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**Chuo-ku, Tokyo, Japan**  
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 [33] **Japan**  
 [31] **43/76821**

[56]

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[54] **ATTACHMENT FOR EMBROIDERING INITIAL LETTERS, PATTERNS AND THE LIKE IN A ZIGZAG SEWING MACHINE**  
 9 Claims, 15 Drawing Figs.

[52] U.S. CL..... **112/102**  
 [51] Int. CL..... **D05c 3/02**  
 [50] Field of Search..... **112/102,**  
**77, 98, 103, 158**

**ABSTRACT:** For embroidering initial letters and/or patterns by means of a zigzag sewing machine an attachment is fixed on the upper surface of the bed plate of a zigzag sewing machine for domestic use, and an oblong cam plate is actuated by making use of vertical motion of the needle bar. An embroidery frame carrying cloth is moved past the needle by means of a mechanism interlocking with said cam plate, thus embroidering initial letters and/or patterns.

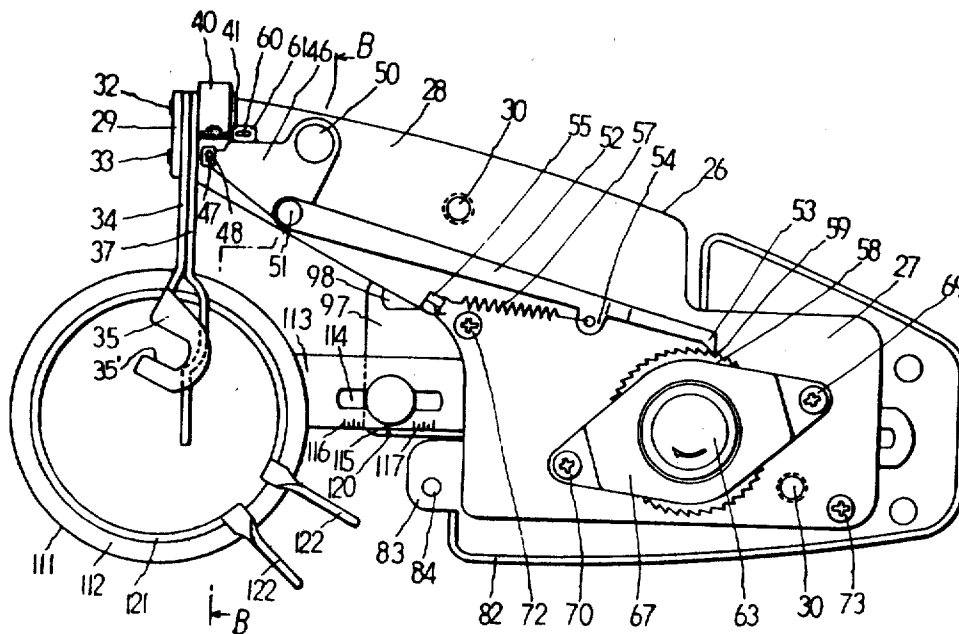


FIG 1

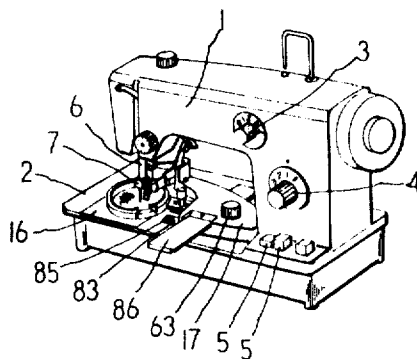
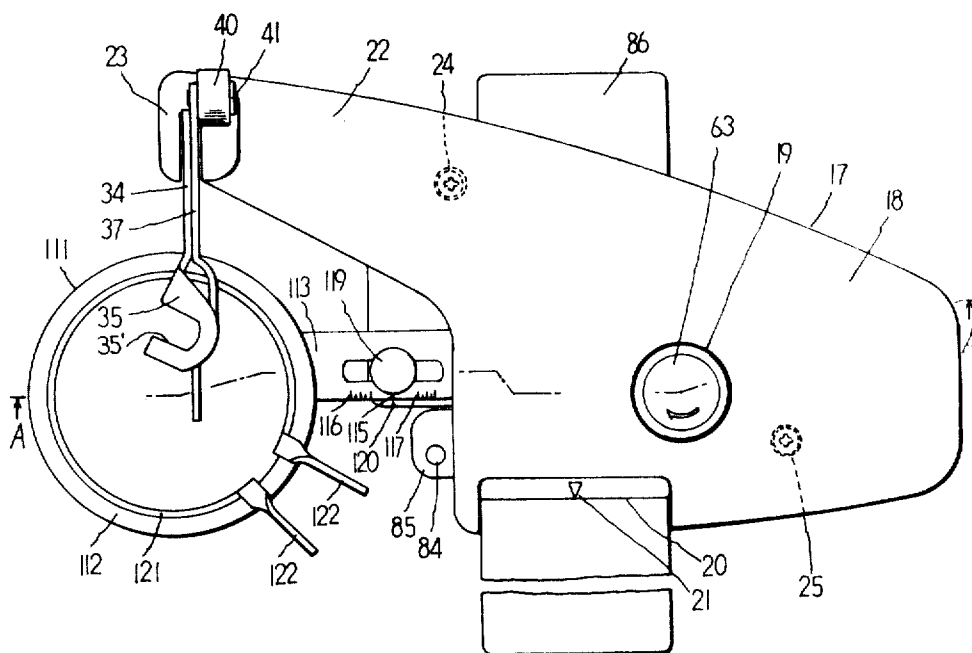


