March 26, 1935. M. C. MILLER 1,995,643

WELT TURNING MECHANISM FOR KNITTING MACHINES

Filed April 2, 1929 4 Sheets-Sheet 1

FIG 1

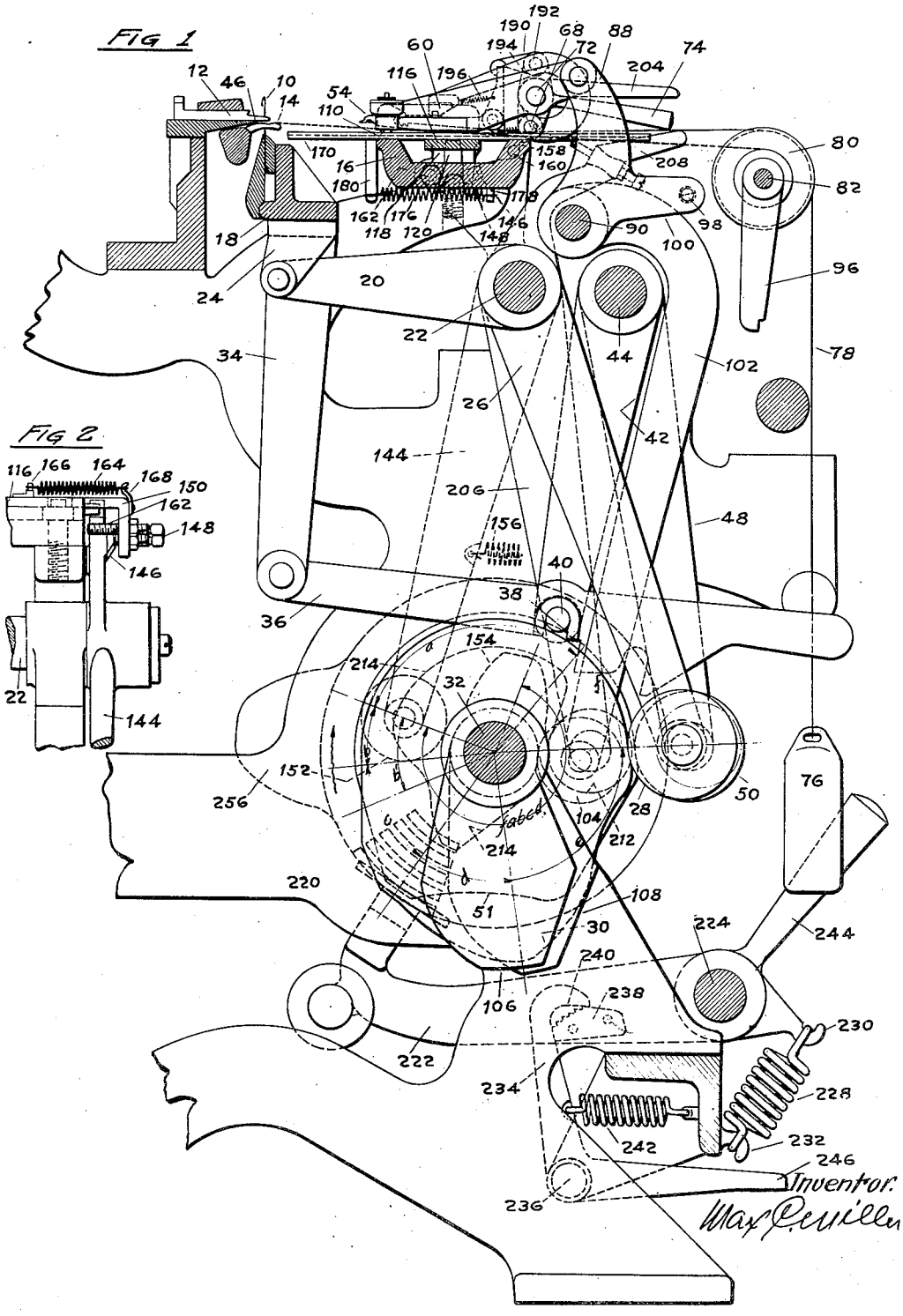


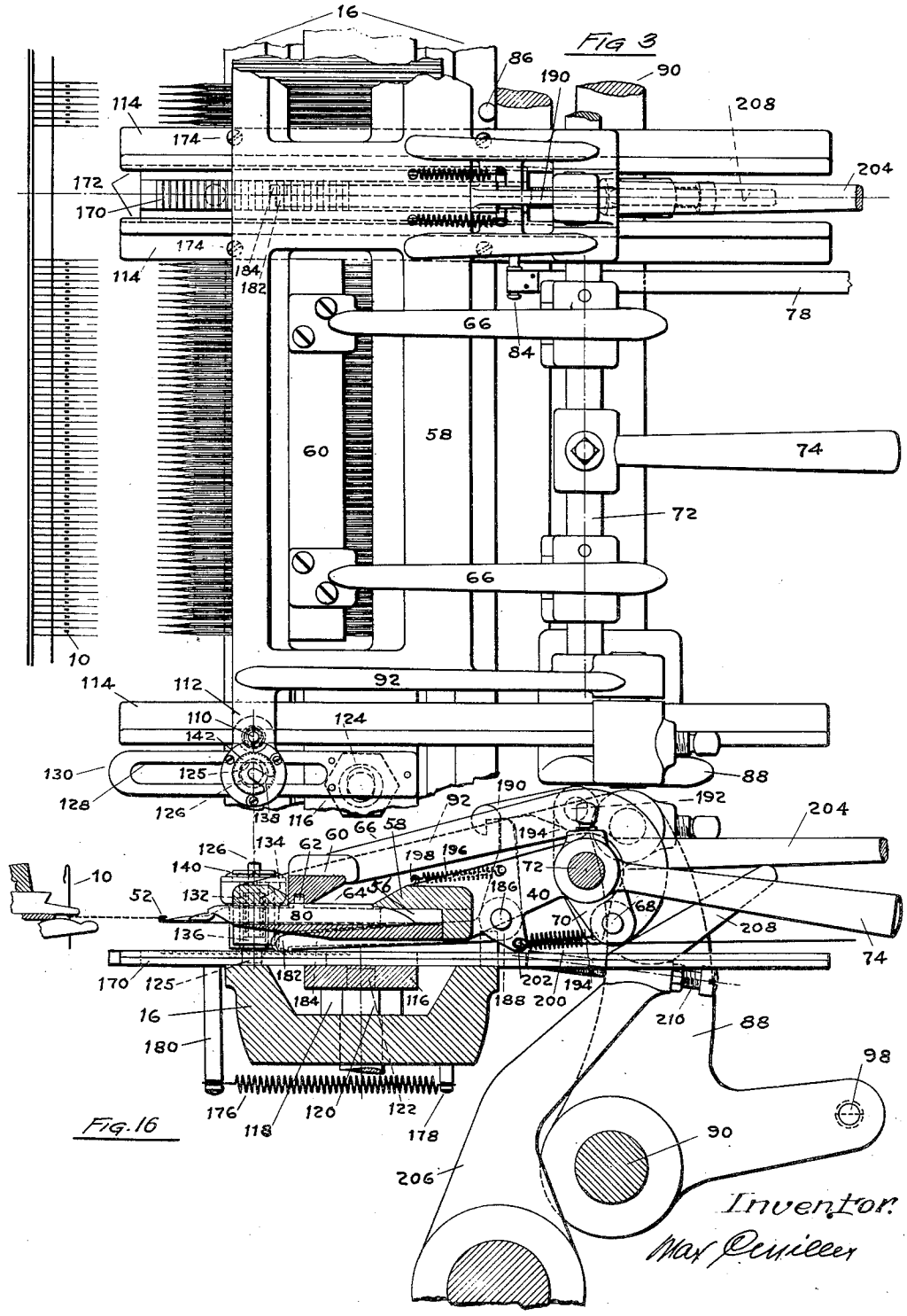
FIG 2

Inventor:
Max C. Miller

March 26, 1935. M. C. MILLER 1,995,643

WELT TURNING MECHANISM FOR KNITTING MACHINES

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Inventor:
Max C. Miller

March 26, 1935. M. C. MILLER 1,995,643

WELT TURNING MECHANISM FOR KNITTING MACHINES

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Fig 4

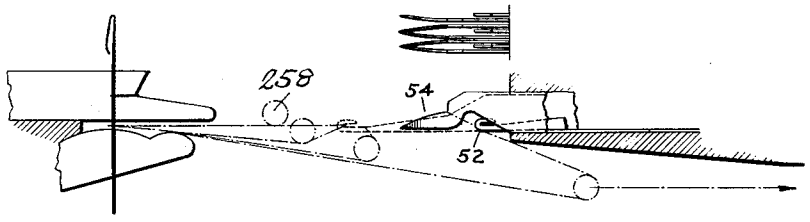


Fig 5

Fig 6

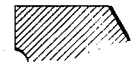
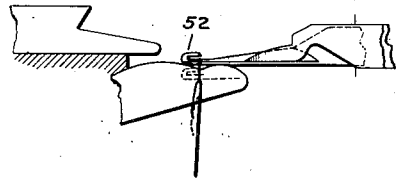


Fig 8



