Dec. 6, 1960 K. C. WILLIAMS 2,962,881

METHOD AND APPARATUS FOR MAKING RUN DOWN PATTERNED FABRIC

Filed April 26, 1957 5 Sheets-Sheet 1

Fig. 1

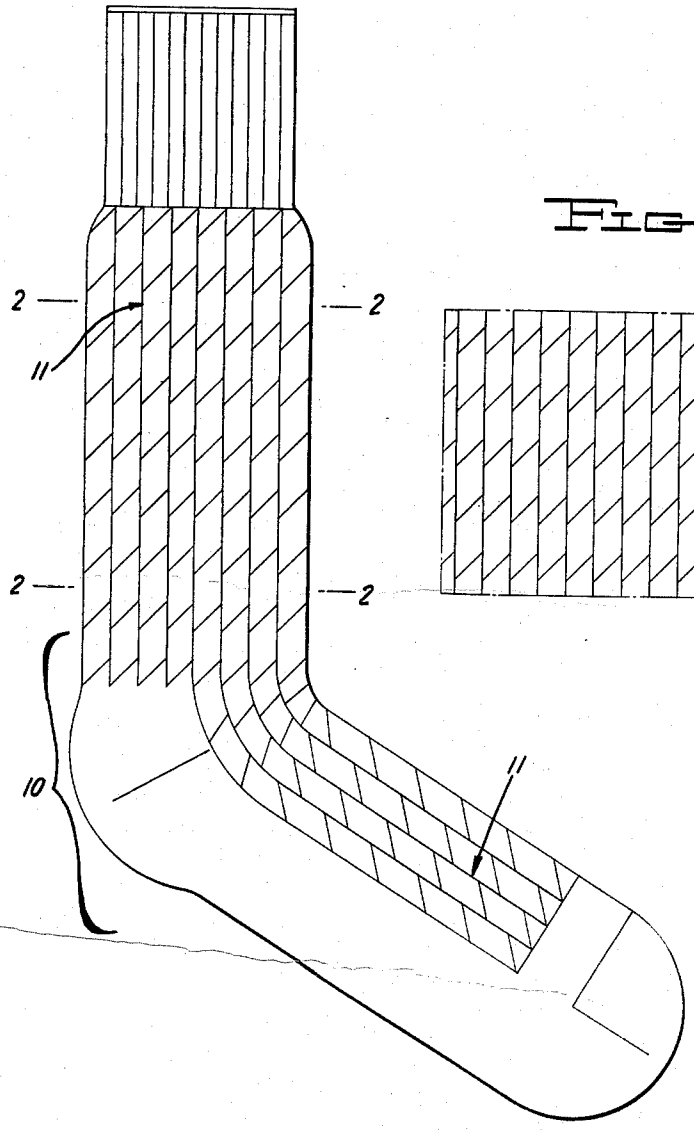


Fig. 2

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Dec. 6, 1960 K. C. WILLIAMS 2,962,881

METHOD AND APPARATUS FOR MAKING RUN DOWN PATTERNED FABRIC

Filed April 26, 1957 5 Sheets-Sheet 2

Fig. 4

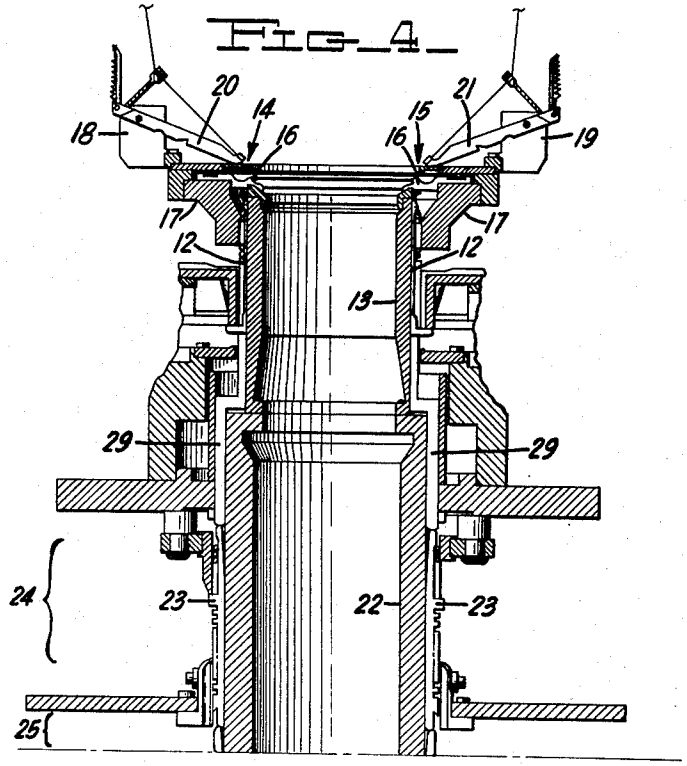
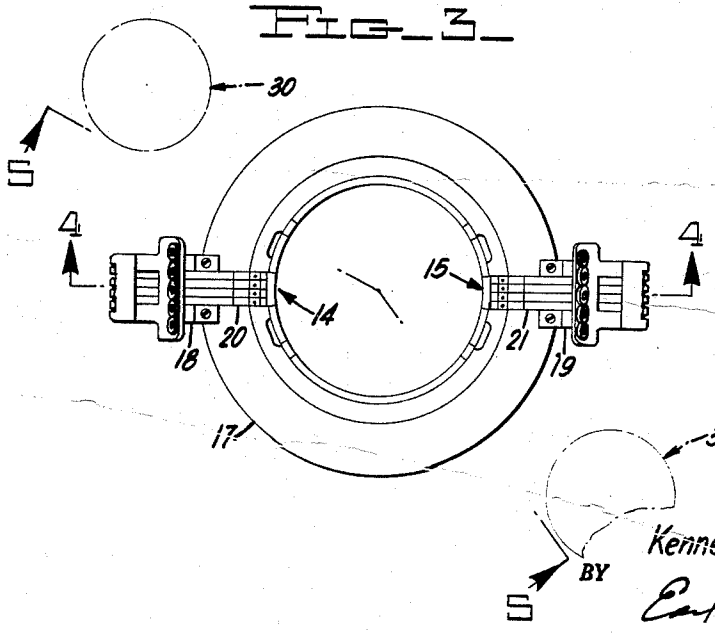


