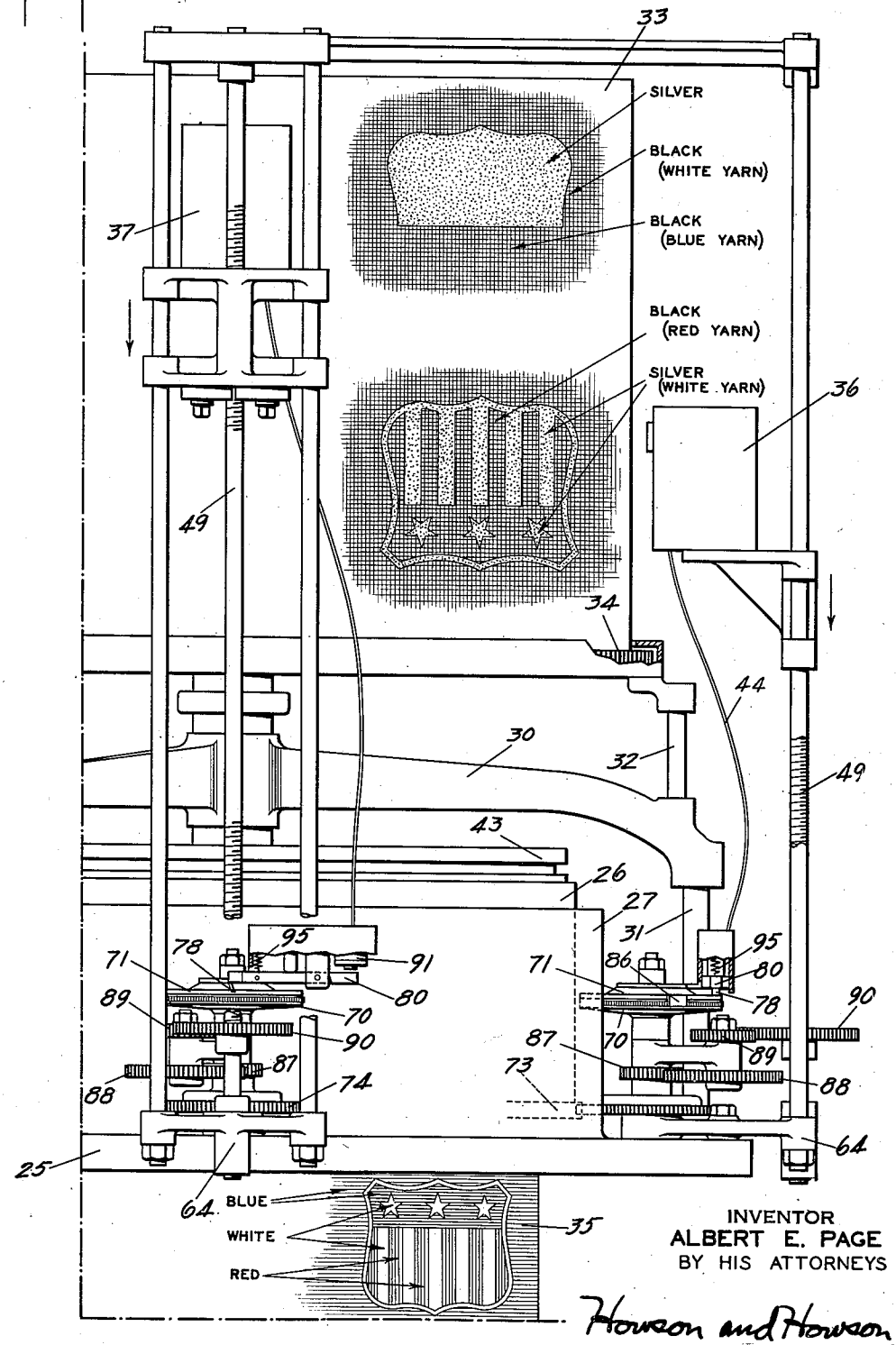
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CIRCULAR KNITTING MACHINE

Filed April 12, 1938 6 Sheets-Sheet 1

Fig. 1.



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CIRCULAR KNITTING MACHINE

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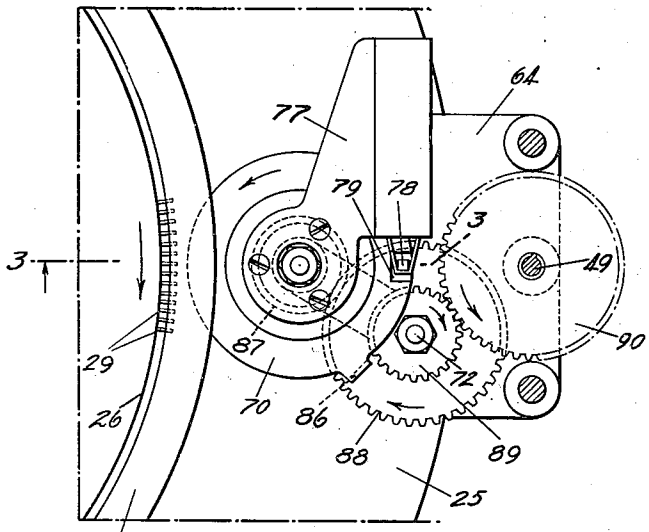


Fig. 2.

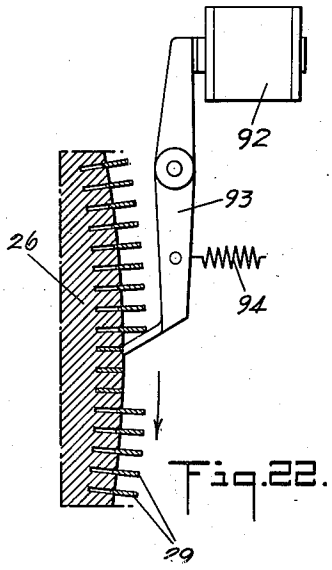


Fig. 22.

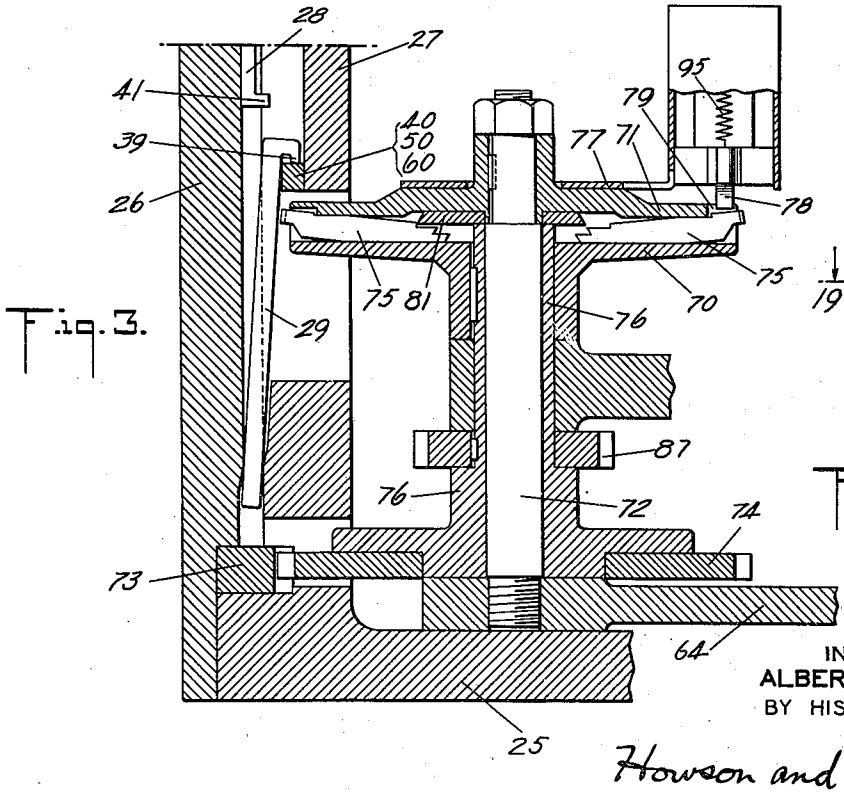


Fig. 3.

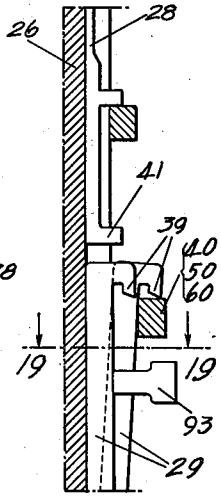


Fig. 23.

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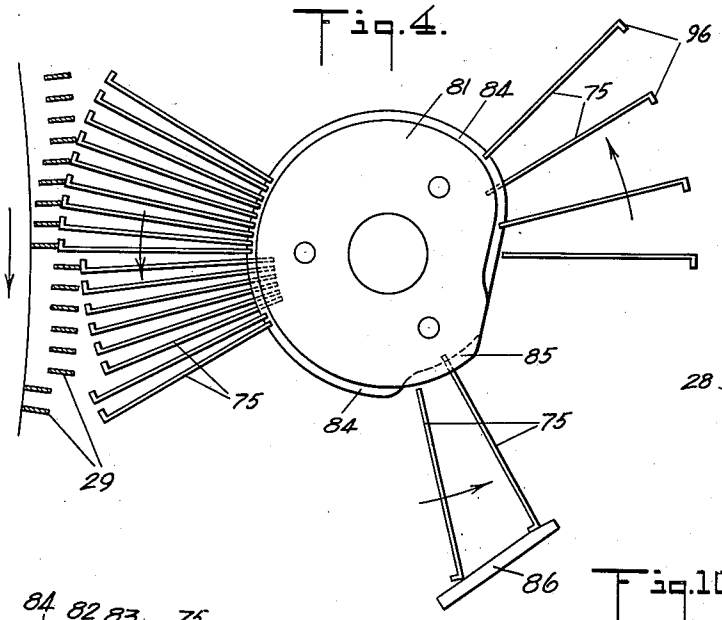
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CIRCULAR KNITTING MACHINE

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Fig. 4.



