April 5, 1960 M. NEWMAN 2,931,197

WARP KNITTING APPARATUS

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Fig. 1.

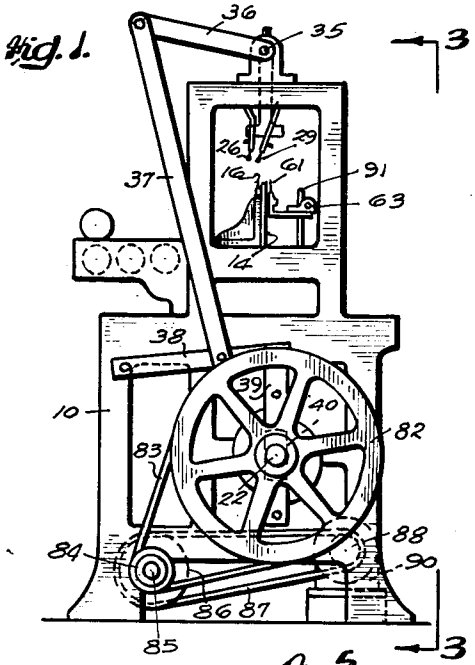


Fig. 2.

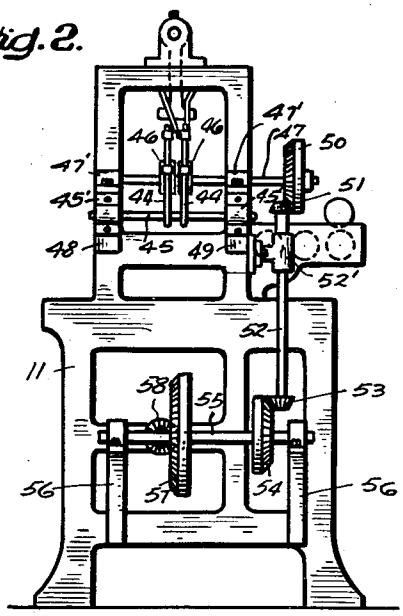
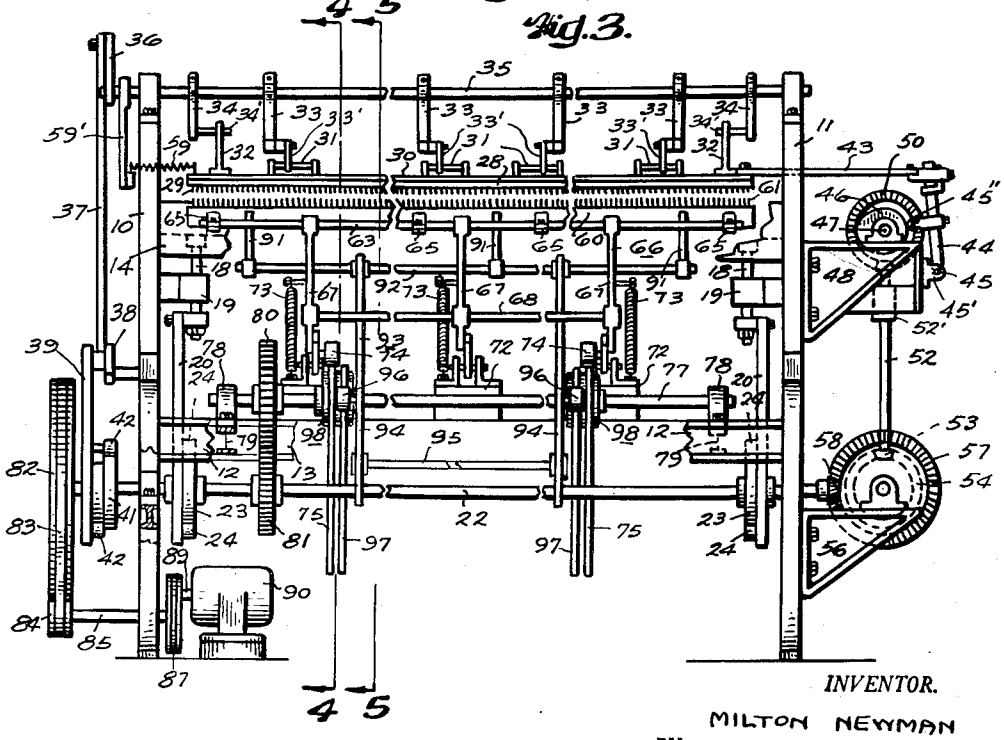


Fig. 3.



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April 5, 1960 M. NEWMAN 2,931,197

WARP KNITTING APPARATUS

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Fig. 8.

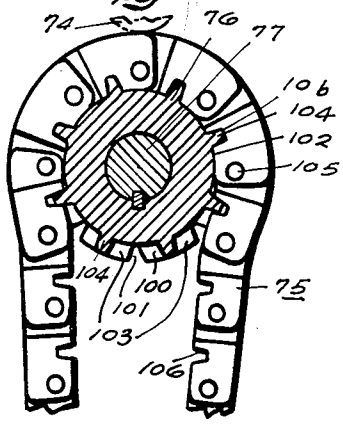


Fig. 4.

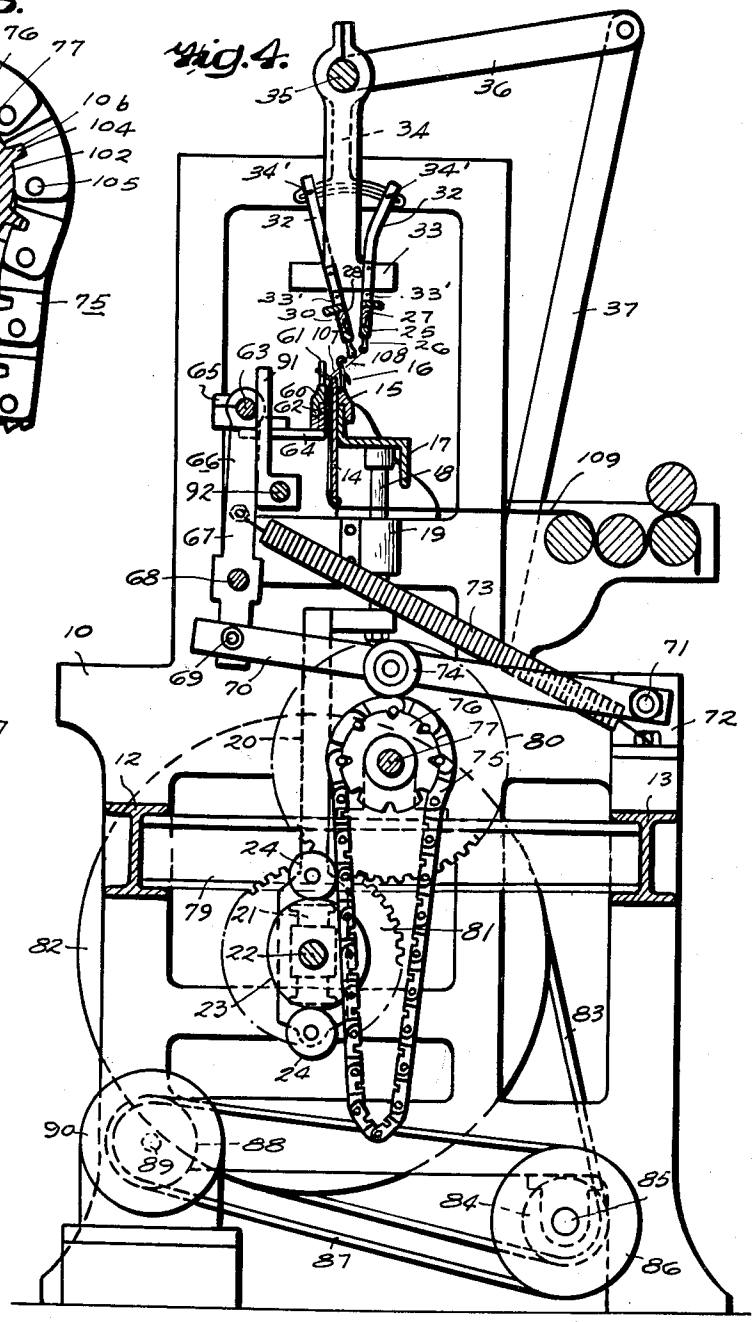
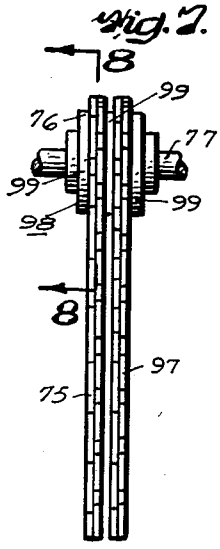


Fig. 7.



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WARP KNITTING APPARATUS

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Fig. 5.