Fig. 3



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METHOD AND APPARATUS FOR MAKING RUN DOWN PATTERNED FABRIC

Filed April 26, 1957 5 Sheets-Sheet 3

FIG. 5

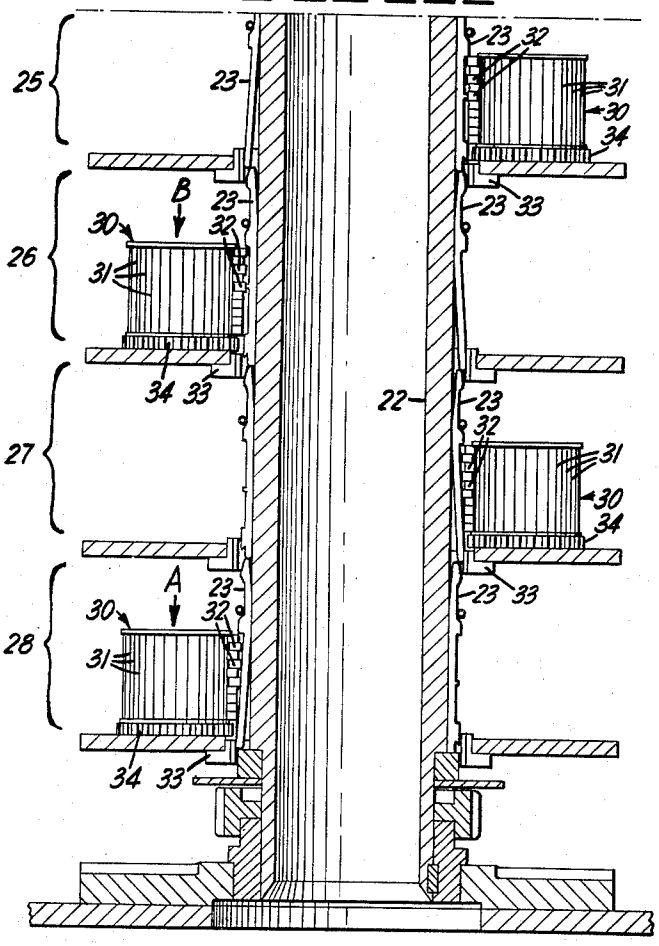
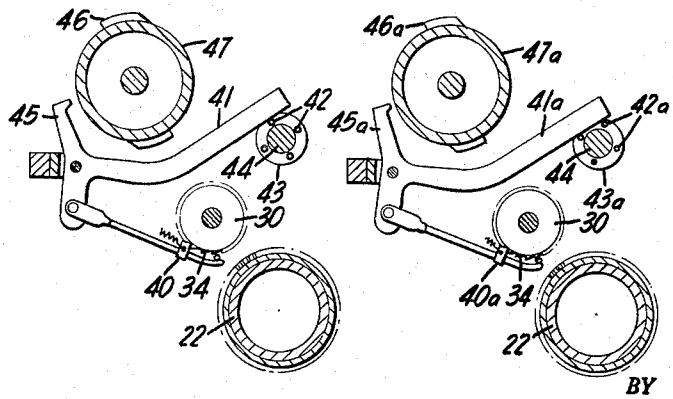


