

Nov. 23, 1954

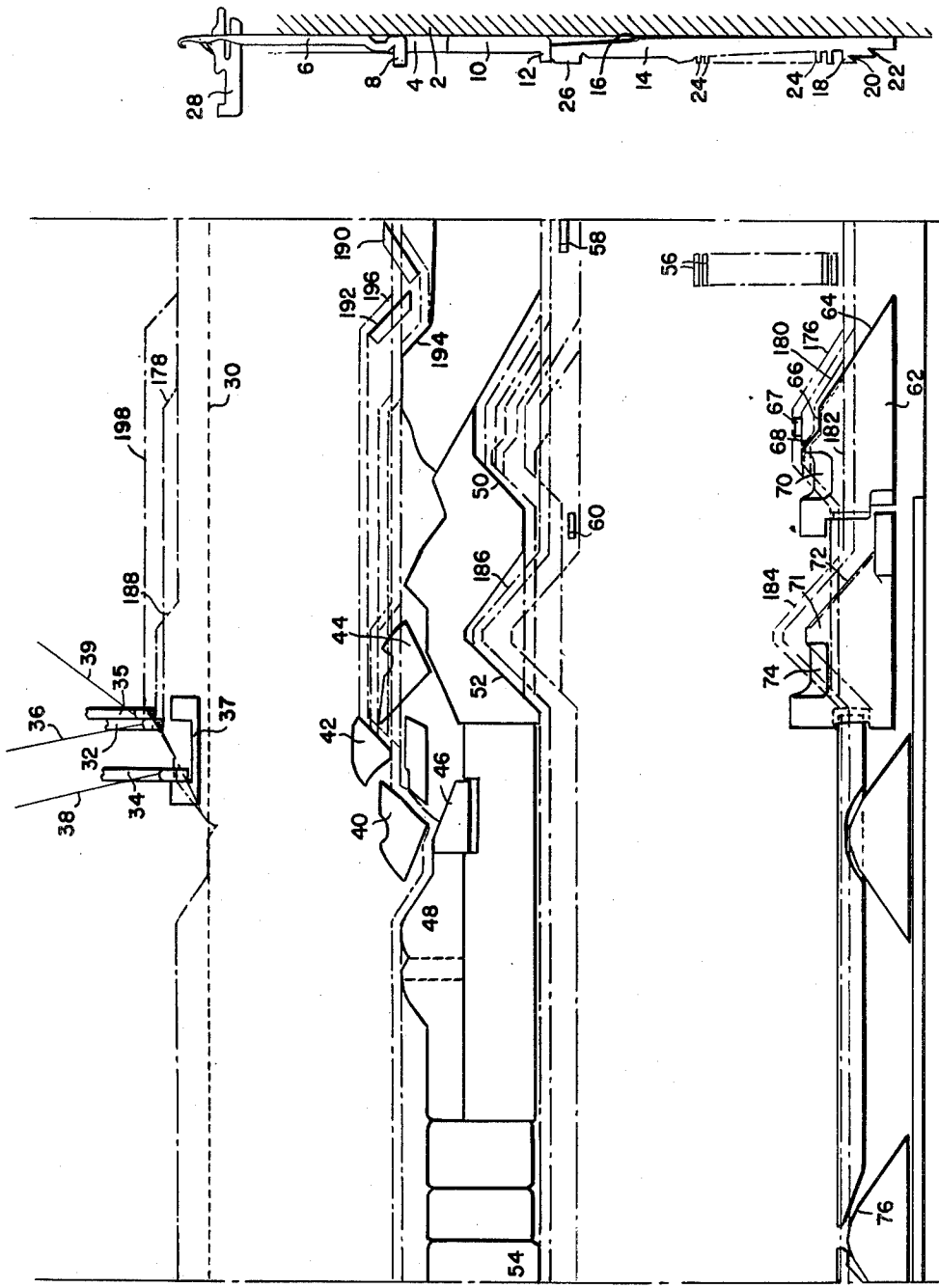
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2,694,908

PATTERN MECHANISM FOR KNITTING MACHINES

Filed April 1, 1952

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

FIG. 8.

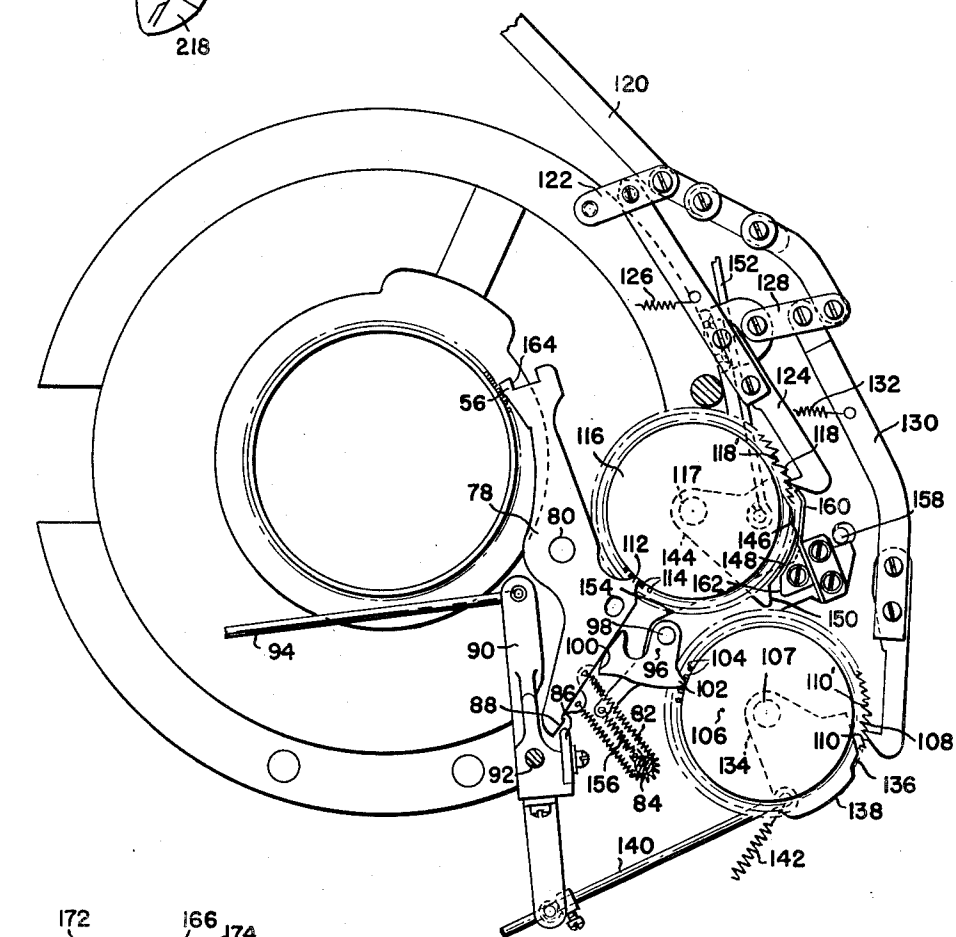
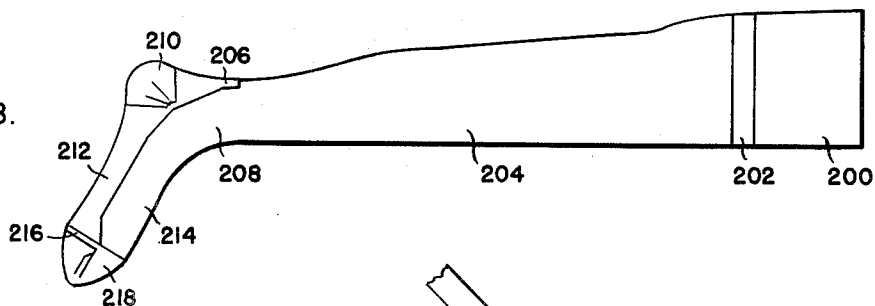


