Sept. 26, 1967 C. F. DOLAN 3,343,509

ZIG ZAG SEWING MACHINE

Filed Dec. 27, 1963 8 Sheets-Sheet 1

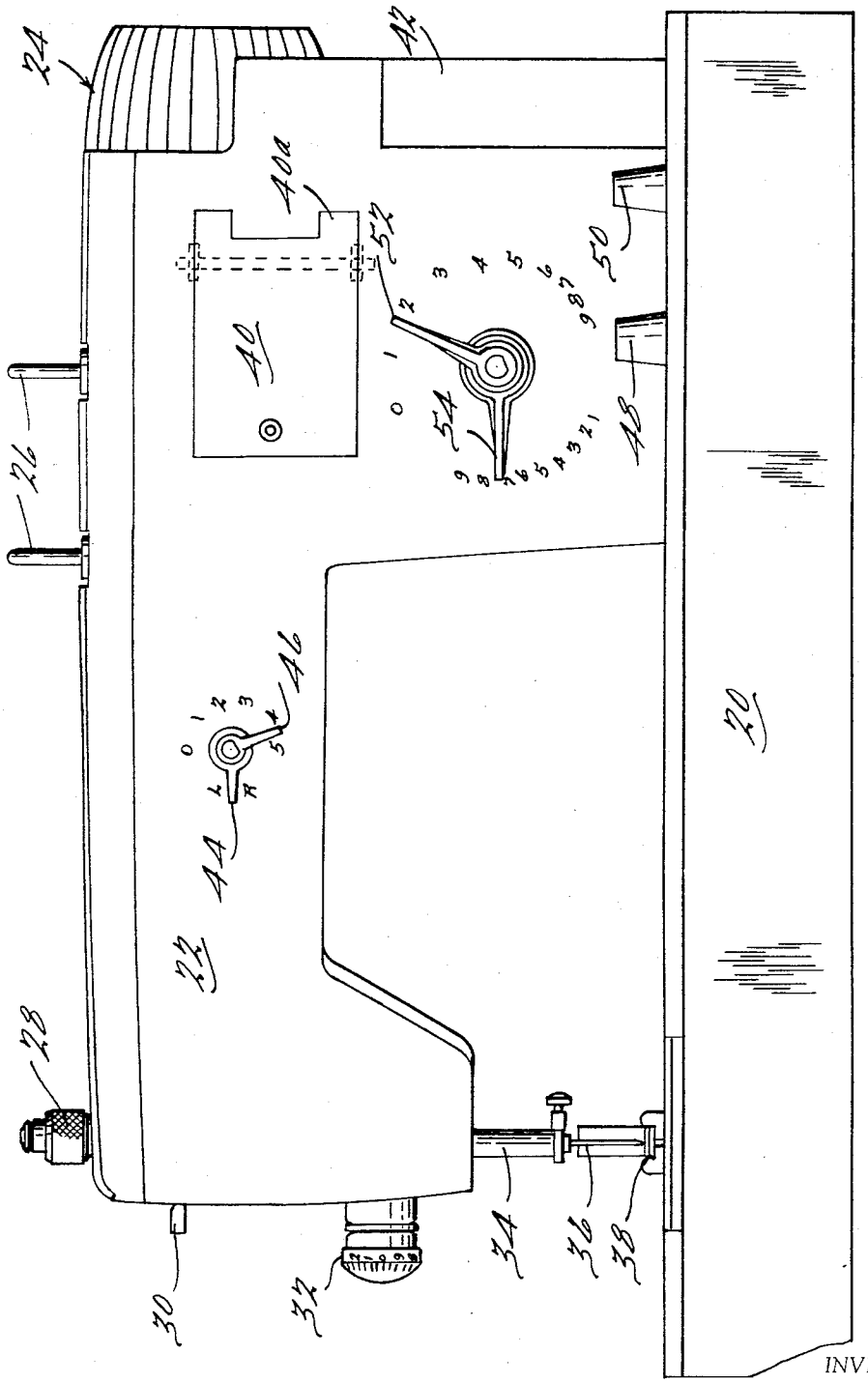

FIG. 1.

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ZIG ZAG SEWING MACHINE

Filed Dec. 27, 1963 8 Sheets-Sheet 2

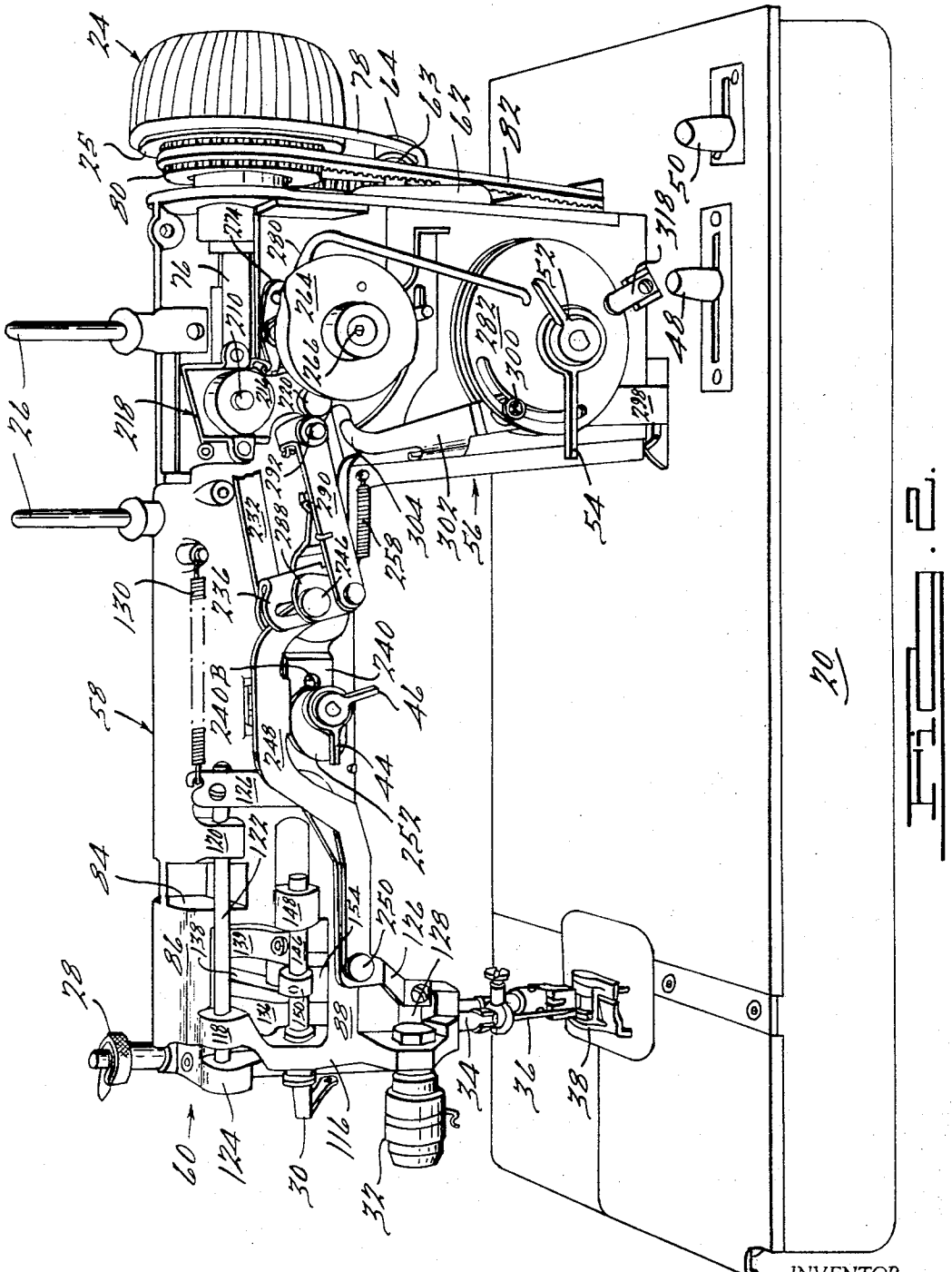

FIG. 2

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ZIG ZAG SEWING MACHINE

Filed Dec. 27, 1963 8 Sheets-Sheet 3

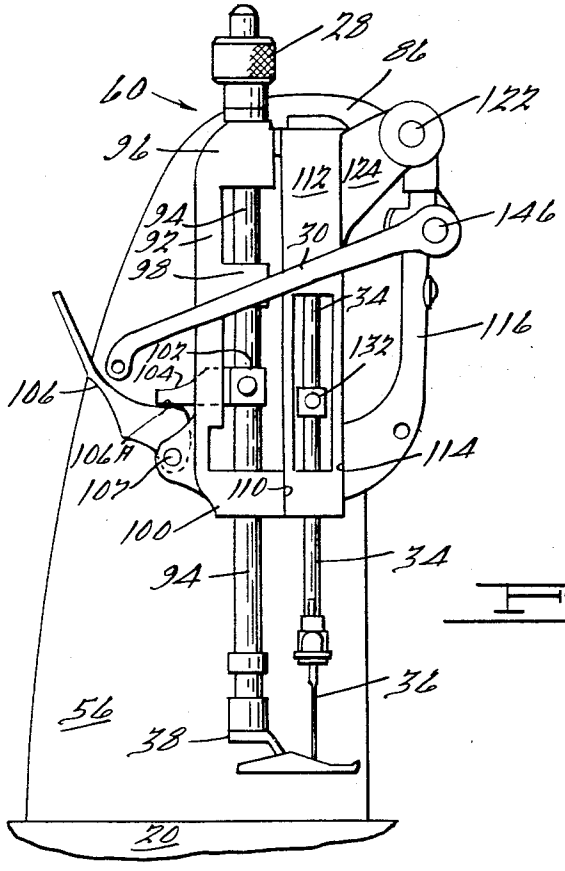

FIG. 3.

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ZIG ZAG SEWING MACHINE

Filed Dec. 27, 1963 8 Sheets-Sheet 4

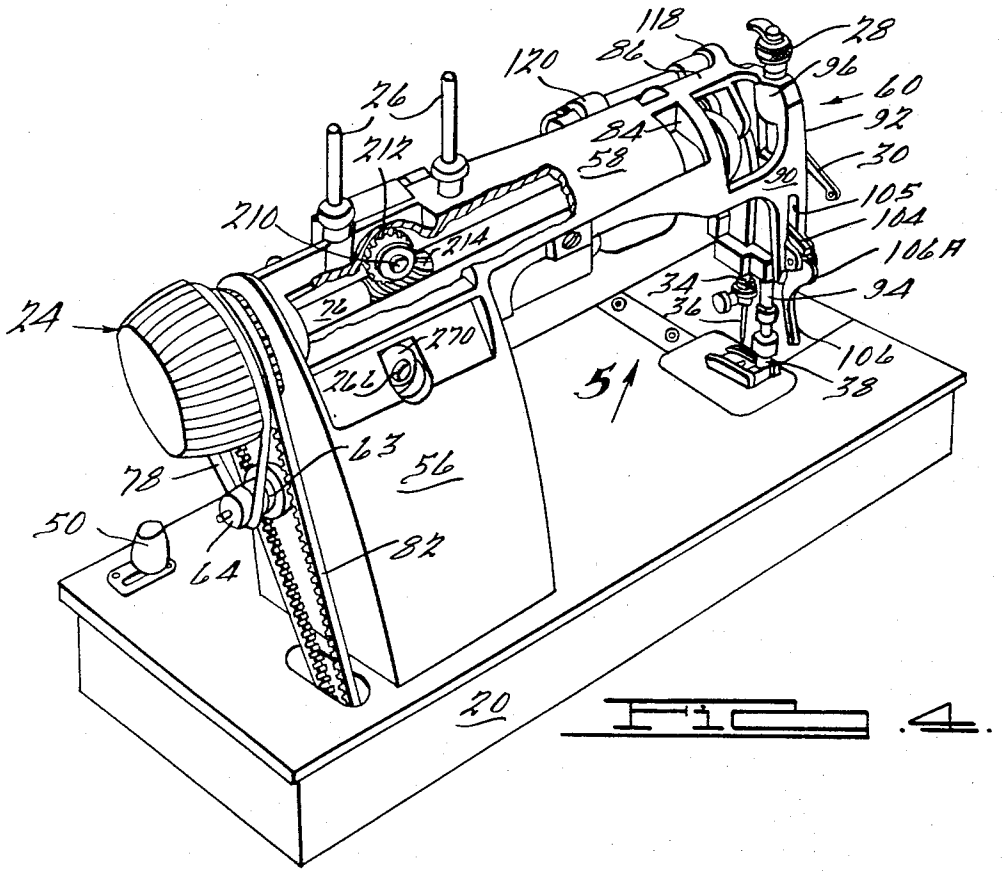

FIG. 4.

