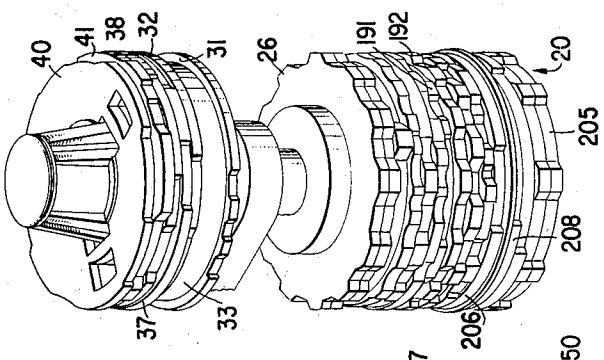
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Fig.1

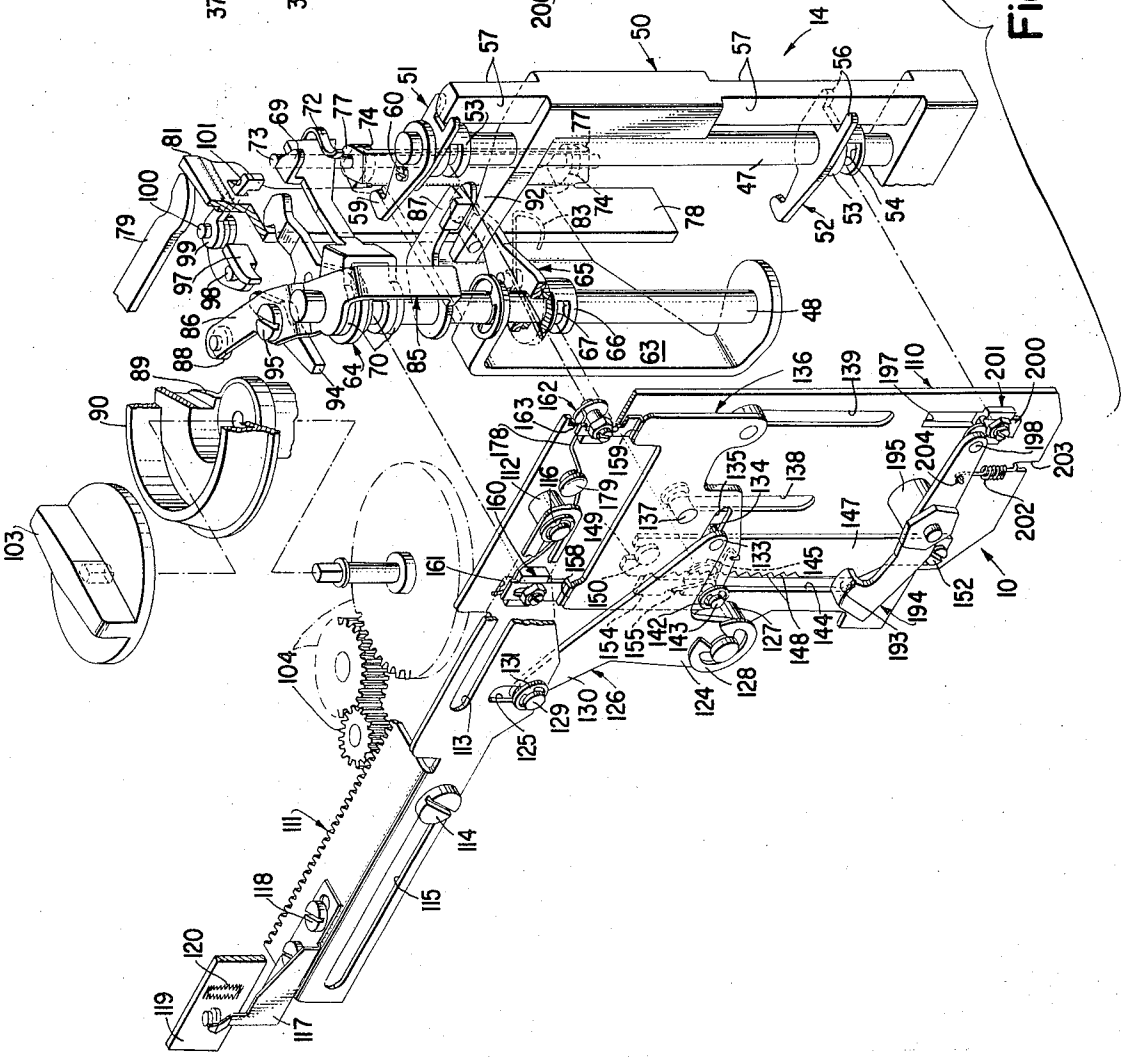
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Fig.3

