Aug. 13, 1946. S. W. AVIS 2,405,871

SEWING MACHINE

Filed May 21, 1943 5 Sheets-Sheet 1

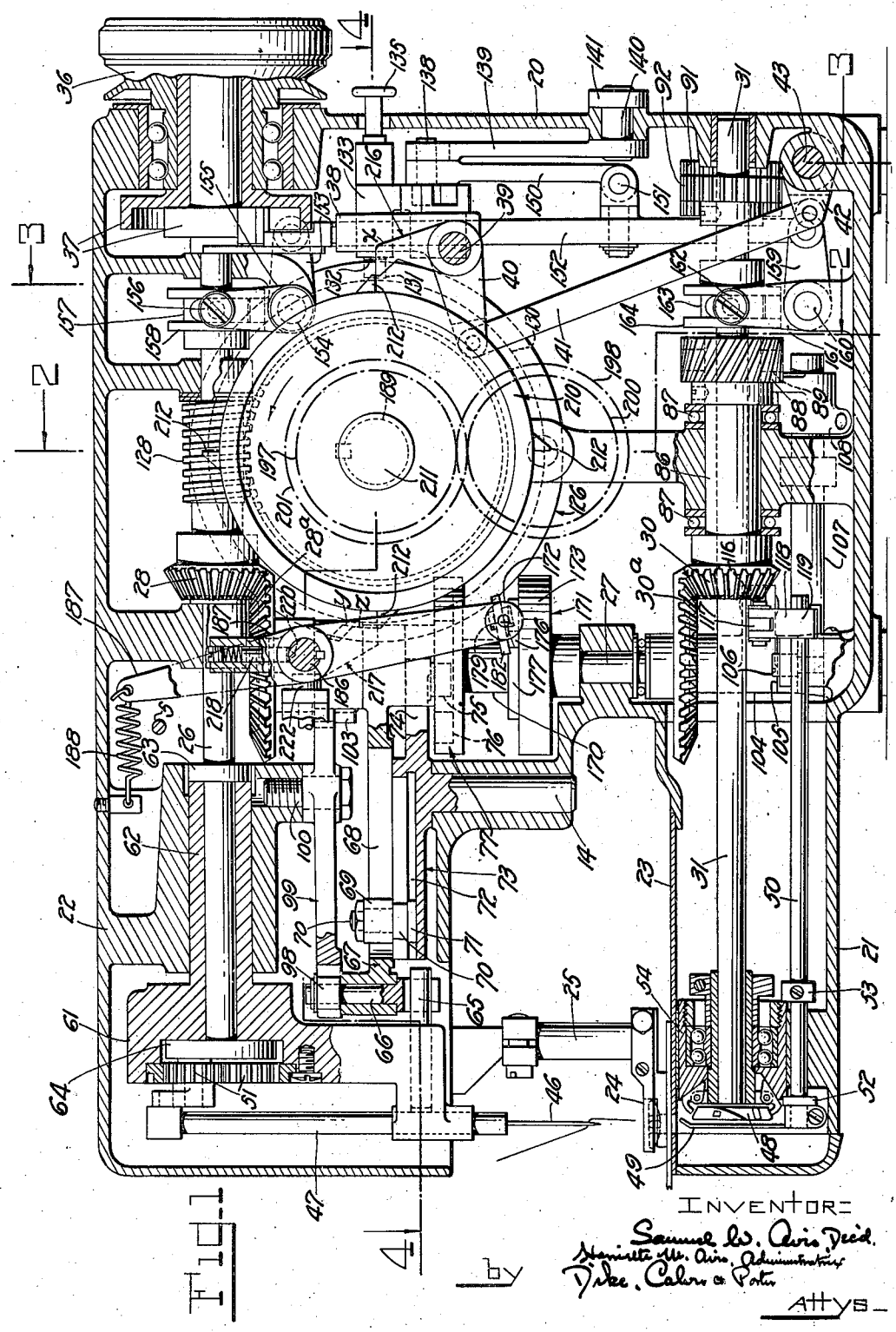


Fig. 1

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SEWING MACHINE

Filed May 21, 1943 5 Sheets-Sheet 2

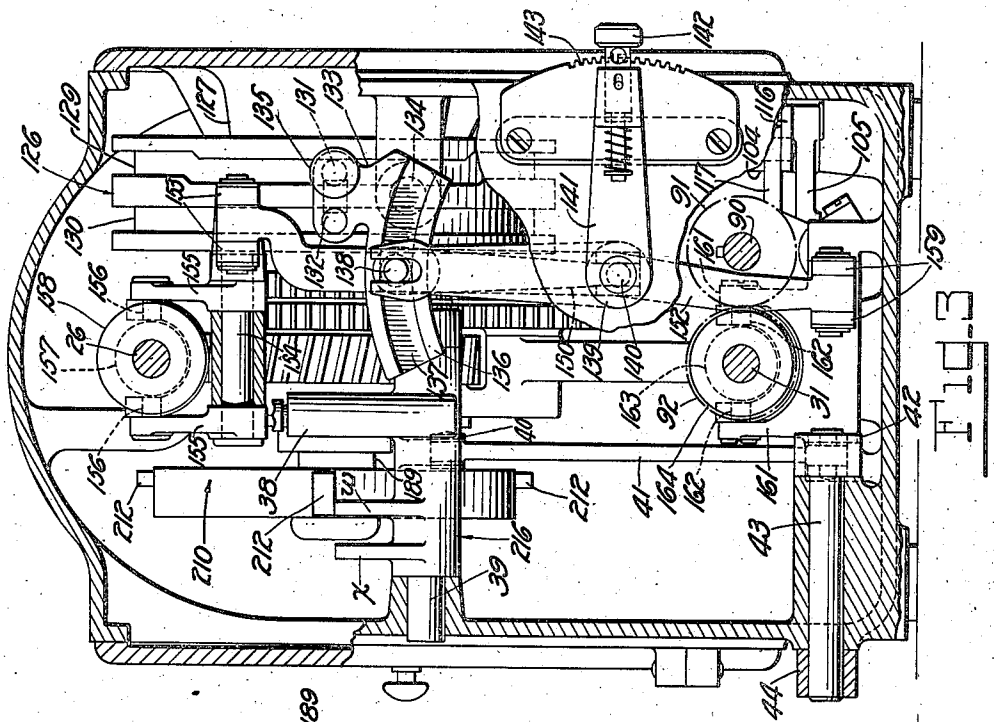


Fig. 3

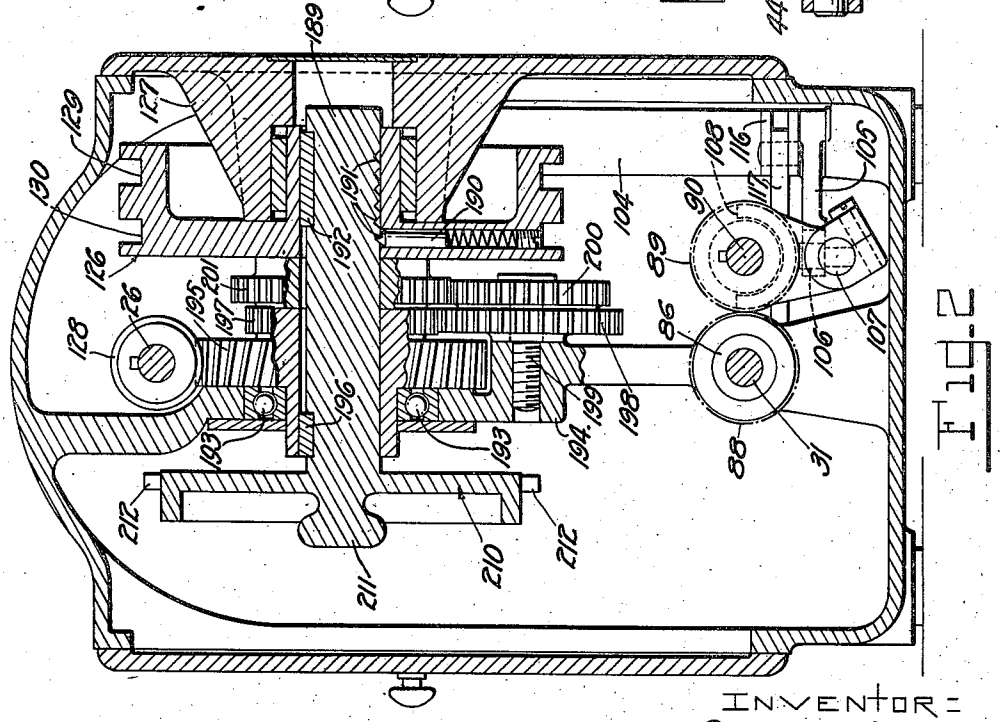


Fig. 2

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Aug. 13, 1946. S. W. AVIS 2,405,871