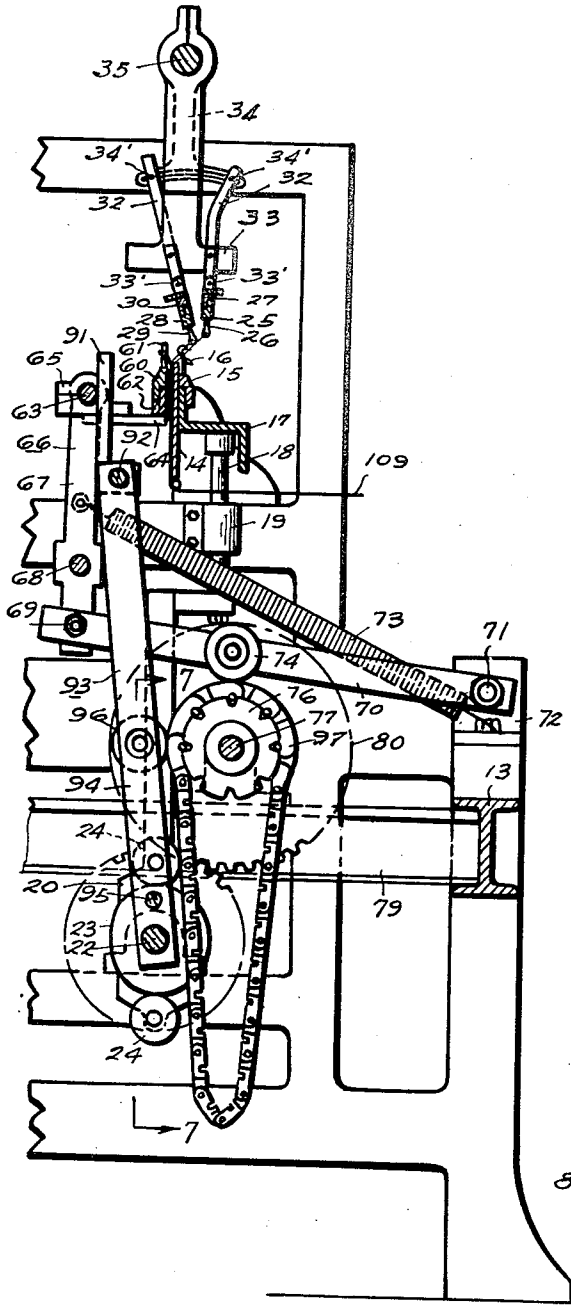
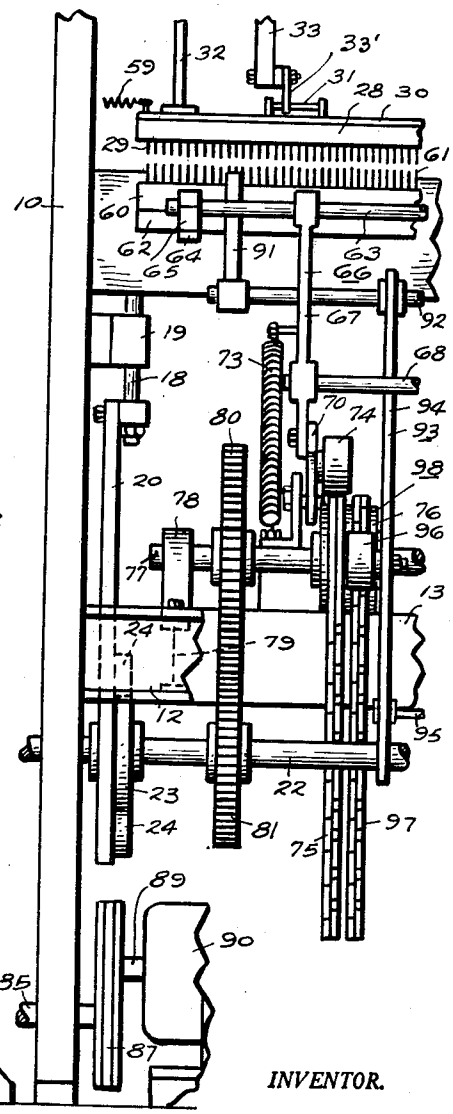


Fig. 6.



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WARP KNITTING APPARATUS

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Fig. 9.

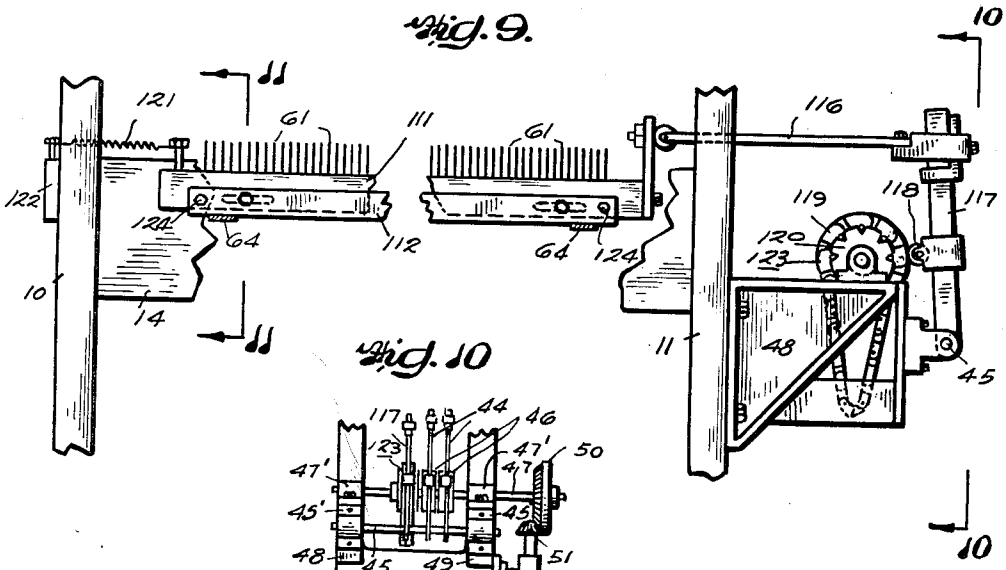


Fig. 10

Fig. 11.

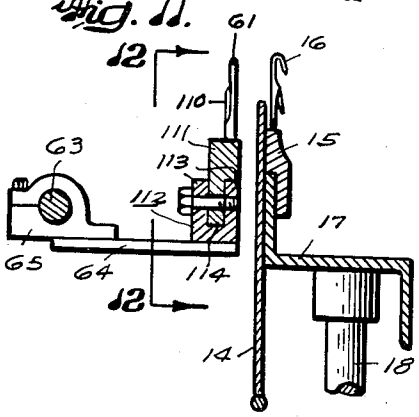
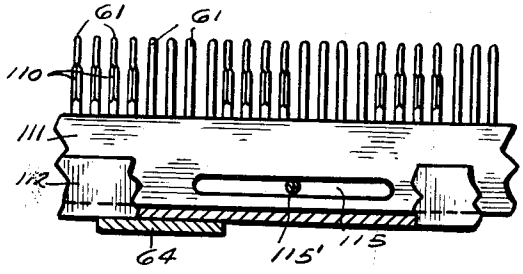


Fig. 12.



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Fig. 13.

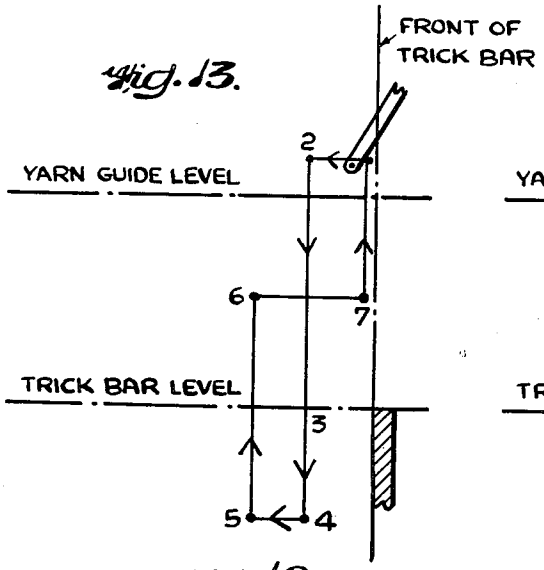


Fig. 14.

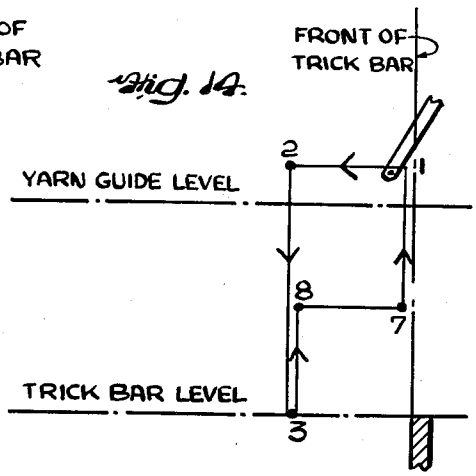


Fig. 19.

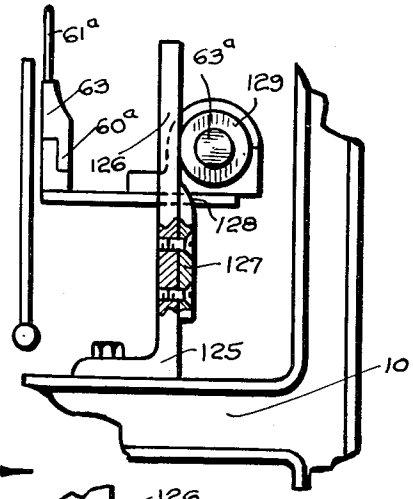


Fig. 15.