FIG. 2.

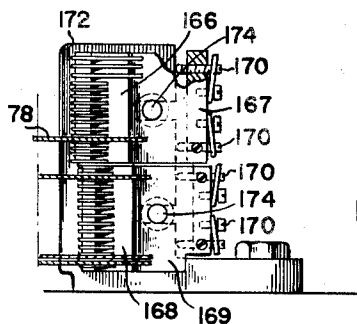


FIG. 5.

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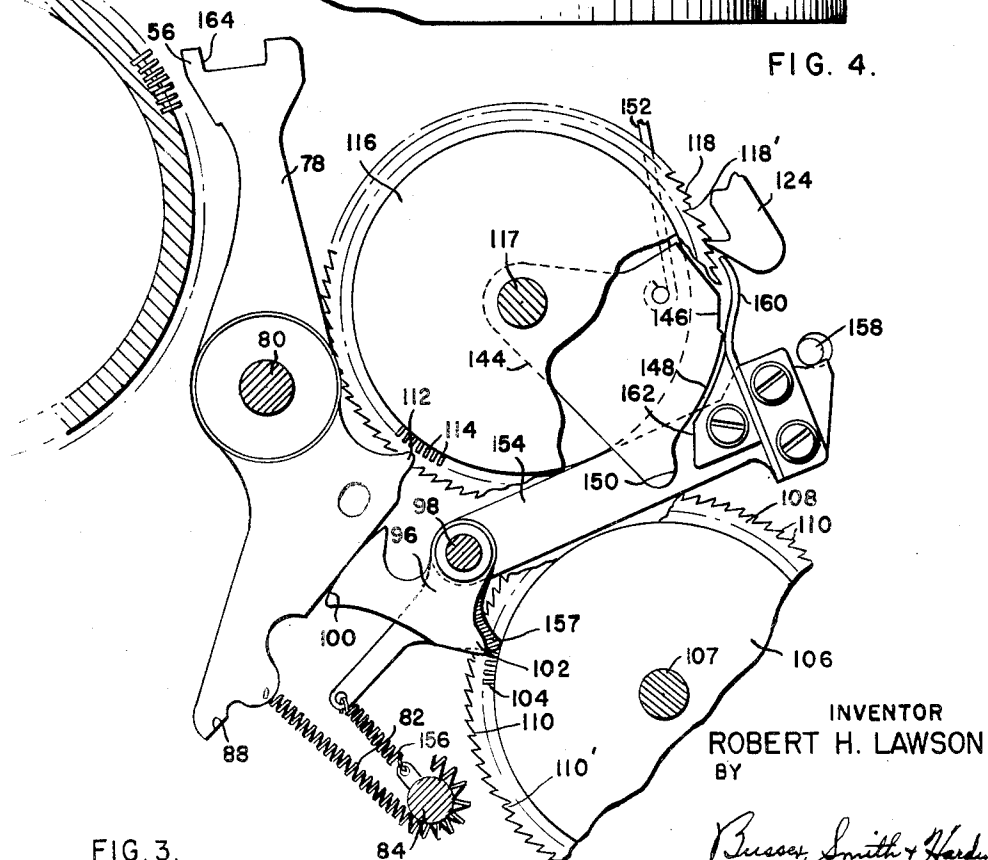
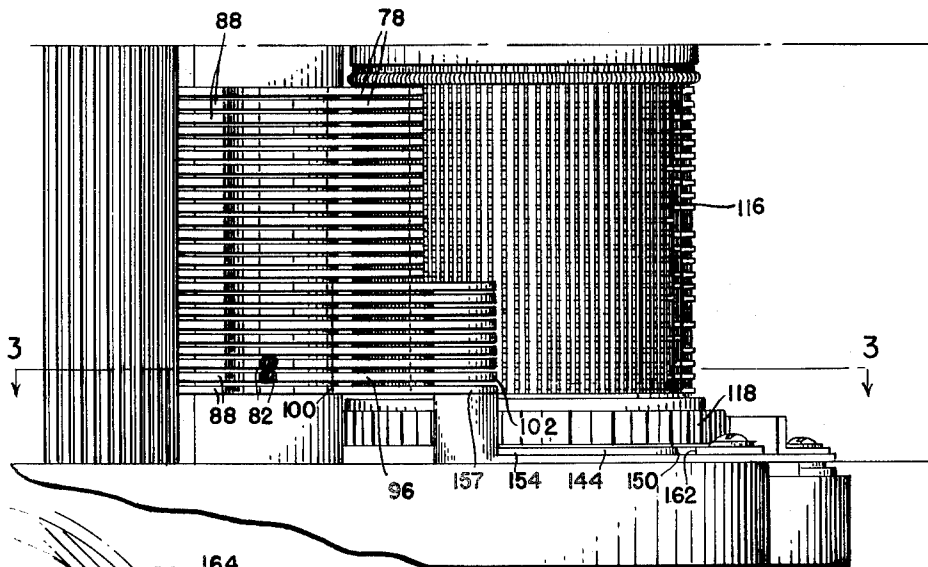
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PATTERN MECHANISM FOR KNITTING MACHINES

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4 Sheets-Sheet 3



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PATTERN MECHANISM FOR KNITTING MACHINES