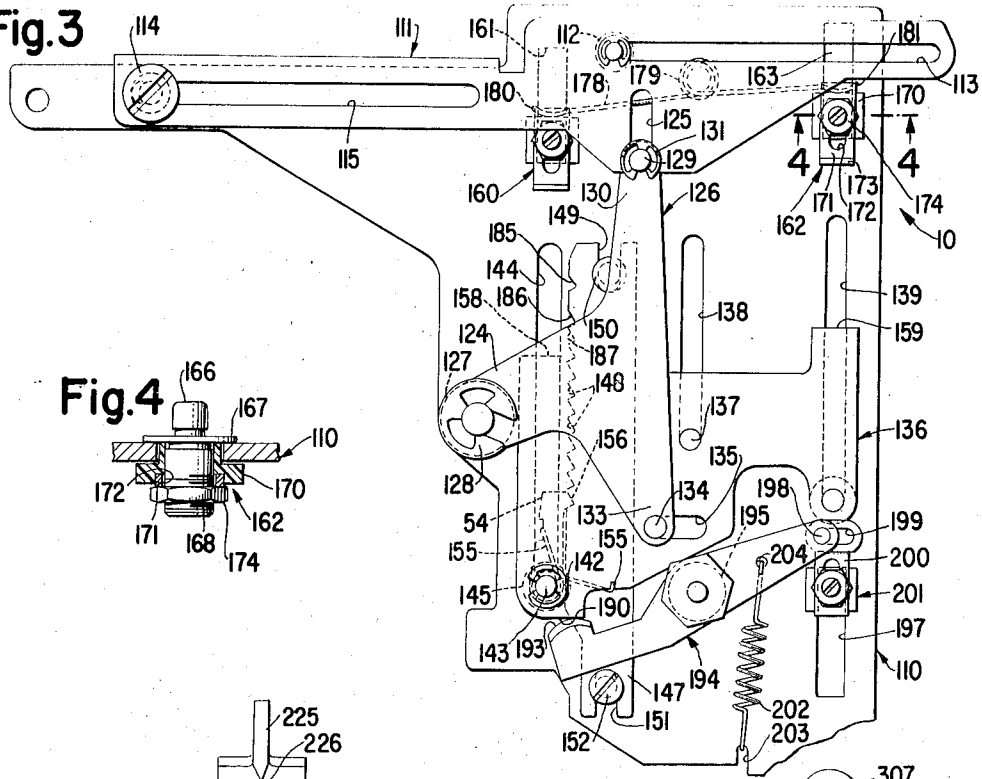

Fig.4

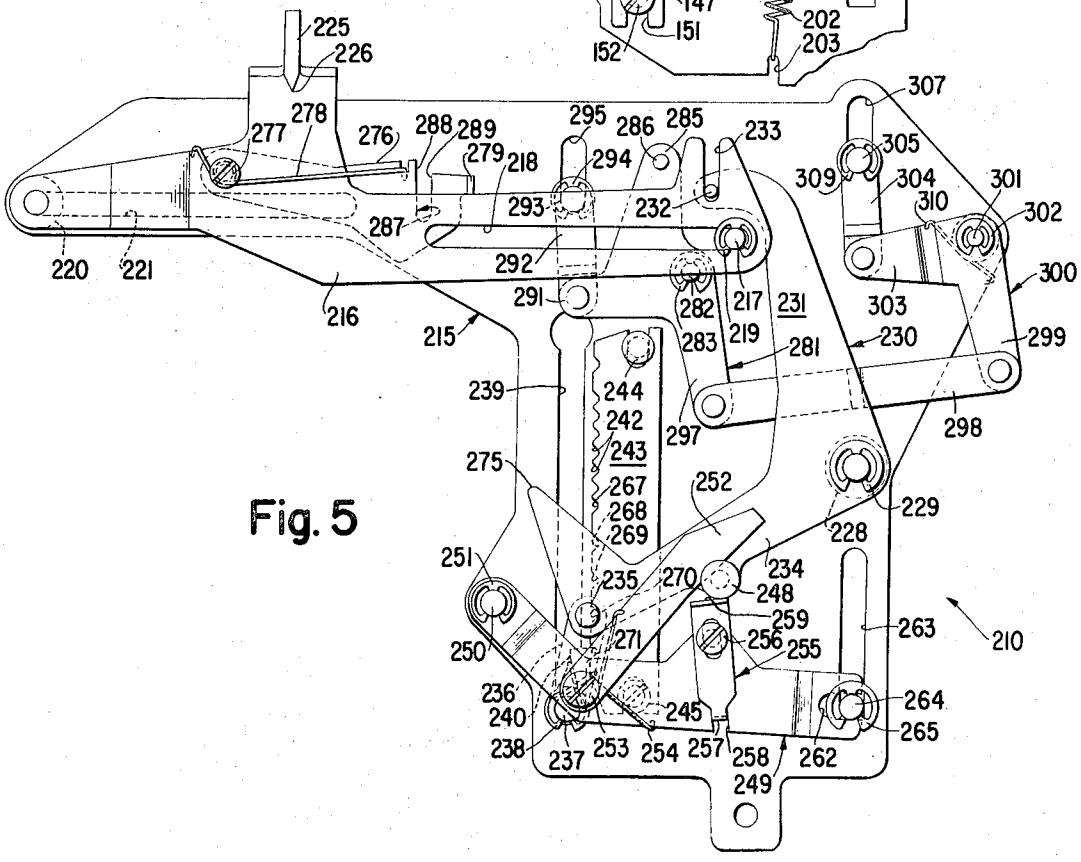

Fig. 5

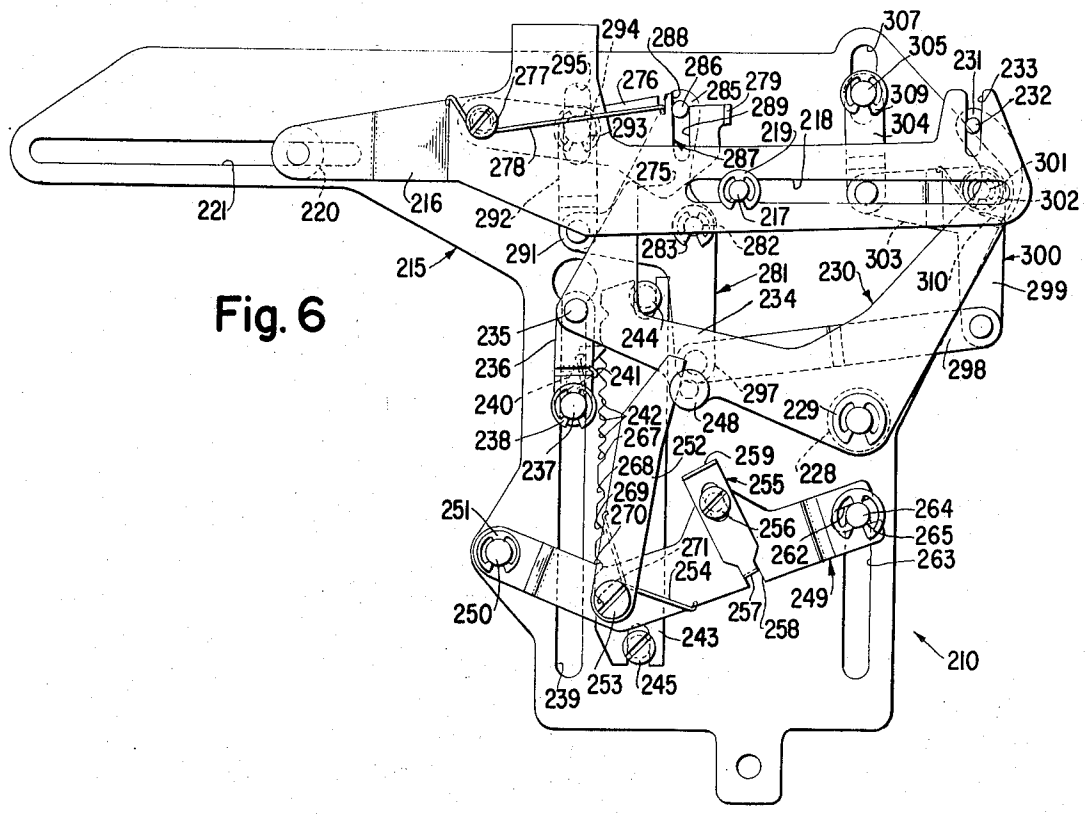
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Fig. 6