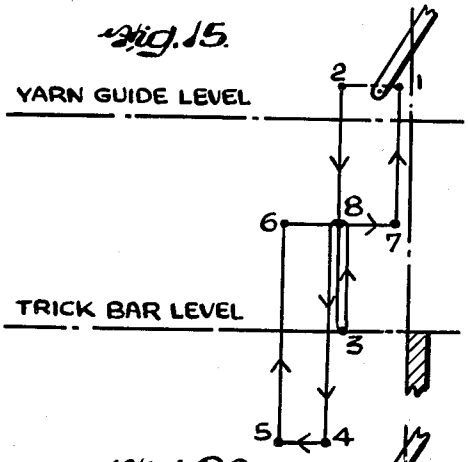
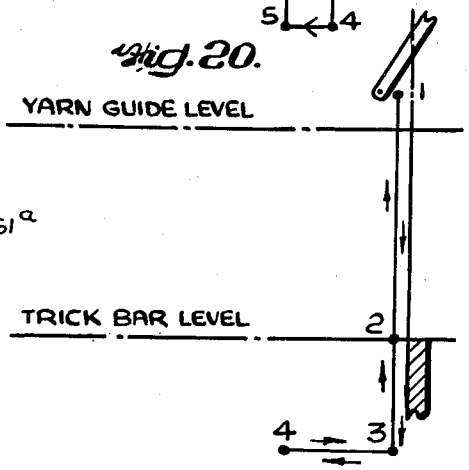


Fig. 20.



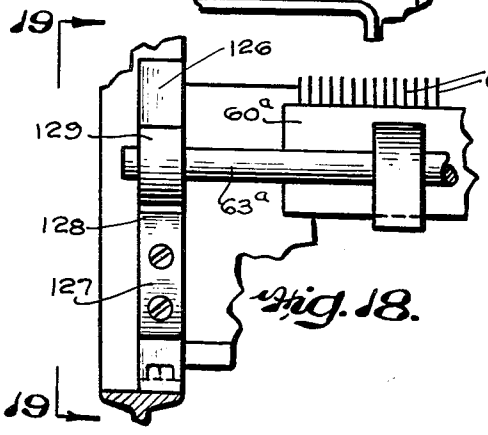


Fig. 18.

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April 5, 1960 M. NEWMAN 2,931,197

WARP KNITTING APPARATUS

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Fig. 16.

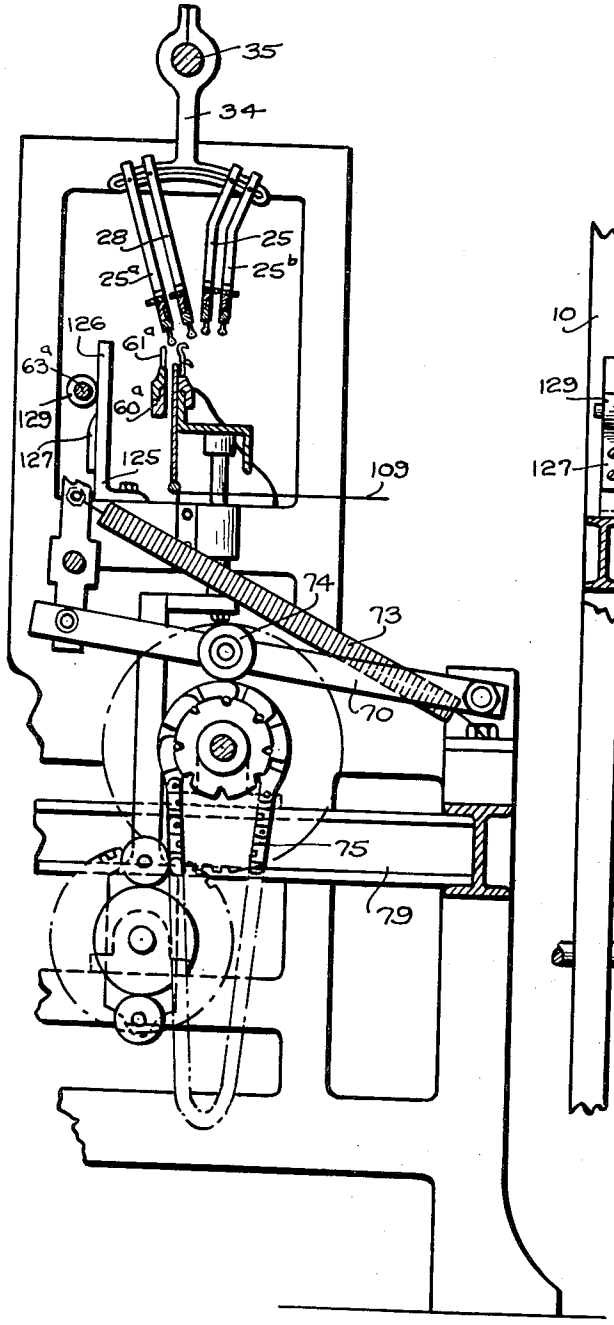
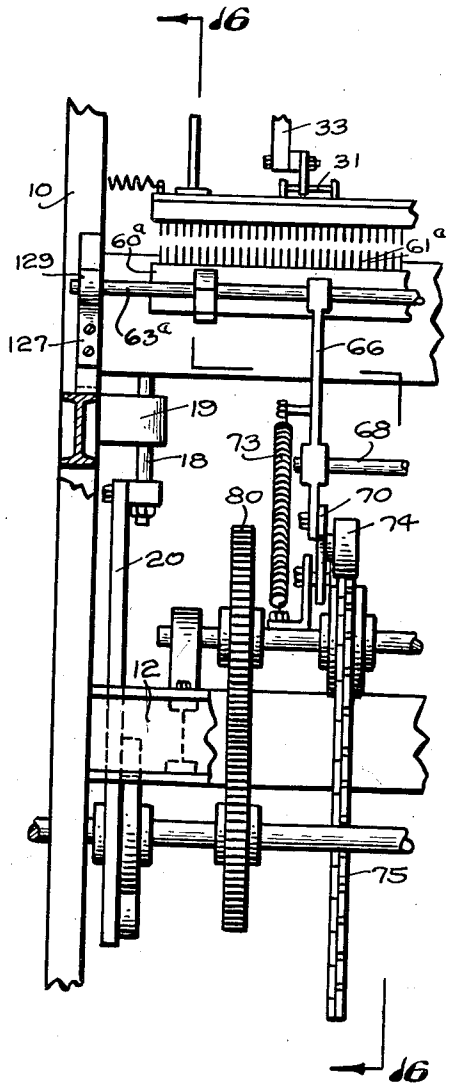


Fig. 17.



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United States Patent Office 2,931,197 Patented Apr. 5, 1960

2,931,197

WARP KNITTING APPARATUS

Milton Newman, Ventnor, N.J.

Application August 9, 1955, Serial No. 527,378

7 Claims. (Cl. 66—84)

This invention relates generally to warp knitting machines that are equipped with loop forming members and more particularly to mechanism for monitoring the loop forming members.

A principal object of the present invention is to provide such a machine with improved means for monitoring the loop forming members whereby the effort and time required for a change over from one mode of operation to a different mode of operation is reduced to a minimum.

Another principal object of the present invention is to provide such a machine wherein a change from one mode of operation to a selected different mode of operation is effected solely by suitably rearranging the component parts of the means for monitoring the loop forming members.

And still another principal object of the present invention is to provide such a machine wherein the means for monitoring the loop forming members comprises articulated endless link chain means trained over revoluble means and operative to determine the pattern of movement of the loop forming members so that at any instant during the operating cycle of the machine the loop forming members will be in a predetermined position.

Another important object of the present invention is to provide such a machine wherein the monitor chains that determine the pattern of movement of the loop forming members may be readily replaced with other monitor chains arranged to afford a selected different pattern of movement.

And another important object of the present invention is to provide such a machine wherein the loop forming members intermittently are shifted in a direction weftwise of the work as the work progresses and the arrangement of the loop forming members is such that shifting of the loop forming members in the manner aforesaid effects a predetermined pattern in the finished work.

Other objects and advantages of the present invention will appear more fully hereinafter, it being understood that the invention consists substantially in the combination, construction, location and relative arrangement of parts, all as described in detail hereinafter, as shown in the accompanying drawings and as finally pointed out in the appended claims.

In the accompanying drawings:

Figure 1 is an elevation of one end of a warp knitting machine constructed in accordance with and embodying the general principles of the present invention;

Figure 2 is an elevation of the opposite end;

Figure 3 is an elevation of the front of the machine, as indicated by line 3—3 in Figure 1;

Figure 4 is an enlarged vertical section on line 4—4 of Figure 3;

Figure 5 is an enlarged vertical section on line 5—5 of Figure 3;

Figure 6 is an enlarged fragmentary front view;

Figure 7 is a vertical section on line 7—7 of Figure 5;

Figure 8 is an enlarged vertical section on line 8—8 of Figure 7;

Figure 9 is a fragmentary front view showing a modification of the form of the machine shown in Figures 1 through 8;

Figure 10 is a fragmentary elevation of one end of the modified form of the machine, as indicated by line 10—10 of Figure 9;

Figure 11 is an enlarged vertical section on line 11—11 of Figure 9;

Figure 12 is a fragmentary section on line 12—12 of Figure 11;

Figure 13 is a diagrammatic view illustrating one cycle of operation of the machine;

Figure 14 is a diagrammatic view illustrating a different cycle of operation of the machine;

Figure 15 is a diagrammatic view illustrating still another possible cycle of operation of the machine;

Figure 16 is a vertical sectional view corresponding to Figure 4, showing a modified construction of the machine;

Figure 17 is a sectional view as taken along the line 17—17 of Figure 16;

Figure 18 is an enlarged front elevational view of a detail of the machine shown in Figures 16 and 17;

Figure 19 is an enlarged side elevational view of the detail shown in Figure 18; and

Figure 20 is a diagramamtic view illustrating an operating cycle of the machine shown in Figures 16 to 19.