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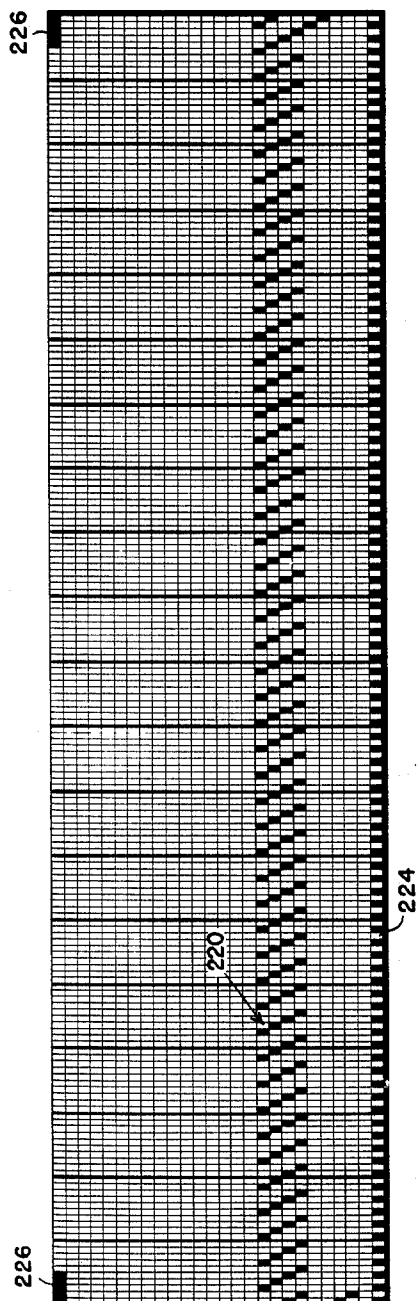


FIG. 6.

226

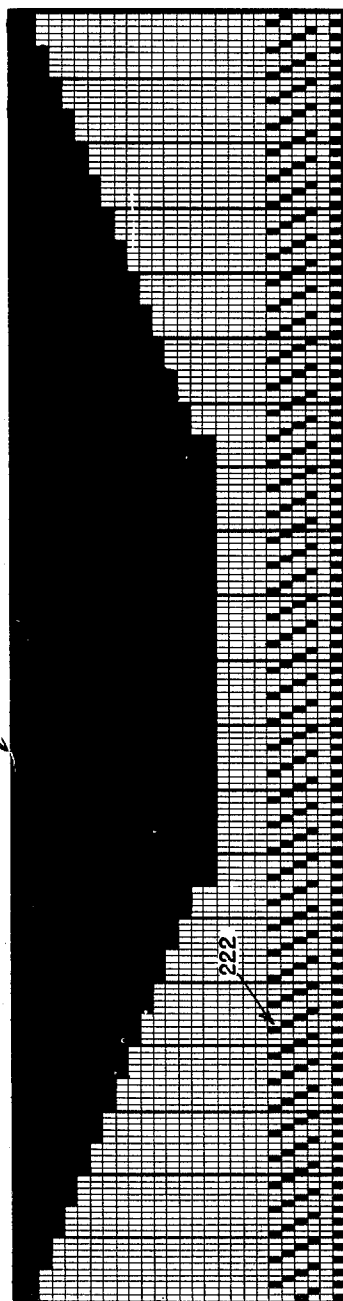


FIG. 7.

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2,694,908

PATTERN MECHANISM FOR KNITTING MACHINES

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Application April 1, 1952, Serial No. 279,827

11 Claims. (Cl. 66—50)

This invention relates to knitting machines and has particular reference to pattern mechanism.

In the knitting of hosiery, it is frequently desirable to provide through leg and instep portions of the hosiery overall patterns such as mesh and, at the same time, in the stocking provide other structural or decorative features such as a high splice, double sole, and various arrangements of clocks, mock seams, patterned shadow welts, or the like.

In accordance with the invention, and as will appear more fully hereafter, there is provided a pattern mechanism which is capable of effecting elaborate control of stitch formation and, at the same time, is relatively simple in construction. When an overall pattern such as a mesh is produced, it is generally desirable to use a trick-wheel for control of the pattern, and in particular if it is desired that the mesh should be uninterrupted at the times when the trickwheel is advanced, it is necessary that the trickwheel should be advanced twice for each revolution of the needle cylinder. This means that any trickwheel of reasonable dimensions must make many revolutions during the production of a stocking. In contrast with the short cycle of repetition of design of mesh or similar pattern, other structural or decorative features such as a shaped high splice, double sole, clock or the like must be made without repeat and in accordance with the invention there is provided a secondary trick-wheel which may be advanced from time to time as dictated by the primary wheel or auxiliary controls to cancel portions of the overall pattern and substitute differently formed areas.

The general objects of the invention are concerned with the attainment of the types of results just indicated and these and other objects will become apparent from the following description read in conjunction with the accompanying drawings, in which:

Figure 1 is a development, looking outwardly, of the cams cooperating with needles and jacks in the needle cylinder of a knitting machine provided in accordance with the invention, there being shown at the right-hand side of this figure a section of the needle cylinder together with a needle, jacks and a sinker associated therewith;

Figure 2 is a plan view showing in particular controlling devices for a pair of trickwheels and their associated elements;

Figure 3 is an enlargement of certain of the elements shown in Figure 2 for the purpose of more clearly indicating details, this figure being, in part, a section on the plane indicated at 3—3 in Figure 4;

Figure 4 is an elevation of certain of the elements shown in Figure 3;

Figure 5 is a fragmentary elevation of certain of the elements shown in Figures 2 and 3;

Figures 6 and 7 are diagrams showing a typical arrangement of jack butts for the formation of a mesh fabric and a shaped high splice; and

Figure 8 is a diagram of a typical stocking produced in accordance with the invention.

Referring first to Figure 1, there is indicated therein a rotary needle cylinder 2 provided with slots 4 in which are located latch needles 6 provided with butts 8 of different lengths in the usual fashion, the needles which form the instep of the foot being provided with relatively long butts, and the needles which form the sole being provided with relatively short butts, an example of which is illustrated in the reissue Patent No. 23,094 to H. N. Sheppard. Associated with each needle and

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located below it in its slot 4 is an intermediate jack 10 provided with a butt 12. Below each intermediate jack and also located in the cylinder slot is a pattern jack 14 which is arranged to be tilted about a fulcrum point indicated at 16. The lower end of each jack 14 is provided with a butt 18 beneath which is a notch 20. Below this and located still further inwardly is a notch 22. As will appear hereafter, these notches 20 and 22 are arranged to engage and ride over cams. Each of the jacks is provided below its fulcrum point 16 with a series of pattern butts 24 which may be selectively removed to provide patterning selections. At its upper end each jack 14 is provided with a butt 26.