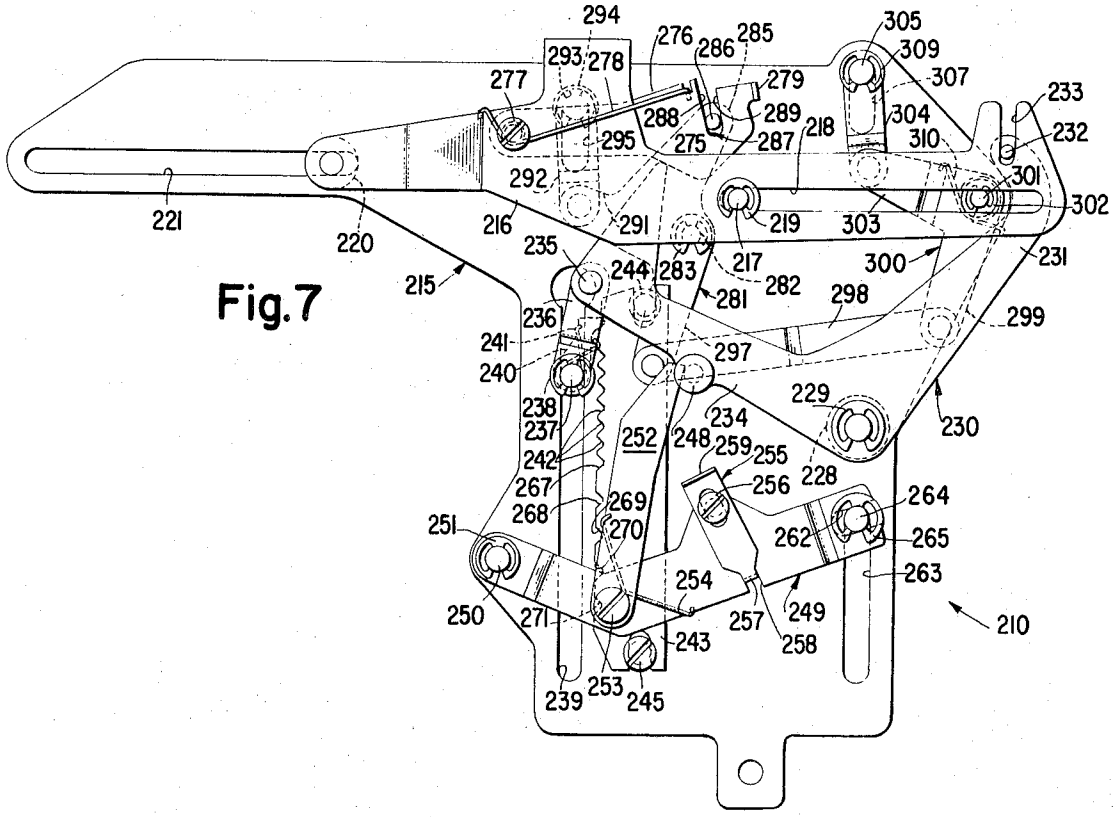
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Fig. 7

CAM SELECTION MODULE

BACKGROUND OF THE INVENTION

The invention pertains to a cam selector in a sewing machine having capability for automatic control of both lateral needle vibration and feed motion.

Heretofore sewing machine selector systems have been devised which control the position of a cam follower for traversing a stack of pattern cams; or the position of two cam followers, one for traversing a stack of feed cams and the other for traversing a stack of pattern cams, resulting in cam controlled feed patterns such as turkish hemstitch or stars. In the latter arrangement it is usual to have a special selector cam which positions both cam followers simultaneously to produce the desired pattern. Selector systems have also been devised wherein each cam has its own cam follower and selection is made through the agency of a separate stack of selector cams, which manipulate the appropriate cam followers into operative position according to the pattern selected. These last mentioned systems require a large multiplicity of parts and a selector cam stack resulting in a bulky system of relatively high cost.

Other systems for manipulating as many as three followers have been devised, using either a second dial for manipulating the third follower or by other means increasing the bulk required for the selection system. What is required is a selection system which is simple both in principle of operation and in construction for manufacturing purposes to elminate the expense and redundacy in the above noted selection systems, and, which may be manipulated by a single control. Ideally, such a selection system should not be limited to the placing of the sewing machine in one or two modes of operation, but should be capable of placing the machine into as many modes of operation as it is capable of.

SUMMARY OF THE INVENTION

It is an object of this invention to provide such a system which is not limited to the control of two or even three cam followers.

The above objects are obtained in a sewing machine having cams for pattern control, simultaneous feed and pattern control, production of a closed pattern such as a buttonhole, and, a replaceable unit of either pattern control or simultaneous feed or pattern control to expand the capabilities of the machine beyond that of the built in cams. By the manipulation of a single first control means, the sewing machine cam followers are positioned to place the sewing machine into any of the four above mentioned modes of operation, as desired, through the positioning of five cam followers. The first control means is directly connected to a first cam follower which traverses a first stack of pattern cams for pattern control of the sewing machine, and, a second stack of pattern cams to be used in association with feed cams for simultaneous feed and pattern control. When the first cam follower is positioned to traverse the second stack of pattern cams, the first control means simultaneously positions a second control means directly connected to a second cam follower which is moved from an inactive position in a blank space to traverse a stack of feed cams. When the first control means is moved from a position of pattern control to that of the closed pattern unit, as for example a buttonhole, the first cam follower may be placed in a position to engage a zigzag cam for the basic zigzag motion required in producing a buttonhole, while simultaneously, the first control means positions a third and fourth control means. The third control means is connected to a ganged third pattern cam follower and needle field follower. The third follower is placed in an inactive position in a blank cam space while the needle field follower abuts a cam which determines the neutral position of zigzag motion in order to fashion the sides and ends of buttonhole. The fourth control means is connected to a fourth follower which abuts a feed cam producing forward feed for one side of the buttonhole, rearward feed for the other side of the buttonhole and finer feeds for the bartack ends of the buttonhole.

When the first control means is moved to the replaceable cam position, the third and fourth control means are positioned by the first control means to place the third and fourth cam followers into a position from which they will abut the pattern cam and the feed cam, respectively, of a replaceable cam. In the event that a replaceable pattern cam is used, the fourth cam follower will be in a blank cam space and will be ineffective to control feed. The needle field follower, in either event, will also be located in a blank, ineffective position as will the first cam follower connected to the first control means.

DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention and the objectives achieved thereby reference may be had to the attached specification and accompanying drawings where:

FIG. 1 is a disassembled perspective view of the selector system and cam stack portion of a sewing machine showing the preferred form of a cam selection module in the replacement cam position;

FIG. 2 is a side view of a portion of the cam stack shown in FIG. 1 indicating the relative placement of the various cam sections;

FIG. 3 is a front elevational view of the cam selection module shown in FIG. 1 in the simultaneous feed and pattern control position;

FIG. 4 is a crosssectional view of the arrangement of the follower positioning pin taken substantially along the line 4—4 of FIG. 3 and showing the typical construction of the third and fourth follower positioning pins;

FIG. 5 is a front elevational view of a second embodiment of a cam selection module also shown in the simultaneous feed and pattern control position;

FIG. 6 is a front elevational view of the cam selection module shown in FIG. 5 shifted to the closed pattern control position; and,

FIG. 7 is a front elevational view of the cam selection module shown in FIG. 4 shifted to he replaceable cam control position.

In FIG. 1 is shown in disassembled perspective a cam selection module **10** which cooperates with a selection and information transfer system **14** to select a cam or cams from a cam stack **20.** Referring to FIG. 2 the cam stack **20** consists of pattern cams **21** especially designed to be used alone, feed cams **22,** pattern cams **23** especially designed to be used with the feed cams **22,** a closed pattern unit **24** and a replaceable cam package **25.** A zigzag cam **26** is used in conjunction with the closed pattern unit **24** to provide basic zigzag motion

of the sewing machine needle bar for the production of, for example, buttonholes. Thus, the cam stack provides pattern capability for simple patterns, cam control feed patterns, a closed pattern such as a buttonhole and a replaceable cam package to expand the capability of the sewing machine beyond that of the built in cams. The closed pattern unit **24**, used for the production of buttonholes, contains a needle feed cam **31** to determine neutral position of zigzag vibration for making side and end stitching, and a feed cam **32** to establish the forward and reverse feed required in the production of the buttonhole. A blank cam **33** is also provided for purposes to be described below.