Fig 7



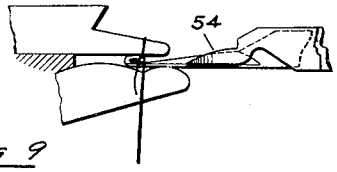


Fig 9

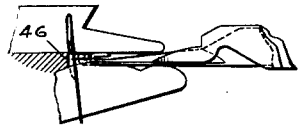


Fig 10

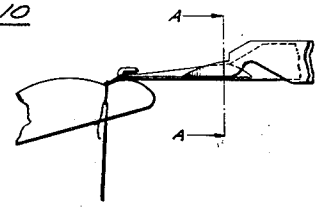


Fig 11



Fig 12

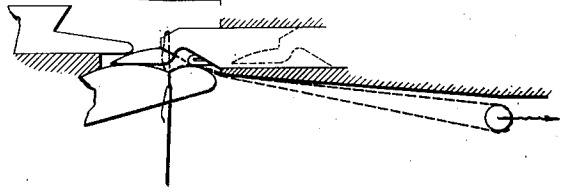
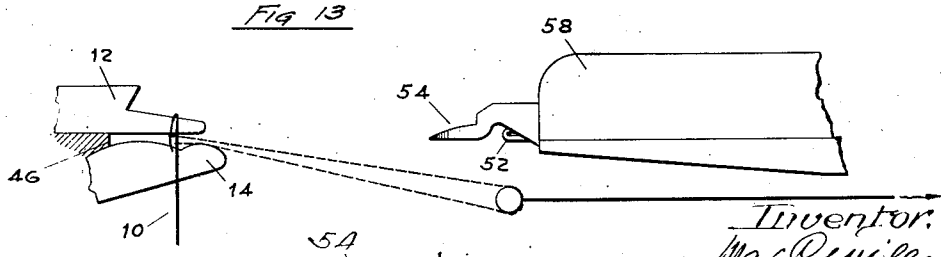


Fig 13



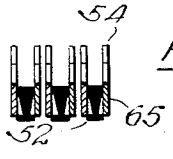


Fig. 14.

Inventor:
Max C. Miller

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WELT TURNING MECHANISM FOR KNITTING MACHINES

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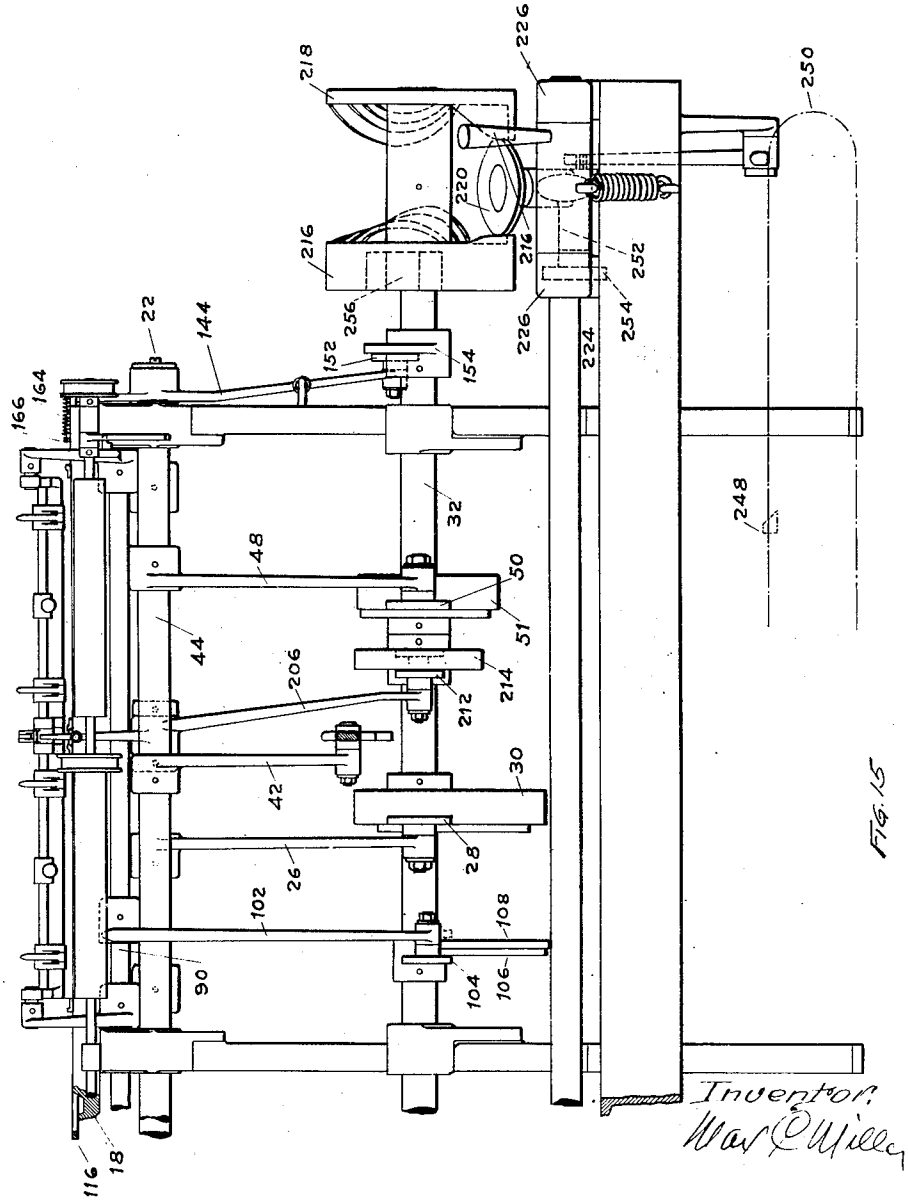


Fig. 15

Patented Mar. 26, 1935 1,995,643

UNITED STATES PATENT OFFICE

1,995,643

WELT TURNING MECHANISM FOR KNITTING MACHINES

Max C. Miller, Cumberland, R. I.