Sinkers 28 are interposed between the needles and are arranged to be acted upon by conventional sinker cams which need not be specifically described. The level of the sinker ledge over which stitches are drawn is indicated by the construction line 30.

The present machine is of single feed type, though it will be evident that the invention is equally applicable to multifeed machines. At the single feed of the machine herein detailed, there are provided yarn feeding fingers 32, 34 and 35 which respectively feed the yarns 36, 38 and 39. The yarn feeding fingers cooperate in usual fashion with a throat plate 37. As will appear in greater detail hereafter, the yarn feeding fingers have different positions so that their yarns are taken selectively by the needles during operation of the machine.

The cams operating on needle butts include a forward stitch cam 40, a center cam 42 and a reverse stitch cam 44. The usual provisions are made for the formation of heels and toes involving conventional pickers which are not illustrated. Cams 46 and 48 serve to raise the needles after they are depressed by the forward stitch cam 40, the cam 48 serving to raise the needles to a tuck level in which the lower ends of their open latches are located below the sinker platform or ledge level 30.

The butts 12 of intermediate jacks 10 are depressed during operation by cams 50 and 52, and these intermediate jacks are levelled by a cam 54 to position the pattern jacks for selection. The intermediate jacks are raised by the pattern jacks.

Arranged to act upon the butts 24 selectively are cams 56 which are provided as the ends of levers hereafter more fully described. The cams 56 are arranged in a stack, there being one at each level corresponding to positions of the butts 24.

Immediately preceding the position of the cams 56 in respect to counterclockwise rotations of the needle cylinder there is a cam 58 arranged to act upon the butts 26 of the pattern jacks. As will appear hereafter, this cam 58 may be at desired times withdrawn by cams on the conventional main cam drum of the machine. A second cam 60 is also arranged to act upon butts 26 of the pattern jacks.

A cam 62 is provided with a sloping sharp edge 64 arranged to engage within notches 20 or 22 of the pattern jacks to raise these jacks when they are positioned for such engagement. Beyond the upper end of the edge 64, the cam 62 is cut away as indicated at 66 to permit the rocking inwardly of pattern jacks under the action of cam 67 on their butts 18. Beyond this cut-away region the cam 62 has a further rise in the form of a sharp edge 68 engageable within notches 20 of the pattern jacks. Beyond this the cam 62 is cut away or relieved at 70 to permit depression of jacks and serving to rock them inwardly to avoid contact with a subsequent cam.

A further cam 71 is provided with a sloping sharp edge 72 arranged to engage within notches 22 to raise jacks after their lower ends are rocked outwardly by cam 60. Cam 71 is relieved at 74 and there provided with a cam surface which will permit the pattern jacks to be lowered and will rock their lower ends inwardly. A pattern jack leveling cam is provided at 76, this cam being arranged to engage notches 20 for positioning of the jacks prior to reselection by cams 56.

Referring now particularly to Figures 2, 3, 4 and 5, there are indicated at 78 the levers, the ends of which constitute cams 56 for operating on butts 24 of the pattern jacks. These levers 78 are stacked, with suitable spacers, on a post 80 to position their cams at proper

levels. Springs 82 trained over a post 84 serve to urge the levers 78 in a counterclockwise direction, as viewed in Figure 2. All of the levers 78 may be simultaneously rocked clockwise by the action of a plate 86 on their ends 88, the plate 86 being carried by a lever 90 pivoted at 92 and having a connection 94 to the main cam drum of the machine.

Associated individually with a lower group of the levers 78 are levers 96 which are pivoted upon a post 98 and are provided with edge portions 100 engageable with their associated levers 78. Each of the levers 96 is provided with a follower portion 102 engageable with butts 104 carried by elements mounted in a conventional trickwheel 106 which is mounted to rotate on a post 107, the trickwheel carrying a ratchet 108 provided with teeth 110, of which one tooth 110' is of less height than the remaining teeth and is provided for retiming.

Each of the levers 78 is provided with a cam follower portion 112 arranged for engagement by the butts 114 of the elements carried by a second trickwheel 116 which is mounted upon a post 117 for rotation, the trickwheel being provided with a ratchet having teeth 118, there being one low tooth 118' for retiming purposes.

A link 120 is arranged to be oscillated lengthwise by connection to a lever operated by cams rotating with the needle cylinder. This lever and its cams are not shown but are of conventional type used for advancing a trickwheel two steps for each revolution of the needle cylinder. In this connection reference may be made to the patent to Houseman 2,264,977, dated December 2, 1941, which explains the utilization of double racking of a trickwheel for each revolution of a needle cylinder to provide patterning which is uninterrupted at the time of trickwheel advance. The link 120 is connected to a lever 122 to which is pivoted a pawl 124 the hook end of which is held in engagement with teeth 118 of trickwheel 116 by a spring 126 except when the pawl is held away from the teeth by guarding means hereafter described. The link 120 is also connected to a second lever 128 to which is pivoted a pawl 130 the hook end of which is arranged to engage the teeth 110 to trickwheel 106 under the action of spring 132.

A guard 134 pivoted on the post 107 is provided with an intermediate step 136 and a high step 138 cooperating with the end of pawl 130. This guard 134 is connected through link 140 to the lever 90 and is urged to a clockwise position by a spring 142 so that during patterning the guard is entirely out of the path of pawl 130. When the step 138 of the guard is in position to be engaged by pawl 130, the end of the pawl is lifted outwardly so as to miss all of the teeth 110 of the trickwheel. When the step 136 is in position to be engaged by the end of the pawl, the pawl end is held partly outwardly so that while it will still engage the teeth 110 it will miss the low tooth 110'.

A guard 144 generally similar to guard 134 is mounted on post 117 of trickwheel 116. This guard 144 is also provided with a pair of steps 146 and 148 cooperating with pawl 124 in the same fashion as the respective steps 136 and 138 cooperate with pawl 130. Additionally the guard 144 is provided with a cam 150. A link 152 connects the guard 144 to a follower acted upon by the main cam drum of the machine. Mounted on the pin 98 which serves to support the levers 96 is a lever 154 located below the levers 96. This lever 154 is urged in a counterclockwise direction by a spring 156 to bring a follower portion 157 into engagement with the lowermost level of butts 104 on the elements in trickwheel 106. In the absence of a butt acting on the follower portion 157 of this lever it is pulled by spring 156 to a position determined by a stop pin 158 carried by the machine frame and at such time a guard 160 carried by the lever is positioned to be engaged in the path of pawl 124 to prevent the pawl on its return movement from engaging a new tooth 118. In other words, the guard 160, in the action of a butt on follower portion 157 of lever 154, causes an interruption of movement of trickwheel 116 despite continued oscillation of pawl 124. On the other hand, when the follower portion 157 is acted upon by a trickwheel butt, the guard 160 is withdrawn and pawl 124 may advance the trickwheel.

