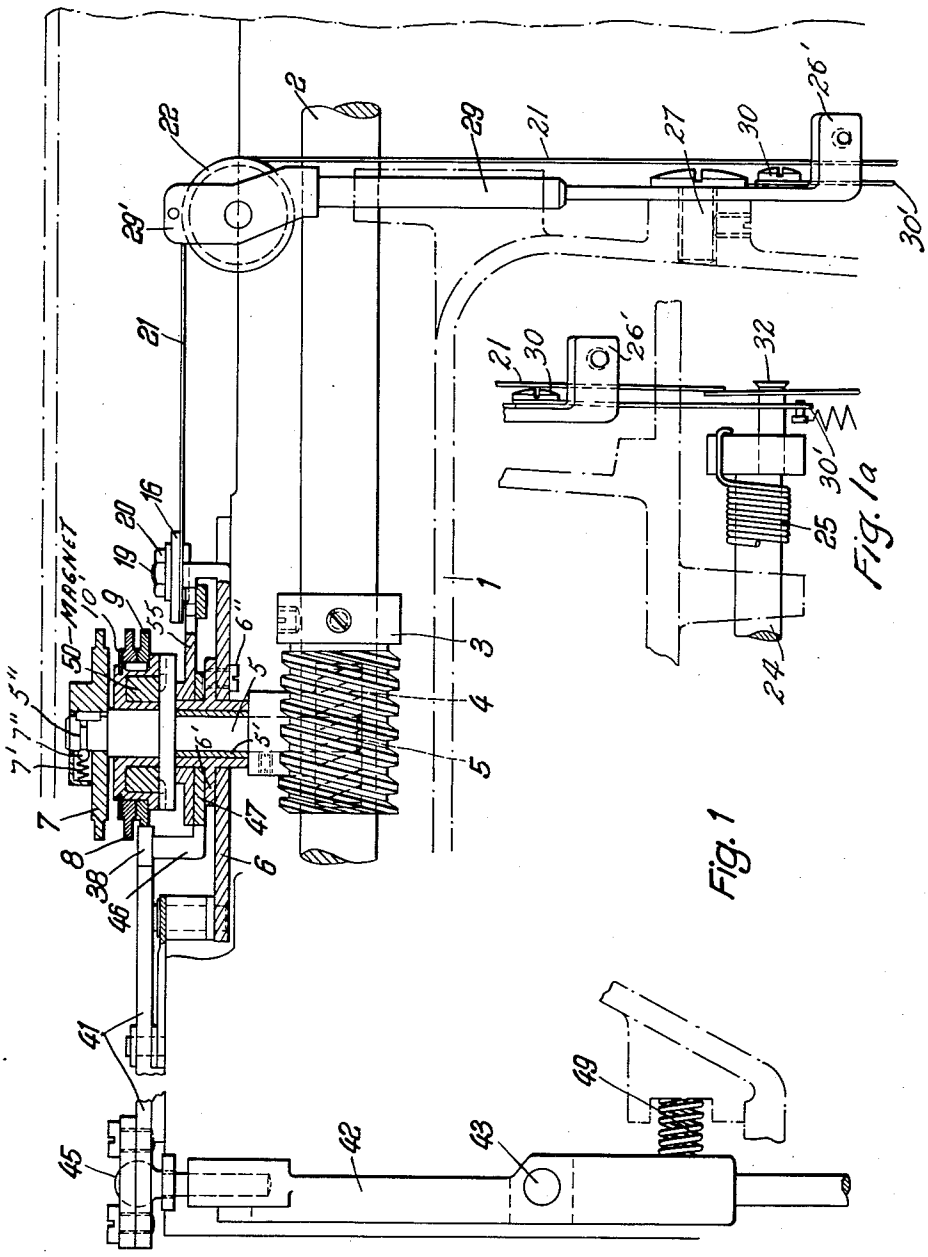
May 9, 1961 W. ENGEL 2,983,240

SEWING MACHINES

Filed June 22, 1956 5 Sheets-Sheet 1



Inventor:
WOLFGANG ENGEL
BY Robert H. Jacob.
AGENT

May 9, 1961 W. ENGEL 2,983,240

SEWING MACHINES

Filed June 22, 1956 5 Sheets-Sheet 2

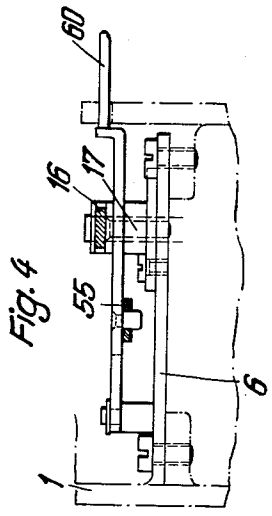


