April 4, 1939. H. H. HOLMES 2,153,019

RIB KNITTING MACHINE

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Fig.5.

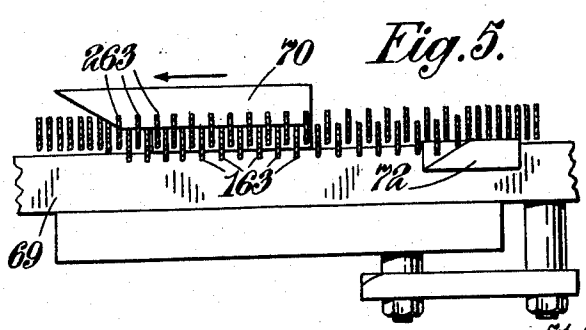


Fig.1.

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April 4, 1939. H. H. HOLMES 2,153,019

RIB KNITTING MACHINE

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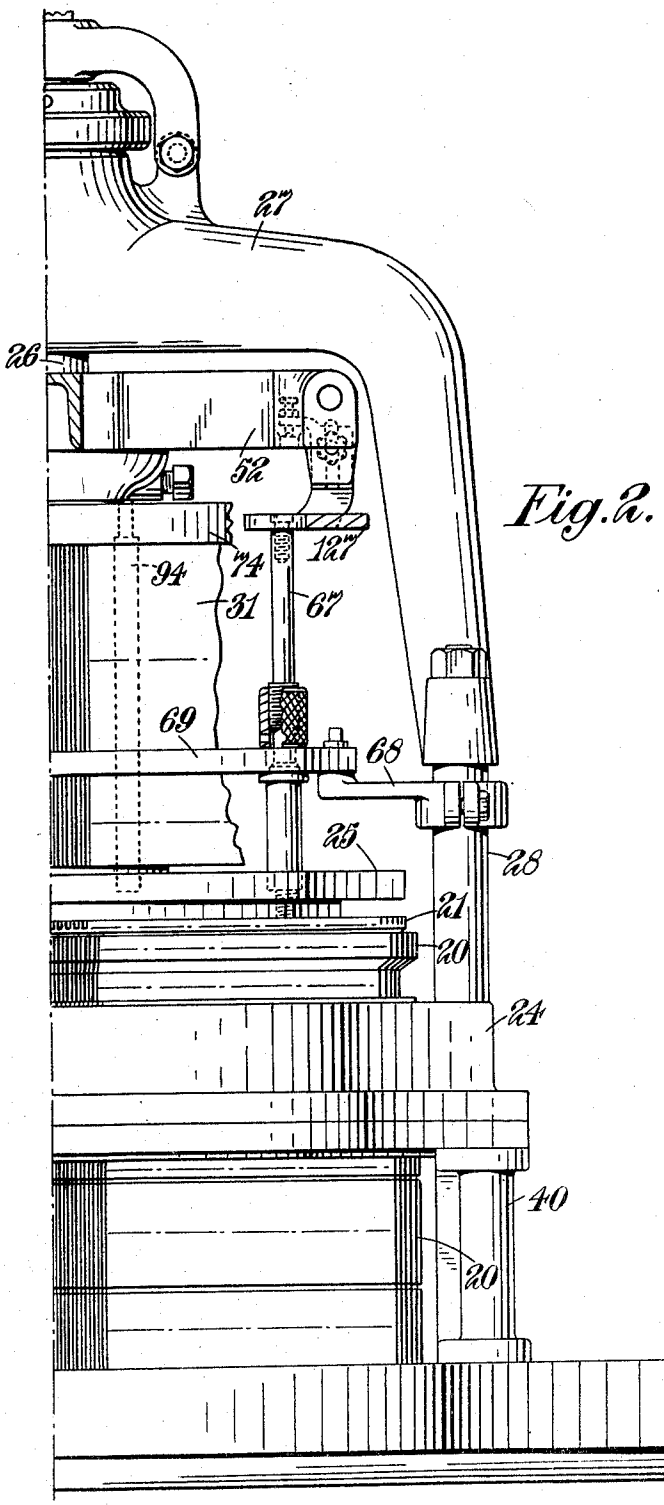


Fig. 2.

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RIB KNITTING MACHINE

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Fig. 3.

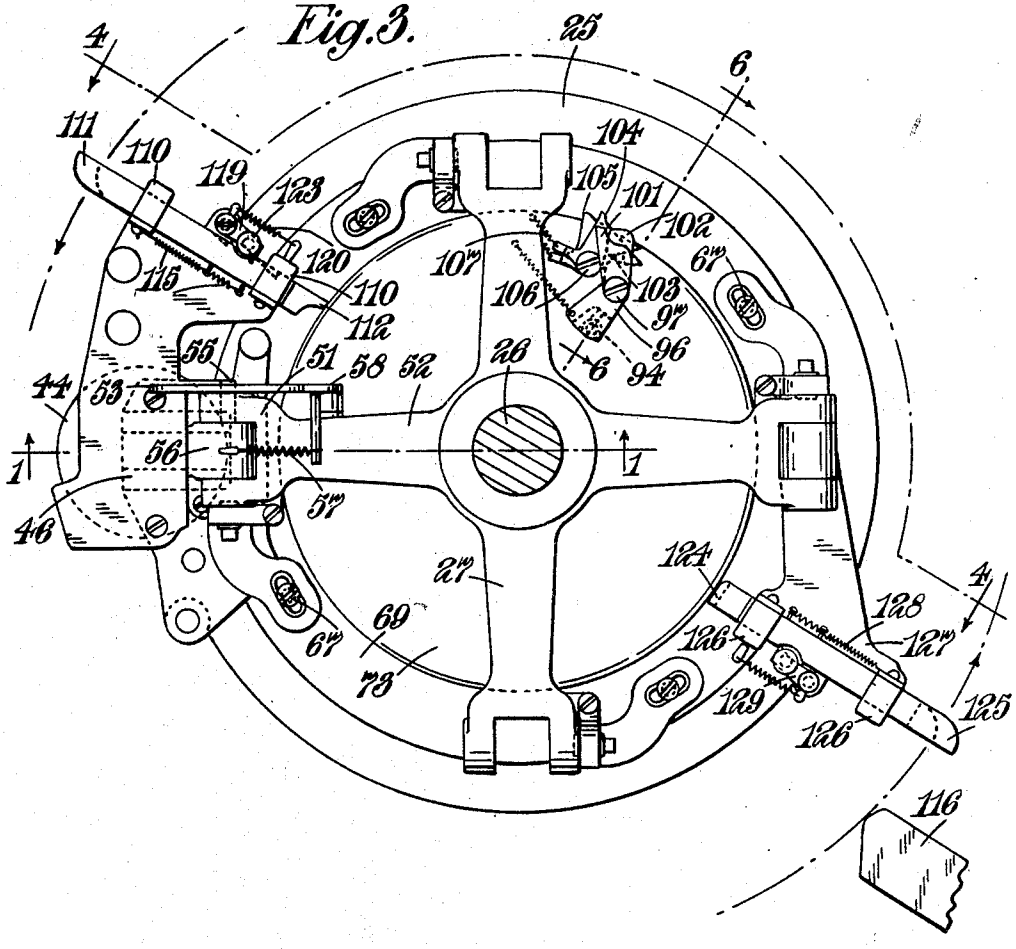
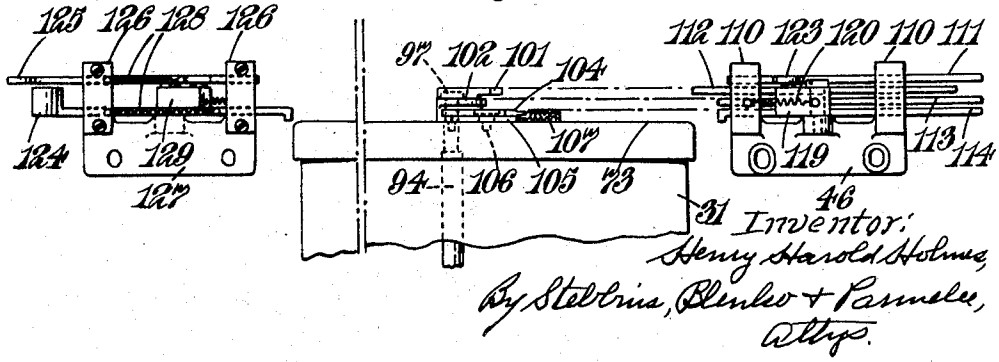


Fig. 4.