FIG. 5A FIG. 5B



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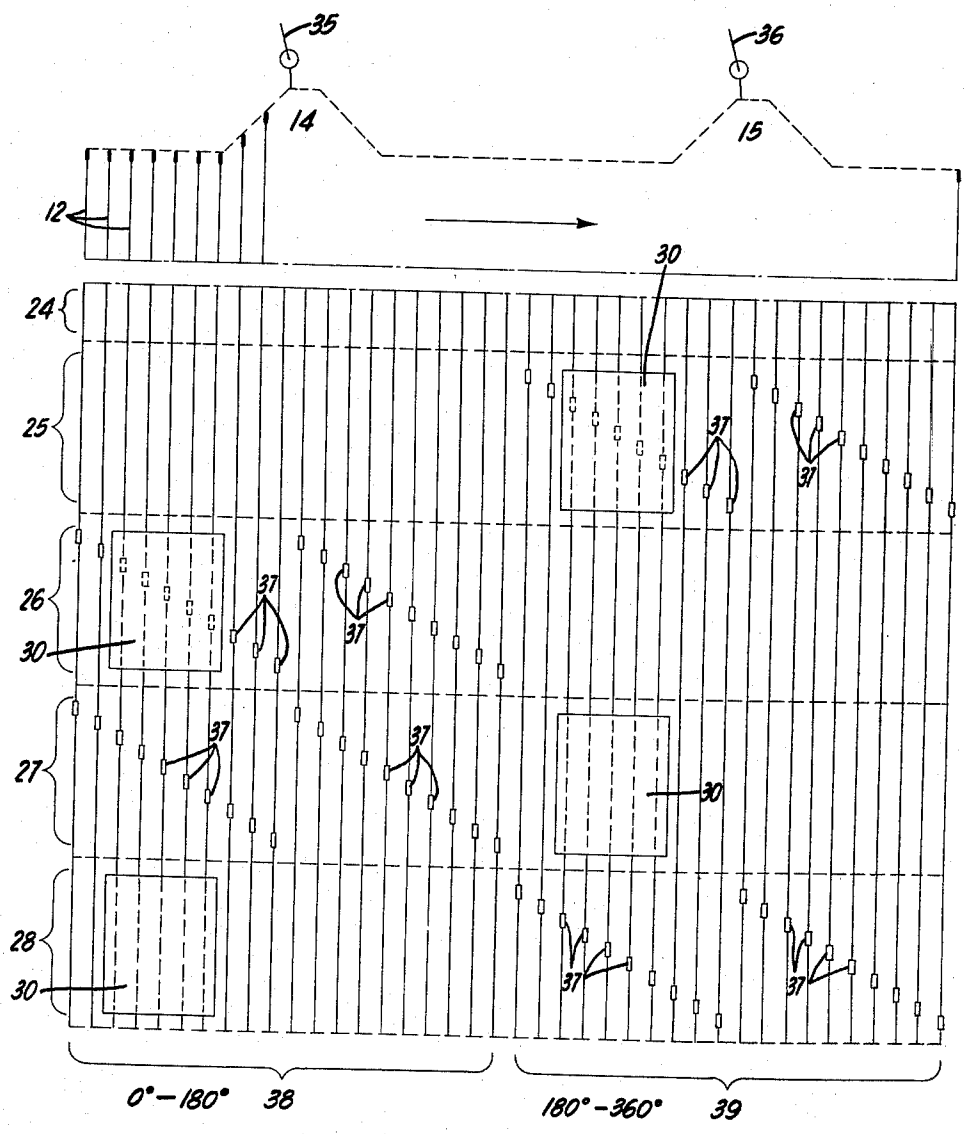
Dec. 6, 1960 K. C. WILLIAMS 2,962,881