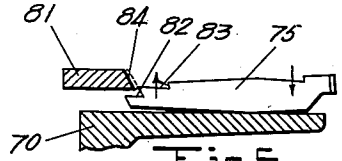


Fig. 5.

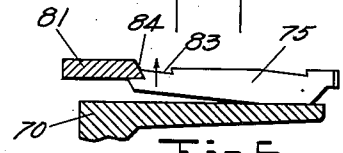


Fig. 6.

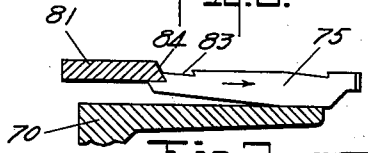


Fig. 7.

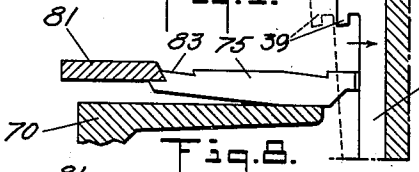


Fig. 8.

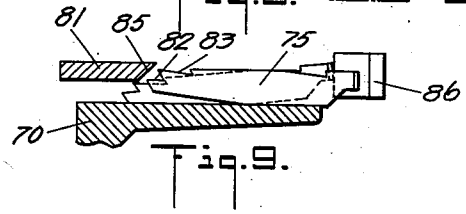


Fig. 9.

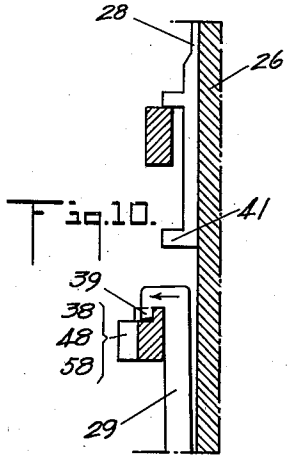


Fig. 10.

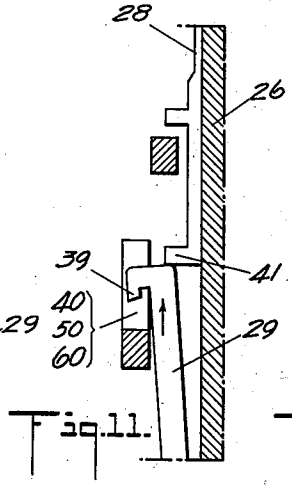


Fig. 11.

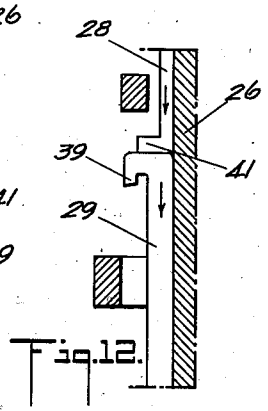


Fig. 12.

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CIRCULAR KNITTING MACHINE

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PATH OF NEEDLES AND JACKS TAKING WHITE YARN AT 1ST FEED

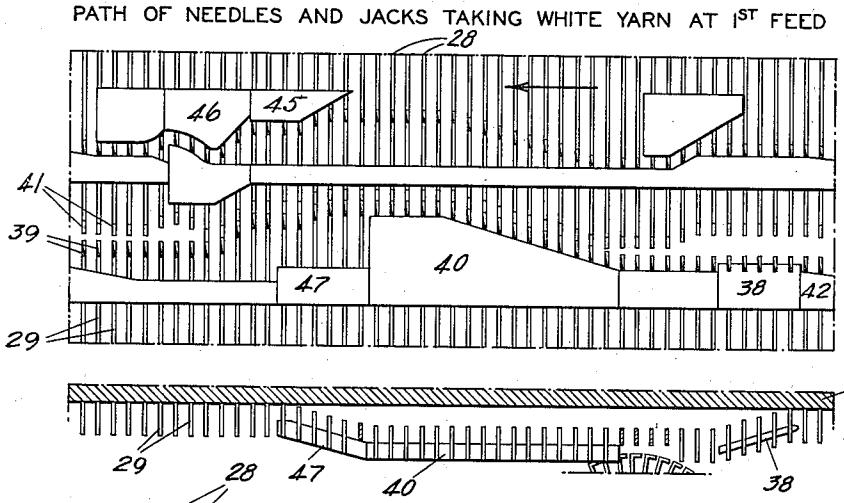


Fig. 13.

1ST FEED

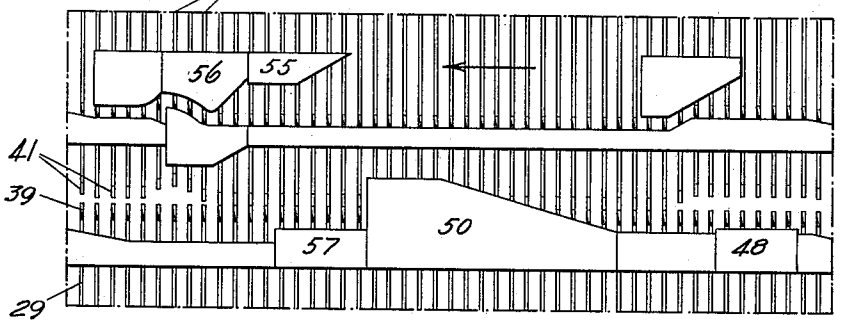
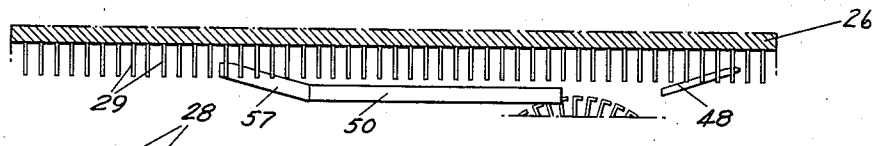


Fig. 14.

2ND FEED



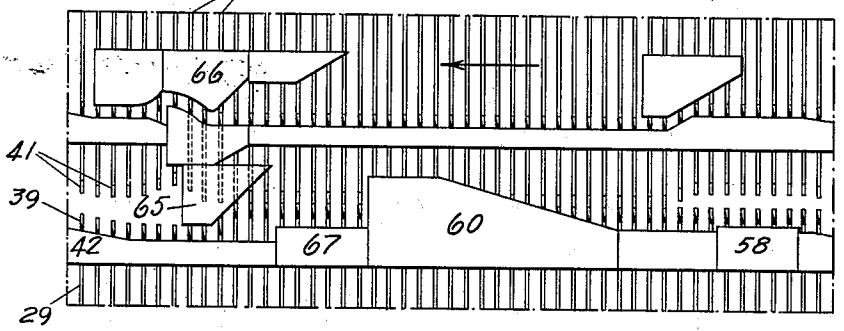
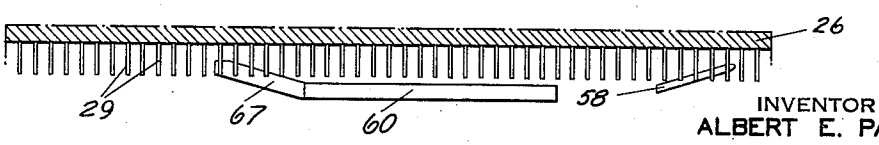


Fig. 15.

3RD FEED



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PATH OF NEEDLES AND JACKS TAKING RED YARN AT 2ND FEED

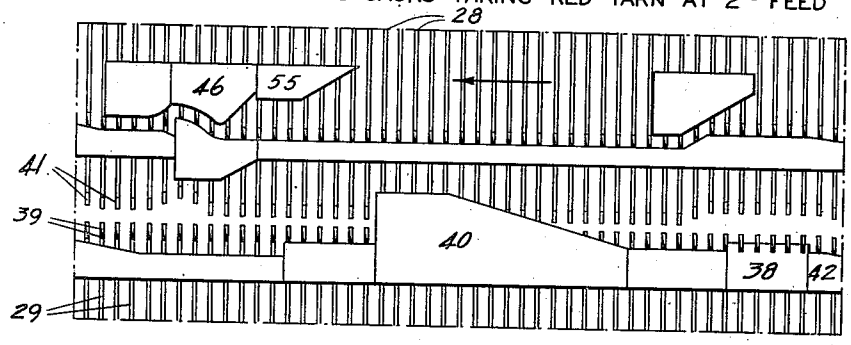
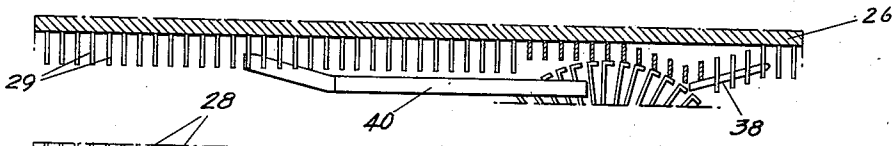


Fig.16.

1ST FEED



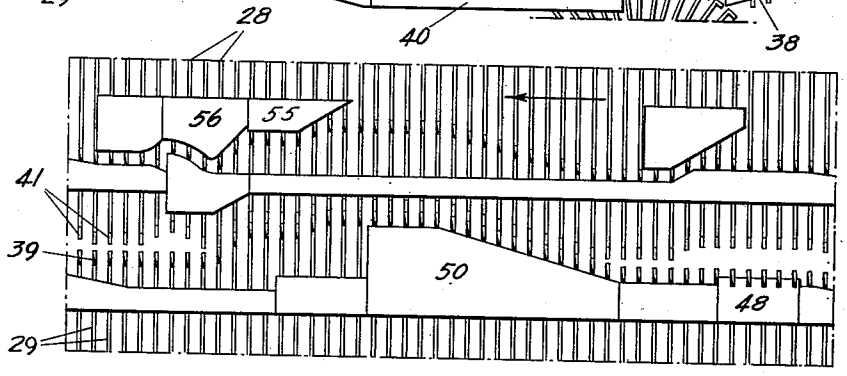
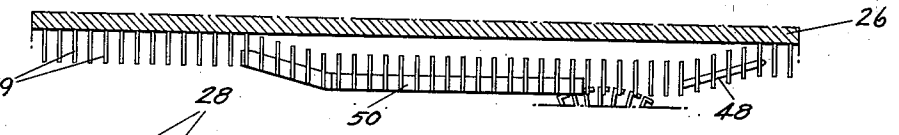


Fig.17.