The replaceable cam package **25** depicted in FIG. **2** comprises two pairs of feed cams and pattern cams which will produce selectively one of two cam control feed patterns. Four cams are joined to created one cam package. Thus, pattern cam **37** cooperates with feed cam **38** to produce one cam control feed pattern. When the cam package **25** is removed, inverted and replaced, pattern cam **40** cooperates with feed cam **41** to produce a second cam control feed pattern. If the feed cam surfaces **38** and **41** are undercut to make them ineffective for determining feed, in other words blank cams, the replaceable cam package **25** becomes effective for pattern control only.

Referring to FIG. **1**, the selection and information transfer system **14** includes a feed cam follower support post **47** and a pattern cam follower support post **48** designed to be affixed in the frame of a sewing machine. Freely pivoted on feed cam follower support post **47** is a feed transfer bar **50** and an upper feed cam follower **51** and lower feed cam follower **52**. Both followers are affixed to hubs **53** which contain slots **54** and are engageable with the cam selection module as will be explained below. The rear portion of both cam followers **51** and **52** are bifurcated **56** to fit closely about slabbed portions **57** of the feed transfer bar **50**. The upper feed cam follower **51** may be made adjustable relative to the lower feed cam follower **52** to compensate for dimensional discrepancies by the expedient of separating a follower portion **59** from the bifurcated portion **56**, the follower portion **59** rotating about hub **53** and joined with a screw **60** to the bifurcated portion **56** affixed to hub **53**, to hold the adjusted position. The feed transfer bar **50** may be connected with the feed regulating system in any of many well known manner.

The pattern cam follower support post **48** pivotably supports a needle position adjusting bracket **63**, an upper pattern cam follower **64** and a lower pattern cam follower **65**. The upper and lower pattern cam followers, **64** and **65**, are affixed to hubs **66** which contains slots **67** also engageable with the cam selection module **10** as will be explained below. A needle position cam follower **69** is ganged with the upper pattern cam follower **64** by ears **70** above and below the upper pattern cam follower to slide up and down the cam follower support post **48** with the upper pattern cam follower **64**, but these parts are capable of relative rotational movement about the support post **48**. The needle position cam follower **69** slides in any up and down motion imparted to it during selection within a resilient member **72** affixed to a rod **73** held by snap rings (not shown) to ears **74** on the end of the needle position adjusting bracket **63** opposite to that supported on the pattern cam follower support post **48**. The rod is also attached by linkage (not shown) to instrumentalities (not shown) which control and maintain the position of the needle position adjusting bracket **63** in order to obtain left, center or right needle position. Also, pivotably supported by the rod **73** on its own ears **77** straddling those ears **74** of the needle position adjusting bracket **63** is a pattern transfer plate **78**. The upper **64** and lower **65** pattern cam followers are interposed between the cam stack **20** and the pattern transfer plate **78** which, while pivoting about the rod **73** transmit the information retrieved from the cam stack by the followers to a driving arm **79** having an end (not shown) attached to a needle bar gate of the sewing machine for causing lateral vibration of a needle bar in ornamental stitching. Contact of the driving arm **79** with the pattern transfer plate **78** is arranged by means of a displaced portion **81** of the pattern transfer plate to coincide with the axis of the rod **73** at one extremity of its many possible positions. The driving arm **79** may be positioned by a mechanism (not shown) from this extremity for the control of bight or width of zigzag stitching produced. When the point of contact of the driving arm **79** coincides with the axis of the rod **73**, the pattern transfer plate **78** merely vibrates about the rod **73** without transferring any motion to the driving arm **79**. As the driving arm **79** is positioned further away from the axis of the rod a greater percentage of the vibration imparted through the follower **64** or **65** from the cam stack **20** is transferred to the driving arm.

Note that the upper **64** and lower **65** pattern cam followers are held by springs **83**, of which only one is shown, into intimate contact with the pattern transfer plate **78**. The driving arm **79** is also urged by a tension spring (not shown) into contact with the pattern transfer plate **78** thereby urging the plate and the upper or lower pattern cam follower into contact with the cam stack **20**.

Also pivoted on the pattern cam follower support post **48** is a bracket **85** having an upper leg **86** and lower leg **87**. On the extremity of its upper leg **86** the bracket **85** carries a cam roller **88**. The cam roller **88** abuts a cam track **89** on a follower unloading dial **90**. As the dial **90** is rotated clockwise the cam roller **88**, following the cam track **89** on the dial, forces the bracket **85** also to rotate clockwise. The lower leg **87** of the bracket **85** impinges on an extension **92** of the feed bar **50** urging the feed bar and the upper **51** and lower **52** feed cam followers by virtue of the bifucation **56** in a counterclockwise direction out of contact with the cam stack **20**. A lug **94** adjustably secured by a screw **95** to the upper leg **86** of the bracket **85** simultaneously contacts and rotates a lever **97** pivoted on a post **98** supported relatively to the sewing machine frame. A link **99** mounted on a pin **100** on the lever **94** and projecting through a hole **101** in the pattern transfer plate **78** is moved by the lever **94** and pulls the pattern transfer plate, and, pattern cam followers **64** and **65**, by virtue of the springs **83**, out of contact with the cam stack **20**. A selector dial **103** connected with the cam selection module **10** by a gear train **104** may then be rotated to reposition the respective followers as is explained below.

The cam selection module **10** contains several parts, all mounted on a support bracket **110** attachable to a sewing machine frame. A rack member **111** cooperating with the gear train **104** is supported on the support bracket **110** by two posts including a post **112** affixed to the support bracket having a reduced diameter pro-

jecting through a elongated slot **113** in the rack member which is held unto the post by a snap ring **116.** The second post (not shown) receives a shouldered screw **114** which supports the rack member **111** at a second elongated slot **115.** Thus, the rack member **111** supported by posts affixed to the support bracket **110** can be manipulated laterally to the extent of the elongated slots **113** and **115** by the gear train **104.** An indicator **117** affixed to the rack by screws **118** may be utilized in conjunction with a sewing machine frame mounted plate **119** (partially indicated), having indicia **120** thereon to give a visual indication of the pattern selected. The indicia **120** shown are representative of the replaceable cam and buttonhole produced by the closed pattern unit.

The rack member **111** in addition to the elongated slots **113** and **117** has a downwardly open vertical slot **125** extending from a bottom edge. A T lever **126** having a leg **124** rotated on a post **127** affixed to the support bracket **110,** and held thereto by a snap ring **128,** has a pin **129** affixed to an arm **130** extending through the open vertical slot **125.** A snap ring **131** retains the pin **129** in the slot **125.** Thus as the rack member **111** moves laterally, the T lever **126** is pivoted about the post **127.**

A second arm **133** of the T lever **126** supports a pin **134** which projects through a horizontal slot **135** in a slide plate **136.** The slide plate **136** has a pair of grooved pins **137** affixed to it which space the slide plate from the support bracket **110,** the grooves in the pins **137** running in parallel vertical slots **138** and **139** in the support bracket. Thus the slide plate **136** is capable of stabilized vertical motion on the support plate **110.** This stable vertical motion is transferred to the slide plate **136** by the rotation of the T lever **126** through the agency of the pin **134** on the second arm **133** of the T lever operating in the horizontal slot **135** in the slide plate **136.**

Attached to the lower left corner of the slide plate **136** by a snap ring **142** is a pin **143** which projects through a third vertical slot **144** in the support bracket **110.** The pin **143** has a collar **145** affixed thereto located on the side of the support bracket **110** opposite the slide plate **136** which prevent the pin from passing through the third vertical slot **144** and provides stability. The pin **143** projects into the slot **67** in the hub **66** of the lower pattern cam follower **65** and positions the lower pattern cam follower as the slide plate **136** is moved up and down.