FIG 2



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FIG 3

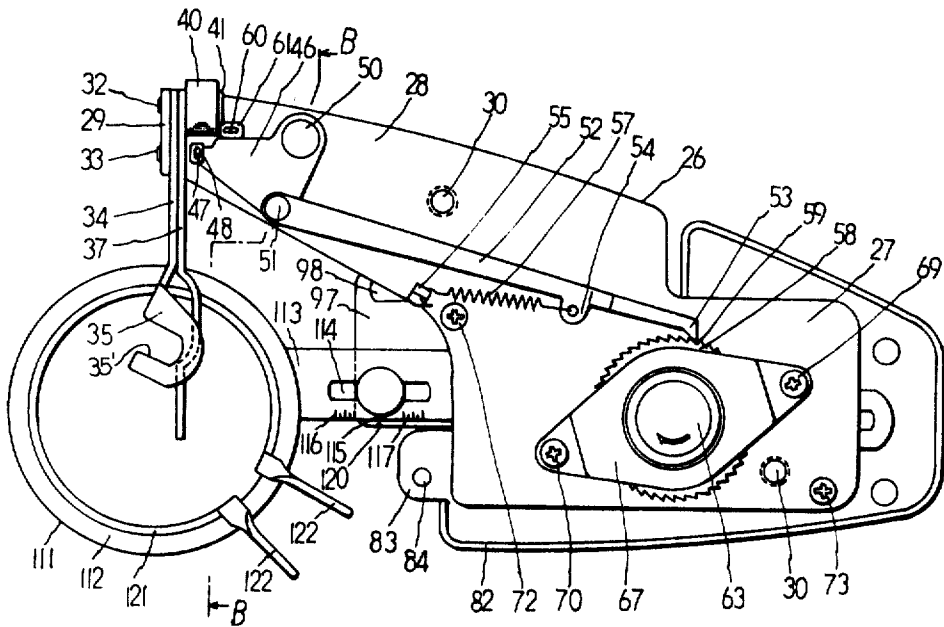
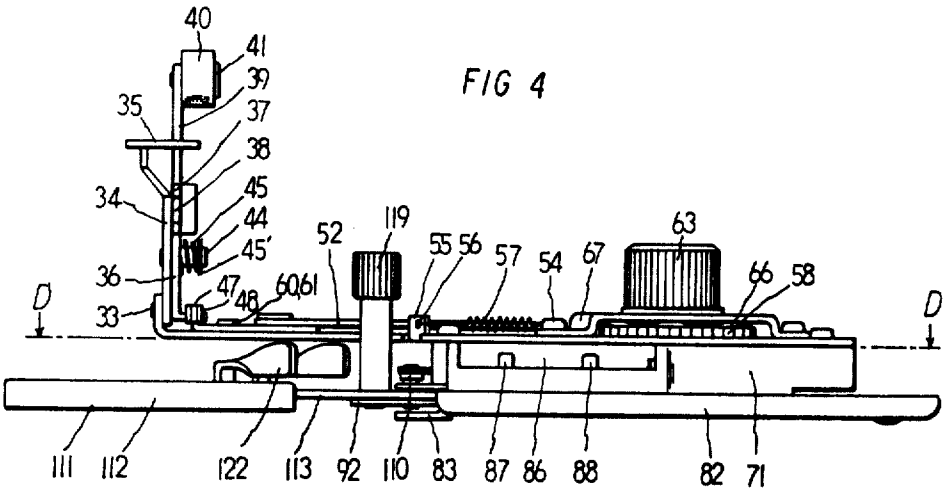
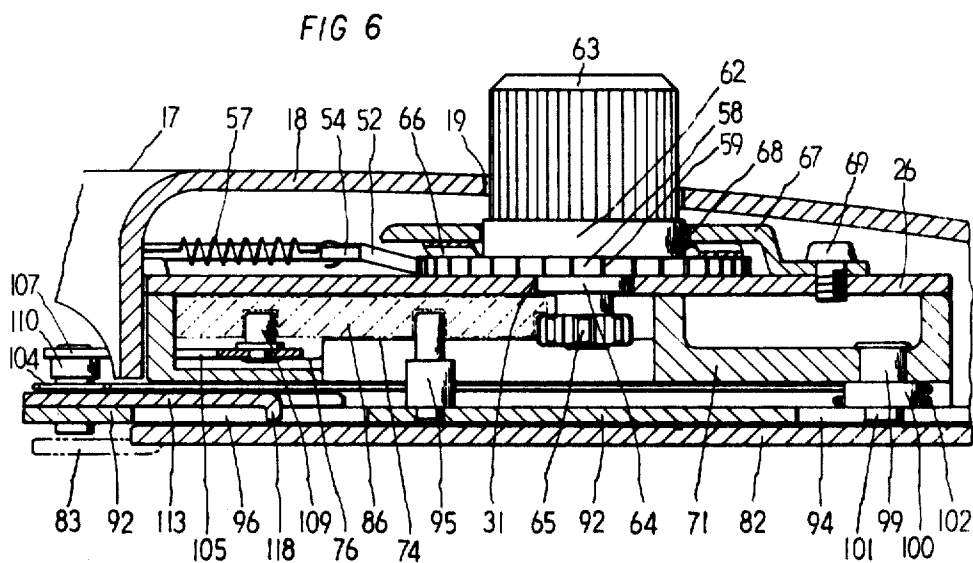
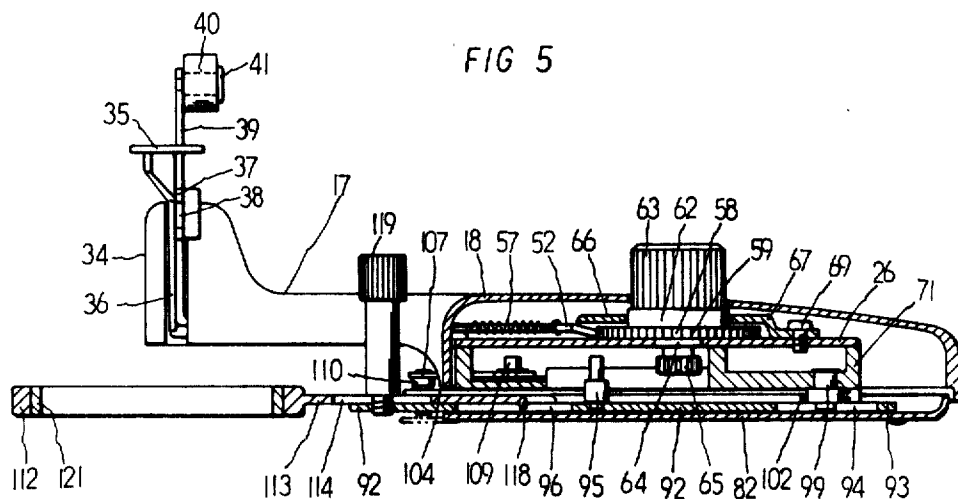


FIG 4



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FIG 7

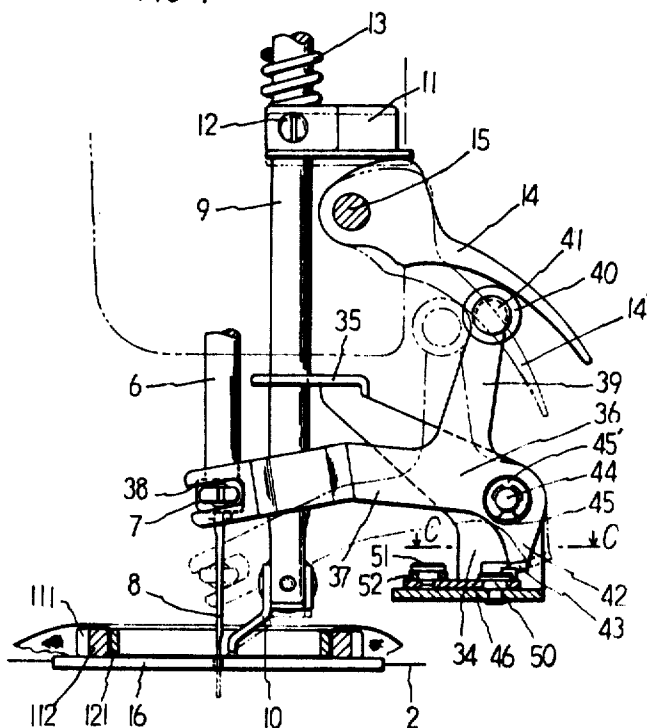


FIG 8

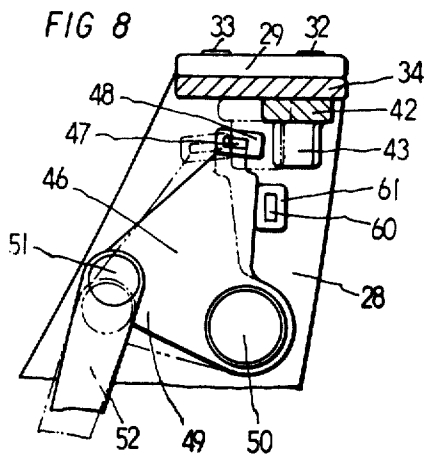
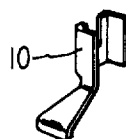


