March 24, 1964 D. N. BERNÉRUS ETAL 3,125,973

ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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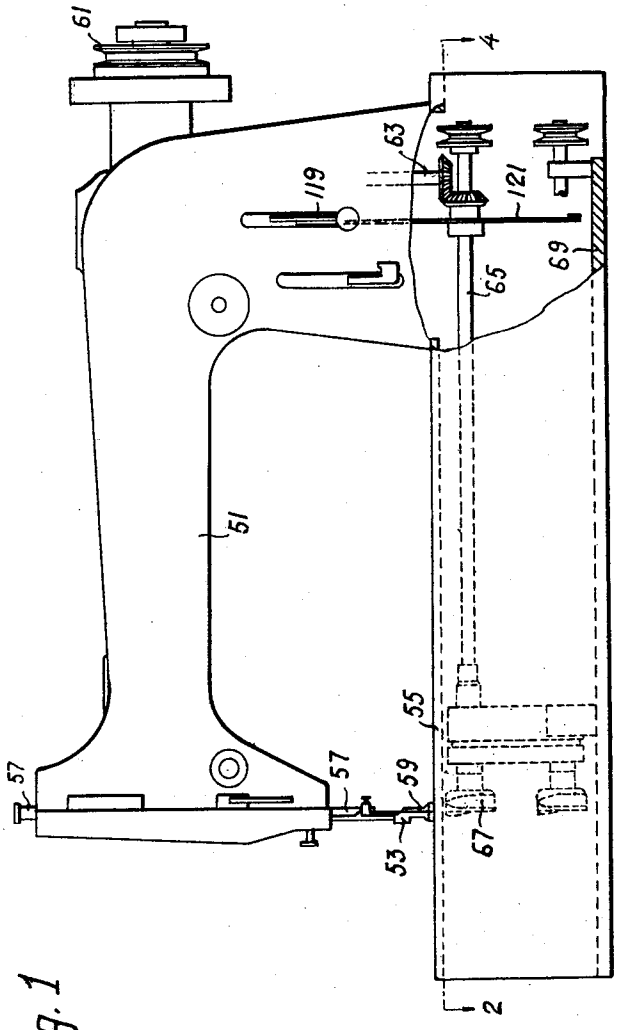

Fig. 1

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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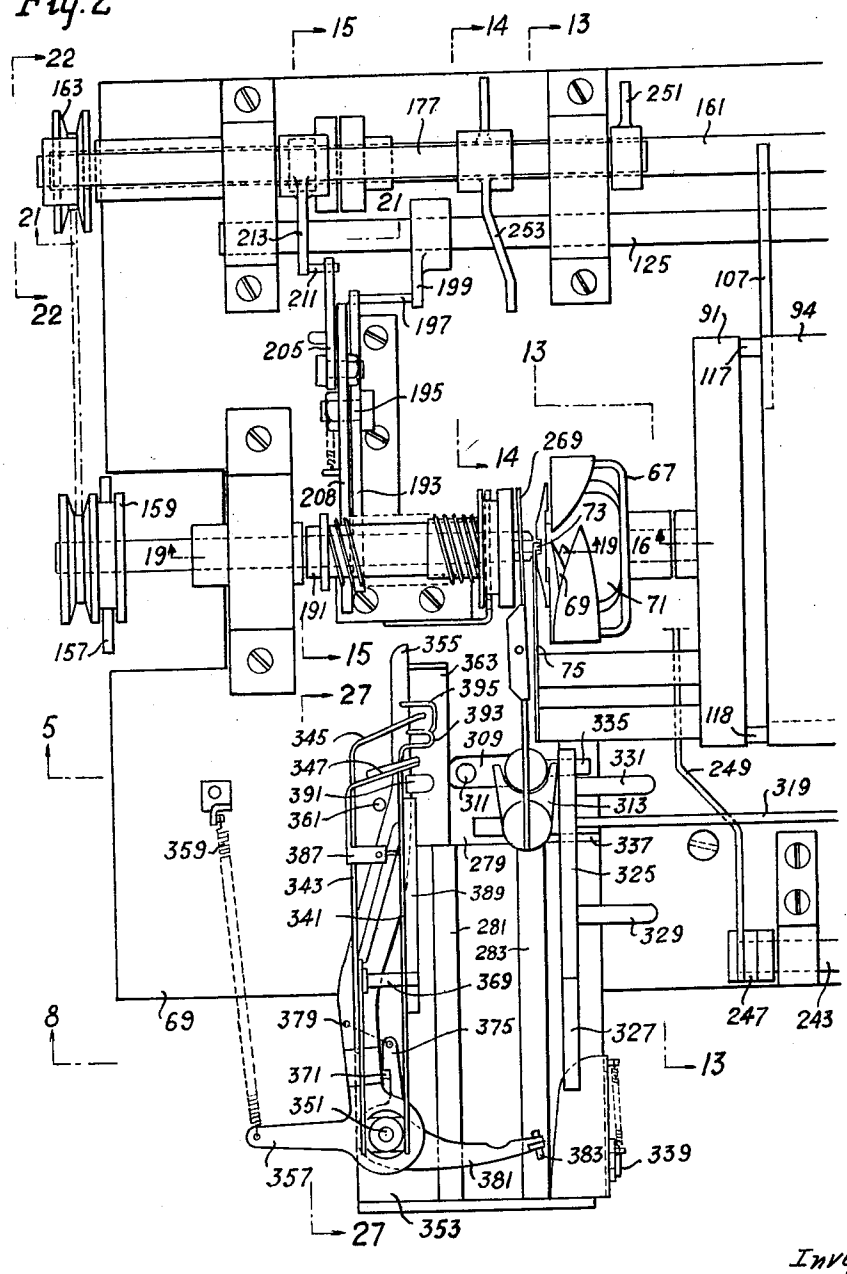
Fig. 2



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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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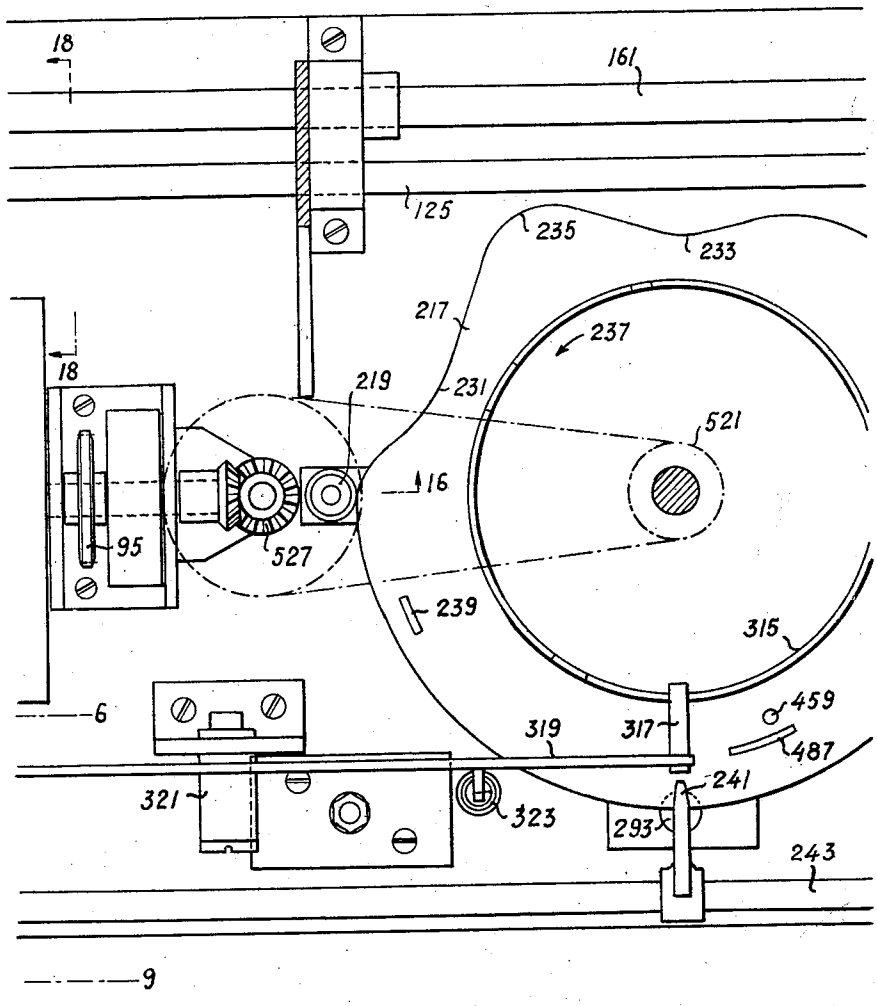
Fig. 3



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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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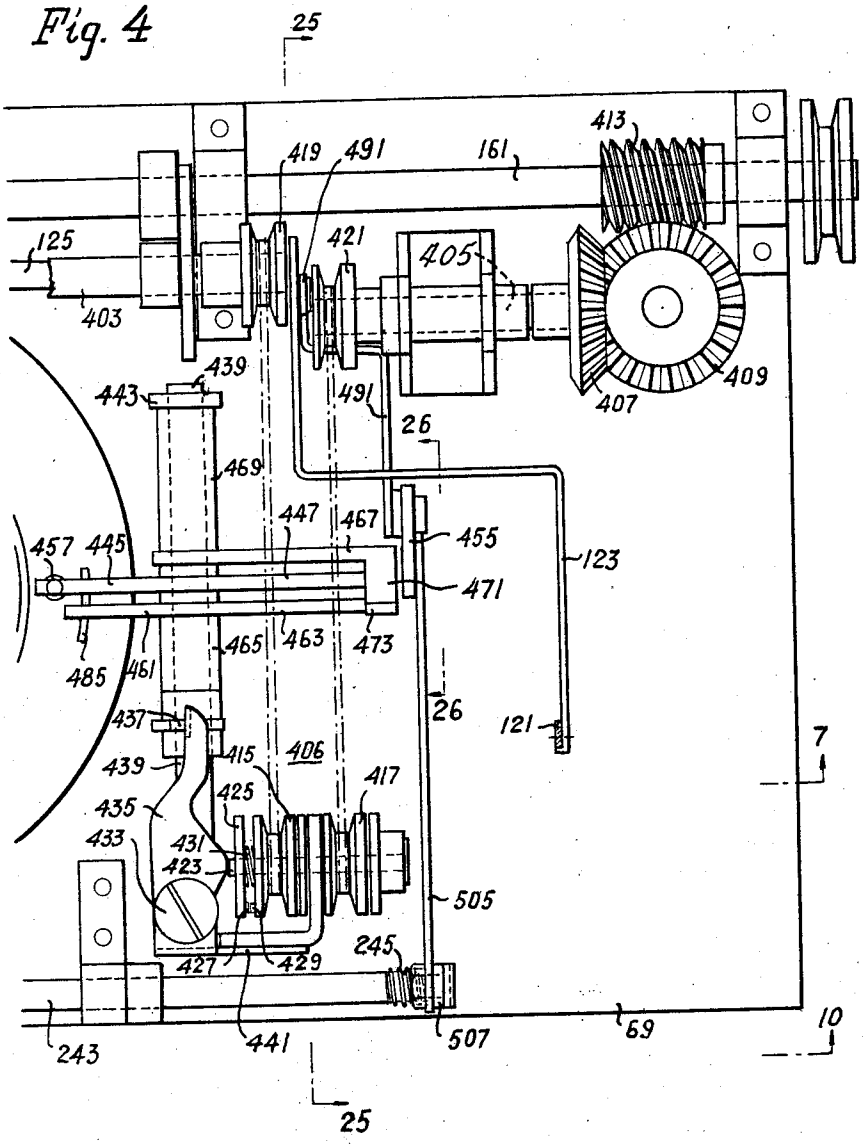
Fig. 4



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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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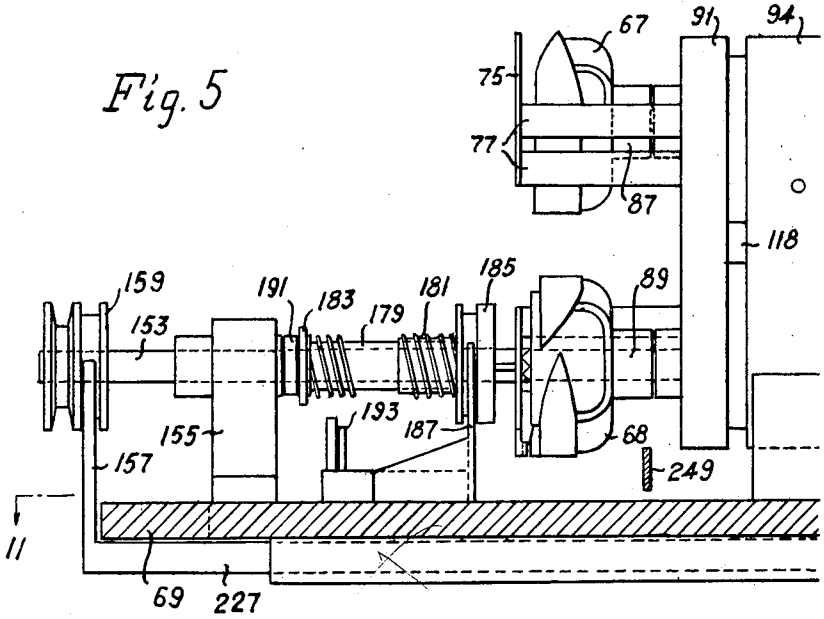
Fig. 5



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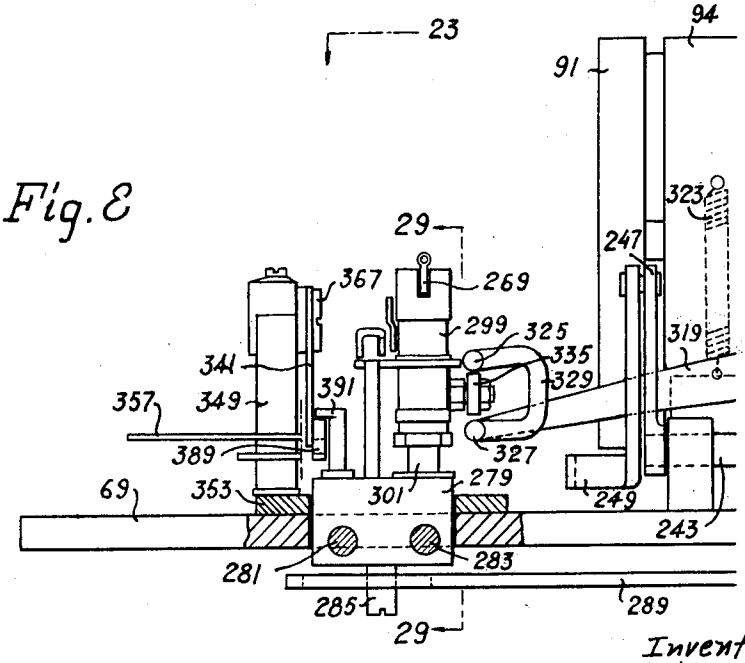