To insure that the lower pattern cam follower **65** will be properly located a plate **147** having a series of serrations **148** on one edge is supported on the support bracket **110** between the slide plate **136** and the support bracket. An upper vertical slot **149** in the plate **147** is guided on a shouldered rivet **150** affixed to the support bracket **110,** and a lower vertical slot **151** in the plate **147** admits a screw **152** threaded into the support bracket. Thus the vertical position of the plate **147** may be adjusted by loosening the screw and moving the plate up or down to the proper position and retightening the screw **152.** A pawl **154** is mounted on the follower positioning pin **143** and a pawl tooth **156** is urged by a torsion spring **155** (see FIG. **3.**) to engage the serrations **148** of the plate **147.** Thereby the position of the follower positioning pin **143** may be centered on a particular cam by adjusting the position of the plate **147** until the pawl tooth **156** is firmly seated in a serration **148** of the plate. Since, as will be explained below, the slide plate **136** is moved to select any mode of machine operation, the plate **147** will contain serrations for all possible variations in any mode of operation. The follower positioning pins for the other cam followers are individually adjustable as will be explained below to compensate for any dimensional discrepancies in the individual components of the cam stack **20.**

The slide plate **136** is formed on its upper left hand corner with a left abutment edge **158.** On its upper right hand corner a similar right abutment edge **159** is located vertically spaced slightly above the left abutment edge **158.** The left abutment edge **158** presses against a left upper pattern follower positioning pin assembly **160** to position the same within a left vertical slot **161** in the support bracket **110.** The right abutment edge **159** presses against a right upper feed follower positioning pin assembly **162** to position the same within a right vertical slot **163** in the support bracket **110.** The constructions of the pin assembly **160** and pin assembly **162** are similar and are indicated in FIG. **4.**

Referring to FIG. **4** the assemblies **160** and **162** include a follower positioning pin **166** formed with a collar **167** and having a threaded end **168.** A plastic member **170** fits over the pin **166** and seats against the collar **167** projecting through the slots **161** and **163** to do so. An abutment member **171** having an elongate hole **172** fits over the pin **166** adjacent to plastic member **170** and presents an abutting face **173** to the abutment edges **158** and **159** of the slide plate **136.** A nut **174** draws and holds the assemblies **160** and **162** together, leaving clearance to the support bracket **110** between the collar **167** and the plastic member **170** to obviate binding. The position of the abutment member **171** may be adjusted within the confines of the elongate hole **172,** and the nut may be tightened to hold this position in order to locate the follower controlled centrally on the cam.

Referring to FIGS. **1** and **3** a torsion spring **178** is coiled about a shouldered rivet **179** affixed to the support member **110** and has its left end **180** seated on the plastic member **170** of the left upper pattern follower positioning pin assembly **160** and its right end **181** seated on the plastic collar **170** of the right upper feed follower positioning pin assembly **162.** Thereby the left assembly **160** and the right assembly **162** are biased downwardly to the bottom of the slots **161** and **163,** respectively, when these assemblies are not positioned by the abutment edges **158** and **159** of the slide plate **136.** The bottom of the slots **161** and **163** is located in a position where the followers controlled by the assemblys **160** and **162** are ineffective.

Thus as the slide plate **136** is moved to its upper extremity by motion of the rack member **110** to the left (see FIG. **1**), the abutment edges **158** and **159** of the slide plate urged the right upper feed follower positioning pin assembly **162** and the left upper feed follower positioning pin assembly **160,** upwardly also. The follower positioning pin **166** of the right upper feed follower positioning pin assembly **162** extends into the slot **54** in the hub **53** of the upper feed cam follower **51,** land, will position this follower when the follower unloading dial **90** has been rotated to remove all followers from contact with the cam stack **20.** Likewise, the follower positioning pin **166** of the left upper pattern follower pin assembly **160** extends into the slot **67** in the

hub 66 of the upper pattern cam follower 64, and, will simultaneously position this follower when all followers are out of contact with cam stack 20. In FIG. 1 pawl tooth 156 of the pawl 154 is shown engaged with the uppermost serration 185 (see FIG. 3) of the serrations 148 in the plate 147. Therefore, the upper feed cam follower 51 is aligned with the feed cam 38 of the replaceable cam package 25. Also, the upper pattern cam follower 64 is aligned with the pattern cam 37 of the replaceable cam package 25. When the upper cam followers are thus aligned with the replaceable cam package 25, the needle position cam follower 69 is located in the undercut blank cam 33 of the closed pattern unit 24 at which position it is ineffective to control needle position, and, the lower pattern cam follower 65 is located in the space in the cam stack 20 above the zigzag cam 26 at which position it also is ineffective. Therefore, the only information transferred to the needle bar and to the feed system of the sewing machine comes from the replaceable cam package 25. As noted above the cams 40 and 41 of the replaceable cam package 25 may become effective to control pattern and feed, respectively, if the replaceable cam package is removed from the machine, inverted and reinserted. Also, as noted above, if the feed cam surfaces 38 and 41 of the replaceable cam package 25 are undercut the upper feed cam follower 51 will become ineffective to control the feed of the sewing machine and pattern cam control only will result.

If the pawl tooth 156 of the pawl 154 were located in the serration 186 (see FIG. 3) of the serrations 148 in the plate 147 immediately adjacent to that shown in FIG. 1, i.e., the slide plate 136 is moved down one serration, the indicator 117 will point indicia 120 indicative of the buttonhole and the followers will be aligned with the cams for the operation of the closed pattern unit 24. Thus, the upper feed cam follower 51 is aligned with the feed cam 32 of the closed pattern unit, and, the needle position cam follower 69 is aligned with the needle field cam 31 of the closed pattern unit to determine the right and left side and the ends of the buttonhole. The lower pattern cam follower 65 is aligned with a zigzag cam 26 which is used to produce the basic zigzag motion required to produce the buttonhole sides and ends. The upper cam follower 64 is located in the undercut blank cam 33 of the closed pattern unit 24 in which position it is ineffective.

If the slide plate 136 is moved to and below two serrations from the position shown in FIG. 1 to the position where the pawl tooth 156 is in engagement with the serration 187 (see FIG. 3) the abutment edges 158 and 159 will not be effective to position the left upper pattern cam follower positioning pin assembly 160 and the right upper feed follower position pin assembly 161, respectively, because these assemblies will be located at the bottom of the slots 161 and 163, respectively, as urged by the torsion spring 178. The upper pattern cam follower 64 will be located in the undercut blank cam 33 of the closed pattern unit 24 and the needle position cam follower 69 will be located in an ineffective position beneath the closed pattern unit 24. The upper feed cam follower 51 will also be located in the undercut blank section 33 of the closed pattern unit 24 in which position it will be ineffective to control feed. The lower pattern cam follower 65 will be aligned with a pattern cam from the group of pattern cams 21, or as shown in FIG. 3 with the pattern cam from the group of pattern cams 23 associated with a feed cam from the group of feed cams 22 depending on how far down the support bracket 110 the slide plate 136 is moved.