Fig. 4

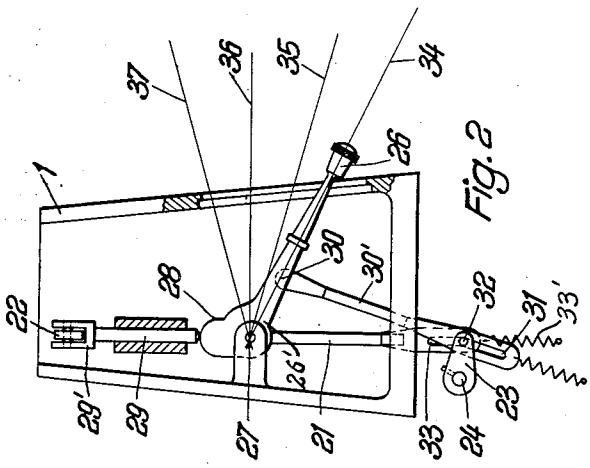


Fig. 2

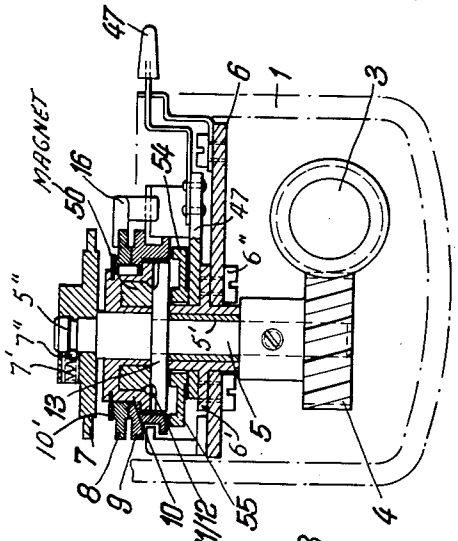


Fig. 3

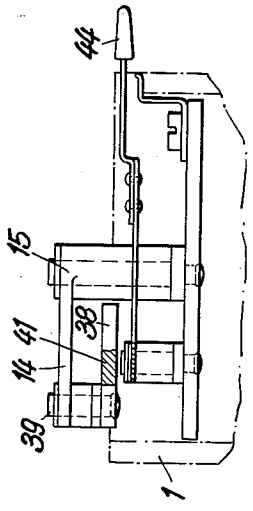


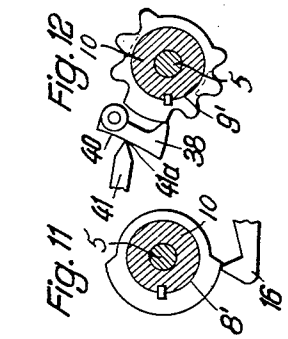
Fig. 5

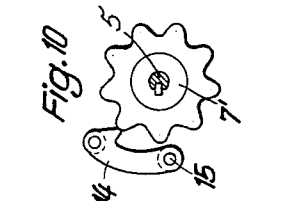
Inventor:
WOLFGANG ENGEL
BY Robert H. Jacob
AGENT