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Fig. 6

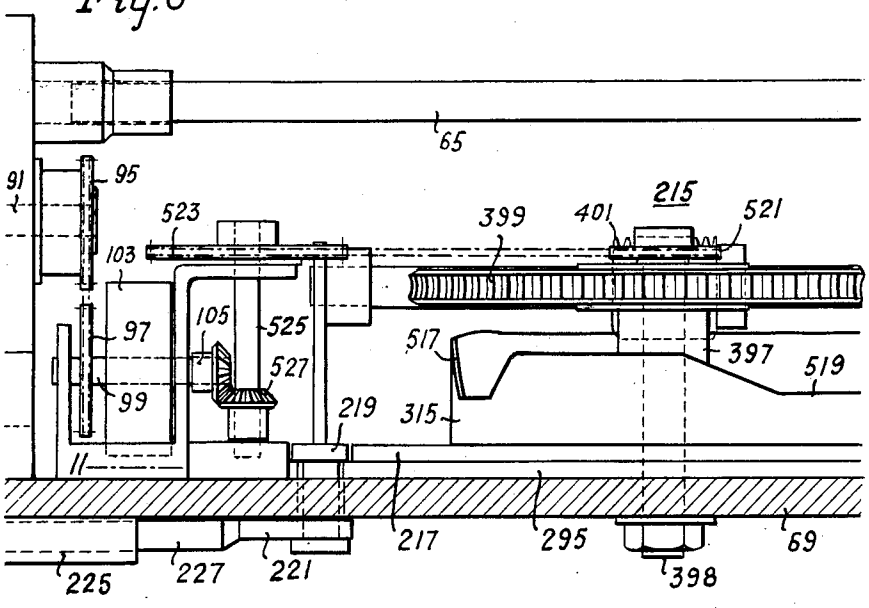

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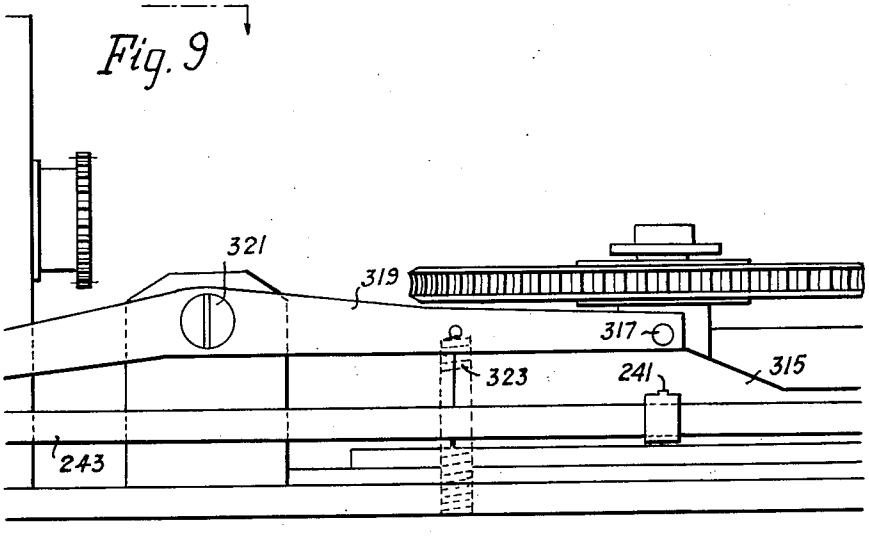
Fig. 9



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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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Fig. 7

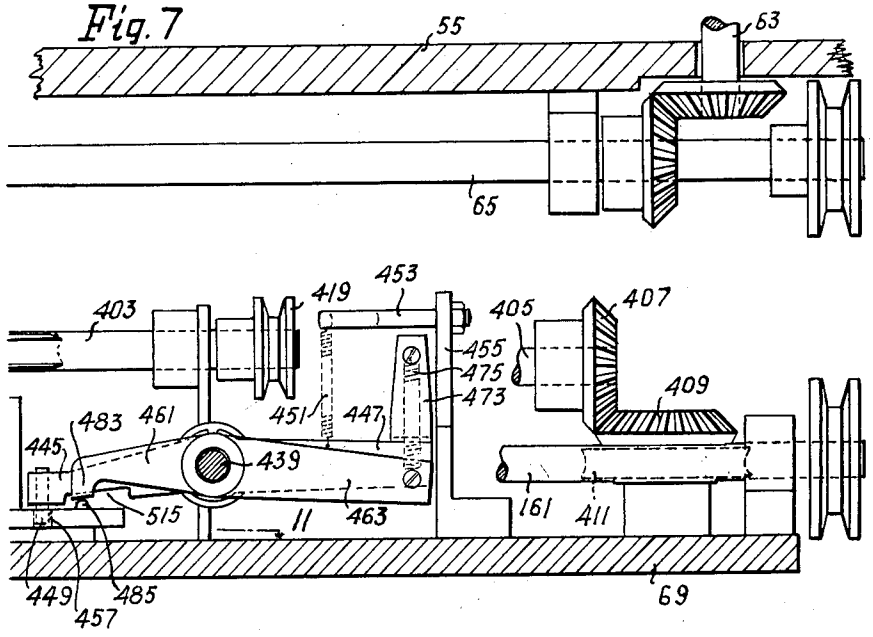
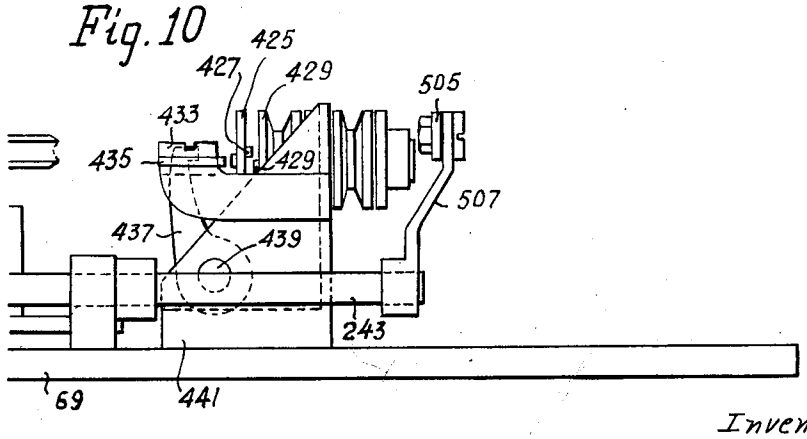


Fig. 10



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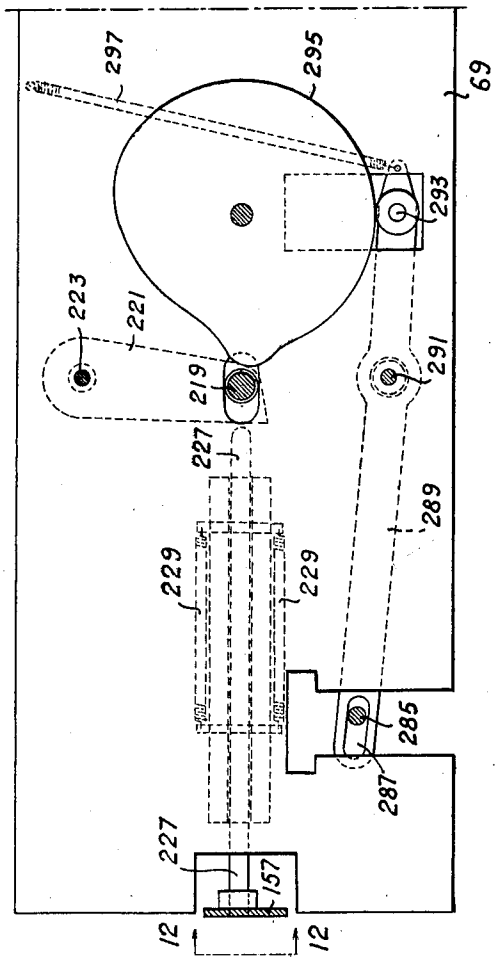

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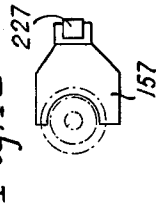

Fig. 12

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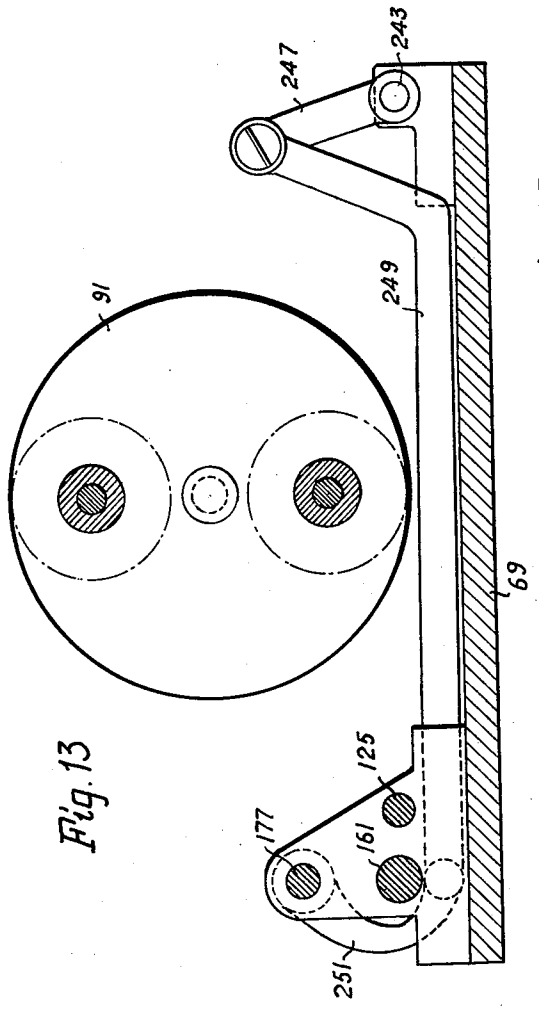

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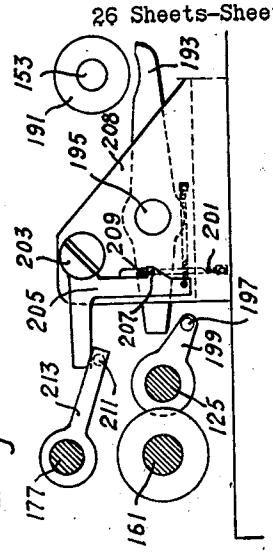

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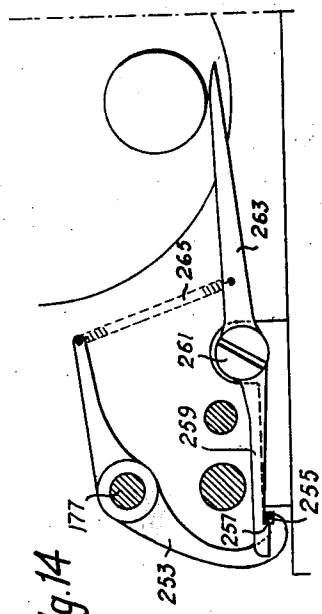

Fig. 14

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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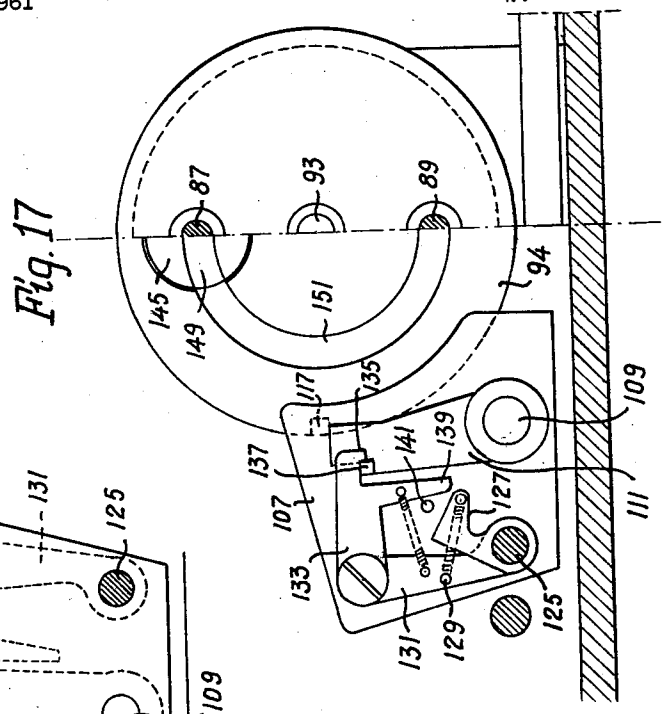

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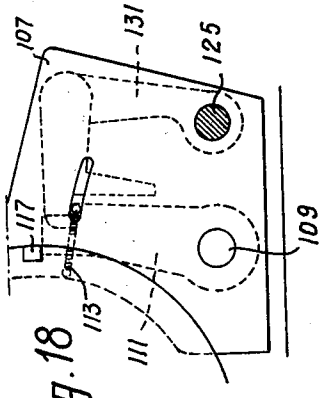

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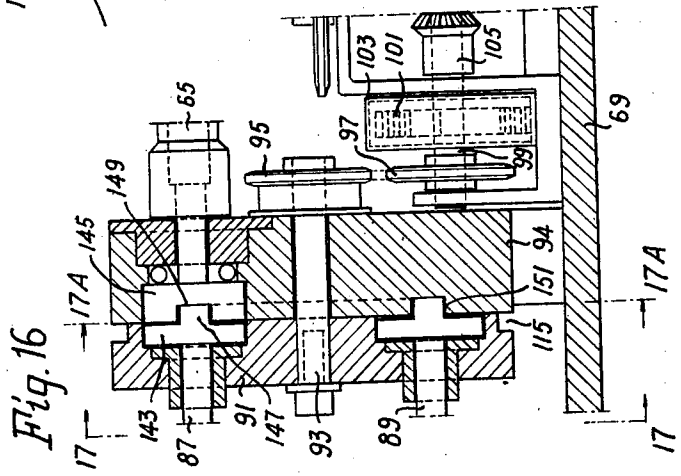

Fig. 16

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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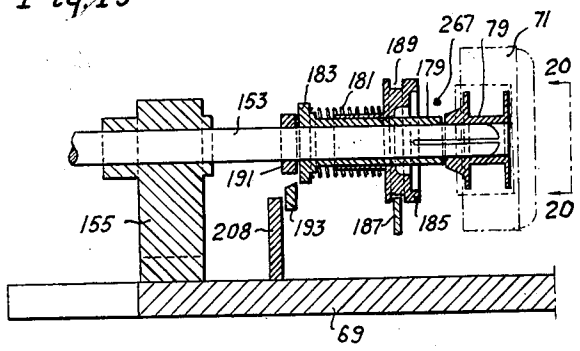
Fig. 19



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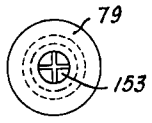

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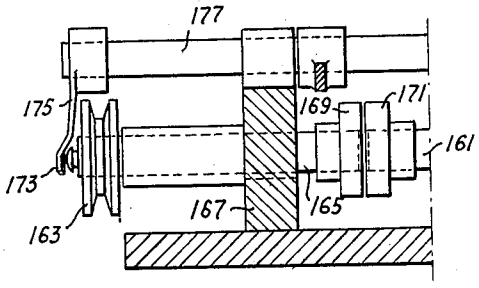

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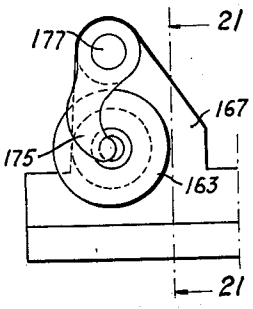

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March 24, 1964 D. N. BERNÉRUS ETAL 3,125,973

ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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Fig. 24

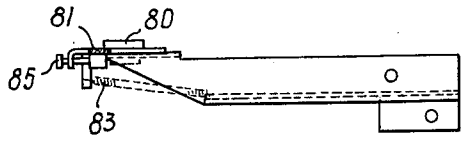
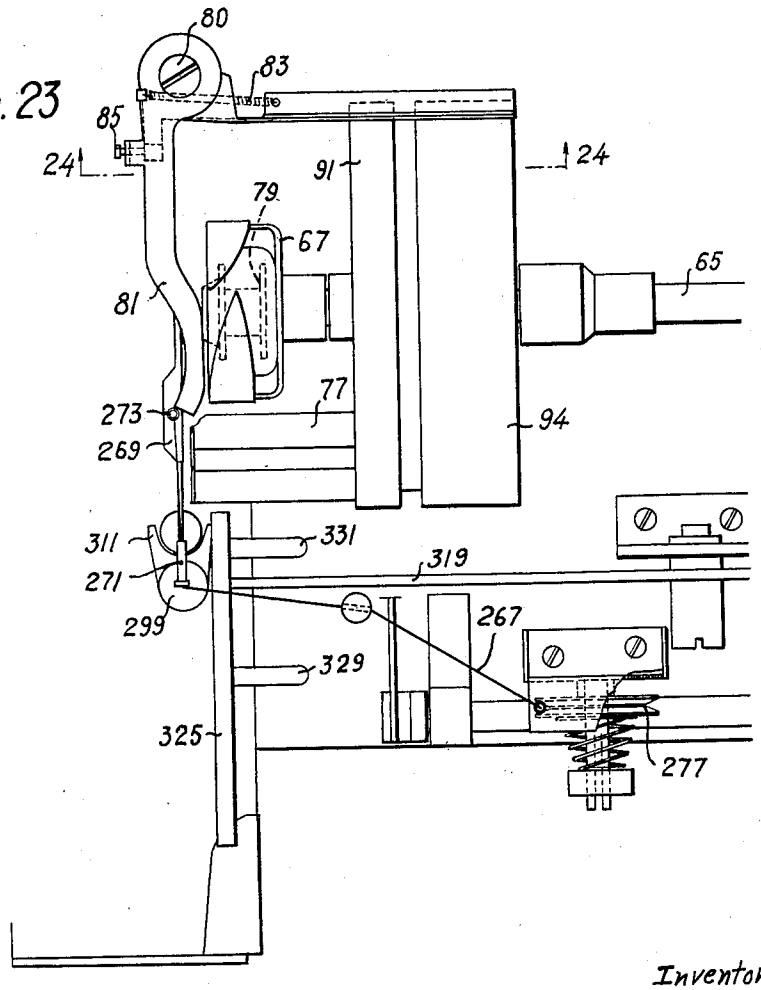