In the embodiment shown the group of pattern cams 21 for pattern control of the needle bar without feed control consists of six cams. More or less cams may be used requiring only slight modification to the cam selection module 10 to accommodate change in the quantity of pattern cams 21. The group of pattern cams 23 associated with the group of feed cam 22 for cam control feed patterns contains four cams, as does the group of feed cams 22. Again, more of less cams for cam control feed pattern may be accommodated by slight modification to the cam selection module 10. In making the transition from the group of pattern cams 21 to the group of pattern cams 23 associated with the feed cams 22, means are required to position the lower feed cam follower 52 from an ineffective position below the cam stack 20 to an effective position aligned with a cam from the group of feed cams 22. This is accomplished as shown in FIG. 3 by including a lower abutment edge 190 on the slide plate 136 which during the transition from the lowermost cam 191 in the group of pattern cams 21 to the uppermost cam 192 in the group of pattern cams 23 strikes an ear 193 of a lever 194 pivoted on a boss 195 affixed to the support bracket 110 (see FIG. 1). The end of the lever 194 opposite the ear 193 supports a pin 198 which engages a slot 199 in a member 200 adjustably affixed to a lower feed cam follower positioning pin assembly 201. The lower feed cam follower positioning pin assembly 201 is constructed similar to the assemblies depicted in FIG. 4. The positioning assembly 201 is slidably supported in a vertical slot 197 in the support bracket 110. From the position of the lever 194 shown in FIG. 1 to that shown in FIG. 3 which represents the lowermost position of the slide plate 136 on the support bracket 110, it will be obvious that the cam 192 in the pattern cam group 23 is designed to operate with the lowermost cam 205 from the group of feed cams 22. Similarly, the lowermost cam 206 in the pattern cam group 23 is designed to operate with the uppermost cam 208 from the group of feed cams 22. In other words, the group of feed cams 22 is traversed from the bottom cam 205 to the top cam 208 of the group 22 as the group of patterns cams 23 designed for use with these feed cams is traversed from the top cam 192 to the bottom cam 206 of the group 23. This arrangement obviates the necessity for blank undercut cam between the groups 22 and 23 and allows the lower feed cam follower 52 to be stored in an ineffective position below the cam stack 20. An extension spring 202, having one end hooked in a hole 204 in the lever 194 and the other end captured in a notch 203 in the support bracket 110, urges this lever to the position shown in FIG. 1 where the follower 52 will be ineffective.

The above description has disclosed a preferred embodiment of a cam selection module used to control the position of five followers in the selection of four modes of sewing machine operation. By manipulation of a single control, a sewing machine operator may position the five followers to select pattern stitching, cam control feed stitching, a closed pattern such as a buttonhole, or a replaceable cam package. In FIGS. 5, 6 and 7 is shown a second embodiment of a cam selection module 210 which accomplishes the same objectives achieved by the preferred embodiment.

Referring to FIG. 5, a support bracket 215 is arranged to support a selector member 216 by means of a post 217, affixed to the support bracket, protruding through a slot 218 in the selector member which is retained to the post by a snap ring 219; and, a second post 220 affixed to the selector member which protrudes through a slot 221 in the support bracket also retained by a snap ring (not shown). The selector member 216 is thereby capable of transverse movement by manipulation of, for example, a finger grip 225 having a pointer 226 thereon for indicating indicia of pattern selected on a frame mounted plate similar to that shown in FIG. 1 for the preferred embodiment.

Pivoted on a boss 228, affixed to the support bracket 215, and held on the boss by a snap ring 229 is a bell crank 230. The bell crank 230 has affixed to the extremity of one arm 231 a pin 232 which pin projects through a upwardly open vertical slot 233 in the selector member 216. The transverse motion of the selector member 216 pivots the bell crank 230 about the boss 228 causing the second arm 234 of the bell crank to move in a vertically disposed arc. Referring to FIG. 6 and 7 it will be seen that the second arm 234 of the bell crank has pivotably attached thereto a link 236.

The end of link 236 opposite that pivotably attached to the second arm 234 of the bell crank 230 carries a lower pattern cam follower positioning pin 237 attached to the link by a snap ring 238. The lower pattern cam follower positioning pin 237 projects through a vertical slot 239 in the support bracket 215. The lower pattern cam follower positioning pin 237 carries between the link 236 and the support bracket 215 a pawl 240 which is biased by a torsion spring 241 against serrations 242 on a plate 243 adjustably secured to the support bracket 215 by a shouldered rivet 244 and a screw 245 in a similar fashion as plate 147 in the preferred embodiment. Thus, the position of the plate 243 with the serrations 242 thereon may be adjusted to locate the lower pattern cam follower positioning pin 238 and thereby the lower pattern cam follower 65 centrally on any cam in the group of pattern cams 21, or, the group of pattern cams 23 associated with a group of feed cams 22, by virtue of the accurate locations of the serrations 242 on the plate 243 relative to each other with regard to the cam spacings.

Referring to FIG. 5 it will be noted that the second arm 234 of the bell crank 230 has a grooved rivet 248 affixed approximately midway down its length. A crooked lever 249, pivoted on a pin 250 affixed to the support bracket 215 and held thereon by a snap ring 251 rotatably supports an arm 252 on a shoulder screw 253 at the crook, the arm and lever 249 being biased together by a torsion spring 254 mounted on the screw 253. The arm 252, however, is restrained by the groove in the groove rivet 248 affixed to the second arm 234 of the bell crank 230 with the result that the crooked lever 249 is pivoted upwardly with upward motion of the second arm 234 due to the force exerted by the torsion spring 254 on the crooked lever. A stop 255, adjustably attached by screw 256 to the crooked lever, and having a bent over edge 257 guided in a slot 258 in the crooked lever, has an abutment face 259 impinging on the groove rivet 248. Therefore, when the bell crank 230 is rotating clockwise from a position indicated in FIG. 5 the crooked lever 249 will rotate upwardly about its pivot 250 under the influence of the torsion spring 254. When the bell crank 230 is rotated counter-clockwise from the position shown in FIG. 6, the grooved rivet 248 will eventually strike the abutment face 259 of the stop 255 and force the crooked lever 249 to rotate clockwise or downwardly.

The end of the crooked lever 249 opposite that end pivoted contains a slot 262 crossing over a vertical slot 263 in the support bracket 215. A lower feed follower positioning pin 264 extends through slot 262 in the crooked lever 249 and the vertical slot 263 in the support bracket 215. The positioning pin 264 is retained in position by a snap ring 265 adjacent the crooked lever 249 and an integral collar (not shown) adjacent the opposite side of support bracket 215. The lower feed follower positioning pin 264 is designed to project into the slot 54 in the hub 53 of the lower feed cam follower 52.