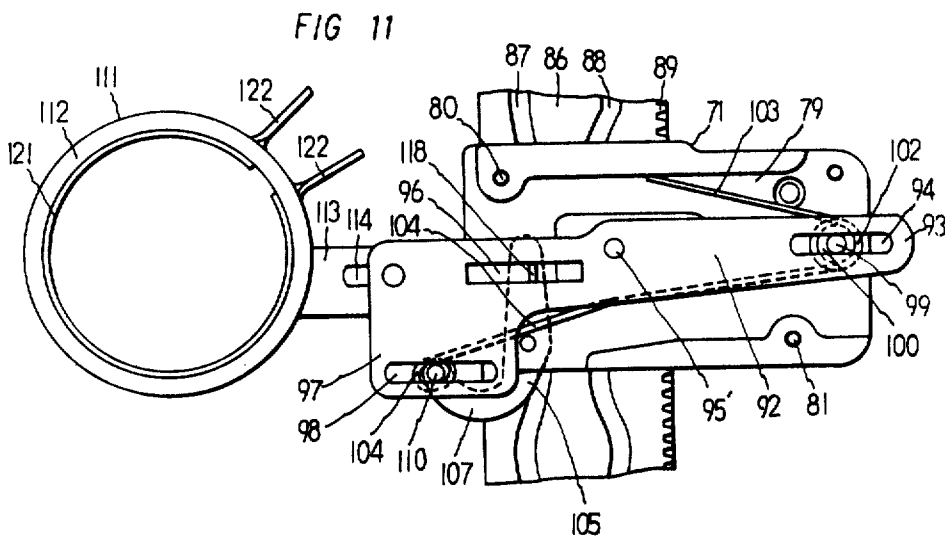
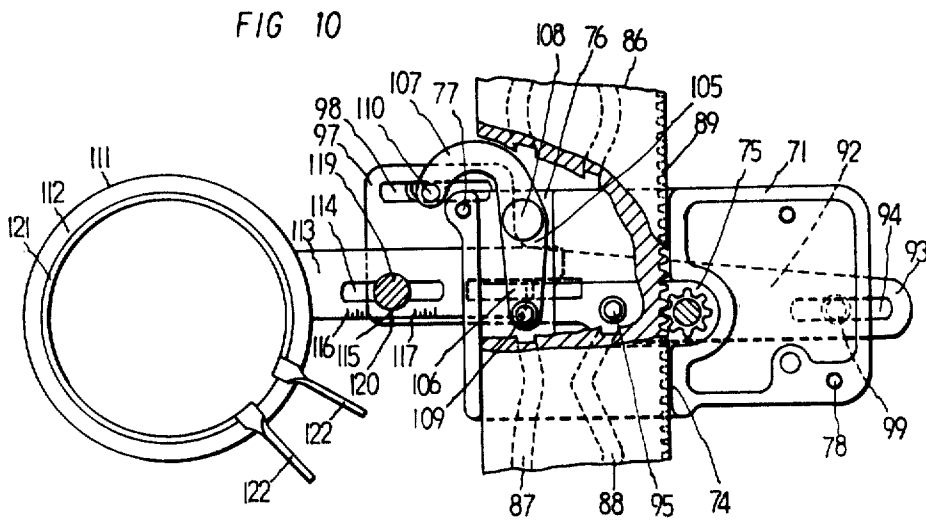
FIG 9



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FIG 12

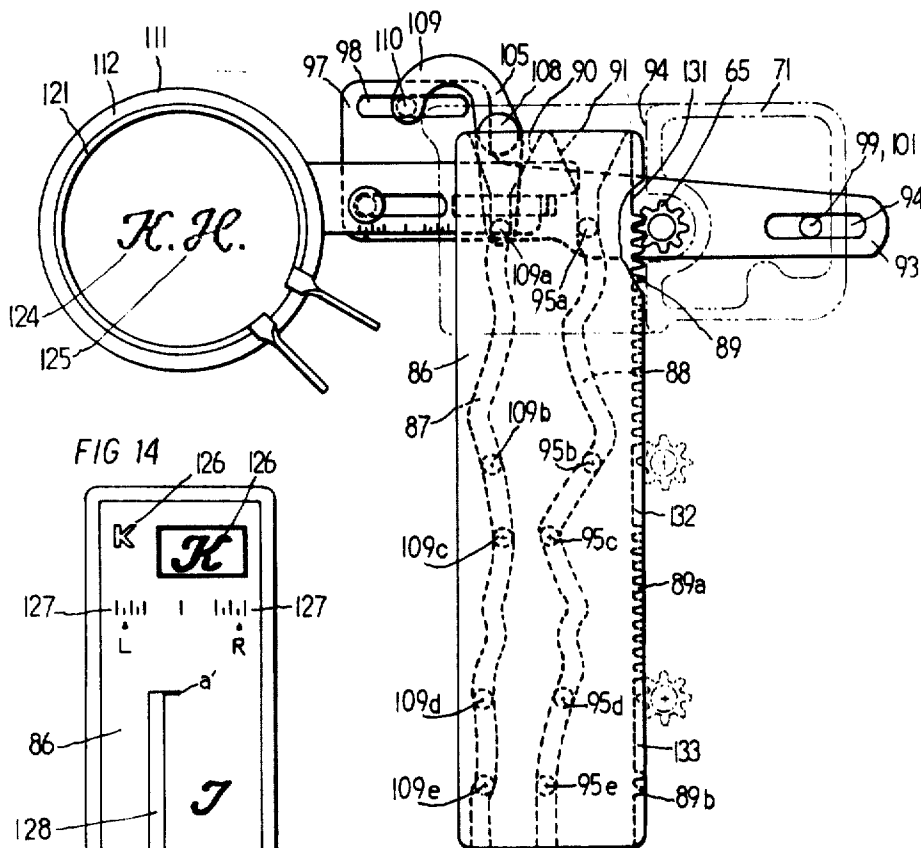


FIG 14

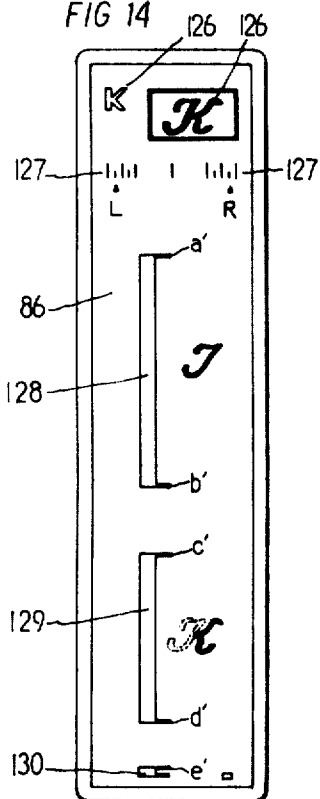
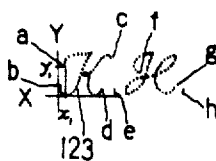


FIG 13

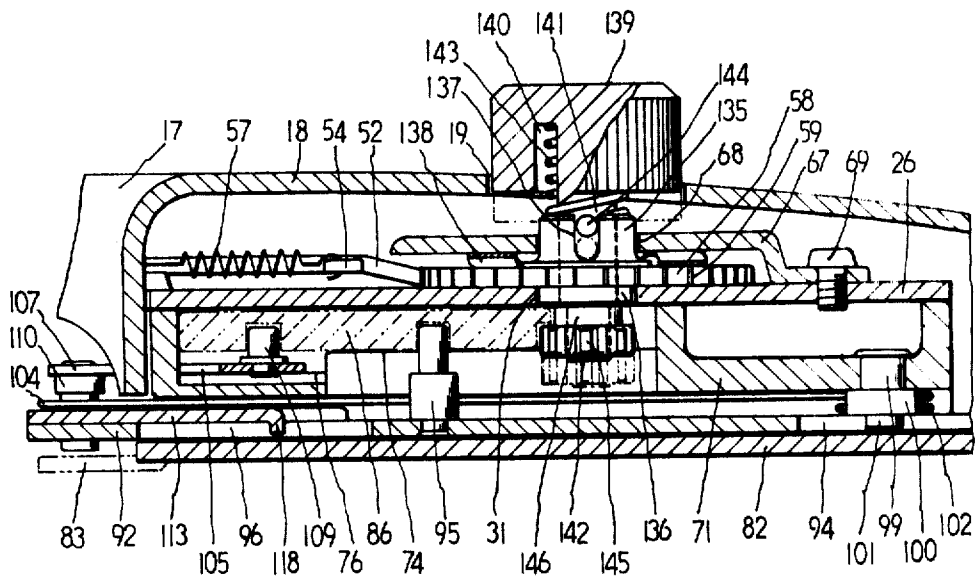


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FIG 15



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# ATTACHMENT FOR EMBROIDERING INITIAL LETTERS, PATTERNS AND THE LIKE IN A ZIGZAG SEWING MACHINE

## BACKGROUND OF THE INVENTION

The usual apparatus for embroidering initial letters using sewing machine comprise devices included in the inner mechanism of the sewing machine body and specialized for their objects, or those devices to be attached to an ordinary machine for straight sewing or to a zigzag machine. However, those devices for embroidering initial letters of complicated decorative style have complicated mechanisms and the cost thereof are too high for home use, having such drawbacks as difficult operation (or handling) thereof and the like, so that the popularization of such devices has not been expected.