METHOD AND APPARATUS FOR MAKING RUN DOWN PATTERNED FABRIC

Filed April 26, 1957

5 Sheets-Sheet 4

Fig. 6



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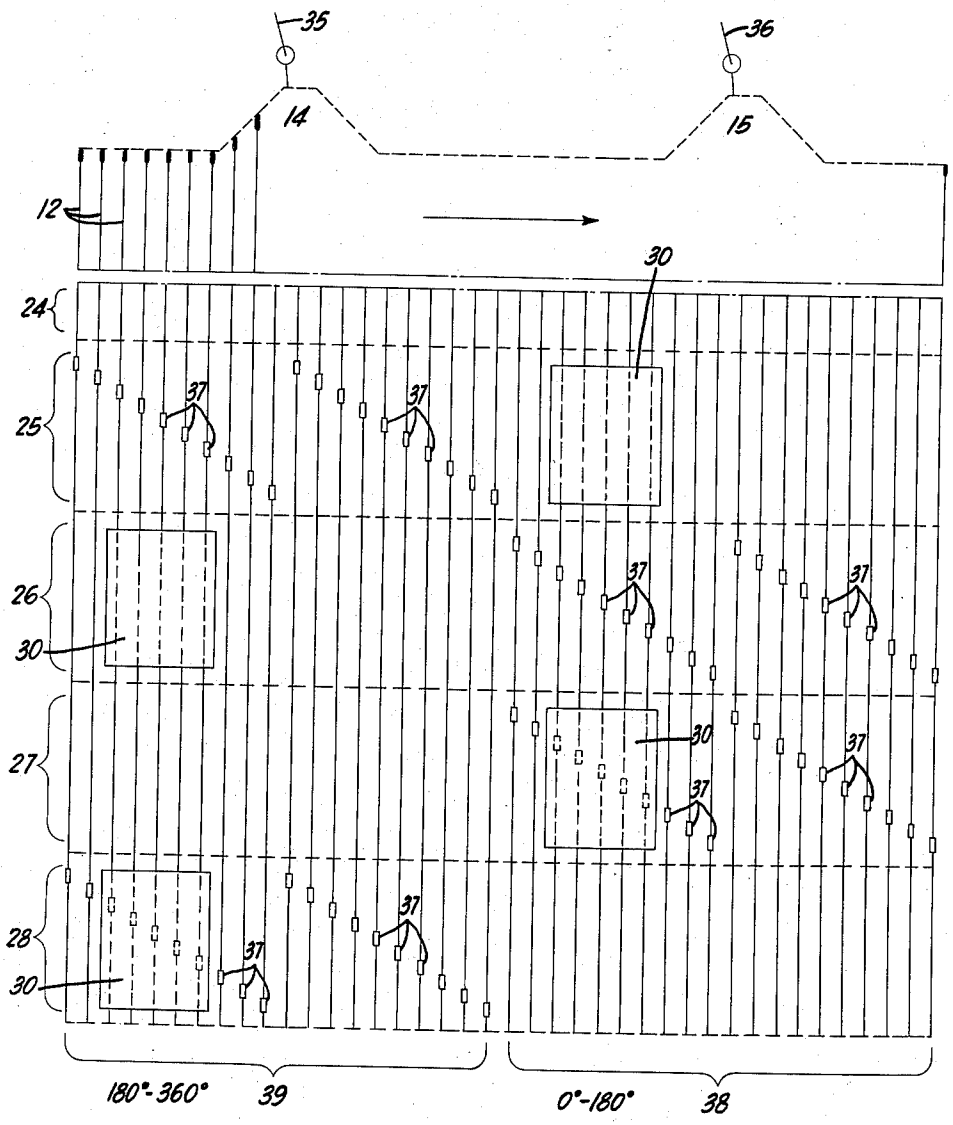
Dec. 6, 1960 K. C. WILLIAMS 2,962,881

METHOD AND APPARATUS FOR MAKING RUN DOWN PATTERNED FABRIC

Filed April 26, 1957

5 Sheets-Sheet 5

Fig. 7



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METHOD AND APPARATUS FOR MAKING RUN DOWN PATTERNED FABRIC

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Filed Apr. 26, 1957, Ser. No. 655,397

11 Claims. (Cl. 66—50)

The present invention relates to the art of knitting and more particularly to an improved method and apparatus for forming a patterned fabric.

Generally, when overall patterned tubular fabrics are made by rotary knitting upon circular knitting machines having known types of selecting devices for selectively actuating the desired ones of the pattern forming elements, for example the jacks, the selection changing from course to course or between groups of courses, the pattern in the fabric contains a pattern-break as a result of such changes. This pattern-break is obviously undesirable and consequently is generally located at the rear of the leg of tubular hosiery in an attempt to make it as inconspicuous as possible but this provides no true solution to the difficulty.

With more specific reference to the conventional construction and the problem presented thereby, a selecting device of the known type referred to, which is located at a knitting station, is circumferentially movable relative to the circle of pattern forming elements it controls (being in a fixed position on a revolving cylinder machine). As the pattern forming elements, such as needle jacks, move past the selecting device, the device does its selecting seriatim upon the elements, the selecting device being customarily indexed at intervals to provide a change in selection of the elements to effect a change of pattern in different courses or groups of courses of the fabric. Since the elements are usually relatively close together, and since a number of the elements will be moving past the selecting device while it is making a change in its selection, it follows that a certain number of the elements will be under the control of the selecting device during the time its selection is being changed, so that this certain number of elements is subject in part to the old and in part to the new selection which causes the break in the pattern. If the change in selection could be made between an adjacent pair of the elements, then there would be no pattern break, however, this is not possible since the time required to make a change in the selecting device is greater than the time it takes for a single pattern forming element to move past the selecting device.

