Nov. 2, 1948. F. LAMBACH 2,452,579

WARP KNITTING MACHINE

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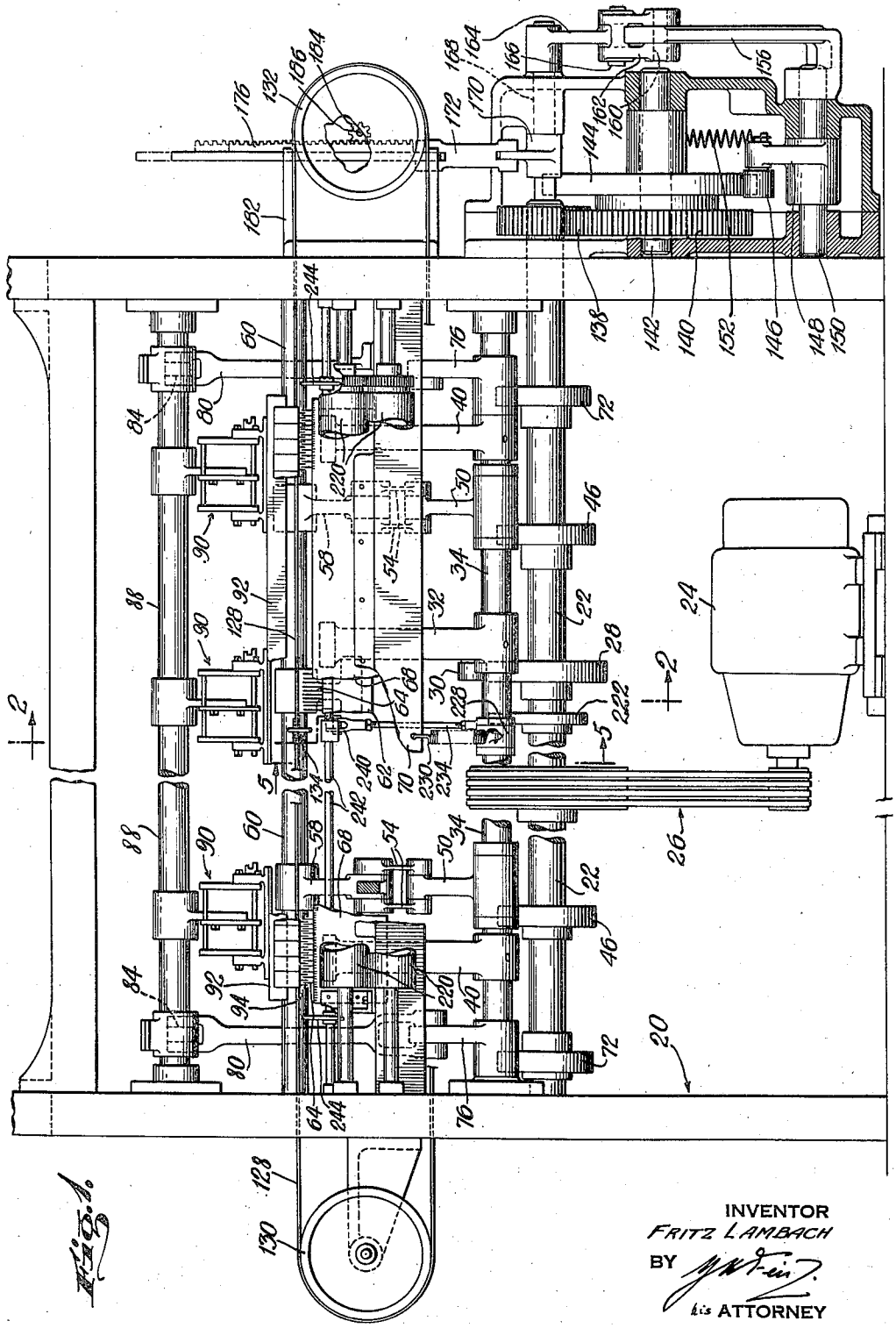


Fig. 1.

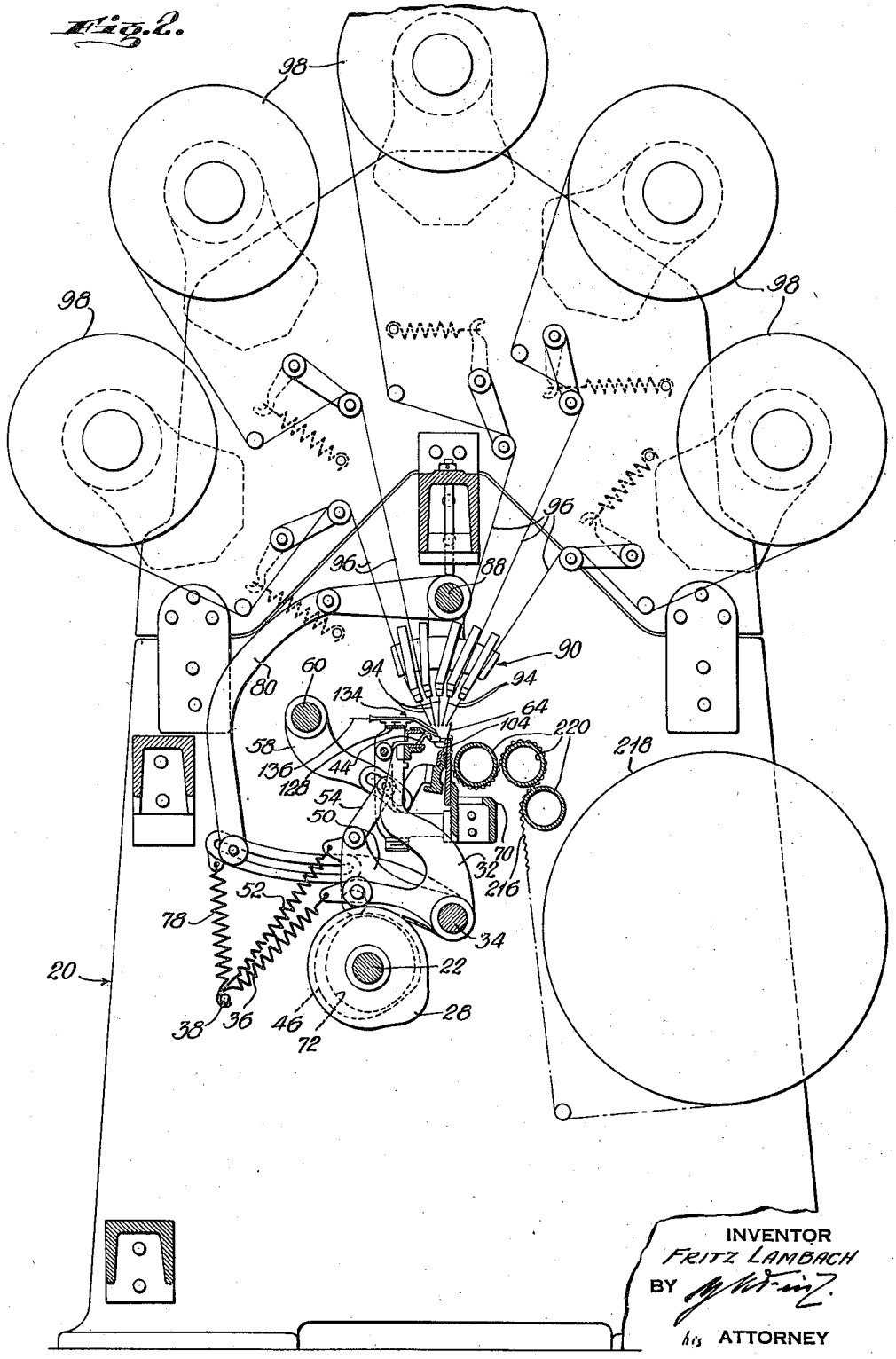
INVENTOR
FRITZ LAMBACH
BY
his ATTORNEY

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WARP KNITTING MACHINE

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Fig. 2.