2ND FEED



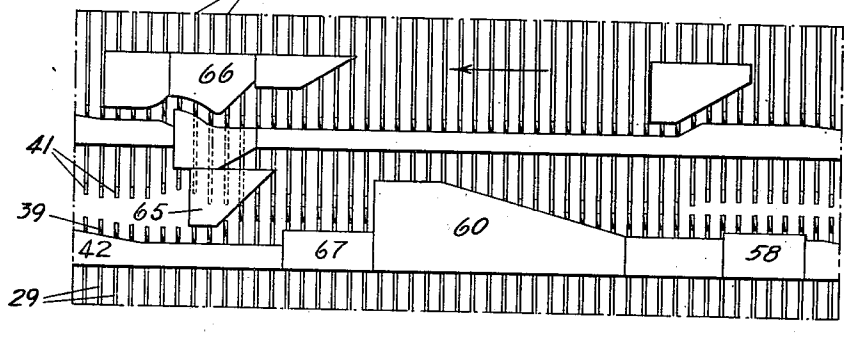
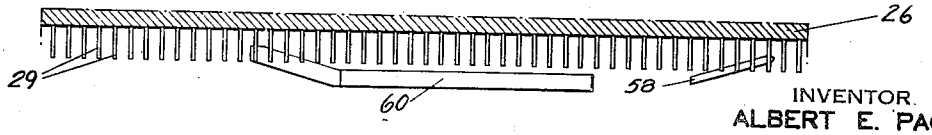


Fig.18.

3RD FEED



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CIRCULAR KNITTING MACHINE

Filed April 12, 1938 6 Sheets-Sheet 6

PATH OF NEEDLES AND JACKS TAKING BLUE YARN AT 3RD FEED

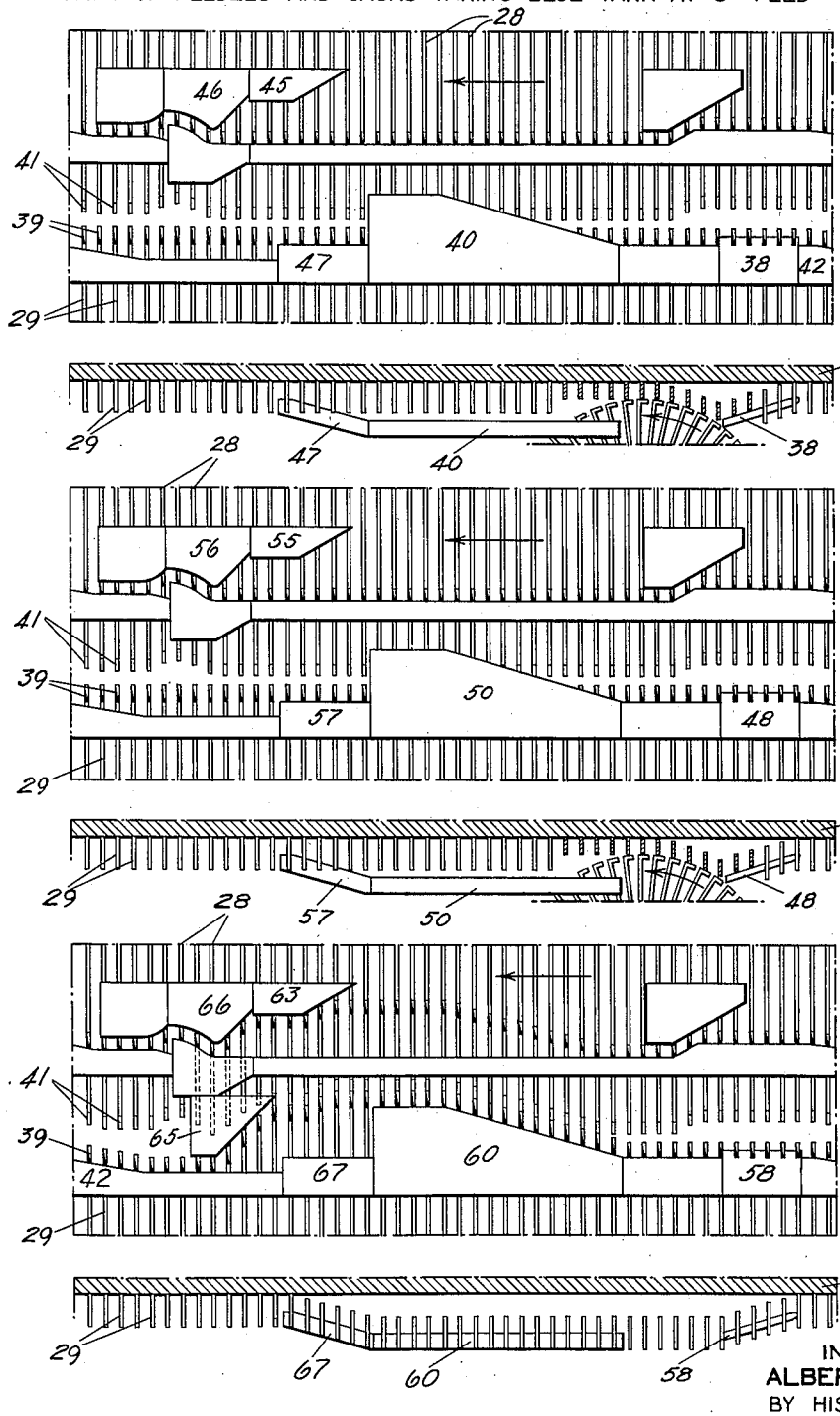


Fig.19.
1ST FEED

Fig.20.
2ND FEED

Fig.21.
3RD FEED

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CERTIFICATE OF CORRECTION.

Patent No. 2,225,842. December 24, 1940.

ALBERT E. PAGE.

It is hereby certified that error appears in the above numbered patent requiring correction as follows: The sheet of drawing containing Figure 24 as shown below should be included as a part of the Letters Patent -

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CIRCULAR KNITTING MACHINE

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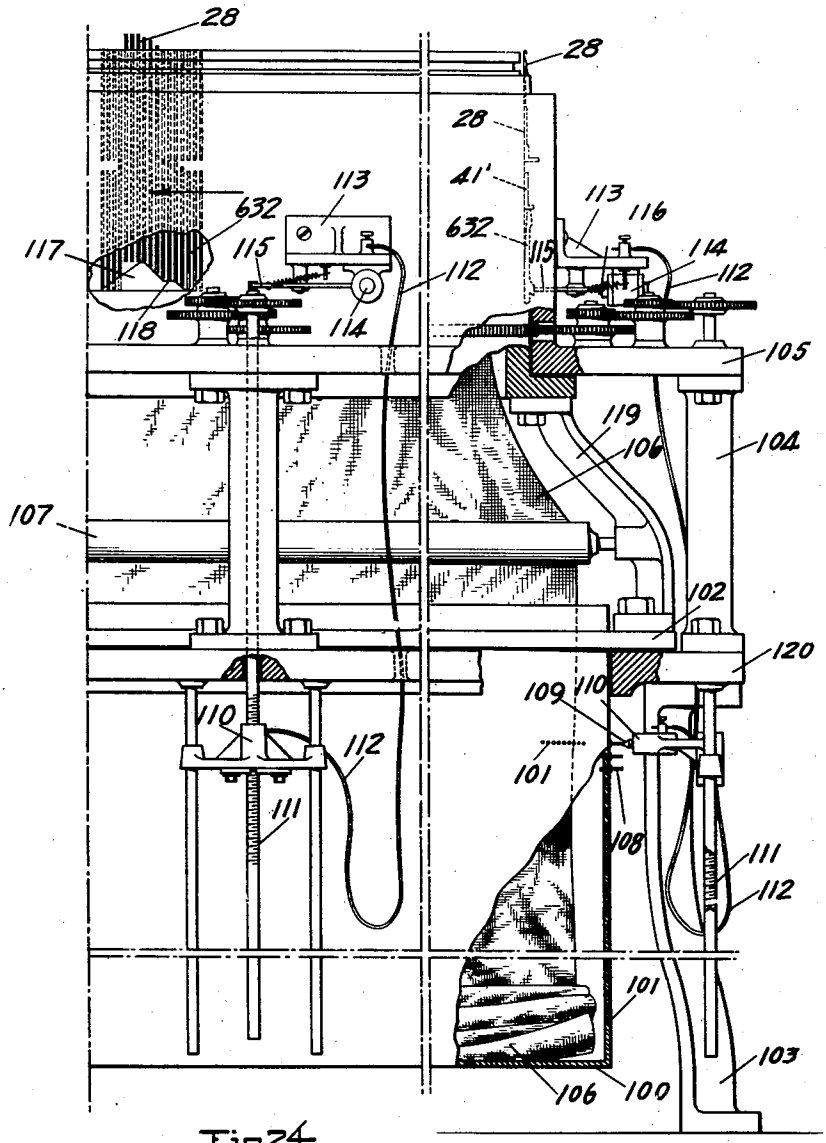


Fig 24.

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in the heading to the drawings, Sheets 1 to 6 inclusive, for "6 Sheets" read --7 Sheets--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of March, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

Patented Dec. 24, 1940

2,225,842

UNITED STATES PATENT OFFICE

2,225,842

CIRCULAR KNITTING MACHINE

Albert E. Page, Brooklyn, N. Y., assignor to Scott & Williams, Incorporated, New York, N. Y., a corporation of Massachusetts

Application April 12, 1938, Serial No. 201,650

34 Claims. (Cl. 66—50)

This invention relates to pattern means in a circular independent needle knitting machine and more particularly to a multi-feed machine having electro-mechanical means for doing the pattern selecting. A colored pattern can be made by knitting pattern yarns at the various feeds selectively and floating those yarns on the inside of the fabric where not selected. It is characteristic of the invention that any desired pattern can be obtained merely by changing the sheet or surface on which the desired pattern representation appears. By the use of pattern reading means, electric impulses can be made to actuate an arm or selecting member which makes all the needle jack selections at one feed. By a unique arrangement of parts the selection at a multiplicity of feeds can be made with one less reading device and arm than there are feeds.

