Feb. 7, 1933. V. LOMBARDI 1,896,635

KNITTING MACHINE

Filed Jan. 19, 1931 4 Sheets-Sheet 1

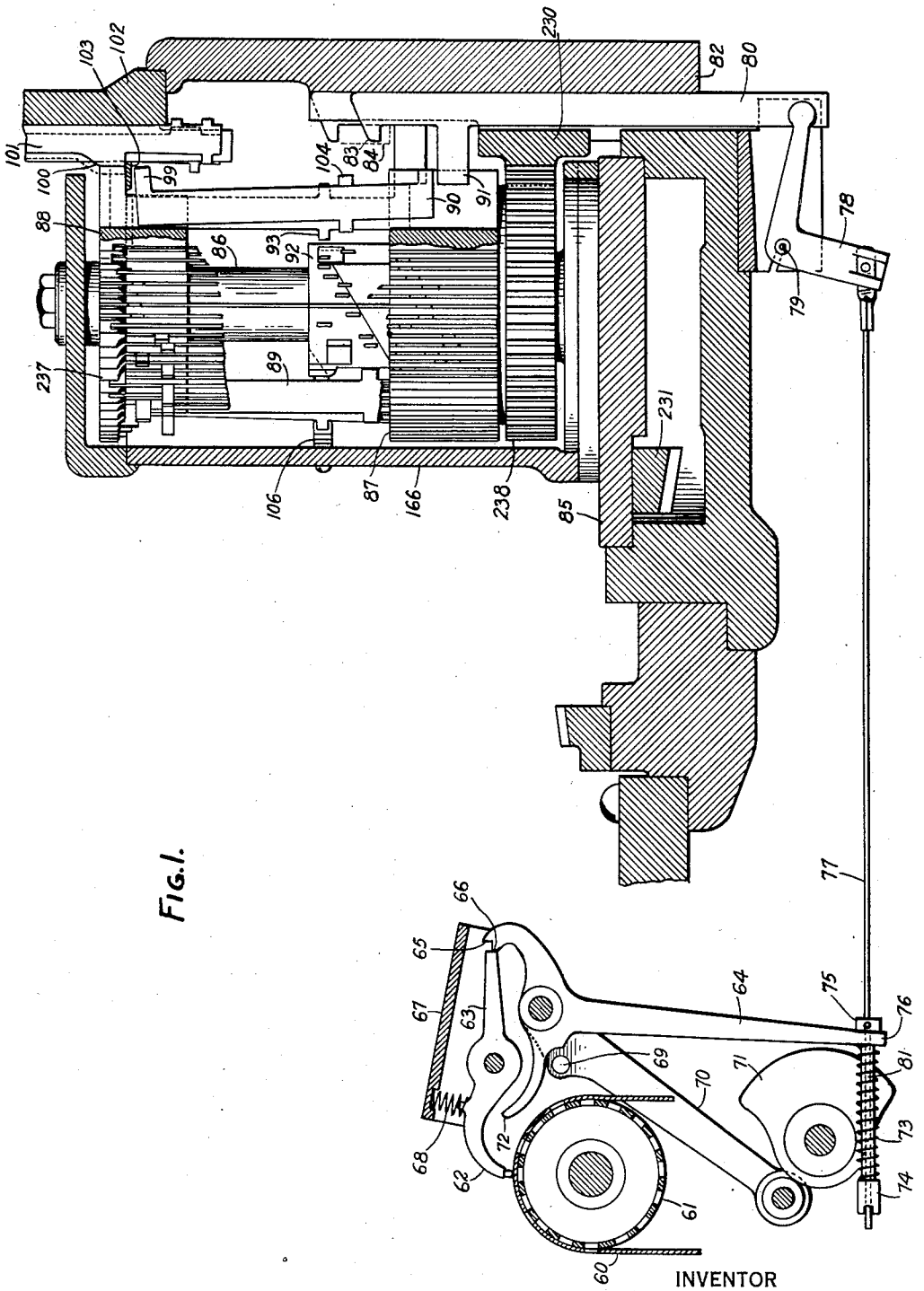


FIG. 1.