Fig. 23



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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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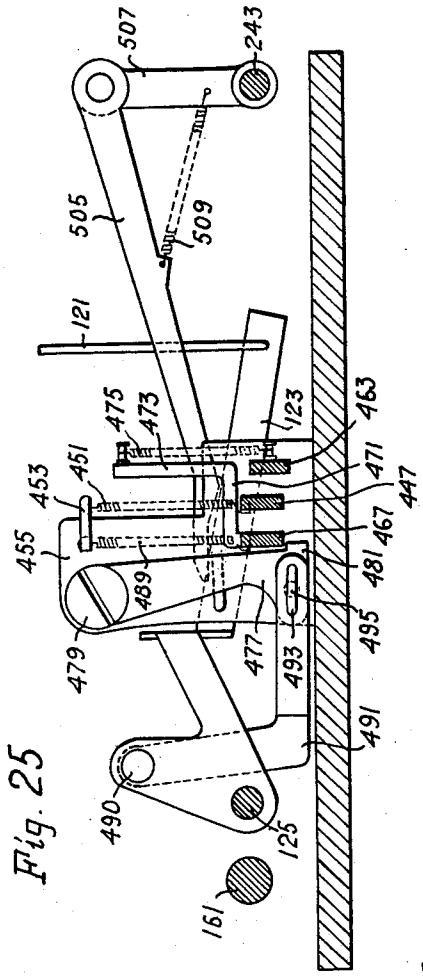

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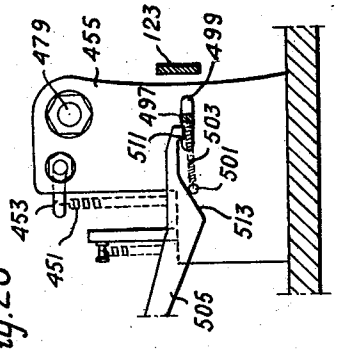

Fig. 26

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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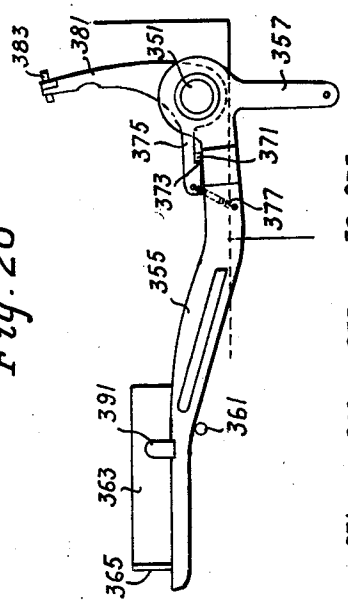
Fig. 28



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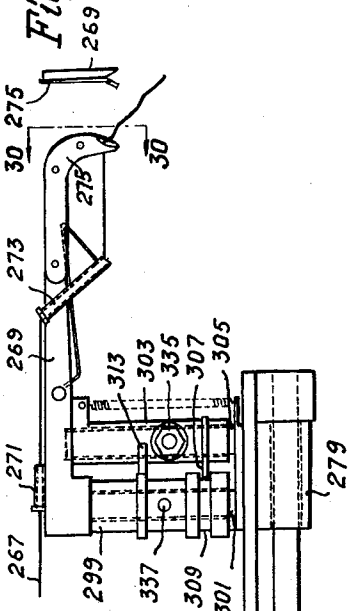

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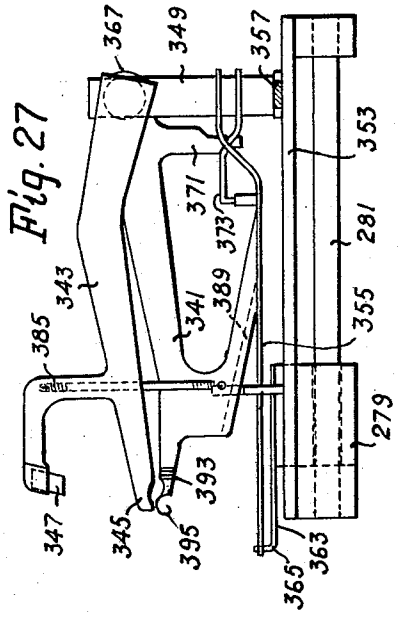

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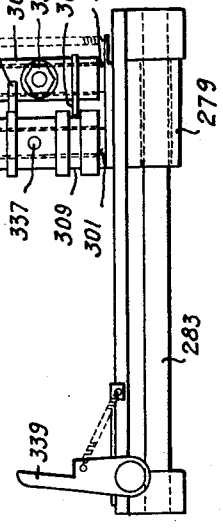

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March 24, 1964 D. N. BERNÉRUS ETAL 3,125,973

ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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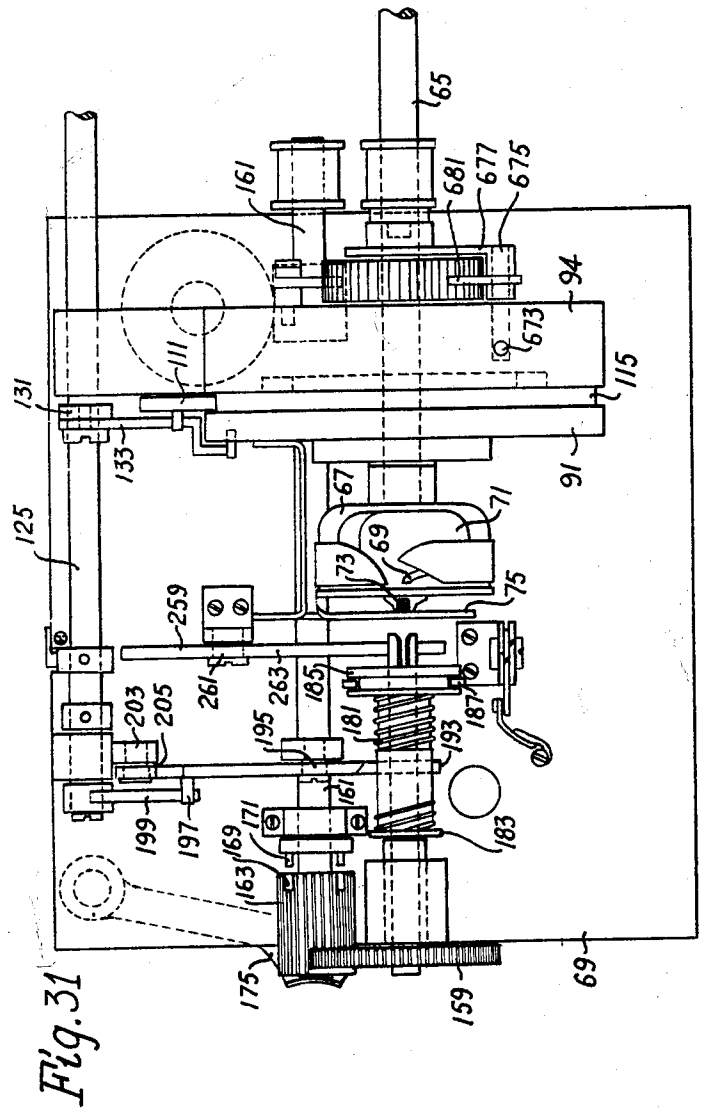

Fig. 31

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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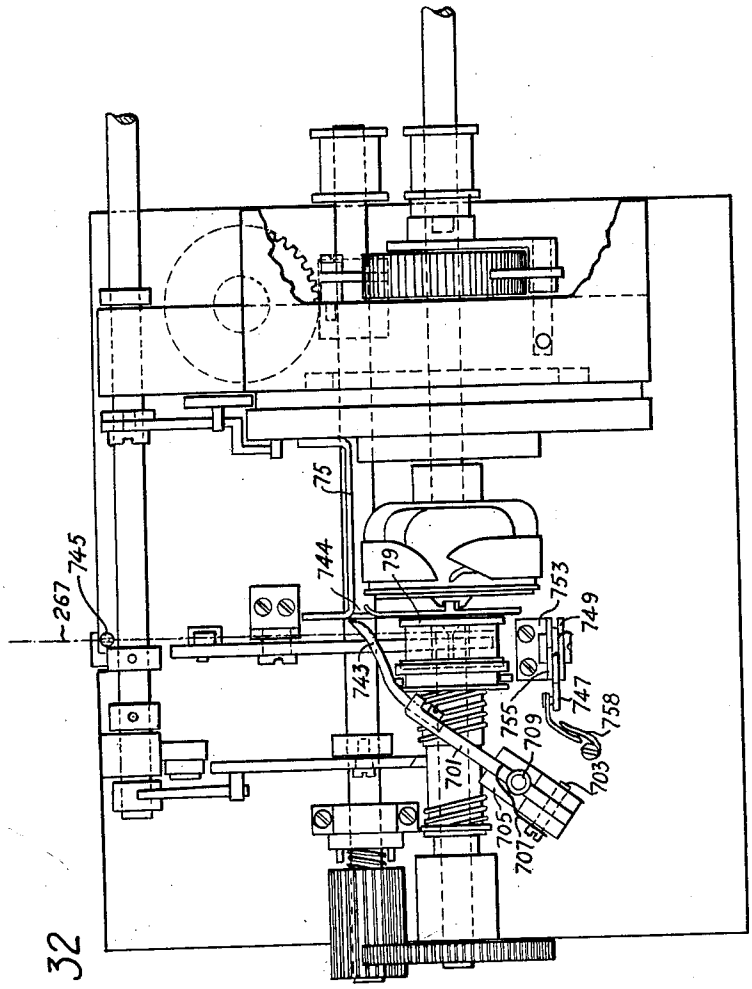

Fig. 32

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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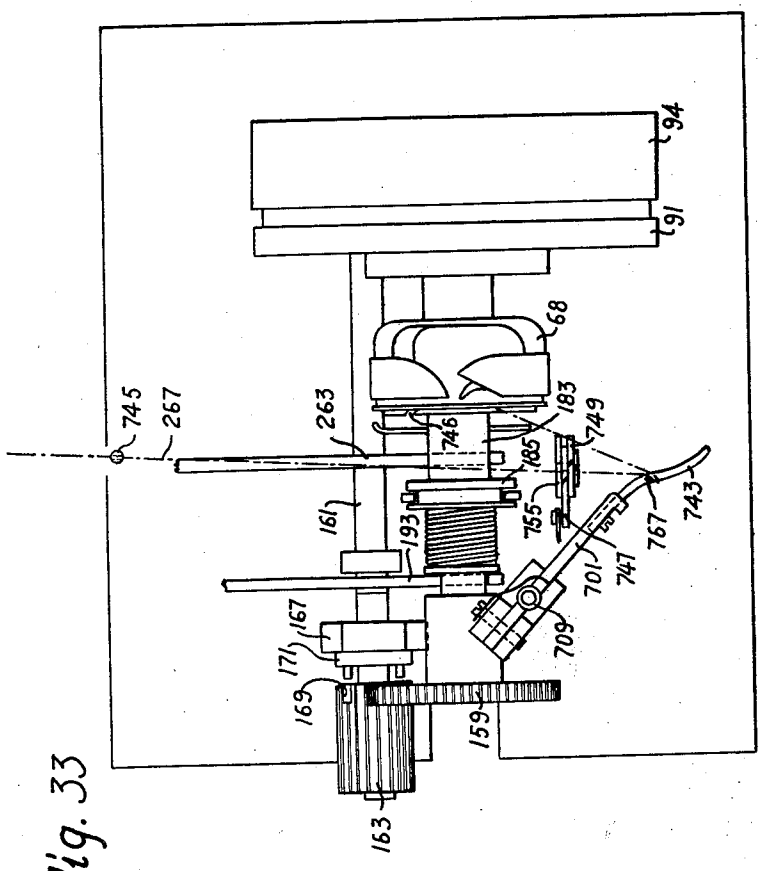

Fig. 33

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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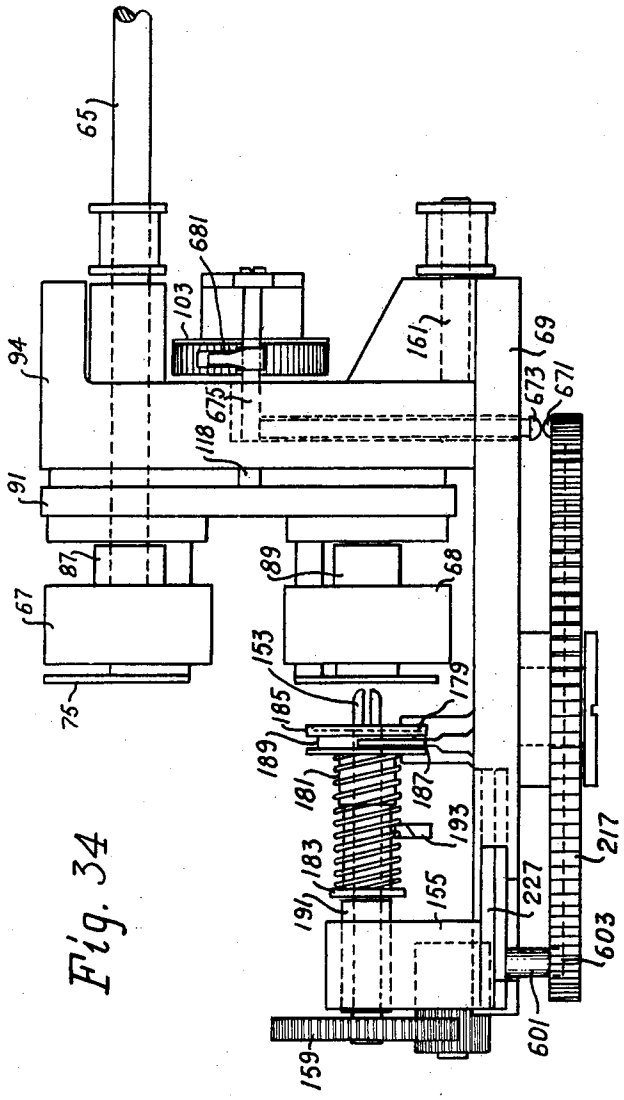