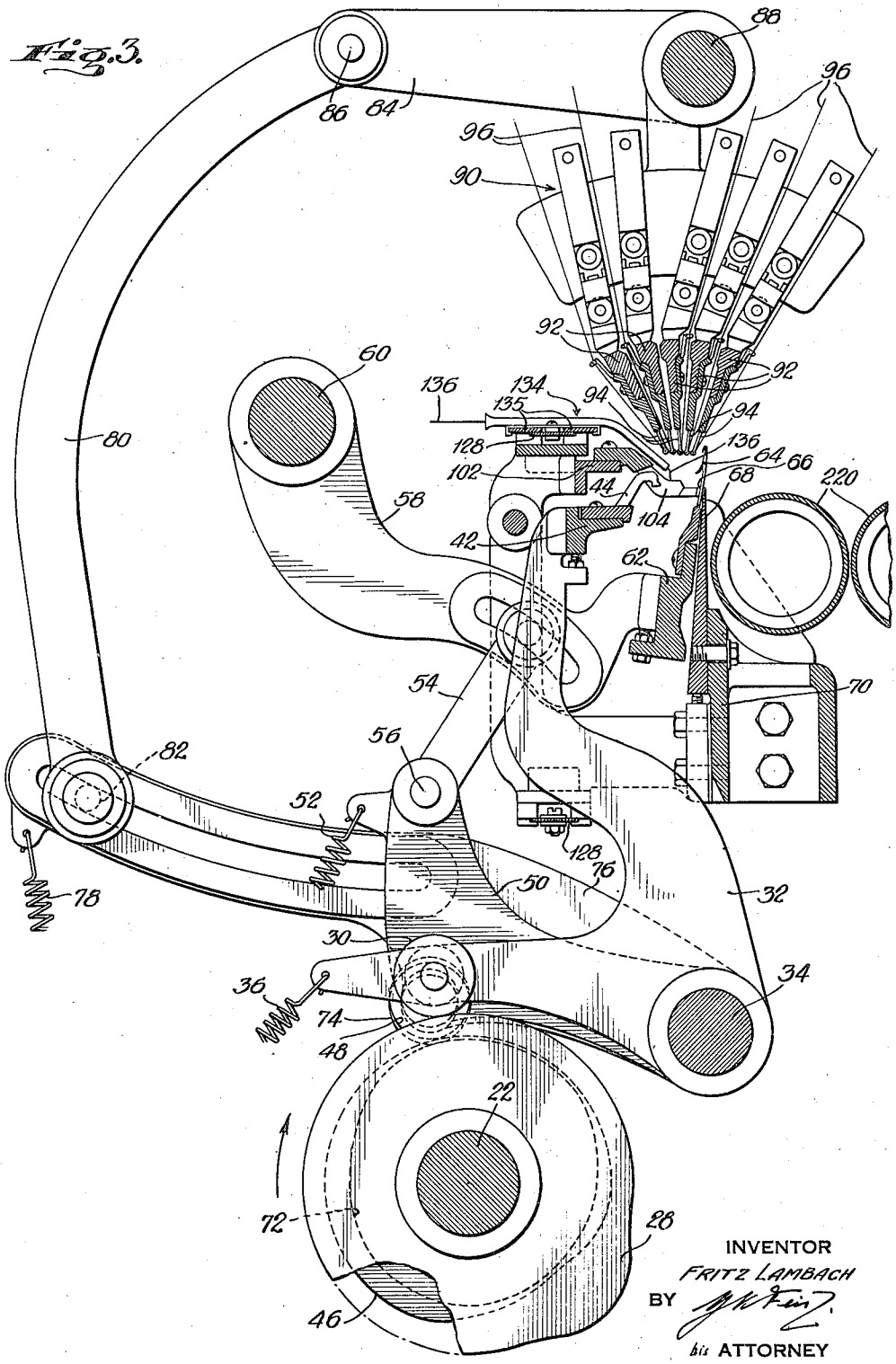
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WARP KNITTING MACHINE

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Fig. 3.



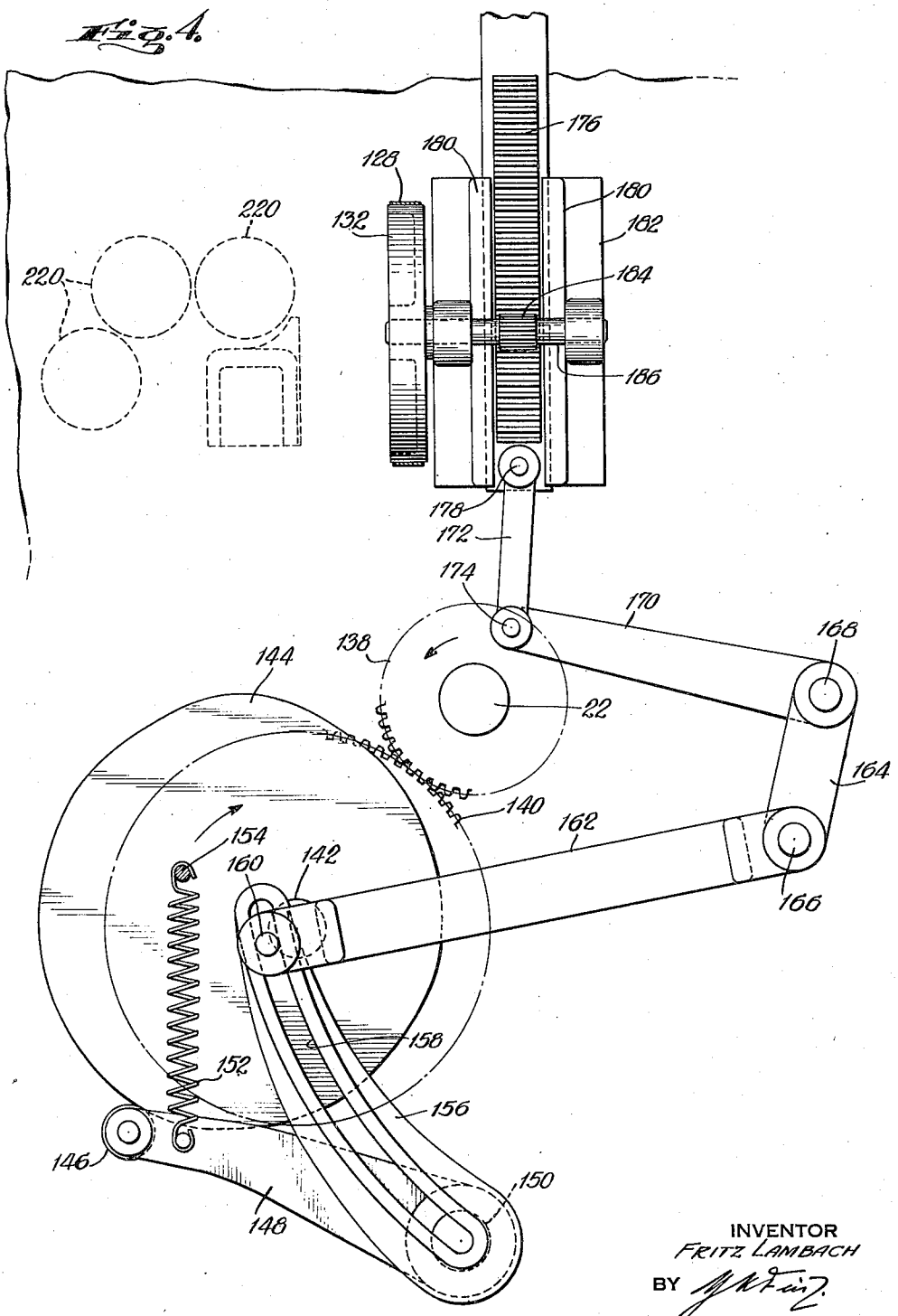
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WARP KNITTING MACHINE