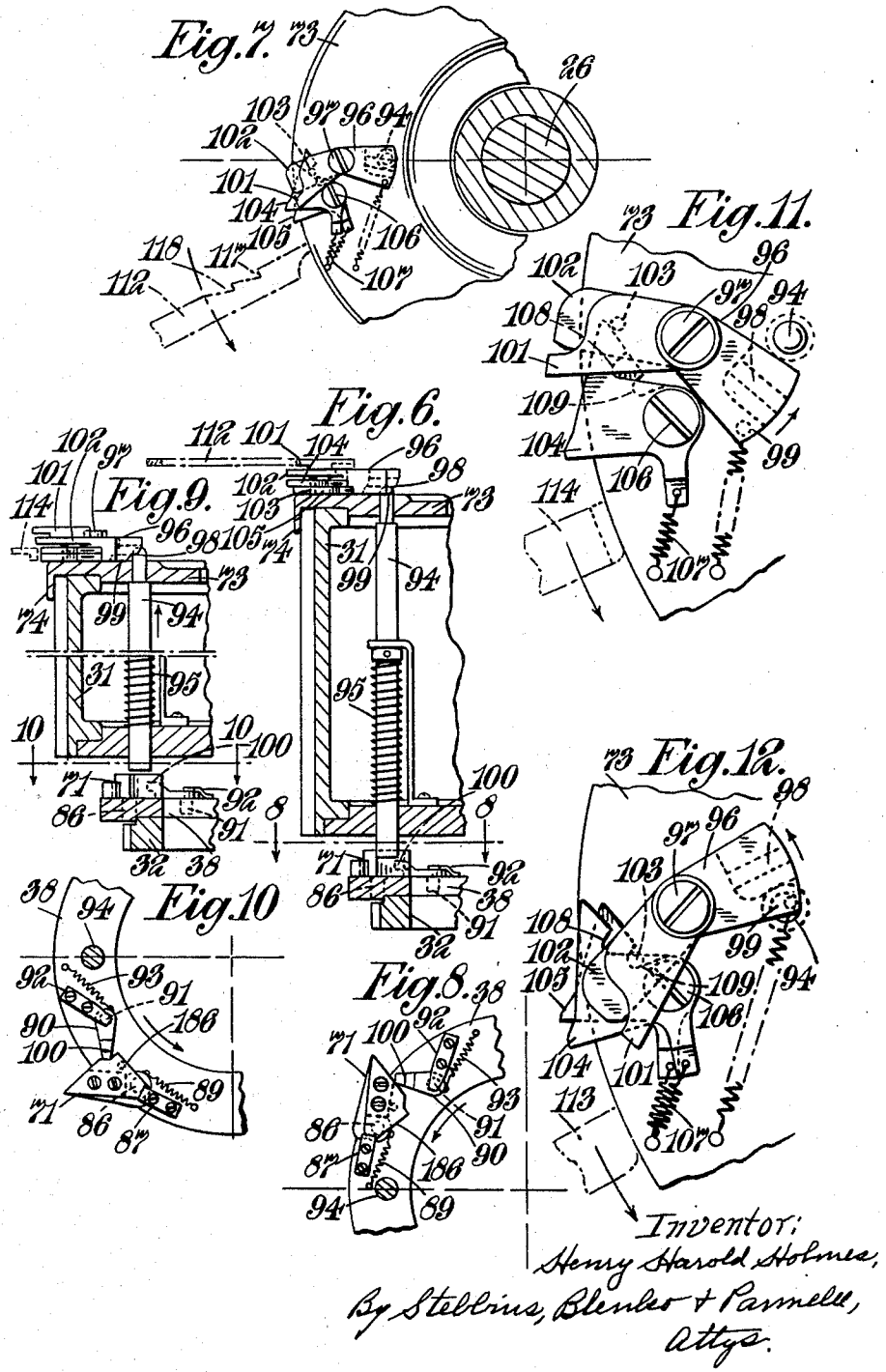


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RIB KNITTING MACHINE

Filed Feb. 2, 1937 8 Sheets-Sheet 4



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RIB KNITTING MACHINE

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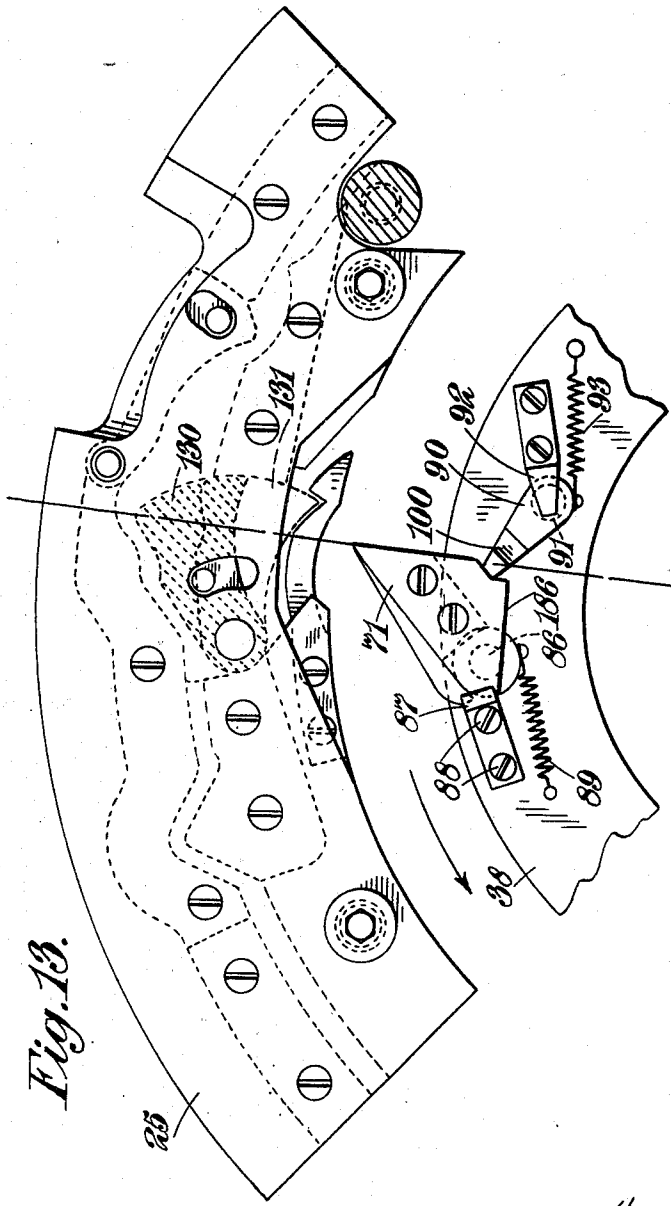


Fig. 13.