Application April 2, 1929, Serial No. 351,997

41 Claims. (Cl. 66—96)

The invention relates to mechanism for turning the welt in the knitting of hosiery and similar fabrics on knitting machines, and is herein disclosed as embodied in a flat knitting machine of the cotton frame type which is particularly adapted for the production of full-fashioned hosiery.

It is customary in the manufacture of hosiery, particularly full-fashioned ladies' hosiery, to have at the upper end of the stocking a doubled-over portion of fabric. This is known as the "welt" and consists of the body fabric doubled-over and integrally united therewith.

In common practice, the welts are turned and transferred manually on the same machine that later knits the balance of the stocking. The machine is turned over to cause a starting course of yarn to be fed to the needles in the usual manner, and is then brought to a stop after the needle hooks have drawn the starting course to the nibs of the sinkers. A comb rack or welt bar which consists of a series of hooks, one for each needle, is inserted between the needles below the sinkers and above the knockover nibs, being accurately positioned by means of guide pieces mounted on the machine and the machine is operated until the needles in the course of their normal movement pull the setting-up course into the hooks of the welt-bar. The machine is now stopped with the needle hooks in their lowest position, with one series of kinks of the setting-up course in the hooks of the needles, and the other series on the knockover nibs as in normal knittting, but also over the shanks of the hooks in the welt bar. At this point, the welt bars are connected to take up rollers through rubber straps or suspenders, and the machine is put into operation to knit the desired length of fabric for the welt.

After the requisite length of fabric has been knitted for the welt, the machine is again stopped with the needles in the intermediate position, and the welt bars are manually transferred by the operator to bring the loops held by the hooks of the welt bars onto the corresponding needles. The loop of fabric thus formed is again attached to the take-up by placing a rod through this loop and connecting it to the regular suspender take-up band. The machine is now turned over slightly to permit the welt bars to be cleared manually from the loops, and the machine is finally put in operation to knit the remainder of the stocking.

One serious objection to this mode of forming the welt, which is now used in general practice, consists in the fact that considerable skill is required on the part of the operator for the loop transferring operation, much more than for other portions of the work which these operatives perform. It also results in a considerable loss of time inasmuch as it is necessary to stop the entire machine which may consist of as many as twenty-eight sections knitting simultaneously, while each section is taken care of in turn by the operator.

It is, therefore, a primary object of the present invention to provide a new and useful mechanism for forming the welt portion of the fabric which is more completely automatic than mechanisms of this description previously developed, and is adapted to produce high grade work much more rapidly and with a less skilled grade of labor than that ordinarily employed.

Where it has been attempted to make use of mechanisms which are more or less fully automatic in operation to form the first course of fabric loops on a welt bar, and then to transfer these loops back again onto the needles to form the turned welt portion of the fabric, no satisfactory means have heretofore been provided for tensioning the fabric. This is due primarily to the comparatively great weight and cumbersome nature of the added mechanism which makes it impossible to adjust the fabric tension within the limits required and at the same time to supply enough force to move the tensioning devices. There are two points in the cycle of operations of the knitting needles when it is essential to have relatively little weight on the fabric and needles, namely, when the sinkers are advanced to measure the yarn, and at and during the time the needles are pressing. It will be borne in mind that in cotton frame and similar machines, the pressing of the needle beards and the measuring of the new loops by the sinkers is done against the yielding resistance of the unsupported needle shanks. The fabric tension employed must, therefore, be adjusted within limits which will insure that the fabric is adequately cleared from about the needles as they are rising after the knockover without at the same time causing the needles to be sprung to an extent which will interfere with the yarn measuring and beard pressing operations. So accurate is the adjustment of the fabric tension required in present day machines, that the operator is expected to change the fabric tension employed as the machine is knitting narrow or wide fabric.

A further object of the present invention is therefore directed to the provision of means for relieving the fabric tension at certain points in

the knitting operation which is particularly well adapted for use in connection with an automatic or semi-automatic mechanism of the type herein described for turning the welt.

Another object of the present invention is to provide in a machine of this type adapted for knitting full-fashioned hosiery or similar fabrics a new and improved welt turning device which will be comparatively light and simple in construction and at the same time reliable and efficient in operation.

With these objects in view, the several features of the invention consist in the devices, combinations, and arrangement of parts hereinafter described and claimed which, together with the advantages to be obtained thereby, will be readily understood by one skilled in the art from the following description taken in connection with the accompanying drawings.

In the drawings, Fig. 1 is a sectional view in left side elevation of the machine; Fig. 2 is a detail view in front elevation of the mechanism for moving the welt hooks and transfer elements into register with the needles; Fig. 3 is a plan view of a section of the machine; Figs. 4 to 13 inclusive are somewhat diagrammatic views showing the parts in different operating position, Fig. 4 shows the needle in its high position after the sinker has measured the yarn and with the welt bar and transfer elements in the normally inactive position, Fig. 5 is a plan view of the welt hooks and transfer elements corresponding to Fig. 4, Fig. 6 shows the needle partially withdrawn with the yarn held on the nib of the sinker and the hooks and transfer elements projected between the needles, Fig. 7 shows the needle retracted to its fullest extent, the sinker elements withdrawn, and the needle loops now held within the welt hooks, Fig. 8 is a somewhat diagrammatic plan view corresponding to Fig. 7, Fig. 9 shows the needle at the moment of pressing off the set-up course, Fig. 10 shows the needle in its normal low knockover position with the transfer elements under fabric tension at the end of the second course, Fig. 11 shows the needle in its low knockover position with the transfer elements advanced to transfer the setting-up course back to the needles, the dotted position of the needle in this view representing the next step in the operation, Fig. 12 is a plan view corresponding to Fig. 11, and Fig. 13 shows the transfer elements again withdrawn to inactive position which is held during the remainder of the knitting operation; Fig. 14 is a sectional view taken on the line A—A of Fig. 10; Fig. 15 is a view in front elevation of a portion of the multiple-section cotton frame machine herein disclosed, two sections being illustrated in this figure; and Fig. 16 is a sectional view in left elevation of substantially the parts illustrated in Fig. 3.

The invention is herein disclosed as embodied in a flat knitting machine of the cotton type which is adapted for knitting full-fashioned hosiery or similar fabrics and comprises a number of sections or needle banks for knitting a number of articles simultaneously on the machine. The needles are indicated in the drawings at 10, the sinkers at 12, and the knockover bits at 14, these parts comprising the usual operating elements for machines of this description. A machine table indicated at 16 of ordinary construction extends throughout the length of the machine.

The needles are rigidly mounted in a needle support bar 18 which is adapted for vertical movements to raise and depress the needles and for lateral movements and turning to press the needle beards. The needle support bar is shown in section in Fig. 1 and the actuating mechanism of ordinary description is shown in Figs. 1 and 15. The actuating connections comprise two or more lever arms such as that indicated at 20 secured to a rock shaft 22 and at their free ends pivotally connected to ears 24 formed on the needle support bar 18. In order to impart the required vertical movements to advance and retract the needles, the shaft 22 is rocked in timed relation to impart the required movements to the needle support bar 18 by means of a cam lever 26 provided at its lower end with a cam roll 28 which is adapted to engage with a corresponding cam 30 mounted on the cam shaft 32 in the machine. For pressing the needles, the needle support bar 18 is provided with a downwardly extending member 34 which is pivotally connected at its lower end to a horizontal link 36. The link 36 is provided with a slot 38 which engages a roll 40 on the lower end of a lever arm 42 rigidly secured to a rock shaft 44 journaled in the machine. This shaft is rocked to move the link 36 and the needle supporting bar with the downwardly extending member 34 about the pivotal connection with the lever arms 20 to cause the needles to be pressed against the surface 46 on the machine frame by means of driving connections which comprise a cam lever 48 secured to the rock shaft 44 and provided at its lower end with a roll 50 adapted to engage with a cam 51 on the cam shaft 32 of the machine.