Referring particularly to Figures 1 through 8, a warp knitting machine constructed in accordance with and embodying the principles of the present invention comprises a rigid frame structure including a pair of floor supported frame sections 10 and 11 that are located respectively at opposite ends of the machine and a pair of members 12 and 13 that extend horizontally respectively across the front and rear of the machine and interconnect the frame sections 10 and 11 at a suitable height above the floor and maintain the same upright.

Extending horizontally lengthwise of the machine and located in a vertical plane is a trick bar 14 the opposite ends of which are suitably supported respectively upon the end frames 10 and 11. Immediately to the rear of and extending parallel to the trick bar 14 is a needle bar 15 that carries a row of upright latch needles 16 and is mounted on a Z bar 17. Depending respectively from opposite end portions of the Z bar 17 are a pair of guide bars 18—18 that are slidably mounted each in a fixed guide 19 which is carried by the associated end section of the frame structure, and depending from each guide 18 is a cam follower bar 20. The lower end portion of the latter is provided with a longitudinally extending slot 21 through which projects a main drive shaft 22 that extends horizontally lengthwise of the machine. Mounted upon each end of the drive shaft 22 is a cam means 23, which in the operation of the machine actuates a pair of rollers 24—24 mounted upon the bar 20, in consequence of which rotation of the main drive shaft 22 is translated into vertical reciprocation of the assembly comprising the bar 20, guide 18, Z bar 17, needle bar 15 and latch needles 16.

Immediately above and extending horizontally parallel to the trick bar 14 is a pillar bar 25 that carries a row of depending pile yarn guiding fingers 26 and which is mounted upon an angle bar 27, and immediately in front of the pillar bar 25 is a second horizontally extending pillar bar 28 that carries a row of depending warp thread guiding fingers 29 and which is mounted upon an angle bar 30. The angle bars 27 and 30 are each provided with intermediate slide bars 31 and end brackets 32 which are slidably connected to suitable extensions 33' and 34' respectively of the brackets 33 and 34 fixedly mounted upon a shaft 35 extending horizontally length-

wise of the machine with opposite end portions thereof journalled in the opposite end sections of the frame structure. One end portion of the shaft 35 is provided with a laterally extending arm 36 that is connected by a depending link 37 and a pivoted arm 38 to an upright cam follower bar 39. The latter is provided with a longitudinally extending slot 40 through which projects the main drive shaft 22. On the latter is mounted cam means 41, which, in the operation of the machine, actuates a pair of rollers 42—42 mounted upon the bar 39, in consequence of which rotation of the main drive shaft 22 is translated into vertical reciprocation of the bar 39 and, through the pivoted arm 38 and link 37, into rocking motion of the assembly comprising the arm 36, shaft 35, brackets 33 and 34, angle bars 27 and 30, pillar bars 25 and 28, and fingers 26 and 29.

Operatively connected to one end of each of the warp thread and pile yarn pillar bars 28 and 25 by a rod 43 is an upright cam follower bar 44, which is pivotally secured at its lower end to a pivot shaft 45 mounted in position by a pair of end supporting brackets 45'—45'. The bars 44—44 mount rollers 45''—45'' that respectively engage a pair of cams 46—46 mounted upon a shaft 47 which extends horizontally across the end of the machine. The shaft 47 is revolubly mounted upon a pair of bearings 47'—47' respectively mounted upon fixed supports 48—49, which latter also support the brackets 45'—45' for the pivot shaft 45, and mounts a bevel gear 50 that meshes with a bevel pinion 51 mounted on the upper end of a vertically extending shaft 52 revolubly mounted in a bearing 52' suitably carried by the support 49 or other fixed structure of the machine. The lower end of the shaft 52 mounts a beveled pinion 53 that meshes with a bevel gear 54 that is mounted upon a shaft 55 which extends horizontally across the end of the machine. The shaft 55 is revolubly mounted upon a pair of brackets 56—56 and mounts a beveled gear 57 that meshes with a beveled pinion 58 on the end of the main drive shaft 22. At the opposite end of the machine the pillar bars 25 and 28 are operatively connected, respectively by a pair of tension springs 59—59, to an arm 59' depending from the shaft 35, while at the control end of the machine said pillar bars 25 and 28 are respectively operatively connected to the upper ends of the cam follower bars 44—44 by the rods 43—43. Thus, the tension springs 59—59, through the intervention of the angle bars 27 and 30, which carry the pillar bars 25 and 28, tend constantly to bias the rollers 45''—45'' into operative engagement respectively with the cams 46—46. In the operation of the machine, the cams 46—46 mounted on the shaft 47 are actuated by the main drive shaft 22 through the system of shafts and gears just described, in consequence of which rotation of the main drive shaft 22 is translated into rocking motion of the cam follower bars 44—44 and, through the rods 43—43, into reciprocable movement of the assembly comprising the angle bar 27, pillar bar 25 and fingers 26, and of the assembly comprising the angle bar 30, pillar bar 28 and fingers 29.

In lieu of the cams 46—46 above described for effecting weft-wise shifting of the pillar bars 25 and 28, it will be understood, of course, that monitor chains, similar to that hereinafter described for effecting left-wise shifting of the pick bar 60 may be employed, these chains being trained about toothed monitor wheels, which are respectively keyed to and driven by the shaft 47. The monitor chains thus employed for weft-wise shifting of the pillar bars 25 and 28 may each comprise a different set of chain links, each set including links of desired depth, so that each of the pillar bars 25 and 28 may be individually shifted to greater or less extent as may be required for the production of a particular type or design of fabric. Of course, the monitor chains thus employed in lieu of cams 46—46 will be in such phase relation as to insure proper synchronized operation of the pillar bars 25 and 28.

Immediately in front of and extending parallel to the trick bar 14 is a pick bar 60 that carries a row of upright picks 61 and which is mounted upon an angle bar 62. A short distance in front of the pick bar 60 and the angle bar 62 and extending parallel thereto is a rigid bar 63 to which bar the angle bar 62 is rigidly secured, as by plates 64 and clamps 65. The bar 63 is part of a movable assembly 66 disposed in a vertical plane and extending lengthwise of the machine, which assembly additionally comprises laterally spaced members 67 that depend from the bar 63 and a bar 68 which extends through corresponding lower end portions of the members 67, parallel to the bar 63. The lower extremities of the members 67 are connected by axially alined pivots 69 to corresponding ends of bar links, designated 70, from which pivots the bar links extend rearwardly across the machine, the rear ends thereof being connected by axially alined pivots (designated 71) to brackets (designated 72) that are carried by member 13 of the rigid frame structure of the machine. Likewise, extending rearwardly from the assembly 66 and biasing the assembly together with the angle bar 62, the pick bar 60 and the picks 61 toward the trick bar 14 are tension springs 73. The weight of the assembly is supported in the manner now to be described.

A pair of rollers 74—74 are mounted intermediate the ends of certain of the bar links 70 for rotation about a common axis that extends horizontally lengthwise of the machine. The undersides of the rollers 74—74 respectively engage the outer peripheries of a pair of articulated endless link chains 75—75. These chains are respectively trained loosely over a pair of revoluble members 76—76 that are mounted upon a shaft 77 which extends horizontally lengthwise of the machine, which shaft 77 is revolubly journalled in a pair of bearings 78—78 respectively carried by a pair of members 79—79 that extend horizontally across the machine, between the members 12 and 13 of the rigid frame structure of the machine. At one end of the shaft 77, intermediate the bearing 78 and the revoluble member 76, is mounted a spur gear 80 that meshes with a spur gear 81 which is mounted on the main drive shaft 22. Mounted on one end of the latter is a pulley 82 over which is trained a belt 83 that extends to and is additionally trained over a pulley 84. The latter is mounted on one end of a shaft 85 that is revolubly journalled in the section 10 of the rigid frame structure of the machine, and mounted on the opposite end of the shaft 85 is a pulley 86 over which is trained a belt 87 that extends to and is additionally trained over a pulley 88 mounted on a shaft 89 of a floor supported electric motor 90. In the operation of the machine, rotation of the motor shaft 89 is translated into rotation of the main drive shaft 22 through the system of belts and pulleys just described, and rotation of the main drive shaft 22, is translated into rotation of the shaft 77 through the gears 80 and 81. The members 76—76 mounted on the shaft 77 rotate with the latter and in turn move the endless link chains 75—75, progressively feeding the same past the overlying rollers 74—74, which are raised and lowered together in accordance with a cycle of operation predetermined by the arrangement of links in the link chains 75—75 as presently to be described. As a result, the bar links 70 swing vertically about the pivots 71 and correspondingly raise and lower the assembly comprising the frame 66 and angle bar 62, the pick bar 60 and the picks 61.

Immediately to the rear of the bar 63 of the rigid frame 66 are upright arms 91 that extend respectively across longitudinally spaced portions of the bar 63 in sliding contact therewith. The lower ends of the arms 91 are secured to a rigid bar 92 that is part of a movable assembly 93 disposed in a vertical plane and extending length-

wise of the machine, which assembly additionally comprises laterally spaced members 94 that depend from the bar 92 and a bar 95, which extends through corresponding lower end portions of the member 94, parallel to the bar 92. The lower extremities of the members 94 are pivotally connected to the main drive shaft 22, in consequence of which the latter supports the weight of the assembly 93.