A block 162 carried by the lever 154 is engageable by the cam 150 on guard 144 so that when this guard is moved counterclockwise to a position bringing step 146

into cooperation with pawl 124 the lever 154 will be rocked clockwise to move guard 160 out of operative position irrespective of the position which might be determined by butts on trickwheel 106. Such action also occurs if step 148 is moved into position for cooperation with pawl 124, the block 162 having a surface which is approximately concentric with the axis of trickwheel 116 for engagement by cam 150 when the guard 144 is moved to its extreme counterclockwise position.

As will appear more clearly hereafter, the butts on the trickwheels 106 and 116 serve to move, either through levers 96, or directly, the levers 78 in a direction to remove their cams 56 from positions to act on jack butts 24. As will appear, the pattern jacks have three alternative positions, their lower ends being rocked fully outwardly, fully inwardly, or to an intermediate position. The last two positions are attained under the action of springs 82 and are determined by stop devices. These stop devices are particularly illustrated in Figure 5. Each of the levers 78 is provided at its upper end as viewed in Figure 2 with a slot 164. The slots of the uppermost levers, i. e. those not associated with levers 96, embrace a vertically extending projection 166 of a member 167 which is secured in an adjusted horizontal position determined by screws 170, in which position it is held by a clamping screw 174 extending through an opening in the form of a slot in a fixed bracket 172. The lower levers 78 similarly have their slots 164 embracing the vertical member 168 of an element 169 also positioned by screws 170 and clamped in position by a screw 174 extending through a slot in bracket 172. As will be noted from Figure 5, the levers of the upper group are permitted to take a position further inwardly toward the axis of the needle cylinder than the levers of the lower group, with the result that when a jack is acted upon by a lever of the upper group it will be rocked fully inwardly while, when acted upon by a lever of the lower group, it will attain an intermediate position.

The alternative needle paths determined by the jack selections will now be described.

Reference will first be made to the conditions achieved when no butt 24 of a pattern jack is engaged by a selecting cam 56. This occurs when all levers 78 at levels of butts on the pattern jack are rocked outwardly by butts on one or both of the trick wheels. Considering the entrance of the elements in the cylinder slots from the right-hand side of the cam development in Figure 1, the needles will enter at tuck lever as determined by their previous rise over cam 48, the free ends of the open latches being located below the sinker platform level 30. The intermediate jacks 10 will have been positioned by cam 54, which cam in cooperation with cam 76 also effects positioning of the pattern jacks. The fragmentary section at the right-hand end of Figure 1 shows the needle and the jacks positioned at these respective levels. Cam 58 acts on butt 26 of each of the pattern jacks moving its upper end inwardly and its lower end fully outwardly.

If, as has been assumed, the pattern jack is not acted upon by any of cams 56, due to the absence of any butt 24 at a level of a cam 56 which is in active position, the pattern jack will remain in its full outer position so that its notch 22 will engage the edge 64 of cam 62 with the result that the butt 18 will rise along the path indicated at 176. The rise of the jack will carry the intermediate jack with it, and toward the completion of the rise of the intermediate jack will raise the needle so that the needle hook follows the path at 178, the needle being raised to clearing level with the free end of its latch located above the sinker platform level 30. A pattern jack, after reaching the top of slope 64, moves horizontally and butt 18 will be engaged by cam 67 to rock the lower end of the jack inwardly. The cut-away region at 66 permits the projection at the outer side of notch 22 to move inwardly. The inner position of the lower end of the jack permits it to pass the cam edge 68 without engagement.

The intermediate jack 10 is next lowered by cam 50 and in turn depresses the pattern jack which may move downwardly past the clearance 70 and then moves horizontally. The depression of the pattern jack by the intermediate jack is insufficient to bring its butt 26 into alignment with cam 60, and accordingly its lower end remains in inner position so as to miss cam 72. Full depression of the pattern jack occurs as the intermediate jack 10 is further lowered by cam 52, and the pattern jack then passes

horizontally, being levelled by the action of cam 76 on it and the action of cam 54 on the intermediate jack.

Following the rise to clearing level at 178, the needle moves horizontally past cam 44 which is withdrawn and is then depressed successively by center cam 42 and stitch cam 40. Yarn fingers 32 and 35 are at such elevated levels that their respective yarns 36 and 39 are not engaged by the needle which accordingly takes only the yarn 38 fed from finger 34. The needle is then raised to tuck level by the successive actions of cams 46 and 48.

There may next be considered the conditions which arise when the lower end of a pattern jack is rocked part way inward due to the action of a cam 56 on a butt 24, the cam 56 being on one of the lower group of levers 78 controlled by the trickwheel 106 through follower levers 96. This occurs when all of the upper group of levers 78 at levels of pattern jack butts are rocked outwardly by butts on elements of trick wheel 116 but at least one of the lower group of levers 78 at the level of a pattern jack butt is released by absence of corresponding butts on elements of both of the trick wheels. The entry of the elements into the right-hand end of the cam development is the same as before, but in this case the lower end of the pattern jack is rocked part way inwardly so that the notch 22 will miss the edge 64 of cam 62 but notch 20 will engage this edge to be raised thereby. Butt 18 will now rise along the path indicated at 180 which, it will be noted, is lower than the path 176. At the end of the rise the butt 18 is below the level of cam 67 which is, accordingly, without action. After passing cam 67 the notch 20 engages cam edge 68 which raises the pattern jack slightly and then intermediate jack 10 is lowered by cam 50 and this action lowers the pattern jack as before to a level which leaves its butt 26 above the level of cam 60. As the pattern jack moves downwardly, its butt 18 is engaged by the relief portion 70 of cam 62 which causes the lower end of the pattern jack to rock inwardly. The pattern jack and intermediate jack thereafter follow the same path as that previously described, the pattern jack missing the cam 71. The rise of the pattern jack and intermediate jack occasioned by the cam edges 64 and 68 is insufficient to cause the intermediate jack to engage the needle. Accordingly, the needle continues to move horizontally at tuck level and passes below center cam 42 and is depressed by stitch cam 40 to take yarn 38 but miss both yarns 36 and 39. The needle is then returned to tuck level by cams 46 and 48, the result being a formation of a tuck stitch.

Consideration may next be given to the conditions arising when, by the action of a cam 56 on a butt of a pattern jack the lower end of the jack is rocked fully inwardly. This action occurs due to one of the upper group of levers 78, one of these at the level of a butt of the pattern jack being released by absence of a corresponding butt on an element of trick wheel 116.