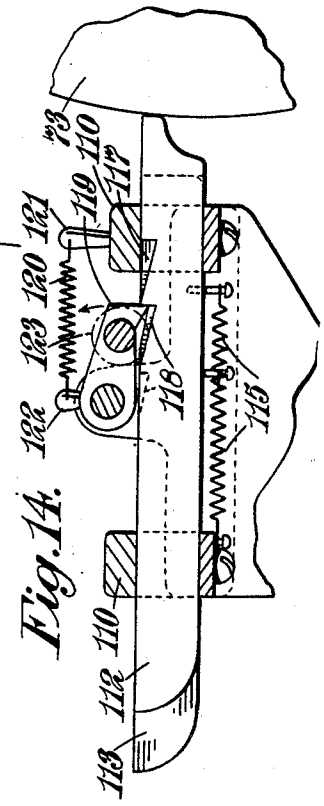


Fig. 14.

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April 4, 1939. H. H. HOLMES 2,153,019

RIB KNITTING MACHINE

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Fig. 15.

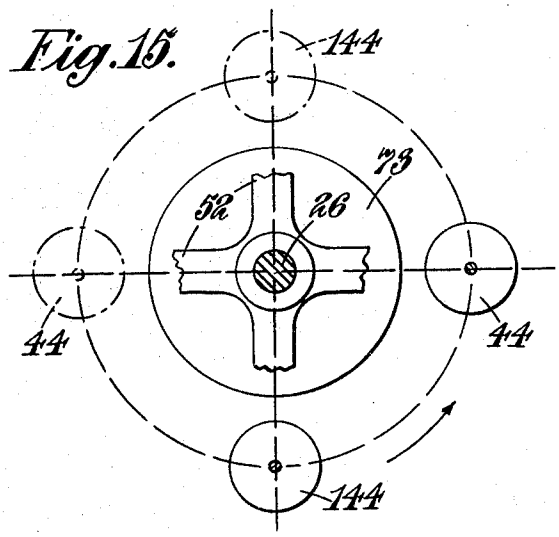
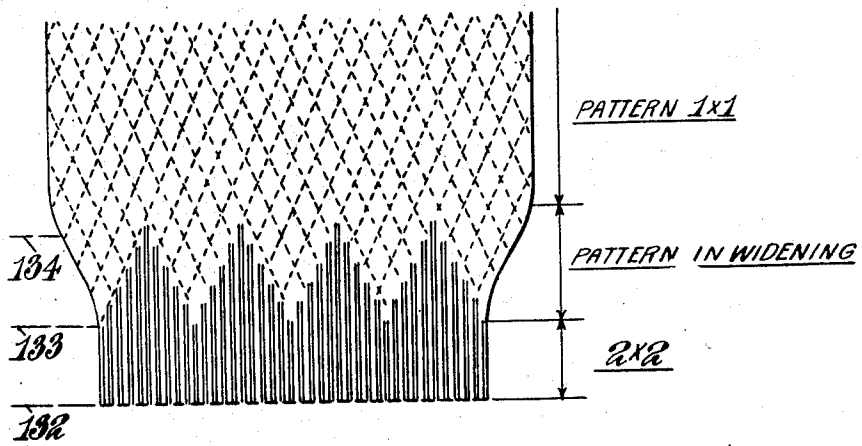


Fig. 16.



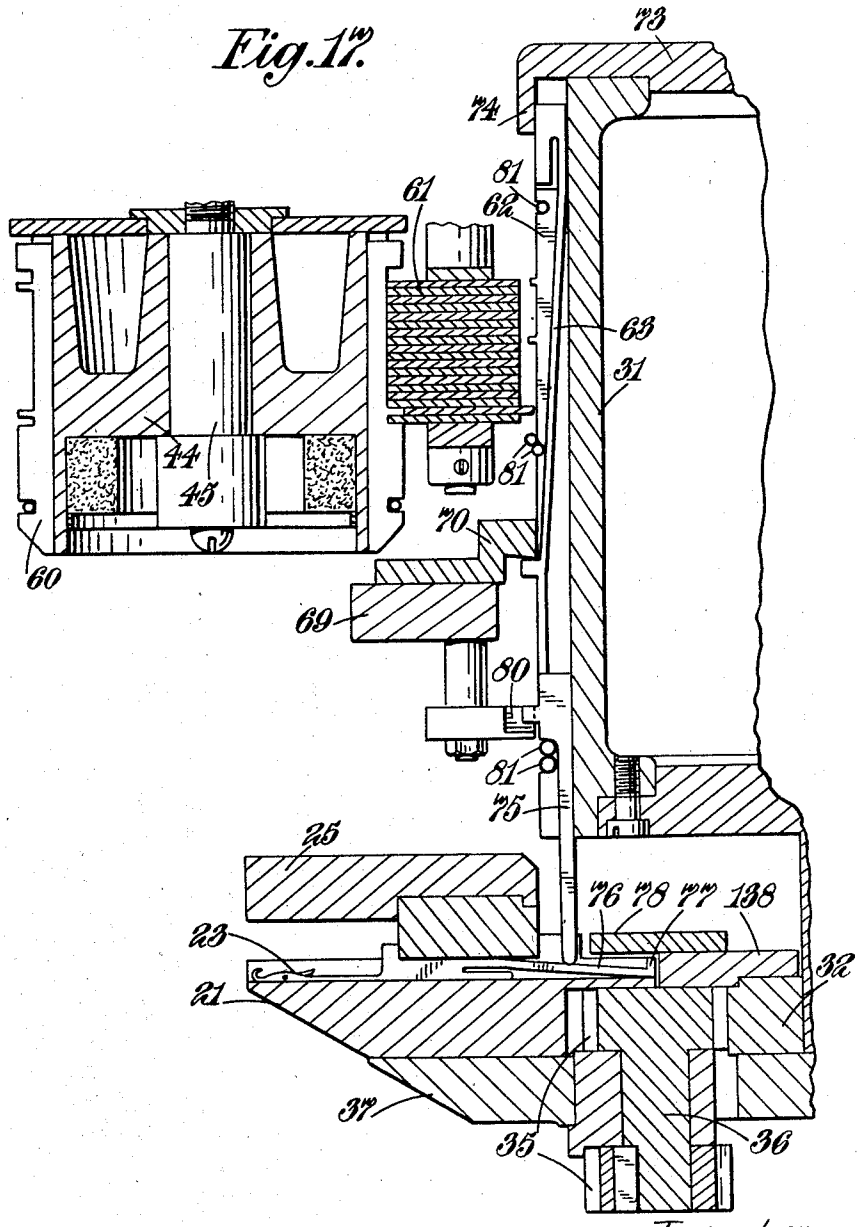
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RIB KNITTING MACHINE

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Fig. 17.