SEWING MACHINE

Filed May 21, 1943 5 Sheets-Sheet 3

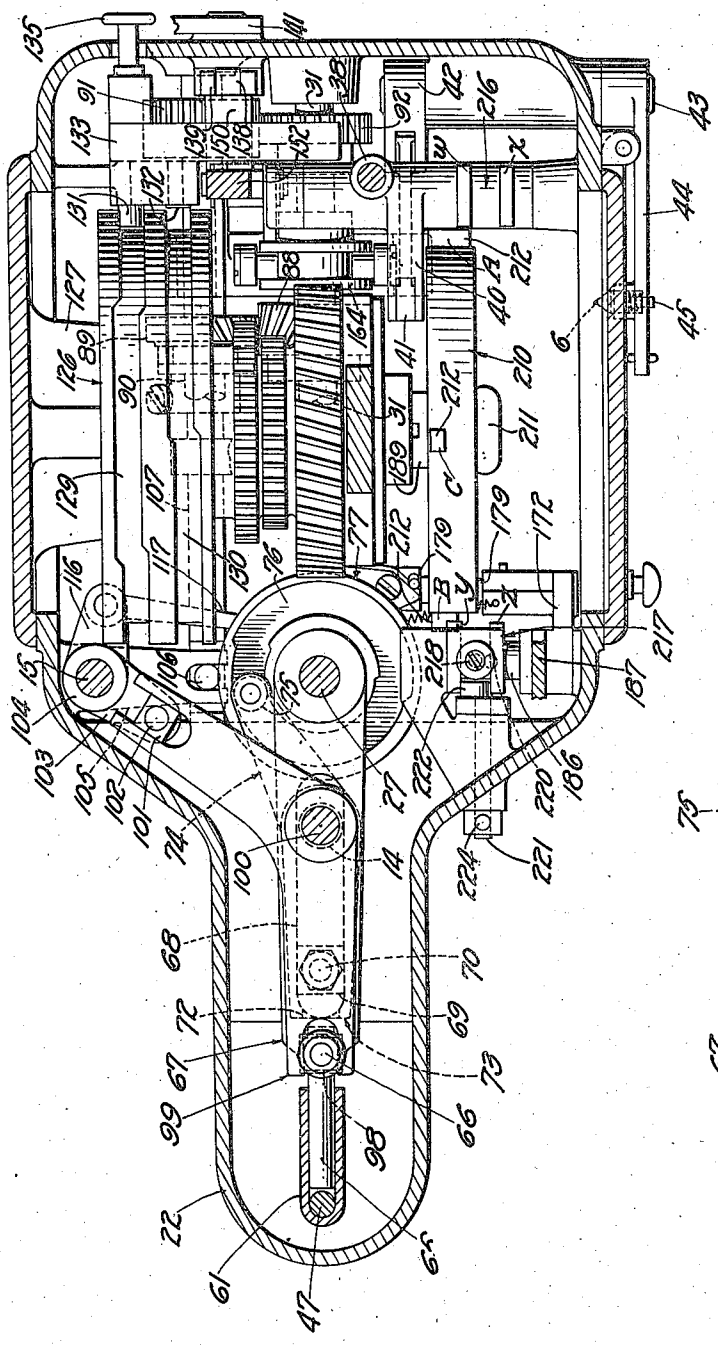


FIG. 4

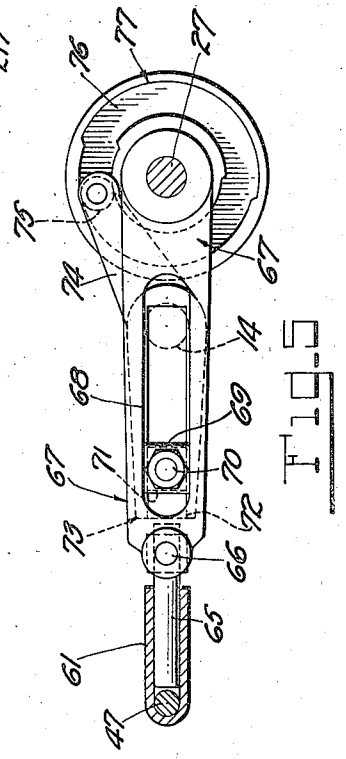


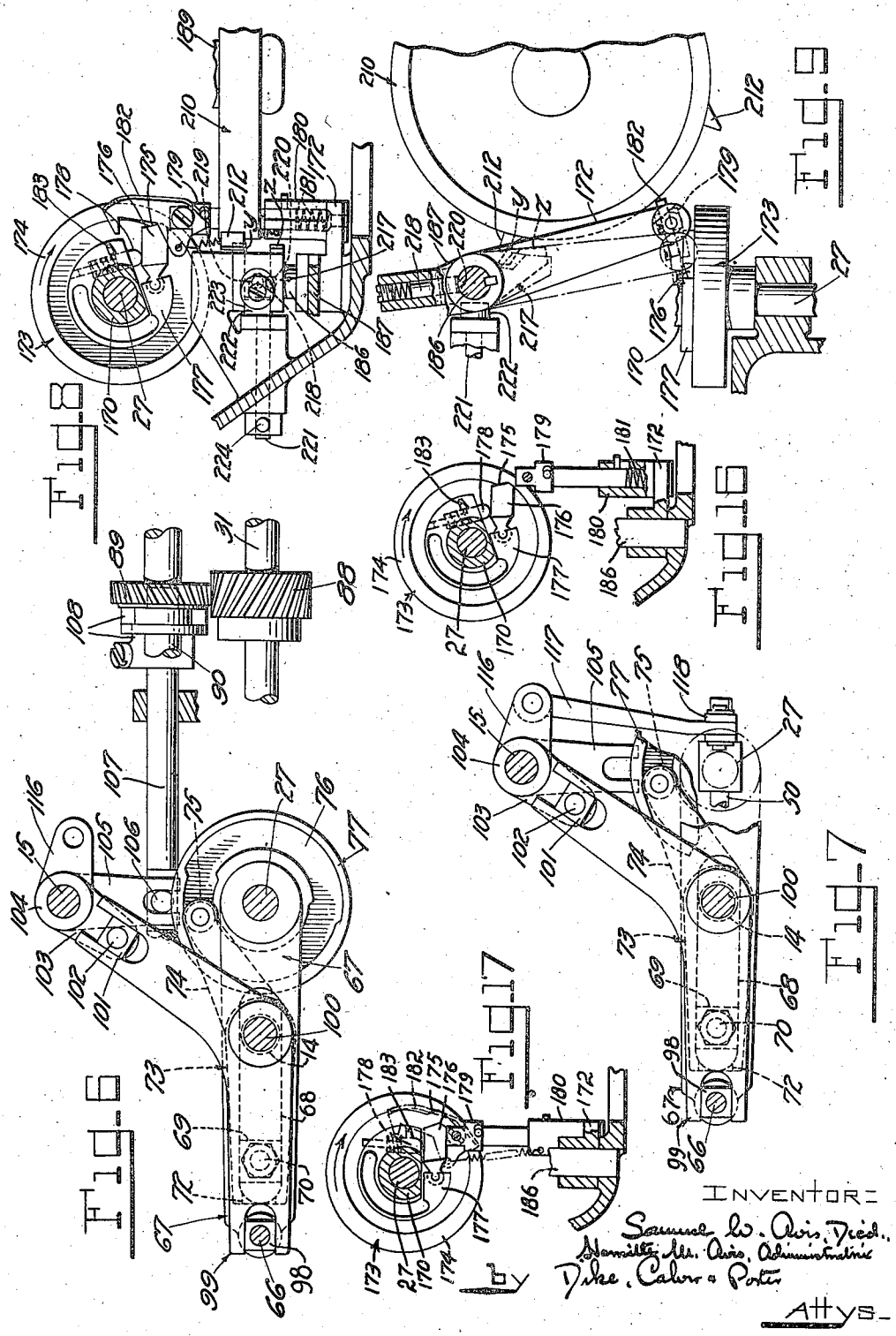
FIG. 5

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Aug. 13, 1946. S. W. AVIS 2,405,871

SEWING MACHINE

Filed May 21, 1943 5 Sheets-Sheet 4



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Aug. 13, 1946. S. W. AVIS 2,405,871

SEWING MACHINE

Filed May 21, 1943 5 Sheets-Sheet 5

Fig. 10

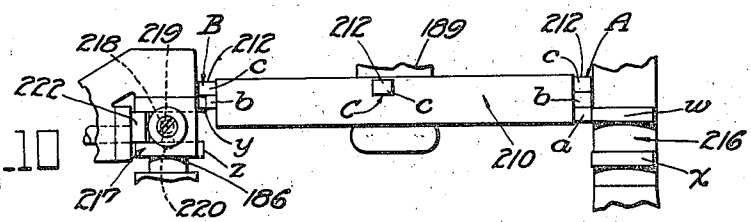


Fig. 11

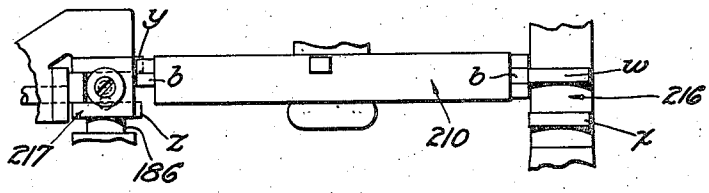


Fig. 12

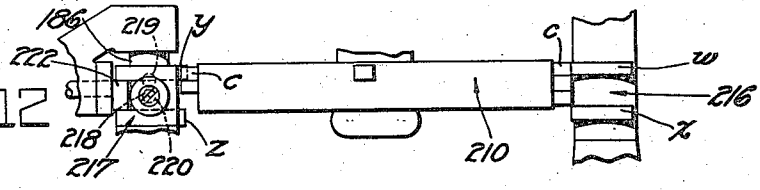


Fig. 13

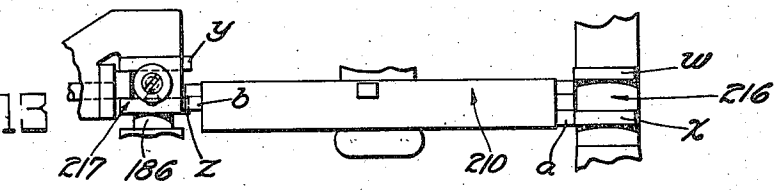


Fig. 14

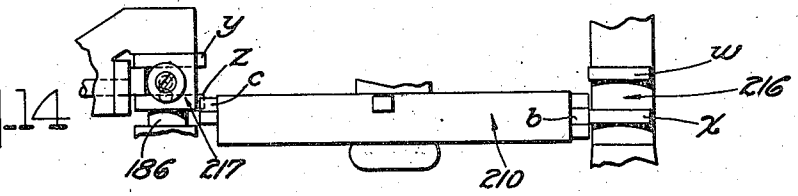
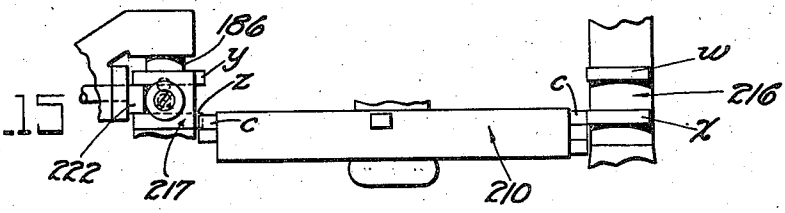


Fig. 15



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Patented Aug. 13, 1946 2,405,871

UNITED STATES PATENT OFFICE

2,405,871

SEWING MACHINE

Samuel W. Avis, deceased, late of Wellesley, Mass., by Harriette M. Avis, administratrix, Wellesley, Mass., assignor to The Reece Corporation, a corporation of Maine

Application May 21, 1943, Serial No. 487,860

32 Claims. (Cl. 112—159)

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This invention relates to sewing machines for automatically performing certain predetermined sewing operations, and especially, although not exclusively, to machines for sewing flat perforated buttons to fabrics, and has for its general object to provide a machine for automatically sewing groups of stitches, which machine, by simple adjustments, can be so set as to vary, within wide limits, the numbers of stitches in each group, the number of groups, and the relative positioning of the latter, the capacity of the machine for adjustment and variability in these respects being greater than that of any similar prior machine of which the inventor is aware.