This application is a continuation in part of my application Serial No. 137,106, filed April 15, 1937.

In the drawings,

Fig. 1 is an elevation of one side of the upper part of a circular three-feed knitting machine embodying my invention, showing an improved form of reading means each comprising a photo-electric cell, the pattern associated with the reading devices, and the design on the resulting fabric;

Fig. 2 is a plan view of a pattern jack selecting wheel and the armature for selecting the horizontal jacks in the wheel;

Fig. 3 is a view in vertical section through the armature and horizontal selecting wheel and one edge of the needle cylinder, taken on the line 3—3 of Fig. 2;

Fig. 4 is a plan view of some of the horizontal jacks in the wheel and the cam surfaces for operating them, the view showing how these jacks select the pattern jacks;

Figs. 5 to 9 are detail views in vertical section through one edge of the horizontal wheel of Fig. 4; Fig. 5 showing the jack after its inner end has been tipped upwardly by the armature till the inner end contacts the raising operating edge of the stationary cam; Fig. 6 showing the jack after the stationary cam has completed the raising of the inner end thereof for projection; Fig. 7 showing the jack after it has been projected outward ready to contact its pattern jack; Fig. 8 showing the cam in the same position after the revolution of the horizontal wheel has brought it into contact with its pattern jack and moved it from the dotted line to the solid line position; while Fig. 9 shows the jack just before and after its outer end has been tipped radially upward and the jack pushed radially inward by the stationary resetting cam;

Fig. 10 is a view in vertical section through one edge of the needle cylinder, showing the upper end of a pattern jack pulled radially outward preparatory to selection and the needle in its lowermost or inoperative position;

Fig. 11 is another view in section similar to Fig. 10 showing the jack pushing its needle upward;

Fig. 12 is a view similar to Figs. 10 and 11 showing the needle pushing the jack downward after passing the knitting point;

Figs. 13, 14 and 15 are developments each in elevation and plan, of the pattern jack and needle cam paths when knitting the white yarn at the first feed; Fig. 13 showing the first feed, Fig. 14 the second feed, and Fig. 15 the third feed;

Figs. 16, 17 and 18 are developments similar to Figs. 13 and 14, showing the paths of the pattern jacks and needles when knitting the red yarn at the second feed;

Figs. 19, 20 and 21 are developments similar to Figs. 13, 14 and 15 showing the paths of the pattern jacks and needles when knitting the blue yarn at the third feed, the views showing the paths at the first, second and third feeds, respectively;

Figs. 22 and 23 illustrate a modified form of armature selection of pattern jacks; Fig. 22 being a plan view taken on the line 19—19 of Fig. 23, and Fig. 23 being a vertical section through the needle cylinder looking toward the armature, showing how that element presses the jacks radially inward; while

Fig. 24 is an elevation of one side of a circular knitting machine embodying the invention in which a contact reading device is used instead of a photo-electric cell.

The invention will be shown and described embodied in a three-feed revolving needle cylinder machine. The machine to be described is a rib machine in which the dial needles knit at each feed but the cylinder needles knit only once for each revolution of the machine. The rib needles knit in the float yarn opposite idle cylinder needles and thus prevent objectionable floats. In this way large float designs can be made.

According to my invention a metallic finger or other device is used to read a representation of the design, and this pattern, moving in synchronism with the needle cylinder, causes the cell or reading member to transmit electric impulses to a single electrically operated arm which picks out all the desired jacks. If a photo-electric cell is

used as the reading device then, according to whether a point on the pattern is read dark or light by the light beam, there are electric impulses or none to operate the armature which has movement relative to the pattern jack.

In the preferred form of the invention the armature does not act directly on the pattern jacks but rather upon horizontal jacks in a pattern wheel, which horizontal jacks transmit selection to the pattern jacks. The example shown in the drawings is a three-feed machine but only two reading devices are necessary. By a unique coordination of the pattern, the pattern jacks and the cams controlling them, it is possible to cause certain needles to take pattern yarns at the first feed, certain other needles to take pattern yarns at the second feed, and all the needles which did not take pattern yarns at the first or second feed to take pattern yarns at the third feed. No needle takes more than one pattern yarn in any revolution of the needle cylinder.

The machine has a bedplate **25** supporting a rotary needle cylinder **26** in which independent needles **28** move vertically in slots, as usual. The needle cylinder is surrounded by a stationary cam cylinder **27**. As can be seen by reference to Figs. 1, 2 and 3 of the drawings, there are pattern jacks **29** associated with the cylinder needles, one below the lower butt **41** of each needle in the needle cylinder and these are adapted to be acted on by cams to raise their respective needles in the general manner described in the Mellor-Bromley British Patent 329,369.

As previously mentioned, one of the objects of this invention is to produce a machine which can knit large designs, that is to say, designs in which a large number of adjacent needles all knit the one pattern yarn. The other pattern yarns, of course, must be floated in back of these needles, and to prevent such floats which would be objectionable, the machine contains in addition the following elements. There is a dial **43** containing dial needles and actuating cams (not shown), there being as many dial needles as there are cylinder needles. As a result, rib fabric is obtained. The dial needles knit at each feed, and since they take the floats which are formed by the cylinder needles, I get three courses of rib stitches for each course of cylinder stitches. The stitches knit by the dial needles appear on the inside of the fabric only and it is therefore immaterial if the three courses of rib stitches are of different colors—they do not affect the pattern on the outside of the fabric. The appearance of the inside of the fabric is similar to that produced by an ordinary three-feed machine.

In the example shown in Figs. 1 to 12 and 23, carried above the needle cylinder and dial on the bedplate **25** by means of a bracket **30** and posts **31** and **32**, is a large pattern drum or holder **33** with an axis coaxial with the needle cylinder. Around the lower edge of this cylinder **33** is a gear ring **34** which, through appropriate gearing (not shown), drives the cylinder in synchronism with the needle cylinder. In the example shown in the drawings the needle cylinder and pattern cylinder revolve in a clockwise direction, as indicated by the horizontal arrow in Fig. 1. On the surface of this cylinder is pasted or otherwise represented the design which it is desired to have reproduced in the fabric. In Fig. 1 the design is a shield of three colors,—white, red and blue, on a background of blue. This is produced by means of photo-electric cells which read the design as only two colors: black or white. The background and part of the design are black and the remainder silver colored. The manner in which these two colors are transmitted into three colors will be explained below. In order that there may be three colors in the shield in the finished fabric, a different colored yarn is fed at each of the three feeds and the machine contains a scanning unit for each feed minus one. A separate representation of the design is required for each scanning unit in the machine in order to give the variations in selection at the different feeds.

As shown in Fig. 1, there are two reproductions of the desired design on the pattern cylinder **33**, the representations being one above the other. In order that the scanning device of one unit may actuate the same group of needles as were actuated by the needles of the other scanning unit, the relative locations of a specific needle, the same point on the various patterns representations and the scanning devices must be accurately maintained circumferentially. It is necessary that the shield or each representation of the design be colored in such manner and the rest of the machine arranged so that only the needles which are to take the pattern yarn at that feed will be selected, and that all the others will not be selected. It might be pointed out in passing that it is the needles whose pattern jacks are pushed back into the cylinder under a movement caused by the electric current from the scanning device, which do not take the yarn. The means of selecting the pattern jacks after they have first been selected by the scanning unit may be described as a pattern jack repeat limiting means.

In the arrangement shown in the drawings, the electrical apparatus is so arranged that when the light rays from the photo-electric cell meet a black surface, current is transmitted through the magnet and the corresponding needle does not take the yarn. The electrical apparatus can be hooked up in a well known manner to cause the reverse to be true, if that seems preferable. Still referring to the example shown in the drawings, the portions of the pattern whose needles are to take the white yarn at the first feed are colored silver, while the portions of the pattern whose needles are not to take the white yarn are colored black.

In the representation of the design to be used by the scanning device for the second feed, it is the red yarn which is to be fed as the pattern yarn and therefore the red portion of this design is shown in silver. The blue portion of the design, i. e., the portion which will receive the pattern yarn at the third feed, is shown in black in the pattern representation for the second feed, and therefore the pattern jacks for that portion of the pattern will be pushed inwardly at the second feed so that they cannot raise their needles due to electric impulses from the photo-electric cell.

It might be noted that the white portion of the pattern is shown in black in the second feed representation. This is merely a precaution as the pattern jack repeat limiting mechanism insures that when a pattern jack has raised its needle at one feed, that pattern jack cannot raise that needle again on the same revolution of the machine. If, however, owing to the patterns desired, such pattern jack repeat limiting mechanism were not incorporated in the machine, then it would be essential to have the white portion of the pattern in black at the second feed.

The selection at the third feed is taken care of by the pattern jack repeat limiting mechanism entirely. This mechanism is so arranged that the jacks which have not been raised at either the first or second feed are sure to be raised at the third feed and allow their needles to take the blue pattern yarn. The result of these manipulations is to produce a shield in three colors, as shown at the bottom of Fig. 1 where the fabric **35** is indicated.

It will be noted that the shield is upside down with relation to the representation of the design on the pattern cylinder **33**, but this is merely due to the direction in which the scanning devices move from line to line (course to course) of the pattern. In the example shown in the drawings the scanning devices move from top to bottom, as indicated by the vertical arrows. If the scanning devices moved in the opposite direction when operating, then the fabric coming out of the bottom of the machine would be the same side up as the pattern on the pattern cylinder **33**.