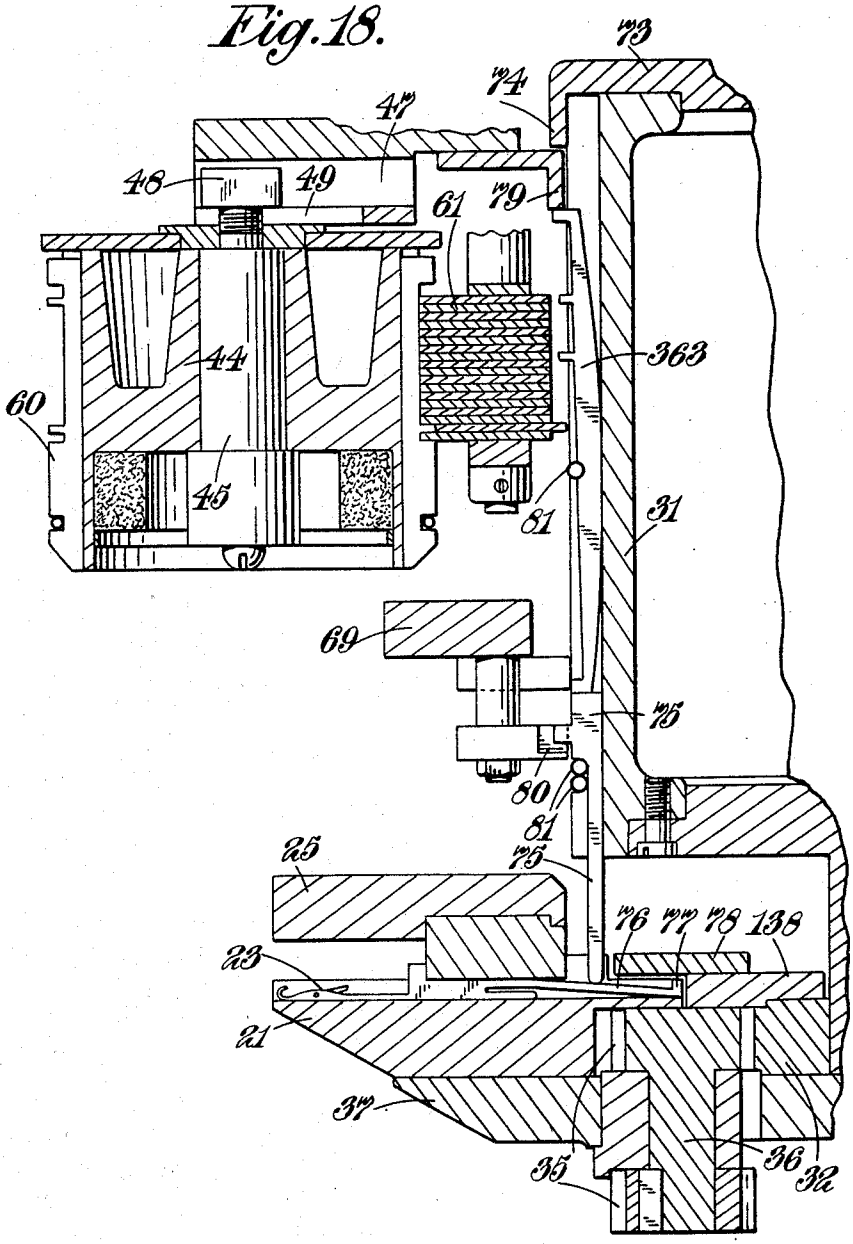
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RIB KNITTING MACHINE

Filed Feb. 2, 1937 8 Sheets-Sheet 8

Fig. 18.



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Patented Apr. 4, 1939 2,153,019

UNITED STATES PATENT OFFICE

2,153,019

RIB KNITTING MACHINE

Henry Harold Holmes, Leicester, England, assignor to Wildt and Company Limited, Leicester, England, a British company, manufacturers

Application February 2, 1937, Serial No. 123,669
In Great Britain February 6, 1936

18 Claims. (Cl. 66—24)

This invention consists in improvements in or relating to rib knitting machines and has for its object to provide an improved form of patterning and an improved patterning scope for such machines.

A known patterned rib fabric has been produced with the aid of a variable needle selector device associated with the needles of one bed and in the case of a dial and cylinder machine the selector device has been associated with the cylinder needles. Two kinds of patterning have sometimes been effected, for example a patterning commonly known as Jacquard patterning and a patterning produced with the aid of tuck stitches; but when the selector is associated with the needles of one bed only as in the case mentioned above the Jacquard patterning effect appears on one face of the fabric and the change in the loop effect produced by the tuck stitches shows mainly on the opposite face.

It is also known in a dial and cylinder machine to employ a Jacquard selector device for the cylinder needles and a trick wheel having a single patterning zone of the customary spiral design type employed with the dial needles to produce what is sometimes known as a "bird's eye" back. For this purpose at one feed alternate dial needles are caused to knit and miss the yarn respectively and at the next feed this operation is reversed so that those needles which have previously knit will now miss and vice versa.

No claim is made herein to any mechanism by which the spiral type of designer mechanism is employed with the dial needles in combination with other patterning means associated with the cylinder needles.

According to the present invention there is provided in combination with the needles of each bed needle selecting means which in the case of the dial needles at least has a number of individual patterning zones by which the pattern effect can be changed course by course or in any predetermined course sequence in accordance with the pattern layout and without making any change in the initial setting of the pattern device.

Any form of trick wheel having a single circle of selector bits, whether those bits are selectively adjustable or not, must result in the production of a spiral design in the pattern produced. The pattern device used in accordance with the present invention is distinguished therefrom by having a plurality of individual pattern zones which collectively will serve to produce a non-spiral pattern. For instance, a pattern drum may be employed having a plurality of pattern zones parallel with the axis of the drum so that the zones can be presented to the needles or needle controlling devices in sequence; or a Jacquard band may be employed having a plurality of lines of perforations.

Whatever form of patterning device is employed the pattern zones may be brought into action in any predetermined or preferred sequence and this sequence may if and when desired be reversed from time to time so that a comparatively long length of knitting can be patterned in accordance with the layout of the patterning device before the pattern is repeated.

The fabric resulting from the present invention and the mechanism for producing the fabric is, therefore, clearly distinguished from the "bird's eye" back fabric and its mechanism in that in the latter the pattern is essentially a spiral pattern and no variation of the pattern control could be obtained.

Needle selecting or patterning means coming within the scope of the present invention may be exemplified for instance by a trick wheel as described in prior United States Letters Patent No. 2,078,571, or British Patents No. 244,887, or No. 245,558, or 267,876, or by a Jacquard mechanism such as is described in prior British Patent No. 223,619; or the mechanism employing a long tape or band which is perforated or embossed to produce the requisite needle selection as described for example in prior British Patent specification No. 249,486. These prior patents are referred to as describing examples only of the various types of patterning mechanism that may be employed in accordance with the present invention, although others in which a relatively large variation in pattern scope is obtainable may be employed.

The pattern means associated with the cylinder needles in accordance with this invention is preferably that having a variety of individual patterning zones as described above, but this is not essential as other patterning means may be employed for the cylinder needles.

In a preferred example of the invention the dial needles are selected by the aid of jacks which are movable in a direction to slide the needles in their tricks and conveniently controlling means for the dial needle jacks comprises a jack cam movable to positions corresponding to tucking and clearing positions of the needles, a locking catch therefor and an endwise movable rod normally free of the cam and catch but movable selectively to engage either the cam or the catch

together with selective controlling means for moving the rod.

The present invention in one of its uses may utilize the pattern mechanism or a pattern mechanism associated with either one or both of the needle beds to introduce idle needles for the purpose of widening or fashioning the fabric. In this case it is preferable also to provide patterning means in such a form that patterning may be effected during fashioning in the fashioned areas, as will be described more fully in the description of a specific form of the invention which follows.

For a fuller understanding of the invention a preferred example will now be described with the aid of the accompanying drawings, in which—

Figure 1 is a sectional elevation of one half of a knitting machine in accordance with the present invention, taken on the line 1—1 of Figure 3,

Figure 2 is an elevation of the other half of the machine, parts only being shown in section,

Figure 3 is a plan view of the machine with certain parts omitted for the sake of clearness,

Figure 4 is a view looking in the direction of the arrows 4—4 shown in Figure 3 and is intended to show the relative positions of the sliders and cams for actuating the jack out-throw cam,

Figure 5 is a detail drawn to a larger scale of the presser and resetting jack cams shown in Figure 1, and looking from the inside of the jack cylinder as shown by the arrow 5 of Figure 1,

Figure 6 is a section on the line 6—6 of Figure 3, showing details of the cams and operating rod for setting the jack out-throw cam;

Figure 7 is a plan of the parts shown in Figure 6 and illustrates in detail the cams which actuate the operating rod;

Figure 8 is a plan of the jack out-throw cam, and is a section on the line 8—8 of Figure 6;

Figure 9 is a view similar to Figure 6 showing the operating rod in a non-operative position;

Figure 10 is a view similar to Figure 8 showing the jack out-throw cam in a locked position and is a section on the line 10—10 of Figure 9;

Figure 11 is a view drawn to a larger scale of the operating cams for the operating rod;

Figure 12 is a view similar to Figure 11 showing the operating cams in a different position;

Figure 13 is a plan, drawn to an enlarged scale, of a portion of the dial cam box and also shows the jack out-throw cam in operative position;

Figure 14 is a detail, drawn to an enlarged scale, of the slider mechanism shown in Figures 3 and 4 and is a sectional plan view intended to show the operation of the sliders;

Figure 15 is a diagrammatic view to illustrate a modified form of pattern control;

Figure 16 is a diagrammatic illustration of work produced on the machine, and

Figures 17 and 18 are respectively alternative arrangements of part of the mechanism shown in Figure 1 but drawn to a larger scale.