The elements enter the cam development the same as previously but due to the action of a cam 56 as just mentioned the lower end of the pattern jack completely misses the cam 62, passing along the horizontal path 182. The level at this time is sufficiently low so that the butt 26 will engage the cam 60 with the result that the upper end of the jack is rocked inwardly and the lower end outwardly. The result is that notch 22 will engage the edge 72 of cam 71 and the pattern jack will accordingly be raised as indicated at 184 and the intermediate jack will be correspondingly raised as indicated at 186. During the latter part of the rise the needle will be engaged by the intermediate jack and raised along path 188 which, it will be noted, rises above the level resulting from the rise at 178. The latch is accordingly cleared but additionally the needle is raised to a sufficiently high level to take yarn 36 as well as yarn 38, though missing yarn 39, the former being taken as the needle is depressed by center cam 42 and the latter as it is depressed by stitch cam 40. The reinforcing yarn 36 is thus additionally incorporated in the stitch. Following the drawing of a stitch the needle is then raised to tuck level by the successive actions of cams 46 and 48. After the rise over cam 71 the pattern jack is lowered by the action of cam 52 on the intermediate jack and the lower end of the pattern jack is rocked inwardly by the cam action of the relief 74. The pattern jack is then levelled as previously described.

Summarizing the above, it will be noted that three

alternative stitch formations are provided: in the first instance the needle is caused to knit main yarn 38 but to miss and float the reinforcing yarn 36; in the second case the needle tucks the main yarn and again misses and floats the reinforcing yarn; in the third case the needle knits both the main yarn and the reinforcing yarn.

In the foregoing descriptions, cams 190 and 192 have been assumed either withdrawn or absent. Assuming, however, that they are present and in action, and needle butts are assumed sufficiently long (though normal short butts) to engage cam 190, the operations previously described will only be modified to the extent that cam 190 will lower the needles which will then move horizontally to be raised by cam 194 to tuck level, the butts passing beneath cam 192 without engagement thereby. As will be evident, all selective actions occur subsequent to the cam 194, so far as the needles are concerned, and accordingly the various selections already described are unchanged.

However, as more fully indicated hereafter, it is sometimes desirable to introduce, generally on only a few needles, an additional yarn which may be conveniently referred to as a mock seam yarn, this yarn being 39 fed from finger 35. The paths previously described involved movements of needles at such low level that the yarn 39 would not be seized.

In cases where it is desired to take the mock seam yarn 39, the needles intended to take this yarn will be at the back of the stocking and accordingly of the short butt series. However, these particular needles will have extra short butts. When cams 190 and 192 are out of action, these needles will act the same as the other short butt needles and will be subject to the same selections under the action of cams 56. However, when it is desired that the mock seam yarn shall be knit, the cams 190 and 192 are moved into action, the cam 190 being moved sufficiently inwardly to engage all needle butts except the extra short ones just mentioned while the cam 192 is moved sufficiently inwardly to engage the butts of the extra short length. Under these conditions all of the butts except the extra short ones will be engaged and lowered by cam 190 and thus caused to move under cam 192 to be later raised by cam 194 as described. The extra short butts, however, will miss cam 190 and will then be raised by cam 192 along the path 196 which will raise these needles to an extra high clearing level at 198. This level 198 is sufficiently high to cause the mock seam yarn 39 to be taken by these needles as they are lowered by center cam 42 and accordingly these needles will take all three of the yarns 38, 36 and 39. This action will occur irrespective of the selections of jacks associated with the extra short butt needle. It will be evident that the mock seam produced by such needles may be started and interrupted by control of cams 190 and 192 from the main cam drum of the machine.

The more general aspects of the selecting devices and of the formation of stockings may now be described with preliminary reference to a typical stocking illustrated in Figure 8. This stocking comprises a welt 200 and a shadow welt 202 followed by the leg 204 during the formation of which patterning occurs to provide, for example, a mesh structure. For consistency of description it may be assumed that the mesh structure is of the type described in the patent to Page 2,501,353, dated March 21, 1950, which mesh involves intermittent tucking according to a predetermined pattern. In the stocking this mesh formation occurs not only in the leg 204 but in the ankle portion 208 in front of a high splice 206 and in the instep 214. The stocking may comprise additionally the conventional heel 210, a so-called cradle sole 212, the advance toe 216 and the toe 218. In particular it may be considered that the high splice 206 and the cradle 212 involve the use of a reinforcing yarn and are shaped by tapering or otherwise.

The operation of the machine will be particularly evident if there is additionally considered the arrangement of butts on the pattern jacks as indicated in Figures 6 and 7, the former showing the arrangement of butts associated with long butt or instep needles while Figure 7 shows the arrangement of butts on pattern jacks associated with the short butt or sole needles.

The blackened rectangles indicate the butts which remain on the jacks. The butts indicated at 220 in Figure 6 and at 222 in Figure 7 provide control for the mesh

pattern. It will be noted that these two groups of butts are displaced lengthwise of the jacks and this arrangement is adopted, as described in the Houseman patent previously referred to, so that the pattern may be continued without interruption about the entire fabric despite intermittent advance of the trickwheel 106. It is for this reason that the trickwheel 106 is advanced twice during each revolution of the needle cylinder, each advance effecting changes of levers 96 which are not exerting control while retaining in position the levers 96 which are exerting control.

The butts at 224 may be provided to differentiate alternate needles in the production of the first courses of the stocking.

The arrangement of the jack butts at 226 provides for the erasing by the action of trickwheel 116 of the pattern selections controlled by trickwheel 106 and the inclusion of the reinforcing yarn for the high splice and sole. The particular operations involved in connection with these butts will be later described.

The sequence of the formation of the stocking shown in Figure 8 is as follows:

At the beginning of the stocking, the trickwheels 106 and 16 will have been timed to initial position with the pawl guard surfaces 136 and 146 in operative position to prevent, due to the low teeth 110' and 118', the pawls 130 and 124 from engaging new teeth to advance the wheels. At this time lever 90 will be in a position to cause plate 86 to hold the levers 78 in their inactive positions. Cams 58 and 60 will be held inactive under control from the main cam drum. Reverse stitch cam 44 will be in its active position in which it will effect clearing of the needles. The reinforcing yarn 36 will be out of action to avoid its being taken due to the rise of the needles over cam 44.

The top will then be knit in conventional fashion using a suitable yarn at the feed, the finger for such yarn not being indicated though it will be understood that there are fingers carrying yarns in addition to those previously described and particularly involved in the novel actions in this machine.

A plain shadow welt may then be knit using another suitable yarn at the feed. It will, of course, be understood that the machine may be of a type arranged to form a turned welt in conventional fashion, the formation of such welt involving no special cooperation with the devices of the present invention.