## SUMMARY OF THE INVENTION

This invention relates to an attachment to be attached to a zigzag sewing machine for domestic use, wherein the apparatus is so contrived that embroidering for initial letters, patterns and the like may be made by anybody, with simplified mechanism and simple handling. When the apparatus is fixed on the upper surface of the bed plate of a zigzag sewing machine, it is combined with the needle bar of the machine, a gear is rotated by the vertical movement of the needle bar, a cam plate, whose oblong face is provided with two grooves and another face is provided with a rack, is inserted into the apparatus, and the cam plate is intermittently moved in accordance with the vertical movement of the needle bar, thereby effected the embroidering for initial letters, patterns and the like.

The apparatus according to the present invention is constituted by a combination of mechanisms, including a mechanism for fixing the apparatus, a mechanism for intermittently pushing up the presser foot, a mechanism for moving the cam plate, a mechanism for moving the embroidery frame, a mechanism for the cam plate, and the like.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing an attachment for embroidering initial letters (hereinafter called "attachment") fixed on the upper surface of the bed plate of a zigzag sewing machine.

FIG. 2 is a top plan view of the attachment.

FIG. 3 is a top plan view with the covering member of the attachment removed.

FIG. 4 is a side view of FIG. 3 seen from the front.

FIG. 5 is a vertical sectional view taken line along A-A of FIG. 2.

FIG. 6 is a vertical sectional view showing a part of FIG. 5 in an enlarged scale.

FIG. 7 is a vertical sectional view taken along line B-B in FIG. 3 as viewed from the right, and illustrating the attachment fixed to the sewing machine as well as the combination and movement of the needle bar, presser bar, presser foot lifter and an arm of the attachment.

FIG. 8 is an enlarged partial sectional view taken along line C-C in FIG. 7 seen from the top.

FIG. 9 is a perspective view of a presser foot to be fixed to the tip of presser bar in case the attachment is used.

FIG. 10 is a sectional view taken along line D-D in FIG. 4 seen from the top, showing a part of the cam plate broken away and the base plate is removed.

FIG. 11 is a bottom view of FIG. 10.

FIG. 12 is a top plan view for explaining the interlocking mechanism of the embroidery frame, which is engaged with the cam plate.

FIG. 13 is an explanatory drawing, showing two handwritten letters indicated by the line stitching.

FIG. 14 is a top plan view of the cam plate.

FIG. 15 is an enlarged vertical sectional view illustrating a second embodiment of the gearing mechanism for driving the cam plate.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

The construction and working of the apparatus according to the present invention will be explained in detail in conjunction with the embodiments shown in the accompanying drawings.

In FIG. 1, 1 is the body of a sewing machine, 2 is the upper surface of the bed plate of the machine, 3 is a knob for changing the swing amplitude of the needle of zigzag sewing machine (breadth of zigzag stitching), 4 is a knob for changing the feeding speed of the cloth, and 5 is a pushbutton for vertical movement of feed gear of the feed mechanism. The feed gear is raised in ordinary sewing and, when embroidering is effected, the feed gear is lowered so that the cloth to be sewn on the surface of the bed plate does not receive the action of the feed mechanism, which is the same case as in the mechanism of an ordinary sewing machine.

In FIG. 1 and FIG. 7, 6 is a needle bar, 7 is a set screw for the needle, 8 is a needle, 9 is a presser bar, and 10 is a presser foot used exclusively for embroidering, and which is attached to the presser bar 9. In the ordinary case, a presser foot for zigzag sewing is attached and, when embroidering is to be effected, it is replaced with a presser foot 10 used exclusively for embroidering and having the shape as shown in FIG. 9. 11 is an arm for the presser bar, and 12 is a screw for fixing the arm 11 to the presser bar 9. 13 is a coiled spring for pressing the presser foot 10 onto the surface of cloth, 14 is a pushup lever, 15 is a supporting shaft for the pushup lever 14. The presser foot 10 is raised and lowered by vertical operations of lever 14. 16 is a needle plate fixed on the upper surface 2 of the bed plate below the needle bar 6. Each of these parts has the construction and function as known in an ordinary zigzag sewing machine.

17 is an attachment for embroidering, mounted on the upper surface 2 of the bed plate, as shown in FIG. 1, and the embroidering of initial letters, patterns and the like may be effected by the operation of sewing machine. The details of this attachment 17 will be explained as follows. As shown in FIG. 2, the upper portion of attachment 17 is covered with a cover 18, which has a hole 19, for projection of a knob 63, on its upper surface, an inserting slot 20 for a cam plate 86, on its front surface, an indicating mark 21 on the center of the upper edge of the inserting slot and a projecting portion 22 on the left rear side. An end 23 of the projecting portion 22 covers an interlocking mechanism portion of a rocking arm 36 for receiving the movement of needle bar 6 of the machine. Cover 18 is secured by screws 24, 25 from the underside of the apparatus. Thus, by removing the screws 24, 25, the cover 18 may be removed. The state, under which the cover 18 removed, is shown in FIG. 3 and FIG. 4. Attachment 17 includes a supporting plate 26, a supporting block 71 and a bed plate 82, for supporting moving members. The attachment has a projection 83 extending from the left end of the bed plate 82 and which is formed with a hole alignable with a threaded hole (not shown) on the upper surface 2 of the bed plate of the sewing machine so as to receive a screw for securing attachment 17 to the upper surface of the sewing machine bed plate. Thus, the entire attachment 17 is secured to the machine by a set screw 85, shown in FIG. 1.

The upper supporting plate 26 is formed with an elongated arm 28 extending from a rectangular plate portion 27 to the left rear side of the same, and the end of arm 28 is bent to form an upwardly extending portion 29. Hole 30 on the right front of the supporting plate 26 and a hole 30' on the elongated arm 28 are threaded to receive screws for fixing the cover 18. On the bent portion 29 of the end of elongated arm 28, a supporting arm 34 is fixed by headed over pins 32, 33. Arm 34 is elongated vertically, and its end is bent horizontally bent to form a horizontal portion 35 having a U-shaped notch 35' engageable with the shaft portion of the presser bar 9 of the machine, thus

assuring proper location of attachment 17 when it is fixed on the upper surface of the sewing machine bed plate and preventing shifting of the attachment during the operation of sewing machine.

Referring to FIG. 3, FIG. 4 and FIG. 7, an interlocking mechanism for pushing up intermittently the presser foot 10 of the presser bar 9 will be explained as follows. 36 is a rocking arm having an elongated leg 37 with a forked portion 38 at its end, a vertical leg 39 extending upwardly at a different position, and a cylindrical roll 40, made of resin on a shaft 41 at the end of arm 39. Rocking arm 36 is pivoted on vertical supporting arm 34 by a fulcrum shaft 44 so that arms 37, 39 may be rocked. A short arm 42 projects downwardly from the rear end of rocking arm 36 and has a tip portion bent in L-shape. This L-shaped portion is shown by 43.

As shown in FIG. 4 and FIG. 7, the end portion of shaft 44 is fixed to the face of the supporting arm 34 and shaft 44 projects therefrom. After rocking arm 36 is fitted to the shaft 44, a coil spring 45 is placed over the shaft and a stop ring 45' is snapped over the end of the shaft to retain the coil spring and the rocking arm on shaft 44.

Rocking arm 36, engaged with shaft 44, forms a body extending laterally of set screw 7 for needle 8, and rocking arm 36 pivots about the axis of shaft 44 in accordance with vertical movement of needle bar 6. Roll 40 on the end of arm 39 engages the inner or undersurface of pushup lever 14 provided for pressing the presser foot down or lifting it from the surface of the cloth, pushup lever 14 usually being hand operated. When needle bar 6 is lowered, rocking arm 36 moves roll 40 to the dotted line position of FIG. 7, or counterclockwise. Such movement of rocking arm 36 is effected by the engagement of set screw 7 in the forked portion 38 of arm 37, and changes the point of contact of roll 40 with pushup lever 14. Thus, lever 14 rotates clockwise about the axis of shaft 15 so that its tip 15 is lowered as indicated at 14' in FIG. 7.