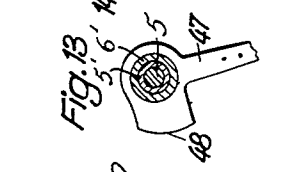
May 9, 1961 W. ENGEL 2,983,240

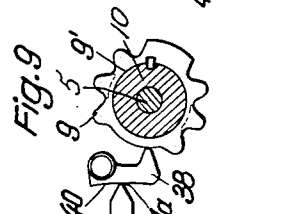
SEWING MACHINES

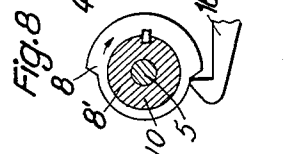
Filed June 22, 1956 5 Sheets-Sheet 3

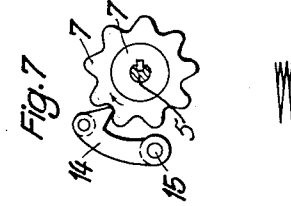












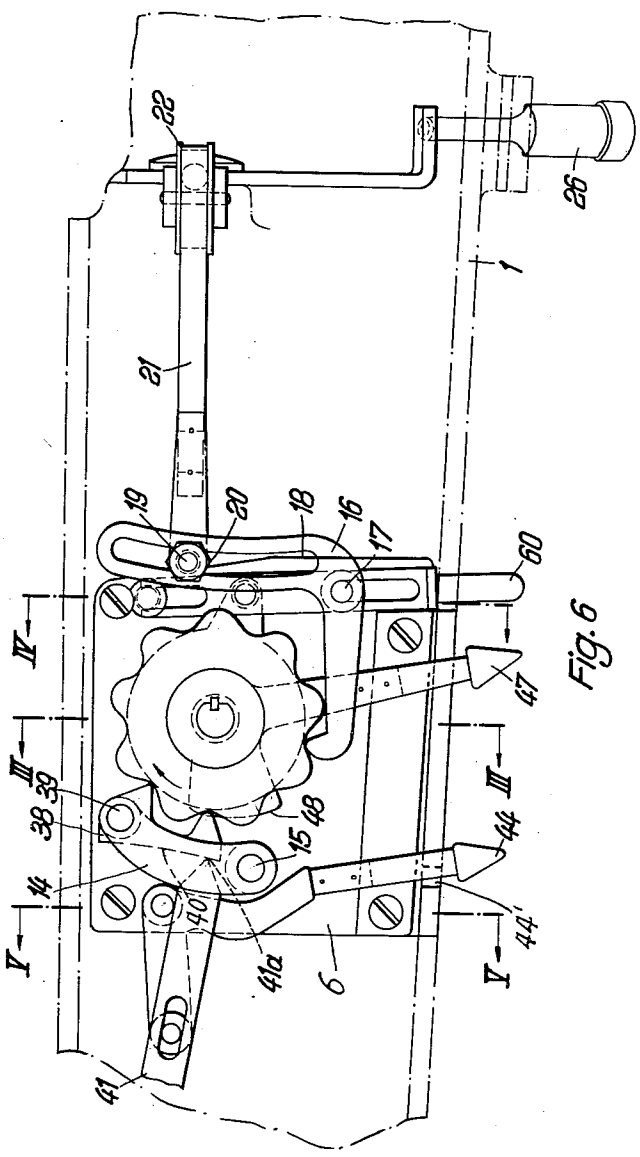


Fig. 6

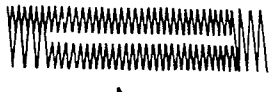


Fig. 17

Inventor:
WOLFGANG ENGEL
BY Robert H. Jacob
AGENT

May 9, 1961 W. ENGEL 2,983,240

SEWING MACHINES

Filed June 22, 1956 5 Sheets-Sheet 4

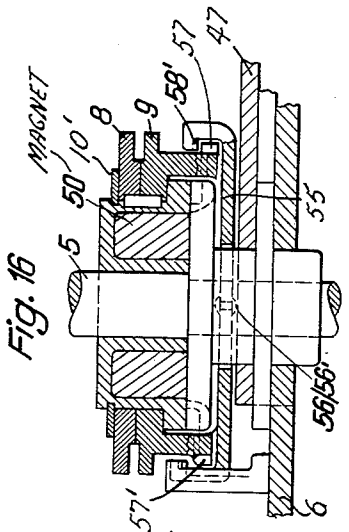


Fig. 16

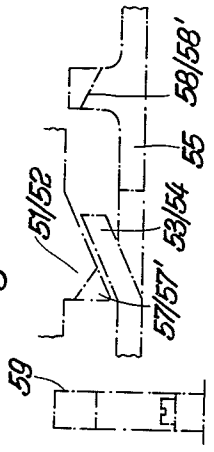


Fig. 14a

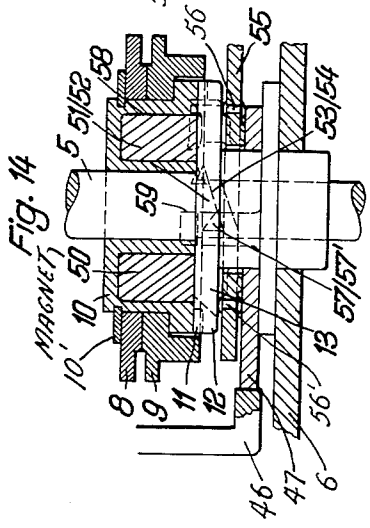


Fig. 14

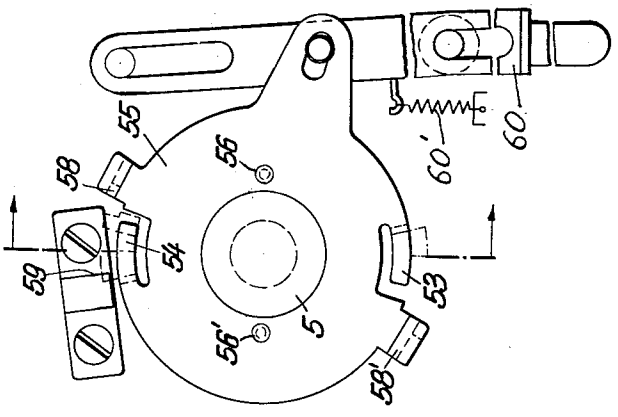


Fig. 15

Inventor:
WOLFGANG ENGEL
BY Robert A. Jacob.
AGENT

May 9, 1961 W. ENGEL 2,983,240

SEWING MACHINES

Filed June 22, 1956 5 Sheets-Sheet 5

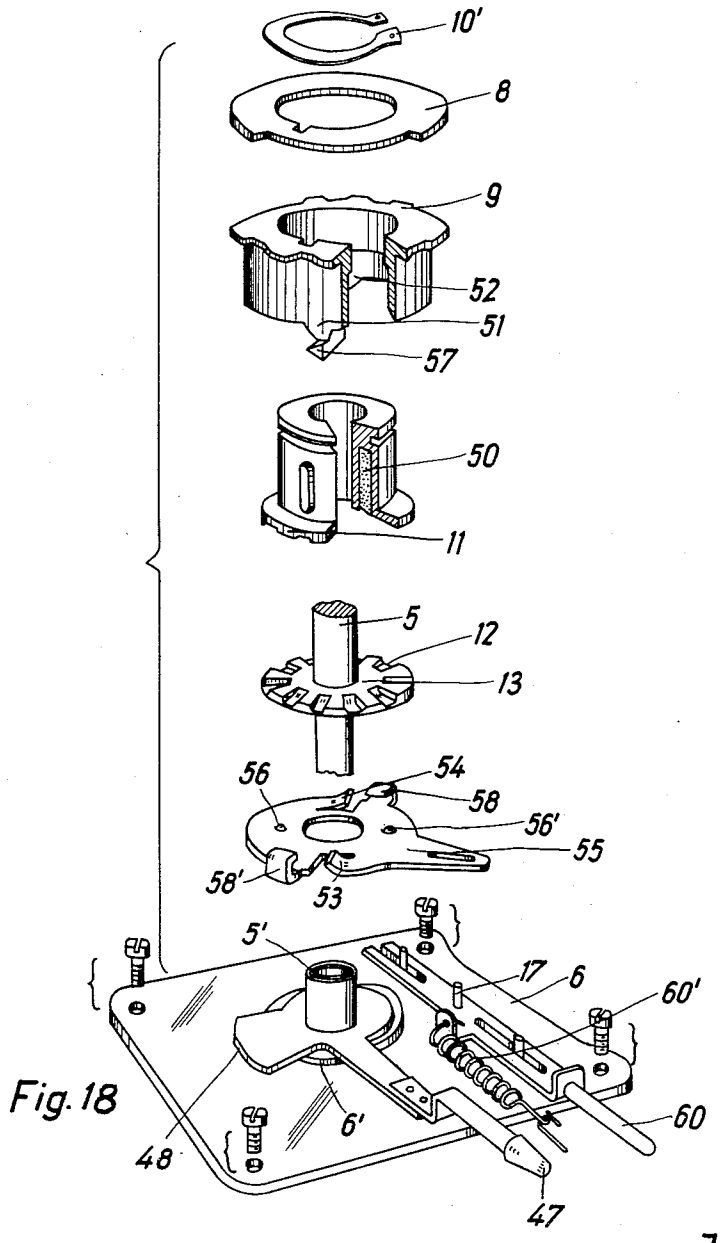


Fig. 18

Inventor:
WOLFGANG ENGEL
BY Robert K. Jacob
AGT.

United States Patent Office 2,983,240 Patented May 9, 1961

2,983,240

SEWING MACHINES

Wolfgang Engel, Bielefeld, Germany, assignor to Phoenix-Nähmaschinen A.G. Baer & Rempel, Bielefeld, Germany

Filed June 22, 1956, Ser. No. 593,246

Claims priority, application Germany June 25, 1955

5 Claims. (Cl. 112—158)

This invention concerns a method for the production of forwardly and rearwardly running decorative seams and machines for carrying out the method.

More particularly, the invention relates to a method for the production of forwardly and rearwardly running decorative seams of the nature of button-hole edgings and to an automatically controlled sewing meachine, suitable for the purpose, with a needle bar which swings out laterally.

In the production of decorative seams on automatically controlled machines intended for the purpose, it is often required that the decorative seam should not be made to advance in one direction, but should be carried forwardly and rearwardly. For example, this is the case in the production of button holes in which firstly the border bounding the one edge of the button hole is to be formed and then, with oppositely directed movement of the material, the border bounding the other edge of the button hole. In this however, certain difficulties arise, for instance due to the fact that the material is not conveyed in precisely the same fashion by the feed