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Fig. 4.



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WARP KNITTING MACHINE

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Fig. 5.

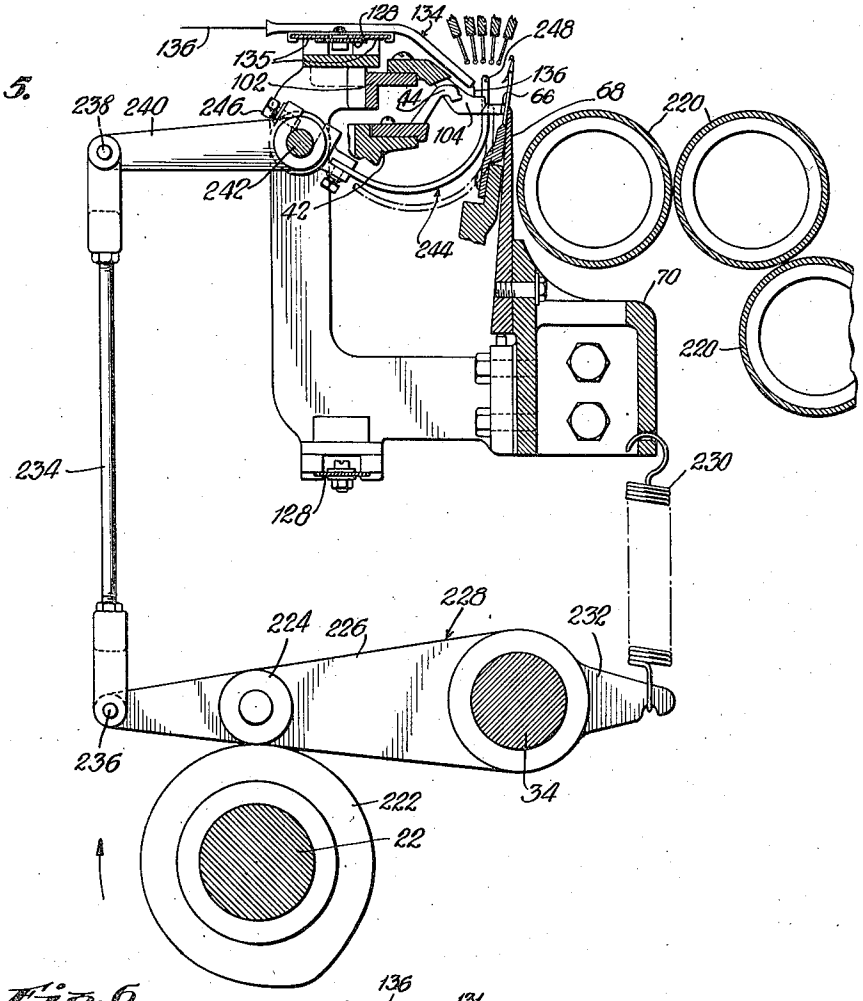


Fig. 6.

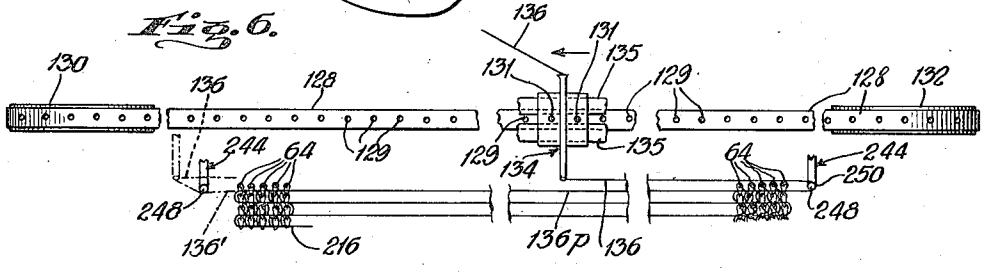
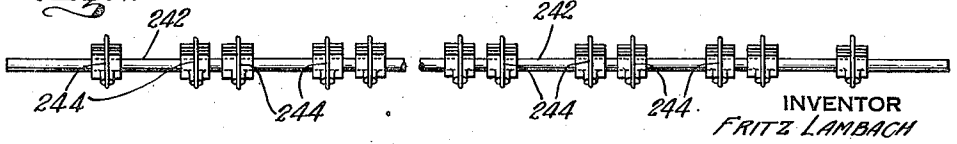


Fig. 7.



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WARP KNITTING MACHINE

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Fig. 12.

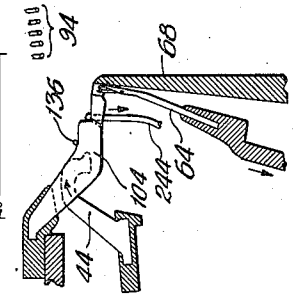


Fig. 17.

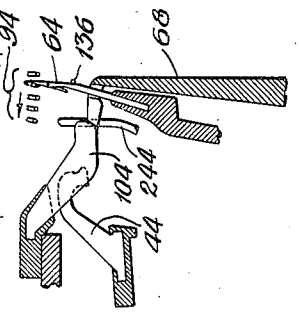


Fig. 11.

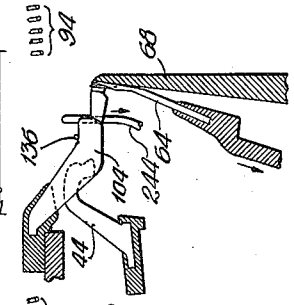


Fig. 16.