The descent of the pushup lever 14 causes the descent of the presser bar arm 11, which is secured to the presser bar 9 and is pressed downward by the pressure of the coiled spring 13 to press the tip of presser foot 10 on the surface of cloth. The timing of descent of the presser bar 9, accompanied by the descent of the needle bar 6, is so adjusted that the tip of the presser foot 10 will press on the surface of the cloth slightly before the tip of needle 8 stitches the cloth. After presser foot 10 has contacted the surface of cloth and stopped, the needle bar 6 descends further and the tip of needle 8 thrusts into the cloth. Then the roll 40 on the end portion of the vertical arm 39 further rotates in counterclockwise direction, so that the pushup lever 14 moves to the position shown by the chain line, whereby the contact of the underside of presser bar arm 11 with the pushup lever 14 is released. On the contrary, when the needle bar 6 ascends, the rocking bar arm 36 rotates in clockwise direction and pushes up the pushup lever 14 to the position indicated by full line, and, in the course of further ascending from the time when the tip of needle 8 disengages the cloth, the pushup lever 14 contacts with the presser bar arm 11 to separate the tip of presser foot 10, for embroidering, from the cloth. The interlocking mechanism for vertical movement of the presser foot 10 due to vertical movement of needle bar 6 moves the embroidery frame, by means of the hereinafter described driving mechanism for the cam plate and interlocking mechanism for embroidery, while the tip reciprocates needle is separated from the cloth. When needle 8 is thrust into the cloth, the presser foot 10 presses on the surface of cloth near the needle, so that the condition of sewing (the condition for forming the seam by entwining of upper and lower thread) will never change and embroidering may be effected under stable conditions. When rocking arm 39 is interlocked with needle bar 6 for oscillation in correspondence with vertical movement of the needle bar, if the needle bar reciprocates vertically at the same position, which is the condition for straight line stitching, no difficulties arise. However, when a zigzag motion is imparted to needle bar 6 for accommodating the width of the ini-

tial letter, some distortion will be caused at the point of engagement between rocking arm 36 and set screw 7. To eliminate any such distortion, the coil spring 45 is provided on fulcrum shaft 44 so that rocking arm 36 can move freely in a lateral direction.

In the next place, the driving mechanism of the cam plate will be explained as follows. As shown in FIG. 3, FIG. 7 and FIG. 8, 46 is a follower arm having a triangular shape, one side of which is bent upward to form a click portion 47, engageable with short leg 42 of the rocking arm 36 and inlaid with a buffer material 48 made of resin. Another side of arm 46 is formed as a horizontal pivotal portion 49, which is pivoted by a supporting shaft 50 on the upper surface of the elongated arm 28 of the supporting plate 26. Thus, the motion of rocking arm 36 is transmitted from L-shaped portion 43 of the small arm 42 to click portion 47. On the pivotal portion 49, one end of a ratchet operating arm 52 is connected by means of a connecting pin 51. The ratchet operating arm 52 is provided with a pawl 53 on its tip portion and a projection 54 for securing a spring is provided on the side face of the ratchet operating arm. On one part of the peripheral edge of the supporting plate 26, there is formed an upwardly bent projection 55 having a hole 56 for securing one end of a tension spring 57 having its opposite end connected to projection 54. Spring 57 biases arm 52 in the return direction and further maintains pawl 53 in contact with the peripheral surface of a ratchet wheel 58 described more fully hereinafter. On the elongated arm 28 near the follower arm 46, there is a stopper 60 inlaid with a buffer material 61 made of resin, and when the ratchet operating arm 52 is pulled back by the tension of the coiled spring 57, the side face of the follower arm 46 is contacted by stopper 60 so that the ratchet actuating arm 52 is stopped at a certain position. The ratchet wheel 58 has a number of oblique ratchet teeth 59 on its periphery and the center of its upper surface is formed with a cylindrical boss 60 and a knob 63 which are integral with each other. A pinion 65 is coaxial with boss 62 and knob 63, and is at the lower end of a shaft portion 64 integral with cylindrical boss 62. 66 is a corrugated circular spring washer placed around the periphery of the cylindrical boss and is held in contact with the upper surface of ratchet wheel 58. 67 designates an arch-shaped supporting member. An aperture 31 is formed at the center of supporting plate 26, and pinion 65 is inserted through this aperture so that the shaft portion 64 fits snugly in the aperture. Thereafter corrugated washer 66 is placed around cylindrical boss 62 which extends through a circular aperture 68 in supporting member 67, the supporting member 67 being secured to member 26 by screws 69 and 70 with sufficient pressure that corrugated washer 66 is slightly compressed. When the parts are thus assembled, pinion 65 projects so supporting plate 26. While ratchet wheel 58 may be turned by operating knob 63, in general it is rotated in one direction only by pawl 53 on the tip of arm 52 and which engages ratchet teeth 59. Reverse rotation of ratchet wheel 58 is prevented by the friction of corrugated washer 66. In FIGS. 5 and 6 the cover 18 of attachment 17 is illustrated as in position, with knob 63 projecting through hole 19 of the cover so as to be easily accessible for manual operation.

The supporting plate 26, on which a series of members comprising the intermittently pushing mechanism for the presser foot 10, the combination of the ratchet operating arm 52 and the combination of ratchet wheel are relationally attached, is fixed on the upper surface of a supporting block 71 by means of screws 72 and 73. In operation, and as viewed in FIGS. 3, 7 and 8, during upward movement of needle bar 6, and at a time when the tip of needle 8 disengages the cloth and the tip of presser foot 10, for embroidering, also disengages the cloth, L-shaped portion 43 of rocking arm 36 contacts click portion 47 of follower arm 46 through the buffer material 48, and pushes follower arm 46 to move counterclockwise as shown by the chain line in FIG. 8. This presses ratchet operating arm 52, which is connected by means of the pin 51 to the follower arm 46, to move to the right (in FIG. 3). Due to this movement, the

pawl 53 of the ratchet operating arm 52 engages with the ratchet teeth 59 of the ratchet wheel 58 to rotate the same in the clockwise direction. During downward movement of the needle bar 6, the rocking arm 36 rotates in the counter-clockwise direction and the L-shaped portion 43 of the short arm 42 tends to part from the side of the click portion 47 of the follower arm 46, so that the ratchet operating arm 52 is pulled back to the left by the restoring action of the coiled spring 57 and the follower arm 46 rotates clockwise following the movement of short leg 42. When the side of the follower arm 46 contacts the stopper 60 on the elongated arm 28 the follower arm 46 stops. The position of the stopper 60 for stopping the follower arm 46 is so determined that the arm is stopped just before the tip of the needle 8 sticks into the cloth and before the presser foot 10 presses the surface of cloth. When the ratchet operating arm 52 is pulled back to the left, the pawl 53 is pulled back while sliding on the sloping surfaces of the ratchet teeth 59 of the ratchet wheel 58, which is held stationary by the friction engagement due to the pressure of the corrugated washer. During continued vertical reciprocation of needle bar 6, when needle 8 moves upwardly and after it has disengaged the cloth, pawl 53 rotates ratchet wheel 58 clockwise, and ratchet wheel 58 remains stationary during retraction of arm 52. Thus, wheel 58 performs an intermittent rotary motion, resulting in that the vertical movement of the needle bar 6 makes the pinion on the underside of the ratchet wheel 58 to rotate intermittently.

The mechanism cooperating with pinion 65 will now be explained. Supporting block 71, shown in FIG. 10, when combined with supporting plate 26, forms a rectangular block and a groove 74 is defined, for guiding a cam plate 86. In FIG. 10, 75 indicates a recess for pinion 65, and 76 indicates a step portion spaced from recess 75 and which is lower than the bottom portion of guide groove 74. Threaded holes 77 and 78 are provided to receive screws securing supporting plate 26.