It is an object of the present invention to provide a method and apparatus for knitting tubular fabric having an overall pattern without a pattern-break therein.

It is also an object of the present invention to provide a method of and apparatus for making a selection upon a circle of pattern forming elements, such as jacks, of a circular knitting machine with changes of selection between one or more courses or groups of courses of knitting, the patterning selection of the pattern forming elements being made in at least two steps. In accordance with the invention the circle of pattern forming elements is divided into at least two groups with a separately acting selecting device for each of the groups, so that during the time that one of said groups is active under the patterning control of its selecting device at a knitting station, the other of said groups is inactive permitting its selecting

device to make a pattern change and vice versa. Thus the pattern change for each group of the pattern forming elements is made individually while that group is inactive with the result that no pattern changes are made upon the elements while they are active, and consequently the pattern is made without a break therein.

The invention will be more fully understood, and further objects and advantages will be apparent, from the following detailed description thereof set forth in connection with the accompanying drawings in which

Figure 1 is a side elevational view of an article of hosiery made in accordance with the present invention;

Fig. 2 is a laid-out-flat view of a section of the tubular leg portion between lines **2—2** of the hosiery shown in Fig. 1, the tubular section being cut on any wale thereof;

Fig. 3 is a diagrammatic plan view of a circular knitting machine embodying the means of the instant invention but otherwise of known type;

Fig. 4 is a sectional view, taken on the line **4—4** of Fig. 3, of the needle cylinder and upper jack cylinder of the machine;

Fig. 5 is a sectional view, taken on the line **5—5** of Fig. 3, of the lower portion of the jack cylinder and illustrating the pattern selecting means;

Fig. 5A is a top plan view of control means for the pattern selecting means as viewed in the direction of the arrow A on Fig. 5;

Fig. 5B is a view similar to Fig. 5A as viewed in the direction of the arrow B on Fig. 5;

Fig. 6 is a schematic view illustrating the pair of knitting stations of the circular knitting machine of Fig. 3 and the pattern selecting means thereof; and

Fig. 7 is a view similar to that of Fig. 6 with parts thereof in a second position.

In Fig. 1, an article of hosiery of normal configuration is indicated generally at **10**, the article being provided with an overall pattern **11** in the leg and in the instep portions thereof the pattern involving pattern changes between courses or groups of courses. The pattern **11**, within the scope of the present invention, may be formed by reverse plating, by float thread knitting, by walewise extending wrap yarns, or by any system of knitting wherein a circular series of pattern forming elements, such as needles, sinkers, yarn fingers, jacks or the like, are selected by an indexable pattern device to form the pattern. In the disclosed embodiment the pattern **11** is preferably formed by float thread knitting upon selected ones of a circular series of needles with the selected needles changing from course to course or between groups of courses, to form the overall pattern **11**, which because of the instant invention, as will be later more fully explained, is without a break therein. This is shown in Fig. 2 where a tubular leg section has been cut vertically along any wale and then laid out flat. It will be noted that the pattern is uniform throughout the fabric.

The method of the instant invention, for the production, for example, of the float thread design illustrated in Figs. 1 and 2, may be practised upon a circular knitting machine of conventional construction, except for modifications hereinafter explained, adapted for rotary or round and round knitting in the main or patterned portion of the stocking. Such machines have one or a plurality of knitting stations with separate selecting devices for the knitting instrumentalities to be operable at each of the stations. The machine of such known type selected for illustration in Figs. 3 and 4, inclusive, and which may be that shown in the patent application of Benjamin Franklin Coile, Serial No. 329,801, filed January 6, 1953, embodies the usual knitting instrumentalities including needles **12** mounted in a needle cylinder **13** for movement through a knitting wave at each of a plurality

of knitting stations. In the embodiment of the machine illustrated, two such stations indicated at **14** and **15** are shown but it will be understood that the invention is applicable to a machine having a greater or lesser number of knitting stations. The needle cylinder is adapted to be rotated in a counterclockwise direction during the formation of the main or patterned area of the stocking by suitable means, not shown, but which may be of any conventional type. The machine also includes the usual sinkers **16** mounted in a sinker-head **17** and stationary yarn feed means **18** and **19**, each preferably including a plurality of yarn feeding fingers **20** and **21**, respectively, mounted for selective movement to and from yarn feeding positions. The operating means for the sinkers, needles, yarn feeding means, etc., are not shown in detail as their particular construction forms no part of the present invention and they may be of any usual or desired form.