Fig. 34

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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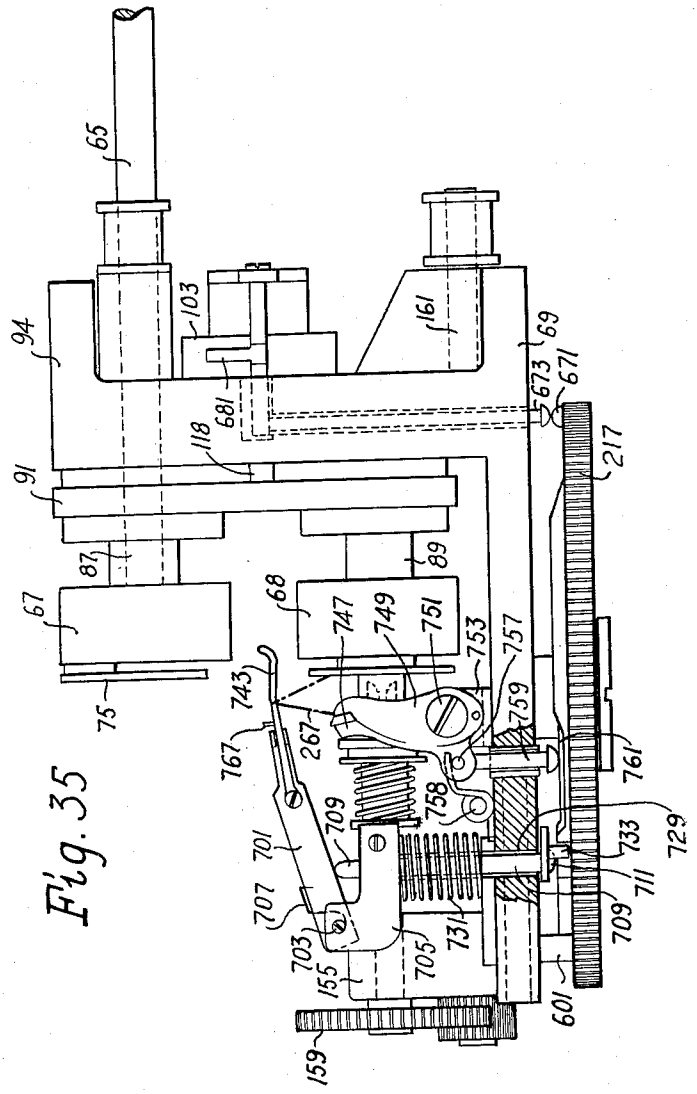

Fig. 35

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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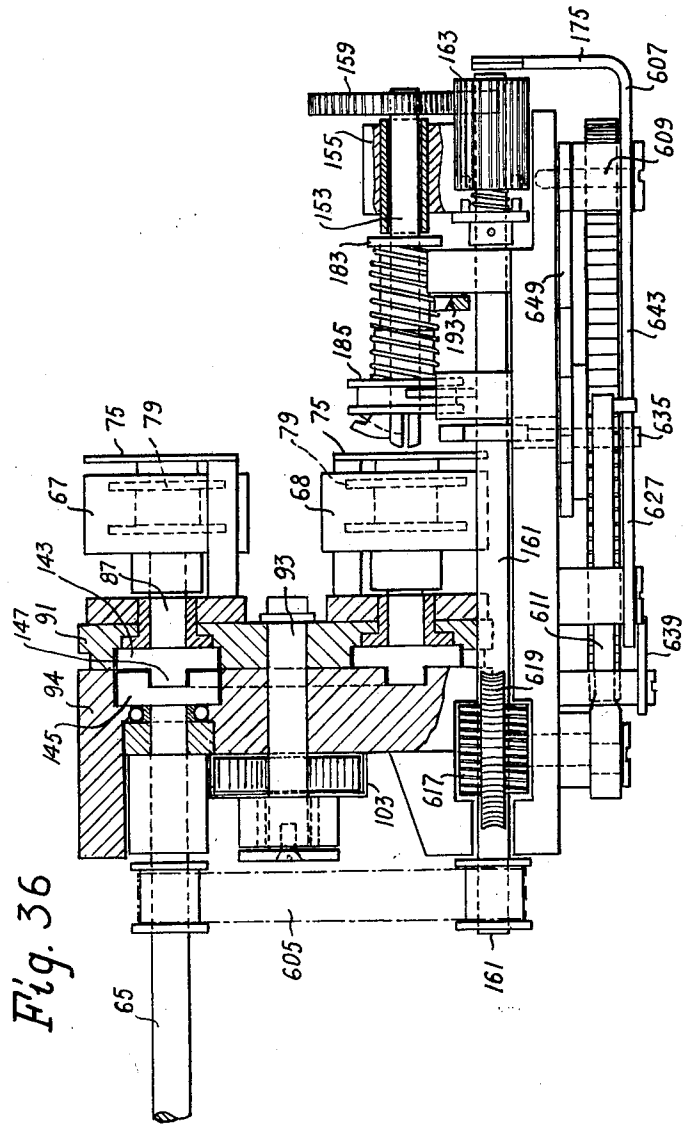

Fig. 36

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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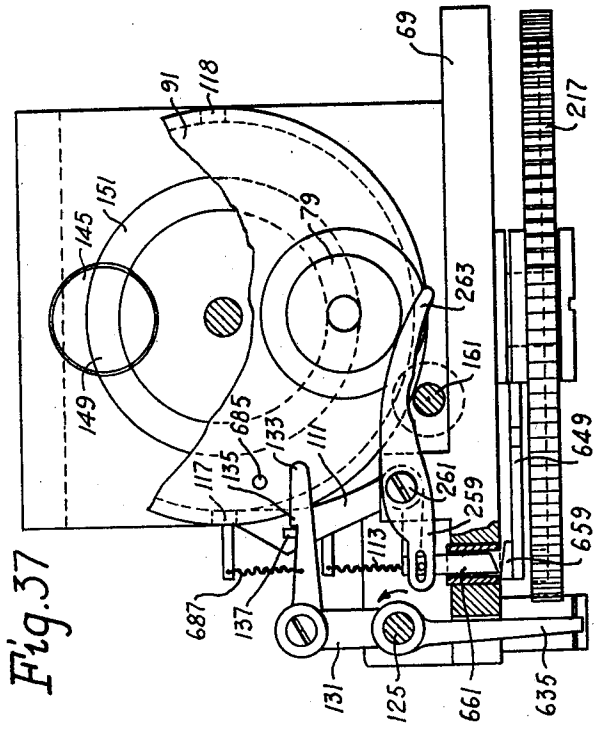

Fig. 37

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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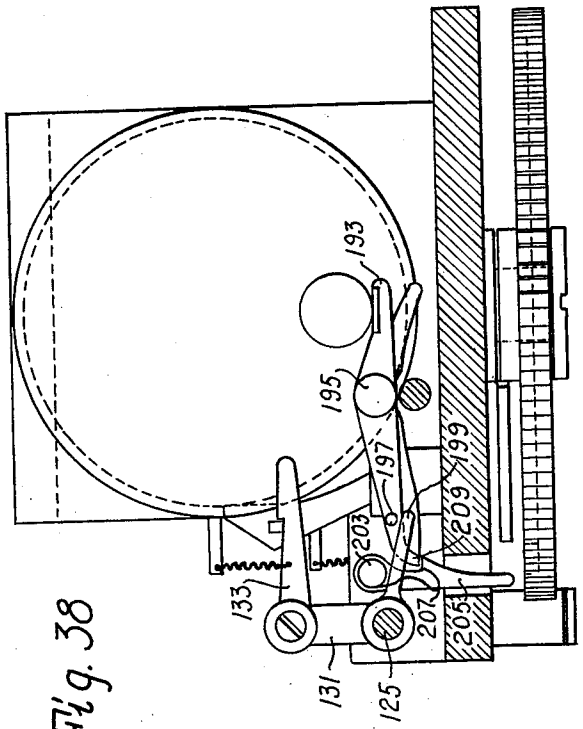

Fig. 38

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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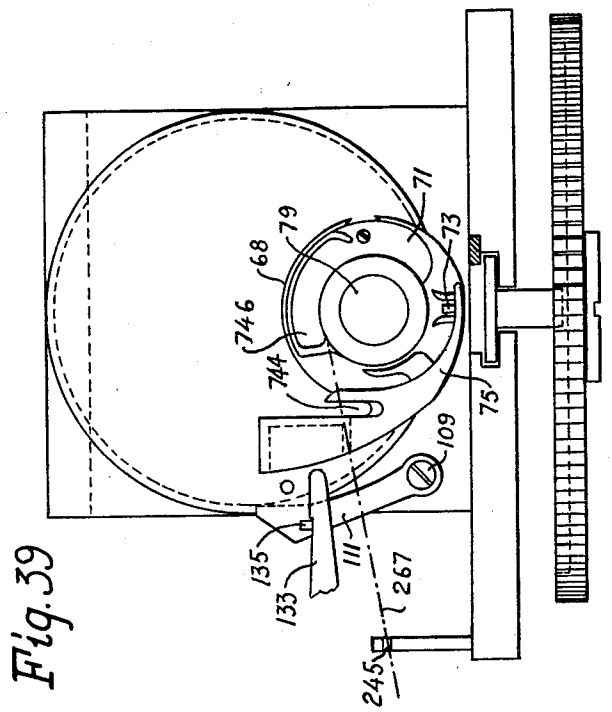

Fig. 39

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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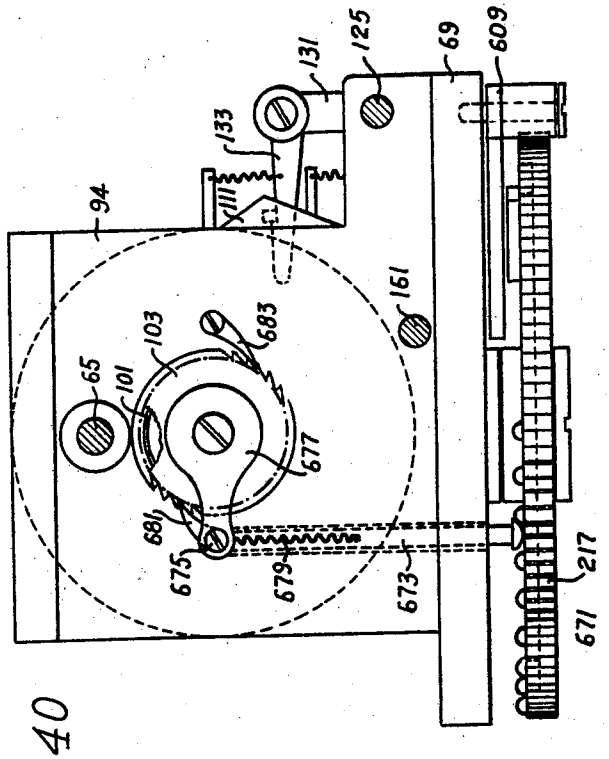

Fig. 40

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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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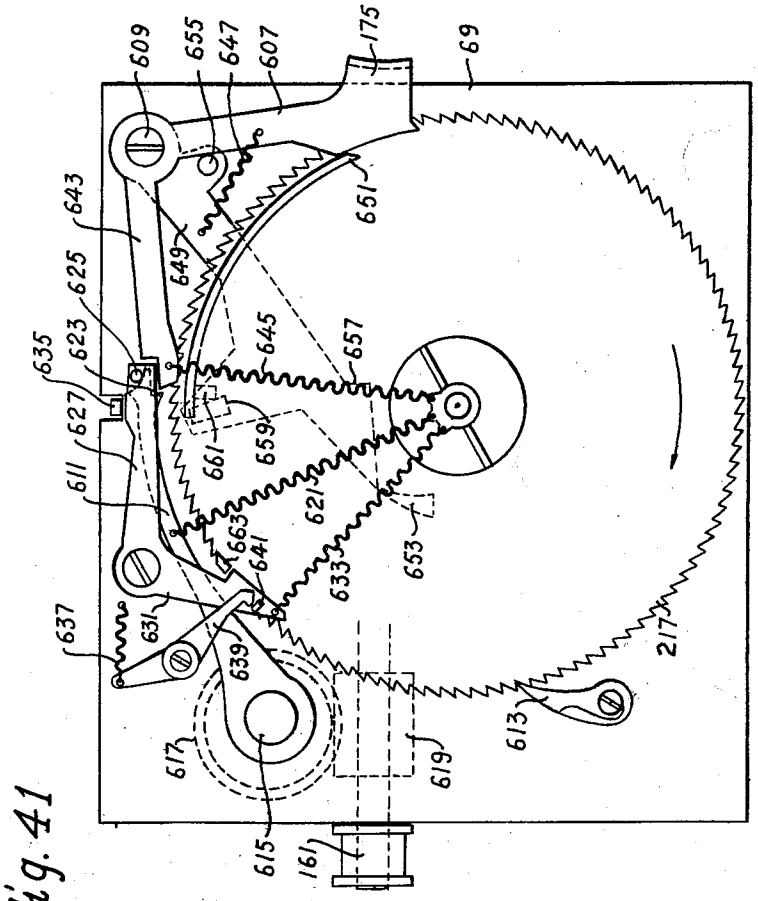

Fig. 41

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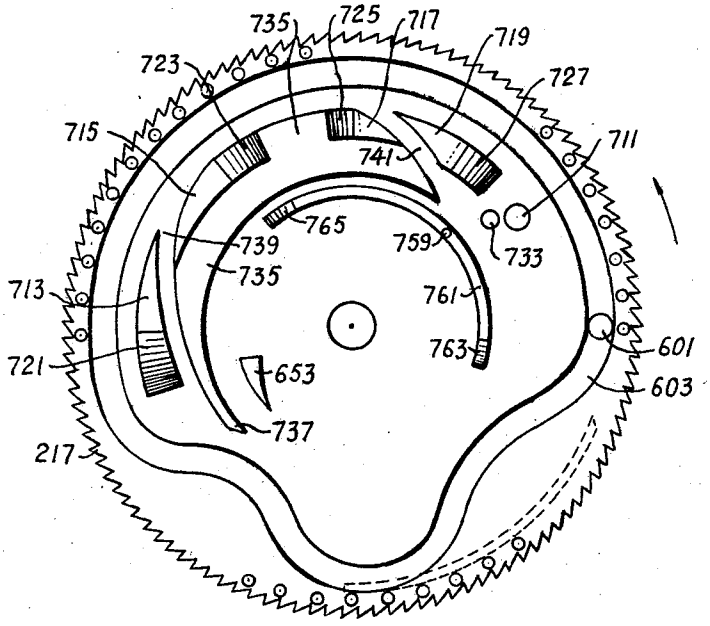
Fig. 42



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ARRANGEMENT IN SEWING MACHINES FOR EXCHANGING BOBBINS

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The present invention relates to sewing machines of the kind in which a bobbin provided with a bottom thread is arranged within a rotary hook or shuttle adapted to cooperate with an upwardly and downwardly moving sewing needle in order to bring the bottom thread through a loop formed out of a top thread.

The bottom thread bobbin which merely can take a rather restricted length of thread, must be changed incessantly which means trouble and loss of time. Especially in garment factories, disturbing stops are caused thereby which considerably reduce the capacity of the machine. The object of the present invention is to eliminate said drawback by providing a mechanical shift of bobbins, which is initiated by the seamstress and which is effected almost instantaneously, so that the sewing can go on continuously and without irritating stops for bobbin changes.

The arrangement according to the invention is characterised essentially in that two, or more, hooks or shuttles are alternately adjustable in a position for cooperation with the needle (working position) and in the provision of means for removal of the bobbin from the hook and the insertion into the hook of a bobbin respooled with thread when the hook takes another position than the first-mentioned position. In a preferred practical embodiment of said basic idea of the invention, two hooks are attached to a preferably disc-shaped holder revolving about a horizontal axis, in such positions symmetrical about said axis that the hooks are shifted when the holder is turned 180°, so that one hook is transferred from the working position to a spooling position simultaneously as the other hook is transferred from said spooling position to the working position.