It should be noted that for this embodiment of the cam selection module 210, the cam stack 20 must be constructed somewhat differently than that described for the preferred embodiment shown above. In the preferred embodiment the cam stack contained a group of pattern cams 23 located directly above a group of feed cams 22 with which they were associated. In this embodiment each pattern cam is located adjacent a feed cam with which it is associated, therefore, referring to FIG. 5 the pawl 240 is located in serration 267 when the lowermost cam 191 of the group of pattern cams 21 determines the zigzag motion of the needle bar of the sewing machine. A blank cam must be provided immediately beneath the cam 191 for a stored position of the lower feed follower 52. The serrations below the serration 267 are spaced at twice the distance of the serrations above serration 267 because the lower pattern cam follower 65 must skip the blank space provided for storage of the lower cam feed follower 52 in order to position the lower pattern cam follower 65 adjacent to a pattern cam associated with a feed cam for cam control feed patterns. This therefore occurs when pawl 240 is seated in serration 268. For each succeeding selection the pattern cam follower 65 must again traverse two cams in order to bypass an adjacent feed cam before aligning with a pattern cam. Thus, double spacing is provided between serration 268 and 269 and between 269 and 270 and between 270 and 271 in order that the lower pattern cam follower 65 may bypass the feed cams individually associated with pattern cams for the production of cam control feed patterns. It should be noted that while position of the lower pattern cam follower 65 may be adjusted by positioning the plate 243 on support bracket 215, the position of the lower feed follower 52 is provided for by adjusting the stop 255 until the follower is aligned with the proper feed cam. This embodiment of the cam selection module 210 is designed so that when the pawl 240 is moved from serration 267 to 268 the groove rivet 248 impinges on the stop 255 and moves the lower feed cam follower 52 from the stored position to a position aligned with the first feed cam adjacent the first pattern cam for the production of cam control feed pattern.

Thus far has been explained how the cam selection module 210 of this second embodiment may be manipulated to choose a pattern cam from a group of pattern cams 21 or a pattern and a feed cam for the production of cam control feed patterns. Referring to FIG. 6 it will be noted, as explained above, that the crooked lever 249 carrying the lower feed follower positioning pin 264 and the lower feed cam follower 52 is stored in a

blank position in a cam stack above the combined pattern and feed cams utilized for the production of cam control feed patterns. In FIG. 6 the selector member 216 is shown in a position where it has rotated the bell crank 230 and the lower pattern cam follower 65 above the group of pattern cams 21 and into a position where the closed pattern unit 24 is called into operation. The second arm 234 of the bell crank 230 has a extension 275 thereto, which extension abuts a lever 276 pivoted by a shoulder screw 277 threaded into the selector member 216. A torsion spring 278 biases the lever 276 to a rest position as secured by an ear 279 on lever 276 (see FIG. 5). As the bell crank 230 is rotated on the boss 228 by the transverse motion of the selector member 216 beyond that required to traverse the pattern cams 21 the extension 275 to the second arm 234 of the bell crank abuts the lever 276 and raises it to an operating position. A three-arm lever 281, rotatably supported on a pin 282 affixed to the support bracket 215 and retained on this pin by a snap ring 283, has a pin 286 on an upper arm 285 of the three-arm lever. The pin 286 extends through a slot 287 in the lever 276. The left edge 288 of the slot 287 extends further upward than the right edge 289 of the slot. Thus, as the selector member 216 is moved to the right from the position shown in FIG. 5 to the position shown in FIG. 6 the left edge 288 of the slot 287 impinges on the pin 286 in the upper arm 285 of the three-arm lever 281. Concurrently the extension 275 to the second arm 234 of the bell crank 230 rotates the lever 276 into an operating position and the pin 286 on the upper arm 285 of the three-arm lever 281 is captured within the left edge 288 and the right edge 289 of the slot 287. The horizontal motion of the selector member 216 thereby rotates the three armed lever 281. A horizontal arm 291 of the three-arm lever 281 is rotatably attached to a link 292 which carries at its opposite end an upper cam follower positioning pin 293 rotatably attached thereto by a snap ring 294 and projecting through a vertical slot 295 in the support bracket 215. The upper cam follower positioning pin 293 is formed with a collar (not shown) on the opposite side of the support bracket 215 and is designed as explained above in the preferred embodiment to position the upper pattern cam follower 64 and the needle positioning cam follower 69 ganged with the upper pattern cam follower. The lower arm 297 of the three-arm lever 281 is rotatably connected to a second link 298 which is rotatably connected at its other end to a first arm 299 of a bell crank 300 pivoted on a pin 301 attached to the support bracket 215, and held thereon by a snap ring 302. The second arm 303 of the bell crank 300 is rotatably connected to a third link 304 which is itself rotatably connected at its other end to a upper feed cam follower positioning pin 305 projecting through a vertical slot 307 in the support bracket 215. The upper feed cam follower positioning pin 305 contains an integral collar (not shown) adjacent the outer side of the support bracket 215 and is held to the third link 304 by a snap ring 309 adjacent the outer side of the third link. A torsion spring 310, mounted on the pin 301, and biased between the support bracket 215 and the bell carnk 300 tends to rotate the bell crank in a counter-clockwise direction to maintain the upper feed cam follower 51 and the upper pattern cam follower 64 as positioned by the respective positioning pins 305 and 293 in ineffective positions in the blank cam 33 of the closed pattern unit 24 when the extension 275 to the bell crank 230 is not engaged with the lower surface of the lever 276.

Referring to FIG. 2, as was explained in the description of the preferred embodiment, when the sewing machine is arranged for pattern stitching or for cam controlled feed pattern sewing, the upper pattern cam follower 64 is aligned with the undercut blank cam 33 of the closed pattern unit 24 while the needle position cam follower 69, ganged with the upper pattern cam follower 64, is aligned below the needle field cam 31 of the closed pattern unit. The upper feed cam follower is also aligned with the blank cam 33 of the closed pattern unit 24. Thus, all three upper followers are located in ineffective positions.

FIG. 6 indicates the position of the various linkage positioning the various followers for operation of the closed pattern unit 24. The lever 276 is shown in a position whereby the slot 287 in the lever has both the left edge 288 and the right edge 289 engaged with the pin 286 affixed to the upper arm 285 of the three-arm lever 281. If the selector member 216 were to be moved to the left as viewed in FIG. 6 the right edge 289 of the slot 287 in the lever 276 would rotate the three-arm lever 281 to locate the upper feed cam follower 51 and the upper pattern cam follower 64 in the ineffective position. Concurrently, as the selector member 216 is moved to the left the bell crank 230 will rotate and remove the extension 275 from contact with the lever 276. The lever 276 under the influence of the torsion spring 278 would rotate downwardly until this ear 279 on the lever 276 contacts the upper edge of the selector member 216 whereupon the pin 286 will be disengaged from the slot 287 in the lever and the position of the upper feed cam follower 51 and the upper pattern cam follower 64 will be maintained in the ineffective position by the torsion spring 310. As in the preferred embodiment when the closed pattern unit 24 is selected the lower pattern cam follower 65 will be positioned adjacent the cam 26 in the cam stack and the needle position cam follower 69 and the upper feed cam follower 51 will be in engagement with the cams 31 and 32, respectively, of the closed pattern unit 24.

Referring to FIG. 7 when the upper pattern and feed cam followers 64 and 51 are placed in a position to engage with the cams 37 and 38, respectively, of the replaceable cam package 25, the lower pattern cam follower 65 is located above the cam 26 in the cam stack where it will be ineffective to control the position of the needle bar of the sewing machine. In both FIG. 6 and FIG. 7 the lower feed cam follower 52, as explained above, will be stored in an ineffective position above the combined pattern and feed cams for cam control feed and just below the group of pattern cams 21 in an undercut blank cam where the follower will be ineffective to control feed motion. The motion of the selector member 216 to the right, from a position shown in FIG. 6 to the position shown in FIG. 7, will also move the lever 276 to the right. By the connection of the lever 276 to the three-armed lever 281 through the pin 286 connected to the three-armed lever, the three-armed lever will be rotated clockwise, elevating both upper cam followers 51 and 64 through the connecting linkages.