The machine illustrated is of the type which employs an elongated jack cylinder **22** either of integral construction or made up of a plurality of sections as desired. The jack cylinder carries series of vertically aligned jacks **23**, one of such series being associated with each of the needles **12**. In the construction shown each jack series comprises five (5) jacks defining jack levels **24**, **25**, **26**, **27** and **28**. Certain of the jacks at levels **25** to **28**, inclusive, are butting patterning jacks suitably of the rocking type while others of the jacks at these levels are without butts for a purpose later explained, and merely serve to transmit lifting movements of jacks of lower levels to jacks of higher levels. Also the jacks at level **24**, insofar as the present invention is concerned, merely serve to transmit movements imparted thereto by the jacks at lower levels through lifters **29** to the needles **12**. It will be understood, however, that the jacks at level **24** may serve other functions not directly involved in the instant invention. For example, they may be used in the making of the heel and toe of the stocking.

Located at each of the jack levels **25** to **28**, inclusive, and in fixed position relative to the jack cylinder, which rotates with the needle cylinder, are selecting devices **30** suitably comprising rotatable trick wheels carrying butted tricks **31** therein, the butts of the tricks acting on horizontally disposed selector levers **32** which in turn act on butts of the butted pattern jacks to rock the jacks to positions in which they will not be lifted by the jack raising cams **33**. In other words, in the type of selecting mechanism used for illustration, the selecting devices operate on those butted pattern jacks which are not to lift their associated needles for movement through the knitting cycle. However, in accordance with conventional practice, the remaining pattern jacks which are lifted by the lifting cams to in turn raise the associated needles, are herein referred to as "selected jacks" and their associated needles as "selected needles." The trick wheels are racked or indexed at predetermined times under the control of the pattern mechanism of the machine to change the selection, by pawl mechanism acting on ratchet wheels **34** carried by the trick wheels. This general type of selecting mechanism and its operation, as well as the means for and control of the indexing of the trick wheels is well known. However a mechanism as shown in said copending Coile application Serial No. 329,801 represented by Figs. 5A and 5B herein will be used for purposes of illustration.

As shown in Fig. 5A, the means for indexing the ratchet wheel **34** of the selecting device **30** at jack level **28** and at the feed **14** includes a pawl **40** which is connected to a pivoted kick lever **41** having a long arm adapted to be intermittently engaged by rollers **42** carried on a collar **43** secured in a shaft **44** which is the quarter turn shaft **176** of said Coile application and which makes one revolution for each four revolutions of the needle cylinder when in rotary motion. The kick lever **41** is provided with a second arm **45** which is adapted to ride on and off of cams **46** carried on a pattern drum **47**. When a cam **46** is beneath the arm **45** the kick lever **41** is held inactive with respect to the rollers **42** and no indexing movement of the selecting device takes place. When the cam **46** is moved from beneath arm **45** kick lever **41** is permitted to engage the rollers **42**, each roller actuating the kick lever to index the selecting device one tooth of the ratchet wheel. The ratchet wheel **34** of the selecting device **30** at the jack level **26** indicated in Fig. 5B is acted on by similar means with the parts having like reference characters, with an exponent "*a*." It will be noted however that in Fig. 5B the rollers **42**^{a} have a different position around the shaft **44** from the pins **42** in Fig. 5A, whereby at the time the selecting device at the jack level **26** is stationary and the levers **32** are acting on the jacks **23** at this level, the selecting device at the level **28** is being indexed by one of the rollers **42**. Likewise, when the selecting device **30** at the level **28** is stationary and acting to select the jacks at this level, a roller **42**^{a} is acting to index the selecting device **30** at the level **26**. The selecting devices **30** at levels **27** and **25**, respectively, for the feed **15**, are indexed in the same manner as at feed **14** and by similar means.

In the operation of a machine as described above to produce a float thread design, the selecting devices determine those jacks which are to be raised by the raising cams **33** and the needles controlled by the selected jacks are caused to rise and take and knit the yarn fed at the associated knitting station. The non-selected jacks and hence the non-selected needles remain at a lower level and consequently do not take the yarn at the knitting stations. This method of float thread knitting is well known and need not be further described.

Referring now particularly to Figs. 6 and 7, there is shown schematic lay-out or developed views of the needle and jack cylinders of the circular knitting machine of Figs. 3 and 4 in connection with the pair of knitting stations **14** and **15** at which yarns **35** and **36**, respectively, are fed to the selected needles of the circle of needles. The showings of Figs. 6 and 7 are identical except that in Fig. 7 the needle and associated jack circles are advanced 180 degrees in a counterclockwise direction (the direction of rotation of the needle cylinders as indicated by the arrows in these figures) with respect to Fig. 6. In accordance with the instant invention, and as distinguished from prior practise, two of the selecting devices **30** both operable on the jacks during their movement in the forward direction, that is the counterclockwise direction, are employed for each of the knitting stations **14** and **15**. One half of the needle circle and the jacks associated therewith is indicated at **38** while the other half of the needle circle and its associated jacks is indicated at **39**.