Further features of the invention will appear from the following description of two embodiments of the invention, which are shown in the accompanying drawings, in FIGS. 1 to 30 and FIGS. 31 to 42, respectively. FIG. 1 is a side view on a reduced scale of a sewing machine equipped with the arrangement according to the first embodiment of the invention. FIGS. 2, 3 and 4 are partial views which should be placed at the side of each other in numerical order from the left to the right and which form together a top plan view and horizontal cross section taken approximately from the line 2—4 in FIG. 1. FIGS. 5, 6 and 7 form together an elevational view and vertical cross section taken from the line 5—6—7 in FIGS. 2, 3 and 4. FIGS. 8, 9 and 10 form a corresponding vertical view and cross section taken from the line 8—9—10 in FIGS. 2, 3 and 4. FIG. 11 is a horizontal view and section on a half scale, taken from the line 11—11 in FIGS. 5, 6 and 7. FIG. 12 is an end view taken from the line 12—12 in FIG. 11. FIG. 13 is a vertical view and section taken from the line 13—13 in FIG. 2. FIG. 14 is a vertical view and section taken from the line 14—14 in FIG. 2. FIG. 15 is a vertical view and section taken from the line 15—15 in FIG. 2. FIG. 16 is a vertical view and section of the hook holder etc. taken from the line 16—16 in FIGS. 2 and 3. FIG. 17 is a vertical view at right angles thereto, the right-hand half being taken from the line 17—17 and the left-hand half being taken from the line 17A—17A in FIG. 16. FIG. 18 is a vertical view of a part of FIG. 17 taken from opposite side or from the line 18—18 in FIG. 3. FIG. 19 is a vertical section of the spooling mechanism taken from the line 19—19 in FIG. 2. FIG. 20 is an end view taken from the line 20—20 in FIG. 19. FIG. 21 is a vertical view and section of a coupling device taken from the line 21—21 in FIG. 2 and in FIG. 22. FIG. 22 is an end view taken from the line 22—22 in FIG. 2. FIG. 23 is a horizontal view corresponding to parts of FIGS. 2 and 3 but completed with details for which there is no room in said figures. FIG. 24 is a view of a detail in FIG. 23 taken from the line 24—24 in FIG. 23. FIG. 25 is a vertical view and section taken from the line 25—25 in FIG. 4. FIG. 26 is a view of a part of FIG. 25 taken from the opposite side or from the line 26—26 in FIG. 4. FIG. 27 is a vertical view of the thread-cutting device taken from the line 27—27 in FIG. 2. FIG. 28 is a horizontal view of a part of the thread cutting device. FIG. 29 is a vertical view of the thread conveyer and the pertaining details taken from the line 29—29 in FIG. 8. FIG. 30 is an end view of a detail taken from the line 30—30 in FIG. 29.

FIG. 31 is a top plan view of the second embodiment of the invention. FIG. 32 is a similar view with the thread conveyer shown, and FIG. 33 is a similar view with the thread conveyer in another position, FIG. 34 is a side view, FIG. 35 is a view from the same side with the thread conveyer shown, and FIG. 36 is a side view from the opposite side. FIGS. 37, 38 and 39 are end views taken from the left in FIGS. 31 to 35 with different parts shown, and FIG. 40 is an end view taken from the right in FIGS. 31 to 35. FIG. 41 is a view taken from below. FIG. 42 is a top plan view of a detail.

The sewing machine shown in FIG. 1 and to which the invention is applied, may be of a known design in everything concerning the stitch forming. Thus as usual it has an arm 51 provided with a presser foot 53 which can be let down on to a bed plate 55, upon which the work piece is fed by means of any known step feeding device. The arm 51 also carries a vertically reciprocating needle bar 57 the lower end of which carries a needle 59 through the eye of which a top thread is passed. The needle bar is driven by a horizontal shaft having a belt pulley 61. By means of a vertical intermediate shaft 63 and bevel gears said first-mentioned shaft also is connected to a drive shaft 65 for the turning of a hook 67 also termed a shuttle. Said hook or shuttle encloses a bobbin with bottom thread and is constructed in a known manner so that a loop of the top thread brought down through the bed plate by the needle 59 is widened and turned over the bobbin, whereupon the loop is let loose so that the top thread can be stretched upwardly, thereby forming a stitch. For every second revolution of the hook and for every reciprocation of the needle a stitch is formed.

The parts which according to the invention are added for the hook shift, are essentially housed in a case-like space below the sewing machine proper and situated between said bed-plate 55 and a bottom-plate 69. The plate 55 with the sewing machine is preferably removable, so that the details of the device which mainly are mounted on the bottom plate 69 are accessible for overhaul.

The hook 67 (FIG. 2) is mainly of conventional design. It comprises an outer rotary part with a guiding member 69 for catching the top thread and widening and carrying the loop thereof around, and a bobbin case 71 which is enclosed in said part and prevented by a catch 73 from taking part in the rotation. The catch 73 is formed upon an arm 75 (see also FIG. 5) which is held by two carrying rods 77. The bobbin 79 (see FIGS. 19 and 20) carrying the bottom thread is loosely inserted in bobbin

case 71. Characteristic for the invention is that the bobbin case 71 is open at one side, so that the bobbin 79 in order to be respooled with thread can be removed out of the bobbin-holder through an axial displacement. When the hook 67 is in the shown working position, the bobbin is prevented from being axially displaced by means of arm 81 swingable about a pivot 80 and attached to the machine frame (see FIGS. 23 and 24), which arm by means of a coiled spring 83 is held in engagement with the outer end of the bobbin. When desired, the arm 81 can be swung away at an angle of 90 degrees, and its shut end position is adjustable by means of a screw 85.

According to the invention, provided in addition to the hook 67 is a second identically shaped hook 68 (FIG. 5). Said two hooks are arranged to be able to shift their positions so that one or the other of them can take the working position in which it cooperates with the needle in order to form a seam, while the hook that is not in the working position, instead is situated in a position (spooling position) in which its bobbin can be removed and new thread be spooled upon the same. The hook 67 is shown in the working position and the hook 68 in the spooling position.

The two hooks 67, 68 are fastened to horizontal shafts 87, 89 (see FIG. 5 and particularly FIG. 16) which are journalled in a hook holder 91 in the shape of a vertically placed disc attached with its centre to a horizontal shaft 93. Said shaft is journalled in a support 94 connected to the bottom plate 69 also having the shape of a vertically placed disc and against the flat side of which the holder 91 bears. By means of chain pulleys 95, 97 and a chain put around them the shaft 93 is connected to a shaft 99 (FIGS. 6 and 16) which is fastened to the innermost turn of a coiled spring 101. Said spring is enclosed in a cover 103 against which the outermost turn of the spring slides with heavy friction. The cover is rigidly attached to a shaft 105 which in a manner to be described below, is periodically turned, whereby the spring 101 is tensioned until the spring force has risen so much that the spring slides relatively to the cover 103. In this way the shaft 99 and therefore the shaft 93 will always be under a suitable tension which strives to turn the hook-holder 91.

The hook-holder 91 is held in one of two diametrically opposite positions by means of a latch device which will now be described with reference mainly to FIGS. 17 and 18. A supporting plate 107 (see also FIG. 2) which is attached to and partly let into the support 94, carries a latch 111 pivotable about a stud 109. By means of a coiled spring 113 the outermost end of said latch is held in engagement with the bottom of a groove 115 (see FIG. 16) in the circumference of the holder 91. Two diametrically opposite shoulders 117, 118 (FIGS. 2 and 5) project from the bottom of said groove 115, and due to the force of the spring 101 one of them is normally held in engagement with the end of the latch 111.

When the thread on the bobbin of the hook 67 situated in the working position is finished and it is desired to replace said hook with the hook 68 which, as will be described below, has had its bobbin respooled with thread during the interval of its remaining in the spooling position the latch 111 is temporarily retracted so that the shoulder 117 is released. Under the action of the spring 101, then holder 91 is turned about its shaft until the latch 111 which in the meantime has snapped back into the groove 115, catches the other shoulder 118. Then the holder 91 has turned 180 degrees about its axis, so that the hook 68 takes exactly the working position just before taken up by the hook 67, whereas the latter has been transferred into the spooling position.

The latch 111 is released by the seamstress by momentarily raising a hand lever 119 (FIG. 1) which by means of a link 121 is connected to a lever 123 (FIGS. 4 and 25) rigidly attached to a control shaft 125 (FIGS. 4, 3, 2, 15, 17, 18 and 25). Rigidly attached to said shaft is an arm 127 which by abutting against a pin 129 on an arm 131 turnable about the shaft 125, can swing said arm. At its outer end the arm 131 carries a latch 133 which by means of a dog 135 can catch a dog 137 upon the latch 111. When the arm 131 is swung anti-clockwise in FIG. 17, the dog 135 of the latch 133 retracts the latch 111 from the shoulder 117 so that the holder 91 is released for hook shift, and shortly thereafter the latch 133 is swung upwardly by a projection 139 thereon abutting against a pin 141 attached to the plate 107. Then the dog 135 releases the dog 137, so that the latch 111 can be swung back under the action of the spring 113 and catch the next shoulder 118, so that the turning of the holder 91 is restricted to 180 degrees. When the hand lever 119 is then released the above described parts return to their starting positions shown in the drawings.

The shaft 87 of the hook 67 situated in the working position is coupled to the drive shaft 65 by means of a coupling consisting of two halves 143, 145 (FIG. 16) and according to the invention so constructed that coupling together of said halves is possible merely in a certain relative angle position of the shafts 87 and 65. That is because the movement of the hook must be coordinated with the movement of the needle bar, and when shifting hooks said coordination of the relative positions must not come in disorder. Simultaneously the coupling is so constructed that it can be disconnected merely in a certain angle position of the drive shaft 65, corresponding to upwardly retracted sewing needle. As shown in FIGS. 16 and 17, to this end one coupling half 143 is formed with a diametrically extending bar 147 and the other coupling half 145 with a diametrically extending groove 149. The bar as well as the groove may be of a rectangular cross section and of almost the same size, so that the bar projects into the groove with merely a slight play. As viewed in an axial direction (FIG. 17) the bar as well as the groove are curved with the shaft 93 as a centre. Provided in the support 94 is a guide in the shape of a groove 151 concentric to the shaft 93 and forming an almost closed circle. Said groove is made with the same profile as the bar 147 and serves to guide the latter when the holder 91 is turned, thereby preventing the hook from turning freely. The ends of the guide 151 are located opposite to the ends of the groove 149 of the coupling half 145, and at the end of the 180 degrees of turning of the holder when shifting the hooks, therefore the bar 147 guided by the groove guide 151 will be inserted into the groove 149, the connection of the shaft 65 either to the shaft 87 or to the shaft 89 therefore taking place with the correct relative angle positions. On the other hand, at the beginning of the turning of the holder 91 the bar 147 can be introduced into the guide 151 merely if the coupling half 145 is situated in the position shown in FIG. 17 in which it provides a continuation of the guide 151. Therefore, the above-described shift when the latch 111 is retracted, can take place merely if the sewing machine has been stopped with the shaft 65 in a predetermined angle position usually corresponding to the needle bar taking its uppermost position. The sewing machine may be so constructed that when the drive motor is disconnected the machine automatically stops in said position, or else it is necessary for instance to adjust a point of the belt pulley 61 (FIG. 1) opposite to a fixed index, before the hand lever 119 is actuated. Or the lever may be locked so that operation of the same is possible merely when the shaft 65 takes its above-mentioned position.

The device for spooling of thread upon the bobbin 79 of the hook 68 when the same is situated in the spooling position will now be described with reference mainly to FIGS. 5 and 19. Said devices comprise a spooling spindle 153 and a mechanism for retraction of the bobbin 79 out of the bobbin holder 68 and its reinsertion therein. The spooling spindle 153 is journalled in a bearing bracket 155 fastened to the bottom plate 69 and arranged concentric to the centre and turning shaft of the hook 68.

Said spindle is axially displaceable by means of a fork 157 engaging a groove in a pulley 159 attached to the spindle. The spindle can be turned by being coupled to the steadily rotating shaft 161 (FIGS. 2, 3, 4 and 21). By means of a belt the pulley 159 is coupled to a pulley 163 attached to the end of the shaft 165 which is displaceably journalled in a bearing bracket 167 and which carries a coupling half 169 that can be brought into engagement with a coupling half 171 upon the end of the shaft 161. Coupling is performed by an axial displacement of the shaft 165 by means of an inclined surface 173 upon the end of an arm 175 attached to a turnable releasing shaft 177, the operation of which will be more closely described in the following. When the shaft 177 and the arm 175 are swung anti-clockwise in FIG. 22, the shaft 165 is displaced so that the coupling 169, 171 is engaged and the shaft 165 is put in rotation and caused to turn the spooling spindle 153.

The end of the spindle 153 is slitted along two diametrical planes at right angles to each other (see FIGS. 19 and 20). The four fingers thus formed are elastically resilient and are so dimensioned that when pushed into the centre sleeve of the bobbin 79 they retain the bobbin by frictional engagement, whereby the bobbin takes part in the rotation of the spindle 153 as well as in its axial motion.

The mechanism for insertion and retraction of the bobbin further comprises a displaceable sleeve 179 which is thread upon the spooling spindle 153 and which is adjustable between a back position shown in FIG. 5 and a fore position shown in FIG. 19. It is influenced by a coiled spring 181 put around the same and abutting with its one end against a flange 183 on the sleeve and with its other end against a disc 185 loosely arranged upon the sleeve and axially retained by means of a fork 187 fastened to the bottom plate 69 and engaging a groove 189 in the circumference of the disc. By means of the spring 181 the flange 183 of the sleeve is held in engagement either with a ring 191 rigidly attached to the spooling spindle 153, or with a latch 193 (FIGS. 2, 5, 15 and 19) if the latter takes its upper position shown in FIG. 19. The latch 193 is pivoted on a stud 195 and can be swung by means of a pin 197 attached to the end of an arm 199 (FIGS. 2 and 15) rigidly connected to the abovementioned control shaft 125. The latch 193 is biassed by a spring 201 striving to raise its operative right end, but said latch can be locked in a lowered position by means of a latch 205 pivoted on a screw 203 and having a dent 207 catching a pin 209 on the latch 193, extending through a slot in the stationary supporting plate 208. The dent 207 can be retracted and the latch 193 released so that it returns to its upper position, and that is by swinging the latch 205 by means of a pin 211 upon an arm 213 which is rigidly attached to the above-mentioned control shaft 177. How the latter is actuated will be stated in the following.

Immediately before a hook shift the spooling spindle 153 is held retracted into the position shown in FIG. 2 and the flange 183 is in engagement with the latch 193. Therefore the end of the sleeve 179 bears against the bobbin 79 and keeps it in the correct position within the bobbin holder. When the hand lever 119 is operated in order to initiate a hook shift and in the above-described manner rocks the control shaft 125, the latch 193 is swung down so that the sleeve 179 is pushed by the spring 181 past said latch into contact with the flange 191. Therefore, immediately after the hooks have been shifted, the spooling spindle 153 and the sleeve 179 take their outer positions shown in FIGS. 2 and 5. Simultaneously the hand lever 119 starts a control mechanism 215 which will be closer described herein below and which turns one revolution per hook shift and which among others comprises the cam disc 217 (FIGS. 3 and 6). Against that disc there bears a roller 219 journalled upon an arm 221 (FIG. 11) located beneath the bottom plate 69 and pivoted about a stud 223. A rod 227 (FIGS. 5, 6, 11 and 12) displaceable in a guide 225 on the lower side of the bottom plate is pressed by coiled springs 229 into engagement with the arm 221 which in its turn presses the roller 219 into engagement with the cam disc 217. At its end the rod 227 carries the above-mentioned fork 157 by means of which the spooling spindle 153 is displaced in the longitudinal direction. The contour of the cam disc 217 comprises two depressions 231, 233, an intermediate crest and a subsequent part having the same radius as the crest 235. It is obvious therefore, that the spooling spindle 153 will be displaced back and forth twice per revolution of the control mechanism, i.e. per hook shift.

When the spooling spindle is moved forward, its slitted end penetrates into the bobbin 79 and grasps the same. The sleeve 179 follows the forward movement of the spindle and will be brought into engagement with the outside of the bobbin. The sleeve 179 also follows in the subsequent retraction of the spooling spindle, because in this case the latch 193 is swung down so that the flange 183 is still held pressed against the flange 191 on the spindle 153. Therefore the bobbin will remain seated upon the end of the spooling spindle and will follow the same when it is retracted out of the bobbin holder 71 and is brought into a position in contact with the supporting disc 189 which on its side facing the bobbin is shaped so as to correspond to the same with the object of being able to clasp an end of the bottom thread therebetween, as will be more closely described herein below.