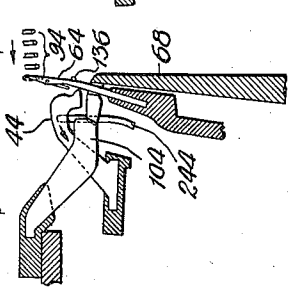


Fig. 10.

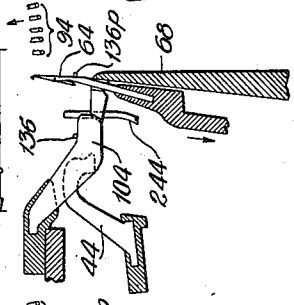


Fig. 15.

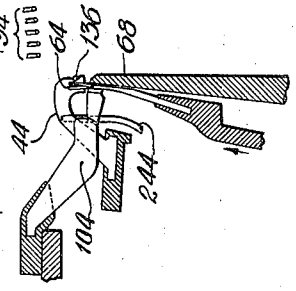


Fig. 9.

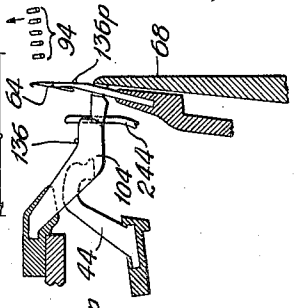


Fig. 14.

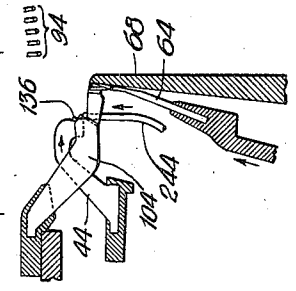


Fig. 8.

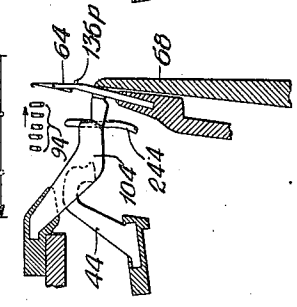
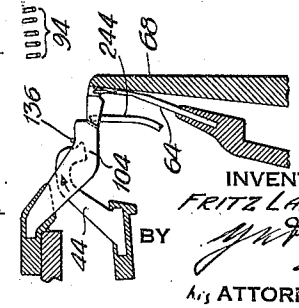


Fig. 13.



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2,452,579

UNITED STATES PATENT OFFICE

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WARP KNITTING MACHINE

Fritz Lambach, Tenafly, N. J.

Application October 3, 1945, Serial No. 620,113

13 Claims. (Cl. 66—84)

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My invention relates to textile machines, and more particularly to warp knitting machines or so-called "Kayloom Machines," wherein one or more reciprocable filler thread carriers are arranged for laying filler thread substantially parallel to the series of needles and wherein reciprocable filler sinkers are arranged for placing the filler thread laid by said filler thread carrier or carriers into position to be incorporated into fabric produced by the knitting implements of the machine from warp yarns drawn from warp beams.

During the movement of the filler thread carrier from a first end position into a second end position for laying filler thread, the filler thread must be engaged with a filler thread retaining means arranged near said first end position. In the hitherto known warp knitting machines of above described type as disclosed for example in the U. S. Patent 2,200,280 to Klumpp and Lambach, a tine like projection of the filler sinker near said first end position is being used for this purpose when the filler sinker is in an intermediate position between its extreme backward and forward positions. This feature requires a standstill of the filler sinkers in said intermediate position and consequently a standstill of the needles and warp guides during the laying of filler thread. Therefore, in hitherto customary warp knitting machines of above described type, the knitting operations of the needles, warp guides, and filler sinkers take place during a rotation of the main shaft through an angle of 180°, and the laying of filler thread by the filler thread carrier or carriers takes place during a subsequent rotation of the main shaft through another angle of 180°. Said restriction of the performance of the knitting operations during half a revolution of the main shaft causes a limit of the speed of rotation of the main shaft in view of the permissible accelerations of the needles, warp guides, and filler sinkers, and said limit of the speed of rotation of the main shaft, of course, causes a limitation of the efficiency of the warp knitting machine.

An object of my invention is to provide a warp knitting machine of above described type, which may be operated at a high speed.

Another object of my invention is to provide a warp knitting machine of above described type, wherein the knitting operations of the needles, warp guides, and filler sinkers may be performed during a full revolution of the main shaft through an angle of 360° and the laying of filler thread may be carried out during a portion of said full

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revolution of the main shaft, so that the main shaft may be rotated at a high speed with the result of a high efficiency of the warp knitting machine.

A further object of my invention is to provide a warp knitting machine of above described type with a special filler thread retaining mechanism.

Still another object of my invention is to improve on the construction of warp knitting machines of above described type as now ordinarily made.

With the above and other objects of the invention in view, the invention consists in the novel construction, arrangement and combination of various devices, elements and parts, as set forth in the claims hereof, certain embodiments of the same being described in the specification and being illustrated in the accompanying drawings forming part of this specification, wherein:

Fig. 1 is a front elevational view of a warp knitting machine according to the invention, some parts being broken away and some parts being shown in section,

Fig. 2 is a vertical sectional view of the warp knitting machine, taken on line 2—2 of Fig. 1,

Fig. 3 is a sectional view similar to the sectional view shown in Fig. 2, said Fig. 3, however, illustrating only the knitting implements and their actuating drives in an enlarged scale,

Fig. 4 is a fragmentary right-hand side elevational view of the warp knitting machine, illustrating the carrier drive actuating the reciprocable filler thread carrier,

Fig. 5 is a sectional view taken on line 5—5 of Fig. 1, illustrating the filler thread retaining mechanism,

Fig. 6 is a somewhat diagrammatical top plan view of the band drive carrying the filler thread carrier, of the filler thread retaining fingers, and of a piece of fabric,

Fig. 7 is a front elevational view of a rod carrying a plurality of filler thread retaining fingers, and

Figs. 8–17 are somewhat diagrammatical illustrations of various positions of the knitting implements relative to each other during a knitting operation.

Referring now to Figs. 1 and 2, 20 generally indicates the frame of the warp knitting machine composed of several parts in any suitable manner. A main cam shaft 22 journalled in suitable bearings of the frame may be rotated by a motor 24 connected with said main cam shaft through a belt drive generally indicated by 26.

Several sinker bar cams 28 (only one being

shown in the drawings) are keyed to the main cam shaft 22. Each of said sinker bar cams 28 is in operative engagement with a roller 30 (see Figs. 1, 2 and 3) rotatably mounted on a sinker bar rocker 32 keyed to a sinker bar shaft 34 rotatably mounted in suitable bearings of the frame. A tension spring 36 stretched between one end of said sinker bar rocker 32 and a stationary point 38 of the machine tends to urge the roller 30 against the surface of the sinker bar cam 28. The other end of said sinker bar rocker 32 and the free end of a plurality of sinker bar arms 40 keyed to the sinker bar shaft 34 carry a sinker bar 42 secured to said ends of the sinker bar rocker and sinker bar arms by screws. The sinker bar 42 extending over the width of the warp knitting machine carries a series of filler sinkers 44 secured thereto in any suitable manner. Above described sinker bar drive 28, 30, 32, 34, 40, associated with said sinker bar 42 may reciprocate the sinker bar 42 with its filler sinkers 44 in a forward and backward direction in dependence on the shape of the sinker bar cam 28.