After the formation of the shadow welt 202, the knitting of the leg 204 with a mesh pattern is initiated. For this purpose, a suitable yarn 38 is introduced, reverse stitch cam 44 is withdrawn, and rock out cams 58 and 60 are put into action though the introduction of the latter may be delayed, if desired, until the beginning of the knitting of the high splice. Yarn 36 may be introduced though this also is not necessary until the beginning of the knitting of the high splice. Lever 90 is now released to release either some or all of the levers 78. At this time it releases, in any event, the lower group of these levers which have cooperation with the levers 96 controlled by trickwheel 106. If the arrangement is such that the upper levers 78 are also released, the guard 144 is held in its timed position, in which case trick butts cooperating with the upper group of levers hold these levers inactive. The pawl guard 134 is withdrawn from cooperation with pawl 130 so that racking commences.

Selections now take place in accordance with the first two selection descriptions above, the jacks being selected to full outer positions of their lower ends or to intermediate positions so that selective knitting and tucking occurs to provide the desired pattern such as that of the Page patent. While not specifically illustrated, the arrangement of butts on the trickwheel 106 acting on levers 96 will be obvious.

The foregoing types of operations then continue until it is desired to begin the formation of the high splice 206. At such time reinforcing yarn 36 is lowered into feeding position and pawl guard 144 is withdrawn from control of pawl 124 so that trickwheel 116 starts to rack as dictated by the trick butt arrangement of the lowest row in trickwheel 106. As has been already indicated, the trickwheel 106 makes a relatively large number of complete revolutions during the formation of a stocking, but through lever 154 this controls the intermittent advance of trickwheel 116 as determined by the butts act-

ing on follower 157 with the result that the trickwheel 116 makes only a single revolution in the formation of each stocking. The intervals between advances may be controlled from trickwheel 106 in any desired fashion to secure, for example, the proper degree of tapering of the high splice and later of the cradle sole.

The function of the trickwheel 116 is essentially that of erasing or negating the selections made by trickwheel 106 with respect to predetermined needles. This may be understood by considering that trickwheel 106 through levers 96 would control the cams 56 for the formation of the desired mesh pattern throughout the entire circumference of the needle cylinder. The action of trickwheel 116 is essentially negative from the standpoint of butts. When a butt is absent on this trickwheel, the corresponding cam 56 is active and will cooperate with those butts 24 which exist on the pattern jacks, the effect being the intermediate rocked position of the jacks. When butts are present on this trickwheel the corresponding cams 56 will be withdrawn and a particular jack will be in its full outer position unless rocked part way inwardly by a particular cam 56 which is not acted upon by a trickwheel butt.

If, however, one of the levers of the upper group is released by its trickwheel 16 so that its corresponding cam 56 moves inwardly, then any pattern jack having a butt 24 at the level of such cam 56 will be rocked fully inwardly with the resulting selection previously described which will cause clearing of the corresponding needle and the taking of both the main and reinforcing yarns. The selections to take the main yarn only or to produce tucking are thereby erased or nullified, the trickwheel 116 effectively assuming an overriding control. This overriding control involves the action of cams 56 on the butts 24 which are indicated at 226 in Figures 6 and 7. The result is the formation of a shaped reinforced high splice determined by these butts and the selection of cams 56 at the various levels. It will be evident that with particular arrangements of the butts at 226 together with particular arrangements of the butts on trickwheel 116 a wide variety of high splice configurations may be produced. At the same time the formation of the mesh pattern continues in the portion of the ankle in front of the high splice.

For the formation of the heel, the conditions previously described in connection with the formation of the welt and shadow welt are reestablished except that the portions 138 and 148 of the pawl guards are moved into active position to interrupt advances of the trickwheels. The formation of the heel takes place in conventional fashion, the pickers, not shown, acting to control narrowing and widening during reciprocatory knitting.

Following completion of the heel, the elements are again restored to the same condition as during the formation of the high splice and the shaped reinforced sole 212 is produced while formation of the mesh pattern continues through the instep 214. As will be evident, the butt formation at 226 on the pattern jacks in cooperation with a suitable setup of butts on trickwheel 116 will secure the desired shaping of the sole.

When the advanced toe 216 is started, the parts are again restored to the conditions involved in the formation of the welts, the guards 134 and 144 being moved to positions bringing steps 136 and 146 into cooperation with the pawls so that retiming takes place. This retiming may continue during the formation of the toe in conventional fashion and need not be completed until just prior to the time the trick wheels are again required to become active after the next stocking has been started.

It may be noted that where a yarn is included through less than half the circumference of a product, as in the case of a mock seam, clock, or the high splice and double sole reinforcing yarn, there should be used a takeup of conventional type for maintaining the yarn under proper control.

While a particular stocking formation has been described in detail, it will be clear that the mechanism which has been described, merely by proper arrangements of trickwheel and pattern butts or by minor modifications, such as auxiliary controls from the main cam drum, may be used for the formation of many other types of products.

One arrangement which may be used to save steps of the auxiliary trickwheel 116 would involve control in

other parts of stockings than those indicated of the pawl guard 144 to interrupt racking of this trickwheel despite the fact that control of lever 154 from trickwheel 106 might dictate racking movements. Conversely, special racking steps at predetermined times might be caused to occur by control of lever 154 from the main cam drum to remove guard 160 from step-inhibiting action. Float stitch arrangements may be readily produced by involving other than solid areas for inclusion of an auxiliary yarn such as the reinforcing yarn already described. One special type of design which may, of course, be readily produced is that involving a so-called framed high splice in which a reinforced high spliced area may be surrounded by a reinforced band with spacings between them. Particular references to certain other possibilities will make clear the wide range of variations of stitch arrangements which may be produced.

One such arrangement, for example, would involve the formation of a clock surmounting a high splice, the clock being of the type described in the patent to Thompson 2,563,082, dated August 7, 1951. A number of the rows of butts forming the group indicated at 226 in Figure 7 could be assigned to the formation of such a clock.

It is common practice to produce open work or other designs in a shadow welt, and such designs may be produced by the formation of float stitches. In such a case the butt setups could be provided to alternate between the stitch formation controlled by fully in and fully out selection of jacks. When the jacks were fully in two yarns would be knit together while with the jacks fully out one of them would be knit and the other floated. It will, of course, be obvious that tuck stitch designs could be formed in the shadow welt in the same fashion as described for their formation in the leg. In this and other arrangements the regions of effectiveness of the stop members 166 and 168 of Figure 5 could be changed to determine which of the levers 78 would move their cams fully inwardly and which would move their cams only part way inwardly. Furthermore, it is obvious that more or less of the intermediate levers 96 could be provided thus to distribute the controls between the trickwheels 106 and 116.