Near the circumference the cam disc 217 is provided with an inclined knob 239 projecting from its flat upper side and adapted for cooperation with an arm 241 which is rigidly attached to a shaft 243 (FIGS. 2 to 4, 8 to 10, 13, 25) journalled on the bottom plate 69. Said shaft is under the steady influence of a coiled spring 245 (FIG. 4) striving to turn the shaft anti-clockwise, as shown in FIG. 13. Rigidly attached to the shaft 243 is an arm 247 which by means of a link 249 is connected to an arm 251 rigidly attached to the above-mentioned releasing shaft 177. The knob 239 is so situated that it passes below the arm 241 when the crest 235 on the cam disc is located opposite to the roller 219. When the knob passes underneath the arm 241, the latter is swung upwards, the shaft 243 being turned clockwise while stretching the spring 245. Said movement is transformed into a counter-clockwise turning movement of the releasing shaft 177 which, as mentioned above, causes that the hitching of the latch 193 (FIG. 15) is unlocked so that the same swings up. The turning of the releasing shaft 177 also effects, as described with reference to FIGS. 21 and 22, that the coupling 169, 171 is connected, whereby the spooling spindle is put in rotation. A thread which is fed and guided in a manner to be more closely described herein below, then is spooled upon the bobbin 79.

Rigidly attached to the releasing shaft 177 is a third arm 253 (FIG. 14). At its lower end said arm has a hitch 255 which can be engaged by a shoulder 257 upon one arm 259 of a two-armed lever pivoted on a screw 261. Connected to the other arm 263 of the lever is a coiled spring 265 striving to swing said arm counter-clockwise and thereby to safeguard the engagement of the hitch 255 and the shoulder 257. Due to said engagement the releasing shaft 177 is retained in its position caused by the knob 239, so that the same is not turned back by means of the spring 245 after the knob 239 has passed the arm 241.

The lever arm 263 shown in FIG. 14 serves to interrupt the rotation of the spooling spindle when the bobbin has been filled with thread. Its outermost end is located underneath the bobbin and in the position shown in FIG. 14 at such a distance thereto that it comes into contact with the outermost thread turns of the bobbin when the same has been sufficiently spooled up. Then the arm 263 is pressed down somewhat so that the hitch 255 is released by the shoulder 257 upon the upswung

lever arm 259. The shaft 177 which due to the connection to the shaft 243 is under spring tension and tries to turn clockwise, then rocks to its other extreme position, the hitch 255 on the clockwise swung arm 253 sliding against the lower side of the outermost end of the arm 259 and turning the lever 259, 263 clockwise so that the tip of the arm 263 serving as a feeler means, is somewhat retracted from the bobbin and brought out of the way of the following movement of the bobbin.

The release effected by the lever arm 263 when the bobbin is filled and the clockwise rocking of the shaft 177 caused thereby further involves that the arm 175 (FIG. 22) is swung to the left so that the shaft 165 gets free to be displaced to the left in FIG. 21 by the action of a spring (not shown), whereby the coupling 169, 171 is disconnected so that its own rotation and the rotation of the spooling spindle is stopped.

By the above-mentioned clockwise rocking motion of the shaft 177 also the arm 213 is swung back to its position of FIG. 15, so that the latch 205 is swung back and its dent 207 takes the position shown. However, at this stage the arm 193 is held swung upwardly, and therefore the pin 209 attached thereto is located beneath the dent 207.

When the control mechanism 215—which has been stopped in a manner to be described below, in the position where the crest 235 of the cam disc 217 is located opposite to the roller 219—is started anew, also as a consequence of the clockwise rocking of the releasing shaft 177, the roller 219 runs down into the second depression 223 on the cam disc 217 and the spooling spindle 153 is displaced to the right for the second time. The sleeve 179 is entrained also in said motion on account of its flange 183 still being in contact with the ring 191 on the spooling spindle. When the flange 183 passes the latch 193 now in its upper position, the flange slides against an inclined surface on the upper side of the latch and forces the same slightly downwards. As soon as the flange has wholly passed the latch 193, the latter swings back upwardly under the action of the spring 201. FIG. 19 shows the bobbin insertion mechanism in the position taken when the roller 219 has reached the bottom of the depression 233. Now the filled bobbin 79 has been reinserted in the bobbin holder 71 but the end of the spooling spindle still is left inserted in the bobbin. During the continued movement of the control mechanism the spooling spindle is retracted for the second time. Now however, the sleeve 179 does not follow but its flange is held stopped by the latch 193, so that the sleeve remains in the forward position shown in FIG. 19 and supports the side of the bobbin while the spooling spindle is displaced to the left, its end thereby being drawn out of the bobbin 79. In the end position the end of the spooling spindle has been completely drawn out of the bobbin and the hook 68 loaded with a refilled spool is ready to be shifted to the upper position, the working position.

The thread 267 (FIG. 29) coming from a supply roll (not shown) is led forth to the retracted bobbin 79 by means of a thread conveyer device shown in FIG. 29 and also in FIGS. 2, 8 and 23. Said device comprises a thread conveyer arm provided with two tubular guides 271, 273 through which the thread is drawn. Riveted to the outermost downwardly directed end of the arm 269 is a blade spring 275, the somewhat outwardly bent end of which together with the obliquely chamfered point of the end of the arm forms a forklike spring clip (see FIG. 30) in which the thread 267 easily can be inserted and retained. In a ready position of the thread conveyer arm the thread is held stretched horizontally between said spring clip and the lower end of the guide tube 273. The thread is supplied to the thread conveyer via a thread tensioning means 277 shown in FIG. 23, and is held stretched thereby. In said ready or rest position the said thread conveyer arm 269 takes the position of FIG. 2, and the part of the thread 267 horizontally suspended on its underside then is located somewhat above the end of the sleeve 179 in its forward position, as is shown in FIG. 19. Thus the thread is held across the path in which the bobbin moves when retracted, and when the bobbin 79 is drawn out the thread will be clasped between the end face of the bobbin and the supporting disc 185. When the bobbin is then turned, the thread is snatched out of the spring clip at the tip of the thread conveyer arm, and the thread then runs from the tubular guide 273 down onto the bobbin where it is spooled up.

From its shown forward position the thread conveyer arm 269 is displaceable in a direction transverse to the spooling spindle 153, to a retracted position. For said motion the thread conveyer arm is attached to a block 279 which is guided upon two parallel rods 281, 283 attached to the bottom plate. Said rods are horizontal and arranged at right angles to the spooling spindle 153.

Provided on the under side of the block 279 is a pin 285 projecting into a slit 287 (FIG. 11) in the end of a lever 289 pivoted on a stud 291 attached to the bottom plate and rockable in the horizontal plane. The other end of the lever carries a roller 293 adapted to cooperate with a flat cam disc 295 forming a part of the control mechanism 215. A coiled spring 297 connected to the lever 289 keeps the roller 293 in contact with the cam disc 295. Its contour is such that it rocks the lever 289 back and forth once per revolution and thereby moves the block 279 and the thread conveyer arm 269 attached thereto, away from the spooling spindle and then returns them to the shown position.

The thread conveyer arm 269 is displaceable also vertically. It is attached to sleeve 299 which surrounds and can be raised and lowered relatively to a vertical pillar 301 attached to the block 279. A second sleeve 303 is displaceable in a similar manner upon a pillar 305 attached to the block 279. The sleeves 299 and 303 are mutually connected in their vertical movements by means of a fork 307 attached to the latter and projecting into a groove 309 on the former. The sleeve 303 is prevented from being turned by a lug 309 (FIG. 2) thereon being guided by a vertical pin 311 attached to the block. On the other hand the sleeve 299 carrying the thread conveyer arm can be rocked somewhat, a fork 313 connected thereto enclosing the sleeve 303 with a certain play. On account thereof the end of the thread conveyer arm can be rocked back and forth along the length of the bobbin. The left extreme position shown in FIG. 2 is taken at the beginning of the spooling operation, and an extreme position to the right is taken by the thread conveyer arm when the same is moved back from the bobbin, in order thereby to be able in a more convenient manner to slip the thread behind a tensioning washer arranged upon the bobbin holder.

The adjustment of the thread conveyer arm 269 in the vertical direction is also derived from the control mechanism 215 which to this end is provided with a curve path formed upon the end of a sleeve-like control means 315. Against said curve path there bears a pin 317 attached to the end of a lever 319 pivoted on a stud 321 attached to the bed plate. A coiled spring 323 is connected to the lever 319 and maintains the pin 317 in contact with the curve path when the same rotates, the lever thereby being rocked in a vertical plane. Attached to the other end of the lever 319 is a horizontal guide consisting of two parallel rods 325, 327 arranged above each other and connected by yokes 329, 331. The rods 325 and 327 enclose from opposite sides a roller 335 fastened to the side of the sleeve 303. The guide formed by the rods 325, 327 is parallel to the guide provided for the block 279 and therefore, when the block 279 is displaced horizontally, the roller 335 runs in its guide without being influenced in the vertical direction. When the lever 319 is rocked by the action of

the spring 323 and the curve path of the control means 315, the guide 325, 327 is raised and lowered bringing with it the roller 335 and the sleeve 303 which in its turn by means of the members 307, 309 entrain the sleeve 299 to which the thread conveyer arm 269 is attached.

Attached to the side of the sleeve 299 is a pin 337 (FIGS. 2 and 29) which comes into contact with a spring-loaded arm 339 pivoted to the bottom plate, when the block 279 with the thread conveyer arm is brought near to its most retracted position. Thereby the sleeve 299 is swung until the right branch of the fork 311 is stopped by the side of the sleeve 303, and in this manner the thread conveyer arm is moved with its outermost end towards a thread cutting device now to be described.

The thread cutting device (FIGS. 2, 8, 27 and 28) which is placed laterally of the guide 281, 283 of the thread conveyer in order to be operated by the block 279 essentially consists of two parts, viz. a thread catcher 341 and a knife holder 343. The knife holder 343 consists of a horizontal arm, the free end 345 of which is bent to the right (FIG. 2) in order to project into the path of the thread, as will be more closely described in the following, and which with an extension bent upwardly and to the right, holds a knife blade 347. At its other end the knife holder 343 is rigidly attached to a sleeve 349 which is pivoted upon a vertical pillar 351 attached to a plate 353 joined to the bottom plate 69. Rigidly attached to the sleeve 349 is also a guide arm 355 and another arm 357 to which a coiled spring 359 is connected, which strives to swing the guide arm 355 to the right away from the pin 361 forming an end abutment therefor. Attached to the upper side of the block 279 is a plate 363, an upturned edge 365 of which co-operates with the right edge of the guide arm 355. Said edge is so bent that when the block 279 is being pushed back (to the right in FIG. 27) the guide arm 355 is swung by the action of the spring 259 in the clockwise direction as seen in FIGS. 2 and 28. The sleeve 349 and the knife holder 343 attached thereto are entrained in said swinging motion, so that when the block 279 and the thread conveyer arm 269 have reached their most retracted positions, the end of the thread conveyer arm then having been swung to its extreme left position as just mentioned, the knife holder has been swung to the right so far that its bent end 345 and also the knife blade 347 are situated in the same vertical plane as the outermost free end of the thread conveyer arm. In said position the thread 269 is held inserted in the spring clip of the thread conveyer arm and is suspended between the same and the bobbin inserted in the hook 68. The relative vertical position is such that the end of the arm 345 is located closely above the thread which is stretched approximately horizontally from said spring clip.

The thread catcher 341 is pivoted on a screw 367 (FIG. 8) on the side of the sleeve 349 and can swing in a vertical plane between an upper end position determined by a pin 369 (FIG. 2) attached to the knife holder 343 and a lower position in which it is locked by the end of a downwardly directed projection 371 on the thread catcher 341 snapping behind a recess 373 formed upon one arm 375 of a bell crank lever 375, 381. Said bell crank lever in journalled upon the pillar 351 independently of the sleeve 349 and so as to be rockable in the horizontal plane. A coiled spring 377 connected between a pin 379 attached to the guide arm 355 and the arm 375, strives to maintain the latter in engagement with the projection 371. Th other arm 381 of the bell crank lever carries at its end an adjustment screw 383 with which the sleeve 299 comes into contact when the same approaches its backward position during the retraction of the thread conveyer arm 269. Then the bell crank lever 375, 381 is swung clockwise so that the engagement with the recess 371 ceases. The thread catcher 341 then quickly snaps into its upper extreme position under the action of a strong coiled spring 385 which is connected between the thread catcher and a bent lug 387 on the knife holder 343. At its lower edge the thread catcher 341 is formed with an inclined rail or ramp 389 projecting therefrom in the lateral direction and co-operating with a hook 391 (best shown in FIG. 8) attached to the block 279 in order to restore the thread catcher 341 from its upper to its lower position when the block moves forward from its retracted position towards the spooling spindle 153. During said movement the hook 391 slides against the upper side of the ramp 389, the thread catcher 341 being swung down while stretching the spring 385 until the projection 371 is caught by the arm 375 as described.

The object of the thread catcher 341 is, during its rapid upwardly swinging motion to move the thread past the knife blade 347 in order to cut the thread, and therefore its end is bent sidewise and then double-folded to form a U-shaped yoke 393. The two shanks of said yoke pass on opposite sides of and close to the knife blade 347, when the thread catcher snaps up to its upper end position. Attached to the yoke 393 is a similar U-shaped wire yoke 395 which when the thread catcher snaps up, moves in a similar manner on opposite sides of and close to the bent end 345 of the knife holder but which then continues a good bit past the same. In respect of movements in the horizontal plane the thread catcher 341 and the knife holder 343 follow each other and when the latter in the above-described manner is swung to the right at the end of the retraction of the block, the two yokes 393, 395 are brought in beneath the thread suspended from the spring clip of the wire conveyer arm 269. When the thread catcher is released in the above-described manner and snaps up, the thread is caught by the yokes 393, 395 and is moved upwardly first against the arm 345 and then against the knife blade 347. The yoke 395 stretches the thread in a loop around the arm 345 and the stretched thread is finally cut by the knife blade 347 when the yoke 393 reaches the level thereof.

Thus the thread cutting device is controlled in relation to the thread conveyer in such a manner that when the former is moved towards the thread in order to cut the same, when the thread conveyer is in the retracted position, and is moved laterally out of the path of the thread conveyer when the same again is displaced forwardly towards the spooling spindle.

The control and the coordination of the above described different operations are effected by means of a control mechanism 215 (FIG. 6) which partly has already been described above and which mainly consists of the curve bodies 217, 295, 315 and means for their turning and for start and stop in predetermined positions.

The above-mentioned curve bodies are rigdly attached to a bearing sleeve 397 pivoted on a vertical shaft 398 attached to the bottom plate 69. Said bearing sleeve also carries a worm wheel 399 driven by a worm gear 401 keyed to a shaft 403 (FIGS. 4 and 7). The shaft 403 receives its motion from a steadily rotating shaft 405 by means of disconnectable coupling 406. In its turn the shaft 405 is driven via a bevelled gear 407, 409 and a worm gear 411, 413 by the drive shaft 161. The coupling 406 comprises two pulleys 415, 417 which by a belt or chain transmission are coupled to a pulley 419 upon the end of a shaft 403 and to a pulley 421 upon the end of the shaft 405, respectively. The pulley 417 is rigidly attached to a shaft 423 which is somewhat displaceable in the axial direction, and the pulley 415 is loosely arranged upon said shaft 423. Attached to the same is also a disc 425 carrying a short coupling pin 427. At the same radial distance the pulley 415 carries a corresponding coupling pin 429 upon its side facing the disc 425. In the position shown in FIG. 4, by means of a coiled spring 431 connected between the disc 425 and the pulley 415 the shaft 423 is brought so far to the left that the pin 427 does not reach the

pin 429 and cannot entrain the same in the rotation of the shaft i.e. the pulley 415 is free and the coupling 406 is disconnected. A lever 435 pivoted on the screw 433 for movement in the horizontal plane, bears against the end of the shaft 423. When said lever is swung to the right, the disc 425 is displaced so that when the shaft 423 runs, the pin 427 of said disc will engage the pin 429 and entrain the pulley 415, i.e. the coupling 406 is connected. Against the end of the lever 435 there bears from the left an approximately vertically extending arm 437 (see also FIG. 10) which is rigidly attached to a horizontal shaft 439 journalled in bearing brackets 441, 443 upon the bottom plate 69. Rigidly attached to the shaft 439 is also a two-armed lever 445, 447, the one arm 445 of which carries a pin 449 at its end. The lever arm 445 is pressed down against the disc 217 forming a part of the control mechanism, by means of a coiled spring 451 (FIGS. 7 and 25) connected between the other arm 447 of the lever and an attachment 453 on a vertical supporting plate 455 attached to the bottom plate 69. When either of two holes 457, 459 provided in the upper side of the disc is located opposite to the arm 445, its pin 449 can drop down therein, the lever 445, 447 taking the position shown in FIGS. 7 and 25 in which the coupling 406 is disconnected, on account of the lever 435 being held by means of the spring 431 in engagement with the arm 437 rigidly attached to the lever 445, 447. In all other positions of the disc 217 than when either of said holes 457, 459 is located opposite to the arm 445, the pin 449 of said arm rests upon the flat upper side of the disc and then the lever 445, 447 is swung clockwise from the position shown in FIG. 7 into a position in which the coupling 406 is connected on account the contact points between the arms 437 and 435 being displaced to the right from their positions in FIG. 4.