Furthermore, several needle bar cams 46 are keyed to the main cam shaft 22. Each of said needle bar cams cooperates with a roller 48 journalled on a needle bar rocker 50 swingably mounted on the sinker bar shaft 34. A tension spring 52 stretched between the needle bar rocker 50 and the stationary point 38 of the machine tends to urge the roller 48 against the surface of the needle bar cam 46. On each side of the needle bar rocker 50, one end of a connecting link 54 is pivoted to the needle bar rocker 50 at 56. The other end of said connecting link 54 is pivotally and adjustably connected with a needle bar arm 58 keyed to a needle bar shaft 60 rotatably mounted in suitable bearings of the frame 20. A needle bar 62 carrying a series of latch needles 64 and extending over the width of the machine is secured to the needle bar arms 58 by screws. Each of the latch needles passes through a slot 66 of a trick plate 68 secured to a member 70 of the frame. Above described needle bar drive 46, 48, 50, 54, 58 associated with the needle bar 62 may reciprocate said needle bar 62 with its latch needles 64 in an upward and downward direction in dependence on the shape of the needle bar cam 46.

Furthermore, several guide bar cams 72 are keyed to the main cam shaft 22. Each of said guide bar cams cooperates with a roller 74 rotatably mounted on a guide bar rocker 76 swingably mounted on the sinker bar shaft 34. A tension spring 78 stretched between the guide bar rocker 76 and the stationary point 38 tends to urge the roller 74 against the surface of the guide bar cam 72. One end of a connecting link 80 is pivotally and adjustably connected with the guide bar rocker 76 at 82, the other end of said connecting link 80 is pivoted to one end of a guide bar arm 84 at 86. The other end of said guide bar arm 84 is keyed to a guide bar shaft 88 rotatably mounted in suitable bearings of the frame 20. A plurality of guide bar hangers generally indicated by 90 is secured to said guide bar shaft 88. Said guide bar hangers 90 carry a plurality of guide bars 92 (in the embodiment shown in the drawings, the machine is equipped with five guide bars) extending over the width of the machine. Each of said guide bars 92 carries a series of warp guides 94, by means of which warp yarns 96 (see Fig. 2) drawn from rotatable warp beams 98 are fed to the latch needles 64. Above described guide bar drive 72, 74, 76, 80, 84, 90 associated with the guide bars 92 may reciprocate the guide bars 92 with their warp guides 94 in a forward and backward direction in dependence on the shape of the guide bar cam 72. Furthermore, the guide bars 92 with their warp guides 94 may be reciprocated in a longitudinal direction by means of a pattern chain drive (not shown in the drawings) in a manner known per se.

As shown in Figs. 3 and 5, a stationary bar 102 forming a part of the frame of the machine carries a series of stationary elements 104. Said stationary elements 104 are spaced from each other in such a way, that the upper end of each filler sinker 44 enters in a space between said stationary elements, whereby said stationary elements guide said filler sinkers during their reciprocating movements as more fully described in my copending patent application relating to "A warp knitting machine," Ser. #617,537 filed Sept. 20, 1945. The free end of each stationary element 104 is in loose engagement with the trick plate 68. Thus, the spaced stationary elements 104 form a bridge extending over the width of the machine.

As best shown in Fig. 1, an endless band 128 of flexible material is trained around two drums 130, 132. Each of said drums is journalled in suitable bearings of brackets mounted on the frame. The drum 132 is connected with a drive, the so-called carrier drive, to be described hereinafter, by means of which the drum 132 may be periodically rotated in clockwise direction and counter-clockwise direction, whereby a periodic reciprocating movement is imparted to the band 128. As best shown in Fig. 6, said band 128 is provided with a series of holes 129. A filler thread carrier generally indicated by 134 is secured to said flexible band 128 by means of screws 131 or the like inserted into holes of the band. The filler thread carrier may slide on a guide 135 mounted on the frame of the machine. The drawings illustrate only one filler thread carrier, but it is understood that a plurality of filler thread carriers may be attached to the band 128, if desired. The filler thread carrier receives a filler thread 136 (see Figs. 3, 5, and 6) from a filler thread supply (not shown). When the filler thread carrier 134 is moved from its extreme right-hand position into its extreme left-hand position and vice versa, filler thread is laid by said filler thread carrier 134 substantially parallel to the series of latch needles 64 onto the bridge formed by the stationary elements 104 which may be called stationary filler thread receiving elements.

The carrier drive associated with the filler thread carrier 134 for reciprocating same is best shown in Figs. 1 and 4. A pinion 138 keyed to the end of the main cam shaft 22 is in mesh with a gear 140 keyed to a shaft 142 journalled in suitable bearings of the frame. A cam 144 keyed to said shaft 142 is in engagement with a roller 146 rotatably mounted on a rocker 148 keyed to a shaft 150 journalled in bearings of the frame. A tension spring 152 stretched between the rocker 148 and a stationary point 154 of the machine tends to urge the roller 146 against the surface of the cam 144. An arm 156 having a slot 158 is keyed to the shaft 150. A pivot 160 pivotally connecting the arm 156 with one end of a connecting link 162 may be adjusted in a desired position in said slot 158. The other end of said connecting link 162 is pivoted to an arm 164 at 166. Said arm 164 is keyed to a shaft 168 journalled in bearings of the frame. The end of an arm 170 keyed to said shaft 168 is pivoted to one end

of a connecting rod 172 at 174. The other end of said connecting rod 172 is pivoted to a rack 176 at 178. Said rack 176 is slidably arranged in a guide 180 mounted on a bracket 182 of the machine. A pinion 184 in mesh with said rack 176 is keyed to a shaft 186 journalled in bearings of the bracket 182. The drum 132 engaged with the band 128 carrying the filler thread carrier or carriers in the manner described above is keyed to the shaft 186. As will be readily understood, above described carrier drive 138, 140, 144, 148, 156, 162, 164, 170, 172, 176, 184, 132, 128 may cause a movement of the filler thread carrier to the right or to the left, depending on the upward or downward movement of the rack 176 in dependence on the shape of the cam 144. The ratio between the pinion 138 and the gear 140 is 1:2, and the cam 144 is of such a shape, that the filler thread carrier performs either one movement to the right with a subsequent standstill in its extreme right-hand position, or one movement to the left with a subsequent standstill in its extreme left-hand position during one full rotation of the main cam shaft 22 corresponding to one cycle of knitting operations. The length of the stroke of the filler thread carrier or carriers may be adjusted by an adjustment of the pivot 160 in a predetermined position in the slot 158; the larger the distance between the pivot 160 and the shaft 150, the larger the stroke of the rack 176 and, consequently, the larger the stroke of the filler thread carrier or carriers attached to the band 128.