In FIG. 11, 79 indicates a groove or recess on the undersurface of supporting block 70 and 71, and 80 and 81 are threaded holes to receive screws securing block 71 to bed plate 82. Cam plate 86 has two different cam grooves 87 and 88 on its rectangular substantially planar undersurface, as shown in FIGS. 10, 11 and 12. Rack teeth are formed along one longitudinal edge of cam plate 86. The cam plate 86 may be inserted in the guide groove 74 of the supporting block 71, and when the supporting plate 26 is combined with supporting block 71 and the cover 18 is fitted to form the attachment 17, the cam plate 86 may be inserted through the inserting slot 20 shown in FIG. 1 and FIG. 2 and may be easily inserted in the guide groove 74. When the cam plate 86 is inserted through slot 20 and reaches guide groove 74 of the supporting block 71, the rack teeth 89 on the side of the cam plate meshes with the pinion 65. The ends of cam grooves 87 and 88 are made as respective funnel-shaped portions 90 and 91 to facilitate the fitting of shafts guided in the two cam grooves as mentioned hereinafter.

In the next place, the interlocking mechanism for embroidery frame by means of the cam plate 86 will be explained, as follows. In FIG. 6 and FIG. 11, 92 is an interlocking plate located in the recess 79 on the underside of the supporting block 71 and is formed to be movable in compliance with the cam groove 88. Namely, the interlocking plate 92 is provided with a long slot 94 on its right end 93, and a shaft 95 extends upwardly at about the central portion (FIG. 6 and FIG. 10). 95' indicates a headed over end of the shaft 95. The tip of shaft 95 extends into the guide groove 74 of supporting block 71, and shaft 95 has a length such that it can extend into cam groove 88 when cam plate 86 is inserted in guide groove 74. A long slot 96 is formed to the left of shaft 95, and the left end of plate 92 is enlarged as at 97 and formed with a long groove 98 adjacent its lower edge, as viewed in FIG. 11.

Each of long slots 94, 96 and 98 in interlocking plate 92 extends at a right angle to the inserting direction of the cam plate 86. 99 is a guide pin whose end extending upwardly from boss 100 is rigidly secured in the supporting block 71, while the

lower end 101 thereof hangs down so as to be engageable with the long slot 94 on the end portion of interlocking plate 92. On the boss 100, a coiled V-shaped spring 102 is attached, and one end 103 of spring 102 contacts a wall surface of the recess 79 of the supporting block 71, and another end 104 thereof is ring shape and positioned above the slot 98.

When slot 94 of plate 92 has the end 101 of guide pin 99 inserted therein and when bed plate 82 is secured, by screws threaded into holes 80 and 81, to the undersurface of supporting block 71, interlocking plate 92 is retained in recess 79 of supporting block 71 and is supported in such a manner that it may be freely moved to either the right or the left, within the limits of groove 94, and may oscillate around guide pin 99 as a center.

At the step portion 76 formed in recess 74 of the supporting block 71, a sickle-shaped feed arm 105 (shown in FIG. 10 and FIG. 11) is pivoted, for oscillation by a pin 108. At a base portion of feed arm 105, a shaft 109 extends upwardly and the tip of shaft 109 is so formed that it may be inserted in and engaged with the cam groove 87 of the cam plate 86. On another arm portion 107, a feed shaft 110 extends downwardly, and its tip passes through the ring-shaped end 104 of spring 102 and is inserted in the long slot 98 in the enlarged portion 97 of the interlocking plate 92. Thus, the left end of the interlocking plate 92 is always pushed in one direction by the action of the spring 102.

111 is an embroidery frame and from a portion of the periphery of a ring-shaped outer frame 112, an integral connecting plate 113 projects. Connecting plate 113 is formed with an elongated slot 114 and, along one side of this slot, there are marked several indication lines, as best seen in FIGS. 2 and 10.

The positions of the indication lines are so arranged that, at about central position of the slot 114, a central line 115 is marked and from positions near both ends of the slot towards the center left indication lines 116 and right indication lines 117, which are comprise several rows of lines, are marked symmetrically. On the end of the connecting plate 113, there is a hook portion 118, to be inserted in the slot 96 of the interlocking plate 92, bent downward (FIG. 6 and FIG. 11). On the left end of the interlocking plate 92, a screw 119, with an operating knob, is threaded into plate 92 and arranged to clamp connecting plate 113 in adjusted position on plate 92. 120 is an indication mark on the interlocking plate 92 corresponding to screw 119 and confronting the indicating lines of the connecting plate 113.

121 is an elastic cloth fitting ring to be inserted in the inner periphery of the outer frame 112 of the embroidery frame, and a portion of the fitting ring is cut, from which portion operating levers 122 project. This corresponds to the known embroidery frame construction whereby the cloth may be stretched on the inner periphery of outer frame 112, without shrinkage, by making use of the elasticity of the fitting link 121. The setting of the position of embroidery frame 111, which comprises a combination of the outer frame 112 and the connecting plate 113, is effected in that the connecting plate 113 is placed on the left upper surface of the interlocking plate 92 (see FIG. 5 and FIG. 10), the hook portion 118 of the connecting plate 113 is inserted in the slot 96 of the interlocking plate and the slotted portion of the connecting plate 113 is clamped on the end of interlocking plate 92 from above by means of the screw 119 with its operating knob indicating lines on the side of slot 114 of the connecting plate 113 are used for determining the position of initial-letters-sewing by selecting and setting the position of either the left side 116 or the right side 117 indicating line to the indication mark 120 on the interlocking plate 92, when the connecting plate 113 is fixed on the interlocking plate 92.

From the above explanation, it will be clear that the combined body formed by plate 92 and embroidery frame 111 may be moved freely to either the right or the left, or may be oscillated around the axis of pin 99 in slot 94, when cam plate 86 is not inserted in the recess 74 of the supporting block 71.

For the purpose of controlling the movement of embroidery frame 111 by means of the grooves 87 and 88 provided on the cam plate 86 to a desired movement, the cam grooves 87 and 88 are preliminarily represented by a moving point 123 along each initial letter (see FIG. 13), which point is measured by coordinates marked X (the direction at a right angle to the forward direction) and Y (forward direction), and in consideration of correction values due to the mechanism, the coordinates  $x_1$  of X for the cam groove 88 and the coordinates  $y_1$  of Y for the cam groove 87 are used to form the cam grooves 87 and 88. Embroidery frame 111 is moved in accordance with the contours of the two cam grooves 87 and 88. Right and left reciprocation of interlocking plate 92 are effected by engagement of cam groove 88 with shaft 95, rocking motion of feed arm 105 is effected by engagement of cam groove 87 with shaft 109, and rocking motion of plate 92 by engagement of shaft 110 in slot 98 of enlarged portion 97 of plate 92. Thus, by the resultant of both motions it becomes possible to guide the embroidery frame 111 to sewing positions along the initial letters. The initial-letter-stitch obtained under these conditions is a letter style represented by lines. However, if the desired width of stitch is given, initial-letter-stitches 124, 125 and the like may be obtained as shown in the fitting ring 121 of the embroidery frame in FIG. 12. For the purposes of obtaining the width of stitch by attachment 17 for embroidering, it is sufficient to set the knob 3, for changing the breadth of zigzag stitching at a position of definite width of stitch, as shown in FIG. 1, to obtain the zigzag motion of the needle 8 by means of known mechanism (not shown) for zigzag stitching housed within the body of a sewing machine.