A pair of rollers 96—96 are mounted intermediate the ends of certain of the members 94 for rotation about a common axis that extends horizontally lengthwise of the machine. The rear sides of the rollers 96—96 respectively engage the outer peripheries of a second pair of articulated endless link chains 97—97 that likewise are respectively trained loosely over the revoluble members 76—76. As the latter rotate, they in turn move the endless link chains 97—97, progressively feeding the same past the rollers 96—96, which are moved fore and aft of the machine together in a predetermined manner. As a result, the assembly comprising the frame 93 and the upright arms 91 swings fore and aft about the main drive shaft 22. As already stated, the assembly including the frame 66 and the angle bar 62, the pick bar 60 and the picks 61 is biased toward the trick bar 14 by the tension springs 73. It will now be apparent that the position of the assembly fore and aft of the machine is controlled by the position of the upright arms 91, the movements of which are followed by the bar 63 of the frame 66. Each revoluble member 76 with its complement of link chain 75 and link chain 97 constitutes a monitor, generally designated 98, for controlling certain operations of the machine. This monitor 98 will now be described in detail.

The revoluble member 76 is provided with a set of three external annular flanges 99 that are axially spaced equally and which are separated by a pair of deep annular chain accommodating grooves 100—100. Circumferentially spaced equally about each flange 99 are a set of eight V-shaped notches 101 that open upon the outer peripheral edge of the flange and which extend inwardly to the base walls of the grooves, designated 102, dividing the flange into a corresponding number of arcuate sections 103. Projecting radially outwardly from the base wall of each groove 100 and each extending across the groove between a pair of opposed arcuate flange sections 103—103 are a set of eight circumferentially equally spaced teeth 104 of a height corresponding to the depth of the groove.

In the machine shown, the endless chain 75 comprises 24 links interconnected by a corresponding number of pins 105, the opposite ends of which are accommodated in the V-shaped notches 101 formed in the side flanges of the chain-receiving groove 100. Each link has opposite end relatively offset leading and trailing portions that are disposed respectively in planes which are parallel to the plane in which the chain travels, being interconnected by an intermediate link portion in a plane normal to the plane of travel aforesaid, each link being thus generally of Z shape in longitudinal cross-section. The leading portion of each link side abuts the trailing portion of the next preceding link, with which it is pivotally interconnected by one of the pins 105, and the trailing portion of the link side abuts the leading portion of the next succeeding link, with which it is pivotally interconnected by another of the pins 105. Immediately in advance of the intermediate link portion aforesaid is a notch 106 that opens upon the inner peripheral edge of the link.

When the chain 75 is operatively mounted upon the revoluble member 76, a section thereof extends over and the remaining section depends loosely from the revoluble member 76. The inner marginal link portions of the first mentioned chain section are received in one of the grooves between a pair of the flanges 99, the notches 106 receiving the teeth 104 that project outwardly from the base wall 102 of the groove 100. The outer peripheral edges of the link curve slightly so that the edges aforesaid of the first mentioned chain section merge smoothly. It will be observed that the chains 75—75 each include a plurality of groups of interconnected links, the grouped links being respectively of predetermined different depths measured radially of their associated drive members so that as said different depth links engage the roller 74 it is alternately raised and lowered to correspondingly raise and lower the pick bar 60. Each group of links in the chain is joined to its adjoining group of links by links of graduated depth, so that the transition from engagement of high depth links with the rollers 74 to engagement thereof by low depth links of the chain is effected smoothly and without any shock to any of the machine parts. It will be appreciated, of course, that as the roller 74 is engaged by the low depth links of the chain, the picks 61 are caused to assume their lowermost position, in which latter position they are inoperative to form loops of the pile yarn 108. Thus, for each orbital revolution of the chain 75 as driven by the member 76, the chain links will act upon the roller 74 to alternately raise and lower it and so correspondingly effect alternate raising and lowering of the picks 61.

It will be noted that the chains 97—97 are each generally similar in construction and mounting to that of the chain 74 and accordingly operate to alternately shift the picks 61 away from and back toward the trick bar 14 to form loops of the pile yarn 108 drawn out from predeterminedly selected stitches of the warp-knitted chains thereof formed of the warp thread 107. The depth of the loop is, of course, determined by the extent of movement of the picks outwardly from the trick bar 14, which movement is in turn governed by suitable variations in the depths of the links of the chains 97—97 operating against their associated rollers 96—96.

In the operation of the machine, the needles 16, fingers 26 and 29 and picks 61 may be actuated in a well known manner so that each set thereof forms a chain of stitches in each of a plurality of ends of the warp thread 107 and lays therein the pile yarn 108, the work or end product being designated 109. In this connection, the plane of that portion of the work last knitted and still engaged with the trick bar 14, i.e., a plane immediately in advance of and parallel to the trick bar, is referred to hereinafter as the plane of the work. It will be understood that the fingers 29 of the warp thread pillar bar 28 operate in conventional manner to lap the warp threads around the latch needles at timed intervals to form warp chains of interconnected stitches, and that the picks 61 are lapped with pile yarn by the fingers 26 of the pile yarn pillar bar 25 as the warp thread stitches are being formed, the thread of the warp stitches being thus wrapped about the pile yarn as the latter is laid in the warp-knitted chain. The wrapping of the warp chain stitches about the ends of pile yarn laid therein is effected at the upper level of the trick bar 14, preliminarily to which the pile yarn has been drawn out of the warp chain to form the desired loops which constitute the pile surface of the fabric.

Let it be assumed that the gear 81 on the main drive shaft 22 and the gear 80 on the shaft 77 are identical, in consequence of which the gear ratio is 1 to 1 and the shaft 77 and the revoluble members 76—76 mounted thereon turn at the same rate as the main drive shaft 22. Since the members 76—76 each have eight teeth 104 and the chains 75—75 each have 24 links, it requires three revolutions of the main drive shaft 22 for one complete pass of the chains 75—75 about the members 76—76. Therefore, the deepest links in the chains 75—75 are presented under the rollers 74—74 once for every three revolutions of the main drive shaft 22, the picks 61 being raised thereby for engagement with the yarns 108 to form loops therein. In addition, the needles 16 are actuated once and one stitch is formed in the yarn

107 each time the main drive shaft makes a complete revolution, so that during each operating cycle of the machine there is formed a repeat of three stitches in the yarn 107 and one loop in the yarn 108.

Let it now be assumed, for example, that it is desired to make a change over from repeats of the nature just described to repeats of four instead of three stitches in the yarn 107 and one loop in the yarn 108. In this event, it is necessary only to replace the chains 75—75 with similar chains each having 32 instead of 24 links. Now, it will require four instead of three revolutions of the main drive shaft 22 for one complete pass of the chains about the members 76—76. Therefore, the deepest links in the chains will be presented under the rollers 74—74 once for every four instead of three revolutions of the main drive shaft 22. The needles 16 again are actuated once and one stitch is formed in the yarn 107 each time the main drive shaft 22 makes a complete revolution, so that during each operating cycle of the machine there is now formed a repeat of four stitches in the yarn 107 and one loop in the yarn 108.

The interaction between the rigid frames 66 and 93 and the chains 97—97 controls the fore and aft movement of the picks 61, which movement determines the length of the loops formed in the yarn 108. The chains 97—97 are the same, as to number of links in a chain, as the chains 75—75 and are arranged on the revoluble members 76—76 so that the deepest links are presented under the rollers 96—96 of the rigid frame 93 at approximately the same time that the deepest links of the chains 75—75 are presented under the rollers 74—74.

Let it now be assumed, by way of further example, that it is desired to make repeats of four stitches in the yarn 107 with a short and a long loop in the yarn 108 associated respectively with the second and fourth stitches. In this event, the chains 75—75 are replaced with chains having 16 links, and the chains 97—97 are replaced with chains having 32 links graduated in depth and arranged with links of minimum depth separating links of medium and other links of maximum depth. Now it will require four revolutions of the main drive shaft 22 for one complete pass of the 32-link chains about the members 76—76 and two complete passes of the 16-link chains about the members 76—76. During each operating cycle of the machine, therefore, the deepest links in the 16-link chains will be presented under the rollers 74—74 twice and the links of minimum and links of maximum depth in the 32-link chain will be presented under the roller 96—96 each only once, in consequence of which there will be formed repeats of four stitches in the yarn 107 with a short and a long loop in the yarn 108 associated respectively with the second and fourth stitches.

By utilizing monitor chains properly designed to provide the requisite groups of different depth links, the loop-forming picks 61 may be made to follow any pattern of movement desired so that at any instant during the operating cycle of the machine they will be in a predetermined position, both horizontally fore and aft of the machine and vertically. For example, to provide the work with loops all of which are uncut, reference is made to Figure 13 which diagrammatically illustrates the path traversed by the upper ends of the picks 61 relatively to fixed planes of the machines. Thus, assuming that the picks 61 are in their completely raised position for engagement thereof with the pile yarn 108, which is properly presented in position for such engagement by the guide fingers 26 of the pile yarn pillar bar 25, under control of the monitor chains 97—97, the picks will move forwardly from the trick bar 14 from the position 1 shown in Figure 13 to position 2 thereof, the extent of such forward motion being determined by the depth of the operative lengths of the monitor chains 97—97 to provide loops of a predetermined length. The picks 61, under control of the monitor chains 75—75 are then lowered from position 2, which is above the horizontal plane of the pile yarn guide level, through the point 3 to the point 4, which is below the upper level of the trick bar, represented by the point 3, and thus below the level at which the loops are bound into the warp knit chain stitches.