As already mentioned, the machine contains pattern jacks **29** each in the usual groove below an independent latch needle **28**. The upper end of each pattern jack has a downwardly depending hook **39** spaced radially outward from the main portion of the jack, and this hook is availed of in connection with the selecting of pattern jacks. In order to make a selection, the upper ends of the jacks are pulled radially outward by cams **38**, **48** and **58** just prior to the first, second and third feeds, respectively. These camming surfaces are mounted on the cam cylinder and can be seen in elevation and perspective in the views in Figs. 13 to 21, inclusive. As any jacks at the normal level, with their upper ends radially inward, reach the cam **38**, **48** or **58**, the cam inserts itself in the space between the main portion of the jack and the depending hook **39**. Rotation of the needle cylinder in the direction indicated in the above-mentioned views by the arrow, moves the upper ends of the pattern jacks radially outward (Fig. 10). When the jacks are pulled outward to this position and have passed off the end of cam **38** or **48** at the first or second feed, the selecting mechanism then can eliminate those jacks which are not to raise their needles at that feed by pushing the upper ends of those jacks radially inward. As in the case of the cam **22** in Fig. 10 of the Mellor-Bromley British Patent 329,369, there is a raising cam at each feed up which the jacks whose upper ends are not pushed radially inward will travel by contact between the hook **39** and the cam. This raises the needle and shortly thereafter the needle engages the pattern yarn. The position of the jacks and needles before raising can be seen in Figs. 3 and 11, and their position after raising and pushing back into the cylinder can be seen in Fig. 12.

The white yarn is fed at the first feed, the red at the second and the blue at the third. The needles and pattern jacks are shown in Figs. 13, 14 and 15 taking the path followed by those jacks and needles which take the white yarn at the first feed. Fig. 13 shows the path of such jacks at the first feed, Fig. 14 at the second feed, and Fig. 15 at the third feed. The paths of needles and jacks in Figs. 16 to 18 are those where the red yarn is taken at the second feed, and in Figs. 19 to 21 the needles and jacks are taking the path which will cause the needles to take the blue yarn at the third feed.

Disregarding for the moment the manner in which jacks are pushed radially inward selectively out of the paths of the raising cams **40** and **50**, I will describe the construction and manipulation of the pattern jacks and resetting cams to obtain the three needle selections from two sets of selecting mechanisms. Lowering cams are provided for each feed, adapted to lower any jack after it has pushed the needle to the desired elevation by itself riding up the cam **40**, **50** or **60**.

It will be noted from an examination of Fig. 13 and Fig. 17 that the lowering of the needles at the first and second feeds by the knitting cams **45**, **46** and **55**, **56** causes the jacks to be pushed downwardly. It is important to note, however, that the knitting cams **45**, **46** and **55**, **56** do not bring the jacks down to the same level at which they were before riding up the raising cam **40** or **50** (see Figs. 13 and 17). This original level is termed the normal level. The jacks lowered by the knitting cams **45**, **46** and **55**, **56** are left just above the path of the resetting cams **48**, **58** with the result that after a jack has once been raised by either the raising cam **40** or the raising cam **50**, it will not be reset by the resetting cam **48** or **58**, as the case may be. However, it is lowered to normal level after the third feed through the aid of a lowering cam **65**. This lowering cam acts directly on the upper ends of all the pattern jacks themselves and lowers them to an elevation such that when they approach the first feed resetting cam **38** again their hooked ends **39** will be engaged and their upper ends pulled radially outward. As a matter of fact, the lowering cam **65** preferably pulls the jacks downwardly a little beyond the necessary level for proper engagement with the resetting cam **38** and then the jacks are brought back up to the normal level by an adjusting cam **42**. In this way it is certain that all the jacks will be at a uniform level when they come to the resetting cam **38**. It will be noted that with this arrangement no pattern jack can ride up more than one of the three cams **40**, **50** or **60** in a single revolution. There need be no means just prior to the third feed to select out any jacks. It therefore follows that all needles which are not selected on the first or second feed ride up the raising cam **60** at the third feed. Thus there is assurance that each needle will get one pattern yarn and one only on each revolution of the machine. Stated another way, the needles knitting at feed **1** are prevented from taking yarn in their hooks or casting off the previous stitch at either feed **2** or feed **3**. The needles knitting at feed **2** are prevented from taking yarn in their hooks or casting off the previous stitch at feed **3**. As a result, although the machine shown and described is a three-feed machine, the cylinder needles actually knit only one complete course of plain fabric per revolution of the machine.

It will also be noted from Fig. 12 that the upper end of the jack which is raising its needle projects radially outward beyond the needle butt. It is by virtue of this fact that the lowering cam **65** after the third feed is able to lower the pattern jack without lowering the needle. If desired a cam adapted to lie in the path of the pattern jacks but not the needle butts could be used just after the second or the first feed as well. Such a cam could be movable vertically so that, like cam **65**, it would either lower all the jacks to the level where they would lie in the paths of the resetting cams **38**, **48**, **58**, or when in another position would lower the pattern jacks no further

than the knitting cams 46 and 56 now lower them in Figs. 13, 14, 16 and 17.

The means for selecting the pattern jacks after they have been reset, i. e., pushed out by cam 38 at the first feed or cam 48 at the second feed, will now be described. The selecting mechanism at the first two feeds is identical. Essentially each mechanism comprises a pattern scanning device having rotary movement relative to the pattern, electric means operated by that scanning device which in turn causes a single element to have mechanical movement directly or indirectly on the pattern jacks which are moving relatively to this single element with the same angular speed at which the pattern is moving. A single armature, electrically operated, has been found to move fast enough to select a single needle or a group of needles in accurate accordance with the pattern passing the scanning device and with sufficient force to drive the upper ends of pattern jacks radially inward, thereby causing selection as between jacks. Obviously the armature can get its electric impulses from any reading, i. e., scanning, device such for instance as a metallic finger. While the lightning-like rapidity of movement of an armature actuated by an electro-magnet from the scanning device can drive the upper end of a single pattern jack into the needle cylinder and get out of the way before the next pattern jack comes along, when more than one pattern jack is to be driven in and the armature therefore stays in against the circumference of the needle cylinder for an appreciable length of time, it may be preferable that the rocking of the jacks be caused by a wiping action of the reading end of the armature, as distinguished from a separate movement for each jack. For this purpose the reading end 78 of the armature is set at an angle with relation to the pattern jacks (see Fig. 1).

In the modification of Figs. 22 and 23, the current from whatever current, voltage or amperage adjusting mechanism (not shown) may be used in connection with the scanning device comes to an electro-magnetic coil 92 that is opposite one end of a lever or armature 93 pivoted intermediate its ends. One end of the armature is in line with the core of the electro-magnet and the other end acts against the upper ends of the pattern jacks. There is a spring 94 acting in opposition to the pull of the electro-magnet, which spring tends to pull the armature away from the electro-magnet and clear of the pattern jacks. The relative length of the two arms of the lever can be adjusted as desired, but in the drawings I have shown them with the magnet arm slightly shorter than the reading arm for the upper ends of the jacks. When the scanning device makes an electric impulse pass through the circuit, the electro-magnet 92 causes the armature 93 to tip and move into the path of the upper ends of the jacks. The simplicity and effectiveness of having the pattern cylinder and the needle cylinder move in synchronism, one past the electric scanning device and the other past a mechanical armature operated by the electric circuit, at the high speed it is possible to obtain from the electric circuit, should be obvious. It will be noted that one armature does selecting all around the cylinder.

The preferred form of translating the electrical impulses into selective movement of the pattern jacks is illustrated in Figs. 1 to 21 of the drawings. In this preferred embodiment the work of the armature actuated by the electro-magnet is made easier by the introduction of a horizontal wheel with small jacks therein between the armature and the pattern jacks in the needle cylinder. The length and strength of the stroke required of the armature are much reduced by means of this mechanism. Mounted on the bedplate 25 of the machine is a horizontal wheel 70 carrying a plurality of small horizontal jacks 75 arranged in radial grooves on the wheel and held in position by a cover 71. The wheel 70 is free to turn on the spindle 72 which carries it. Around the needle cylinder just above the bedplate is a gear ring 73 revolving with the needle cylinder inside the cam cylinder 27. The cam cylinder is cut away opposite the spindle 72 to permit a gear 74 to mesh with the gear ring 73. Rivetted to the gear 74 on the shaft 72 is a sleeve 76 extending upwardly to the wheel 70 and serving to drive the wheel. The additional gearing appearing in Figs. 1, 2 and 3 of the drawings, associated with the spindle 72 and adjacent thereto, is for the purpose of turning screws 49 to cause vertical movement of the photo-electric cells or scanning devices. The train includes gears 87, 88, 89 and 90. The drive for the horizontal wheel 70 and the spacing of the horizontal jacks 75 are such that as the needle cylinder revolves and the horizontal wheel turns, a horizontal jack comes opposite each pattern jack in the needle cylinder.