The welt turning mechanism which is employed in the illustrated machine and forms more specifically the subject matter of the present invention comprises a series of welt hooks and transfer elements adapted to cooperate with the needles in each section of the machine. This mechanism is semi-automatic in operation and can be controlled by the operator to form the loops of the setting-up course in all the sections simultaneously on the welt hooks and then at the end of the welt turning operation, to transfer these loops to the needles. The welt hooks are actuated automatically in timed relation to the knitting operation to take the loops of the setting-up course and are then moved yieldingly away from the needles to tension the fabric loops. At the end of the welt turning operation, the welt hooks and their cooperating transfer elements are brought forward and act in timed relation to the movements of the knitting elements to transfer the loops held on the welt hooks to the needles. In order to provide a simple and efficient means for carrying out these operations, the welt hooks are mounted to slide in a slotted bed or carriage so that they may be extended beyond or retracted between the transfer elements which are mounted on the carriage and form continuations of the side walls of the slots in which the welt hooks slide. The carriage, which, as illustrated in the drawings, extends across two sections of the machine, is adapted for a slight sideways movement to position the welt hooks in line with the spaces between the needles during that part of the operation when the new loops are formed on the welt hooks and then to place the hooks directly in line with the needles for the transferring operation after the welt portion of the fabric has been knitted. The carriage is also adapted for movement towards and away from the work and is

normally held yieldingly in a retracted position to provide an adequate fabric tension during the knitting of the first few courses.

Since the tension required to move the relatively heavy carriage and at the same time properly clear the fabric from about the needles is so strong as to interfere seriously with the operation of the needles during the yarn sinking and beard pressing operations, the present invention further contemplates the provision of mechanism for automatically relieving the tension at these points in the operation. The mechanism provided for this purpose comprises a series of pawls pivotally secured to the carriage and adapted to engage with a rack which is mounted to move forward and back on the machine frame. Cam actuated levers are provided which act in timed relation to the knitting operation to release the pawls so that they are permitted to engage with the rack and at the same time move the rack and the carriage forwardly to release the tension on the fabric and needles.

The welt turning mechanism comprises a series of welt hooks 52 corresponding to the needles of each section and a series of transfer elements 54 cooperating therewith for transferring the loops from the hooks back to the needles. The hooks are mounted for movement back and forth in slots 56 formed in a slide or carriage 58 which extends the length of two sections of the machine, and are adapted to be moved forward and back in unison by the engagement of a slotted control bar 60 mounted to slide on the carriage with corresponding butts 62 on the shanks of the welt hooks. The transfer elements are in the form of thin blades and two of these blades are mounted in each slot, one on either side of the welt hook, and are held rigidly in position in the slots by the engagement of a raised section 64 of each transfer element with abutting portions of the carriage 58, as clearly shown in Fig. 16. These elements (see Figs. 4 to 13 inclusive) are provided with spring tips adapted to close about the welt hooks when the welt hooks are in retracted position and are notched or shouldered to hold the loops of yarn taken from the welt hooks. The spring tips at their extreme ends are located in a plane below the welt hooks, and the notched or shouldered portions of these elements are in a plane above the welt hooks, the tips and notches being connected by a curved or sloping surface up which the loops held by the welt hooks may ride during the welt turning operation, as will be hereinafter described. The notched or shouldered portions support the loops of yarn taken from the welt hooks out of the path of the welt hooks so that the welt hooks may be withdrawn to their retracted position without catching on the loops. While the welt hooks are in advanced position, the tips of the transfer elements are received in grooves 65 in the sides of the hook members.

The movements which are imparted to these elements acting in conjunction with the needles during the welt turning operation to form the new loops on the welt hooks and later to transfer these loops to the needles are fully illustrated in Figs. 4 to 13 and may be briefly described as follows. During the knitting of the setting-up course, the carriage in which the welt hooks and transfer elements are mounted is moved automatically towards the needles and the welt hooks 52 which have previously been pushed out beyond the ends of the transfer elements 54 are advanced between the needles above the knockover bits and below the sinkers as shown in Fig. 6, so that the loops of the first course are formed against the shanks of the welt hooks as the needles are retracted to their knockover position. Before the needles have been depressed to their full limit, however, the welt hooks are moved sideways slightly by a sidewise movement of the carriage to bring them in line with the needles and between the knockover elements so that as the needles are withdrawn to their fullest extent, the welt hooks may be permitted to yield in the direction of the needle movement, as shown in dotted lines in Fig. 7. As the needles are again raised to form the next succeeding series of loops, the welt hooks are withdrawn under tension applied to the carriage to clear the previously formed fabric loops from the needles, and the knitting proceeds until the loops are to be transferred back to the needles. As the knitting progresses, the carriage is retracted to the rear end of its slide. At this point, a welt rod is placed across each piece of fabric knitted and attached to a rubber strip or suspender provided to maintain the required tension on the fabric during the knitting of the remaining portion of the welt fabric. As the knitting progresses and the welt rod in each section of the machine is withdrawn beneath the carriage, the loops held on the hooks 52 will tend to slide up and spread on the curved surfaces of the transfer elements 54 to free the loops from the welt hooks. The welt hooks may now be withdrawn by the operator to their retracted position as shown in full lines in Fig. 4. The movement of the welt rod as the welt fabric is knitted and the transfer of the loops held on the welt hooks to the transfer elements are illustrated in a series of dotted line positions in Fig. 4. After a sufficient length of welt fabric has been knitted, the carriages with the transfer elements 54 are advanced to a position in close proximity to the needles and are then projected automatically over the needles in timed relation to the knitting operation so that on the upstroke of the needles, the loops held on the transfer elements 54 will be placed around the shanks of the needles 10. The carriage and the transfer elements are then withdrawn and the loops are knitted into the fabric in the usual manner.

The control bars 60 provided for each section of the machine are operated to advance or retract the welt hooks 52 in the carriage 58 by means of two arms 66 rigidly secured to each control bar 60 which are curved downwardly at their rear ends and are connected by pivots 68 to lever arms 70 which are rigidly secured to a rock shaft 72. A hand lever 74 is provided to rock the shaft 72 for the purpose of moving the welt hooks to their advanced or retracted positions in the carriage 58.

Each carriage 58 cooperating with two sections of the machine is adapted for movement towards and away from the work and also may be given a slight sidewise movement to bring the welt hooks momentarily in line with the spaces between the needles during the operation of setting-up a new course of stitches in the machine. Inasmuch as it is desirable to tension the fabric being knitted to clear the work from the needles, particularly when the needles are advancing to receive new yarn, each slide or carriage 58 carrying the welt hooks is moved yieldingly away from the knitting elements by means of a weight 76 which is secured to one end of a steel tape 78 which extends upwardly over a roller 80 carried by the roller shaft 82 and is connected at its other end to a

pin 84 on the carriage 58. The retracting movement of the carriage under the influence of the weight 76 is limited by the engagement of the carriage with a stop pin 86 formed on the frame of the machine.