In the attachment 17, which comprises the combination of interrelated mechanisms, the relation between the initial letters and the cam plate 86 will be explained as follows. The style of penmanship of initial letters exemplified in FIG. 12 and FIG. 13 expresses "K" on the left and "H" on the right. In writing "K," the stitching starts from a point "a" and ends at a point "b" then shifts to a point "c" and ends at a point "d." Thus one initial letter is completed by the combination of two lines and the letter has added thereto a period at a point "e." In this case, the cam plate 86 is so formed, as shown in FIG. 12, that the cam plate 86 inserted in the recess 74 of the supporting plate 71 guides the shafts 109 and 95 by funnel-shaped portions 90 and 91 on the ends of the cam grooves 87 and 88, and has a portion 131 without rack teeth so as not to engage pinion 65 until the starting position of the stitching, i.e. the position shown by the shafts 109a and 95a at the point "a" of the initial letter "K," is reached and the cam plate 86 is freely and positively inserted.

Now, the indicating lines on the cam plate for stitching the initial letter "K" shown in FIG. 14 will be explained as follows. On the cam plate, there are marked indicating lines corresponding to respective initial letters and, for example, on the cam plate for stitching the initial letter "K," a style of penmanship corresponding to the kind of the initial letter is so marked that the user may easily take out a desired cam plate. This procedure is the same as in a cam plate for embroidering. As the indicating lines, initial letters 126 and the like are marked on the end of cam plate and, when some letters are combined, the interval under best condition is preliminarily determined. Thus indicating lines 127, which indicate the combinations of the indicating mark 120 of the interlocking plate 92 with the indicating lines 116 and 117 and the like of the connecting plate 113, are marked. Further, in the central portion of the cam plate, there are marked indications showing the range of motion for the cam plate corresponding to the desired initial letters stitching, i.e. the range of sewing by the operation of the machine, for example, 128 shows the left-half of "K" and 129 shows the right-half of "K," and when the cam plate is moved between these indications, during operation of the machine, the initial letters sewing is completed. Finally, the sewing position for a period 130 is shown. When the initial letters are written in a continuous style of penmanship, the indications 128, 129 and the like are written in a body. Cam plate

86 is inserted through the slot 20 of the cover 18 of the attachment 17, and the knob 63 is turned in the direction of the arrow shown on the upper end thereof to make the pinion 65 slightly mesh with the end portion of the rack 89. At the same time, the start position "a" of the indication 128 on the upper surface of the cam plate is set to an edge shown by the indicating mark 21 of the slot 20, and when the machine is started from this position, the cam plate 86 is moved and the shafts 109a and 95a are guided along the cam grooves 87 and 88. When the embroidery frame 111 reaches the point "b" of the letter and the shafts come to the position shown by 109b and 95b (in the drawing, it is assumed that each shaft moved in the related groove), the second portion 132 without rack teeth is reached. Consequently, the cam plate 86 will stop at a position where the pinion 65 passes the end of the rack and the end "b" of the indication 128 on the upper surface of cam plate will coincide with the indicating mark 21 of the cover 18. At this position, the machine is once stopped and the cam plate 86 is moved by pushing, so that the embroidery frame 111 is quickly moved from the point "b" to the point "c" of letter. At a position of the shafts shown by 109c and 95c, the rack 89a and the pinion 65 will again become in mesh. Thus the interval from the point "c" to the point "d" of the letter is stitched. In the same manner as mentioned, the third portion 133 without rack teeth is so located on the rack 65 that the cam plate 86 will once stop at a point "b" of the indicating line 127, thus acknowledging the stop of the cam plate 86 as well as of the machine. Then the cam plate 86 is moved by pushing, and shafts are moved to the positions 109e and 95e. A few rack teeth 89b remain in the portion 133 to make the period "e" comprising a few stitchings. Thus the stitching at the point "e" and its position will be determined by the contact of the cam with driving pinion 65.

The style of penmanship of initial letter "H" on the right starts from the point "f" and ends at the point "g," forming a continuous letter, so that it is not necessary to have any portion without rack teeth until the letter reaches to the point "g," while, after the point "g," a portion, there is a portion without rack teeth and a few teeth are provided to determine the stitching at the period "h" and its position.

There is no difficulty in forming a cam plate for a continuous letter. However, in the case of letters or embroiderings divided into several parts, the rack 89 is provided with a portion without teeth at connection points of letters or embroiderings, for example, in case the stitch will shift from the point "b" to the point "c" of initial letter "K," the stop of the cam plate 86 is acknowledged and at the same time the machine is stopped, and the cam plate 86 is located at the next position of stitch point. Thus the points, at which the letters, embroiderings and the like will end or start on the way, become clear, and even though they are complicated they may be simply-stitched when the cam plate 86 is formed as mentioned above.

Another embodiment of the invention, with respect to the connection between pinion 65, meshing with rack 89 of cam plate 86, as shown in FIG. 6, and ratchet wheel 59 will now be explained with reference to FIG. 15.

In this embodiment of the invention, cylindrical bosses 135 and 136 are formed integrally on the upper and lower faces of the ratchet wheel, a through bore extends axially of these bosses and of the ratchet wheel, and a diametric slot 137 is cut across the boss 135. 138 is a corrugated washer, which is inserted on the upper face of the ratchet wheel. 139 is a knob, 140 is a circular chamber for a spring, which is made by boring the inner portion of the knob from its lower face, 141 is a shaft projecting from the lower surface of the knob, and 143 is a coiled spring, which is placed around shaft 141 of the knob 139 with its another end inserted in chamber 140. 144 is a cotter pin, which is pressed into the center of the shaft 141 at the middle portion thereof and both ends of which project long from the shaft 141. 145 is a pinion having a cylindrical portion 146 on its upper face, of which the end face contacts with the end face of boss portion 136 on the lower face of the ratchet wheel.

The above mentioned members are connected in the following relation. Namely, the lower boss portion 136 of the ratchet wheel 134 is inserted in the hole 31 of the supporting plate 26 and the corrugated washer 138 placed on the upper boss portion 135, and, by means of the supporting member 67, the corrugated washer is fixed by the screw 69 under such a condition that the washer is suitably compressed. In the through hole passing through the center of the ratchet wheel, the shaft 141 of the knob 139 is inserted from above under the condition that the coiled spring 143 embraces the shaft, the pin 144 on the shaft is engaged with the notched groove 137 of the upper boss portion of the ratchet wheel, the pinion 145 is inserted in the shaft portion which is projecting from the lower face of the ratchet wheel, and a shaft end 142 is headed over and fixed to form the shaft 141 and the pinion 145 into a one-piece body. Under this condition of connection, the pinion 145 is biased by the pressure of the coiled spring 143 in such a manner that the end portion of boss 136 on the lower face of the ratchet wheel is always in contact with the end of cylindrical portion 146 of the pinion, and when the cam plate 86 is inserted, the pinion 145 meshes with the rack 89 on the side face of the cam plate. When knob is pushed down from the above, the pinion 145 may be moved downward through the shaft 141, and the contact between the rack 89 and the pinion 145 may be released.

For the purpose of driving the cam plate of attachment 17, using the embodiment shown in FIG. 15, it is easy to change the engage position of ratchet wheel 58, knob 63 and pinion 65, and an additional advantageous effect is attained. For instance, when the thread is wanted or snapped during initial letter stitching, the machine is once stopped, the knob 139 is pushed down to move the pinion 145 together with the shaft 141 downward, and the engagement between the pinion 145 and the rack 89 is released. Thus the cam plate 86 may be freely pulled back to the position where the thread is wanted or snapped. (In case of the construction described in the first embodiment, it is necessary to turn the knob after the machine is stopped and the cam plate is once fed idly and is taken out, then it is put in the former position again to continue the stitching.) Thus, when these troubles are encountered during initial letter stitching, initial letters having a complete form may be made by simple operation of the knob without leaving any break in the portion of stitched letters.

Now, the operation of the attachment 17 will be explained collectively, as follows.

When the needle bar 6 ascends, the presser foot is intermittently pushed up, the elongated arm 37 of the rocking arm 36 of the mechanism is raised by means of the set screw 7 to rotate the rocking arm 36 in the clockwise direction, and the pushup lever 14 is raised from the position shown by the chain line 14' to the position shown by the full line in FIG. 7 by means of the cylindrical roll 40 of the vertical arm 39. Along with raising this pushup lever, the presser bar 9 and the presser foot 10, for embroidering, on the tip of the presser bar are raised, thus releasing the cloth to make the embroidery frame 111 movable.