device—the material food dog—in the two directions of movement. The decorative seam would therefore require a different number or arrangement of stitches for the forward movement than for the return and its end does not terminate cleanly at the commencement when the previously known automatically acting zig-zag sewing machines are used. Similar difficulties also arise with other forwardly and rearwardly running decorative seams.

The invention accordingly provides remedies in that both the automatic control and also manual control are employed, during the formation of the seam, to bring about the necessary adjustments of the machine, that is particularly the adjustment of the size of overstitch or stitch width, the position of the stitch region and the amount and direction of the feed movement.

When sewing button-holes, this can be effected, in particular, by first producing the first terminal stitches and the commencement of the first border automatic control with rearward operation of the machine and then completing the first border with manual control and rearward operation, whereafter the second terminal and the commencement of the second border are effected under automatic control with forward operation of the machine and finally the second border is completed by manual control with forward operation.

The sewing machine for carrying out the method of the invention is so constructed that it permits of change over from automatic control to hand control, that is it can be switched over from one mode of operation to the other, during stitch production. Preferably the sewing machine has cams for controlling the width of the stitch, the position of the stitch, the length of the stitch and the variation of the stitch width, of which cams one a least can be selectively coupled to its camshaft. Suitably, however, this selective coupling to the camshaft is provided for a plurality of the said cams, say in such a fashion that the cam for the stitch width is constantly in driving connection with the camshaft, whereas the cams for the stitch position and/or the stitch length and/or the variation of the stitch width can be coupled selectively to the camsshaft. The uncoupling may then be effected automatically by such shaping of the cams that they themselves release the connection to the camshaft at the end of the prescribed movement.