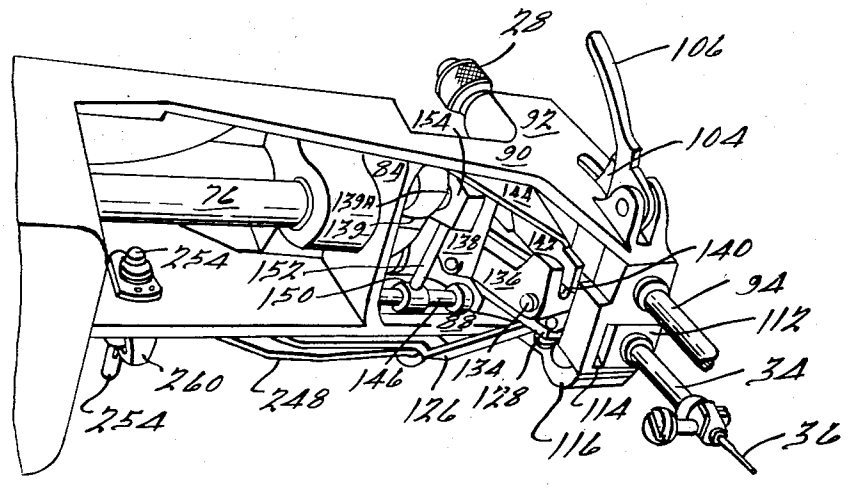

FIG. 5.

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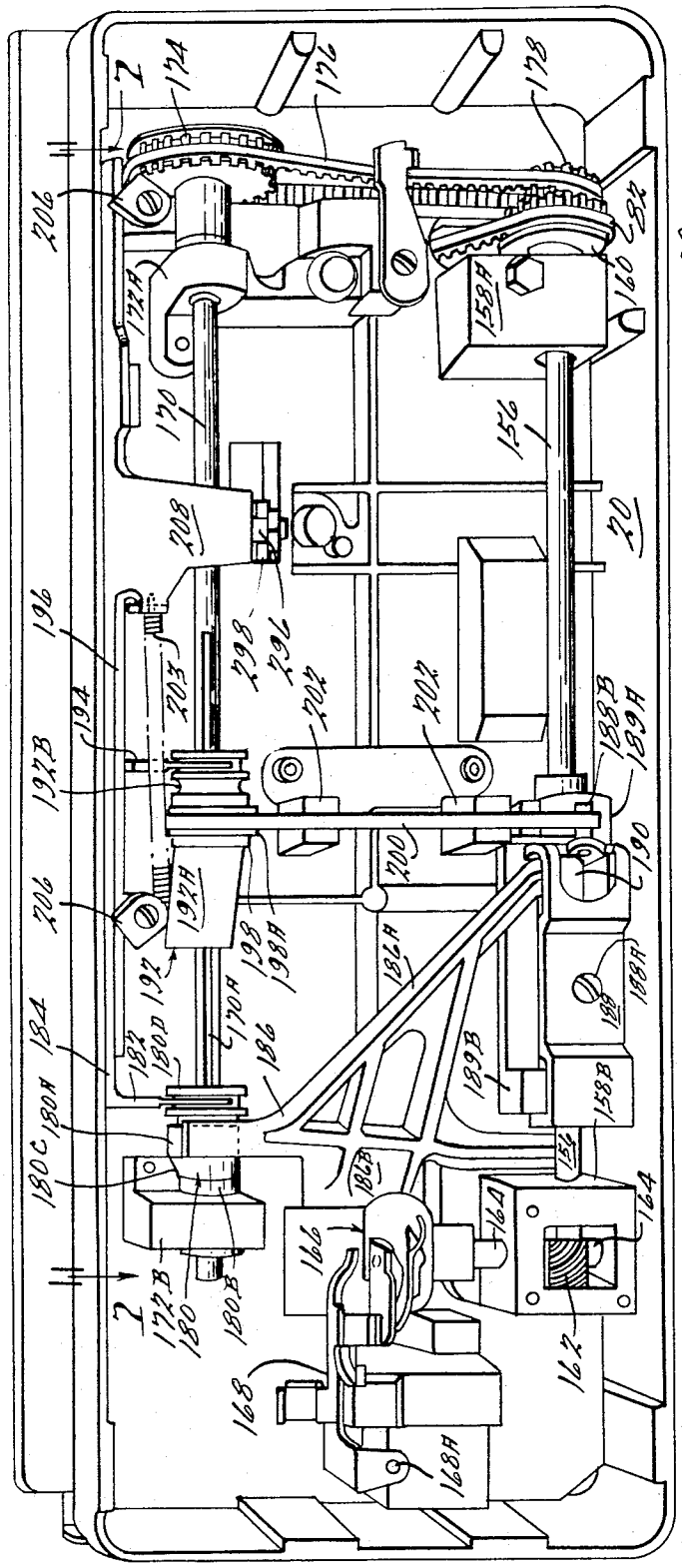
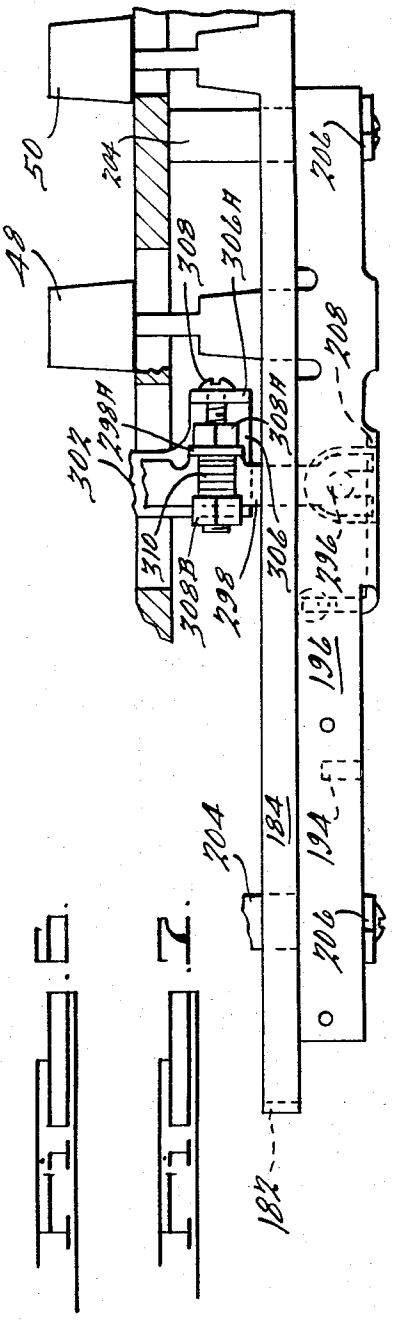
ZIG ZAG SEWING MACHINE

Filed Dec. 27, 1963 8 Sheets-Sheet 5





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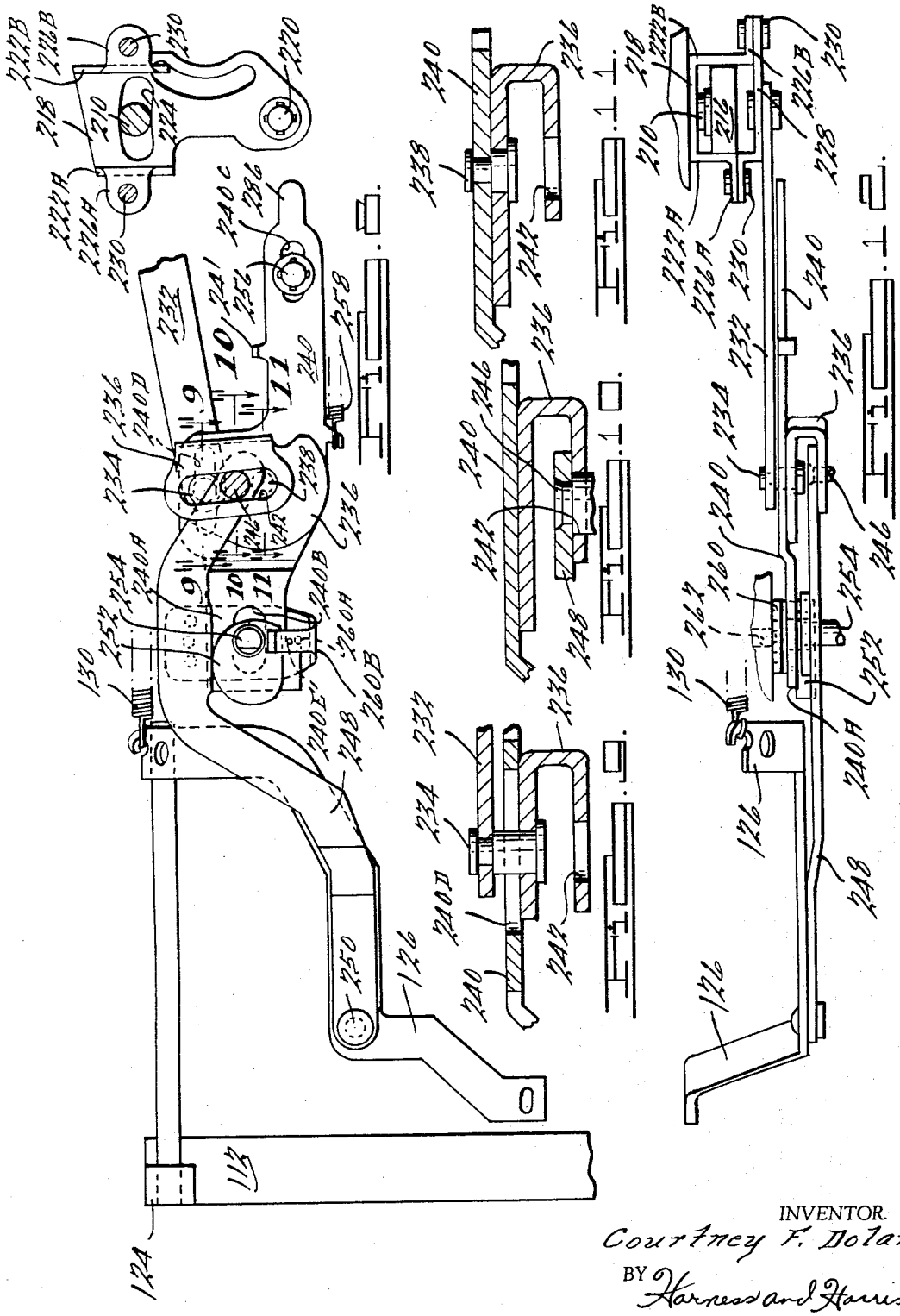
ZIG ZAG SEWING MACHINE