At the levels **28** and **25** (Fig. 6), the half circles **39** of the patterning jacks are provided with typical pattern butt lay-outs indicated at **37** to provide the desried control of the needles associated therewith. However, the other half circles **38** of the jacks are idle non-patterning jacks without butts and which are not raised by the raising cams at those levels and act only to transmit the movement of lower patterning jacks, if any. Similarly, the half circles **38** of the jacks at levels **26** and **27** are provided with pattern butt lay-outs **37** while the other half circles **39** of jacks at these levels are such idle non-patterning jacks without butts.

During the formation of the stocking **10** the overall pattern **11** is knitted at knitting stations **14** and **15**. With the needles and jacks in the positions relative to the knitting stations shown in Fig. 6, the active half circle **38** of patterning jacks at level **26** will be operative at knitting station **14** under the control of the selector device **30** at level **26** to form the pattern. Similarly, the active half circle **39** of patterning jacks at level **25** will be operative at knitting station **15** under the control of the selector device **30** at level **25** to form the pattern. At

this time the selector devices 30 at levels 27 (for knitting station 15) and 28 (for knitting station 14) are opposite the idle jacks at these levels. The operative mechanism for indexing the selector devices heretofore described is set up by suitably positioning the rollers 42 and 42*a* around the shaft 44 so that as the idle jacks pass the selecting devices 30 at these levels such selecting devices are indexed to move new selectors or tricks 31 into position to enable them to make new jack selections when the butted jacks again pass the selecting devices. Inasmuch as this indexing of the selecting devices takes place during the passage of the idle jacks, no interference or pattern break occurs, jack selection continuing uninterruptedly on the active half circle of patterning jacks at levels 25 and 26 where no indexing of the selecting devices takes place at this time.

As the needle and jack cylinders continue to rotate to the position of Fig. 7, the half circle 39 of butted patterning jacks at level 28 under the control of the previously indexed selector device 30 at this level will be operative to select needles to knit at station 14 to form the pattern. Similarly, the half circle 38 of butted jacks at level 27 will be operative to select needles to knit at knitting station 15 under the control of the previously indexed selector device 30 at that level to form the pattern. At this time the selector devices 30 at levels 26 (for knitting station 14) and 25 (for knitting station 15) are opposite the idle jacks at these respective levels and these selecting devices 30 are accordingly indexed while the idle jacks pass them with no selection being made upon the idle jacks.

Continued rotation of the machine will bring the parts again to the position of Fig. 6 and then again to the position of Fig. 7 and so on. Summarizing the above description, it will be noted that the circle of jacks for each knitting station is divided into two parts at two levels with a selector device at each of the levels. For station 14 the active jack half circles 38 and 39 are at levels 26 and 28, respectively, while the idle jack half circles 38 and 39 are at levels 25 and 27, respectively. For station 15 the active jack half circles 38 and 39 are at levels 27 and 25, respectively, while the idle jacks half circles 38 and 39 are at levels 28 and 26, respectively. It will be understood that the method of the present invention may be practised with other lay-outs of the jacks and needle selectors. For example, the selecting devices 30 for each station may be placed at adjacent jack levels. Also, the division of the active jacks at each level need not be equal. The important feature is that the pattern is set up on at least a pair of circumferential and vertically spaced groups of jacks with a selecting device for each of the jack groups, the selector device for each patterning jack group being indexed when that jack group is not active at the knitting station. It should be noted that the patterns on the two selecting devices 30 at each knitting station will be complementary.

It follows that since the indexing of the selecting devices for each group of active patterning is made before such patterning jacks reach the selecting devices, there can be no double selection among the patterning jacks, and consequently no break in the overall pattern being knitted into the fabric.

Having thus described my invention in rather full detail, it will be understood that these details need not be strictly adhered to but that various changes and modifications may be made all falling within the scope of the invention as defined by the following claims.

I claim:

1. The method of providing a seriatim selection of a circular series of pattern forming elements at a knitting station of a circular knitting machine by selecting means rotatable relative to said series of elements, comprising the step of dividing said elements into at least a pair of circumferentially and vertically spaced groups and the step

of providing independent selections of the elements of each of said groups.

2. The method of providing a seriatim selection of a circular rotatable series of pattern forming elements at a knitting station of a circular knitting machine by selecting means rotatable relative to said series of elements, comprising the step of dividing said elements into at least a pair of groups thereof spaced both circumferentially and vertically, and the step of providing independent selections of the elements of each of said groups during a single rotation of said series of pattern forming elements.

3. The method of providing a seriatim selection of a circular rotatable series of pattern forming elements at a knitting station of a circular knitting machine by selecting means rotatable relative to said series of elements, including the step of dividing said elements into at least a pair of circumferentially and vertically spaced groups and the step of providing a selection change for the elements of one of said groups while at least certain of the elements of the other of said groups are operative at said knitting station during a single rotation of said series of pattern forming elements.