The previously known zig-zag sewing machines for the production of button holes, in which the material is clamped fast and is positively controlled, are simply one-purpose machines of complicated construction. The feed dog executes a quadrangular movement and carries the material along intermittently by friction. When sewing a button hole, it is thus practically impossible, as already indicated, for the right and left borders to possess the same number of stitches.

In contrast, the invention permits of the provision of a universal zig-zag sewing machine of simple construction in which manual control means and automatic control means are used, in one working operation, for changing the adjustment on the machine, whereby the aforesaid difficulties can be avoided.

By way of example of an embodiment of the invention, the drawings show a decorative-stitch control unit of a button-hole sewing machine in which disc cams of a tpye known per se operate the needle-bar rockers. The invention can, of course, also be utilized in sewing machines with a decorative-stitch control unit in which the disc-cams automatically control the setting means of a zig-zag device.

In the drawings:

Figure 1 represents the front elevation of a sewing-machine arm with a control unit for the production of decorative stitches and for the automatic production of button holes,

Figure 1*a* is a detail showing the connection of the mechanism to the feed dog setting shaft,

Figure 2 the stitch-setting lever mechanism in side elevation,

Figure 3 a section on the line III—III in Figure 6, as seen in the direction of the arrows,

Figure 4 a section on the line IV—IV in Figure 6, as seen in the direction of the arrows,

Figure 5 a section on the line V—V in Figure 6, as seen in the direction of the arrows,

Figure 6 the plan view of the arm with the control unit,

Figures 7 to 9 indicate the positions of the cams **7**, **8** and **9** and also the positions of the levers co-acting with these cams, at the commencement of the first locking,

Figures 10 to 12 indicate the positions of the cams **7**, **8** and **9** and also the positions of the levers co-acting therewith, at the commencement of the second locking,

Figure 13 represents the hand lever **47** and its cam surface **48**,

Figures 14 to 16 illustrate the manner of operation of the clutch, Figure 14*a* representing, in chain lines, a partial elevation, corresponding to Figure 14 to a larger scale,

Figure 17 shows a diagrammatic representation of a button-hole seam, such as is produced with the various working positions of Figures 7 to 13,

Figure 18 is an exploded view of the clutch and cam mechanism.

Mounted in the arm **1** of the sewing machine, in accordance with Figure 1, is the arm shaft **2** which drives the camshaft **5** by way of the worm **3** and wormwheel **4**. This shaft **5** is rotatably mounted in a sleeve **5'** secured to flanged sleeve **6'** fastened by screws **6''** to support plate **6** which is secured by screws and suitable flanges to the arm **1**. Interchangeably disposed on the camshaft **5** (Figures 7, 8 and 9), are the cam disc **7** which

imparts lateral deflection to the needle transversely of the direction of feed of the material, the cam **8** which controls the amount and direction of the material feed, and the cam **9** which determines the general lateral position of the needle. The cam **7** is connected to the cam shaft by a key and groove and is secured against axial displacement by a ball **7''** biased into groove **5''** in shaft **5** by spring **7'**. The cams **8** and **9** are arranged securely on a clutch bushing **10** by key and groove means and are secured against axial displacement by a lock ring **10'**. Clutch bushing **10** is mounted freely on the camshaft **5** and carries on its lower end face, as more clearly shown in Figure 3 or Figure 14, teeth **11** which can enter into corresponding tooth gaps **12** in a flange **13** of the cam shaft **5**. The cam **7** for the lateral deflection of the needle cooperates with the oscillating lever **14** (Figures 5 to 7) which rocks about the pivot **15** fixed on the support plate **6**. The cam **8** for influencing the amount and direction of the material feed co-operates with the bell-crank lever **16** (Figures 4 and 6) which rocks about the pivot **17** fixed on the support plate **6**. The lever **16** has the longitudinal slot **18** in which the pin **19** (Figure 6) can be displaced. The nut **20** is provided for securing the adjusted position of this pin. Secured to this pin **19** is a steel band **21** which runs over the guide roller **22** and is operatively connected to the setting lever **23** rigidly mounted on the setting shaft **24** (Figure 2). Under the action of the spring **25** (Figure 1), by way of lever **23** and the steel band **21**, the lever **16** bears resiliently against the cam surface of the cam disc **8**. Setting shaft **24** is rocked as determined by cam **8** by way of bell crank lever **16**, band **21** and setting lever **23** to control the material feed as described in U.S. Patent No. 2,846,966. To make it possible, when sewing without automatic action, to render the action of the cam **8** on the setting mechanism of the feed device ineffective and thereby to change over, in accordance with the invention, to hand control, the guide roller **22** can be lowered. This is effected by the same lever **26** (Figure 2) with which the amount and direction of the feed are adjusted by hand. This hand lever **26**, which has an angularly extending member **26'** and, which is mounted in the arm **1** at the joint **27**, carries the cam **28** on which bears the pin **29** likewise mounted in the arm and connected firmly to a fork **29'** carrying the roller **22**. A pull rod **30'** is rotatably disposed on the lever **26** at the point **30** and has, at its lower end, a longitudinal slot **31** which receives the pin **32**, fixed on the setting lever **23**. At its lower end, the steel band **21** likewise has a longitudinal slot **33** which receives the pin **32** and is biased by spring **33'** against guide roller **22**. If the lever **26** is situated in the position **34** shown in Figure 2, the guide roller **22** is raised and the steel band **21** is tensioned under the action of the spring **25** and the lever **16** bears on the cam **8**.