As best shown in Figs. 1, 5 and 6, the machine is equipped with a filler thread retaining mechanism. For this purpose, a filler thread retainer cam 222 is keyed to the main cam shaft 22. A roller 224 contacting the surface of said filler thread retainer cam 222 is rotatably mounted on a first arm 226 of a double-armed lever 228 swingably mounted on the sinker bar shaft 34. A tension spring 230 stretched between the stationary member 70 of the machine and the second arm 232 of said double-armed lever 228 tends to urge the roller 224 against the surface of the filler thread retainer cam 222. One end of a connecting link 234 of adjustable length is pivoted to the arm 226 of the double-armed lever 228 at 236, and the other end of said connecting link 234 is pivoted at 238 to an arm 240 keyed to a rod 242 journalled in suitable bearings of the frame of the machine. A filler thread retaining finger 244 is adjustably mounted on said rod 242 by means of a set screw 246 on each side of the machine. The active end portion 248 of each filler thread retaining finger is adjacent the series of latch needles 64, and projects above the level of the upper surface of the bridge formed by the filler thread receiving elements 104, when it is in the effective position shown in full lines in Fig. 5. As long as the round portion of the filler thread retainer cam 222 is in engagement with the roller 224, the filler thread retaining fingers 244 are held in said effective position shown in full lines; when, however, the rise of the filler thread retainer cam 222 comes in engagement with the roller 224, the filler thread retaining finger 244 is lowered into the ineffective position shown in dash and dot lines in Fig. 5, wherein the active portion 248 of the filler thread retaining finger is below the level of the bridge formed by the elements 104.

The shape of the various controlling cams on the main cam shaft and the positioning of said controlling cam means on said main cam shaft and relative to each other is such, that the following operations of the various knitting implements of the machine are performed during a rotation of the main cam shaft through an angle of 360°, i. e. during one cycle of knitting operations.

Fig. 8 is a somewhat diagrammatical illustration of the position of the various knitting implements corresponding to the position of said knitting implements shown in Figs. 1, 2, 3, 5, and 6, wherein the main cam shaft 22 is in a position hereinafter called its starting position. According to Fig. 8, the latch needles 64 are in their highest position, the filler sinkers 44 rest in their extreme backward position, the warp guides 94 start a forward swinging movement from their extreme backward position, the filler thread carrier 134 is in an intermediate position during its movement from its right-hand end position into its left-hand end position for laying filler thread (said filler thread is not shown in Fig. 8, as the filler thread carrier 134 has not yet reached the plane of the cross section according to line 2—2 of Fig. 1), and the filler thread retaining fingers 244 are in their efficient position. Fig. 8 furthermore shows filler thread 136p laid during a preceding movement of the filler thread carrier 134 from its extreme left-hand position into its extreme right-hand position during a preceding cycle of knitting operations; said filler thread 136p is at the interval of knitting operations illustrated by Fig. 8 in front of the latch needles 64 for a subsequent incorporation into the fabric produced by the knitting implements of the machine. During above mentioned movement of the thread carrier 134 to the left, the filler thread 136 is in engagement with the right-hand filler thread retaining finger 244 as shown in Fig. 6.

Fig. 9 illustrates the position of the knitting implements after a rotation of the main cam shaft through an angle of approximately 75° from above mentioned starting position. The latch needles 64, the filler sinkers 44, and the filler thread retaining fingers 244 are still in the same position as in Fig. 8. The warp guides 94, however, now are in their extreme forward position and start a shifting movement in a longitudinal direction, substantially parallel to the series of latch needles. The filler thread carrier 134 still moving to the left is now nearer to its extreme left-hand position, so that filler thread 136 laid by the filler thread carrier 134 is shown resting on the filler thread receiving elements 104.

Fig. 10 illustrates the position of the knitting implements after a rotation of the main cam shaft through an angle of 125° from above mentioned starting position. Now, the latch needles 64 start their downward movement, the filler sinkers 44 are still at rest, the warp guides 94 still perform their shifting movement, the filler thread carrier 134 is still moving to the left, and the filler thread retaining fingers 244 are still in their efficient position.

Fig. 11 illustrates the position of the knitting implements after a rotation of the main cam shaft through an angle of approximately 180° from above mentioned starting position. The latch needles 64 are still moving downwardly after having incorporated the filler thread 136p into the fabric (the filler thread 136p is not shown in Fig. 11). The filler sinkers 44 are still at rest and the warp guides 94 are now likewise at rest. The filler thread carrier 134 is still moving to the left and has not yet reached its end position. The filler thread retaining fingers 244 now start a downward movement, so that the right-hand

filler thread retaining finger (see Fig. 6) becomes disengaged from the loop **250** formed by the filler thread **136** laid around said filler thread retaining finger, and that, consequently, the loop **250** is taken up by the pull of the filler thread carrier during a further movement thereof to the left.

Fig. 12 illustrates the position of the knitting implements after a rotation of the main cam shaft through an angle of approximately 195° from above mentioned starting position. The latch needles **64** now are at a standstill in their lowest position. The filler sinkers **44** start their forward movement. The warp guides **94** are still at a standstill. The filler thread carrier **134** is still moving to the left. The filler thread retaining fingers **244** are still moving downwardly.

Fig. 13 illustrates the position of the knitting implements after a rotation of the main cam shaft through an angle of approximately 200° from its starting position. The latch needles **64** and the warp guides **94** are at a standstill. The filler sinkers **44** are in an intermediate position during their forward movement. The filler thread carrier **134** now is at a standstill in its extreme left-hand position shown in dash and dot lines in Fig. 6. Said end position of the filler thread carrier is to the left of the filler thread retaining finger **244** as the stroke of the filler thread carrier is larger than the distance between the right-hand and left-hand filler thread retaining fingers. As may be seen from said Fig. 6, the filler thread **136** has been laid by the filler thread carrier in a plane in the rear of the plane of the active portion **248** of the left-hand filler thread retaining finger **244**. Said filler thread retaining finger **244** now is in its downward ineffective position as shown in Fig. 13.

Fig. 14 illustrates the position of the knitting implements after a rotation of the main cam shaft through an angle of approximately 215° from its starting position. The latch needles **64** start their upward movement. The warp guides **94** and the filler thread carrier **134** are at a rest. The filler sinkers **44** are in a more forward position during their forward movement and are pushing the filler thread **136** towards the needles. The filler thread retaining fingers **244** are moving upwardly, but their active portion is still below the level of the filler thread **136**, so that the filler sinkers **44** may push the filler thread **136** over the left-hand filler thread retaining finger into the position **136'** shown in Fig. 6.

Fig. 15 illustrates the position of the knitting implements after a rotation of the main cam shaft through an angle of approximately 225° from its starting position. The latch needles are in an intermediate position during their upward movement. The filler sinkers are in their extreme forward position, from which they now start their backward movement. The filler thread **136** has been placed in front of the latch needles **64** and the filler thread retaining fingers **244** are again in their upper effective position so that after a backward movement of the filler sinkers **44** the filler thread, being in the position **136'** shown in Fig. 6, comes in engagement with the active portion **248** of the left-hand filler thread retaining finger **244**. The warp guides **94** and the filler thread carrier **134** are at a standstill.