Filed Dec. 27, 1963 8 Sheets-Sheet 6



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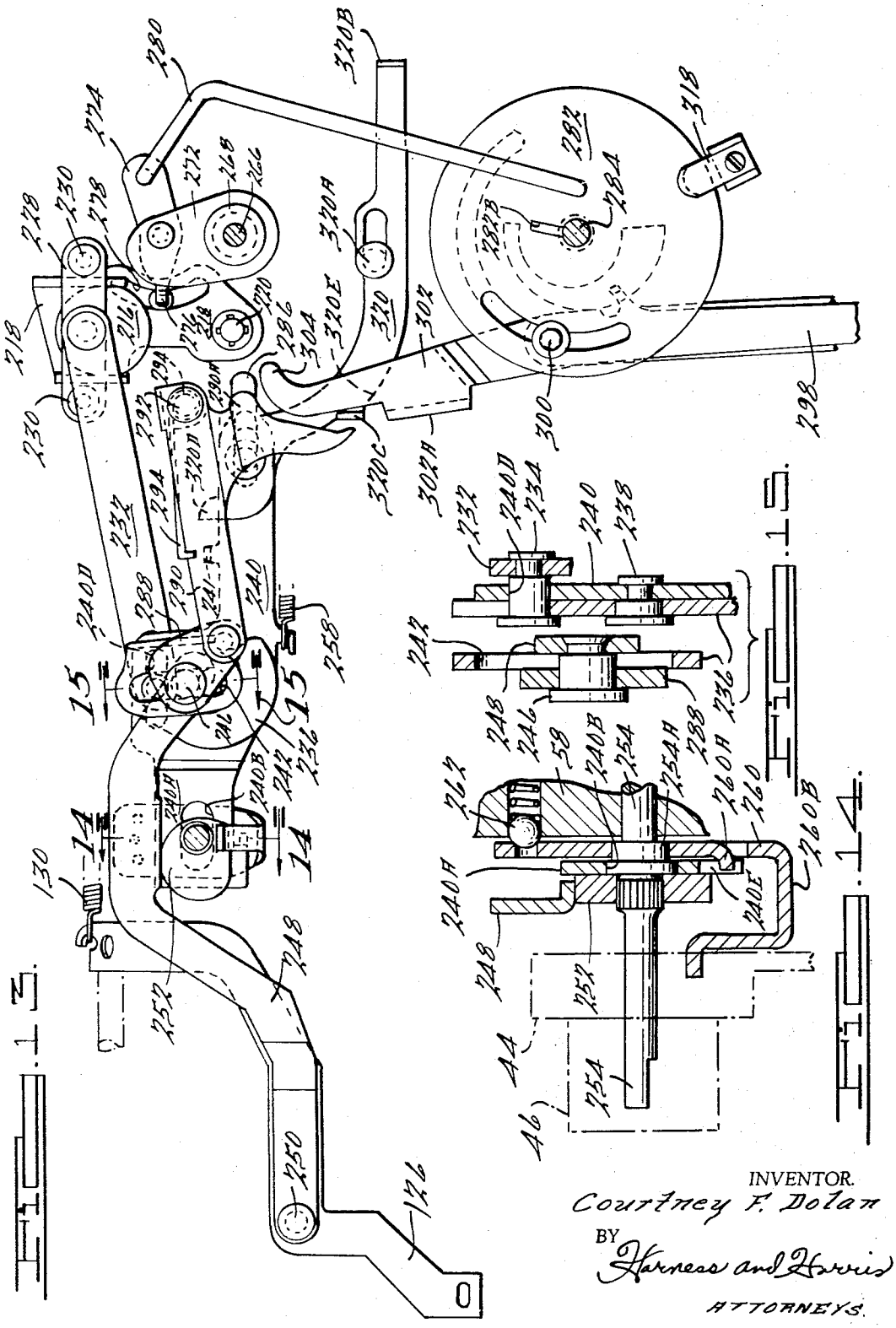
ZIG ZAG SEWING MACHINE

Filed Dec. 27, 1963 8 Sheets-Sheet 7



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ZIG ZAG SEWING MACHINE

Filed Dec. 27, 1963 8 Sheets-Sheet 8

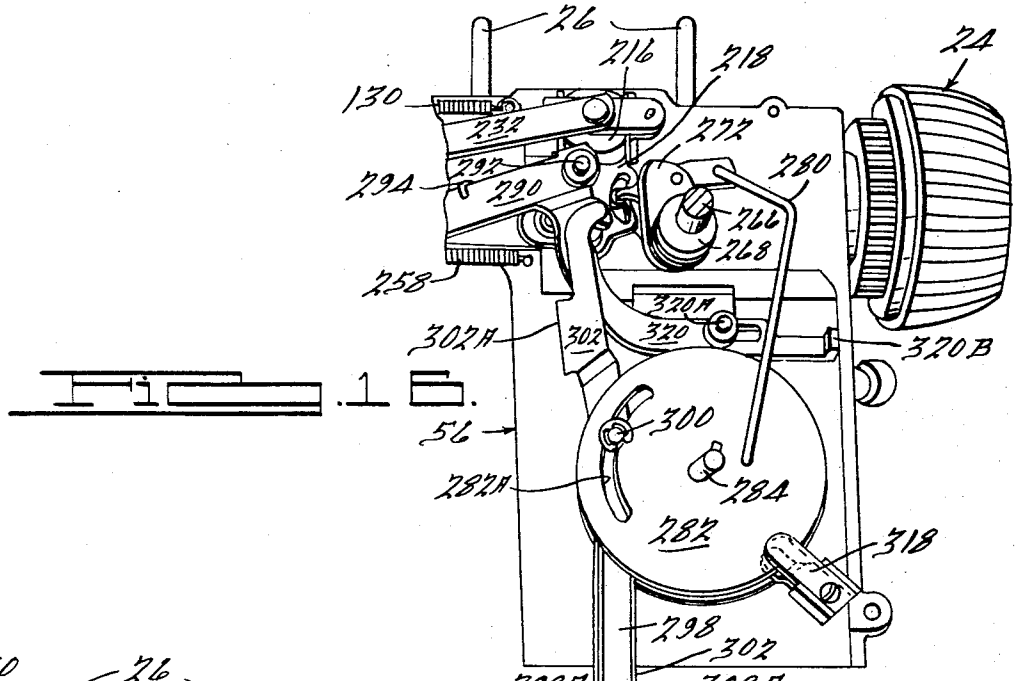

FIG. 1.

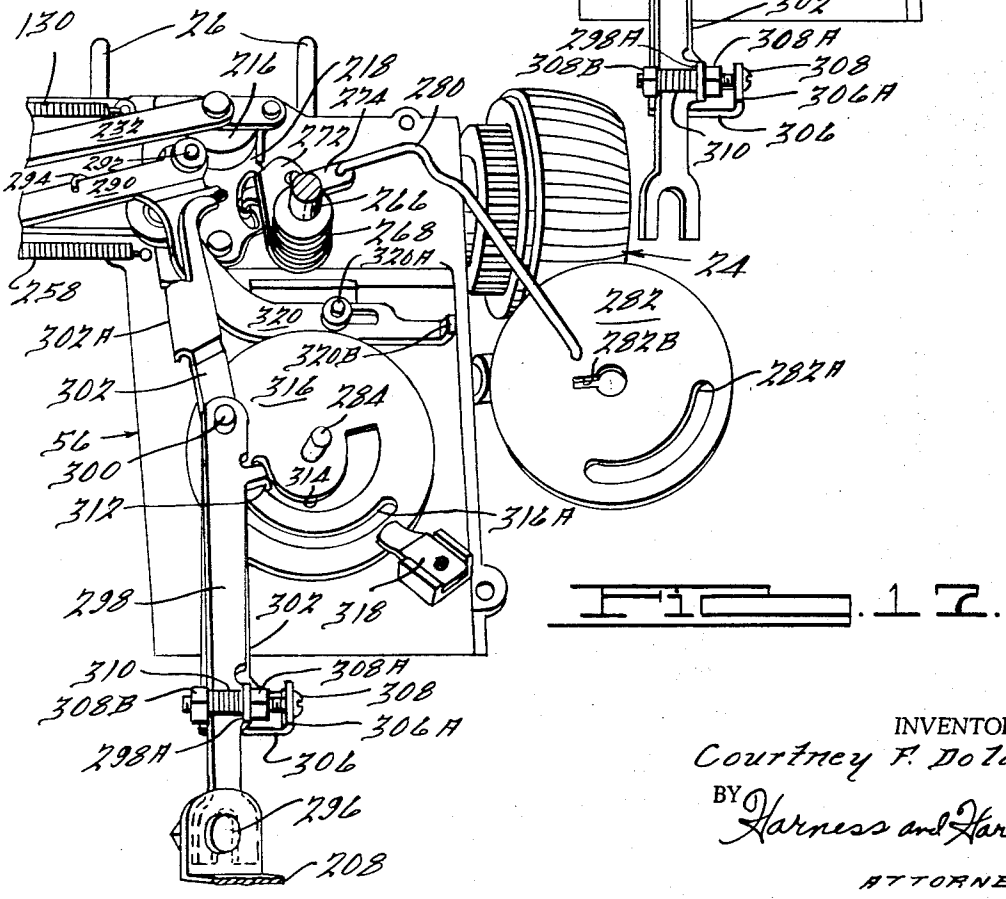

FIG. 17.

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United States Patent Office 3,343,509 Patented Sept. 26, 1967

3,343,509

ZIG ZAG SEWING MACHINE

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Filed Dec. 27, 1963, Ser. No. 333,990
7 Claims. (Cl. 112—158)

This invention relates to an improved sewing machine of the zig zag type and more particularly to such a machine which includes a novel combination of automatic operation and manual operation by means of removable and replaceable pattern cams with manual controls that may vary or over-ride the automatic pattern cam control.

Sewing machines of the zig zag type have been known in the past and generally have relied upon either one of two zig zag mechanisms by which is meant the mechanism that produces lateral movement of the needle i.e., movement in the plane generally normal to the direction of feed of the material through the machine. In the first such zig zag mechanism the needle is pivoted about a horizontal axis spaced upwardly from the work material and generally parallel to the direction of material feed so that the needle may swing somewhat in the manner of a conventional pendulum to produce lateral movement of the needle thread while the needle is reciprocating verticaly. The second type of zig zag mechanism holds the needle vertical while it is reciprocating but supports the needle on the ends of arms radiating from a vertical support axis so that the needle moves in a portion of a cylindrical path normal to the direction of material feed somewhat similar to the movement of a conventional gate with resulting lateral movement of the needle thread.