A machine, for example, for sewing flat perforated buttons usually comprises stitch forming mechanism including a needle and a cooperating looper or the equivalent, mechanism for relatively vibrating the needle and work to cause the needle to pass alternately through the several holes of a pair to form a group of a predetermined number of attaching stitches and thereafter to pass two or more times through the same hole to form a tying stitch to complete the group, and, for the purpose of sewing a four hole button, mechanism for relatively shifting the stitch forming mechanism and work after the completion of a group of stitches through one pair of holes to cause the formation of a similar group through the other pair, together with means for automatically stopping the machine after the completion of one or more groups. In prior machines of this type, the vibrating means has usually included a cam the shape of which determined the number of stitches in each group, that is to say, the number of attaching stitches formed before the completion of a group by a tying stitch, so that differently shaped cams were necessary for different stitch groups, and possibility of variation in this respect was sharply limited except by removing and replacing the cam. The same has been true of the means for relatively shifting the stitch forming mechanism and the work to change the stitching position. In accordance with the present invention a machine is provided which, by a simple adjustment, will automatically sew a wide variety of stitch groups, each completed by a tying stitch, by the use of a single vibrating cam of fixed shape, and will cause relative shifting of the stitch forming mechanism and the work after the completion of stitch groups of a wide variety of number of stitches each. The particular machine hereinafter described is designed to be adjusted or set to sew automatically either one or two groups of

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six, eight, twelve, or sixteen stitches each, to complete each group by a tying stitch, and, when two groups are sewn, to place these either in one pair of holes of a two hole button or in the two pairs of holes of a four hole button. It will be obvious, however, that this design can be modified to provide for a greater or smaller number of possible stitch groups of a greater or smaller number of stitches each.

The invention further relates to machines of the type wherein the vibrating movement to cause the needle to pass alternately through different holes in the button is imparted to the needle, as distinguished from the work, and wherein the under thread handling means comprises a rotary loop taker, and, in this connection, has for its object to provide mechanism whereby the proper cooperation of the under thread handling means with the needle in different lateral positions of the latter is insured. To this end the stitch forming mechanism comprises a needle, a rotary loop taker, and a loop deflector, together with means, operated by a single cam or the equivalent, for vibrating the needle, alternately advancing and retarding the loop taker, and operating the loop deflector, such unitary control making certain the proper relative timing of the several movements.

While the invention is particularly applicable to machines for sewing flat perforated buttons, certain features thereof may be employed to equal advantage in other sewing machines such, for example, as tacking machines and machines for attaching articles other than flat buttons.

The invention will best be understood from the following description of a preferred embodiment thereof illustrated in the accompanying drawings, this, however having been chosen for purposes of exemplification merely, it being obvious that said invention, as defined by the claims hereunto appended, may be otherwise embodied without departure from the spirit and scope thereof.

In said drawings:

Fig. 1 is a substantially central, longitudinal, vertical section of the machine.

Fig. 2 is a vertical transverse section taken substantially on the line 2—2, Fig. 1.

Fig. 3 is a rear end elevation partly broken away and showing some of the parts in section taken substantially on the line 3—3 of Fig. 1.

Fig. 4 is a horizontal section taken substantially on the line 4—4, Fig. 1.

Fig. 5 is a fragmentary plan view of the needle vibrating mechanism.

Fig. 6 is a similar view of the looper advancing and retarding mechanism.

Fig. 7 is a similar view of a portion of the loop deflector operating mechanism.

Fig. 8 is a fragmentary plan view, partly in section, and Fig. 9 a similar elevation of the stop mechanism for the needle vibrating cam and the controlling devices therefor.

Figs. 10 to 15 are fragmentary plan views of the stop mechanism control, showing different adjustments.

Figs. 16 and 17 are simplified fragmentary plan views similar to Fig. 8, showing the stop mechanism for the needle vibrating cam in running and stopping position, respectively.

The machine herein shown is of the general type described in the Reece Patent No. 2,158,199, May 16, 1939, wherein the work is held stationary and all of the movements necessary in sewing a two-hole or a four-hole button are imparted to the stitch-forming instrumentalities.

The frame of the machine comprises an upright hollow casing 20 having at the bottom a forwardly projecting hollow horn 21 and at the top an overhanging hollow head 22. The said frame or casing, together with certain minor attached parts, is such as to afford the necessary enclosures, supports, bearings, etc., for the various moving parts.

The horn 21 carries a work plate 23 upon which the fabric to which the buttons are to be attached is supported and against which it is clamped by a presser foot having associated therewith a button clamp 24 for holding the individual buttons and positioning them for the operation of the sewing instrumentalities. Said presser foot and button clamp are carried by a spring pressed presser foot bar 25 arranged and operated in any suitable manner, for example, as shown in the Reece patent above referred to.

The main driving instrumentalities include a main or needle shaft 26 journalled in bearings in the upper part of the casing 20 and head 22, a vertical cam shaft 27 driven through beveled gears 28 and 28*a* from the shaft 26, and a looper shaft 31 journalled in bearings in the bottom of the casing, extending into the hollow horn 21, and driven through beveled gears 30 and 30*a* and other gearing hereinafter described from the cam shaft 27. Power is applied to the main shaft 26 through a belt pulley 36 and a suitable clutch and stop mechanism 37 controlled by a stop arm 38 on a rock shaft 39 in such a manner that when said stop arm is in the position shown in Fig. 1 the pulley 36 is disconnected from the shaft 26 and the machine is at rest, and when said stop arm is swung to the left (as viewed in said figure) the pulley is connected with said shaft to rotate the latter. Said stop mechanism may be of any suitable type such, for example, as that described in the above mentioned Reece patent, or as hereinafter described in connection with the stop mechanism for the needle vibrating means. The rock shaft 39 is provided with an arm 40 connected by a link 41 with an arm 42 on a second rock shaft 43 provided at the outside of the casing with an arm 44 (Figs. 3 and 4) which may be connected with a suitable starting treadle (not shown), whereby the stop arm 38 may be moved into running position to start the machine, said arm being restored to the stopping position shown by automatic controlling mechanism hereinafter described. The stop arm is yieldingly held in either of the above positions by a spring pressed positioning plunger 45 (Fig. 4) carried by the arm

44 and engageable with recesses 6 in the frame, only one of said recesses being shown.

The stitch-forming instrumentalities comprise a longitudinally reciprocating needle 46 carried by a needle bar 47, a rotary looper 48 carried by the looper shaft 31, and an oscillatory loop deflector 49 carried by a rock shaft 50. The looper 48 may be of any usual form but as shown is of the ring type described in the Kohler and Lachman Patent No. 393,766, December 4, 1888, and supported and driven by devices such as those shown in the Bolton Patent 376,364, January 10, 1888. The needle bar 47 is reciprocated from the shaft 26 through suitable connections, generally indicated at 51, which may be of any conventional type but which as herein shown are of the character described in the Reece Patent No. 2,193,344, March 12, 1940.