At the trick bar level, designated by the pick point 3, the picks are still engaged with the loops and they become disengaged from the loops as the picks move downwardly from the point 3 to the point 4. In order to avoid any possibility of entanglement of the picks with the loops from which they have just been disengaged upon return upward movement of the picks, the picks are shifted from the point 4 horizontally forward of the plane of the trick bar to the point 5 under control of the monitor chains 97—97, which latter point is, of course, spaced forwardly of the ends of the previously formed loops. The picks are then free to move upwardly and are so moved by the monitor chains 75—75 upwardly to the point 6 which is above the trick bar level and below the yarn guide level, from which point the picks are moved rearwardly toward the plane of the trick bar under control of the monitor chains 97—97 to the point 7, from whence the picks are moved upwardly to point 1 under control of the monitor chains 75—75 to again engage the pile yarn 108.

Where it is desired to provide the work with a pile all of which is cut, as by cutting all of the loops after they have been pulled out to length by the picks 61, the said picks are respectively provided with knife edges 110 (as see Figure 11), which knife edges are operative to cut through the bight ends of the loops in manner well known in the art of producing cut pile fabric. However, the cycle of operation for the production of such cut fabric is somewhat different from that employed in producing uncut loops, because once the pile loops are cut they offer no interference to return upward movement of the picks. Thus, as diagrammatically shown in Figure 14, for the production of cut pile fabric, the knife edge picks move from their initial position 1 horizontally to position 2 to draw the pile yarn into loops of the requisite length, this movement being under the control of the monitor chains 97—97. Thereafter, under control of the monitor chains 75—75 the picks are lowered from the point 2 to point 3, which is approximately the upper level of the trick bar 14, and then, while still under the control of the monitor chains 75—75, the said picks are raised to cause their knife edges to shear through the bight ends of the loops, the picks for this purpose being raised to the point 8, from which point the picks are horizontally shifted back toward the plane of the trick bar to the point 7 under control of the monitor chains 97—97. Thereupon the picks are raised vertically under the control of the monitor chains 75—75 to present their upper ends into pile yarn engaging position at the starting point 1 of the cycle of the operation.

In certain instances, it may be desired to produce work having both looped and cut pile extending along each given weft-wise course of the work being produced on the machine, for which purpose the pick bar 60 may be fitted with picks of which only selected ones have knife edges. For the production of such work the cycle of operation follows that which is diagrammatically illustrated in Figure 15, wherein it will be observed that the picks move outwardly from their initial position 1 to their position 2 under control of the monitor chains 97—97 to provide loops of the requisite length, and thence downwardly to position 3 under control of the monitor chains 75—75. In this position 3 all of the picks are still in engagement with the yarn and so hold the loops extended outwardly from the trick bar. When, however, the picks are moved upwardly from the point 3 to the point 8, still under control of the monitor chains 75—75, the picks, which are fitted with knife edges, shear through the loops engaged therewith to cut the same, following which, while under control of the monitor

chains 75—75, the picks are lowered from the point 8 to the point 4 to thereby disengage the noncutting picks from their loops. Thereafter, the picks are shifted outwardly from the point 4 to the point 5 under control of the monitor chains 97—97 so as to clear the picks from the bight ends of the uncut loops, following which the picks are moved upwardly to point 6 under control of the monitor chains 75—75 and thence horizontally to point 7 under control of the monitor chains 97—97. Finally, the picks are shifted vertically from point 7 to point 1 under control of the monitor chains 75—75 for reengagement thereof with the pile yarn.

It will be appreciated that for proper operation of the machine to produce either loop or cut pile fabric, the monitor chains 75—75 and 97—97 operate conjointly and synchronously, and accordingly, the linkage arrangement of the monitor chains 75—75 must be properly related and timed to that of the monitor chains 97—97. Thus, where looped pile fabric is being produced, the linkage arrangement of the pick raising and lowering monitor chains 75—75 should be such as to hold the picks in their fully raised position for the full interval of time required for outward shifting of the picks to the extent necessary to form loops of predetermined depth, this outward shifting of the picks being effected by the monitor chains 97—97. Stated conversely, for the production of uncut looped pile fabric, the linkage arrangement of the monitor chains 97—97 should be such as to draw the loops out of the yarn 108 to their fullest extent during the interval that the picks are held in their raised position by operation of the monitor chains 75—75.

Where cut pile fabric is to be produced, the linkage arrangement of the monitor chains 97—97 is such as to hold the picks in coincidence with the outer ends of the fully extended loops for the additional period required for cutting of the loops, and thus, for cut loops the monitor chains 97—97 will have a greater number of high depth links connected together in a group than would be the case where the loops are not to be cut. In other words, for cut pile fabric the high depth links grouped together in the monitor chains 97—97 are of sufficient number to hold the picks 61 at their outermost position for a preselected length of loop for a period of time sufficient to enable the picks to move upwardly for cutting of the loops and thence downwardly into their lowermost position, from which latter position the picks are rectilinearly shifted back against the trick bar. It will be appreciated, of course, that groups of picks 61 having knife edges and groups of picks devoid of knife edges may be alternately arranged so as to provide the finished work with a corresponding arrangement of warp-wise extending stripes or areas respectively of cut and uncut loops.

It will be observed, however, that in making a change from one mode of operation to another no change is required in the means for transmitting power from the motor 90 to the revoluble members 76—76, i.e., the shafts 22, 77, 85 and 89 rotate respectively at the same rates of speed regardless of the nature of the repeat desired. In this connection, while, for the sake of simplifying explanation of operation of the machine, the ratio of the gear 81 on the main drive shaft 22 to the gear 80 on the shaft 77 is assumed to be 1 to 1, this ratio is not essential and more commonly is in the order of 1 to 4.

Likewise, it will be observed that a monitor chain may be removed from its revoluble member 76 easily and quickly simply by removing one of the pins 105, which quick-detachably secures together a pair of links, and then lifting the chain from the revoluble member 76, and the chain thus removed may be replaced by another chain just as easily and quickly by reversing this procedure.

In the form of the warp knitting machine described thus far, while the pick mounting bar 60 is capable of movement vertically up and down and horizontally fore and aft of the machine, it is incapable of movement horizontally toward either end of the machine, i.e., weft-wise of the work. However, referring particularly to Figures 9 through 12, a modified construction is shown wherein the pick mounting bar is not only capable of movement vertically up and down and horizontally fore and aft of the machine, but additionally is capable of movement horizontally toward either end of the machine, i.e., weft-wise of the work.

In this modified form of the machine, the pick mounting bar 60 and the angle bar 62 are replaced respectively by a pick mounting bar 111 and a guide bar 112. The bottom of the pick bar 111 is slidably received between the side walls 113—113 of a channel 114 formed in the top of the guide bar 112 and is provided with elongated slots 115 through each of which there extends a pin 115' the opposite end portions of which are secured respectively to the opposite side walls 113—113 of the channel 114. At one end of the pick mounting bar 111 is a rod 116 that connects the pick mounting bar 111 with an upright arm 117 the lower end of which is mounted on the pivot 45. The arm 117 mounts a roller 118 that engages the outer periphery of an articulated endless link chain 119 which is trained over a revoluble member 120 mounted on the shaft 47. To the opposite end of the pick mounting bar 111 is secured a tension spring 121 that is anchored to a member 122 mounted on the end section 10 of the frame structure. The spring 121 acts to constantly urge the roller 118 into engagement with the outer periphery of the chain 119. The chain 119 and the revoluble member 120 over which it is trained are component parts of a monitor, designated generally by the numeral 123, that is generally similar to the monitors 98—98 in construction, mounting and operation. In view of the detailed description of the monitors 98—98 already set forth, a detailed description of the monitor 123 is deemed to be unnecessary for a full understanding of the present invention.

In the operation of the machine, the revoluble monitor member 120 rotates with the shaft 47 and in turn moves the monitor chain 119, progressively feeding the same past the roller 118, which is moved lengthwise of the machine in a predetermined manner. As a result, rotation of the shaft 47 is translated into rocking motion of the arm 117 and, through the rod 116, into axial shifting movement of the pick mounting bar 111, i.e., movement of the bar 111 in the direction of its length or weftwise of the work. It will be understood that the guide bar 112 is secured to the underlying plates 64 and that the pick mounting bar 111, slidably mounted on the guide bar 112, moves relative thereto. In addition, it will be understood that the rod 116 is secured to the pick mounting bar 111, slidably mounted on the guide bar 112, moves relative thereto. In addition, it will be understood that the rod 116 is secured to the pick mounting bar 111 and the arm 117 by universal type connections which permit freedom of movement of the pick mounting bar 111 vertically up and down and horizontally fore and aft of the machine.

Let it be assumed that groups of picks 61 having knife edges and groups of picks 61 devoid of knife edges are arranged alternately on the pick mounting bar 111, the monitor chains 75—75 and 97—97 are replaced with chains suitably arranged for effecting the pattern of movement of the picks 61 necessary for cutting the loops, described hereinbefore, and the monitor chain 119 is replaced with a chain provided with links uniform in depth. While such links pass under the roller 118, the pick mounting bar 111 is held against movement weft-wise of the work, in consequence of which the machine operates to furnish the work with warp-wise extending stripes or areas respectively of cut and uncut loops.