A two-armed lever 461, 463 is arranged with its bearing sleeve 465 freely turnable upon the shaft 439. Also an arm 467 with a bearing sleeve 469 is freely turnable upon said shaft 439. At its free end the arm 467 has a horizontal laterally bent part 471 which extends above the lever arms 447, 463, and an adjoining vertical part 473. Connected between said last mentioned part and the lever arm 463 is a coiled spring 475. The arm 467 is rockable from its upper position shown in FIG. 25 into a lower position in which its part 471 bears against the upper side of the lever arm 463 in its shown position. A latch 477 swingable in the vertical plane and pivoted on a screw 479 upon the supporting plate 455 is provided at its lower end with a projection 481 which in the shown position projects below the arm 467 and locks the same in said upper position. Also the lever arm 463 is swingable between an upper and a lower position, the lower position being shown in FIGS. 7 and 25. Said lower position is taken when a beak 483 formed upon the end of the other arm 461 rests against one of two wedge-shaped knobs 485, 487 projecting from the upper side of the disc 217. When the knobs have moved past the beak, the same rests upon the flat upper face of the disc 215, and the lever arm 463 then takes its upper position in which it is held by means of the spring 475 into contact with the part 471. Connected between the arm 467 and the attachment 453 is a coiled spring 489 striving to swing the arm 467 and (by the intermediary of the spring 475) also the arm 463 upwardly so that the beak 483 is held pressed down against the disc 217.

When the arm 467 is held locked in its upper position by the latch 477, the lever arm 447 by means of a spring 451 is held into contact with the part 471, but only under the provision that the pin 449 on the other arm of the lever projects into any of the holes 457 and 459, the coupling 406 then being disconnected as above described.

When the latching of the arm 467 ceases due to the latch 477 being swung to the left, the arm 467 is swung down due to the contraction of the spring 475 which is stronger than the spring 489, until the part 471 comes to rest upon the lever arm 463 in its lower position. On account of the spring 475 also overcoming the spring 451, the lever arm 447 is entrained so that also said arm is swung to its lower position. Therefore the pin 449 is raised out of the hole in the disc 217 and frees the same for rotation and at the same time the coupling 406 is connected in the above-described manner, whereby the shaft 125 is connected to the steadily rotating shaft 161 and starts to turn the control mechanism 215.

When the knob 485 (or 487) has passed the beak 483, the lever 461, 463 gets free to swing counter-clockwise in FIG. 7 and its arm 463 together with the arm 467 will be swung to its upper position by means of the spring 489. The lever arm 447 will remain close to its lower position on account of the disc 217 in the meantime having turned somewhat so that the pin 449 cannot be introduced into the hole 457 (or 459) but will abut against the flat face of the disc after a slight backward movement of the lever 445, 447 has taken place under the action of the spring 451. Therefore the coupling 406 remains connected until the control mechanism 215 has turned so much that the pin 449 can drop into the second hole 459 (or 457).

The turning movement of the latch 477 which as mentioned above, starts the control mechanism, is derived from the hand lever 119 (FIG. 1). As already has been described, said lever is connected by means of the link 121 to the swinging arm 123 attached to the control shaft 125. Pivoted on a pin 490 on said swinging arm 123 is a link 491 which is bent several times at right angles and which with an elongated horizontal slit 493 embraces a pin 495 upon the latch 477. When the hand lever 119 is moved upwards, the link 491 is displaced to the left in FIG. 25, the right end of the slit 493 entraining the pin 496 and swinging the latch 477 so that the arm 467 is released and can drop down. The latch 477 further carries a pin 497 (FIG. 26) which extends through a horizontal slit 499 in the bracket plate 455. Extended between said pin 497 and a pin 501 attached to the bracket plate 455 is a coiled spring 503 striving to keep the latch 477 in engagement with the arm 467, so that its extension 481 either can catch the arm 467 in its upper position or rest against the side of the arm 467 when the latter takes its lower position. When the hand lever 119 is released, the link 491 is displaced back to the right, the latch 477 not being influenced on account of the lost motion of the coupling, between the slit 493 and the pin 495.

The latch 477 can be swung not only by means of the hand lever 119 but also by the actuation of the pin 497 by means of an arm 505. Said arm is pivoted to a crank 507 attached to the above-mentioned shaft 243 and held in engagement with the pin 501 by means of a coiled spring 509. In the shown position the outermost end 511 of the arm 505 in the horizontal direction almost extends to the pin 497 in the position thereof corresponding to latching of the arm 467, and in the vertical direction said arm end 511 overlaps said pin 497. The said position of the arm 505 corresponds to the angle position taken by the shaft 243 when its arm 241 (FIG. 3) rests upon the knob 239. When the knob 239 has passed and the latching at 255, 257 (FIG. 14) is dissolved, the shaft 243 is turned by the spring 245, as has already been mentioned above, and it pushes forth the arm 505 so that its end 511 abuts against the pin 497 and moves the same to the right in FIG. 26. Thereby the latch 477 is swung so that the arm 467 is released and can swing down, if it is not prevented therefrom in any other manner. During the continued movement of the arm 505 to the right, an oblique face 513 on its under side slides upon the pin 501, whereby the arm 505 is swung somewhat upwards, so that its tip 511 is raised and is made free of contact with the pin 497 which immediately retracts by the action

of the spring 503. When therefore the arm 505 has reached its outermost right-hand position, the pin 497 is again free to move independently of the arm 505, as in the shown left-hand position.

The above-described release by means of the arm 505 is used for starting the control mechanism anew when it has been stopped by the pin 457 on the lever 445 having been pressed down into the hole 459. Immediately before the corresponding angle position of the disc 217 has been reached, the knob 239 has moved the arm 241 upwards and has turned the shaft 243 clockwise in FIG. 25, so that the arm 505 has taken the shown position. Furthermore the knob 487 has swung the lever 461, 463 clockwise in FIG. 7 into the shown position. The arm 467 has been and in said position still is caught in its upper position by means of the latch 477.

The releasing impulse emanates from the lever arm 263 described above with reference to FIG. 14. When the latter is actuated on account of the bobbin being wound to the desired degree of filling, the shaft 177 and the shaft 243 connected thereto are let loose to turn somewhat under the action of the spring 245, the shaft 177 clockwise and the shaft 243 counter-clockwise in FIG. 13. Thereby the arm 505 is moved forward from its shown one end position into its other end position, and during said displacement it operates the pin 497 in the above-described manner, so that the latch 477 is briefly swung away from the arm 467. The continued course is the same as has been described above when the latch 477 was actuated by the hand lever 119. Thus the coupling 406 is connected and the control mechanism turns until a whole revolution has been covered after the release by means of the hand lever 119, viz. until the pin 499 anew drops into the hole 457. It should be observed that the lever arms 445 and 461 are provided with recesses in their under faces which allow the knob 239 which is located at a greater radial distance than the knobs 485, 487, to pass said arms without touching the same.

Secured to the worm gear 399 (FIG. 6) is a chain pulley 521 which by means of a chain drives a chain pulley 523 attached to a vertical shaft 525 which in its turn by means of a bevelled gear 527 is connected to the above-mentioned shaft 105. In this manner the power required for winding-up the spring 101 (FIG. 16) is taken from the control mechanism.

The control mechanism 215 which is started and stopped in the just described manner, also supplies the necessary power and serves to co-ordinate the various above-described functions. These shall now be briefly described in chronological order.

With a few, particularly mentioned exceptions the drawing figures show the various parts in the positions taken during a running sewing operation. As soon as the sewing machine is at all in operation, the shaft 161 runs, which also applies to the parts connected thereto up to the coupling 406. The hook 67 is turned by the shaft 65 in synchronism with the needle bar 57 and merely with slight breaks for correcting the position of the sewn garment. For the rest, all parts located between the bedplate 65 and the bottom-plate 69 are at stand-still.

When the seamstress notices that the bottom thread is finished, the machine is stopped with the needle-bar retracted in its uppermost position (also the hook being stopped in a predetermined angle position), then she raises the hand lever 119 and immediately releases it again. Thereby the control shaft 125 is turned and approximately simultaneously performs three different releasing functions, viz. connection of the coupling 406, release of the bobbin removal sleeve 179, so that said sleeve is displaced to its left-hand end position, and temporary retraction of the catch 111, whereby the hook holder 91 is turned 180 degrees. Thus the hooks 67, 68 are exchanged, so that the hook with empty bobbin is transferred to the lower position, the spooling position, and the other hook with full bobbin is transferred to the upper position, the working position. Therefore almost immediately after the actuation of the hand lever 119 the machine is ready to continue the sewing.

During the rotation of the control mechanism the cam disc 217 gets active first and displaces the spooling shaft 153 first to the right, its end being inserted into the bobbin, and then back to the left, whereby the bobbin is retracted out of the bobbin holder and its flange is pressed against the supporting disc 185 so that the thread inserted in the spring clamp of the thread conveyer arm is clamped therebetween. Simultaneously with the crest 235 of the disc 217 reaching the roller 219, the knob 239 penetrates below the lever 241, whereby the shaft 177 is turned counter-clockwise and the shaft 243 is turned clockwise. Immediately thereafter the hole 459 also reaches a position accurately below the pin 449 and the control mechanism is stopped. Due to the turning of the shaft 177 the coupling 169, 171 is connected and the spooling spindle is put in rotation, the thread being snatched out of the spring clamp of the thread conveyer arm, and the thread starts being wound upon the bobbin. When the bobbin is fully spooled and the arm 263 is actuated by the outermost windings, the latching of the parts 255 and 257 is dissolved and the shafts 177 and 243 swing back. Then the coupling 169, 171 is disconnected so that the spooling spindle ceases to rotate and furthermore the catch 477 is operated, so that the control mechanism is put in motion again. Now the spooling spindle displaces the bobbin into the bobbin holder and the sleeve 179 is caught by the arm 193. Simultaneously with said renewed displacement of the spooling spindle to the right the curve bodies 315 and 295 start to be active so that the thread conveyer arm is moved away from the bobbin and is also raised. When the bobbin is completely introduced into the bobbin holder the thread conveyer arm has reached its highest position, and when then the spooling spindle is retracted out of the bobbin (which is now retained by the remover sleeve 179 caught by the arm 193) the thread conveyer arm is quickly lowered by the cooperating of the pin 317 and the steep slope 517 (FIG. 6) of the curve body 315. Then the thread is slipped in behind the tensioning washer of the bobbin holder and furthermore the spring clamp of the thread conveyer arm is from above brought down over the stretched thread, so that the same is grasped again by the spring clamp. When the spooling spindle has been wholly retracted, the thread conveyer arm has reached a position so far back that the thread-cutting device starts swinging to the right. Said swinging motion continues while the thread conveyer arm is moved further back and also swings somewhat to the left, the point of the thread located immediately beyond the spring clamp of the thread conveyer arm being introduced between the yokes 393, 395 and the arm 345. Finally the sleeve 299 of the thread conveyer arm abuts against the arm 381, whereby the thread catcher 341 of the thread-cutting device is released and the thread is cut. During the continued turning motion of the control mechanism the thread conveyer arm is again brought forward in the direction towards the spooling spindle. The hook 391 of the block 279 then runs along the upper side of the ramp 389 and swings down the thread catcher 341 while stretching the spring 385, until the member 341 is finally caught at 371, 373. During the forward movement of the thread conveyer the thread-cutting device is swung away out of the path of the former due to cooperation of the parts 365 and 355. During the final part of the forward movement of the thread conveyer arm a depressed part 519 of the guiding path of the curve body 315 causes that the thread conveyer arm is first raised and then lowered again. Thereby the thread grasped by its spring clamp is from above brought into its position at the side of the supporting ring 185. Now the working cycle is completed and when the control mechanism has

turned a complete revolution from the starting position, its drive is disconnected so that the device comes to rest. Thereafter it remains in a position of readiness in order to be able to repeat the described hook exchange when required.

The embodiment shown in FIGS. 31 to 42 is similar in great parts to the embodiment just described, and details thereof which wholly correspond to or have the same or corresponding functions as details shown FIGS. 1 to 30 are designated with the same reference numerals as therein. A closer description of such details is not given below, because a comparison with the first embodiment will make them fully clear. The following description will set forth fully merely such details as are constructed or function in a different manner.

The movement back and forth of the spooling spindle 153 for the removal of the bobbin out of the hook 68 and reinsertion of the same therein after respooling of thread is controlled by the cam disc 217 (FIG. 34) which now is located below the bottom plate 69 and rotary about a vertical axis, a pin 601 attached to the slide 227 cooperating with a groove 603 in the upper face of the cam disc 217. The pedestal 155 in which the spooling spindle is journalled, is attached to the slide 227 and brings the spindle with it in the axial direction. The movement for rotating the spooling spindle is derived from the drive shaft 65. By means of a belt 605 (FIG. 36) said shaft is connected to the shaft 161 which by means of a claw coupling 169, 171 (FIG. 41) can be coupled to a wide gear wheel 163 meshing with a gear wheel 159 attached to the end of the spooling spindle. Due to the great width of the gear wheel 163 it is possible not only to displace the spooling spindle axially with a maintained gear mesh, as is apparent from a comparison between FIGS. 31 and 33, but also to displace axially the coupling half 169 connected to the gear wheel 163 in order to throw in the coupling 169, 171. Said coupling motion takes place by the end of the gear wheel 163 being engaged by an upturned end 175 of a bell crank lever 607, 643 (FIGS. 34 and 41) which is pivoted upon a vertical pin 609 fastened to the underside of the bottom plate 69.

The cam disc 217 is teethed at its periphery and is fed by a step-feeding device comprising a pawl 611 and a catch 613. The pawl 611 is pivoted on a pin 615 excentrically arranged upon a shaft which by means of a worm gear 617, 619 is connected to the shaft 161 and therefore steadily driven, so that the pawl 611 performs a reciprocating feeding motion. A coiled spring 621 acting upon the pawl strives to keep the feeding point 623 of the pawl in engagement with the teeth on the periphery of the cam disc 217, but in the shown position such an engagement is prevented by a pin 625 upon the end of the pawl resting upon the end of one arm 627 of a bell crank lever 627, 631 biassed by a coiled spring 633 connected to its other arm 631. Therefore the pawl 611 is idling until said bell crank lever 627, 631 is swung away in the clockwise direction so that the pawl point 623 engages the cam disc. Such a swinging motion and therefore a start of the turning motion of the cam disc 217 is caused for each hook shift by means of an arm 635 (see also FIG. 37) attached to a shaft 125 which can be rocked in the direction of the arrow by means of a hand lever (not shown) corresponding to the lever 119 of the first embodiment. After the swinging motion of the bell crank lever thus obtained, its arm 631 is caught by a pivotable catch 639 which is biassed by a spring 637 and which with a hook is put behind a boss 641 upon the arm 631. The pawl 611 can be lifted and made inoperative also by means of the arm 643 of the bell crank lever 607, 643. A spring 645 maintains said bell crank lever in the shown position but it can be rocked clockwise by a stronger spring 647 which is stretched between the arm 607 and an arm 649 also pivoted on the pin 609. However, said spring is inactive in the shown position because the arm 607 engages the outside of a arcuate cam 651 projecting from the underside of the cam disc 217. Only when the cam disc has been fed in the direction of the arrow that far (about 60 degrees) that the rear end of said cam has passed the end of the arm 607, the spring 647 can swing the arm 643 upwards in FIG. 41 and thus stop further feed of the cam disc, the arm 649 in the meantime having being swung clockwise from the position of FIG. 41 by a cam 653 on the upperside of the cam disc, whereby a pin 655 attached to the arm 649 has been withdrawn from engagement with the arm 607 and made counterclockwise turning motion of the latter possible. After the cam 653 has passed a pointed projection 657 upon the arm 649, the latter is free and would swing back under the combined action of the springs 645 and 647, had it not been locked by co-operation between a shoulder 659 arranged thereupon and a locking pin 661 which is vertically displaceable and biassed in the downward direction by a spring. Said pin is operated by means of the lever arm 263 (FIG. 37) known from the first-described embodiment, which rests against the outermost windings of the bobbin 79 and serves to stop the spooling of thread when the bobbin is filled. A new start of the turning motion of the cam disc 217 takes place only when the lever arm 263 has raised the locking pin 661 so that the shoulder 659 can pass past the same and the arm 649 can swing back to the shown position. The pin 655 then entrains the bell crank lever 607, 643 in the turning motion, whereby the pawl 611 can start again to work on the periphery of the cam disc and turn the same. Simultaneously the coupling 169, 171 is thrown in. When the cam disc almost has completed one revolution, a boss 663 thereon hits the end of the catch 639 and brings the same out of engagement with the boss 641 on the bell crank lever arm 631. However, the latter is not swung back to its shown position under the action of the spring 633 until the boss 663 has dropped in behind a nose on the arm 631, the cam disc then having been returned to its initial position after having completed one revolution. Then the pawl 611 is moved again into its inoperative position and the feed of the cam disc ceases.