In the operation of the machine, the needle 46 is laterally vibrated between successive longitudinal reciprocations thereof to cause the same to pass alternately through the two holes of a pair in the button, the loop deflector 49 being simultaneously oscillated and the looper 48 alternately advanced and retarded in its rotation to cause said looper to properly enter the thread loops formed by the needle in the several lateral positions of the latter. These movements are suspended at predetermined times to cause the needle to pass twice through the same hole to form a tying stitch. In addition, in sewing a four-hole button, the stitch-forming instrumentalities (i. e., needle, looper, and loop deflector) are periodically shifted in a direction transverse to the direction of lateral vibration of the needle to cause them to sew stitches in different pairs of holes. To the latter end the shafts 26, 31 and 50 are all axially movable, having splined connections with the axially immovable power transmitting elements in driving relation therewith, including the driven member of the main clutch and stop mechanism 37. The rock shaft 50 is caused to move axially in unison with the looper shaft 31 by means of collars 52 and 53 fixed to said rock shaft and embracing the looper-carrying head 54 on the looper shaft.

The mounting of the needle bar 47 whereby the needle is given its vibrating and shifting movements is generally similar to that described in the Avis Patent No. 2,186,228, January 9, 1940. Said needle bar is guided in upper and lower arms of a yoke 61 formed on a sleeve 62 loose on the shaft 26 but held for axial movement therewith between a collar 63 and the crank disk 64 of the driving connections 51, which collar and disk are fast on said shaft. The yoke 61 carries a pin or stud 65 embraced by the forked lower end of a stud 66 carried by a lever 67 fulcrumed on the cam shaft 27. The lever 67 (Figs. 1, 4, 5, 6, and 7) is formed with a longitudinal slot 68 which receives a block 69 pivoted on a stud 70 having a head 71 adjustable in a way 72 formed in a lever 73 fulcrumed at 14 in the frame. By adjusting the head 71 in the way 72 the amplitude of movement imparted by the lever 73 to the lever 67, and by the latter to the yoke 61, can be varied. The lever 73 has an arm 74 carrying a cam follower 75 which engages a cam groove 76 in a cam 77 on the cam shaft 27. The cam groove 76 has two radially offset portions of equal length, and the ratio of the gears 28, 28*a* and 30, 30*a* is such that the cam shaft 27 is rotated at one-half the speed of the shafts 26 and 31. Consequently the yoke 61 will be rocked and the needle bar 47 moved laterally alternately in oppo-

site directions after each longitudinal reciprocation of said needle bar.

The mechanism for rotating the looper shaft 31 is shown in Figs. 1 to 4 and 6. The beveled gear 30 is carried by or formed integral with one end of a sleeve 86 loose on said shaft and rotatable in bearings 87 by which it is held against axial movement. Secured to the opposite end of the sleeve 86 is a spiral gear 88 which meshes with a spiral gear 89 splined on a countershaft 90 for movement longitudinally thereof, said countershaft being journalled in suitable bearings in the frame. Fixed to the countershaft 90 is a spur gear 91 which meshes with a spur gear 92 fast on the looper shaft 31. By the foregoing connections the looper shaft 31 is continuously rotated, while, by moving the spiral gear 89 axially of the countershaft 90, the angular position of the looper 48 with respect to that of the looper shaft may be advanced or retarded, as more fully explained in the Avis Patent No. 2,250,696, July 29, 1941.

Referring to Figs. 1, 4, 6 and 7, the stud 66 carries at its upper end a pivoted block 98 embraced by the forked end of a lever 99 pivoted at 100 to the frame, and the other arm of which is likewise formed with a forked end embracing a block 101 pivoted on a stud 102 carried by an arm 103 on a vertical rocking sleeve 104 (see also Figs. 1 and 2) carried by an upright rod 15 suitably secured in the frame. At its lower end the sleeve 104 has an arm 105 the forked end of which embraces a stud 106 carried by one end of a link 107 suitably guided in the frame for longitudinal movement. The link 107 carries a fork 108 engaging a groove in the hub of the spiral gear 89, whereby the latter is moved axially of the countershaft 90 to advance or retard the looper as above explained. The rocking sleeve 104 is provided adjacent its lower end with a second arm 116 (Fig. 7) connected by a link 117 (see also Fig. 1) with a bifurcated arm 118 on a hub 119 splined to the rock shaft 50, whereby said rock shaft and the loop deflector 49 are oscillated. It will be observed that the lateral vibration of the needle, the advance and retardation of the looper, and the oscillation of the loop deflector are all produced by the single cam 77, and that the amplitude of these movements is simultaneously varied by the adjustment of the single stud 70, thereby insuring the proper coordination of these movements.

Referring to Figs. 2 to 4 the shafts 26 and 31 are moved axially to shift the stitch-forming devices for the purpose of causing the latter to place stitches in different pairs of holes in a button by means of a cam 126 journalled in bearings in a boss 127 on the wall of the casing and driven, as hereinafter more fully described, from a worm 128 (see also Fig. 1) formed on a sleeve secured to or integral with the beveled gear 28. The cam 126 is formed on its periphery with two cam grooves 129 and 130 shaped respectively to produce shifting movements after a 90° or a 180° movement of said cam. Cooperating with the grooves 129 and 130 are alternatively operative cam follower pins 131 and 132 carried by a lever 133 fulcrumed at 134 in the machine frame. The cam follower pins 131 and 132 are so interconnected, as described, for example, in the Avis Patent No. 2,158,171, May 16, 1939, that when one of said pins is engaged with its groove the other will be disengaged, and vice versa, and for convenience of operation one of said pins may be provided with an operating handle 135 (Figs. 1 and 4) accessible from the exterior of the casing. The lever 133 has an arm 136 formed with an arcuate groove 137 in which is adjustably mounted a stud 138. By adjusting said stud in said groove the amplitude of the movement imparted to parts connected by said stud with the lever 133 can be varied in accordance with the spacing of the pairs of holes in the button, and the groove 137 is of such length that the stud 138 can be moved into a position coaxial with the fulcrum 134, so that no movement will be imparted to said stud, as in sewing a two-hole button. For convenience in so adjusting the stud 138 it is embraced by the forked upper end of one arm of a bell crank lever 139 pivoted at 140 in the wall of the casing and having at the exterior of the latter an arm 141 carrying a latch 142 adapted to coact with a notched segment 143.

Connected with the stud 138 is the upper end of a link 150 connected at its lower end, by a universal joint 151, with a vertically disposed link 152. At its upper end the link 152 is connected with an arm 153 on a rock shaft 154 journalled in the frame and having thereon a pair of arms 155 carrying at their ends studs 156 engaging a groove 157 in a collar 158 secured to the shaft 26. At its lower end the link 152 is connected with an arm 159 on a rock shaft 160 journalled in the frame and having thereon a pair of arms 161 carrying at their ends studs 162 engaging a groove 163 in a collar 164 secured to the shaft 31.