In this position **34**, therefore, the material-feed is automatically controlled. If the lever **26** is moved to the position **35**, the roller **22** is lowered by means of the cam **28**. The automatic control of the material feed is thereby rendered inoperative and the pin **32** is moved, under the action of the spring **25**, so far downwardly that it comes to bear at the end of the slot **31**. In this position, the machine sews the largest forward stitch. If the lever **26** is displaced beyond the zero position **36** to the position **37**, then the maximum rearward stitch is obtained. The cam **9** for the lateral position of the needle co-operates with the position lever **38** which, as Figure 6 shows, is rotatably pivoted on the oscillating lever **14** at the pivot joint **39** and carries the slide surface **40** along which the connecting bar **41** can be displaced by means of the lever **44**. In accordance with Figure 1, the connecting bar **41** is connected at the left by means of the ball joint **45** to the pendulous frame **42** which, at the point **43** is mounted in the head of the arm **1** in pointed pins or pintles. For the purpose of controlling the lateral position of the needle by hand, the position lever **38** has a pin **46** (Figure 1) which bears under the action of the spring **49** against the cam surface **48** (Figures 6 and 13) of the hand lever **47** which can be turned about the axis of the camshaft.

The control unit further possesses an arrangement which allows the cams **8** and **9** to be uncoupled from the camshaft automatically and coupled thereto manually. This is effected by axial shifting of the clutch bushing **10** on the camshaft **5**.

In order to ensure reliable driving of the clutch bushing **10** in the engaged condition, this bushing has in its interior a permanent magnet **50** which draws it firmly against the flange **13** of the camshaft **5**. The cam **9** for the lateral position of the needle further possesses, on its under side, two cam crests **51** and **52** (Figure 14 and 14*a*) which, during turning of the cam **9**, run on to corresponding coacting cam crests **53** and **54** on the clutch disc **55**, which is arranged to be rotatable about the axis of the camshaft **5**, and thereby raise the clutch bushing **10** until the teeth **11** have come out of engagement with the tooth gaps **12** in the flange **13**, whereupon the cams **8** and **9** thus come to rest. In order to avoid jamming on shifting of the clutch bushing **10**, the clutch ring or the clutch disc **55** has two domed cam crests **56**, **56'** which are displaced by 90° in relation to the crests **54** and **53** and which permit of adjustment of the clutch ring **55** to suit the differences in height, resulting from production causes, between the crests **51** to **54**.

To effect coupling, the operator presses on the clutch lever **60** against the action of the spring **60'** (Figure 15). The clutch ring **55** pivotally connected to the clutch lever **60** is thereby rocked. Due to the slope of the crests **51–54**, the cams **8** and **9** partake in this rocking movement until the noses **57** or **57'** on the crests **51** and **52** (Figures 14, 14*a* and 16) bear against the stop **59** (Figures 14*a* and 15) which is fixed by screws to the support plate **6**. Upon further rocking of the clutch ring **55**, the crests **53** and **54** slide past under the noses **57** and **57'**, whereupon they release the crests **51** and **52** so that the clutch bushing **10** can slide down again and return to the coupling position in which it engages with the flange **13** by means of the teeth **11**. Should satisfactory engagement not be brought about by the weight of the coupling bushing **10** itself, the inclined surfaces **58** and **58'** of the clutch ring **55** will encounter correspondingly inclined surfaces of the noses **57** and **57'** and, upon the further rocking, will positively press the clutch bushing **10** downwardly and thereby couple it with the flange **13**. After release of the handle **60**, the clutch ring **55** and the handle **60** will return to their original positions under the action of the spring **60'**.

For the automatic sewing of button holes, the cam **7** for the lateral deflection of the needle has cam surfaces which produce zig-zag stitches. The cam **9** for the lateral position of the needle has cam surfaces which are so shaped that, by movements superimposed upon the zig-zag movements, they produce terminal cross stitches (the transverse seams closing the ends of the button hole) and create the right and left borders by changing the lateral position of the needle. For this purpose, the cams **7** and **9** are so co-ordinated that, during the sewing of the locking seams, the needle deflections and the movement determining the mean needle positions take place at the same time and to the same side and that, for example, the first button-hole stitch commences with a deflection of the needle to the left and with the left-hand position of the needle and that the button hole is completed with the needle in the left-hand position.