In the first above-mentioned pendulum type zig zag movement the amount of "throw" or lateral movement of the needle thread is inherently limited because the point at which the needle thread is picked up by the shuttle is, of course, below the material being sewed and the arc through which the needle point can swing is limited by the natural limitations imposed by the path of movement of the shuttle. Since the arc limitations are below the material the width of the zig zag pattern that can be formed in the material which is closer to the pivot point is inherently less than such natural limitations. In the second or gate mechanism although the needle maintains a vertical position as it moves laterally there is inherent difficulty in maintaining the proper relationship between the needle point and the shutttle. This means that as the needle point follows its arcuate path some complicated mechanism has to be provided to move the shuttle on a corresponding arcuate path so as to maintain the proper needle thread pickup relationship.

Accordingly, it is a principal object of the present invention to provide a zig zag sewing mechine mechanism in which a shuttle hook rotates in a vertical plane lateral to the direction of cloth feed and means is provided for imparting lateral motion in that plane to a needle which in all positions is vertically disposed for reciprocation normal to a horizontally positioned cloth or work piece. This construction accommodates a substantial lateral movement of the needle relative to the shuttle hook and work at the level of the work. The arc of the rotatable shuttle hook accommodates maintenance of a proper cooperating relationship between the shuttle hook and the vertically reciprocable needle throughout a plurality of selective lateral needle positions and the full benefit of such lateral needle movement is available at the level of the work due to the constant vertical disposition of the needle.

It is, of course, another object of the present invention to provide power mechanism for effecting the above-mentioned lateral movement of the vertically reciprocable needle.

Further objects of the present invention are to provide novel control mechanisms to control the amount of throw or lateral movement of the needle, to provide for selective positioning of the needle at any station within the extent of its lateral movement, mechanism for controlling the length of the stitch, mechanism for selectively controlling the direction of material feed automatic controls utilizing removable and replaceable pattern cams, and a selective manual control that may, in some instances, be utilized to over-ride the automatic controls even when the machine is in operation.

Another object of the present invention is to provide novel pattern cam driving means that effects selectively "infinitely variable" speed of rotation of the pattern cam with resulting infinite variation in the length of the pattern being dictated by the pattern cam. The expression "infinitely variable" is used advisedly, but for all practical purposes infinite variation is accomplished by the mechanism embodying the present invention as will become apparent hereinafter.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIG. 1 is a front elevational view of a sewing machine employing the present invention;

FIG. 2 is a perspective view of the machine of FIG. 1 with the protective shroud removed;

FIG. 3 is an elevational view of the head assembly of the machine of FIG. 2 as viewed from the left end of FIG. 2;

FIG. 4 is a perspective view of the rear of the machine of FIG. 2;

FIG. 5 is a perspective view of a portion of the machine taken in the direction of the arrow **5** of FIG. 4;

FIG. 6 is a perspective view of the bottom of the machine of FIG. 2;

FIG. 7 is a fragmentary view of a portion of the machine taken in the direction of the arrows **7—7** of FIG. 6;

FIG. 8 is a fragmentary view of a portion of the external mechanism on the front of the machine of FIG. 2;

FIG. 9 is a fragmentary sectional view taken on the line **9—9** of FIG. 8;

FIG. 10 is a fragmentary sectional view taken on the line **10—10** of FIG. 8;

FIG. 11 is a fragmentary sectional view taken on the line **11—11** of FIG. 8;

FIG. 12 is a plan view of a portion of the external mechanism on the front of the machine;

FIG. 13 is a fragmentary view of a portion of the external mechanism on the front of the machine including certain automatic control elements;

FIG. 14 is a vertical sectional view taken along the line **14—14** of FIG. 13;

FIG. 15 is a vertical sectional view taken along the line **15—15** of FIG. 13;

FIG. 16 is a fragmentary perspective view of some of the control elements of the machine; and

FIG. 17 is a view similar to FIG. 16 with certain elements exploded.

FIG. 1 of the drawing shows a front view of a sewing machine embodying the present invention with a shroud or protective covering over the upper portion thereof. In FIG. 1 can be seen a base **20**, a protective shroud **22** and other conventional sewing machine components including a hand wheel **24**, a pair of spool spindles **26** on which spools (not illustrated) for needle threads can be

positioned, a presser foot assembly caps **28**, a loop taker **30**, a needle thread tension adjustment device **32**, a needle bar **34** having a needle **36** carried thereby, and a presser foot assembly **38**. A door **40** in shroud **22** provides access to a pattern cam to be described herein and a removable cover portion **42** below the hand wheel **24** provides access to a motor and drive belts which will be described herein.

FIG. 1 also shows the operator actuatable controls for the machine. To the left of the pattern cam door **40** are two coaxially mounted knobs or levers **44** and **46** which provide manual control of the zig zag motion of the needle. The knobs or levers referred to are respectively the manual needle position control **44** and the manual throw control **46**. A manual feed control knob **48** and a manual feed dog cam release knob **50** extend upwardly from the upper surface of the base **20**. A pair of levers are coaxially mounted on a horizontal axis and comprise a manual feed control limiter lever **52** and a manual pattern expander lever **54**. Each of these manually operable levers will be described in greater detail hereinafter in connection with the mechanisms that they respectively actuate.

FIG. 2 is a perspective view of the sewing machine of FIG. 1 with the protective shroud **22** removed. The upper part of the machine consists of an upright portion or post **56** and a horizontal arm **58** extending from the post and over the base of the machine. The latter terminates in a head assembly **60**.

The post **56** is provided with a hollow lower portion in which is mounted an electric motor **62** which serves as a source of driving power for the machine. The motor **62** has a driven shaft **63** extending therefrom and carrying a main drive pulley **64**.

A main drive shaft **76** extends lengthwise through the arm **58** and carries at the righthand end, as viewed in FIGURE 2, a hand wheel and pulley assembly **24**. The main drive shaft **76** is driven by a belt **78** which passes around the main drive pulley **64** and a driven pulley **25** of the hand wheel assembly **24**. Also included as part of the hand wheel and pulley assembly **24** is a driving pulley **80** having a drive belt **82** passing therearound and down into the base **20** of the machine to drive a feed mechanism and shuttle mechanism in a manner to be described herein. It will be noted that this driving pulley **80** is notched across its outer periphery and that the drive belt **82** is similarly notched on its inner face. This is to provide a positive, non-slip, driving relationship between the main shaft **76** and the feed and shuttle mechanisms which are driven through belt **82** so that movements of the needle (which is driven by the main shaft) will be maintained in proper timed relationship to movements of the shuttle and feed mechanisms.

Referring to FIGURES 2 and 3 of the drawings, means for mounting the needle for lateral movement can be seen at the left end of FIGURE 2 in the head assembly **60** of which the FIGURE 3 is an end view. The head assembly **60** includes supporting means carried on the end of the arm **58** which, as can be seen in FIGURES 2, 3 and 4, comprises an inner transverse wall **84**, an upper wall **86**, and front and rear bridging members **88** and **90** respectively which extend from said transverse wall **84**. The upper wall **86** and the rear bridging member **90** carry at their outer ends a presser foot rod support **92** for a presser foot rod **94** which is best illustrated in FIGURE 3. Support for the presser foot rod **94** is provided by three bosses **96**, **98** and **100** at the upper, intermediate, and lower portions, respectively of the presser foot rod support **92**. Coaxial bores are provided through each of these bosses to slidably receive the presser foot rod **94**. Extending upwardly from the upper boss **96** is a conventional cap and spring assembly **28** which contains a spring tending to bias the rod downwardly in a manner well known in the art. A collar **102** is affixed to the presser foot rod **94** and has a finger **104** integral therewith and extending rearwardly therefrom (FIGURE 3) through a vertical slot **105** (FIGURE 4) provided therefor in the support **92**. The finger **104** is abutted by a cam lever **106** which is pivotally mounted at **107** on support **92** and facilities raising and lowering the presser foot **94**. With the cam lever **106** in the lowered position as shown in FIGURE 4, the rod **94** and the presser foot assembly **38** carried at the lower end thereof are urged downwardly against the feed claws (not shown) by the spring of the cap and spring assembly **28**. When it is desired to raise the presser foot the operator lifts the cam lever **106** thereby causing surface **106A** to elevate the finger **104** as shown in FIGURE 3. The rod **94** and associated presser foot assembly **38** are maintained in their elevated position by over-center positioning of the cam surface **106A** with respect to the pivotal mounting **107** of the cam lever **106**.

Lateral movement of the needle is a characteristic of zig zag sewing machines and mechanism for this purpose will be described. The lower boss **100** of support **92** is provided with a forwardly facing flat face **110** which abuts a cooperative flat surface provided on a needle bar carrier member **112**. As will be noted in FIGURE 3, the needle bar carrier **112** is provided with a front face which is abutted at the lower extremity thereof by a rearwardly facing supporting face **114** formed on the lower end of a structural member **116** that is in turn supported by the front bridging member **88** and the upper front wall **86** of the head casting. This structural member **116**, as can be seen most clearly in FIGURE 2, includes a boss **118** integral therewith and also affixed to the upper wall **86**. A second boss **120** is formed on the arm **58** inwardly from the transverse wall **84**. Coaxial bores are respectively provided in each of the bosses **118** and **120** to slidably receive support rod **122**. The rod **122** has a terminal portion which extends beyond the boss **118** and is affixed in an extension **124** on the needle bar carrier **112**. The opposite end of the support rod **122** extends beyond the boss **120** and the upper end of a needle bar carrier connector member **126** is affixed thereto. The lower end of the needle bar carrier connector member **126** is affixed, as can be seen in FIGURE 2, to an inward extension **128** provided on the lower end of the needle bar carrier **112**. Thus, as can be seen in FIGURES 2 and 3, the needle bar carrier member **112**, which provides the vertical guideway for the needle bar **34** (which needle bar in turn carries the needle **36** in the conventional manner) is held in a vertical position in one vertical plane between the bearing faces **110**, **114** at the lower end thereof and by the support rod **122** at the upper front portion thereof, the rod **122** being reciprocative in the bores provided in the bosses **118** and **120** respectively. The connector member **126** extending between the inner end of the support rod **122** and the inward extension **128** on the lower end of the needle bar carrier **112** maintains the carrier in vertical position in a second vertical plane normal to the just mentioned first vertical plane. As can be seen in FIGURE 2, a spring **130** connects between a hook provided on the connector member **126** and a hook provided on the arm **58** to bias the needle bar carrier **112** inwardly. A force exerted through the connector member **126** to the left, as viewed in FIGURE 2 by means to be described herein, in opposition to the tension spring **130** will move the needle bar carrier member outwardly. At all times the needle bar carrier member **112** is maintained absolutely vertical. Thus, the lateral motion of the needle is provided for while it is still free to reciprocate vertically to form the stitches in cooperation with the shuttle mounted in the base **20**.

Referring now to FIGURES 4 and 5, in particular FIGURE 5, the mechanism for providing vertical reciprocation of the needle bar **34** within the needle bar carrier **112** can be explained in further detail. It will be noted from FIGURE 3 that a collar **132** is affixed to the needle bar. Extending inwardly from this collar **132**, as

can be seen in FIGURE 5, is a connecting pin **134** that is pivotally engaged by the lower end of a connecting rod **136**. The upper end of the connecting rod **136** pivotally engages a link **138** which link is in turn rigidly affixed to the end of a crank pin **139A** of a crank **139**, the crank **139** being affixed to the end of the main shaft **76**. Thus, as the main shaft **76** is rotated the crank **139**, link **138**, and the connecting rod **136** effect vertical reciprocation of the needle bar **34** and the needle **36** carried at the bottom end of the needle bar **34**. It will be noted in FIGURE 5 that the lower end of the connecting rod **136** is provided with a groove **140** therein. This groove receives a guide member **142** which is a part of a bracket **144** that is affixed to the previously referred to rear bridging member **90**. The guide member **142** serves to maintain the connecting rod **136** in a single vertical reciprocating path. The needle bar carrier member **112**, however, may at the same time be reciprocating laterally to impart zigzag movement to the needle. The connecting pin **134** on the collar **132** that is affixed to the needle bar **34** is therefore long enough to slide within the lower end of the connecting rod **136** thus maintaining the driving connection between the connecting rod **136** and the needle bar **34** regardless of lateral movement of the needle bar.