During the operation of the machine in knitting the welt, each carriage 58 will be retracted gradually to its rearmost position in contact with the stop pin 86. The carriages are also maintained in this retracted position while the welt turning mechanism is inoperative during the knitting of the body portion of the fabric. It is, however, necessary to move the carriages to substantially their most advanced position in order to cooperate with the knitting elements to form the new loops on the welt hooks during the setting-up operation, and again to transfer these loops to the needles at the end of the welt turning operation. In order to simplify the construction of the parts and to avoid the necessity of using cams with steeply angled surfaces, means are provided for bringing the carriages manually to an advanced position before they are brought under the influence of their operating cams.

The movement of each carriage 58 towards and away from the work is controlled by means of levers 88 which are rigidly secured to a rock shaft 90 journaled in the machine frame and are pivotally connected with rearwardly extending arms 92 which form the rear supports for the carriage 58. Means not here shown are provided for enabling the operator manually to rotate the rock shaft 90 in order to move the carriages to a partially advanced position. A latch lever 96 loosely hung on the shaft 82 is now moved by the operator into engagement with a pin 98 on an arm 100 formed on one of the levers 88 to hold the carriage in this position. As the carriage is moved forward from this point with a continued movement of the levers 88, the pin 98 will ride out of contact with the notch, allowing the latch lever 96 to swing down to its inoperative position.

The carriages 58 are moved forward from this point automatically to bring the welt hooks across the line of the needles at the required point in the operation of the knitting elements in setting up the first course of loops by means of mechanism which comprises a cam lever 102 rigidly secured to the rock shaft 90 and at its lower end provided with a cam roll 104 adapted to engage with a corresponding cam on the cam shaft 32 of the machine. Since the precise moment at which the carriage 58 will be advanced to cooperate with the knitting elements during the setting-up operation will differ from the movements required during the operation of transferring the loops on the welt hooks back to the needles, separate cams are provided which are brought alternatively into contact with the cam roll 104 during these respective operations. During the setting-up operation of the machine, the cam roll 104 will engage with a cam 106 to advance the carriage 58 and bring the welt hooks across the line of the needles while during the transferring operation, the cam shaft 32 is shifted to bring a cam 108 into operative relation with the cam roll 104.

Each carriage 58 is supported at its forward end by means of spring plungers such as that shown at 110 in Figs. 3 and 16 mounted in a lug 112 in the carriage which are adapted to ride on the raised guideways 114 to provide a sliding support for the carriage. With this construction, the carriages 58 and welt hooks 52 are enabled to move down yieldingly to prevent rupture or unnecessary straining of the yarns when the needles are depressed to knock over the loops of the setting-up course held on the welt hooks.

At the same time that the welt hooks are advanced to take the new loops of the setting-up course, mechanism is rendered operative to impart a slight sidewise movement to each carriage 58 so that the welt hooks are moved from their normal position in line with the needles so that the hooks may advance unobstructed to the required position between and abreast of the needles.

The mechanism for imparting a sidewise movement to the carriage 58 comprises the bar 116 which extends throughout the length of the machine. This bar is carried on nuts 118 on the supporting bolts 120 which are used to secure the table 16 to the side frames. The upper ends of the bolts 120 are turned down to form guiding pins 122 which cooperate with slots 124 in the bar 116 to determine the direction of movement of the bar. Each carriage 58 is connected to move with the bar 116 by the engagement of an eccentric portion 125 of a pin 126 rotatably mounted in the lug 112 on the carriage 58 with a transverse slot 128 formed in a bracket 130 which is secured to the bar 116. An exact adjustment of the carriage 58 with relation to the bar 116 may be secured by rotating the pin 126. The pin is yieldingly seated in its bearing by means of a compressing spring 132 coiled about the pin 126 between a shoulder 134 formed in the bearing and a flange 136 on the lower portion of the pin 126, and is held adjustably in position by the engagement of a gear segment 138 formed in a cap 140 on the pin with corresponding gear teeth 142 formed on the upper end of the bearing.

The bar 116 is given an endwise movement in timed relation to the rotation of the cam shaft 32 to move the carriages 58 with the welt hooks 52 out of line with the needles during the setting-up operation by means of mechanism which comprises a lever 144 which is loosely mounted to turn on the shaft 22 and is provided at its upper end with a cam surface 146 which engages a stop screw 148 on the bent-over end 150 of the bar 116. At its lower end, the lever 144 is provided with a cam roll 152 which engages with a corresponding cam 154 on the cam shaft 32. A tension spring indicated at 156 in Fig. 1 tends to move the lever 144 in a direction to cause the raised surface of the cam 154 to remain in engagement with the stop screw 148 and hold the carriage 58 with the welt hooks 52 in line with the needles. When not in contact with the actuating cam 154, the movement of the cam roll 152 and lever 144 to the left, as viewed in Fig. 1, is limited by the engagement of a notch 158 in the upper part of the lever with a lug 160 on the table 16. The movement of the bar 116 to the left as viewed in Figs. 2 and 15, when the cam 146 on the lever 144 rides out from under the stop screw 148, is determined by means of a set screw 162 to bring the welt hooks accurately in line between the needles. The bar 116 is held yieldingly to the left, as viewed in Figs. 2 and 15, to hold one or the other of the stop screws 148 or 162 in contact with their opposing surfaces by means of a tension spring 164 which is secured at one end to a pin 166 on the table 16 and at the other end to a finger 168 secured to the bar 116.

Another feature of the present invention is directed to the provision of mechanism for releasing the fabric tension exerted by the weight 76 through the welt hooks 52 during the pressing and yarn sinking portions of each knitting cycle. This mechanism comprises a rack 170

mounted to slide in guideways 172 which are secured by screws 174 to the table 16 which forms a fixed part of the machine. The rack 170 is normally held in a retracted position towards the rear of the machine by means of a tension spring 176 which is secured at one end to a pin 178 on the table 16 and at its other end to a pin 180 on the rack. Engaging with the rack teeth are two pawls 182 and 184 which are mounted to swing about a pivot 186 formed on a lug 188 on the carriage 58 and are further provided with parallel vertically extending arms adapted to engage a latch 190 which is pivotally mounted at 192 on one arm of a lever 194. The pawl levers 182 and 184 are provided with a series of teeth which are offset with relation to each other one-half a tooth so that a comparatively fine adjustment of the carriage 58 with relation to the rack 170 is obtained. Tension springs indicated at 196 extending between points on the upwardly extending portions of the pawl levers 182 and 184 and hooks 198 on the carriage 58 tend to hold the pawls in engagement with the rack 170.

The pawl levers 182 and 184 are normally held out of contact with the rack 170 by the engagement of the latch 190 on the lever arm 194 which is held in a retracted position by means of a relatively heavy tension spring 200 stretched between a downwardly extending arm of the lever 194 and pin 202 on the carriage 58. The lever 194 also has a rearwardly extending arm 204. In order to relieve the tension imposed by the weight 76 on the newly knitted fabric, mechanism is provided which acts at predetermined points in the cycle of knitting operations to permit the pawl levers 182 and 184 to engage with the rack 170 and then acts to advance the rack, carrying with it the carriage 58 against the pressure of the weight 76. This mechanism comprises a lever 206 which is loosely mounted on the shaft 22 and is provided with an upwardly extending projection 208 which is adapted to engage with the arm 204 to rotate the lever 194 and the latch 190 to release the pawl levers 182 and 184. At the same time that the pawl levers 182 and 184 are released to engage with the rack 170, an adjustable screw stop 210, mounted on the lever 206, is adapted to engage with the rear end of the rack 170 and move it forwardly to release the tension on the fabric. A downwardly extending arm of the lever 206 carries a cam roll 212 which is adapted to engage with a corresponding cam 214 on the cam shaft 32 of the machine to impart the required movements to the lever 206.