4. The method of providing a seriatim selection of a circular rotatable series of pattern forming elements at a knitting station of a circular knitting machine by selecting means rotatable relative to said series of elements, including the step of dividing said elements into at least a pair of both circumferentially and vertically spaced groups, and the step of providing independent selections of the elements of each of said groups by said selecting means during a single rotation of said series of pattern forming elements, the selection for each of said groups being made prior to their period of activity at said knitting station.

5. The method of providing a seriatim selection of a circular rotatable series of jacks for selecting needles at a knitting station of a circular knitting machine by selecting means rotatable relative to said needle circle, including the step of dividing said jacks into at least a pair of groups thereof spaced both circumferentially and vertically, and the step of providing independent selections for each of the jack groups by said selecting means during a single rotation of said series of jacks.

6. The method of operating at least one knitting station of a circular knitting machine of the type having a circular rotatable series of independent needles, a plurality of vertically aligned jacks associated with each of said needles at a plurality of levels, said jacks being rotatable with said needles, and indexable selecting means operable upon said jacks at each of said levels, including the step of dividing said needles into at least a pair of groups, the step of associating active jacks with the needles of one of said groups and inactive jacks with the needles of the other of said groups at one of said levels, the step of associating active jacks with the needles of said other of said groups and inactive jacks with the needles of said one of said groups at a second of said levels, and the step of indexing the selecting means at said first and second levels during a single rotation of said jacks, the indexing of each of said selecting means taking place prior to the passage of active jacks thereby.

7. The method of operating at least a pair of knitting stations of a circular knitting machine of the type having a circular rotatable series of independent needles, a plurality of vertically aligned jacks associated with each of said needles at a plurality of levels, said jacks being rotatable with said needles, and indexable selecting means associated with said stations and operable upon said jacks at each of said levels, including the step of dividing said needles into a first and second group thereof, the step of associating active jacks with the needles of said first group and inactive jacks with the needles of said second group at a pair of said levels, the step of associating active jacks with the needles of said second group and inactive jacks with the needles of said first group at a second pair of

said levels, and the step of indexing the selecting means at said pairs of levels during a single rotation of said jacks, the indexing of each of said selecting means at each of said knitting stations taking place prior to the passage of active jacks thereby.

8. In a circular gnitting machine including a circle of needles, a knitting station, means for rotating said circle of needles relatively to said knitting station, and means for feeding yarn to said circle of needles at said knitting station, the improvement comprising a group of patterning elements associated with a portion of the circle of needles, a second group of patterning elements at a second level associated with another portion of the circle of needles, separate indexable means for controlling the operation of the patterning elements of each of said groups, each said controlling means being relatively movable between operative and inoperative positions with respect to the patterning elements controlled thereby, and means for indexing said controlling means when in said inoperative position.

9. In a circular knitting machine including a circle of needles, a knitting station, means for rotating said circle of needles relatively to said knitting station and means for feeding yarn to said needles at said station, the improvement comprising a group of patterning elements at one level and associated with a portion of the circle of needles, a second group of patterning element at a sec- level associated with another portion of the circle of needles, and separate indexable patterning element selecting means associated with each of said groups and relatively movable between operative and inoperative positions with respect thereto, and means for indexing said selecting means when in said inoperative positions.

10. In a circular knitting machine including a circle of needles, a knitting station, means for rotating said circle of needles relatively to said knitting station, and means for feeding yarn to said needles at said knitting station, the improvement comprising a group of patterning jacks at one level and associated with successive needles of a portion of the circlie of needles, indexable means for selecting operative ones of said patterning jacks and movable with respect to said group of patterning jacks between operative and inoperative positions, a second group of patterning jacks at a second level and associated with successive needles of another portion of the circle of needles, indexable means for selecting operative ones of said patterning jacks of said second group, and movable with respect to said second group between operative and inoperative positions, and means for indexing said selecting means when in their inoperative positions.

11. In a circular knitting machine including a circle of needles, a knitting station, means for rotating said circle of needles relatively to said knitting station and means for feeding yarn to said needles at said knitting station, the improvement comprising a group of patterning jacks at one level and associated with successive needles of a portion of the circle of needles, selecting means including an indexable pattern wheel for selecting the operative jacks of said group at said level, said group of jacks being movable into and out of operative relationship with respect to said selecting means, a second group of patterning jacks at another level and associated with successive needles of another portion of the circle of needles, selecting means including an indexable pattern wheel for selecting the operative jacks of said second group at said second level said second group of jacks being movable into and out of operative relationship with respect to said second mentioned selecting means, and means for indexing said pattern wheels when said selecting means are out of operative relationship to their respective groups of jacks.

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