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

1. A pattern cam selector mechanism for a sewing machine having a camshaft with a plurality of pattern

cams carried thereon, a plurality of cam followers shiftably supported for movement along said cam stack for tracking selected ones of said pattern cams in said cam stack, each follower operatively associated with a different instrumentality of said sewing machine, a single operator influenced selector member carried in said sewing machine for influencing the pattern cam tracking relationship of each of said plurality of pattern cam followers, a single control member shiftably supported in said sewing machine continuously over a predetermined range, means influenced by said operator influenced selector member for directly regulating the position of said control member within said entire range, means for interconnecting one of said cam followers to said control member for movement therewith over the entire range of shifting movement of said control member, means for shiftably supporting the others of said plurality of cam followers independently of said control member, and means effective over only portions of said entire range of shifting movement of said control member for interconnecting said control member to shift said other of said plurality of cam followers.

2. A pattern cam selector mechanism as set forth in claim 1 in which said means effective over only portions of said entire range of shifting movement of said control member for interconnecting said control member to shift said other of said plurality of cam followers includes a separate operative interconnection between said control member and each of said others of said plurality of cam followers, respectively, each of said operative interconnections being effective over a different portion of said entire range of shifting movement of said control member.

3. A pattern cam selecting mechanism as set forth in claim 1 wherein said means for shiftably supporting said other of said plurality of pattern cam followers includes an independent carrier means for each of said other pattern cam followers, a support bracket shiftably supporting said independent carrier means, said support bracket including stop means limiting motion of each of said independent carrier means to a range less than said entire range of shifting movement of said control member.

4. A pattern cam selection mechanism as set forth in claim 3 wherein said control member includes abutment surfaces and said independent carrier means includes abutment surfaces, said abutment surfaces interengaging over portions of said entire range of shifting movement of said control member to shift said independent carrier means and said pattern cam followers thereby supported into selective tracking engagement with pattern cams of said pattern cam stack.

5. In a zigzag sewing machine having a frame, a gate supported in said frame for lateral oscillation, a needle bar supported in said gate for endwise reciprocation, driving means to drive said needle bar in endwise reciprocation, first operating means to cause said gate and said needle bar to undergo lateral oscillation, said first operating means including a set of individually selectable first cams and a first cam follower therefor, a feed mechanism, second operating means for controlling said feed mechanism, said second operating means including individually selectable second cams and a second cam follower therefor, a closed pattern unit, a replaceable cam, said replaceable cam including capability for actuating both said first operating means and said second operating means, a third cam follower for said replaceable cam and associated with said first operating means, a fourth cam follower for said closed pattern and said replaceable cam and associated with said second operating means and a fifth cam follower for said closed pattern unit moveable with said third cam follower and associated with said first operating means for determining needle field operation, wherein the improvement comprises:

a. first control means having an operating range, said first control means connected with said first cam follower to control the position thereof;

b. second control means connected with said second cam follower, said second control means positioned to be actuated by said first control means during a first portion of said operating range of said first control means;

c. third control means connected with said third cam follower and said fifth cam follower to control the positions thereof, said third control means positioned to be actuated by said first control means during a second portion of said operating range of said first control means;

d. fourth control means connected with said fourth cam follower to control the position thereof, said fourth control means positioned to be actuated by said first control means during said second portion of said operating range of said first control means.

6. In a zigzag sewing machine having a frame, a gate supporte in said frame for lateral oscillation, a needle bar supported in said gate for endwise reciprocation, driving means to drive said needle bar in endwise reciprocation, first operating means to cause said gate and said needle bar to undergo lateral oscillation, said first operating means including a set of individually selectable first cams and a first cam follower therefor, a feed mechanism, second operating means for controlling said feed mechanism, said second operating means including individually selectable second cams in coaxial alignment with said first cams and a second cam follower therefor, a closed pattern unit in coaxial alignment with said first and second cams, a replaceable cam in coaxial alignment with said closed pattern unit and said first and said second cams, said replaceable cam including capability for actuating both said first operating means and said second operating means, a third cam follower for said replaceable cam and associated with said first operating means, a fourth cam follower for said closed pattern and said replaceable cam and associated with said second operating means, and a fifth cam follower for said closed pattern unit moveable with said third cam follower and associated with said first operating means for determining needle field of operation, wherein the improvement comprises:

a. first control means for having an operating range, said first control means connected with said first cam follower to control the position thereof;

b. second control means connected with said second cam follower to control the position thereof, said second control means positioned to be actuated by said first control means during a first portion of said operating range of said first control means;

c. third control means connected with said third cam follower and said fifth cam follower to control the positions thereof, said third control means positioned to be actuated by said first control means

during a second portion of said operating range of said first control means;

d. fourth control means connected with said fourth cam follower to control the position thereof, said fourth control means positioned to be actuated by said first control means during said second portion of said operating range of said first control means.

7. In a zigzag sewing machine as set forth in claim **6** wherein said coaxial aligned cams include a first section within which said first cam follower is ineffective to operate said first operating means during a portion of said second portion of said operating range of said first control means and said third, fourth and fifth cam followers are ineffective to operate said first and second operating means during said first portion of said operating range of said first control means; and, wherein said coaxial aligned cams include a second section within said second cam follower is ineffective to operate with said second operating means.

8. In a zigzag sewing machine as set forth in claim **7** wherein said first control means includes a support bracket attachable to said frame adjacent said coaxially aligned cams, a plate slidable on said support bracket in a direction parallel to the axis of said coaxially aligned cams, a first pin affixed to said plate and connecting said plate to said first cam follower, and means for moving said plate in stepwise fashion to individually select a cam from said set of first cams.

9. In a zigzag sewing machine as set forth in claim **8** wherein said plate includes a first abutment member and said second control means includes a second pin slidably mounted on said support bracket and connected to said second cam follower, resilient means biasing said second pin and said second follower to a position where said second cam follower is ineffective to operate said second operating means, and, means connecting said first abutment member and said second pin during said first portion of said operating range of said first control means to shift said second pin and said second cam follower to a position where said second cam follower is effective to operate said second operating means.

10. In a zigzag sewing machine as set forth in claim **9** wherein said plate includes a second abutment member and said third control means includes a third pin slidably mounted on said support bracket and connected to said third and fifth cam followers, resilient means biasing said third pin and third and fifth cam followers to a position where said cam followers are ineffective to operate said first operating means, and means connecting said second abutment member and said third pin during said second portion of said operating range of said first control means to shift said third pin and said third and fifth cam followers to a position where said third and fifth cam followers are effective to operate said first operating means.

11. In a zigzag sewing machine as set forth in claim **10** wherein said plate includes a third abutment member and said fourth control means includes a fourth pin slidably mounted on said support bracket and connected to said fourth cam follower, resilient means biasing said fourth pin and fourth cam follower to a position where said fourth cam follower is ineffective to operate said second operating means, and, means connecting said third abutment member with said fourth pin during said second portion of said operating range of said first control means to shift said fourth pin and said fourth cam follower to a position where said fourth cam follower is effective to operate said second operating means.

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