Like reference numerals indicate like parts in the several figures of the drawings.

Referring first of all to Figures 1 to 3, the needle cylinder 20 and the needle dial 21 having needles 22 and 23 respectively sliding in tricks therein are arranged relatively to one another in the usual manner, these parts in the example illustrated being stationary, while cam boxes associated with them are rotatable. The cylinder cam box is designated generally at 24 and the dial cam box at 25. Each cam box contains a system of knitting cams which may be of any usual form and are so well known in themselves that they need no illustration in detail. A vertical shaft 26, coaxial with the needle cylinder and dial, is suspended from above and is connected by bracket 27 and posts 28 to the cylinder cam box in a manner customary in rib knitting machines. Near its lower end the shaft 26 is journalled in a dial supporting hub or sleeve 29 to which the dial 21 is fixed.

Above the dial and supported by the lower sleeve 29 and surrounding the upper sleeve 30 also fixed to the shaft is a jack cylinder 31 which is coaxial with the dial and needle cylinder and has around its periphery a plurality of vertical tricks to accommodate jacks that are employed selectively to actuate the dial needles. The needle cylinder, the needle dial and the jack cylinder are all held circumferentially in fixed relationship, the dial and jack cylinders being located relatively to the needle cylinder by an arrangement of dogs familiar to those skilled in the art.

Surrounding the lower extension of the jack cylinder so as to be rotatable relatively thereto and to the needle dial is a ring gear 32 of a diameter equal to a second ring gear 33 that is carried by a sleeve 34 fixed to the shaft 26. The two ring gears are connected by pinions 35 of equal diameter carried at opposite ends of a short spindle 36 that is journalled in the dial supporting plate 37 extending from the sleeve 29. The ring gear 32 forms part of or is rigidly connected to a cam ring 38 which carries the jack out-throw cam or cams to be described in detail later. This cam ring and its gear 32 are driven at the same speed as the needle cam box which is itself rotated by means of a ring gear 39 driven from a main driving shaft (not shown), posts 40 connecting the ring gear 39 with the cylinder cam box 24. An anti-friction thrust bearing 41 is inserted between sleeves 29 and 34 and from the dial supporting plate 37 are arms 42 which are preferably of the vibrating type and are spaced angularly apart around the plate. Each carries a roller 43 bearing against an extended cam surface of sleeve 34 as shown in order also to steady the stationary parts relatively to the revolving parts by engagement with co-operating dogs 420 fixed internally to cylinder 20. These parts form the system of dogs previously mentioned.

For any one or more of the yarn feeds with which the machine may be supplied there is a trick wheel 44 for selectively actuating the dial needle jacks. Each trick wheel may be in the main similar to that described in prior British Patent No. 267,876 and is rotatably supported on a shaft 45 depending from a bracket 46 of the machine so that the axis of the trick wheel 44 is parallel with that of the jack cylinder.

The bracket 46 has a channel 47 in which is located a nut 48 screwing on to the upper end of spindle 45. The upper screwthreaded end of the spindle which is of reduced diameter can slide radially in a slot 49 formed in the lower wall of channel 47 so that the position of the trick wheel 44 can be accurately adjusted radially relatively to the jack cylinder 31.

The bracket 46 is pivotally mounted at 50 in ears 51 extending radially outward from a plate-like extension 52 of sleeve 30. The bracket 46 is normally retained in its position shown by means of a notched catch 53 pivoted at 54 in extension 52 and urged to engage its notch with a pin 55 on arm 56 projecting upwardly from bracket 46.

The catch 53 is held in engagement by means of spring 57 and is in the form of a bell-crank so that by moving the upper arm 58 against the tension of spring 57 the catch can be released and the bracket 46 swung outwardly about pivot 50 until pin 55 is engaged with a second notch 59 of catch 53. In this position a convenient access is given to the trick wheel for loading or changing the bits 60 which are received in known manner in vertical tricks in the trick wheel. This feature is also of value in obtaining access to the jack assembly located in the cylinder 31.

As is known, bits 60 will have outwardly projecting butts at various heights in accordance with pattern requirements and these butts act through the medium of intermediate cams 61 pivotally mounted in bracket 46 to engage correspondingly located butts on swinging pressers 62 situated one in front of each upper jack member 63. That is to say, in each trick of the wheel 31 there will be an upper jack member 63 of the sprung type with a presser 62 lying in front of it and below the upper jack member 63 is an intermediate jack member 64 and a lower swinging jack 65. The jack member 63 is a sprung jack, that is to say, by its own resilience the lower end of the jack normally rests in the position illustrated in Figure 1 and can be pressed inwardly from that position by a swinging cam 61 when the latter is swung towards the jack by engagement with a butt on one of the bits 60 that has been brought into register with the cam by a step-by-step rotation of trick wheel 44. Intermediate jack 64 is a sliding jack, whereas jack 65 is both sliding and swinging, that is to say, it can swing radially about a hooked engagement 66 with the lower end of the intermediate jack 64.

The selection by means of a trick wheel such as 44 and intermediate swinging cam 65 is so well known as, for instance, from the description of prior British Patent No. 267,876 that no further description will be necessary nor will it be requisite either to describe or illustrate the mechanism by which the trick wheel 44 is stepped round on its spindle 45 on each revolution of the machine or at any desired sequence in the revolutions of the machine.

Supported by posts 67 secured between parts 25 and 52 and also by brackets 68 carried by posts 28 is a cam ring 69 rotated at the same speed as the needle cylinder 20 on which is supported a jack depressing cam 70. When the lower extremities of jacks 63 remain outwardly as in Figure 1, outwardly projecting butts at their lower ends will be engaged by cam 70 and will be depressed thereby thus forcing down intermediate jack 64 and swinging jack 65 to bring the lower end of the latter behind its associated dial needle. This is the position of the parts illustrated in Figure 1 and after selection and actuation of the associated needles the jacks are returned by a jack resetting cam 72 (Figure 5) also carried by cam ring 69 to their upper positions where the swinging jack 65 will be clear of and above their corresponding dial needles. If the jacks are selected from the trick wheel 44 those selected jacks 63 will be pressed inwardly against their own resilience so that their lower butts are clear of the jack depressing cam 70 and in consequence the lower swinging jacks 65 will not be brought into a position to engage their dial needles. In Figure 5 the jacks for which no selection has been made and which have themselves been depressed are indicated by the reference numeral 163, whereas those which have been selected and non-depressed are indicated by 263. Those jacks which have been depressed will have their lower ends brought to a position behind their corresponding dial needles 23 so that a jack out-throw cam 71 carried by cam ring 38, acting through the swinging jacks 65, will move those dial needles outwardly. The selected or non-depressed jacks, however, will swing freely when engaged by the out-throw cam 71 but will not actuate their corresponding dial needles. It will be understood, therefore, that as the jack out-throw cam passes and engages with all the lower jacks in sequence only those dial needles will be moved outwardly whose corresponding jacks have been depressed.