Referring again to FIGURE 2, the mounting and the actuation of the loop taker **30** can be described. It will be noted that the loop taker **30** is affixed to the end of an actuating bar **146** that extends through and is journalled adjacent its outer end in the structural member **116** and is journalled at its inner end in a boss **148** provided on the arm casting adjacent the inner transverse wall **84**. A collar **150** is affixed to the actuating bar **146** intermediate the supporting bosses and, as can be seen in FIGURE 5, an actuating rod **152** extends rearwardly therefrom. The distal end of the actuating rod **152** is slidably received in a bore provided in the lower portion of a bearing block **154**. The upper portion of the bearing block **154** is journaled on the crank pin **139A** of crank **139** on an axis normal to rod **152**. The bearing block **154** is retained on the crank pin by the link **138** which link, as has been previously described, is rigidly affixed to the end of the crank pin. It will be noted that the bore in the lower portion of the bearing block **154** that receives the distal end of the actuating rod **152** is located below the crank pin. Thus, as the crank rotates the bearing block rocks on the crank pin so that the actuating rod may remain below the crank pin regardless of the position of the crank in its rotation. As the crank rotates carrying with it the bearing block **154**, the actuating rod **152** is moved up and down in an arcuate path thus rocking the loop taker actuating bar **146** consequently moving the loop taker **30** up and down in an arcuate path corresponding to the arcuate path of movement of the actuating rod **152**. As the crank rotates the bearing block **154** slides along the actuating rod **152** toward and away from the collar **150**. As illustrated in FIGURE 5, the bearing block **154** is in the downward portion of the rotary path in which it would be carried by rotation of the crank **139** and will move downwardly, rearwardly and upwardly and so on to complete that rotary motion. It will be noted that at the point of rotation depicted in FIGURE 5, the bearing block **154** is adjacent the distal end of the actuating rod **152** and thus because of its position remote from the collar **150**, a long downward movement of the bearing block will produce a relatively slow rotary movement of the actuator bar **146** and a correspondingly slow movement downward of the end of the loop taker **30**. As the crank continues its rotation the bearing block slides towards the collar. Thus, when the bearing block starts on its upward portion of its rotational cycle, the actuator rod is moved upward much more rapidly in comparison to the speed at which it moves downwardly. This slow downward movement of the loop taker and rapid upward movement facilitates the looping of the needle thread around the bobbin thread in the making of a stitch, as will become apparent hereinafter. The mechanism just described for accomplishing this slow downward movement and rapid upward movement is known conventionally as a "Whitworth" quick return mechanism. As will be noted in FIGURE 5, the link **138** is affixed to the end of the pin of the crank **139** in a predetermined number of degrees rotationally advanced from the rotation of the bearing block **154**. Thus, as in FIGURE 5, the needle has already completed its downward movement and is on its upward movement while the loop taker actuating bearing block **154** is still on its downward movement. This, as is conventional, is to facilitate the passing of the needle thread around the shuttle in the base of the machine. As the crank **139** continues its rotation the loop taker will be rapidly moved upward to finish tying the knot around the bobbin thread almost simultaneously with the beginning of the next downward movement of the needle.

FIGURE 6 of the drawing is a bottom view of the machine embodying the present invention as shown in FIGURE 2 and illustrates the shuttle operating mechanism and the feed mechanism mounted in the base **20** of the machine. These mechanisms are essentially the same as those disclosed in Patent No. 2,679,220 dated May 29, 1954 in which I am a co-inventor. The main exceptions are that the shuttle drive shaft is utilized also as the rock shaft and the rotational axis of the shuttle is disposed at right angles to the shuttle drive shaft, as will become apparent hereinafter.

In FIGURE 6 a shuttle drive shaft **156** is rotatably mounted in the bearing blocks **158A** and **158B**, longitudinally of the base near the rear thereof. At the right end of the shuttle drive shaft **156** there is affixed a shuttle drive shaft pulley **160** about which the drive belt **82** passes, the belt **82** serving as a driving connection to the driving pulley **80** which is included in the hand wheel **24** as previously described and the pulley **160** being notched across its face in the same manner as the driving pulley **80**. At the lefthand extremity of the shuttle drive shaft **156** a helical gear **162** is formed and is positioned within the bearing block **158D** to mesh with a corresponding helical gear (not shown) on the end of a shuttle stub shaft **164** that is rotatably journaled in bearing block **158D** at right angles to the shuttle drive shaft **156**. The shuttle stub shaft **164** carries a shuttle assembly **166** for rotation therewith. It will be noted that the axis of rotation of the shuttle assembly **166** is at right angles to the plane of lateral movement of the needle of the machine. The shuttle is positioned under the needle so that the lateral movement of the needle is equidistant on each side of the vertical diameter of the shuttle. The necessary cooperation of the hook of the shuttle with the needle can tolerate this movement of the needle to one side and the other of the axis of rotation of the shuttle while still permitting for the picking up of the needle thread by the shuttle hook. In the machine embodying the present invention full advantage is taken of this tolerance to permit maximum lateral or zig zag movement of the needle and because of this tolerance no compensating movement of the shuttle is necessary with respect to the lateral movements of the needle.

The shuttle mechanism illustrated in FIGURE 6 and suitable for the machine embodying the present invention is of the type shown in Patent No. 2,673,541 dated Mar. 20, 1954. One added feature in the machine illustrated herein is a gate mechanism **168** which is pivoted about a vertical pin **168A** for swinging motion to carry the bobbin into and out of the shuttle assembly when it is necessary to refill the bobbin or change the color of the bobbin thread. In other respects the gate is similar in function to the gate numbered **72** in Patent No. 2,673,541.

Mounted longitudinally in the base there is a cam drive shaft **170** journaled for rotation in bearing blocks **172A** and **172B**. This shaft is similar in function and purpose, together with the cam mounted thereon, as the feed cam shaft numbered **22** in the Patent 2,679,220 previously re-

ferred to. At the right end of the cam drive shaft **170**, as viewed in FIGURE 6, there is mounted a pulley **174** which is driven by a belt **176** from a driving pulley **178** which is affixed to the end of the shuttle drive shaft **156**. The pulleys **178** and **174** are notched across their outer face and the belt **176** is provided with similar notches on the inner periphery thereof in the same manner as previously described in connection with belt **82**, in order that the rotation of the cam drive shaft **170** may be properly synchronized with the rotation of the shuttle drive shaft **156** and hence with the movements of the shuttle. Since the shuttle drive shaft **156** is synchronized in rotation with respect to the rotation of the main drive shaft that in turn drives the needle up and down, the feed mechanism which is actuated by the cam drive shaft **170** as hereinafter described is thereby properly synchronized with the needle movements.

At the left end of the cam drive shaft **170**, a feed lift cam **180** is keyed for rotation with the shaft **170**. The shaft **170** is provided with an extended keyway **170A** to facilitate sliding of the feed lift cam **180** along the shaft into either one of two predetermined positions. The feed lift cam **180** consists of an eccentric nose portion **180A**, a concentric portion **180B**, a tapered portion **180C** joining the concentric portion and the eccentric portion, and an extended concentric portion **180D**. Extended portion **180D** has a peripheral groove therein which the forked extension **182** from a feed lift cam release rail **184** is journaled, thereby facilitating shifting of the feed lift cam by means of the manually operable feed dog cam release knob **50** which was previously described in connection with FIGURE 1. The forked end of a lift cam follower arm **186** embraces the lift cam **180** and the arm extends across the machine with the branch **186A** diverging therefrom so that the entire arm is somewhat A-shaped. The divergent ends of the lift cam follower arm **186** extend under the shuttle drive shaft **156**, as viewed in FIGURE 6, i.e., are positioned between the shuttle drive shaft and the under surface of the base of the machine. These ends of the arm are hingedly joined to downward extensions provided at each end of a rocker frame **188**. The rocker frame **188** is supported for rocking movement by means of a support sleeve **190** that is journaled in bearing blocks **189A** and B. The rocker frame **188** is attached to the support sleeve **190** by any suitable means such as a bolt **188A**. The internal diameter of the support sleeve **190** is sufficiently large to provide clearance of shaft **156** which passes therethrough and the downward extensions at either end of the rocker frame **188** are of course provided with suitable holes to permit clearance passage therethrough of the shaft **156**. The arm **186** has another extension laterally therefrom indicated by the numeral **186B** which extends between the shuttle and the lower surface of the base of the machine and carries, in the conventional manner, feed claws that extend through a suitable opening in the base into cooperative engagement with the presser foot.

Mounted intermediate the ends of the cam drive shaft **170** is a feed control cam **192** which is keyed to the shaft for rotation therewith and is slidable therealong by means of the keyway **170A**. The feed control cam **192** has a cylindrical body portion **192A** thereof positioned at an acute angle, of the order of 7 degrees, to the axis of the shaft **170**, the cylinder axis crossing the shaft axis approximately midway of the length of the cylindrical body portion **192A**. At one end of cam **192** is an extension **192B** that is concentric with the shaft **170** and which has an annular groove therein concentric with the shaft to receive the forked extension **194** from a feed control cam rail **196**. The feed control cam rail may be actuated manually by the manually operable feed control knob **48** previously described in connection with FIGURE 2 of the drawings. A cam ring **198** is keyed to the control cam **192** and the inner diameter thereof is angled the same as the cam so that the cam slides within the ring and the ring rotates with the cam and the shaft **170**. One end of a rocker actuating arm **200** is annular and is adapted to fit in an exterior annular groove **198A** in the cam ring **198**. The annular end of the actuating arm **200** is retained in the groove **198A** by any suitable means such as a conventional snap ring arrangement. The surface of the groove **198A** is, of course, cylindrical and parallel with the shaft **170** so that as the cam **192** is slid through the ring **198** to various positions the eccentric action of the cam is varied. The rocker actuating arm **200** extends rearwardly and is supported in bifurcated downward extensions **202** from the base **20**, and the rearward end of the arm is rotatably affixed to the rocker frame **188** by means of a pin **188B** fixed to one end of the rocker frame on the opposite side of the support sleeve **190** from the point of affixing of the end of the arm **186A**. Thus, as the feed control cam rotates the eccentric motion imparted to the actuator arm **200** is translated through the rocker frame **188** into a to and fro motion of the lift cam follower arm **186** while at the same time lift cam **180** is imparting an up and down motion to the follower arm **186**. Thus, in the conventional manner, the feed claws carried by the extension **186B** on the follower arm are given the conventional usual four motions, i.e., up and down and back and forth.