The horizontal jacks rest on their lower edges and these are curved so that the jacks can rock according to whether their outer or inner ends are pushed down. The armature 80 which is acted on by the electro-magnet of the photo-electric cell circuit, is carried in a bracket 77 mounted in a non-revoluble manner on the top of the spindle 72. The reading end 78 of the armature overlies the outer ends of the horizontal jacks 75 as they come around to a point radially outward from the needle cylinder. As in the case of the construction shown in Figs. 22 and 23, this reading end 78 of the armature is bent so that it presents a camming surface to the jacks for use primarily when more than one horizontal jack is to be depressed in succession. This reading end 78 operates through a notch 79 in the cover 71 of the horizontal wheel. The cover 71 does not revolve. There is a stationary cam plate 81 fastened on the underside of the cover 71 which is adapted to act on the horizontal jacks to complete the selections started by the armature 80. This cam plate 81 also assists in repositioning the horizontal jacks for their next selection by the armature. The jacks can be seen most clearly in Fig. 4, and it will be observed that the tail of each jack has two notches therein, 82 and 83, the lower or end notch 82 having an overhanging shoulder at the end toward the upper notch 83. The shape and effect of the stationary cam plate 81 on the jacks at various stages of their revolution about the plate are shown in Figs. 4 to 9 inclusive. Fig. 3 is a sectional view taken radially across the horizontal wheel in a line passing through the center of the machine, this section therefore coming directly under the point where the reading end 78 of the armature lies. This corresponds with the jack appearing horizontally on the right in Fig. 4 and also with the jack in Fig. 5. At this point the cam plate 81 is bevelled or toed outwardly at its lower end at an angle 84 corresponding roughly with the overhang of the lower or end notch 82 of the horizontal jack 75. If an electric impulse should cause the read-

ing end 78 of the armature to push the outer end of the horizontal jack downwardly to a slight extent, the jack would then take the position shown in Fig. 5. In this position the overhang of the notch 82, as the wheel continues its revolution, would come against the raising edge or toe 84 in the stationary cam plate, and as the toe or bevel above described continues on the cam plate, the plate continues the rocking movement of the jack which was started by the armature and the jack comes to the position shown in Fig. 6. It will be noted that the jack has already started to move radially outward, and in Fig. 7 the radially outward movement has been completed and the jack has reached the position of the uppermost jack on the right in Fig. 4. The radius of the cam plate now remains uniform for say 180° and until the horizontal jacks have passed the point of contact or nearest approach to the pattern jacks in the needle cylinder. The outer ends of the horizontal jacks are bent to present a pushing surface 96, and it is this pushing surface which contacts the pattern jacks, as shown in Figs. 4 and 8. This can also be seen in Figs. 13 to 21. The dotted outline of a jack in Fig. 8 is the one which has not been pushed inward by a horizontal jack, and the solid outline is one which has been pushed in. The little arrow in this figure indicates the direction of movement of the jack from the outward to the inner position in response to the push of the horizontal jack. The length of radial movement of the horizontal jack is greater than the vertical length of movement of the reading end 78 of the armature. Also the amount of pressure required to move a pattern jack inward with its long surface contacting with the slot in the needle cylinder is much greater than the amount of vertical pressure needed to move the small horizontal jack. As the horizontal jacks move away from the needle cylinder, the outer ends of the jacks which had been pushed radially outward slip off the bevelled portion 84 of the cam plate 81 and come opposite an overhanging bevel. Simultaneously their outer ends come against a stationary cam 86 which pushes the jacks inward and by virtue of the overhang 85 just referred to, they are caused to be tipped again till their outer ends are upward and ready for selection by the armature on the next revolution of the wheel. This cam 86 is carried on an extension of the cover 71. The upper notch 83 is cut in the tails of the jacks to permit those tails to pass under the cam plate 81 whenever the jacks are not selected. As in the case of the construction in Figs. 22 and 23, there is a tension spring 95 to retract the reading end of the armature after release by the electric current.

The relation of the wheels 70 and the cams acting on the pattern jacks can be seen in Figs. 13 to 21. After passing one of the raising cams 40, 50 or 60, the jacks all have their upper ends pressed radially inward by a cam 47, 57 or 67 at the first, second and third feeds respectively. In order that the operation may be understood more clearly in these figures, some of the jacks 29 are shown broken off at the level of the horizontal jack 75, while the rest of them are views from the top showing the projecting portion forming the hook 39. Thus in Fig. 13 four jacks 29 are shown opposite the horizontal selecting jacks 75 with their tops broken off in order to make it clear that when the horizontal jacks are not projected they have no effect on the pattern jacks. Similarly another jack is shown broken off at the push-in cam 47 to illustrate how the pushing-in operation is achieved. Again in Figs. 16, 19 and 20, some of the jacks are broken off to show the effect on those elements of the horizontal jacks when the latter are projected. The portions referred to, of Figs. 13, 16, 19 and 20, are the horizontal sections and not the elevations. In this entire series of views from Fig. 13 to Fig. 21, the horizontal arrows indicate the direction of movement of the needles and jacks. The horizontal wheels 70 present the horizontal jacks at a level just below the raising cams 40, 50 and 60, as shown in Fig. 3. When the horizontal jacks are projected, the rotation of the horizontal wheel causes the corresponding jacks to be pushed radially inward and miss the raising cam 40 or 50, as shown for instance in Figs. 16, 19 and 20. The grouping of the jacks in Figs. 13 to 21 is not intended to correspond to the pattern shown in Fig. 1 but is chosen to illustrate the operation of the machine.

The construction of the one embodiment of the invention having been described, its operation will now be set forth. Assuming that the photo-electric scanning devices begin their scanning at the top of the pattern representations on the drum 33, and that the drum is revolving in the direction indicated by the horizontal arrow between the two pattern representations in Fig. 1, the patterning is carried out as follows. I will first follow through the selection and manipulation of the jacks for the white portions of the shield. This is done at the first feed. The No. 1 photo-electric cell 36 is connected to and operated in conjunction with the first feed. It controls the white yarn. The pattern representations on the drum 33 being one directly above the other and the photo-electric scanning device 37 being approximately above the second feed in the same manner as the first cell 36, it follows that the photo-electric scanning device 36 at the first feed will transmit selections first. It will be noted in Fig. 1 that the white portions of the shield are shown in silver. The background on which the representations of the shield are mounted can be made to cause the corresponding cylinder needles to miss the yarn or, if desired, can be made to cause the yarn to be taken. In the example shown in the drawings the background is colored black and the needles do not take the pattern yarn. When any portion of the silver color comes opposite the scanning device, no impulse will be transmitted through the electric circuit 44, the armature 80 will not tip any horizontal jacks 75, these jacks therefore will not be projected, and the pattern jacks 29 will go by the horizontal jacks 75 in the manner shown in the lower part of Fig. 13. (It might be noted that just prior to reaching a position opposite the horizotal jacks 75, all the pattern jacks were brought up to the normal level by adjusting cam 42 and then pulled radially outward by the resetting cam 38.) As a result of the failure of any of these horizontal jacks 75 to push their corresponding pattern jacks 29 radially inward, all the pattern jacks which correspond to the white portions of the shield will ride up the raising cam 40 and raise their needles to take the pattern yarn at the first feed. Immediately after passing beyond the raising cam 40, the pattern jacks 29 are pushed radially inward by the push-in cam 47 till their backs are again in contact with the needle cylinder, and shortly thereafter the knitting cam 46 in pushing the needles down-

ward carries the pattern jacks down till the hooks of the needles are below the level at which they can take the pattern yarn. This pushes the pattern jacks down but not to the normal level at which the pattern jacks traveled before starting up the raising cam **40**. Travelling along at this level, when the pattern jacks come to the resetting cam **48** for the second feed, their hooks **39** are just above the resetting cam and the jacks are therefore not affected by this resetting cam, as can be seen in Fig. 14. The same is true at the third feed, as shown in Fig. 15, where the hooks **39** of the jacks are above the resetting cam **58** and the jacks continue through the third feed without being tipped radially outward or caused to change their level by going up the raising cam **60**. In this way these white yarn pattern jacks do not raise their needles to take the pattern yarn at the second and third feeds, as shown in Figs. 14 and 15. After passing the raising cam **60** at the third feed and the push-in cam **67** immediately following it, the upper ends of the raised pattern jacks meet the lowering cam **65** which pushes them down from their inoperative level, leaving them at a level slightly below the normal level.

All the dial needles, however, proceed with their regulating knitting operations at each feed.

Having followed the operation of such jacks as control the knitting of the white yarn at the first feed, as shown in Figs. 13, 14 and 15, I will now follow the manipulation of the jacks which are to knit the red yarn at the second feed, as shown in Figs. 16, 17 and 18. Before proceeding to the description of this second feed, it might be pointed out that the following occurs when the white thread portion of the representation **51** of the shield for the second photo-electric scanning cell comes in front of its beam of light. As shown in Fig. 1, this white portion of the shield can be shown in silver not only in the representation which corresponds to the first cell **36**, but also in the representation which is read by the second cell **37**. As a result no impulses are transmitted to the horizontal jacks **75** at the second feed when the white portion of the shield passes in front of the scanning device for that feed. In Fig. 14 none of the horizontal jacks **75** are shown projected, and the pattern jacks are not disturbed. However, the pattern jacks for the white yarn are travelling at a level above the normal one and have not been reset by cam **48**, and therefore no selecting out of pattern jacks is possible anyway.

The raising of the needles at the second feed to take the red pattern yarn will now be discussed. The representation of the red stripes of the shield which passes in front of the scanning device **36** for the first feed is colored black, which causes reaction in the photo-electric cell and an electric impulse passes through the circuit **44** to the magnet controlling the armature **80** at the first feed. As a result the reading end **78** of the armature is depressed and tips the horizontal jacks to the position shown in Fig. 5 where the overhang on the inner end catches on the edge **84** of the cam plate **81** and the completion of the tipping then occurs as shown in Fig. 6. Immediately thereafter the projection of the horizontal jack beyond the wheel **75** occurs, as shown in Fig. 7, and the continued rotation of the wheel pushes the corresponding pattern jacks back out of line with the raising cam **40**. As already explained, all the red or second feed pattern jacks approach the push-out cam **38** at the normal level and have their upper ends tipped outwardly. Therefore, all these jacks are pulled outwardly and immediately pushed in again by the horizontal jacks **75** which are projected in response to the electric impulse from the scanning cell caused by the black color in the red stripe portions of the shield in the lower representation **52** on the drum **33**. None of the red pattern jacks therefore are raised on cam **40** at the first feed. They approach the resetting cam **48** at the second feed at normal level and are projected out by it. The silver portions of the representation **51** at the second feed allow the armature to remain idle and these jacks ride up the raising cam **50** as shown in Fig. 17, and their needles take the red yarn at this feed. After leaving the raising cam they are lowered again by their needles through the action of the stitch cams **55**, **56** to a level slightly above normal, as in the case of the needles which took the white yarn at the first feed. Therefore at the third feed their upper ends are not pulled outwardly by the resetting cam **58** and are not raised on the cam **60** to take the blue yarn. After passing the raising cam **60** and the push-in cam **67**, they meet the lowering cam **65** and are pushed down from their inoperative level to one below normal, where the cam **42** brings them up to normal level in time for engagement by the resetting cam **38** prior to the first feed on the next revolution.