In order to render the actuating cams for the welt turning mechanism operative when required during the welt turning operation and then to render these cams inoperative during the knitting of the remainder of the fabric, mechanism is provided for imparting endwise or shogging movements to the cam shaft 32 to bring these cams into operative relation to their corresponding cam rollers. The mechanism employed for this purpose in the machine herein described comprises the two cam discs 216 and 218 mounted on the cam shaft. Opposite each other on the adjacent faces of these discs, cam surfaces are formed which are adapted to engage between them a roll 220 rigidly mounted against endwise movement on the end of a lever 222 which is mounted to turn on a pivot shaft 224. To prevent any play in either direction, the hub of the lever 222 is fitted snugly at each end against the supporting brackets 226 for the pivot shaft 224. The engagement of the roll 220 fixed against endwise movement as above described with the cam surfaces on the discs 216 and 218 causes the cam shaft to be shogged or moved endwise to the designated position. A tension spring 228 secured at one end to the hook 230 on the hub of the lever 222 and at its other end to a fixed point 232 on the machine frame tends to rotate the lever to move the roll 220 radially towards the axis of the discs 216 and 218. The lever is held adjustably in position against the pressure of this spring by the engagement of a latch 234 pivoted at 236 on the machine frame with a corresponding abutment or stop 238 on the lever 222 which is provided with a series of steps 240 to position the lever 222 to engage the roll 220 with the correct cams. A tension spring 242 tends to swing the latch 234 toward the abutment 238 so that as the lever 222 carrying the roll 220 is depressed against the pressure of its spring, the latch will move into engagement with each step in turn.

The position of the lever 222 carrying the disc 220 to determine the position of the cam shaft 32 lengthwise in the machine is controlled by means of a hand lever 244 formed on the hub of the lever 222 and also by means of a lever arm 246 formed on the hub of the latch lever 234 which is moved automatically to set the latch lever 234 on the required stop 240 of the abutment 238 by engagement with stops such as that indicated at 248 on the pattern chain 250 (see Fig. 15).

Mechanism is also provided which is rendered operative after certain of the cams have performed their functions in the welt turning operation to return the cam shaft 32 automatically to its normal operating position with the lever 222 and cam roll 220 fully retracted as illustrated in Figs. 1 and 15. This mechanism comprises a lever arm 252 which is offset from the lever 222 and carries a cam roll 254 which is adapted for certain positions of the cam shaft 32 to engage with a cam surface 256 on the cam disc 216 to force the lever 222 and the roll 220 away from the cam shaft 32 to the position shown in Figs. 1 and 15, where it is automatically held by the engagement of the latch 234 with the highest step of the abutment 238.

The operation of the machine is as follows: Preparatory to the formation of the setting-up course of loops on the needles, the shaft 90 is rotated manually by the operator in a counter-clockwise direction, as viewed in Figs. 1 and 16, to advance each carriage 58 to a point where it is held by the engagement of the latch lever 96 with a corresponding pin 98 on the arm 100 of the lever 88. The welt hooks 52 are at this time advanced in their slots to a point clear of the transfer elements 54 by the operator through the rotation of the shafts 72 with their hand levers 74. The machine is now set in operation to form a setting-up course of loops and the welt turning mechanism is thrown into operation to cause these loops to be placed on the welt hooks 52. In order to render the welt turning mechanism operative for this purpose, a bump such as that indicated at 248 on the pattern chain 250, is brought into contact with the arm 246 of the latch lever 234, withdrawing the latch from the stop 238 and permitting the lever 222 to swing upwardly to bring the roll 220 opposite the proper cams.

The cams brought into operation, in addition to the regular knitting cams 30 and 51 by

the shogging of the cam shaft 32, include the cam 154 for causing the welt hooks to be moved laterally into line between the needles, the cam 106 for actuating the carriage to bring the welt hooks across the line of the needles, and the cam 214 for actuating the rack to relieve the tension on the fabric. The further rotation of the cam shaft now causes the carriages 58 to be moved endwise to bring the welt hooks 52 in line with the spaces between the needles and each carriage is then advanced to bring the hooks between the needles and directly above the knockover bits and below the sinkers, as shown in Fig. 6, and the new thread is laid on the sinker nibs. As the sinkers are withdrawn and the needles are retracted to their knockover position, the loops are formed over the welt hooks as shown in Fig. 7, the carriages at the same time being moved sidewise to their original position with the hooks in line with the needles and between the knockover bits so that the welt hooks and the carriages 58 are permitted a slight downward movement against the pressure of the spring plungers 110 on which each carriage is mounted. At this point, the lever 102 for advancing the carriages rides off the high portion of its actuating cam 106 so that the carriages are withdrawn under the pressure of the weight 76 to tension the loops. At this point in the operation of the machine, another bump on the pattern chain 250 engages the arm 246 of the latch lever 234, causing this to be retracted to engage another step on the abutment 238 and thus positioning the cam roll 220 to engage with the shogging cams to impart another endwise movement to the cam shaft 32 so that the lever 102 for advancing each carriage 58 to bring the welt hooks 52 between the needles, and the lever 144 for moving the carriages 58 sideways will be disconnected from their actuating cams.

When the needles rise on the next knitting operation, the welt hooks 52 and the carriage 58 are released and are permitted to rise to their normal position and are retracted to tension the loops under the yielding pressure of the weight 76. Since it is desirable during the operation of sinking yarn about the needles (illustrated in Fig. 4) and during the pressing operation (illustrated in Fig. 9) to relieve the tension as above explained, the lever 206 is actuated at the desired points in the knitting operation and by the engagement with its cam 214 so that the projection 208 makes contact with the handle 204 of the latch to release the ratchet pawls 182 and 184 and the set screw 210 engages with the rack 170 to advance each carriage against the pressure of the weight 76. At the end of the yarn sinking operation and again after the needle pressing operation, the lever 206 is retracted so that the pawls are taken out of contact with the rack and the rack is permitted to fall back under the pressure of its spring 176.

While the knitting is progressing to a point where the carriage is at the rear end of its slide against the stop pin 86, a welt rod as indicated in dotted lines at 258 in Fig. 4, is placed across each piece of fabric knitting and attached to a rubber strip or suspender. The successive steps of this operation are illustrated in dotted lines in Fig. 4. Finally, in order to transfer the loops held on the welt members back to the needles, the carriages are again brought forward manually by rotating the shaft 90 so that the detent arm 96 can be brought into engagement with the pin 98, the welt hooks, however, being at the same time retracted so that the loops are held on the transfer elements 54. Since at this time it is necessary for the carriage to be advanced at a different point in the cycle of knitting operations in order to bring these loops over the needles on their advance stroke and then to retract the carriage as the needles are again depressed to the knockover position, the cam shaft 32 is again shogged to cause the lever 102 to engage with the appropriate cam 108. For this purpose, the lever 222 carrying the roll 220 for determining the lengthwise position of the cam shaft is rotated manually by the operator to move the roll 220 outwardly against the pressure of its spring 228 to the correct position which is determined accurately by the engagement of the latch 234 with an abutment on the pattern chain 250 to position the latch 234 opposite the proper step. After nearly one revolution of the cam shaft 32 during which the loops are transferred as above described to the needles, the lever 222 and the cam roll 220 are returned to their normal operating position through the operation of the cam 256 operating on the roll 254 which acts to return the lever 222 and the latch 234 to the positions illustrated in Fig. 1. From this point, the knitting of the stocking proceeds in the usual manner.