When the feed control cam is in its extreme left position, as illustrated in FIGURE 6 (and toward which position it is biased by a tension spring **203** affixed between the rail **196** and the base of the machine) the feed claws are moved from the front toward the back of the machine at the same time that they are lifted upward thus feeding the material between the feed claws and the presser foot away from the operator and into the needle in what is conventionally known as forward feed. This results because the shaft **170** is rotated in a clockwise direction as viewed from the right-hand end whereby the nose **180A** of the lift cam is proceeding to lift the arm **186** at the same time that the feed control cam **192** will be imparting forward motion to the actuator arm **200** and thus rearward motion to the feed claws. As the control cam **192** is slid to the right, as viewed in FIGURE 6, the amount of this forward feed diminishes as the cam ring **198** approaches the zero position of the cam, i.e., midway between the extremities of the angled body portion **192A**. To the left of this zero portion the movement of the actuator arm **200** would then be rearwardly when the feed claws are in their raised position thus imparting a forward motion to the feed claws which would feed the material toward the operator, i.e., backward.

When it is desired to have no feed whatsoever, i.e., to release the feed claws, the lift cam **180** is slid to the right as viewed in FIGURE 6 by means of the feed lift cam release rail **184** so that the forked end of the arm **186** then rests on the concentric portion **180B** of the lift cam which imparts no up and down motion whatsoever to it and maintains it in a lowered position in which the feed claws are out of engagement with the presser foot. This permits manual movement of the material under the needle in all directions—as when darning.

FIGURE 7 is a view taken in the direction of the arrows **7—7** of FIGURE 6 with portions broken away to show the details of the mounting of the feed lift cam release rail **184** and the feed control cam rail **196**. The rails are mounted with the feed lift cam release rail **184** above the feed control cam rail **196** in edgewise arrangement. They are retained in notches provided in posts **204**, that depend downwardly from the under surface of the base **20**, by means of retainer clips **206**. As can be seen in FIGURES 6 and 7, a further ear **208** extends rearwardly and upwardly a short distance from the lower edge of the feed control cam rail **196** for purposes which will be de-

scribed hereinafter in connection with automatic operation of the machine.

Referring to FIGURES 2 and 4 of the drawings, it can be seen that a zig zag cam shaft **210** is journaled for rotation on the upper part of post **56** at right angles to the main drive shaft **76**. On the rear of the shaft **210** there is affixed a helical gear **212** which meshes with a helical gear **214** formed on main drive shaft **76** as can be seen in FIGURE 4, whereby the zig zag cam shaft **210** is driven directly from the main drive shaft **76**. Rigidly affixed to the front end of the zig zag cam shaft **210** is a zig zag cam **216** and, as can be seen in FIGURE 2, the zig zag cam is embraced by a zig zag cam follower **218** which is shown in greater detail in FIGURE 8.

FIGURE 8 is a fragmentary view showing the elements that impart the zig zag or lateral motion to the needle bar carrier and thus to the needle and needle thread, and also illustrates manually operable controls which determine (a) the amount of lateral movement of the needle or zigzag, i.e., the manually operable throw controls, and (b) the predetermined station along the lateral path of movement of the needle which will be the center point for the zig zag or throw, i.e., the manually operable needle position controls. FIGURE 12 is a plan view including the elements of FIGURE 8 and certain additional elements not shown in FIGURE 8.

FIGURE 9 is a fragmentary sectional view on the line **9—9** of FIGURE 8 in the direction of the arrows. FIGURE 10 is a fragmentary sectional view taken on the line **10—10** of FIGURE 8 in the direction of the arrows, and FIGURE 11 is a fragmentary sectional view taken on the line **11—11** of FIGURE 8 in the direction of the arrows.

FIGURE 13 is a fragmentary view similar to FIGURE 8 with the elements utilized for automatic control added. FIGURE 14 is a vertical sectional view taken along the line **14—14** of FIGURE 13 in the direction of the arrows, and FIGURE 15 is a vertical sectional view taken along the line **15—15** of FIGURE 13 in the direction of the arrows. FIGURES 14 and 15 will be referred to for convenience in describing both the manual control and the automatic control features.

Referring first to FIGURE 8, it will be seen that the zig zag cam follower **218** is pivotally mounted at its lower end to the arm **58** of the machine by a stud and snap ring **220** or other suitable pivotal mounting means. At its upper portion the cam follower **218** is provided with two upstanding side flanges **222A** and **222B** that embrace the zig zag cam **216** (as can be seen in FIGURE 12). The cam follower is also provided with an arcuate slot **224** the boundaries of which ride on the zig zag cam shaft **210**. The radius of the slot **224** is determined by the distance from the pivot point **220**. The upstanding flanges **222A** and **222B** are provided with out-turned ears **226A** and **226B**, respectively. As can be seen in FIGURE 12 and FIGURE 13, a strap **228** extends between the two ears **226A** and **226B** in front of the zig zag cam **216** and is joined to the ears by any suitable means such as rivets **230**. Pivotally affixed to the center of this strap **228** is one end of a zig zag cam link **232**. Thus, as the zig zag cam rotates, it bears alternately against the upstanding flanges **222A** and **222B** of the zig zag cam follower **218** thus pivoting the cam follower about the pivot point **220** thereof and imparting a to and fro motion to the zig zag cam link **232** which, as will become apparent hereinafter, imparts lateral motion or throw to the needle bar carrier and thus to the needle carried thereby.

The opposite end of the zig zag cam link **232** is provided with a shouldered rivet **234** (FIGURE 9) which serves to pivotally connect the link with a zig zag width follower **236**. As can be seen in FIGURE 9, the zig zag width follower **236** is a generally U-shaped member and the pin **234** connects the cam link **232** to the rear portion thereof near the top. Near the bottom of the rear portion of the zig zag width follower **236**, a shouldered rivet **238** pivotally connects the width follower **236** to a needle position follower **240**, as can be seen in FIGURES 8 and 11. The front portion of the width follower **236** is provided with a generally vertical slot **242**. A shouldered rivet **246** rides in the slot **242** (FIGURE 10) and connects one end of a zig zag control link **248** with the zig zag width follower **236**, as can be seen in FIGURES 8 and 10. The opposite end of the zig zag control link **248** is pivotally connected, as by the rivet **250**, to the needle bar carrier connector **126**. Thus, the to and fro movement imparted to the zig zag cam link **232** by the zig zag cam and cam follower rocks the zig zag width follower **236** about its pivot point **238**. This rocking motion of the zig zag width follower **236** is translated by the zig zag control link **248** into a straight line lateral movement or "throw" of the needle bar carrier through the needle bar connector **126**. This is the so-called zig zag motion or lateral throw of the needle and needle thread.

As mentioned in connection with FIGURE 1, the operator of the machine may utilize the knob **46** for manual zig zag control to determine the amount of throw. As can be seen in FIGURE 8, a mid-portion of the zig zag control link **248** bears on a manual throw control cam **252**. As this cam is turned clockwise as viewed in FIGURE 8 it forces the right end of the link **248** further toward the top of the slot **242**, i.e., further from the pivot point **238** of the width follower **236**. At its one extreme adjustment the pin **246** which connects the end of link **248** to follower **236** would be at the extreme top of slot **242** and would thus overlie the pin **234** that connects the zig zag cam link **232** to the follower **236** with the result that the entire movement of the link **232** would be transmitted to the link **238**. At the opposite extreme of the adjustment of the cam **252** the pin **246** would be adjacent the bottom of slot **242** overlying the pivot point **238** of the follower **236** and consequently none of the motion of link **232** would be transmitted to link **248**.

The manual throw control cam **252**, as can be seen in FIGURE 14, is affixed to a shaft **254** which in turn is rotatably mounted in the arm **58** of the machine as can be seen from FIGURE 5. To the front end of this shaft is affixed the control knob **46**. A ball and socket detent mechanism such as is shown in FIGURE 14 in detail may also be mounted on the rear end of the shaft **254**, as shown in FIGURE 5, to hold the cam **252** at any desired point of rotation.

It has been previously mentioned that the zig zag width follower **236** is pivotally mounted on the needle position follower **240**. The needle position follower **240** extends generally horizontally with a left end portion thereof **240A** extending behind the cam **252** with a slot **240B** being provided in this end portion to clear shaft **254**. The opposite end of the needle position follower **240** is slidably affixed to the arm **58** of the machine by means of the elongated slot **240C** and the post and snap ring **256**, or other suitable fastening means, extending through the slot **240C**. As in FIGURES 8–11, the major intermediate portion of the needle position follower **240** is behind the zig zag width follower **236** and there is provided in this intermediate portion a third elongated slot **240D** near the top thereof in which the pin **234** that connects the end of the cam link **232** to the follower **236** is guided whereby the motion of the end of the cam link **232** is constrained in a horizontal path. As shown in FIGURES 8 and 13, the needle position follower **240** is biased to the right as there viewed by a tension spring **258** which engages between an ear provided on the lower edge of the needle position follower and a pin provided on the post **58** of the machine as can be seen in FIGURE 2. Referring to FIGURES 8 and 14, it can be seen that the end portion **240A** of the needle position follower **240** is provided at its lower edge with a vertical face **240E** which is biased by the tension spring **258** against a finger **260A** that extends forwardly from a needle position lever **260**. The needle position lever **260** is mounted

for rotation on an enlarged portion 254A of the shaft 254 behind the needle position follower 240 and has a portion 260B extending from the bottom thereof forwardly and then upwardly, as can be seen in FIGURES 14 and 8, to engage the manually operable needle position control knob 44 which is illustrated in phantom lines in FIGURE 14 and which is also mounted for rotation on shaft 254. The upper portion of the needle position lever 260 is engaged by a detent mechanism such as the spring and ball 262 illustrated in FIGURE 14 which, as can be seen in FIGURE 8, engages any one of three recesses provided in the lever 260 whereby the lever may be selectively positioned in any one of three positions by the control knob 44, i.e., "left," "center," and "right." As shown in FIGURE 8, the manually operable needle position control knob 44 of FIGURES 1 and 14 has been set in the "center" position at which position the needle is initially midway between the left and right extremes of the throw so that as the cam link 232 rocks the follower 236 about the pivot point 238 the zig zag motion or throw of the needle is equally to the right and to the left of this center position of the needle. If the manual needle position control knob 44 is turned clockwise the lever 260 would also be turned clockwise and the finger 260A bearing against the face 240E of the needle position follower 240 would move the needle position follower to the left. It will be noted that this would move the pivot point 238 of the follower 236 to the left as viewed in FIGURE 8 and would, in fact, bodily move the entire follower 236 to the left slightly thus forcing the zig zag control link 248 to the left moving the needle into its left station. In this position pivot point 238 would underlie the extreme leftward extent of travel of the pin 234, i.e., the entire to and fro motion of the pin 234 carried by the end of the cam link 232 would be to the right of the pivot point 238. It follows that when the needle position control knob 44 is rotated counterclockwise, the tension spring 258 urges the needle position follower 240 to the right to carry it into its extreme right position with consequent movement of the needle to its extreme right station at which point the pivot 238 of the follower 236 underlies the extreme rightward movement of the pin 234 so that the zig zag movement of the needle would be all to the left from the extreme right position. Obviously, the spring detent means 262 is utilized to maintain the needle position follower at its selected position and thus pre-disposes the needle at either one of the center, right, or left stations. It should be noted, particularly in connection with FIGURE 14, that the needle position lever 260, the end portion 240A of the needle position follower 240, and the knob 44 are free to move on the shaft 254 without interfering with the rotational movement of the shaft to be imparted by knob 46 that is firmly affixed to the end of the shaft whereby to selectively position the throw control cam 252 that is likewise affixed to the shaft 254 for rotation therewith.