The motion for turning the hook holder 91 is accomplished in another manner than in the first-described embodiment. The spiral spring 101 (FIG. 40) known therefrom is at its centre connected to the shaft 93 of the hook holder and, as shown in FIGS. 31, 34 and 40 its case 103 against which the outtermost turn of the spring slides with friction, is arranged to be wound by a step-feeding mechanism taking its motion from the cam disc 217. At the edge of its upper face said cam disc carries a number of rounded knobs 671 which cooperate with the lower end of a push rod 673 displaceable in a bore in the bracket 94. The upper end of the rod 673 is connected to a horizontal pin 675 atttached to a pivoted arm 677 biassed by a coiled spring 679. Pivoted on the pin 675 is a step-feeding pawl 681 acting upon teeth formed on the peeriphery of the spring case 103. A catch 683 is arranged on the opposite side of said case. When the cam disc 217 is turned, the push rod 673 is caused to move up and down, whereby the pawl 681 feeds the case 103 and thus winds up the spring 101.

The devices for the release of the hook holder 91 when the hooks are shifted, mainly correspond to what is shown in and described with reference to FIG. 17. However, the arm 131 (FIG. 37) is directly attached to the release shaft 125 controlled by the hand lever, and the latch 133 is arranged to be disengaged from the latch 111 by means of a pin 685 attached to the hook holder 91, and to be returned upwardly by a coiled spring 687 after said pin has passed, so that a new engagement with the latch 111 can take place.

The thread conveyer by means of which the thread is put in such a position that the thread end can be grasped by the bobbin in its retracted position, is arranged to work in a manner considerably deviating from what is de-

scribed above with reference particularly tto FIG. 29. Whereas there the thread conveyer is arranged to hold the thread all the time and after cutting to move the outermost end of the thread into a correct position for respooling, in the embodiment now described the thread conveyer is arranged to hold the thread merely in certain moments and to lay it off in a stationary clamping device.

The thread conveyer comprises an arm **701** (FIGS. 32, 33 and 35) which is pivoted about a horizontal pin **703** attached to a holder **705**. The arm **701** is biassed by a spring **707** striving to press the same down into a bottom position in which it bears against the top face of the holder **705**, and may be swung upwardly by means of a rod **709** which by the spring **707** is held with its lower rounded end **711** in contact with the upper side of the cam disc **217** or with cams thereon **713**, **715**, **717** and **719** (FIG. 42). The cams **713** and **715** are equally high and their pointed ends overlap so that the rod end can ride over the interspace between them when the cam disc **217** rotates, without being operated. The same applies to the cams **717** and **719**. The outer ends of the cams form inclined ramps **721**, **723**, **725** and **727** where the rod end **711** can slide up onto and down from the cams when the cam disc is turned. In this manner the thread conveyer arm **701** is swung from the bottom position into the top position shown in FIG. 35 and back again twice for each complete revolution of the cam disc **217**. The holder **705** is fastened to the upper end of a vertical sleeve **729** which is journalled in the bottom plate **69**, is secured against axial displacement and encloses the rod **709**. Arranged around said sleeve is a coiled spring **731** striving to swing the thread conveyer arm **701** anticlockwise in FIG. 32 into an end position determined by a stop not shown and located somewhat beyond the position shown in said figure. Attached to a flange formed on the lower end of the sleeve is an excentric pin **733**. Said pin is meant to cooperate with the radially outer face of a cam **735** formed on the upper side of the cam disc **217** adjacent to but being lower than the cams **715**, **717**. The pin **733** is held in engagement with said face by means of the spring **731**. During the latter part of the turning motion of the cam disc the fore point **737** of the cam **735** meets the pin **733** and displaces the same radially outwards, whereby the sleeve **729** is turned and the thread conveyer arm **701** is swung clockwise away from its initial position or one end position. When the cam disc has moved so far that the part of the cam **735** lying between the cams **715** and **717** is located opposite to the pin **733**, the arm **701** has been swung into its other end position shown in FIG. 33. When the cam disc is further turned, the arm **701** is returned to its initial position by the action of the spring **731**. The oblique interspaces **739** and **741** serve to allow the passage of the pin **733** between the cams **713** and **715**, and between the cams **717** and **719**, respectively.

At its free end the arm **701** has a member in the shape of a crook **743** suitable for catching the thread to be spooled. Said crook is made of a metal wire bent and pointed at its end. When the arm **701** takes its initial or rest position, said crook is located to the left of the thread path shown in FIG. 32, which extends from a fixed guiding eye **745** to the retracted bobbin **79**, the arm **701** not interfering with the thread during the spooling operation. When the cam disc **217** has turned that far that the respooled bobbin **79** has been reinserted in the bobbin case **71** and the thread **267**, which is held stretched by thread tensioning means not shown, runs in the path shown in FIG. 39, the movement of the thread conveyer starts with the arm **701** being swung into the position of FIG. 32 on account of the cam point **737** meeting the pin **733**. Then the crook **743** is brought with its point towards the bottom of a slit **744** (FIG. 39) formed in the plate **75**, the hitch **73** of which serves to prevent rotation of the bobbin case. Immediately thereupon the rod end **711** rides up on the ramp **721**, whereby the arm **701** is swung upwardly in the vertical plane, its crook from below engaging the thread **267** and safety catching the same on account of its point entering into the slit **744**. When the cam disc is turned further, the pin **733** is actuated by the steeply rising part of the cam **735** and the arm **701** which has been raised sufficiently high for its crook to pass above the hook **68**, is swung further, the thread **267** being drawn in behind a tensioning washer **746** (FIGS. 33 and 39) of the bobbin case and is stretched out to form a loop. FIG. 35 shows the position in which the arm **701** has reached about half way of its swinging motion, and FIG. 33 shows the end position in which the arms turns back.

The thread cutting device consists of a pair of scissors having upright shanks **747**, **749** (FIGS. 32, 33 and 35) which by means of a screw **751** are attached to an angle bracket **753** on the bottom plate **69**. The shank **749** is stationary, and the shank **747** is pivotable about the screw **751**. The edges of the two shanks are held in engagement with each other by means of a blade spring **755** also attached to the angle bracket **753** by means of the screw **751**. Attached to an ear upon the pivotable shank **747** is a pin **757** against which rests the end of a spring **758** attached to the bottom plate and striving to open the scissors by swinging the shank **747** anticlockwise in FIG. 35. A rod **759** vertically displaceable in the bottom plate bears with its rounded lower end against the cam disc **217** or a arc-shaped cam **761** arranged thereon and is located with its upper end straight below the pin **757**. When, as in the initial position the rod **759** rests upon the cam **761**, the scissors are closed and when the pin during the further turning motion of the cam disc, rides down the ramp **763** (FIG. 42) the scissors are opened by the spring **758**. When during the continued turning motion of the cam disc, the rod **759** meets the rising ramp **765** at the other end of the cam **761**, the rod is raised and the scissors are caused to perform a cutting operation.

The scissors are combined with a clamping device for holding the thread end cut by the scissors. Said clamping device consists of the blade spring **755** and the moveable shank **747**. The edges of said members, moveable along each other, are blunt whereby they cannot cut a thread introduced therebetween but instead draw in the thread between them, the thread end being clamped by the elastic force of the blade spring **755**.

When the loop of the thread **267** has been drawn out to the maximal extent by the arm **701** in the turning position (see FIG. 33) and when the cam disc **217** is further turned, the arm **701** is lowered due to the rod end **711** riding down the ramp **723**. The thread loop which during the last part of the swinging motion of the arm **701**, has slid somewhat upon the crook **743** and has come to rest against a projection **767** thereon, then is laid down with one part into the gap of the scissors. Immediately thereupon the ramp **765** runs in beneath the rod **759**, whereby the thread **267** resting in the gap of the scissors is first clamped between the blade spring **755** and the moveable shank **747** and is immediately thereupon cut at the outside of the clamping spot by means of the shanks **747**, **749** of the scissors, so that the thread part going to the bobbin **79** is let loose. During the part of the turning of the cam disc remaining until the revolution is completed, the arm **701** now freed of the thread is raised upwardly, is swung back above the hook **68** and is lowered again on its other side, thus anew taking its initial position.

As is apparent particularly from FIG. 33, the clamping device **755**, **747** is located relatively to the guiding eye **745**, on the opposite side of the spooling spindle **153** and in such a position that the thread **267** is suspended across the path taken by the bobbin **79** when retracted out of the bobbin case into the spooling position, the thread being clamped in the same manner as described above with reference to FIG. 19. After said clamping has

taken place, the clamping device releases its grasp of the thread end on account of the ramp 763 allowing depression of the rod 759 and swinging of the shank 747 by the spring 758. Therefore the thread end is loose when then the spooling starts.

The vertical turning axis of the thread conveyer, i.e. the axis of the turnable sleeve 729, is located on the same side of the spooling spindle as the clamping device but somewhat closer to the spooling spindle than the latter and it is located farther from the hook 68 than the clamping device. Therefore the thread conveyer gives the thread loop a motion which is particularly favourable for the insertion of the thread behind the tension washer of the bobbin case as well as for its insertion into the combined clamping and thread cutting device.

We claim:

1. In a lock stitch sewing machine, two rotary shuttles, a holder carrying said shuttles and pivoted about a horizontal axis, a spring striving to turn said holder, means locking said holder in either of two positions, and means operable at will for releasing said locking means, whereby the holder is quickly turned by said spring from its one into its other position and the shuttles are mutually shifted.

2. In a sewing machine having a reciprocating needle adapted to sew with a top thread and a bottom thread at a needle working position, means for supplying bottom thread to said working position, said means comprising a rotatable member positioned below said needle, at least two spaced hooks on said member for carrying a supply of said bottom thread, said hooks being spaced from each other so that when one is in the working position, the other is in a non-working, thread replenishing position, and means for rotating said member so that said spaced hooks are sequentially brought into said working position from the non-working position.

3. A sewing machine according to claim 2 including means for replenishing the thread supply on each of said hooks when the hook is in the non-working position.

4. A sewing machine according to claim 2 including a bobbin associated with each of said hooks for carrying said bottom thread; means for removing each such bobbin from the hook associated therewith when said hook is in the non-working position and means for associating a thread-replenishing bobbin with said hook while in the non-working position.

5. A sewing machine according to claim 2 wherein said rotatable member comprises a disc-shaped holder mounted for rotation about a horizontal shaft, said hooks being mounted on said disc-shaped holder symmetrically about said shaft whereby when one of said hooks is moved from said working position to a non-working position, the other of said hooks is moved from said non-working position to the working position.

6. A sewing machine according to claim 5 including spring means constructed and arranged for mechanical winding, said spring means being operatively associated with said shaft so as to urge said shaft to turn, and means for locking said holder against the turning action of said spring in a desired position, said locking means including a latch whereby, upon release, said holder is rotated to position said hooks as desired.

7. A sewing machine according to claim 5 wherein said hooks are rotatably mounted on hook shafts journalled in said holder, said machine including a drive shaft coaxial with a hook shaft when its hook is in the working position and means for coupling said hook shaft to said drive shaft only when said shafts are in a single predetermined angular position.

8. A sewing machine according to claim 7 including means for disengaging the coupling only in a predetermined anugular position of the drive shaft when said needle is moved away from said working position.

9. A sewing machine according to claim 7 wherein said coupling comprises two halves, one half of said coupling having a bar extending from the face thereof and the other half of said coupling having a groove in the face thereof for receiving said bar.

10. A sewing machine according to claim 7 including support means for said hook shafts, said means including a guide in the shape of an annular groove, one half of said coupling means being connected to said hook shaft and having means engaging said guide in all other positions of the hook than the working position to prevent the hook from turning.

11. A sewing machine according to claim 4 including spindle means for winding thread on the bobbin removed from a hook in the non-working position, said spindle means being coaxial with said hook, and means for returning the thus wound bobbin to one of said hooks.

12. A sewing machine according to claim 11 including an axially displaceable mechanism for removing the bobbin from its hook, said mechanism including said winding spindle, the end of said spindle being shaped to carry with it the bobbin.

13. A sewing machine according to claim 12 including a displaceable sleeve mounted upon the winding spindle and adapted to bear against the bobbin when the winding spindle is retracted.

14. A sewing machine according to claim 11 including a feeler engaging the outermost windings of the bobbin being rewound, said feeler being operative to stop the rotation of the winding spindle and operatively associate the bobbin with its hook.

15. Apparatus according to claim 11 including a conveyor for the bottom thread to be rewound, means for moving said conveyor in a predetermined path, said conveyor carrying the bottom thread for rewinding to the bobbin and a clamping device located in path of movement of said conveyor, said conveyor cooperating with said clamping device to hold said bottom thread, said clamping device being so located that the bottom thread can be grasped by the bobbin in its retracted position and wound thereon.

16. A sewing machine according to claim 15 including thread tensioning means, said bottom thread conveyor being arranged to draw out a loop of the bottom thread and to move the same in such a path that one part thereof is drawn in behind said tensioning means and the other part is inserted into said clamping device.

17. A sewing machine according to claim 15 wherein the bottom thread conveyor consists of an arm pivotal in the horizontal as well as in the vertical plane, the end of said arm being shaped as a crook and adapted for catching the bottom thread loop, said arm being movable in a path extending from one side of the hook in the winding position, up above the same and down on the oppposite side of said hook.

18. A sewing machine according to claim 15 and further including a pair of scissors for cutting the bottom thread arranged close to the clamping device and cooperatively operable therewith, one blade of the scissors forming part of the clamping device.

19. In a sewing machine including a reciprocating needle, a set of shuttles rotatable about a horizontal axis and mounted for alternate cooperation with the needle to form lock stitches and means for replenishing one of said shuttles with thread while another of said shuttles is cooperating with the needle, said means comprising a mechanism for removing a bobbin axially out of the shuttle when in the non-working position and inserting a rewound bobbin therein.

20. In a sewing machine including a reciprocating needle, a set of shuttles rotatable about a horizontal axis, each of said shuttles being adapted for sequential operative association with said needle to form lock stitches, a holder carrying said shuttles and means for rotating said holder about a horizontal axis in order to bring one

shuttle at a time in operative association with the needle to form said lock stitches.

21. In a sewing machine, a reciprocating needle, at least two shuttles rotatable about a horizontal axis, each of said shuttles being adapted to carry thread and cooperate with the needle at a working position to form lock stitches while the other shuttle is in a non-working position, and a carrying member mounted for rotation about a horizontal axis, said shuttles being mounted on said member in positions symmetrical relative to said axis.

22. In a sewing machine, a reciprocating needle, two rotatable shuttles, a bottom-thread bobbin associated with each of said shuttles, means for shifting said shuttles so that one of said shuttles is in a working position cooperating with said needle and the other of said shuttles is in a non-working position and means for removing the bobbin from the shuttle which is in the non-working position and inserting therein a rewound bobbin.

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