Having thus described the invention, what is claimed is:

1. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks to receive the initial course of loops of the welt fabric, and two transfer elements mounted to operate one on each side of each hook to transfer loops held on the hooks to the needles.

2. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving the initial loops of the welt portion of the fabric, a carriage on which the hooks are mounted, a series of transfer elements on the carriage movable relatively to the hooks, and means for actuating the carriage.

3. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving the initial loops of the welt portion of the fabric, a series of transfer elements cooperating therewith, a carriage on which the hooks and transfer elements are supported adapted for movement toward and away from the needles, and means for moving the carriage transversely of the needles to transfer the hooks and the associated transfer elements from the loop taking to the transfer position.

4. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving initial loops of the welt portion of the fabric, a carriage on which the hooks are supported situated on a plane substantially at right angles to that of the needles, and a series of transfer elements secured to the carriage to cooperate with the hooks.

5. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving initial loops of the welt portion of the fabric and adapted for movement in a plane substantially at right angles to that of the needles, and a series of transfer elements cooperating therewith movable in sub-

stantially the same plane to transfer the loops held on the welt hooks back to the needles.

6. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks, a carriage in which the welt hooks are mounted to slide, and a series of transfer elements secured to the carriage for transferring loops held on the welt hooks back to the needles.

7. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks, a carriage in which the welt hooks are mounted to slide, a series of transfer elements secured to the carriage for transferring loops, and means for moving the welt hooks simultaneously to an advanced or retracted position in the carriage.

8. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks and a series of transfer elements, a pair being provided for each welt hook and movable relatively to the welt hooks to transfer the loops formed on the welt hooks back to the needles.

9. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks, and a series of transfer elements movable relatively thereto, a pair being provided for each welt hook, one at either side of the hook, and provided with spring tips adapted to make contact in advance of the welt hook.

10. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving initial loops of the welt portion of the fabric, and a series of transfer elements, a pair being provided one on each side of each hook with cam surfaces to spread and raise the loop out of engagement with the welt hook.

11. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving initial loops of the welt portion of the fabric, and a series of transfer elements movable relatively thereto in substantially the same plane with the hooks, a pair being provided one on each side of each hook with cam surfaces to raise and hold a loop out of engagement with the welt hook.

12. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving initial loops of the welt portion of the fabric, a welt fabric tensioning rod for tensioning the fabric to the rear of the welt hooks, and a series of transfer elements cooperating with the welt hooks having cam surfaces to permit loops held on the hooks to slide to a position on the transfer elements out of the line of movement of the welt hooks.

13. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving initial loops of the welt portion of the fabric, and a series of transfer elements movable relatively to the welt hooks in substantially the same plane and provided with cam surfaces to position the loops on the transfer elements out of contact with the hooks.

14. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks, and a series of transfer elements movable relatively to the hooks, a pair being provided for each hook with tips notched to enable a loop of yarn taken from the welt hook to be placed about the needle and then cast off from the transfer element tips.

15. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks, a carriage slotted to permit the welt hooks to move relatively to the carriage, and a series of transfer elements fixed against movement in the carriage, a pair being provided for each welt hook to transfer a loop held on the hook back to the needles.

16. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating web holders, a series of welt hooks, transfer elements cooperating therewith, means for advancing and retracting the welt hooks, and means for moving the welt hooks laterally relatively to the needles from a position in line between the needles for receiving the initial course of loops of the welt portion of the fabric to a position in line with the needles for the transferring operation.

17. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks on which the initial loops of the welt portion of the fabric are formed, a series of transfer elements for transferring the loops back to the needles, means for moving the transfer elements relatively to the hooks to place the loops on the transfer elements beyond the ends of the welt hooks, and means acting in timed relation to the knitting operation to advance the transfer elements to transfer the loops back to the needles.

18. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks adapted to move as a unit, means acting in timed relation to the knitting operation to move the welt hooks into a knock-over position between the needles to receive the initial loops of the welt portion of the fabric, a series of transfer elements movable relatively to the welt hooks to place the loops on the tips of said elements beyond the ends of the welt hooks, and means acting in timed relation to the knitting operation to advance the transfer elements to transfer the loops back to the needles.

19. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks adapted to operate in a plane substantially at right angles to that of the needles, means acting in timed relation to the knitting operation to move the welt hooks into a knock-over position between the needles to receive the initial loops of the welt portion of the fabric, a series of transfer elements movable relatively to the welt hooks to place the loops on the transfer tips of said elements beyond the ends of the welt hooks, and means for automatically advancing the transfer elements to place the loops over the rising needles.

20. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a se-

ries of welt hooks, a carriage grooved to receive the welt hooks, means for advancing and retracting the hooks in the carriage as a unit, and a series of transfer elements fixedly mounted in pairs in the slots, one to each side of each welt hook.

21. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks, a carriage grooved to receive the welt hooks, means for advancing and retracting the hooks in the carriage as a unit, a series of transfer elements fixedly mounted in the carriage for transferring loops held on the hooks back to the needles, and means acting in timed relation to the knitting operation to advance the carriage to bring the welt hooks to a knock-over position between the needles in laying the setting-up course of yarn, and thereafter to advance the carriage to cause the transfer elements to transfer the loops formed on the welt hooks back to the needles.

22. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving initial loops of the welt portion of the fabric, a carriage on which the hooks are mounted, a series of transfer elements on the carriage movable relatively to the hooks, means for providing a tension on the carriage to clear the fabric from the needles, and means for relieving the tension on the carriage at a predetermined point in the knitting cycle.

23. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving initial loops of the welt portion of the fabric, a carriage on which the hooks are mounted, means for applying a tension to the carriage to clear the previously formed fabric loops from the needles, and means for relieving the said tension at a predetermined point in the knitting cycle.

24. In a knitting machine for producing turn welt fabric, the combination with a series of needles and their cooperating knitting elements, of a welt turning mechanism comprising a series of instrumentalities for receiving initial loops of the welt portion of the fabric, a carriage on which said instrumentalities are mounted movable toward and away from the needles, means for applying a tension to the carriage to clear the previously formed fabric loops from the needles during the knitting of subsequent fabric courses, and means for relieving said tension for a predetermined portion of each knitting cycle.

25. In a knitting machine for producing turn welt fabric, the combination with a series of needles and their cooperating knitting elements, of a welt turning mechanism comprising a carriage, elements supported on the carriage to cooperate with the needles to turn the welt, means for applying a tension to the carriage to clear the previously formed fabric loops from the needles during the knitting of welt fabric courses, means for relieving the said tension during a predetermined portion of each knitting cycle, and means for advancing the carriage and elements supported thereon to bring said elements into operative engagement with the needles to take a course of loops from the needles, and thereafter to return said loops to the needles.

26. In a flat full-fashioned knitting machine, the combination with cooperating knitting elements including a stationary press, of a series of spring beard needles movable as a unit with relation to the press, means for imparting a predetermined motion to the needles for the knitting of each course including vertical movements to draw down the loops and horizontal movements toward and away from the press, a welt turning mechanism comprising a series of hooks for receiving initial loops of the welt portion of the fabric, a take-up device acting on the hooks to maintain a tensioning strain on the fabric to clear previously formed loops to the backs of the needles, and means for relieving said tension during a predetermined portion of said needle motion.