It will be observed that whenever a needle is to pass the first or second feed without taking the pattern yarn at that feed, and that needle has not yet knit on that revolution, the corresponding jack is acted on by its resetting cam and then pushed back again by a horizontal jack, thus preserving the jack in its normal level until it reaches the feed where it is to go up the raising cam.

Figs. 19, 20 and 21 illustrate the path of needles and jacks where the needles are to take the blue yarn at the third feed. As above indicated, the pattern jacks are maintained at normal level until they reach the third feed, by being reset by the cam **38** at the first feed, pushed in by cam **47** at that feed, reset again by cam **48** and pushed in again by cam **54** at the second feed, and reset for the third time by cam **58** at the third feed. At this feed, there being no selecting wheel, all the jacks which did not take pattern yarns at either the first or second feed ride up the cam **60** and take the blue yarn. The needles are drawn down by knitting cams **63** and **66** while the jacks pass under cam **65**.

In order that the machine may operate in the manner above described, it is necessary that the pattern holder, i. e., the drum **33**, and the needle cylinder shall move in synchronism, that the holder shall have movement relatively to the scanning device, and the needle cylinder have movement relatively to the armature. It will be noted that in the construction set forth, elements and forces are used each peculiarly adapted to perform the function for which it is set. Thus a scanning device is used to observe a pattern representation which permits the pattern to be changed at will with perfect ease by merely making a representation of the pattern. Electricity is then used, which moves as fast as light, to transmit the impulses to a pivoted armature, thus getting a short mechanical movement of tremendous rapidity. The horizontal wheel and horizontal jacks add the necessary length of movement and strength of movement to operate large spring-pressed jacks, while the peculiar co-

ordination of pattern jacks and cams gives tremendous increase to the pattern possibilities of the machine by enabling one to produce a three-color or three-feed pattern by the use of only two sets of selecting devices.

A somewhat simpler type of reading mechanism is shown in Fig. 24, where a metallic finger, reading pins on a drum to close the electric circuit, is employed instead of the pattern representation and photo-electric cell of Fig. 1. The machine is still a revolving needle cylinder machine with multiple feeds. The needles 28 and intermediate jacks 41' are in the same cylinder, and the stationary cam cylinder 105 is supported by pedestal brackets 104, a supporting ring 120 and the main legs 103 of the machine. The needle cylinder is supported by brackets 119 and a ring 102 which revolve with the cylinder, the ring 102 turning on the stationary supporting ring 120. Rolls 107 on the brackets 119 feed the knitted fabric 106 down from the needles.

Turning with the needle cylinder and carried by the revolving ring 102 is the usual metal cam 100 for collecting the fabric 106. I use this metal cam 100 as a pattern drum by boring holes 101 therethrough in spiral courses corresponding to the number of feed controls needed. In these holes—which correspond in number per revolution or circle to the number of needles—I put pins 108 wherever I desire to actuate an electro-magnetic hammer 115 to move a corresponding jack 632. (The jacks are the familiar rocking jacks of the Ivan W. Grothey Patent 1,678,385, dated July 24, 1928.)

The element to contact the pins 108 in proper succession wherever they are inserted is a metallic reading finger 109 on an arm 110 movable vertically on a rod 111 which is threaded and is revolved by one of the gears driven by the needle cylinder, as in the case of Fig. 1. Guide rods for the arm 110 can also be provided as shown. This arm can be electrically connected to the magnet 114 for the hammer 115 by a wire 112. The magnet and hammer are carried on a bracket 113 on the cam cylinder 105. There is the usual tension spring 116 acting on the hammer in opposition to the magnet. In Fig. 24 I have shown a raising cam 117 suitable for raising non-selected jacks 632. (The horizontal arrow indicates the direction of movement of the jacks and needles.) The step 118 in this cam is the height at which the jacks contact the needles. While the hammer is shown selecting prior to the cam 117, it can be located so as to select on the step 118 where the jacks have all been brought to a more accurate height, as in the case of cam 42, Fig. 13. The manipulations at the successive feeds are similar to those in Figs. 13 to 21.

Many modifications which do not depart from the scope of my invention will occur to those skilled in the art.

What I claim is:

1. In a circular knitting machine, a holder for a pattern and a needle cylinder, the two revolving in synchronism, independent needles in said cylinder and jack means associated with said needles, a cam cylinder, means thereon for raising selected jacks and their needles to take yarn and knit, and an electrically operated member to select jacks for patterning by rocking same, in combination with means to read the pattern and transmit electric impulses to the selecting member, said reading and selecting members being circumferentially stationary.

2. In a circular knitting machine, a holder for a pattern, means to read a pattern on the holder, a needle cylinder and independent needles and jacks therein, in combination with a pivoted arm to select jacks, and electrical means controlled by the reading device to operate said arm, the pattern holder and the needle cylinder having rotary movement in synchronism to each other and relative to the reading device and arm respectively.

3. In a circular knitting machine, a circumferentially stationary electric reading device, a rotary holder for a pattern, a rotary needle cylinder and independent needles and jacks therein, in combination with a pivoted arm to select jacks, and electrical means controlled by the reading device to operate said arm, said pattern holder and needle cylinder rotating in synchronism with each other.

4. In a circular knitting machine, an electric reading device, a holder for a pattern having rotary movement relative to the reading device, a needle cylinder and independent needles and jacks therein, in combination with an arm to select jacks, and electrical means controlled by the reading device to operate said arm, the needle cylinder having rotary movement relative to the arm, while the pattern holder and the needle cylinder rotate in synchronism with each other.

5. In a circular knitting machine, an electric reading device movable in a vertical dimension, a rotary drum opposite said reading device adapted to carry a pattern on its surface, a rotary needle cylinder and independent needles and jacks therein, in combination with a mechanical selecting element for the jacks circumferentially stationary with relation thereto, and electrical means controlled by the reading device adapted to operate the mechanical selecting means, the drum and the needle cylinder moving in synchronism to each other.

6. In a circular knitting machine, an electric reading device and a drum for presenting a pattern to said device, said device and drum having rotary and vertical movements relative to each other, a rotary needle cylinder and independent needles and jacks therein, in combination with a movable element adapted to select jacks having a circumferentially stationary position on the machine, and electrical means controlled by the reading device to operate said movable element, the rotary movement of the needle cylinder and the drum being in synchronism to each other.

7. In a circular knitting machine, a rotary needle cylinder, independent needles and pattern jacks therein, and a wheel whose periphery rotates toward and away from the needle cylinder, in combination with a plurality of jacks radially arranged in said wheel adapted when selected to cause selection among the pattern jacks, an electrically operated arm to give a selecting movement in one plane to selected jacks, and cam means on said wheel to project such jacks in another plane to make subsequent selection from among the pattern jacks as the wheel revolves.

8. In a circular knitting machine, a rotary needle cylinder, independent needles and pattern jacks therein, and a wheel whose periphery rotates toward and away from the needle cylinder, in combination with a plurality of jacks radially arranged in rocking position in said wheel, an electrically operated arm to give selected jacks a preliminary rocking movement, and a cam on said wheel to complete the rocking movement and project such jacks to make selections from among the pattern jacks as the wheel revolves.

9. In a multi-fed circular knitting machine, a circle of independent needles and pattern jacks associated therewith, means at a plurality of feeds for selecting jacks by elimination from those at normal level, and a cam at each feed for raising at that feed jacks selected in order that their needles may take a pattern yarn, in combination with a cam only after the last feed for returning all raised jacks to normal level.

10. In a multi-feed circular knitting machine, a circle of independent needles and pattern jacks associated therewith, means at all feeds positioning for raising all jacks at normal level, and means at a plurality of feeds selecting jacks by moving out of raising position all the other jacks at normal level, in combination with a cam at each feed raising selected jacks in order that their needles may take a pattern yarn, and a cam only after the last feed for returning all raised jacks to normal level.

11. In a multi-feed circular knitting machine, a circle of independent needles and pattern jacks associated therewith, means at all feeds positioning for raising all jacks at normal level, and means at a multiplicity of feeds selecting jacks by moving out of raising position all the other jacks at normal level, in combination with a cam at each feed raising selected jacks in order that their needles may take a pattern yarn, cam means after one or more feeds lowering the raised jacks to a level where they cannot be positioned for raising, and a cam after the last feed for returning all raised jacks to normal level.

12. In a multi-feed circular knitting machine, a circle of independent needles and pattern jacks associated therewith, means at all feeds positioning for raising all jacks at normal level, and means at all but the last feed selecting jacks by moving out of raising position all the other jacks at normal level, in combination with cams at all feeds located after the selecting means where present, raising all jacks that are left in raising position at normal level thereby causing those needles to take a pattern yarn, cam means after all but the last feed lowering the raised jacks to a level where they cannot be positioned for raising, and a cam after the last feed for returning all jacks to a normal level.

13. In a multi-feed circular knitting machine, a pattern holder, a needle cylinder revolving in synchronism with the holder, independent needles in said cylinder and jack means associated therewith to raise selected needles to take a pattern yarn, means at each feed positioning for raising all jacks at normal level, and an electrically operated member at each of one or more feeds selecting jacks for raising by pushing all the others at normal level out of raising position, in combination with means to read a pattern and transmit electrical impulses to each selecting member.

14. In a multi-feed circular knitting machine, a holder for separate patterns for each feed except the last, a needle cylinder revolving in synchronism with the holder, independent needles in said cylinder and jack means associated therewith to raise selected needles to take a pattern yarn, means at each feed positioning for raising all jacks at normal level, and an electrically operated member at each feed except the last selecting jacks for raising by pushing all the others at normal level out of raising position, in combination with means to read each pattern separately and transmit electrical impulses to each selecting member in accordance with its pattern, cams at all feeds raising all jacks that are left in raising position, cam means after all but the last feed lowering the raised jacks to a level where they cannot be positioned for raising, and a cam after the last feed for returning all jacks to a normal level.