Now let it be assumed that the chain 119 is provided with links of maximum depth grouped together and

links of minimum depth grouped together. While either group of links in passing under the roller 118, the pick mounting bar 111 is held against movement weft-wise of the work, in consequence of which the machine operates to provide the work with stripes, as before. However, at the point in the operation of the machine when one group of links passes under the roller 118 and the other moves into engagement with the roller 118, the pick mounting bar 111 shifts weft-wise of the work, in consequence of which successive sections of the stripes are offset relative to one another weft-wise of the work. It will be appreciated that the chain 119 effects the desired offset all in one movement of the pick mounting bar 111 to furnish the work with a pattern of rectangular areas arranged more or less in checker board fashion, but the chain 119 can be replaced with a chain arranged to effect the desired offset in successive stages to furnish the work with a pattern of diagonally extending stripes or areas respectively of cut and uncut loops.

It will be understood that instead of utilizing a chain provided with links uniform in depth so as to furnish the work with warp-wise extending stripes or areas respectively of cut and uncut loops, the rod 116 and the tension spring 121 may be disconnected from the pick mounting bar 111 and the latter locked against sliding movement relative to the guide bar 112, as by screws 124.

It will be observed, as in the case of the revoluble members 76—76, in making a change from one mode of operation to another no change is required in the means for transmitting power from the motor 90 to the revoluble member 120, i.e., the shafts 22, 55, 52 and 47 rotate respectively at the same rates of speed regardless of the desired shifting movement of the pick mounting bar 111 weft-wise of the work.

In certain instances it may be desirable to provide the machine of the present invention, as shown, for example, in Figure 16, with an additional pile yarn pillar bar 25^a for guiding and delivering additional ends of pile yarn 108 to and about the chain stitch needles 16 and the pick 61. For weft-wise shifting of this auxiliary yarn guiding pillar bar, there is operatively associated therewith a monitor control consisting of a monitor chain and drive wheel assembly similar to that employed for effecting weft-wise shifting of the pillar bar 25. By employing an additional pillar bar as just mentioned, additional ends of yarn may be directed to the needles of the picks, as desired, to form different designs. Thus, the additional yarn guiding pillar bar 25^a may shift in exact correspondence with the pillar bar 25 or it may shift in opposite direction with respect to the shifting of the bar 25, the conjoint shifting of the two bars being effected simultaneously or in sequence, as determined by the operation of the monitors which respectively control the weft-wise shifting of the loop-forming yarn-guiding pillar bars.

It will be understood, of course, that for the production of pile fabrics wherein the warp knitted chain stitches with the pile yarn incorporated therein by the apparatus of the present invention are interconnected by back weft yarns laid to extend laterally back and forth across parallel warp knitted chains to tie the same together, the apparatus of the present invention may include an additional back weft yarn bar 25^b (as see Figure 16), which is operated in conventional manner to shift longitudinally, that is, weft-wise of the work, in timed relation to operation of the pillar bars 25, 25^a and 28. This additional bar 25^b, which is disposed in substantial parallel relation to and rearwardly of the pillar bars 25, 25^a and 28, carries a series of yarn-guiding fingers, similar to the fingers 26 and 29 of the bars 25 and 28, for guiding and delivering to the warp-chain-stitch-forming needles of the machine a plurality of additional ends of back weft yarn. These back weft yarns are laid into the warp chain stitches in conventional manner to provide a back filling for the fabric, which filling may be of any formation, such as are shown, for example, in my prior United States Letters Patent Nos. 2,229,469, of January 21, 1941 (see Figures 9, 10 and 11 thereof) and No. 2,435,897, of February 10, 1948 (Figure 3 thereof).

In certain instances a complete fabric may be produced, that is, a fabric wherein the warp knitted chain stitches with the loop-forming yarns incorporated therein are joined together by the machine of the present invention even without the aforementioned additional back weft yarn bar 25^b, as by following a procedure like that disclosed and described in my prior Patent No. 2,396,525, of March 12, 1946. In this latter construction, the back filling is formed of the same yarn as that of which the loops are formed, the yarns in such case being extended back and forth across two or more adjoining chain stitches throughout the fabric, the loops being in such case formed as desired at the points of reversal of the back weft yarn.

Figures 16 to 20, inclusive, illustrate a modified construction of machine which includes all of the hereinbefore mentioned pillar bars 25, 25^a, 25^b and 28 and which is particularly characterized by the provision therein of means for limited movement of the pick bar toward and away from the trick bar for the production of warp-knitted fabric having uniform depth uncut pile loops throughout. In order to produce a fabric having a uniform depth of pile formed of relatively short uncut loops all of the same length, the monitor chains 97—97 hereinbefore described may be dispensed with and in place thereof the machine may be provided with a simple camming mechanism now to be described for effecting limited in and out motion of the pick bar and of the picks carried thereby. In the modified arrangement of Figures 16 and 17 the pick bar is designated generally by the reference numeral 60^a and its associated picks by the reference numeral 61^a. As in the previously described modification, vertical motion of the pick bar 60^a is controlled by the monitor chains 75—75 operating on the rollers 74 respectively mounted on the pivoted bar links 70, which in turn are operatively connected to the pick bar by the members 67 and other parts associated therewith forming the assembly 66, the said assembly being biased toward the trick bar 14 by the tension springs 73, all in the manner and for the purpose hereinbefore described.

In lieu of the monitor chains 97—97 operating against the rollers 96—96 mounted upon the pivoted members 94 of the movable assembly 93 for effecting in and out motion of the pick bar toward and away from the trick bar 14, the rigid frame of the machine at each opposite end thereof has fixedly secured thereto a bracket member 125 having a vertically extending rail or track portion 126 disposed rearwardly of the bar 63^a forming part of the movable assembly C6, which bar 63^a is secured to and supports the pick bar 60^a. In the arrangement shown in Figures 16 and 17, this bar 63^a is of greater length than the bar 63 of the machine as shown in Figures 1 to 6, inclusive, so that its opposite ends extend approximately to the opposite ends of the main frame of the machine, at which ends of the machine are mounted the aforesaid bracket members 125—125. The vertically extending track portion 126 of each bracket member is provided adjacent its lower end with a cam plate 127, the upper edge of which is beveled, as at 128, to provide an inclined cam surface between the adjoining frontal flat surfaces of the cam plate 127 and the track portion 126 extending thereabove.

The bar 63^a is fitted with a pair of revoluble rollers 129—129 respectively alined with and adapted to move along the frontal surfaces of the vertical tracks 126—126 and the offset frontal surfaces of the cam plates 127—127. The cam rollers 129—129 are respectively biased into constant engagement with the vertically extending

offset cam surfaces just described by the tension of the springs 73—73.

It will be apparent that upon upward and downward vertical movement of the bar 63ª under influence of the monitor chains 75—75, the cam rollers 129—129 mounted on the bar 63ª will alternately move horizontally toward and away from the trick bar as they pass from one to the other of the relatively offset surfaces of the track members 126—126 and the cam plates 127—127, the bar 63ª being at its innermost position when the rollers are engaged with the flat surface of the tracks 126—126, as shown in Figure 16, and being at its outermost position when the cam rollers 129—129 are respectively in engagement with the offset surfaces of the cam plates 127—127.

The point at which the bar 63ª and the pick bar 60ª associated therewith moves toward or away from the trick bar may be adjusted as desired by suitable adjustment of the cam plates 127—127 along the vertically extending track portions 126—126 of the fixed members 125—125. To this end, the cam plates 127—127 may each be provided with elongated slots therein through which project suitable mounting screws 130 for securing the cam plates to the members 125—125 in the desired vertically adjusted position.

Figure 20 illustrates diagrammatically the operation of the machine of the modified construction shown in Figures 16 to 19, inclusive, it being noted that the picks 61ª shift vertically in a plane spaced forwardly of the vertical plane of the trick bar to the extent required for the production of loops of predetermined uniform length. Assuming that the picks are in their uppermost position with the top ends thereof at point 1 (see Figure 20) for engagement of the picks by the pile yarn delivered thereto by the fingers of the pile yarn pillar bar 25, upon further operation of the machine the picks will be lowered under control of the monitor chains 75—75 through the point 2, at the upper level of the trick bar, to the point 3, at which point the picks are withdrawn from the loops which had been bound into the warp chain stitches at said upper level of the trick bar. When the loops are so bound into a weft-wise course of the warp chain stitches, the said course of stitches with their loops move downwardly below the trick bar level and simultaneously the picks, which have been withdrawn from said warp-wise course of loops, shift horizontally away from the trick bar, that is, from the point 3 to the point 4, to clear the picks from the loops from which they have just been withdrawn and so permit the bight ends of the loops to pass downwardly below the upper ends of the picks when the latter are in their lowermost position. Thereafter the picks shift horizontally back from the point 4 to the point 3 and thence upwardly to point 1 to reengage the pile yarn to form a succeeding weft-wise course of loops, following which the cycle of operation just described is repeated for as many weft-wise courses of looped pile material as is desired to be produced.

It will be noted that in this modified arrangement the picks do not move outwardly from the plane of the trick bar to form loops of desired length, but instead move upwardly and downwardly in a substantially fixed vertical plane which is spaced from the trick bar the extent necessary to form loops of the predetermined uniform length. Thus, the loops are formed about, retained by, and drawn off the picks during the period that the cam rollers 129—129 are in engagement with the outer surfaces of the track portions 126—126 of the fixed members 125—125. The pick bar and its associated picks move outwardly from the trick bar only when the rollers 129—129 are engaged by and ride upon the outer surfaces of the cam plates 127—127, which outward movement is effected only after the picks have been freed from the loops when the latter are brought down to the upper level of the trick bar 14.