To one familiar with the patterns that can be produced by zig zag sewing machines, it will be apparent that thus far the machine embodying the present invention which has been described contains all the necessary elements for manually setting and varying any of the conceivable patterns that can be made by such a machine. That is, I have provided for adjustment of the throw from zero to maximum, positioning of the needle at any of the three stations center, left or right, and have also provided for the selective determination of the direction and amount of feed of the material which is being sewed.

Referring now to FIGURES 13–17 of the drawings, FIGURE 13 is a view similar to FIGURE 8 but shows in addition to the elements of FIGURE 8 the elements for automatic control of needle position, throw, and feed direction and speed. These three control functions are controlled automatically by a pattern cam 264 which is visibly mounted on the machine in FIGURE 2. The pattern cam is of the removable and replaceable type and has three cam surfaces thereon, one for each of the three above mentioned controls. A pattern cam shaft 266 is rotatably mounted in the post 56 in parallel relationship to the zig zag cam shaft 210 and adjacent thereto as shown. The pattern cam shaft is driven through a conventional one-way clutch mechanism 268 drivingly engaging the front end thereof and is held against rotation in the opposite direction by a similar one-way clutch 270 engaging the rear end thereof and which is visible only in FIGURE 4 of the drawing. Engaging the one-way clutch 268 is one end of a pattern cam driver link 272. Adjacent the opposite extremity of the driver link 272 a connector link 274 is pivotally connected thereto. The connector link 274 is pivoted to the driver link 272 midway of the extremities of link 274 and at one end terminates in a finger 276 which carries a sleeve bearing and which extends into an arcuate slot 278 in the zig zag cam follower 218. The radii of the edges of the slot 278 are determined by their respective distances from the pivot point of the connector link 274. Thus, as the zig zag cam follower 218 is rocked about its pivot point 220 by the zig zag pattern cam this rocking motion is transmitted through the connector link 274 and the pattern cam driver link 272 to the one-way clutch 268 which results in a ratchet-like turning of the pattern cam shaft 266 and the pattern cam carried thereby is rotated continually in one direction.

It will be noted that at the opposite end of connector link 274 from the finger 276 there is pivotally affixed one end of a wire link 280 which extends downwardly and is pivotally attached at its lower end to a pattern expander control disc 282. The expander control disc 282 is mounted for rotation on a shaft 284 which extends through a bore provided in the center thereof. The manually operable pattern expander lever 54 referred to in connection with FIGURE 1 is also mounted for rotation on the shaft 284 and has a finger extending rearwardly therefrom that engages in a keyway 282B of the expander control disc 282 whereby manual manipulation of the pattern expander lever 54 serves to rotate expander control disc 282 about shaft 284. Rotational movement of the expander control disc 282 results in changing the position of finger 276 of the connector link 274 within the slot 278 via the wire link 280 between the disc 282 and the connector link 274. When the finger 276 is at the top of slot 278 the maximum movement of the pattern cam follower 218 is transmitted to the pattern cam driver link 272 and thus the pattern cam shaft and pattern cam are turned at maximum speed. When the finger 276 is at the bottom extremity of the slot 278 it coincides almost exactly with the pivot point 220 of the pattern cam follower 218 and little or none of the movement of the pattern cam follower is transmitted to the pattern cam driver link so consequently the pattern cam shaft and pattern cam turn very slowly or not at all. This particular adjustment gives an infinite variation in the speed of rotation of the pattern cam which, as previously mentioned, is a novel feature of the machine embodying the present invention that results in the possibility of varying manually and infinitely the length of the pattern which is dictated by the pattern cam.

It has been mentioned that each pattern cam is provided with three cam surfaces to control three particular elements of operation of the machine. Referring to FIGURE 8, it will be noted that the needle position follower 240 terminates at its righthand end as there illustrated in a projecting cam follower finger 286. This cam follower finger 286 is positioned to engage the cam surface on a pattern cam that dictates needle position. To enable the finger 286 to engage the cam surface, the manual needle position control knob 44 is turned counterclockwise to the "right" position. This permits the tension spring 258 to pull the needle position follower 240 to its extreme right position thus engaging the cam follower finger 286

against the surface of the pattern cam so as to respond to the dictates of the pattern cam.

The next feature to be described is the automatic throw control. As mentioned previously, the amount of throw is determined by the position of pin **246** in slot **242** of the zig zag width follower **236** in relation to the pivot point **238** of the width follower. As can be seen most clearly in FIGURE 15, the pin **246** extends forwardly through the slot **242** in width follower **236** to provide pivotal engagement with one end of an intermediate link **288**. The opposite end of the intermediate link **288** (FIGURE 13) is pivotally connected to one extremity of an L-shaped cam follower arm **290** which is pivotally mounted to the arm **58** of the sewing machine at its apex such as by post and snap ring **292** and which includes at an intermediate portion of its other arm a cam follower finger **290A** that, of course, engages the throw control cam surface of the pattern cam. A coil spring **294** positioned on post **292** in a conventional manner has one extremity thereof engaging the top of the upper arm of the L-shaped cam follower **290** to urge it downwardly thus biasing the cam follower finger **290A** against the surface of the pattern cam. This spring biasing action also serves to maintain the zig zag control link **248** biased downwardly against the manual throw control cam **252**. When it is desired to have automatic throw control by the pattern cam the manual throw control knob **46** of FIGURE 1 is rotated to its zero position which places the pin **246** in the downward extremity of the slot **242** of zig zag width follower **236** so that the cam follower finger **290A** bearing against the appropriate cam surface of the pattern cam will respond to the dictates of the pattern cam and thus through the L-shaped cam follower arm **290** and intermediate link **288** varying the position of pin **246** in the slot **242** to adjust the amount of throw as dictated by the pattern cam.

The remaining control feature dictated by the pattern cam is feed control direction and speed. As has previously been discussed in connection with FIGURES 6 and 7, the feed control cam rail **196** has been provided with a rearwardly and upwardly extending ear **208** the upward extension of which is provided with suitable engaging means such as a shouldered bolt or rivet **296** which is best seen in FIGURE 6. This headed bolt **296** is engaged by the forked lower end of a reverse lever **298** which reverse lever is pivotally affixed to the post **56** of the sewing machine at its upper end by a pin **300**. Pin **300** extends from the post parallel to and spaced from the shaft **284**. This reverse lever therefore provides positive connection to the feed control cam rail **196** and therefore control of material feed direction and amount. The reverse lever **298** is actuated by a reverse cam follower **302** which is pivotally mounted intermediate its ends on the pin **300** behind the reverse lever **298**. At the upper end of the reverse cam follower **302** is formed a cam follower finger **304** which follows the appropriate cam surface of the pattern cam for control of feed direction and speed, or in other terms, stitch control. As can be seen in FIGURES 16 and 17, the lower end of reverse cam follower **302** is provided with a lateral extension **306** which terminates in a forwardly extending ear **306A** that extends forwardly past the front surface of the reverse lever **298**. Threaded through this ear **306A** is a bolt **308** which is locked in place in the ear by any suitable means such as a conventional lock washer under the head of the bolt. The bolt **308** extends through a clearance hole in an upstanding ear **298A** provided on the reverse lever **298**. A lock nut **308A** is threaded on the bolt before it is passed through the ear **298A** and engages against the right face of the ear **298A**. A compression spring **310** is positioned over the portion of the bolt **308** extending to the left side of the ear **298A** and a lock nut **308B** is threaded onto the end of the bolt. Thus, compression spring **310** bearing between the left face of the ear **298A** and the nut **308B** provides a yielding connection between the reverse cam follower **302** and the reverse lever **298** for a reason which will now become apparent. It has been explained in connection with FIGURE 6 that the tension spring **203** biases the feed control cam rail to the left in FIGURE 6 which is also to the left in FIGURES 16 and 17. This, then, urges the lower end of the reverse lever **298** to the left and likewise through the compression spring **310**, the nut **308B** and the bolt **308** urges the lower end of reverse cam follower **302** to the left thus biasing the cam follower finger **304** on the upper end of the reverse cam follower **302** against the appropriate cam surface of the pattern cam. The compression spring **310** must, of course, be stronger than the tension spring **203** so as not to override the dictates of the pattern cam. However, it will be noted in FIGURE 17 that the reverse lever **298** carries adjacent its upper end below the pivot pin **300** a finger **312** that engages in an arcuate and flaring slot **314** in a feed control limiter disc **316**. Thus, if the pattern cam dictates counterclockwise rotation of the reverse lever **298** about its pivot **300** further than the finger **312** engaged in slot **314** will permit, the compression spring **310** is compressed and no damage occurs. Obviously, a clockwise rotation of reverse lever **298** about its pivot **300** is dictated by a falling away of the pattern cam surface from the cam follower finger **304** so that if more clockwise rotation is dictated than will be permitted by the finger **312** engaged in slot **314** no damage occurs as the cam follower finger **304** simply does not follow completely the falling away cam surface. The lock nut **308A** is, of course, adjusted on the bolt **308** to permit complete following by the cam follower finger **304** of the falling away cam surface in those instances where the limiter disc **316** has been rotated to place the widest portion of the slot **314** adjacent the finger **312** thereby permitting complete response to the dictates of the pattern cam.

It should be here noted that the slot **314** in the feed control limiter disc is symmetrical on either side of the centerline thereof. That is, at each point along its length the edges of the slot are spaced the same distance from the center thereof. The centerline of the slot corresponds to center positioning of the feed control cam **192**. Thus, the opposite edges of the slot **314**, at any given point throughout its length, correspond to equal speeds of material feed in opposite directions.

The stitch control limiter disc **316** is affixed to the shaft **284** for rotation therewith and, as has been pointed out with respect to FIGURE 1, the manual feed control limiter lever **52** is likewise affixed to this shaft and provides for manual rotation thereof. The feed control limiter disc, therefore, performs two functions. As has been just described it can be used to limit response to the dictates of the pattern cam. Its second function is in connection with manual feed control. That is, the manual feed control knob **48** of FIGURE 1 is utilized to move manually the feed control cam rail **196**. Without the feed control limiter disc **316** this manual adjustment can be anywhere between the two extremes of most rapid forward feed and most rapid reverse feed. Let it be assumed that the operator wishes to shift alternately between a certain speed of forward feed and an equal speed of reverse feed. The feed control limiter disc **316** then performs its second function, for the operator first sets the manual feed control limiter knob **52** to the appropriate index number for the feed speed. Because of the bias of the spring **203** on the feed control cam rail **196**, it will shift to forward feed direction at the speed just set and the knob **48** will likewise be carried to the left. When the operator desires to reverse the direction of the feed but still have the same speed of feed she merely grasps the knob **48** and moves it to the right which motion will be limited by the finger **312** of the reverse lever **298** positioned in the slot **314** so that movement of the knob to the right and consequently the speed of the reverse feed will be limited to that necessary to produce the predetermined feed of speed without further attention by the operator. This reverse feed will

continue so long as the operator holds the knob **48** in its extreme right position, or there may be suitable spring detents provided for on the cam rail **196** that it would hold the knob in any desired position.

It will be noted that the feed control limiter disc **316** is provided with an additional arcuate slot **316A** and that the pattern expander control disc **282** is also provided with a similar arcuate slot **282A**. As is apparent from the drawings the slots **316A** and **282A** embrace the pin **300** to assist in support of the respective discs. It can also be noted, as apparent in FIGURE 16, that a friction retainer means, such as the finger, spring, and bolt **318**, is provided to restrict and hold disc **282** in position for rotational movement on shaft **284**. A snap ring, as illustrated in FIGURE 16, is also positioned on the protruding end of the pin to assist in maintaining discs **316** and **282** and levers **302** and **298** in position.