As above pointed out, each complete rotation of the cam 77 produces one complete lateral vibration of the needle and the corresponding movements of the looper and loop deflector, so that, by interrupting the rotation of said cam during two or more longitudinal reciprocations of the needle, said needle can be caused to pass a plurality of times through the same hole to form a tying stitch, and by varying the time of such interruption the number of attaching stitches formed in a group completed by a tying stitch can be varied at will without any change in the shape of the groove 76 in said cam. To this end, referring to Figs. 1, 8, 9, 16 and 17, the cam 77 is carried by a sleeve 170 loose on the shaft 27 and adapted to be connected for rotation therewith by a clutch and stop mechanism generally indicated at 171 and controlled by a stop arm 172. The stop mechanism 171 may be of any suitable type but as shown most clearly in Figs. 8, 16 and 17 comprises a driving disk 173 secured to the shaft 27 and having an annular flange 174 formed with a notch 175 to receive a latch or dog 176 pivoted to a driven disk 177 carried by the sleeve 170, said latch being normally urged in the direction to engage said notch by a spring pressed plunger 178. Cooperating with the latch 176 is a laterally extending finger 179 mounted in a socket 180 carried by the stop arm 172, said finger having a limited resilient yielding movement in said socket against the pressure of a spring 181. When the stop arm is in the position shown in Figs. 8 and 16, and in full lines in Fig. 9, the latch 176 is free to engage the notch 175, and the cam 77 is connected with the shaft 27 for rotation therewith. When the stop arm 172 is in the position shown in Figs. 1 and 17 and in broken lines in Fig. 9, the finger 179 is located in the path of movement of the latch 176, and, as the shaft 27 rotates in the direction of the arrow on Figs. 8, 16 and 17, engagement of the latch 176 with the finger 179 causes said latch to be disengaged from the notch 175, thereby

disconnecting the cam 77 from the shaft 27 and positively stopping said cam, as shown in Fig. 17, the stopping impact being cushioned by the yielding of said finger, and the recoil being checked to bring the cam to rest in a predetermined angular position by the engagement of a spring controlled dog 182 carried by said finger with a lug 183 on the disk 177, as shown in broken lines in Fig. 17. The stop arm 172 is keyed to a rock shaft 186 and formed with an extension 187 connected at its upper end to the frame by a spring 188 (Fig. 1) tending normally to hold the same against a stop 5 and consequently to hold the stop arm in the running position shown in full lines in Fig. 9, said stop arm being periodically moved into the stopping position by automatic controlling mechanism hereinafter described.

Referring particularly to Fig. 2, disposed coaxially within the hub of the cam 126 is a controller shaft 189 which is axially slidable into a plurality of longitudinal positions determined by engagement of a spring-pressed positioning plunger 190 carried by the cam with a series of cavities 191 formed in the shaft. As shown, there are six cavities 191, providing for six longitudinal positions of the shaft 189. The shaft 189 carries a key 192 adapted to connect the same with the cam 126 for rotation in unison therewith, said key being of sufficient length and being so disposed as to maintain the connection in all longitudinal positions of said shaft. Rotatably mounted on the shaft 189 and in bearings 193 in a frame member 194 is a worm gear 195 which meshes with the worm 128. The shaft 189 carries a second key 196 adapted, when the shaft is in its inner positions, to connect the same with the worm gear 195 for rotation in unison therewith. Secured to or formed integral with the hub of the gear 195 is a spur gear 197 which meshes with a spur gear 198 rotatable on a stud shaft 199 carried by the frame member 194. Connected with the gear 198 for rotation in unison therewith is a second spur gear 200 which meshes with a spur gear 201 loose on the shaft 189 but adapted to be connected therewith by the key 192 when the shaft is in its outer positions. The gears 197, 198, 200 and 201 constitute reduction gearing, and the arrangement is such that when the shaft 189 is in certain of its inner positions (in the present instance, three positions), said shaft will be directly connected by the key 196 with the gear 195 and will, together with the cam 126, rotate in unison therewith, and when said shaft is in certain of its outer positions (in the present instance, likewise three positions), the key 196 will be disengaged from the gear 195 and the key 192 engaged with the gear 201, whereupon said shaft and cam will be rotated at a reduced speed. The machine herein shown is so designed that when the shaft 189 is directly connected with the gear 195 said shaft will make one complete rotation during twenty-four reciprocations of the needle bar, and when driven through the reducing gearing it will make one complete rotation during thirty-two reciprocations.

Secured to or formed integral with the outer end of the shaft 189 is a controller disk 210 having associated therewith a handle 211 whereby said shaft can be conveniently adjusted into its several longitudinal positions. Disposed about the periphery of the controller disk 210 at intervals of 90° (see also Figs. 1 and 4) are four bevelled stop elements or projections 212. Said stop elements, as shown most clearly in Fig. 4, are of different lengths axially of the disk, one of said elements, designated A in Fig. 4, being of a length substantially equal to the width of the disk, another B diametrically opposite A being of a length substantially equal to two-thirds of the width of the disk, and the others C being of a length substantially equal to one-third of the width of the disk. These differently proportioned stop elements constitute, in effect, three axially spaced circumferential sets of stop elements of a different number each, as diagrammatically illustrated in Fig. 10 at *a*, *b* and *c*, the set *a* comprising only one stop element, the set *b* comprising two stop elements spaced 180°, and the set *c* comprising four stop elements spaced at 90°.

Secured to the rock shaft 39 of the stop arm 38 of the main stop mechanism 37 is a stop dog 216 adapted to cooperate with the stop elements 212 in such a manner that, when the controller 210 is rotated in the direction of the arrow in Fig. 1, engagement of a stop element with said dog will force the latter toward the right and move the stop arm 38 into stopping position, as shown in said figure. The stop dog 216 is bifurcated to provide two operative portions *w*, *x* (Figs. 4 and 12) alternatively engageable with the stop elements 212, the spacing of such portions being such that only one will be engaged by any of the stop elements in any longitudinal adjustment of the shaft 189 and controller 210, as will be obvious from Figs. 10 to 15. Splined on the shaft 186 for a limited longitudinal movement thereon into the inner and outer positions shown, for example, in Figs. 11 and 12, respectively, is a similar stop dog 217, said dog being yieldingly retained in said positions by a spring pressed plunger 218 carried thereby with a pair of cavities 219 and 220 in the shaft 186, and being movable from one of said positions to the other by a spindle 221 journalled in the casing wall and having an eccentric pin 222 engaging a groove 223 in the dog, said spindle having at the exterior of the casing an operating handle 224 by which it can conveniently be turned. The stop dog 217 is likewise bifurcated to form operative portions *y* and *z* (Figs. 12 and 13) spaced similarly to the portions *w* and *x* of the dog 216 and adapted to be alternatively engaged by the stop elements 212 to force the stop arm 172 for the vibrating means stop mechanism 171 into stopping position against the tension of the spring 183, as shown in Fig. 1. The operative faces of the engaging portions *y* and *z* are of sufficient length to hold the stop mechanism disengaged for the period necessary to cause the needle to make two or more strokes in the formation of a tying stitch and inasmuch as the portion *z* is operative when the parts are adjusted to turn the cam 126 and controller 210 at a relatively slow speed, the face of said portion may be somewhat shorter than the face of the portion *y*. It will, of course, be understood that the arrangement is such that a stop element 212 will traverse the face of an engaging portion of the dog 217 before the dog 216 is moved far enough by a stop element to operate the main stop mechanism 37, as will be clear from Fig. 1, so that a tying stitch will be completed before the machine is stopped.

In Fig. 10, the shaft 189 and controller disk 210 are shown in their innermost position, in Fig. 15 in their outermost position, and in Figs. 11 to 14 inclusive in four intermediate positions. In the positions shown in Figs. 10, 11 and 12 the shaft 189 is directly connected with the gear 195,

and in Figs. 13, 14 and 15 it is connected to be driven through the reduction gearing.