The cam **8** for influencing the feed of the material carries cam surfaces which are shaped so that the material is conveyed rearwardly. The position of the crests **51** and **52** in relation to the cams **8** and **9** on the one hand and to the crests **53** and **54** on the other hand is made such that the cams **8** and **9** rotate with the camshaft **5**

only while producing terminal cross stitches for the button-hole.

For the automatic sewing of button holes, the lever **26** (Figure 2) is brought into the position **34** and the lever **47** (Figure 6) is set to the extreme right-hand position, so that the pin **46** (Figure 1) does not bear against the cam surface **48** (Figure 6), but the lever **38** is in contact with the cam **9**. The lever **44** (Figure 6) is set so that the point **41***a* of the connecting bar **41** is situated approximately at the middle of the length of the slide surface **40** (Figure 9). This position is marked by a notch **44'** in the arm of the machine. The cams **8** and **9** are coupled to the camshaft **5** and thus to cam **7** by operating the handle **60** and the machine is then ready for the automatic sewing of button holes. Upon the commencement of sewing, the machine sews the first terminal stitches of the button hole. The material is conveyed rearwardly and, after about one quarter to one half of a revolution of the camshaft, the locking or terminal stitches are completed. Thereupon the cam **9** imparts to the needle a right-hand position with which the right-hand border of the button hole is sewn. The crests **51** and **52** run on to the crests **53** and **54** and, after a half revolution, uncouple the cams **8** and **9** from the shaft. The right-hand position of the needle and the rearward conveyance of the material are thus maintained, so that the machine continues to sew the right-hand border of the button hole, unaffected by the coupling, until the handle **60** is actuated thereby coupling the cams **8** and **9** again to the camshaft **5**. Upon the commencement of the second half revolution of the cam **8**, the conveyance of the material is changed to forward feed while upon the commencement of the second half revolution of the cam **9** the latter first of all produces the second terminal seam by movements superimposed on the lateral deflections produced by the cam **7** and then adjusts the needle to the left. The machine then sews the second border of the button hole. After the completion of the second half revolution of the cams **8** and **9**, the teeth **11** of the clutch bushing **10** and the tooth gaps **12** in the flange **13** of the camshaft **5** are brought out of engagement by the crests **51**–**54**. The cams **8** and **9** thus remain stationary after the second half revolution, without the position of the needle and the direction and amount of the material feed being changed. Consequently the machine continues, unaffected by the coupling, to sew the second border of the button hole until the machine is stopped.

The cams, such for example as **7**, **8**, **9**, may also be designed as cams closed on themselves. The number of clutch teeth **11** on the clutch bushing **10** corresponds to the number of crests of the cam **7** for the lateral deflections of the needle if this cam is designed as a zig-zag cam.

Instead of the cam discs such as **8**, **9**, the clutch bushing **10** may also carry a cam band. By this means it is possible also to produce eyelet-holes automatically with the arrangement described. In this case, the cam crests **51** and **52** would be situated on the cam band.

Since, upon the completion of the button-hole seam, the disengaged cams **8**, **9** assume a position such that both the lever **38** and also the lever **16** are located on the smallest cam-surface circle, it is possible to continue to work with the machine without changing the cams or other manipulations as with any other zig-zag machine or, however, to produce a further button-hole by operating the hand lever **60**.

I claim:

1. In a zig-zag sewing machine of the type having an arm shaft, a needle bar, a needle bar oscillator and a connecting bar pivotally connected at one end to said oscillator, needle bar oscillating means, and stitch position setting means including first and second cam follower means, respectively, adapted to transfer cam controlled movements to the other end of said connecting bar, and step control means adapted to change the length and direction of the material feed steps of the machine and including third cam follower means, guiding mechanism comprising three cams operatively supported on a cam shaft having driving engagement with said arm shaft, one said cam being fixedly connected to said cam shaft and being adapted to impart oscillating impulses to said connecting bar by way of said first cam follower means, the second said cam being operatively connected to said connecting bar by way of said second cam follower means to impart positioning movements thereto, and the third said cam being operatively engaged by said third cam follower means, and coupling means interposed between said cam shaft and said second and third cams including actuating means operative to establish the coupling between said cam shaft and said second and third cams and automatically operative in two positions of rotation of said cam shaft and said cams to disengage said coupling means.

2. In a zig-zag sewing machine of the type having an arm shaft, a needle bar, a needle bar oscillator and a connecting bar pivotally connected at one end to said oscillator, needle bar oscillating means, and stitch position setting means including first and second cam follower means, respectively, adapted to transfer cam controlled movements to the other end of said connecting bar, and step control means adapted to change the length and direction of the material feed steps of the machine and including third cam follower means, guiding mechanism comprising three cams operatively supported on a cam shaft having driving engagement with said arm shaft, one said cam being fixedly connected to said cam shaft and being adapted to impart oscillating impulses to said connecting bar by way of said first cam follower means, the second said cam being operatively connected to said connecting bar by way of said second cam follower means to impart positioning movements thereto, and the third said cam being operatively engaged by said third cam follower means, and coupling means interposed between said cam shaft and said second and third cams including actuating means operative to establish the coupling between said cam shaft and said second and third cams and automatically operative in two positions of rotation of said cam shaft and said cams to disengage said coupling means, said second and third cams being connected to one another and movable on said cam shaft, said cam shaft having a flange portion presenting tooth gaps and said second cam presenting teeth adapted to engage said gaps.