15. The combination with a knitting machine having a plurality of needles arranged in a circular series, selectively operable actuating elements for said needles, and means for actuating said elements to cause their respective needles to take part in the knitting operation, of means for selecting the elements to be actuated, comprising an electrically operated control device including a member operable to engage and positively move individual elements, means for giving the device and elements a relative movement during which the device and elements are brought successively into operating relation, a pattern, and means for supplying current to said device in accordance with variations in said pattern.

16. The combination with a knitting machine having a plurality of needles arranged in a circular series, selectively operable jacks for the respective needles, and means for moving jacks and their associated needles to cause said needles to take part in the knitting operation, of means for effecting the selection of the jacks to be actuated comprising an electro-magnetically operated member for engaging and positively moving individual jacks to position them with relation to said moving means, means under the control of a pattern for actuating said member, and means for giving said device and jacks a relative movement during which the device comes into operative relation with the jacks successively.

17. The combination with a knitting machine having a support, a plurality of needles arranged in a circular series in grooves in said support, selectively operable jacks on the support for controlling and operating their respective needles, and means for moving jacks and their associated needles in said grooves to cause said needles to take part in the knitting operation, of means for effecting the selection of the jacks to be actuated comprising an electrically operated control device including a member movable to engage and positively move individual jacks to position them with reference to said moving means, means for giving the device and jacks a relative movement during which said member comes into operative relation with said jacks successively, and means including a pattern for supplying current to said device in accordance with variations in said pattern.

18. The combination with a knitting machine having a support, a plurality of needles arranged in a circular series in grooves in said support, selectively operable jacks, one in each groove, for controlling the action of respective needles, and means for moving jacks and their associated needles in said grooves to cause said needles to take part in the knitting operation, of means for selecting the jacks comprising an electrically operated hammer member operable to engage individual jacks and positively position them with relation to said moving means, means for giving the member and jacks a relative movement during which the member comes into operative relation with said jacks successively, and means including a pattern for supplying current to operate said member in accordance with variations in said pattern.

19. The combination of a knitting machine

having a support, a plurality of needles arranged in a circular series in grooves in said support and a jack in each groove for actuating its associated needle, of means for selecting said jacks and shifting them to control the action of their respective needles in the knitting operation, comprising a member operating electrically to engage and positively shift individual jacks, means for giving the member and jacks a relative movement during which the member comes into operative relation to the jacks successively, and means including a pattern for supplying current to actuate said member in accordance with variations in said pattern.

20. The combination of a knitting machine having a support, a plurality of needles arranged in a circular series in grooves in said support and jacks on the support for actuating the respective needles, of means for selecting said jacks and shifting them to control the action of their respective needles in the knitting operation, comprising a control device including an electromagnetically operated member operable to strike and move selected jacks, means for giving the member and jacks a relative movement during which the member comes into operative relation to the jacks successively, and means including a pattern for supplying current to actuate said member in accordance with variations in said pattern.

21. In a knitting machine, the combination of a plurality of needles arranged in a circular series, a plurality of selectively operable elements for actuating the needles to cause them to take part in the knitting operation, and means for selecting the elements to be actuated including an electromagnetically operated hammer for striking and shifting individual elements, a source of power for operating said hammer, a pattern, means reading the pattern and controlling the supply of power from the source to the hammer in accordance with variations in the pattern, and means for giving the hammer and elements a relative movement in accordance with the progress of the knitting operation.

22. In a knitting machine, the combination of a plurality of needles arranged in a circular series, selectively operable elements for actuating the needles to cause them to take part in the knitting operation, and means for selecting the elements to be actuated including an electromechanical translating device including a movable member operated to strike and shift individual elements, a source of power for operating said device, a pattern, means reading the pattern and controlling the supply of power from the source to the device in accordance with variations in the pattern, and means for giving the member and elements a relative movement in accordance with the progress of the knitting operation.

23. In a knitting machine, the combination of a plurality of needles arranged in a circular series, a plurality of selectively operable elements for actuating respective needles to cause them to take part in the knitting operation, said elements being arranged in a circular series, and means for selecting the elements to be actuated including an electromechanical translating device operable to strike and move individual elements, a source of power for operating said device, a pattern, means reading the pattern and controlling the supply of power from the source to the device in accordance with variations in the pattern, and means for giving the device and elements a relative movement in accordance with the progress of the knitting operation.

24. In a knitting machine, the combination of a circular needle bed rotating on a vertical axis, a circular series of needles mounted on the circular needle bed, a circular series of selectively operable elements for actuating the needles to cause them to take part in the knitting operation, and means for selecting and moving said elements including a cylindrical pattern mounted offset from the circular needle bed on the same axis, means for reading the pattern, and means for giving the pattern and reading means a relative movement synchronized with the rotation of the circular needle bed.

25. In a knitting machine, the combination of a circular needle bed rotating on a vertical axis, a circular series of needles mounted on the circular needle bed, a plurality of selectively operable elements for actuating the needles to cause them to take part in the knitting operation, and means for selecting and moving said elements including a cylindrical pattern mounted offset from the circular needle bed on the same axis, means for reading the pattern, means for giving the pattern and reading means a relative movement synchronized with the rotation of the circular needle bed, an electromechanical translating device operable to engage and move individual elements, means for giving the elements and device a relative movement in accordance with the progress of the knitting operation, and means for supplying power to the said device under the control of said reading means.

26. In a knitting machine, the combination of a circular needle bed rotating on a vertical axis, a circular series of needles mounted individually in slots in the surface of the circular needle bed, a plurality of selectively operable elements for actuating the needles to cause them to take part in the knitting operation, and means for selecting and moving said elements including a cylindrical pattern mounted for rotation on a vertical axis and offset from the circular needle bed, means for reading the pattern, means for giving the pattern and reading means a relative movement in synchronism with the rotation of the needle bed, an electromechanical translating device operable to engage and move individual elements, means for giving the device and elements a relative movement during which the device and elements are successively in cooperative relation, and means for supplying power to said device under the control of said reading means.

27. In a knitting machine, the combination of a circular needle bed rotating on a vertical axis, a circular series of needles mounted on the circular needle bed, a group of selectively operable elements for actuating the needles to cause them to take part in the knitting operation, and means for selecting the elements including a cylindrical pattern mounted for rotation on a vertical axis and offset from the circular needle bed, means for rotating the pattern with the circular needle bed, means for reading the pattern, an electromechanical translating device, means for giving the device and elements a relative movement during which they come successively into cooperative relation with one another, and means under the control of the reading means for supplying energy to the device in accordance with the variations in the pattern.

28. In a knitting machine, the combination of a circular needle bed rotating on a vertical axis,

a circular series of needles carried by the circular needle bed, a group of selectively operable elements for actuating the needles to cause them to take part in the knitting operation, and means for selecting said elements including a cylindrical pattern mounted offset from the circular needle bed, means for rotating the pattern in synchronism with the circular needle bed, means for reading the pattern, an electromagnetically operated hammer operable to strike and move individual elements, means for giving the hammer and elements a relative movement during which the hammer comes into cooperative relation with the elements successively, and means under the control of the reading means for operating the hammer in accordance with variations in the pattern.

29. In a knitting machine, the combination of a plurality of needles arranged in a circular series, a plurality of selectively operable elements for actuating the needles to cause them to take part in the knitting operation, and means for selecting the elements to be actuated including a hammer, means for moving the elements relative to the hammer to cause them to be presented successively thereto, an electromagnet for operating the hammer to cause it to strike and move individual elements, a source of power for the electromagnet, a pattern, means reading the pattern and controlling the supply of power from the source to the electromagnet in accordance with variations in the pattern, and means for giving the pattern and reading means a relative movement.

30. The combination with a circular knitting machine of the multiple feed type having needles and associated jack members arranged in an endless series, and a cam at each feed operable to move the members to cause their corresponding needles to knit, of a control mechanism which includes an electromechanical translating device at each feed except one operable to select the members to be actuated by the cam at said feed, a pattern for each such device, and a reader for reading each pattern and controlling the operation of the associated device in accordance with the requirements of the pattern.

31. In a circular knitting machine of the multiple feed type having needles and associated jack members arranged in an endless series, a cam at each feed operable to move the members to select their corresponding needles for knitting, an electromechanical translating device at each feed except the last operable to select the members of needles to knit at said feed, means adjacent each device to cause the members of needles which have knit at the feed of said device to reach the following device out of selective relation thereto, a pattern for each device, and a reader for reading each said pattern and controlling the operation of the device in accordance with the pattern.

32. In a circular knitting machine of the multiple feed type having needles and associated jack members arranged in an endless series, a cam at each feed operable to move the members to select their corresponding needles for knitting, an electromechanical translating device at each feed except the last operable to select the members of needles to knit at said feed, means adjacent each device to cause the members of needles which have knit at the feed of said device to reach the following device out of selective relation thereto, a pattern for each device, each pattern carrying a representation of the parts of the pattern to be formed of the yarn supplied at the feed of said device, and a reader for reading each said pattern and controlling the operation of the device in accordance with the pattern.

33. A pattern control mechanism for circular knitting machines of the multiple feed type which comprises a device at each feed except one for selecting the needles to knit yarn at said feed, a pattern for each device, each pattern bearing a background and a representation of the parts of the pattern to be knit of yarn at the feed of said device, and a reader reading each pattern and controlling the operation of the associated device in accordance with the pattern.

34. A pattern control mechanism for circular knitting machines of the multiple feed type which comprises a plurality of devices, each at a feed, for selecting the needles to knit yarn at said feed, a pattern for each device, each pattern bearing a representation on a neutral background of the parts of the pattern to be knit of yarn at the feed of said device, and a reader reading each pattern and controlling the operation of the associated device in accordance with the pattern.

ALBERT E. PAGE.

CERTIFICATE OF CORRECTION.

Patent No. 2,225,842. December 24, 1940.

ALBERT E. PAGE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 3, for the word "transmitted" read --transmuted--; line 20, for "patterns" read --pattern--; page 6, first column, line 28, for "regulating" read --regular--; page 8, first column, line 1, claim 9, for "fed" read --feed--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of January, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.