In order to prevent the upper ends of upper jacks 63 from moving outwardly and so making the movement of their lower ends uncertain, a cap 73 is provided on the jack cylinder 31 and has an overhanging flange 74 to engage the upper ends of those jack members whatever may be their position of sliding adjustment. Plate 73 is made segmentally in order that any section thereof may be removed to give access to upper ends of tricks in cylinder 31 for removal or insertion of jacks.

In a modified construction illustrated in Figure 17 upper sprung jacks 63 and pressers 62 are provided as before but the lower jack members 64 and 65 are replaced by a lower portion 75 which is now in one piece. When this portion is moved downwardly by selection it engages a spring end 76 of an associated dial needle 23 (or a jack associated therewith) to move a butt 77 at the end of the sprung portion either into or out from the path of an actuating cam. In the example shown selection of a jack 75 serves to move the butt 77 out from the path of an out-throw cam 78 which now acts directly on the needles (or on jacks sliding in the needle tricks in company with the needles). This example may be inverted by making arrangement such that when the spring end 76 of a needle or needle jack is depressed its butt 77 is moved into the path of an out-throw cam which in this case will be at the level of the out-throw cam ring 138.

In a further alternative illustrated in Figure 18, instead of employing upper spring jacks 63 upper cradle or rocker jacks 363 are employed which rock about their inner edges at a position approximately midway in their lengths. When the upper ends remain outwardly as in Figure 18 by non-selection from trick wheel 44 upper butts on each of the jacks will be moved into the influence of a press-down cam 79 and this will serve to move the jacks 363 and their lower jacks 75 (similar to that of Figure 17) to function in the manner already described in connection with the previous modification. In both cases resetting jack cams 80 will be employed to reset the jacks in an upward direction after they have functioned.

The jacks and/or jack pressers are held in their tricks by spring bands 81 arranged wherever they are found to be most advantageous or necessary.

In Figures 17 and 18 except for the parts that have been specifically described above the other constructional features will be similar to that already referred to in connection with Figures 1 to 3.

For pattern control of the cylinder needles there will be a trick wheel 82 for each of one or more feeds and this wheel operates through intermediate selectors 83, pressers 84 and sprung needle jacks 85, in a manner exactly correspond-

ing to the action of the similar parts already described in connection with the pattern mechanism for the dial needle jacks. The trick wheels 82 are carried in brackets 286 in a manner similar to the support described for the trick wheels 44, the brackets 86 being mounted to rotate with ring gear 39. As again the action of each trick wheel 82 on the needle cylinder corresponds in all its essentials to that described in prior British Patent No. 267,876, no further details are necessary herein as reference may be made to the prior patent if necessary for more precise details of operation.

The jack out-throw cam 71 of the construction according to Figures 1 to 3 and the out-throw cam 78 of Figures 17 and 18 may all be of similar form and their construction and actuation will now be described in greater detail with references to Figures 4 to 16.

Cam 71, to be seen most clearly in Figure 13, is pivotal about a pin 86 carried by cam ring 38. The pin extending from the bottom of cam 71 may be slipped into a recess in cam ring 38 and a retaining plate 87 secured by screws 88 to the cam ring 38 overlies one end of cam 71 to prevent it from lifting. Normally, a spring 89 serves to draw the cam radially inwards and a catch 90 pivotally mounted in cam ring 38 by means of a pin 91 and top plate 92 (similar to pin 86 and top plate 87) serves to hold the cam in its adjusted position in a manner to be described below. A spring 93 tends normally to pull the catch radially inwards.

The position of cam 71 is adjusted by means of an endwise movable rod 94 the axis of which is parallel to that of the needle cylinder and is transverse to the surface of the dial and the profile of cam 71 which latter is in a plane parallel to the dial needle bed or substantially parallel thereto.

The rod 94 is controlled to be depressed, against the action of a lifting spring 95 coiled around it, to two different positions by means of a swinging cam plate 96 pivotally mounted on a pin 97 carried by cover 73 for the jack cylinder. The cam plate 96 is stepped as shown in Figures 6, 7, 9, 11 and 12 two steps being denoted by numerals 98 and 99 respectively. Each of the steps is preceded by a sloping portion so that as the cam plate 96 is swung over the upper end of rod 94 the latter will be moved down easily on to one or the other of the two steps. When rod 94 is depressed to the level of the first step 98 the lower end of the rod has been brought into a position (Figure 6) to engage edge 186 of cam 71 and to swing the cam outwardly to the position shown in Figures 10 and 13 where the cam is engaged by catch 90 to hold it in that position. When rod 94 is depressed to the full extent by the second step 99 it will engage an upstanding portion 100 of catch 90 and will swing the latter against the tension of spring 93 to release the cam 71. Spring 89 will then draw the cam inwardly to the position of Figure 8 and in this position the cam will swing jacks 65 to move the needles, whose jacks have been lowered, to a tucking position. When cam 71 is moved outwardly to its greatest extent as in Figures 10 and 13 the needles will be moved to a clearing position.

It will be understood that cam 71 and catch 90 are mounted on plate 38 and are thereby continuously rotated past rod 94. Consequently these parts can be set or reset when occasion demands as they move into engagement with and then clear of rod 94.

Cam plate 96 is in the form of a bellcrank the other arm of which has two abutments 101 and 102 at different heights. A depending catch pin 103 is in a position to be engaged by either one or the other of two swinging catches 104 and 105 both pivotally mounted about a pin 106 also carried in cap 73. Tail ends of the catches are pulled upon by springs 107 which serve to turn the catches about their pivot so as to tend always to force the other ends of the catches towards pin 103. Thus, if external striker plates, between which and the cover 73 there is relative rotation about the axis of the machine, are brought into engagement with abutments 101 or 102, the cam plate will be swung from the position of Figure 11 into either of its two positions of adjustment relatively to rod 94. A striker plate engaging abutment 101 will swing the cam plate sufficiently far to bring pin 103 into a notch 108 of catch 104 thus depressing rod 94 to its first position to engage cam 71. The rod will be held in position by engagement of the pin in notch 108. On the other hand, if a striker plate engages abutment 102 it will swing cam plate 96 to its fullest extent so as to bring rod 94 into a position to engage and release catch 90 and in that event pin 103 will be held in notch 109 in catch 105.

The striker plate assembly required for the operation of the parts just described will now be explained.

Mounted on plate 46 are spaced guides 110 in which four sliders 111, 112, 113 and 114 are received. The sliders 112, 113 and 114 comprise some of the striker plates above mentioned and slider 111 is a common release for the striker plates. Each of the sliders is spring urged by a spring 115 which tends normally to draw it outwardly away from the axis of the machine and each striker plate can be selectively moved inwardly against its spring control by means of an external lifter plate 116 (Figure 3) which may be moved into register with any one of the sliders at will under any preferred form of pattern control. Such a pattern control, which may be in the form of a pattern chain or the like, is well understood and does not require any description or illustration herein.

Each of the sliders 112, 113 and 114 has formed in it two notches 117 and 118 to be engaged alternatively with a spring catch 119, the control spring 120 for which is anchored between a peg 121 on the inner bracket 110 and a peg 122 fixed to the catch 119. Thus, the catch is normally urged towards the notches and is deep enough to engage one or the other of the notches in all those sliders simultaneously. Thus, assuming, as is shown in Figure 4, that slider 112 has been moved inwardly by engagement with lifter plate 116 (between which and the sliders there is relative rotation about the axis of the machine) it will be held in that position by the catch while the other sliders are similarly held in their outermost positions. The catch has mounted on it a roller 123 to be engaged by a cam surface (in the form of a single notch) on the top slider 111 so that when that slider is moved inwardly it will release the catch by pressing on the roller 123 to move the catch outwardly free from the notches in all the sliders so that they may be all released. In a similar way when any one slider is moved into position the slope between the first and second notches will move the catch

to release any other slider that has previously been moved inwardly.