3. In a zig-zag sewing machine of the type having an arm shaft, a needle bar, a needle bar oscillator and a connecting bar pivotally connected at one end to said oscillator, needle bar oscillating means, and stitch position setting means including first and second cam follower means, respectively, adapted to transfer cam controlled movements to the other end of said connecting bar, and step control means adapted to change the length and direction of the material feed steps of the machine and including third cam follower means, guiding mechanism comprising three cams operatively supported on a cam shaft having driving engagement with said arm shaft, one said cam being fixedly connected to said cam shaft and being adapted to impart oscillating impulses to said connecting bar by way of said first cam follower means, the second said cam being operatively connected to said connecting bar by way of said second cam follower means to impart positioning movements thereto, and the third said cam being operatively engaged by said third cam follower means, and coupling means interposed between said cam shaft and said second and third cams including actuating means operative to establish the coupling between said cam shaft and said second and third cams and automatically operative in two positions of rotation of said cam shaft and said cams to disengage said coupling means, and supporting means disposed above

said arm shaft supporting said cam follower means and said cam shaft, said first and second cam follower means comprising first and second levers, respectively, said levers having a pivot connection proximate adjacent ends thereof and said first lever being pivotally mounted at its other end on said supporting means.

4. In a zig-zag sewing machine of the type having an arm shaft, a needle bar, a needle bar oscillator and a connecting bar pivotally connected at one end to said oscillator, needle bar oscillating means, and stitch position setting means including first and second cam follower means, respectively, adapted to transfer cam controlled movements to the other end of said connecting bar, and step control means adapted to change the length and direction of the material feed steps of the machine and including third cam follower means, guiding mechanism comprising three cams operatively supported on a cam shaft having driving engagement with said arm shaft, one said cam being fixedly connected to said cam shaft and being adapted to impart oscillating impulses to said connecting bar by way of said first cam follower means, the second said cam being operatively connected to said connecting bar by way of said second cam follower means to impart positioning movements thereto, and the third said cam being operatively engaged by said third cam follower means, and coupling means interposed between said cam shaft and said second and third cams including actuating means operative to establish the coupling between said cam shaft and said second and third cams and automatically operative in two positions of rotation of said cam shaft and said cams to disengage said coupling means, and supporting means disposed above said arm shaft supporting said cam follower means and said cam shaft, said first and second cam follower means comprising first and second levers, respectively, said levers having a pivot connection proximate adjacent ends thereof and said first lever being pivotally mounted at its other end on said supporting means, said second lever being adapted to follow the movements of said first lever by way of said pivot connection and having a sliding surface, and a setting arm having a handle and having sliding engagement with said connecting bar and said other end of said connecting bar having sliding engagement with and being movable along said sliding surface in response to movement of said setting lever.

5. In a zig-zag sewing machine of the type having an arm shaft, a needle bar, a needle bar oscillator and a connecting bar pivotally connected at one end to said oscillator, needle bar oscillating means, and stitch position setting means including first and second cam follower means, respectively, adapted to transfer cam controlled movements to the other end of said connecting bar, and step control means adapted to change the length and direction of the material feed steps of the machine and including third cam follower means, guiding mechanism comprising three cams operatively supported on a cam shaft having driving engagement with said arm shaft, one said cam being fixedly connected to said cam shaft and being adapted to impart oscillating impulses to said connecting bar by way of said first cam follower means, the second said cam being operatively connected to said connecting bar by way of said second cam follower means to impart positioning movements thereto, and the third said cam being operatively engaged by said third cam follower means, and coupling means interposed between said cam shaft and said second and third cams including actuating means operative to establish the coupling between said cam shaft and said second and third cams and automatically operative in two positions of rotation of said cam shaft and said cams to disengage said coupling means, said actuating means including a cam disk journalled around said cam shaft and having a first cam conformation for disengaging said coupling means and said second and third cams being supported on said cam shaft by means of a clutch bushing having a second cam conformation adapted to be engaged by said first cam conformation in a predetermined position of said cam shaft in which said second cam means has set the needle bar oscillator for sewing the border of a button hole or the like and prior to the position in which said second cam means becomes operative to shift said needle bar oscillator from the sewing of the border stitches to sewing of wider terminal stitches.

References Cited in the file of this patent

UNITED STATES PATENTS

1,611,372	Rader	Dec. 21, 1926
1,675,508	Muller	July 3 ,1928
2,378,534	Beyer	June 19, 1945
2,653,557	Casas-Robert et al.	Sept. 29, 1953
2,684,649	Scarpa	July 27, 1954
2,755,754	Urscheler	July 24, 1956
2,764,895	Bono	Oct. 2, 1956

FOREIGN PATENTS

300,900	Switzerland	Nov. 1, 1954