Fig. 16 illustrates the position of the knitting implements after a rotation of the main cam shaft through an angle of approximately 245° from its starting position. The latch needles **64** and the filler thread retaining fingers **244** now are at a standstill in their highest position. The filler sinkers are in an intermediate position during their backward movement. The warp guides **94** are in an intermediate position during a backward swinging thereof. The filler thread carrier is still at a standstill in its extreme left-hand position.

Fig. 17 illustrates the position of the various knitting implements after a rotation of the main cam shaft through an angle of approximately 260° from its starting position. The latch needles **64** and the filler thread retaining fingers **244** are at a standstill in their highest position. The filler sinkers **44** are at a standstill in the extreme backward position. The warp guides **94** are still moving backwardly. The filler thread carrier **134** now starts a movement to the right for laying filler thread. During such a movement of the filler thread carrier to the right, the filler thread **136** (being in the position **136'** shown in Fig. 6) is laid around the active portion of the left-hand filler thread retaining finger **244**, so that a loop similar to the loop **250** shown at the right-hand filler thread retaining finger in said Fig. 6 is formed around the left-hand filler thread retaining finger, which now retains the filler thread laid by the movement of the filler thread carrier to the right.

After the performance of a full revolution of the main cam shaft, i. e. a rotation of the main cam shaft through 360° from its starting position, all knitting implements except the filler thread carrier are again in the position shown in full lines in Fig. 8. As the filler thread carrier performs only a movement in one direction during such a full revolution of the main cam shaft or cycle of knitting operations, the filler thread carrier is now in the dash line position **134'** shown in Fig. 8 on its way towards its right-hand end position.

As will be readily understood from above, during a full revolution of the main cam shaft or one cycle of knitting operations, at least the latch needles **64** or the warp guides **94** or the filler sinkers **44** are moved for the performance of knitting operations. In other words, the knitting operations of said knitting implements are not restricted to a rotation of the main cam shaft through 180°, they are, however, performed during a rotation of the main cam shaft through 360°. Furthermore, the laying of filler thread by a longitudinal movement of the filler thread carrier takes place during a portion of said cycle of knitting operations, while the main cam shaft is rotated through an angle of approximately 300° (the laying of filler thread takes place between the positions shown in Fig. 17 and Fig. 13; Fig. 17 illustrates the position of the knitting implements after a rotation of the main cam shaft through an angle of 260° and Fig. 13 illustrates the position of the knitting implements after a rotation of the main cam shaft through 200°, so that the main cam shaft is rotated through an angle of 300° between the positions shown in Fig. 17 and Fig. 13). Moreover, as may be seen from the drawings, the latch needles **64** do not remain at a standstill, but perform a downward movement during the greater portion of the longitudinal movement of the filler thread carrier for laying filler thread. Furthermore, the drawings show, that the filler sinkers **44** are not in an intermediate position, but in their extreme backward position during the greater part of the longitudinal movement of the filler thread carrier for laying filler thread.

As best shown in Fig. 2, the fabric 216 produced by the knitting implements is taken up by a take-up roller 218 after passing over a series of tension rollers 220. The take-up roller 218 and the tension rollers 220 are driven in any suitable manner by the main drive of the machine.

If it is desired to knit a plurality of narrow fabrics, ribbons, or the like on the machine, a plurality of filler thread carriers is attached to the flexible band 128, and a small stroke of said filler thread carriers corresponding to the width of the narrow fabrics is adjusted by means of an adjustment of the pivot 160 in the slot 158 (see Fig. 4). Furthermore, several pairs of filler thread retaining fingers 244 (one pair for each filler thread carrier) are attached to the rod 242 as shown in Fig. 7. Said pairs of filler thread retaining fingers are arranged in such a way, that the distance between the filler thread fingers of each pair is somewhat smaller than the stroke of the filler thread carriers. It is understood, that the filler sinkers are removed from the sinker bar opposite the location of a filler thread retaining finger.

I have described preferred embodiments of my invention, but it is understood that this disclosure is for the purpose of illustration and that various omissions or changes in shape, proportion or arrangement in parts as well as the substitution of equivalent elements for those herein shown and described may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

What I claim is:

1. A warp knitting machine comprising: a needle bar carrying a series of needles, at least one guide bar carrying a series of warp guides, a guide bar drive associated with said guide bar for periodic actuations thereof with its warp guides so as to feed warp yarns to said needles, a needle bar drive associated with said needle bar for imparting periodic reciprocating movements to same with its needles in a predetermined direction towards and away from said warp guides, at least one filler thread carrier, a carrier drive associated with said filler thread carrier for imparting periodic movements to same in a longitudinal direction so as to lay filler thread substantially parallel to said series of needles, a sinker bar carrying a series of filler sinkers, a sinker bar drive associated with said sinker bar for imparting periodic movements to same with its filler sinkers towards and away from the direction of the strokes of said needles so as to place, during a movement towards said needles, filler thread laid by the filler thread carrier in position to be incorporated into fabric produced by the knitting implements of the machine, and controlling means associated with said drives for coordinating their functions and the functions of said needles, warp guides, filler thread carrier, and filler sinkers, and the assembly being such as to impart a longitudinal movement to said filler thread carrier during a movement of said needles away from said warp guides.

2. In combination with a warp knitting machine as claimed in claim 1, said assembly being further such as to maintain said filler sinkers in a position out of the path of said needles during the movement of the latter away from the warp guides when a longitudinal movement is imparted to said filler thread carrier.

3. A warp knitting machine comprising: a needle bar carrying a series of needles, a needle bar drive associated with said needle bar for imparting periodic reciprocating movements to same with its needles in a predetermined direction, at least one guide bar carrying a series of warp guides, a guide bar drive associated with said guide bar for periodic actuations thereof with its warp guides so as to feed warp yarns to said needles, at least one filler thread carrier, a carrier drive associated with said filler thread carrier for imparting periodic movements to same in a longitudinal direction so as to lay filler thread substantially parallel to said series of needles, a sinker bar carrying a series of filler sinkers, a sinker bar drive associated with said sinker bar for imparting periodic movements to same with its filler sinkers towards and away from the direction of the strokes of said needles so as to place, during a movement towards said needles, filler thread laid by the filler thread carrier in position to be incorporated into fabric produced by the knitting implements of the machine, a rotatable main shaft, and controlling means connected with said main shaft and associated with said drives for coordinating in timed relation their functions and the functions of said needles, warp guides, filler thread carrier, and filler sinkers, and the assembly being such as to impart a movement to at least one group of knitting implements out of said groups of needles, warp guides, and filler sinkers throughout one revolution of said main shaft equalling one cycle of knitting operations and as to impart a longitudinal movement in one direction to said filler thread carrier during a portion of said cycle of knitting operations.