At this moment, the click portion 47 of the follower arm 46 (see FIG. 3, FIG. 7 and FIG. 8) of the mechanism for moving the cam plate is pushed and moved by the tip of short leg arm 42 of rocking arm 36 to rotate the follower arm 46 in the counterclockwise direction around the supporting arm 50. Thus the ratchet wheel 58 is rotated in the amount of one tooth in the clockwise direction through the ratchet operating arm 52. Due to the rotation of this ratchet wheel 58, the cam plate 86 is advanced by means of the rack 89 meshing with the pinion 65. (See FIG. 12.) By the advance of this cam plate 86, the interlocking plate 92 is moved right or left or oscillated around the center of the guide pin 99 (101) corresponding to the shape of the cam grooves 87 and 88 as effective through the cam follower shafts 109 and 95 of the interlocking mechanism for the embroidery frame, which are respectively inserted in the two cam grooves 87 and 88 provided on the underside of the cam plate 86. Due to this movement, the em-

broidery frame 111 is moved, because this frame is formed integrally with the connecting plate 113, which is fixed to the interlocking plate 92 by means of the screw 119.

On the contrary, when the needle bar 6 descends, the rocking arm 36 is rotated in the counterclockwise direction, and the roll 40 of the vertical leg 39 is moved in the direction shown by the chain line to lower the tip of the pushup lever 14. Accompanied with the descent of the pushup lever 14, the presser bar 9 and the presser foot 10, for embroidering, are pushed down by the action of spring 13. Thus the descent of the presser foot 10 is stopped when its tip contacts the cloth under pressure. The L-shaped portion 43 of the end of short leg 42 of the rocking arm 36 is retracted out of contact engagement with the click portion 47 of the follower arm 46. Additionally the ratchet operating arm 52 is pulled back by the tension of the coiled spring 57 and is stopped when the follower arm 46 abuts against the stopper 60.

From this position, the needle 8 penetrates the cloth and again ascends and, just after the tip of needle leaves the surface of cloth, the mechanism of the attachment is operated along with the mechanism for lifting presser foot 10, while the mechanism for moving the cam plate is operated to move the embroidery frame. This operation is successively repeated and, in combination with the zigzag motion of the needle 8, the embroidering is performed.

Due to the fact that, with the attachment of the present invention, the vertical motion of the needle bar is used as the driving source for moving the embroidery frame, the power requirements are easily provided. The cam plate, for moving the embroidery frame with a predetermined motion, has two cam grooves at the same horizontal level on one surface, and has indicating marks to facilitate its operation, whereby handling of the cam plate is simplified. In addition, the cam plate is inserted from the user's side of the sewing machine and at a right angle to the length of the machine, so that the stopping of the cam plate may be easily acknowledged. Thus, any miss during sewing may be avoided or corrected.

We claim:

1. An attachment for embroidering initial letters, patterns, and the like, constructed for disengageable securement to the upper surface of the bed plate of a zigzag sewing machine having a vertically reciprocable, laterally oscillatable needle bar carrying a needle, and a vertically displaceable presser bar mounting a presser foot engageable with a cloth work piece, said attachment comprising, in combination, an attachment mounting base securable to the upper surface of said machine bed plate; a relatively elongated substantially rectangular and substantially flat cam plat having a pair of cam grooves extending longitudinally of its under surface; a mounting and guiding structure secured to said mounting base and having first means defining a substantially rectangular cross section and substantially rectilinear guide slot, for a cam plate, extending transversely of said attachment, and second means defining a recess an interlocking member mounted in said recess for limited displacement longitudinally of said attachment and limited oscillation about a substantially vertical axis, said interlocking member having an oscillatable end projecting from said structure toward said needle bar; a pair of cam followers operatively associated with said interlocking member and engageable with respective grooves of a cam plate inserted into said guide slot; a rocking arm mechanism mounted on said structure and including a rocking arm engageable with said needle bar for rocking responsive to reciprocation of said needle bar, and arm means cooperable with said presser bar to lift the presser foot responsive to upper movement of said needle bar; a follower arm operable by said rocking arm mechanism; pawl and ratchet mechanism operable by said follower arm and cooperable with a cam plate inserted into said guide slot to step the cam plate longitudinally of said guide slot; and an embroidery frame secured to the projecting end of said interlocking member for conjoint movement with the latter; said rocking arm mechanism, responsive to retraction of said needle from the work piece

and disengagement of the presser foot from the work piece, operating said follower arm to operate said pawl and ratchet mechanism to advance the cam plate longitudinally of said guide slot; said cam followers reciprocating and oscillating said interlocking member in accordance with the contours of the respective cam grooves to correspondingly reciprocate and oscillate said embroidery frame relative to said needle.

2. An attachment as claimed in claim 1, in which said mounting and guiding structure includes an upper supporting plate having an elongated arm extending horizontally therefrom toward said needle bar when said attachment is secured on the upper surface of said machine bed plate, said elongated arm having its free end bent upwardly to form a substantially vertically extending supporting arm; the free end of said supporting arm being bent to extend horizontally and being formed with a U-shaped notch to embrace said presser bar accurately to locate said attachment on said machine.

3. An attachment, as claimed in claim 2, in which said zig-zag sewing machine includes a pushup lever operable to lift said presser arm and a presser foot attached thereto; pivot means oscillatively mounting said rocking arm mechanism on said supporting arm; said rocking arm having a forked end engageable with a set screw securing said needle in said needle bar; said rocking arm mechanism including an upwardly extending leg rotatably supporting a roller engageable with said pushup lever to lift said presser foot responsive to upward movement of said needle bar.

4. An attachment, as claimed in claim 2, including means oscillatably mounting said follower arm on the upper surface of said elongated arm, said follower arm having an upwardly bent click portion; said rocking arm mechanism including a downwardly extending short leg engageable with said click portion to oscillate said rocking arm to operate said pawl and ratchet mechanism; said pawl and ratchet mechanism including a ratchet wheel rotatably mounted in said mounting and guiding structure, a pawl pivotally connected at one end to said follower arm and having its opposite end cooperable with said ratchet wheel, and a pinion in said recess fixed to rotate with said ratchet wheel.

5. An attachment, as claimed in claim 4, in which each cam

plate has rack teeth along one of its longer edges engageable with said pinion; the two cam grooves of each cam plate being at the same horizontal level.

6. An attachment, as claimed in claim 1, in which said pair of cam followers includes a first cam follower and a second cam follower respectively engageable with first and second cam grooves of a cam plate inserted into said guide slot; said first cam follower in association with the first cam groove effecting reciprocation of said interlocking member and the embroidery frame secured to the projecting end of the latter; a feed arm oscillatably mounted intermediate its ends on said mounting and guiding structure; pin and slot means connecting one end of said feed arm to the oscillatable projecting end of said interlocking member; said second cam follower being mounted on the opposite end of said feed arm and, in association with the second groove of a cam plate, effecting oscillation of said interlocking member and an embroidery frame secured to the latter.

7. An attachment, as claimed in claim 5, in which portions of said one longer edge of a cam plate are free of rack teeth at points corresponding to the termination of stitch sequences during embroidery, whereby advance of a cam plate through said guide slot by said pinion is interrupted at said terminations of said stitch sequences.

8. An attachment, as claimed in claim 5, including means mounting said pinion for axial displacement, relative to said sprocket wheel, between the first position in which said pinion is engageable with the rack teeth of a cam plate inserted into said guide slot and a second position in which said pinion is ineffective to engage the rack teeth of cam plate inserted in said guide slot; means biasing said pinion to said first position; and manually operable means effective to move said pinion to said second position.

9. An attachment, as claimed in claim 8, in which said pinion is secured to a shaft extending axially through said sprocket wheel; a knob on the other end of said shaft; coupling means connecting said shaft and said sprocket wheel for conjoint rotation; and a coil spring interposed between said coupling means and said knob to bias said pinion to said first position.

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