The sliders or striker plates 112 and 113 co-operate with abutments 101 and 102 respectively and slider 114 is wide enough at its inner end to co-operate with both catches 104 and 105. Thus, if slider 112 is moved inwardly to the position shown in Figure 4 it will engage abutment 101 so as to move cam plate 96 to bring the first step over rod 94. Alternatively, if slider 113 had been moved to a position corresponding to that of 112 in Figure 4 it would have engaged abutment 102 to turn cam plate 96 to bring its second step over rod 94. This action will at the same time release slider 112 and the latter will then return outwardly under control of its spring 115. When slider 114 is moved inwardly it engages with both catches 104 and 105 (releasing slider 112 or 113) so that whichever one of abutments 101 and 102 has been actuated pin 103 will be released and the composite arm comprising cam plate 96 will return to its inoperative position. Rod 94 will rise upwardly under the action of spring 95 clear of both cam 71 and catch 90. To release slider 114 it is necessary to actuate slider 111 for the purpose already described or, in fact, at any time that it is required to release any or all of the sliders.

There is another striker plate 124 in the form of a slider mounted diametrically opposite those already described and with it is associated release slider 125. These are carried in a similar manner in guides 126 in a bracket 127 secured to one of the cross arms 27, as clearly shown in Figure 3. The two sliders 124 and 125 are normally drawn outwardly by springs 128 in a manner similar to those described in connection with the sliders opposite to them. The lifter plate 116 when brought into engagement with the outer end of the slider 124 moves it inwardly and in this position engages the catches 104 and 105 and can be held locked in this position by a catch 129 similar in its action to catch 119. The slider 124 can be used for changing the setting of the cam plate 96 previously effected by either the sliders 112 or 113 so that a change in the position of cam 71 can be altered at each half revolution. In the case of a four feeder machine this means that the position of cam 71 can be changed at every second feed and so on. The slider 125 operates in a manner similar to the slider 111 to release catch 129 from engagement with slider 124.

Referring now to Figure 13 there is shown in addition to the jack out-throw cam a section of the dial needle cam system comprising a divided clearing cam in two parts 130 and 131 arranged one above the other and of similar profile. Although both cams are below the upper plate of the cam box and are indicated in dotted lines, the upper one of the two cams is shaded in order clearly to define its outline.

Normally, the dial and cylinder will both be furnished with long and short butt needles and will be set out in accordance with the form of ribbing selected. For instance, supposing a 2 x 2 rib is to be knitted the cylinder and dial needles will each be set out with two short butt needles alternating with two long butt needles, in a well understood manner to produce a 2 x 2 rib fabric from which a change is to be made to a 1 x 1. In the cylinder cam system there will also be split clearing cams corresponding to cams 130 and 131 in the dial.

While 2 x 2 rib knitting is in progress cam 130 which actuates the long butt dial needles and the corresponding cam in the cylinder for the long butt cylinder needles will be in operation, while cam 131 for the dial needles and the corresponding cam for the cylinder needles are inoperative. After a required length of this knitting has been produced, say a length represented by the portion between lines 132 and 133 of Figure 16, a gradual widening can be introduced either by gradually introducing the short butt dial needles or by gradually introducing the short butt cylinder needles, or by gradually introducing short butt needles in both cylinder and dial, either together or alternately in the cylinder and then in the dial. The short butt needles which have up till then remained idle and which are to be introduced are selected by the pattern drum 44 or 82 and at the same time cam 71 and an equivalent cam in the cylinder is moved to its clearing position so that those short butt needles which have been selected by the pattern drum will be utilised course by course in accordance with that selection. This widening is shown in that portion of the fabric lying between lines 133 and 134 in Figure 16 and it will be seen that not only is the fabric widened but the nature of the ribbing is altered in a zigzagged line, it being assumed that the idle needles are symmetrically introduced. When a position corresponding to line 134 is reached the fabric will then be a plain 1 x 1 rib and the re-entrant angular portions in the widening are also of a 1 x 1 rib character. These portions are represented by crossed dotted lines in Figure 16.

When the complete 1 x 1 rib stage of knitting (i. e. at the position of line 134) has been reached the cam 131 for the dial needles and the corresponding cam for the cylinder needles will be moved to the clearing positions and cam 71 can be retracted whereupon a plain 1 x 1 rib can be produced.

If, on the other hand, it is desired to pattern any portion of the 1 x 1 rib fabric, where those patterned portions are to be produced both cams 130 and 131 will be retracted if the patterning is to be produced only by the dial needles. At the same time cam 71 will be moved out of its clearing position and needle selection will take place by means of pattern drum 44. A similar effect can be produced in the cylinder either alternatively or simultaneously by retracting the split clearing cams corresponding to cams 130 and 131 and by utilizing the pattern drum 82 and an auto-tuck-clearing cam in co-operation with the pattern drum.

By this means full and miss stitches can be produced on the assumption that the auto-tuck-clearing cam for the cylinder needles is operative to its full extent. A full stitch is one in which a needle is actuated to draw a new loop from the feed of yarn through an existing loop held on the needle up to that time and after drawing the new loop the old loop is cast off. A miss stitch occurs when the needle fails to take a new loop as the yarn feed is passing the needle and consequently when that needle makes the next full stitch in the next or a succeeding course after the miss stitch has occurred, the length of yarn which the needle failed to take in the miss stitch course will float across that needle wale at the back of the fabric. In making a miss stitch the needle is so actuated that the old loop is not cast off until the next full stitch is made by that needle.

In an alternative patterning arrangement the cylinder needles can all remain in operation by

utilizing the normal split clearing cam to actuate both long and short butt needles. For the dial needles, however, cam 71 can be moved inwardly to its full extent, that is to a tuck position, whereupon selected dial needles will form tuck stitches, and the remainder will entirely miss the yarn.

The above are given as examples only of the use of the apparatus described and it will be appreciated that a very wide change or selection of patterning can be produced by alternative positioning of the various movable cams in both cylinder and dial cam systems in conjunction with the layout of the pattern drums.

It has been assumed in the foregoing that both for the cylinder and for the dial a single pattern drum is employed, in which case a portion of each bit comprising an annular zone around the drum will be utilized for widening and another portion for patterning.

Alternatively, however, the arrangement diagrammatically illustrated in Figure 15 can be employed in which two pattern drums 44 and 144 are utilized, the former for widening and the latter for patterning after widening has been completed. Similarly, two pattern drums may be employed for the cylinder.

The invention is not limited to any particular number of feeds. It is to be understood also that the invention can be applied to a rotating cylinder and dial machine in which case the necessary modifications will be made to enable those parts which have been described above as revolving to remain stationary and vice versa.

In Figure 15 two additional drums shown in chain-lines corresponding to 44 ad 144 in full-lines are also shown so that there is one drum for each feed. Alternatively, means may be provided to retain the jacks or needles in the positions at which they are selected at one feed during the time that they pass a successive feed or feeds. This means would, for example, come into operation preferably after the second drum 144 has performed its operative function assuming that the number of drums employed is less than the number of feeds.

I claim:

1. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, cam systems for the cylinder and dial needles for producing rib knitting, and in addition needle selecting means for both cylinder and dial needles, said selecting means having a plurality of individual patterning zones of the type for producing non-spiral patterns and having, at least for the dial needles, selecting means comprising a jack cam, jacks interposed between the jack cam and the dial needles, the said jack cam being adjustable at least to positions corresponding to those for producing tucking or clearing by the needles, a locking catch for said cam, and an endwise movable rod normally free of the cam and catch but movable selectively to engage either the cam or the catch, and selective controlling means for actuating said rod.