4. A warp knitting machine comprising: a needle bar carrying a series of needles, a needle bar drive associated with said needle bar for imparting periodic reciprocating movements to same with its needles in a predetermined direction, at least one guide bar carrying a series of warp guides, a guide bar drive associated with said guide bar for periodic actuations thereof with its warp guides so as to feed warp yarns to said needles, at least one filler thread carrier, a carrier drive associated with said filler thread carrier for imparting periodic movements to same in a longitudinal direction so as to lay filler thread substantially parallel to said series of needles, a sinker bar carrying a series of filler sinkers, a sinker bar drive associated with said sinker bar for imparting periodic movements to same with its filler sinkers towards and away from the direction of the strokes of said needles so as to place, during a movement towards said needles, filler thread laid by the filler thread carrier in position to be incorporated into fabric produced by the knitting implements of the machine, a rotatable main shaft, and controlling means connected with said main shaft and associated with said drives for coordinating in timed relation their functions and the functions of said needles, warp guides, filler thread carrier, and filler sinkers, and the assembly being such as to impart a movement to at least one group of knitting implements out of said groups of needles, warp guides, and filler sinkers throughout a rotation of said main shaft through an angle of 360° and as to impart a longitudinal movement in one direction to said filler thread carrier during a rotation of said main shaft through an angle of approximately 300°.

5. A warp knitting machine comprising: a needle bar carrying a series of needles, at least

one guide bar carrying a series of warp guides, a guide bar drive associated with said guide bar for periodic actuations thereof with its warp guides so as to feed warp yarns to said needles, a needle bar drive associated with said needle bar for imparting periodic reciprocating movements to same with its needles in a predetermined direction towards and away from said warp guides, spaced filler thread retaining means effective adjacent said series of needles, a filler thread retainer drive associated with said spaced filler thread retaining means for periodically rendering same ineffective, at least one filler thread carrier, a carrier drive associated with said filler thread carrier for imparting periodic movements to same in a longitudinal direction so as to engage filler thread with an effective filler thread retaining means and to lay such filler thread substantially parallel to said series of needles, a sinker bar carrying a series of filler sinkers, a sinker bar drive associated with said sinker bar for imparting periodic movements to same with its filler sinkers towards and away from the direction of the strokes of said needles so as to place, during a movement towards said needles, filler thread laid by the filler thread carrier in position to be incorporated into fabric produced by the knitting implements of the machine, and controlling means associated with said drives for coordinating in timed relation their functions and the functions of said needles, warp guides, filler thread retaining means, filler thread carrier, and filler sinkers, and the assembly being such as to render said filler thread retaining means ineffective during an interval shortly before the filler thread carrier reaches the end of its stroke until the filler thread laid by the filler thread carrier during said stroke has been placed by the filler sinkers into position for incorporation into the fabric.

6. In a warp knitting machine as claimed in claim 5, said assembly being further such as to impart a longitudinal movement to said filler thread carrier during a movement of said needles away from said warp guides.

7. In a warp knitting machine as claimed in claim 5, said assembly being further such as to impart a longitudinal movement in one direction to said filler thread carrier during a standstill of said filler sinkers in their extreme backward position.

8. In a warp knitting machine as claimed in claim 5, a rotatable main shaft, said controlling means being connected with said main shaft, and said assembly being further such as to impart a movement to at least one group of knitting implements out of said groups of needles, warp guides, and filler sinkers during one revolution of said main shaft equalling one cycle of knitting operations and as to impart a longitudinal movement in one direction to said filler thread carrier during a portion of said cycle of knitting operations.

9. In a warp knitting machine as claimed in claim 5, a rotatable main shaft, said controlling means being connected with said main shaft, and said assembly being further such as to impart a movement to at least one group of knitting implements out of said groups of needles, warp guides, and filler sinkers during a rotation of said main shaft through an angle of 360° and as to impart a longitudinal movement in one direction to said filler thread carrier during a rotation of said main shaft through an angle of approximately 300°.

10. A warp knitting machine comprising: a needle bar carrying a series of needles, a needle bar drive associated with said needle bar for imparting periodic reciprocating movements to same in a predetermined direction, spaced filler thread retaining means arranged adjacent said series of needles, movable carrying means carrying said spaced filler thread retaining means for normally holding the active portion thereof in an effective position, at least one reciprocable filler thread carrier, the stroke of said reciprocable filler thread carrier being larger than the distance between said spaced filler thread retaining means, a carrier drive associated with said filler thread carrier for imparting periodic movements to same in a longitudinal direction so as to lay filler thread around the active portion of a filler thread retaining means and substantially parallel to said series of needles, a sinker bar carrying a series of filler sinkers, a sinker bar drive associated with said sinker bar for imparting periodic movements to same with its filler sinkers towards and away from the direction of the strokes of said needles so as to place, during a movement towards said needles, filler thread laid by the filler thread carrier in position to be incorporated into fabric produced by the knitting implements of the machine, and a filler thread retainer drive associated with said movable carrying means for periodically moving said filler thread retaining means into an ineffective position during an interval shortly before the filler thread carrier reaches the end of its stroke until the filler sinkers reach substantially their extreme end position placing the filler thread into position for incorporation into the fabric.

11. In a warp knitting machine as claimed in claim 10, said spaced filler thread retaining means being adjustably mounted on said carrying means.

12. In a warp knitting machine as claimed in claim 10, said carrying means being in the shape of a rod rotatably mounted on the machine, said rod extending parallel to said series of needles, said spaced filler thread retaining means being mounted on said rod, and said filler thread retainer drive being coupled with said rod for imparting periodic oscillating movements thereto.

13. A warp knitting machine comprising: a needle bar carrying a series of needles, a needle bar drive associated with said needle bar for imparting periodic reciprocating movements to same in a predetermined direction, a series of filler thread receiving elements arranged adjacent said series of needles, spaced filler thread retaining means arranged adjacent said series of needles, movable carrying means carrying said spaced filler thread retaining means for normally holding the active portion thereof in an effective position, at least one reciprocable filler thread carrier, the stroke of said reciprocable filler thread carrier being larger than the distance between said spaced filler thread retaining means, a carrier drive associated with said filler thread carrier for imparting periodic movements to same in a longitudinal direction so as to lay filler thread around the active portion of a filler thread retaining means and onto said series of filler thread receiving elements substantially parallel to said series of needles, a sinker bar carrying a series of filler sinkers, a sinker bar drive associated with said sinker bar for imparting periodic movements to same with its filler sinkers towards and away from the direction of the strokes of said needles so as to place, during a movement towards said needles, filler thread laid onto said filler

thread receiving elements in position to be incorporated into fabric produced by the knitting implements of the machine, and a filler thread retainer drive associated with said movable carrying means for periodically moving said filler thread retaining means into an ineffective position during an interval shortly before the filler thread carrier reaches the end of its stroke until the filler sinkers reach substantially their extreme end position placing the filler thread into position for incorporation into the fabric.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,951,104	Mills	Mar. 13, 1934
2,200,280	Klumpp et al.	May 14, 1940
2,247,092	Klumpp et al.	June 24, 1941