It will also be evident that various areas of plain and tuck stitched designs may be provided by suitable selections and arrangements of butts.

Plain areas in the high splice region, sole or other regions may be provided merely by omission of reinforcing yarn in which case the alternative of having the jacks in fully inward position would involve the erasure of designs and the knitting of plain fabric.

A mock seam may be produced stopping at the reinforcing above the heel by following the same procedure indicated above for a clock. If, however, it is desired to run a mock seam through a high splice, there may be utilized a pair or more of extra short butt needles in cooperation with cams 190 and 192 along with the addition of the yarn 39. Even more elaborately a clock of variable width formed under control of butts of the group 226 in Figure 7 could be continued through a high splice also controlled by such butts by providing the continuation only through the use of a mock seam yarn such as 39 together with control of extra short butt needles by cams 190 and 192.

In similar fashion a mock seam of uniform width could be provided above a clock and as a continuation thereof without involving the necessity of providing additional controls from trickwheel 116. Such a mock seam may be started and terminated to additionally form a plain clock stem, either above or extending through a high splice merely by introducing the cams and the mock seam yarn where a seam is to begin and removing it when it is to end.

It may be noted that while as specifically described, a lever 78 associated with an auxiliary lever 96 is generally controlled only by trick wheel 106, (except for the mentioned possibility of using trick wheel 116 to achieve the same results a plate 86), various types of control may be secured by dual control of certain of levers 78 by actions of both trick wheels, with or without controls of groups of levers by members such as 86.

It will be obvious that numerous possibilities are presented by the type of mechanism which has been described.

What is claimed is:

1. Pattern mechanism for knitting machines com-

prising a first cyclically operating pattern device, members controlled by said pattern device for determining selective operations of knitting instrumentalities, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device controlling said members, and means controlled by the first pattern device for imparting step by step movements to the second pattern device, said second pattern device controlling said members to nullify controlling actions thereof by the first pattern device.

2. Pattern mechanism for knitting machines comprising a first cyclically operating pattern device, members controlled by said pattern device for determining selective operations of knitting instrumentalities, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device controlling said members, means controlled by the first pattern device for imparting step by step movements to the second pattern device, and means controlling step by step movements of the second pattern device independently of the first pattern device.

3. Pattern mechanism for knitting machines comprising a first cyclically operating pattern device, members controlled by said pattern device for determining selective operations of knitting instrumentalities, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device controlling said members, means controlled by the first pattern device for imparting step by step movements to the second pattern device, said second pattern device controlling said members to nullify controlling actions thereof by the first pattern device, and means controlling step by step movements of the second pattern device independently of the first pattern device.

4. Pattern mechanism for knitting machines comprising a first cyclically operating pattern device, elements of one group acted upon by said pattern device, members controlled by said pattern device through said elements for determining selective operations of knitting instrumentalities, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device, elements of a second group acted upon by the second pattern device and through which the second pattern device additionally controls said members, and means controlled by the first pattern device for imparting step by step movements to the second pattern device, said second pattern device controlling said members to nullify controlling actions thereof by the first pattern device.

5. Pattern mechanism for knitting machines comprising a first cyclically operating pattern device, elements of one group acted upon by said pattern device, members controlled by said pattern device through said elements for determining selective operations of knitting instrumentalities, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device, elements of a second group acted upon by the second pattern device and through which the second pattern device additionally controls said members, and means controlled by the first pattern device for imparting step by step movements to the second pattern device, the elements of said two groups effecting different types of control of said members.

6. Pattern mechanism for knitting machines comprising a first cyclically operating pattern device, members controlled by said pattern device for determining selective operations of knitting instrumentalities, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device controlling said members, means controlled by the first pattern device for imparting step by step movements to the second pattern device, and means for independently retiming said pattern devices.

7. Pattern mechanism for knitting machines comprising a first cyclically operating pattern device, elements of one group acted upon by said pattern device, members controlled by said pattern device through said elements for determining selective operations of knitting instrumentalities, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device, elements of a second group acted upon by the second pattern device and through which the second pattern device additionally controls said members, means controlled by the first pattern device for imparting step by step movements to

the second pattern device, and means for controlling at least some of said elements independently of control by said pattern devices.

8. A knitting machine comprising independent needles, elements cooperating with said needles for the formation of stitches, a first cyclically operating pattern device, members controlled by said pattern device for determining selective formation of stitches by said needles, means imparting movements to said pattern device at each course of knitting, a second cyclically operating pattern device controlling said members, and means controlled by the first pattern device for imparting step by step movements to the second pattern device, one of said pattern device controlling formation of two different types of stitches by the needles, and the other of said pattern devices controlling formation of two different types of stitches by the needles, one of the first mentioned types of stitches being different from both of the second mentioned types.

9. A knitting machine comprising independent needles, elements cooperating with said needles for the formation of stitches, a first cyclically operating pattern device, members controlled by said pattern device for determining selective formation of stitches by said needles, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device controlling said members, means controlled by the first pattern device for imparting step by step movements to the second pattern device, and means in addition to said pattern devices for controlling, during the formation of courses controlled by said pattern devices, the formation of stitches differing from those controlled by said pattern devices.

10. A knitting machine comprising independent needles, elements cooperating with said needles for the formation of stitches, a first cyclically operating pattern device, members controlled by said pattern device for determining selective formation of stitches by said needles, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device controlling said members, means controlled by

the first pattern device for imparting step by step movements to the second pattern device, one of said pattern devices controlling formation of two different types of stitches by the needles, and the other of said pattern devices controlling formation of two different types of stitches by the needles, one of the first mentioned types of stitches being different from both of the second mentioned types, and means in addition to said pattern devices for controlling, during the formation of courses controlled by said pattern devices, the formation of stitches differing from the stitches of all of the aforementioned types.

11. A knitting machine comprising independent needles, elements cooperating with said needles for the formation of stitches, a first cyclically operating pattern device, members controlled by said pattern device for determining selective formation of stitches by said needles, means imparting movement to said pattern device at each course of knitting, a second cyclically operating pattern device controlling said members, means controlled by the first pattern device for imparting step by step movements to the second pattern device, one of said pattern devices controlling formation of two different types of stitches by the needles, and the other of said pattern devices controlling formation of two different types of stitches by the needles, one of the first mentioned types of stitches being different from both of the second mentioned types, and means in addition to said pattern devices for controlling, during the formation of courses controlled by said pattern devices, the formation of stitches differing from the stitches of all of the aforementioned types and overriding the controlling actions of said pattern devices.

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