27. In a flat full-fashioned knitting machine, the combination with cooperating knitting elements including a stationary press, of a series of spring beard needles movable as a unit with relation to the press, means for imparting a predetermined motion to the needles for the knitting of each course comprising vertical movements to draw down new loops and horizontal movements toward and away from the press, a take-up device engaging the fabric to maintain a tensioning strain thereon to clear the previously formed loops to the backs of the needles, and means for relieving said tension during a predetermined portion of said needle motion.

28. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving initial loops of the welt portion of the fabric, a carriage on which the hooks are mounted, a rack, a pawl acting when rendered operative to connect the carriage to the rack, means for tensioning the carriage to clear the previously formed fabric loops from the needles, and means acting in timed relation to the knitting operation to engage the pawl with the rack and to move the rack to relieve the tension on the fabric.

29. In a knitting machine for producing turn welt fabric, the combination with a series of needles and their cooperating knitting elements, of welt turning mechanism comprising a carriage freely movable toward and away from the needles substantially in a plane transversely of the needle shanks, elements supported on the carriage to cooperate with the needles to turn the welt, and means for advancing the carriage and welt turning elements supported thereon to bring said elements into operative engagement with the needles to take a course of loops from the needles, and thereafter to return said loops to the needles.

30. In a knitting machine for producing turn welt fabric, the combination with a series of needles and their cooperating knitting elements, of welt turning mechanism comprising a carriage, elements supported on the carriage to cooperate with the needles to turn the welt, a support on which the carriage is adapted to move freely toward and away from the needles substantially in a plane transversely of the needle shanks, and means for advancing the carriage and welt turning elements supported thereon to bring said elements into operative engagement with the needles to take a course of loops from the needles, and thereafter to return the said loops to the needles.

31. In a knitting machine for producing turn welt fabric, the combination with a series of needles and their cooperating knitting elements, of welt turning mechanism comprising a carriage, elements supported on the carriage to cooperate with the needles to turn the welt, a support on which the carriage is adapted to move freely to-

ward and away from the needles substantially in a plane transversely of the shanks of the needles, means for advancing the carriage and welt turning elements supported thereon to bring said elements into operative engagement with the needles to take a course of loops from the needles, and thereafter to return the said loops to the needles, and means for positioning the carriage lengthwise of the needle series to cause the said welt turning elements to assume one position with relation to the needles in taking the loops, and a second position with relation to the needles in transferring the loops back to the needles.

32. In a knitting machine for producing turn welt fabric, the combination with a series of needles and their cooperating knitting elements, of welt turning mechanism comprising a carriage, elements supported on the carriage to cooperate with the needles to turn the welt, a support on which the carriage is adapted to move freely toward and away from the needles substantially in a plane transversely of the needle shanks, a tensioning device for moving the carriage yieldingly away from the needles, a fabric take-up adapted to engage with the turned portion of the fabric, and means for advancing the carriage and welt turning elements supported thereon to bring said elements into operative engagement with the needles to take a course of loops from the needles, and thereafter to return said loops to the needles.

33. A welt turning mechanism for a knitting machine having, in combination with a series of needles and cooperating knitting elements, a series of welt hooks for receiving the initial loops of the welt portion of the fabric, a series of transfer elements cooperating with the welt hooks to return the loops to the needles at the end of the welt turning operation, and a welt fabric tensioning rod for tensioning the fabric adapted with the continued knitting of the welt portion of the fabric to draw the loops from the hooks onto the transfer elements.

34. In a knitting machine for producing turn welt fabric, the combination with a series of needles, their cooperating knitting elements, and a cam shaft from which these elements are actuated, of welt turning mechanism comprising a carriage, elements supported on the carriage to cooperate with the needles to turn the welt, a support on which the carriage is adapted to move freely toward and away from the needles substantially in a plane transversely of the needle shanks, and means actuated from the cam shaft when rendered operative to advance the carriage and welt turning elements supported thereon to bring the welt turning elements into operative engagement with the needles to take a course of loops from the needles and thereafter to return the said loops to the needles.

35. In a knitting machine for producing turn welt fabric, the combination with a series of needles, their cooperating knitting elements, and a cam shaft from which these elements are actuated, of welt turning mechanism comprising a series of welt hooks for receiving the initial loops of the welt portion of the fabric, a series of transfer elements cooperating therewith, a carriage on which the hooks and transfer elements are supported adapted for movement toward and away from the needles, and mechanism actuated from the cam shaft when rendered operative to advance the carriage to one position to bring the welt hooks into cooperative relationship with the needles and to a second position to bring the transfer elements into cooperative relationship with the needles.

36. In a knitting machine for producing turn welt fabric, the combination with a series of needles and their cooperating knitting elements, of a welt turning mechanism comprising a carriage, a series of welt hooks and transfer elements mounted to move relatively to each other on the carriage, a support on which the carriage is mounted to move freely towards and away from the needles, a cam for moving the carriage laterally to bring the transfer elements and welt hooks alternatively into cooperative relationship to the needles, and adjustable stops for limiting the movement of the carriage in each direction.

37. The combination in a flat knitting machine comprising a series of needles; of welt mechanism including a slidable element with a series of instrumentalities adapted to individually remove the loops of the initial course of knitting from the needles, and automatic mechanism whereby the slidable element is gradually moved horizontally away from the needles as the welt fabric is being knit, and is thereafter moved horizontally toward the needles after completion of a definite length of such fabric for replacement of the loops on its instrumentalities upon said needles to close the welt.

38. In a flat knitting machine for producing turn welt fabric, the combination with a series of needles and their cooperating knitting elements, of cam means for actuating said needles and cooperating elements to form a continuously knitted fabric, a welt turning mechanism comprising a single carriage movable toward and away from the needles and elements mounted thereon to cooperate with the needles to turn the welt, and means acting automatically in timed relation to the operation of the needles to advance the carriage to bring the said elements into operative relationship to the needles to engage with the initial loops of the welt portion of the fabric and thereafter to advance the carriage during the continued knitting of the fabric to cause the loops to be returned to the needles.

39. In a straight knitting machine, the combination of a cam shaft, needles and their cooperating knitting elements actuated from the cam shaft to form a continuously knitted fabric, hooks arranged to cooperate with the needles to engage with an initial course of loops formed thereby, mechanism for operating said hooks and for imparting cooperating movements to the needles to set up the initial course of fabric, and means acting in timed relation to the rotation of the cam shaft to disconnect the hooks from said operating mechanism to permit the retraction of said hooks to take up subsequently knitted courses of fabric.

40. In a straight knitting machine, the combination of a cam shaft, needles and their cooperating knitting elements actuated from the cam shaft to form a continuously knitted fabric, hooks arranged to cooperate with the needles to engage with an initial course of loops formed thereby, a series of transfer elements for transferring the loops back to the needles, mechanism controlled from the cam shaft for operating said hooks and for imparting cooperating movements to the needles to set up the initial course of the fabric, means acting in timed relation to the rotation of the cam shaft to disconnect the hooks from said operating mechanism to permit the retraction of said hooks to take up subsequently knitted courses of fabric, and mechanism controlled from the cam shaft for operating said transfer elements and

for imparting cooperating movements to the needles to return the loops to the needles.

41. In a knitting machine for producing turn welt fabric, the combination with a series of needles and their cooperating knitting elements, of a welt mechanism comprising a carriage, hook elements supported on the carriage, means for positioning said carriage and hook elements supported thereon to receive an initial course of yarn, resilient supporting means for the carriage to permit the carriage and hook supported thereon when engaged by the yarn of the initial course to be drawn down with the downward movement of the needles to maintain a tensioning strain on the yarn against said hook elements, and a take-up device acting on said carriage to take up the fabric during the knitting of subsequent courses.

MAX C. MILLER.