Referring once again to FIGURE 13, a cam follower release lever **320** is provided and is mounted for sliding movement by the post **256** which also mounts needle position follower **240** and by the post **320A**. At its right-hand end it is provided with a forwardly turned extension **320B** which extension, by reference to FIGURE 1, engaged by the extension **40A** on the pattern cam door **40** of the shroud **22** when the door is open. This moves all of the cam follower fingers to the left away from engagement with the pattern cam so that the pattern cam may easily be removed and replaced with another. These releases of the various cam followers result because of the ear **320C** that engages with the lower extremity of L-shaped follower arm **290**, the finger **320D** that engages the release ear **241** provided in needle position follower **240**, and the rearwardly extending flange **302A** on the reverse cam follower **302** that is engaged by surface **320E** of the cam follower release lever **320**.

I claim:

1. A sewing machine comprising a supporting structure, a needle mounted in said supporting structure for longitudinal reciprocation and for movement laterally of the direction of reciprocation, a driving member supported on said supporting structure for reciprocatory movement of a predetermined magnitude relative to said supporting structure, power means for imparting reciprocation to said driving member in synchronism with the needle reciprocating movements, driven mechanism operatively connected to said needle for shifting said needle in a lateral reciprocatory motion in response to reciprocation of said driven mechanism, a first cam follower slidably carried by said supporting structure, means defining a pivot carried by said cam follower, a motion translating device pivotally supported on the above mentioned pivot means, said driving member being operatively connected to said motion translating device to impart oscillation thereto in response to reciprocation of the driving member, said motion translating device having an elongated track provided with portions located at different radial distances from the above mentioned pivot means, said driven mechanism including drive transmitting means cooperating with the above mentioned track to transmit motion from said motion translating device to said driven mechanism, a second cam follower movably mounted on said supporting structure, means carried by said second cam follower and operatively connected to said drive transmitting means to selectively position said drive transmitting means in said track to selectively establish an effective lever arm between said drive transmitting means and said pivot means to preselect the magnitude of motion to be transmitted to said driven mechanism and needle from the predetermined reciprocatory movement of the driving member, a first cam rotatably carried by said supporting structure and operatively connected to said power means and to said second cam follower to vary the effective lever arm in response to information derived from said first cam, and supplemental control means operable to slide said first cam follower and its associated pivot laterally relative to said supporting structure to a plurality of preselected stations which serve as reference points for the above mentioned lateral reciprocatory motion of said needle and its associated driven member, said supplemental control means including a cam rotatably carried by said supporting structure and operatively connected to said power means in driving relationship with said first cam follower.

2. A sewing machine comprising a supporting structure, a needle mounted in said supporting structure for longitudinal reciprocation, said supporting structure having a surface adapted to receive work material to be sewn, feed mechanism operable to selectively move such material in either forward or reverse directions across said surface for sequential penetration by said needle, driving mechanism operatively connected to said needle and to said feed mechanism to drive the latter in synchronism with the needle reciprocating movements, said feed mechanism including a control member movably carried by said supporting structure for movement between a plurality of stations in which forward and reverse directions of movement of the work material and different rates of movement of the work material are established relative to the needle reciprocation, a first manually operable means for selectively positioning said control member in the above mentioned plurality of stations, a cam rotatably carried by said supporting structure and operatively connected to said driving mechanism for rotation thereby, said cam carrying information as to desired rates and directions of movements of said work material, a cam follower movably mounted on said supporting structure for movement in response to cam rotation, a yieldable motion transmitting mechanism operatively connecting said cam follower and said control member to selectively move the latter to some of the above mentioned stations in response to cam induced movement of the cam follower, and second manually operable means carried by said structure movable to selectively position obstructions in the vicinity of a portion of said cam follower to effectively limit the stations to which either said cam or said first manually operable means can position said control member.

3. A sewing machine comprising a supporting structure, a needle mounted in said supporting structure for longitudinal reciprocation, said supporting structure having a surface adapted to receive work material to be sewn, feed mechanism operable to selectively move such material in either forward or reverse directions across said surface for sequential penetration by said needle, driving mechanism operatively connected to said needle and to said feed mechanism to drive the latter in synchronism with the needle reciprocating movements, said feed mechanism including a control member movably carried by said supporting structure for movement between a plurality of stations in which forward and reverse directions of movement of the work material and different rates of movement of the work material are established relative to the needle reciprocation, a cam rotatably carried by said supporting structure and operatively connected to said driving mechanism for rotation thereby, said cam carrying information as to desired rates and directions of movements of said work material, a cam follower movably mounted on said supporting structure for movement in response to cam rotation, a motion transmitting mechanism operatively connecting said cam follower and said control member to selectively move the latter to some of the above mentioned stations in response to cam induced movement of the cam follower, and a manually operable means carried by said structure and movable to selectively position obstructions in the vicinity of a portion of said cam follower to effectively limit the stations to which said cam can position said control member, said last mentioned means comprising a plate movably mounted on said supporting structure and having a slot of graduated width therein and receiving a portion

of said cam follower in the slot so that sides of the slot limit motion of the cam follower and movement of the plate disposes slot portions of other width in operative relation with said last mentioned portion of said cam follower.

4. A sewing machine comprising a supporting structure, a needle mounted in said supporting structure for longitudinal reciprocation, said supporting structure having a surface adapted to receive work material to be sewn, feed mechanism operable to selectively move such material in either forward or reverse directions across said surface for sequential penetration by said needle, driving mechanism operatively connected to said needle and to said feed mechanism to drive the latter in synchronism with the needle reciprocating movements, said feed mechanism including a control member movably carried by said supporting structure for movement between a plurality of stations in which forward and reverse directions of movement of the work material and different rates of movement of the work material are established relative to the needle reciprocation, a first manually operable means for selectively positioning said control member in the above mentioned plurality of stations, a cam rotatably carried by said supporting structure and operatively connected to said driving mechanism for rotation thereby, said cam carrying information as to desired rates and directions of movements of said work material, a cam follower pivotally mounted on said supporting structure and having a portion in contact with said cam for movement in response to cam rotation, said cam follower having a tab projecting therefrom intermediate its last mentioned portion and its pivotal mounting, a motion transmitting mechanism operatively connecting said cam follower and said control member to selectively move the latter to some of the above mentioned stations in response to cam induced movement of the cam follower, and second manually operable means carried by said structure movable to selectively position obstructions in the vicinity of a portion of said cam follower to effectively limit the stations to which either said cam or said first manually operable means can position said control member, said second manually operable means comprising a plate rotatably mounted on said supporting structure and having a crescent shaped slot therein receiving said cam follower tab, said slot being so arranged relative to said cam follower that pivotal movement of said cam follower induces movement of its tab laterally across the width of the slot and the sides of the slot serve to limit motion of said tab while rotation of said plate selects a particular slot width from an infinite number of available slot widths and locates the selected slot width in operative relation with said tab to thereby limit the stations which said control member can assume.

5. A sewing machine comprising a supporting structure, a needle mounted in said supporting structure for longitudinal reciprocation, said supporting structure having a surface adapted to receive work material to be sewn, feed mechanism operable to selectively move such material in either forward or reverse directions across said surface for sequential penetration by said needle, driving mechanism operatively connected to said needle and to said feed mechanism to drive the latter in synchronism with the needle reciprocating movements, said feed mechanism including a control member movably carried by said supporting structure for movement between a plurality of stations in which forward and reverse directions of movement of the work material and different rates of movement of the work material are established relative to the needle reciprocation, a cam rotatably carried by said supporting structure and operatively connected to said driving mechanism for rotation thereby, said cam carrying information as to desired rates and directions of movements of said work material, a cam follower pivotally mounted on said supporting structure and having a portion in contact with said cam for movement in response to cam rotation, said cam follower having a tab projecting therefrom intermediate its last mentioned portion and its pivotal mounting, a motion transmitting mechanism operatively connecting said cam follower and said control member to selectively move the latter to some of the above mentioned stations in response to cam induced movement of the cam follower, and a manually operable means carried by said structure and movable to selectively position obstructions in the vicinity of a portion of said cam follower to effectively limit the stations to which said cam can position said control member, said manually operable means comprising a plate rotatably mounted on said supporting structure and having a crescent shaped slot therein receiving said cam follower tab, said slot being so arranged relative to said cam follower that pivotal movement of said cam follower induces movement of its tab laterally across the width of the slot and the sides of the slot serve to limit motion of said tab while rotation of said plate selects a particular slot width from an infinite number of available slot widths and locates the selected slot width in operative relation with said tab to thereby limit the stations which said control member can assume.

6. A sewing machine comprising a supporting structure including a work surface, a shuttle provided with a hook and rotatably supported by said supporting structure on one side of said work surface, means supporting a needle from said supporting structure on the other side of said work surface for reciprocation in a first direction in stitch forming cooperation with said shuttle and hook and including mechanism selectively operable to impart lateral movements to said needle in a second direction lateral to said first direction, feed mechanism carried by said supporting structure and selectively operable to advance work across said work surface between said needle and said shuttle, power means carried by said supporting structure operative to impart said reciprocation to said needle in said first direction and rotation to said shuttle and hook, first means selectively operable to impart movement to the above mentioned mechanism for imparting lateral movements to said needle and including a first cam follower, second means selectively operable to operatively connect said power means to the above mentioned feed mechanism and including a second cam follower, information carrying cam means rotatably carried by said supporting structure in operative engagement with said first and said second cam followers, and selectively variable power transmitting mechanism comprising a reciprocating member carried by said supporting structure and reciprocated by said power means at a constant magnitude of reciprocatory movement, and motion translating mechanism operatively engaging between said reciprocating member and said information carrying cam means operative to translate said reciprocatory movement into rotary movement of said cam means, said motion translating mechanism including means to selectively vary the amount of the reciprocatory movement of said reciprocating member that is translated therethrough into said rotary movement of said cam means.

7. A sewing machine comprising a supporting structure including a work surface, a shuttle provided with a hook and rotatably supported by said supporting structure on one side of said work surface, means supporting a needle from said supporting structure on the other side of said work surface for reciprocation in a first direction in stitch forming cooperation with said shuttle and hook and including mechanism selectively operable to impart lateral reciprocal movement to said needle in a second direction lateral to said first direction, feed mechanism carried by said supporting structure and selectively operable to advance work across said work surface between said shuttle and said needle, power means carried by said supporting structure and operative to impart said reciprocation to said needle in said first direction and rotation

to said shuttle and hook, first control means selectively operable to operatively connect said power means to the above mentioned mechanism for imparting lateral reciprocal movement to said needle and including a first cam follower, second control means selectively operable to operatively connect said power means to the above mentioned feed mechanism and including a second cam follower, information carrying cam means rotatably carried by said supporting structure in operative engagement with said first and said second cam followers, and selectively variable power transmitting mechanism comprising a reciprocating member carried by said supporting structure and reciprocated by said power means at a constant magnitude of reciprocatory movement, and motion translating mechanism operatively engaging between said reciprocating member and said information carrying cam means operative to translate said reciprocatory movement into rotary movement of said cam means, said motion translating mechanism including means to selectively vary the amount of the reciprocatory movement of said reciprocating member that is translated therethrough into said rotary movement of said cam means.

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