Of course, it will be apparent that various designs and effects may be produced by the machine of the modified construction shown in Figures 16 to 19, inclusive, as in the case of the previously described machine, the only difference being that the pile loops are all uncut and are of a uniform length depending upon the initial spacing of the pick bar from the trick bar. It will also be understood that weft-wise movement of the several pillar bars 25, 25ª, 25ᵇ and 28 may be effected and controlled by the use of cams or monitors, as hereinabove described in connection with the machine shown in Figures 1 to 12. Also, in similar fashion the pick bar may be shifted weft-wise, as desired, under control of a monitor or cam, as hereinbefore described.

The apparatus of the present invention makes possible the production of various designs and effects in the pile surface of the fabric. Thus, for example, it will be appreciated that by eliminating selected picks along the pick bar, the fabric will be devoid of loops which would have been normally formed by such pick bars and thus the fabric will have warp-wise extending lines of the loop yarn without, however, any loops pulled out of said yarn to thereby provide in effect a striped design in the fabric. The warp-wise extending lines so devoid of loops may be of a width corresponding to that produced by a single warp-knitted chain or it may be as wide as desired, depending upon the number of adjoining picks which may have been omitted from the pick bar.

The same general effect could also be obtained by permitting all of the picks to remain in the pick bar but omitting the ends of loop yarns which are normally delivered to certain selected ones of the picks, in which case certain of the warp chains would be completely devoid of any loop yarn.

Still other variations in design effect are possible by delivering to the machine pile yarns of different color and/or composition, selected yarns of a given color or composition being fed to selected picks of the pick bar. Of course, all of these different design effects may be accomplished in fabrics wherein the pile is formed completely of uncut loops or where the pile is all cut or where the pile is formed of a combination of cut and uncut loops, and all these various effects may be obtained whether or not the machine is operated to shift the pick bar laterally, that is, weft-wise of the fabric, through the intervention of the monitor chain 119.

It will be understood, of course, that the present invention as hereinbefore described and as shown in the accompanying drawings is susceptible of various changes and modifications which may be made from time to time without departing from the general principles or real spirit of the invention, and accordingly, it is intended to claim the same broadly, as well as specifically, as indicated by the appended claims.

What is claimed as new and useful is:

1. In a warp knitting machine, the combination comprising a row of picks extending weft-wise of the work, monitor means for said picks including toothed axially spaced members mounted for rotation about a common horizontally extending axis, articulated endless link chains respectively trained over said revoluble members, the links of each chain being graduated in depth, and means operatively interposed between said monitor means and picks for mounting and actuating the latter including a pair of laterally spaced elongated frame supporting members rockable about a horizontal axis and extending respectively over a first pair of said link chains in contact therewith, a first rigid frame extending upright from said frame supporting members, rockable about a horizontal axis and spring biased toward said work, and a second upright rigid frame interposed between said first frame and the work and having portions respectively overlying a second pair of said link chains in contact therewith, said row of picks being mounted upon said first frame, said first pair of chains being operative for

rocking said frame supporting members thereby to raise and lower said first frame and the picks carried thereby, and said second pair of chains being operative for moving said second frame, and through the medium of the latter said first frame, thereby to move said picks horizontally away from said work against the influence of said spring bias.

2. In a warp knitting machine, the combination comprising a row of picks extending weft-wise of the work, monitor means for said picks including toothed axially spaced members mounted for rotation about a common horizontally extending axis, articulated endless link chains respectively trained over said revoluble members, the links of each chain being graduated in depth, means operatively interposed between said monitor means and picks for mounting and actuating the latter including a pair of laterally spaced elongated frame supporting members rockable about a horizontal axis and extending respectively over a first pair of said link chains in contact therewith, a first rigid frame extending upright from said frame supporting members, rockable about a horizontal axis and spring biased toward said work, and a second upright rigid frame interposed between said first frame and the work and having portions respectively overlying a second pair of said link chains in contact therewith, said row of picks being mounted upon said first frame, and means for actuating said monitor means including a horizontally extending first shaft mounting said toothed revoluble members, and a main drive shaft parallel and geared to said first shaft, said second frame being rockably mounted upon said main drive shaft, said first pair of chains being operative for rocking said frame supporting members thereby to raise and lower said first frame and the picks carried thereby, and said second pair of chains being operative for rocking said second frame, and through the medium of the latter rocking said first frame, thereby to move said picks horizontally away from said work against the influence of said spring bias.

3. In a warp knitting machine, the combination comprising a row of picks extending weft-wise of the work, means mounting the same for movement warp-wise, normal to the plane, and weft-wise of the work including an upright frame mounted for movement warp-wise and normal to the plane, of the work, and secured against movement weft-wise of the work, a pick carrying member mounted upon said frame for shifting movement relative thereto weft-wise of the work, and means biasing said pick carrying member in one direction weft-wise of the work, and monitor means including three toothed revoluble members, and three articulated endless link chains respectively trained over said revoluble members, the links of each chain being greater in number than the teeth of the associated revoluble member, and being graduated in depth, a pair of said chains being operatively engaged with said frame, and being movable by the associated ones of said revoluble members to effectively control the movement of said frame warp-wise and normal to the work, and the third one of said chains being operatively engaged with said pick carrying member and being movable by the associated revoluble member for shifting said pick carrying member weft-wise of the work against the influence of said bias.

4. In a warp knitting machine, the combination comprising a row of picks extending weft-wise of the work, means mounting the same for movement warp-wise, normal to the plane, and weft-wise of the work including an upright frame secured against movement weft-wise of the work, rockable about an axis extending weft-wise of the work and mounted for movement warp-wise of the work, a pick carrying member mounted upon said frame for shifting movement relative thereto weft-wise of the work, and spring means for biasing said pick carrying member in one direction weft-wise of the work, and monitor means including three toothed revoluble members, and three articulated endless link chains respectively trained over said revoluble members, the links of each chain being greater in number than the teeth of the associated revoluble member, and being graduated in depth, a pair of said chains being operatively engaged with said frame, and being movable by the associated ones of said revoluble members respectively to effectively control the rocking and the warp-wise movements of said frame, and the third one of said chains being operatively engaged with said pick carrying member, and being movable by the associated revoluble member for intermittently shifting said pick carrying member against the influence of said spring bias.

5. In a warp knitting machine, the combination comprising a row of picks extending weft-wise of the work, monitor means for said picks including axially spaced pairs of camming mechanisms mounted for rotation about a common horizontally extending axis, said camming mechanism each including a series of cam elements of varying depth radially of said axis, and means operatively interposed between said monitor means and picks for mounting and actuating the latter including a pair of laterally spaced elongated frame supporting members rockable about a horizontal axis and extending respectively over a first pair of said camming mechanisms in contact therewith, a first rigid frame extending upright from said frame supporting members, rockable about a horizontal axis and spring biased toward said work, and a second upright rigid frame interposed between said first frame and the work and having portions respectively overlying a second pair of said camming mechanisms in contact therewith, said row of picks being mounted upon said first frame, said first pair of camming mechanisms being operative for rocking said frame supporting members thereby to raise and lower said first frame and the picks carried thereby, and said second pair of camming mechanisms being operative for moving said second frame, and through the medium of the latter said first frame, thereby to move said picks horizontally away from said work against the influence of said spring bias.

6. In a warp knitting machine, the combination comprising a row of picks extending weft-wise of the work, means mounting the same for movement warp-wise, normal to the plane, and weft-wise of the work including an upright frame mounted for movement warp-wise and normal to the plane, of the work, and secured against movement weft-wise of the work, a pick carrying member mounted upon said frame for shifting movement relative thereto weft-wise of the work, and means biasing said pick carrying member in one direction weft-wise of the work, and monitor means including three revoluble camming mechanisms each including a series of cam elements graduated in depth radially of their axis of rotation, the graduated cam elements of a pair of said camming mechanisms being operatively engaged with said frame, and being movable by the associated ones of said revoluble camming mechanisms to effectively control the movement of said frame warp-wise and normal to the work, and the graduated cam elements of the third one of said camming mechanisms being operatively engaged with said pick carrying member and being movable by its associated revoluble camming mechanism for shifting said pick carrying member weft-wise of the work against the influence of said bias.

7. In a warp knitting machine, the combination comprising a row of picks extending weft-wise of the work, means mounting the same for movement warp-wise, normal to the plane, and weft-wise of the work including an upright frame secured against movement weft-wise of the work, rockable about an axis extending weft-wise of the work and mounted for movement warp-wise of the work, a pick carrying member mounted upon said frame for shifting movement relative thereto weft-wise of the work, and spring means for biasing said pick carrying

member in one direction weft-wise of the work, and monitor means including three revoluble members each having associated therewith an endless set of cam elements graduated in depth radially of the axis of rotation of the associated revoluble member, the graduated cam elements of a pair of said revoluble members being operatively engaged with said frame, and being movable by the associated ones of said revoluble members respectively to effectively control the rocking and the warp-wise movements of said frame, and the graduated cam elements of the third one of said revoluble members

being operatively engaged with said pick carrying member, and being movable by the associated revoluble member for intermittently shifting said pick carrying member against the influence of said spring bias.

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