2. A rib knitting machine according to claim 1 in which the jack cam has a profile situated in a plane substantially parallel to the plane of the dial needles, and the endwise movable rod has its axis transverse to the surface of the needle dial.

3. A rib knitting machine according to claim 1 in the form in which the selctor controlling means for the rod comprises a cam plate movable to adjustable extents operatively to engage said rod for the purpose of moving it endwise to varying degrees to cause it selectively to engage the jack cam and co-operating means on the jack cam and the rod whereby different degrees of movement are imparted to the jack cam by different degrees of movement of the rod.

4. A circular rib knitting machine according to claim 1 having an adjustable cam plate for controlling movement of said rod, the said cam plate comprising an arm of a pivoted lever, the other arm of which has abutments of different extents, in combination with selectable striker plates, pattern control means for said striker plates to cause them selectively to engage said abutment, there being relative movement about the axis of the machine between the striker plates and the abutments.

5. A circular rib knitting machine according to claim 1 having an adjustable cam plate for controlling movement of said rod, the said cam plate comprising an arm of a pivoted lever, the other arm of which has abutments of different extents, in combination with selectable striker plates, pattern control means for said striker plates to cause them selectively to engage said abutment, there being relative movement about the axis of the machine between the striker plates and the abutments, and catches for the cam arm individual to the positions of adjustment thereof and an additional striker plate to engage and release said catches.

6. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting means for both cylinder and dial needles in which the selecting means for at least the dial needles comprises a pattern drum, a co-operating tricked jack cylinder having in some or all of its tricks a jack assembly comprising three elements, namely, an upper jack, an intermediate jack and a lower jack whereof the upper jack is a sprung jack and is selectively actuated from the pattern drum, all three jacks being slidable lengthwise in the tricks selectively to bring the lower jacks into and out from engagement with the dial needles, and the lower jack element being additionally pivotally mounted with respect to the intermediate jack.

7. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting means for both cylinder and dial needles in which the selecting means for at least the dial needles, comprises a pattern drum, a tricked jack cylinder having in some or all of its tricks a jack assembly comprising three elements, namely, an upper jack, an intermediate jack and a lower jack whereof the upper jack is a sprung jack by which direct selection is made from the pattern drum and all three jacks are slidable lengthwise in the tricks into and out from positions of engagement between the lower jacks and the dial needles, butts on the upper jacks and a depresser cam to engage butts on non-selected upper jacks whereby the jack assemblies of said non-selected jacks will be depressed to a position to engage corresponding dial needles.

8. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for

producing rib knitting, and needle selecting means for both cylinder and dial needles in which the selecting means for at least the dial needles comprises a pattern drum, a co-operating tricked jack cylinder having in some or all of its tricks a jack assembly comprising three elements, namely, an upper jack, an intermediate jack and a lower jack whereof the upper jack is a sprung jack and is selectively actuated from the pattern drum, all three jacks being slidable lengthwise in the tricks selectively to bring the lower jacks into and out from co-operation with the dial needles, and the lower jack element is additionally pivotally mounted with respect to the intermediate jack, and a jack out-throw cam co-operating with each of the lower swinging jacks with means selectively to adjust the cam in order to adjust movement of the jacks and their selected needles to varying extents.

9. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting means for both cylinder and dial needles in which the selecting means for at least the dial needles comprises a pattern drum, a co-operating tricked jack cylinder having in some or all of its tricks a jack assembly comprising three elements, namely, an upper jack, an intermediate jack and a lower jack whereof the upper jack is a sprung jack and is selectively actuated from the pattern drum, all three jacks being slidable lengthwise in the tricks selectively to bring the lower jacks into and out from co-operation with the dial needles, and the lower jack element is additionally pivotally mounted with respect to the intermediate jack, and a jack resetting cam by which all the jacks that have been depressed are restored to their normal level.

10. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting means for both cylinder and dial needles in which the selecting means for the needles of at least one bed comprises a pattern drum, a co-operating tricked jack cylinder having in some or all of its tricks a jack assembly comprising three elements, namely, an upper jack, an intermediate jack and a lower jack whereof the upper jack is a sprung jack and is selectively actuated from the pattern drum, all three jacks being slidable lengthwise in the tricks selectively to bring the lower jacks into and out from co-operation with the dial needles, and the lower jack element is additionally pivotally mounted with respect to the intermediate jack, and a jack out-throw cam co-operating with each of the lower swinging jacks with means selectively to adjust the cam in order to adjust movement of the jacks and their selected needles to varying extents, and a jack re-setting cam by which all the jacks that have been depressed are restored to their normal level.

11. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting means for both cylinder and dial needles in which the needle selecting means for at least the dial needles comprises a pattern drum, a tricked jack cylinder having in some or all of its tricks a jack assembly comprising an upper sprung jack and a lower endwise movable jack whereof the upper jack is subject to direct selection from the pattern drum and the lower jack co-operates with the dial needles, said dial needles having sprung shanks selectively actuated by endwise movement of the jack assemblies.

12. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting means for both cylinder and dial needles in which the needle selecting means for at least the dial needles comprises a pattern drum, a tricked jack cylinder co-operating with the drum and having in some or all of its tricks a jack assembly comprising an upper sprung jack and a lower endwise movable jack whereof the upper jack is subject to direct selection from the pattern drum and the lower jack co-operates with the dial needles, said needles having in addition sprung jacks associated with them in the dial, the said jacks being selectively engaged by the endwise movable jack assemblies.

13. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting means for both cylinder and dial needles in which the needle selecting means for the dial needles at least comprises a pattern drum, a tricked jack cylinder having in some or all of its tricks rocking jacks selectively actuated by the pattern drum, a depresser cam, butts on said rocking jacks selectively movable into and out from the path of the depresser cam, and lower jack members combined with said rocking jacks and endwise movable thereby selectively to co-operate with the dial needles.

14. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting means for both cylinder and dial needles in which for at least one needle bed needle selecting means comprises two pattern devices, the first of which considered in its action upon the needles at any given yarn feed operates to select and gradually reintroduce idle needles for the purpose of fashioning and is followed in its action by the second one which operates selectively for patterning the fabric at least during widening.

15. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting means for both cylinder and dial needles in which the selecting means for at least one needle bed comprises two pattern devices, the first of which considered in its action upon the needles at any given yarn feed operates to select and gradually reintroduce idle needles for the purpose of fashioning and is followed in its action by the second one which operates selectively for patterning the fabric after widening has been effected.

16. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, knitting cam systems for the cylinder and dial needles for producing rib knitting, and needle selecting

means for both cylinder and dial needles in which the selecting means for at least one needle bed comprises two pattern devices, the first of which considered in its action upon the needles at any given yarn feed operates to select and gradually reintroduce idle needles for the purpose of fashioning and is followed in its action by the second one which operates selectively for patterning the fabric during and after widening.

17. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, normal knitting cam systems for cylinder and dial needles, non-spiral selective patterning means associated with the cylinder needles, and non-spiral selective patterning means associated with the dial needles, the said patterning means at least for the dial needles comprising a drum selector, sprung needle jacks and intermediate selector cams serving to afford operative connections between the drum selector and the sprung needle jacks, and a jack cam additional to the out-throw cam of the normal dial needle cam system for actuating selected needles.

18. A rib knitting machine of the individual needle type comprising in combination cylinder and dial needle beds, needles therein, normal knitting cam systems for cylinder and dial needles, non-spiral selective patterning means associated with the cylinder needles, and non-spiral selective patterning means associated with the dial needles, the said patterning means at least for the dial needles comprising a drum selector, sprung needle jacks, intermediate selector cams serving to afford operative connections between the drum selector and the sprung jacks, an out-throw cam which is additional to the out-throw cam of the normal knitting cam system and also a jack cam operating to move the jacks lengthwise in accordance with the selection effected by the patterning means.

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