With the parts adjusted as shown in Fig. 10, (the dog 217 being in its inner position) the stop element *a* is in a position to cooperate with the portion *w* of the main stop mechanism dog 216, and the stop elements of the set *b* are in a position to cooperate with the portion *y* of the vibrating means stop mechainsm dog 217. The machine will therefore stop after one complete rotation of the controller disk 210 and cam 126, and stop mechanism 171 will be operated just prior to each 180° movement of said parts. Consequently, the machine will sew two groups of stitches of twelve stitches each, each group being completed by a tying stitch, and if the cam follower 132 is engaged with the cam groove 130, and the stud 138 properly adjusted in the groove 137 in accordance with the hole spacing, these two groups of stitches will be sewn through the two pairs of holes in a four-hole button.

With the parts adjusted as shown in Fig. 11, the stop elements of the set *b* are in position to engage the portion *w* of the dog 216 and the stop elements of the set *c* in position to engage the portion *y* of the dog 217. The machine will therefore stop after a 180° movement of the controller disk 210 and cam 126, and the vibrating stop mechanism will be operated just prior to the completion of each movement of 90° of said parts. Consequently, the machine will sew two groups of six stitches each, each group being completed by a tying stitch, and if the cam follower pin 131 is engaged with the cam groove 129 and the stud 138 properly adjusted in the groove 137, these two groups of stitches will be sewn through the two pairs of holes of a four-hole button.

When the controller disk is in the position shown in Fig. 12, and the stop dog 217 moved into its outer position as also shown in said figure, the portions *w* and *y* of the dogs 216 and 217 will both be engaged by the stop elements of the set *c*, and the machine will sew one group of six stitches completed by a tying stitch and stop. Since only one group of stitches is sewn, as through one pair of holes in a two-hole button, the stud 138 will at this time be adjusted into a position coaxial with the fulcrum 134.

With the parts adjusted into the position shown in Fig. 13 (the stop dog 217 being returned to its inner position) the stop element *a* is in position to engage the portion *x* of the dog 216, the stop elements of the set *b* are in a position to engage the portion *z* of the stop dog 217, and the shaft 189 is connected for the reduced speed drive. The machine will, therefore, sew two groups of stitches of sixteen stitches each, each group being completed by a tying stitch, and with the cam follower 132 and stud 138 adjusted as above described in connection with Fig. 10, these two groups of stitches will be sewn through the two pairs of holes in a four-hole button.

With the parts in the position shown in Fig. 14, the stop elements of the set *b* are in position to engage the portion *x* of the dog 216, and the stop elements of the set *c* in position to engage the portion *z* of the dog 217. The machine will then sew two groups of stitches of eight stitches each, each group completed by a tying stitch, and if the cam follower 131 and stud 138 are adjusted as above described in connection with Fig. 11, these two groups will be sewn through the two pairs of holes of a four-hole button.

With the controller disk in the position shown in Fig. 15, and the dog 217 again adjusted into its outer position, the stop elements of the set *c* will engage both the portion *x* of the dog 216 and the portion *z* of the dog 217, and the machine will sew one group of eight stitches completed by a tying stitch, the stud 138 being adjusted into the coaxial position above referred to in connection with Fig. 12.

In addition to the above adjustments, if the controller disk be in the position shown in Fig. 11, and the stop dog 217 moved into its outer position, the stop elements of the set *b* will be in a position to engage both the portion *w* of the dog 216 and the portion *y* of the dog 217, so that the machine will sew one group of twelve stitches completed by a tying stitch and stop, the stud 138 being at this time adjusted into its coaxial position. Similarly with the controller disk in the position shown in Fig. 14, and the dog 217 in its outer position, the machine will sew one group of sixteen stitches completed by a tying stitch. It will thus be seen that for sewing one group of stitches through one pair of holes of a two-hole button, the dog 217 is adjusted into its outer position and the stud 138 adjusted into a position coaxial with the fulcrum 134, whereas for sewing two groups of stitches through the two pairs of holes of a four-hole button, the stop dog 217 is adjusted into its inner position and the stud 138 adjusted in the groove 130 at an appropriate distance from the fulcrum 134.

Other variations in the character of the work done are possible. For example, with the parts in the positions shown in Figs. 10, 11, 13 and 14, and the pin 138 moved into the coaxial position, the machine will sew, through the same pair of holes, two groups of stitches each completed by a tying stitch.

What is claimed is:

1. In a sewing machine having driving means and stitch forming mechanism including a longitudinally reciprocating and laterally vibratory needle, a cooperating looper, and a loop deflector, a common actuator and connections for vibrating said needle laterally and operating said loop deflector, and connections for operating said actuator from said driving means.

2. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating and laterally vibratory needle, a cooperating rotary looper, and a loop deflector, and a single cam and connections operated thereby for vibrating said needle laterally, angularly advancing and retarding said looper, and operating said loop deflector.

3. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, and means for automatically suspending the operation of said vibrating means including a controller and means for moving said controller at a variable speed with respect to the speed of reciprocation of said needle.

4. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, and means for automatically suspending the operation of said vibrating means including a controller adjustable to cause suspension after a variable movement thereof, and means for moving said controller at

a variable speed with respect to the speed of reciprocation of said needle.

5. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter in one direction, means for automatically suspending the operation of said vibrating means including a controller and means for moving said controller at a variable speed with respect to the speed of reciprocation of said needle, and means operating at a constant speed with respect to the speed of movement of said controller for relatively shifting said work holding means and needle transversely of the latter in another direction.

6. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, a cam and connections for relatively vibrating said work holding means and needle transversely of the latter, an actuator for said cam operated at a constant speed with respect to the speed of reciprocation of said needle, and automatic stop mechanism for disconnecting said cam from its actuator and stopping the same while the reciprocation of the needle continues.

7. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, a cam and connections for relatively vibrating said work holding means and needle transversely of the latter, an actuator for said cam operated at a constant speed with respect to the speed of reciprocation of said needle, and automatic stop mechanism for disconnecting said cam from its actuator and stopping the same while the reciprocation of the needle continues, said stop mechanism being adjustable to stop said cam after a variable number of reciprocations of said needle.

8. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, a cam and connections for relatively vibrating said work holding means and needle transversely of the latter in one direction, a second cam and connections for relatively shifting said work holding means and needle transversely of the latter in another direction, an actuator for said first named cam operated at a constant speed with respect to the speed of reciprocation of the needle, stop mechanism for disconnecting said first named cam from its actuator and stopping the same, a controller for said stop mechanism, and means for operating said controller and second cam at a constant relative speed which is variable with respect to the speed of operation of said actuator.

9. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, means for reciprocating said needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, stop mechanism for stopping said vibrating means while the reciprocation of the needle continues, and a controller for said stop mechanism having a plurality of sets of differently spaced stop elements, said controller being adjustable to render the several sets selectively operative to operate said stop mechanism.

10. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, stop mechanism for said vibrating means, a controller for said stop mechanism having a plurality of sets of differently spaced stop elements, said controller being adjustable to render the several sets selectively operative to operate said stop mechanism, and means for moving said controller at a variable speed with respect to the speed of reciprocation of said needle.

11. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, stop mechanism for said vibrating means, a controller for said stop mechanism having a plurality of sets of differently spaced stop elements, and a stop dog for causing operation of said stop mechanism and having a plurality of operative portions engageable by said stop elements, said controller being adjustable to bring the several sets of stop elements into position to engage the several portions of said dog.

12. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, means for reciprocating said needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, stop mechanism for stopping said vibrating means while the reciprocation of the needle continues, a controller for said stop mechanism having a plurality of sets of differently spaced stop elements, and a stop dog for causing operation of said stop mechanism and adjustable to cause the same to be selectively engaged by the several sets of stop elements.

13. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, stop mechanism for said vibrating means, a controller for said stop mechanism having a plurality of sets of differently spaced stop elements, and a stop dog for causing operation of said stop mechanism, said controller and dog being both adjustable to cause said dog to be selectively engaged by the several sets of stop elements.

14. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, stop mechanism for said vibrating means, a controller for said stop mechanism having a plurality of sets of differently spaced stop elements, and a stop dog for causing operation of said stop mechanism and having a plurality of operative portions engageable by said stop elements, said controller and dog being both adjustable to bring the several sets of stop elements selectively into position to engage the several portions of said dog.

15. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, a main stop mechanism for said machine, a stop mechanism for said vibrating means, and a common controller for said stop mechanisms.

16. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, a main stop mechanism for said machine, a stop mechanism for said vibrating means, and a common controller for said

stop mechanisms, said controller being adjustable to cause operation of the several stop mechanisms at variable times.

17. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, a main stop mechanism for said machine, a stop mechanism for said vibrating means, a common controller for said stop mechanisms, and means for moving said controller at a variable speed with respect to the speed of reciprocation of said needle.

18. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, a main stop mechanism for said machine, a stop mechanism for said vibrating means, and a common controller for said stop mechanisms having a plurality of sets of differently spaced stop elements, said controller being adjustable to render the several sets selectively operative to operate the respective stop mechanisms.

19. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter in one direction, a main stop mechanism for said machine, a stop mechanism for said vibrating means, a common controller for said stop mechanisms, means for moving said controller at a predetermined speed with respect to the speed of reciprocation of said needle, and means operating at a constant speed with respect to the speed of movement of said controller for relatively shifting said work holding means and needle transversely to the latter in another direction.

20. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter in one direction, a main stop mechanism for said machine, a stop mechanism for said vibrating means, a common controller for said stop mechanisms, means for moving said controller at a variable speed with respect to the speed of reciprocation of said needle, and means operating at a constant speed with respect to the speed of movement of said controller for relatively shifting said work holding means and needle transversely to the latter in another direction.

21. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, a main stop mechanism for said machine, a stop mechanism for said vibrating means, a common controller for said stop mechanisms having a plurality of sets of differently spaced stop elements, and a pair of dogs for causing operation of said stop mechanisms respectively, each of said dogs having a plurality of operative portions, said controller being adjustable to bring the several sets of stop elements selectively into position to engage the several portions of the respective dogs.

22. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, a main stop mechanism for said machine, a stop mechanism for said vibrating means, a common controller for said stop mechanisms having a plurality of sets of differently spaced stop elements, and a pair of dogs for causing operation of said stop mechanisms respectively, at least one of said dogs being adjustable to cause the same to be selectively engaged by the several sets of stop elements.

23. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, a main stop mechanism for said machine, a stop mechanism for said vibrating means, a common controller for said stop mechanisms having a plurality of sets of differently spaced stop elements, and a pair of dogs for causing operation of said stop mechanisms respectively, the dog for causing operation of the stop mechanism for said vibrating means being adjustable to cause the same to be selectively engaged by the several sets of stop elements.

24. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, a main stop mechanism for said machine, a stop mechanism for said vibrating means, a common controller for said stop mechanisms having a plurality of sets of differently spaced stop elements, and a pair of dogs for causing operation of said stop mechanisms respectively, said controller and at least one of said dogs being both adjustable to cause said dogs to be selectively engaged by the several sets of stop elements.

25. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, a main stop mechanism for said machine, a stop mechanism for said vibrating means, a common controller for said stop mechanisms having a plurality of sets of differently spaced stop elements, and a pair of dogs for causing operation of said stop mechanisms respectively, each of said dogs having a plurality of operative portions said controller and the dog for causing operation of the stop mechanism for said vibrating means being both adjustable to bring the several sets of stop elements selectively into position to engage the several portions of the respective dogs.

26. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, stop mechanism for said vibrating means, a controller for said stop mechanism having a plurality of sets of differently spaced stop elements, and variable speed mechanism for driving said controller, said controller being adjustable to set said variable speed mechanism and to render the several sets of stop elements thereon selectively operative to operate said stop mechanism.

27. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, stop mechanism for said vibrating means, a controller for said stop mechanism having a plurality of sets of differently spaced stop elements, a stop dog for causing operation of said stop mechanism, and variable

speed mechanism for driving said controller, said controller being adjustable to set said variable speed mechanism and to render the several sets of stop elements thereon selectively operative to engage said dog, said dog having a plurality of operative portions engageable respectively by said elements in accordance with the setting of said variable speed mechanism.

28. In a sewing machine, stitch forming mechanism including a longitudinally reciprocating needle, work holding means, means for relatively vibrating said work holding means and needle transversely of the latter, stop mechanism for said vibrating means, a controller for said stop mechanism having a plurality of sets of differently spaced stop elements, a stop dog for causing operation of said stop mechanism, and variable speed mechanism for driving said controller, said controller being adjustable to set said variable speed mechanism and to render the several sets of stop elements thereon selectively operative to engage said dog, said dog having a plurality of operative portions engageable respectively by said elements in accordance with the setting of said variable speed mechanism, and said dog being itself adjustable to further control the engagement of the portions thereof by said elements.

29. In a sewing machine, stitch forming mechanism, work holding means, and means for relatively shifting said stitch forming mechanism and work holding means to cause the former to form in the work separated groups of stitches in different positions, said shifting means including a controlling element having provision for causing shifting from one stitch forming position to another at different times during a given movement of said element.

30. In a sewing machine, stitch forming mechanism, work holding means, and means for relatively shifting said stitch forming mechanism and work holding means to cause the former to form in the work separated groups of stitches in different positions, said shifting means including a controlling element having alternatively operative portions for causing shifting from one stitch forming position to another at different times during a given movement of said element.

31. In a sewing machine, stitch forming mechanism, work holding means, and means for relatively shifting said stitch forming mechanism and work holding means to cause the former to form in the work separated groups of stitches in different positions, said shifting means including a cam having a plurality of cam surfaces adapted respectively to cause shifting from one stitch forming position to another at different times during a given movement of said cam.

32. In a sewing machine, stitch forming mechanism, work holding means, and means for relatively shifting said stitch forming mechanism and work holding means to cause the former to form stitches at different points in the work, said shifting means including a controlling element having alternatively operative portions for causing shifting at different times during a given movement thereof, and means for moving said element at a variable speed with respect to the speed of operation of said stitch forming mechanism.

HARRIETTE M. AVIS,
Administratrix of the Estate of Samuel W. Avis, Deceased.