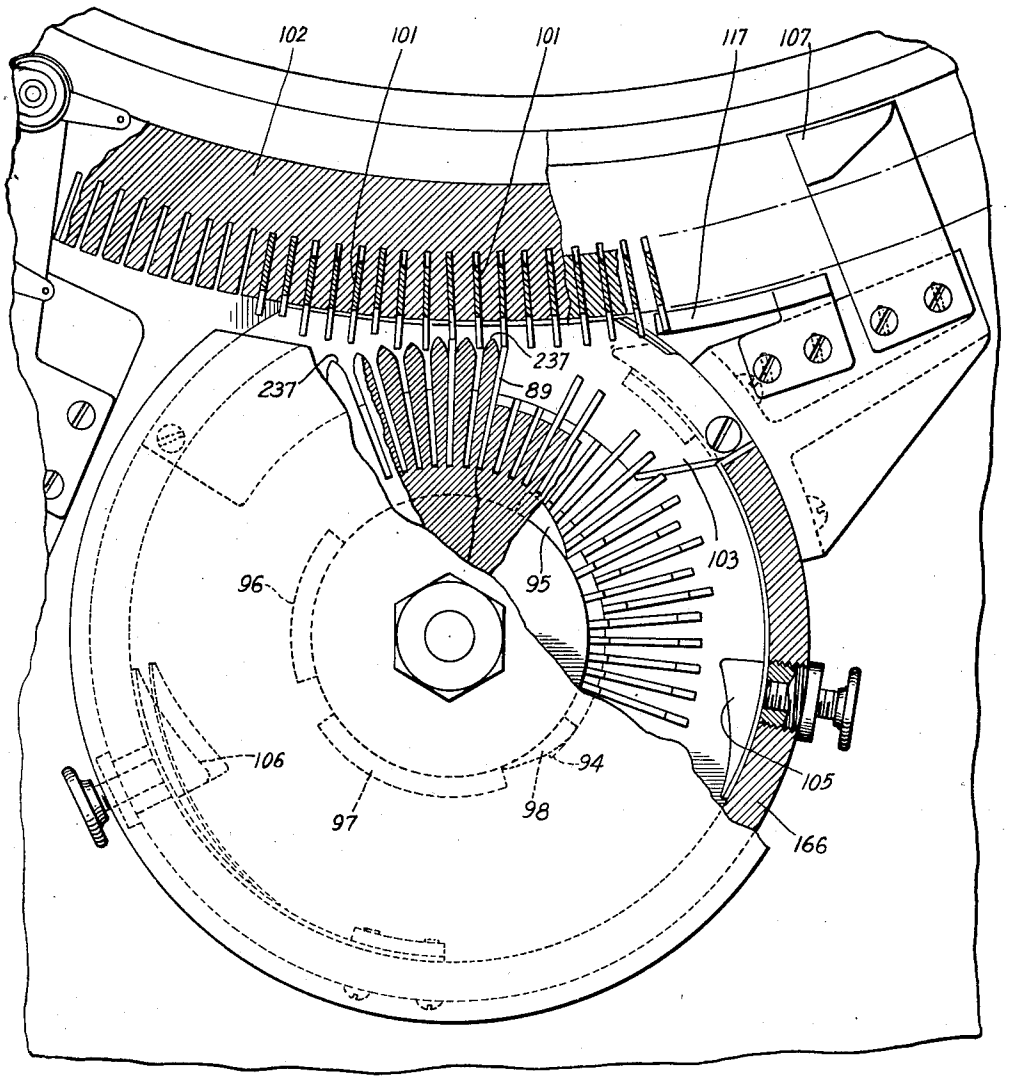
INVENTOR
VINCENT LOMBARDI
BY Bennett & Jackson
ATTORNEY

Feb. 7, 1933. V. LOMBARDI 1,896,635

KNITTING MACHINE

Filed Jan. 19, 1931 4 Sheets-Sheet 2

FIG. 2.



INVENTOR
VINCENT LOMBARDI
BY Bennett H Jackson
ATTORNEY

Feb. 7, 1933. V. LOMBARDI 1,896,635

KNITTING MACHINE

Filed Jan. 19, 1931 4 Sheets-Sheet 3

FIG.5.

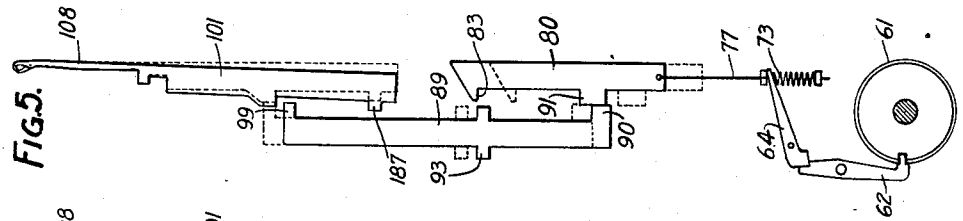
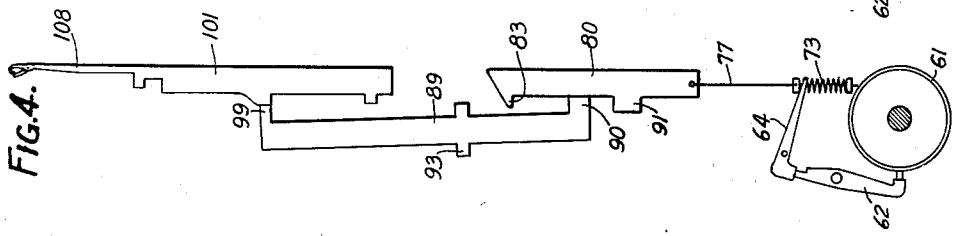


FIG.4.



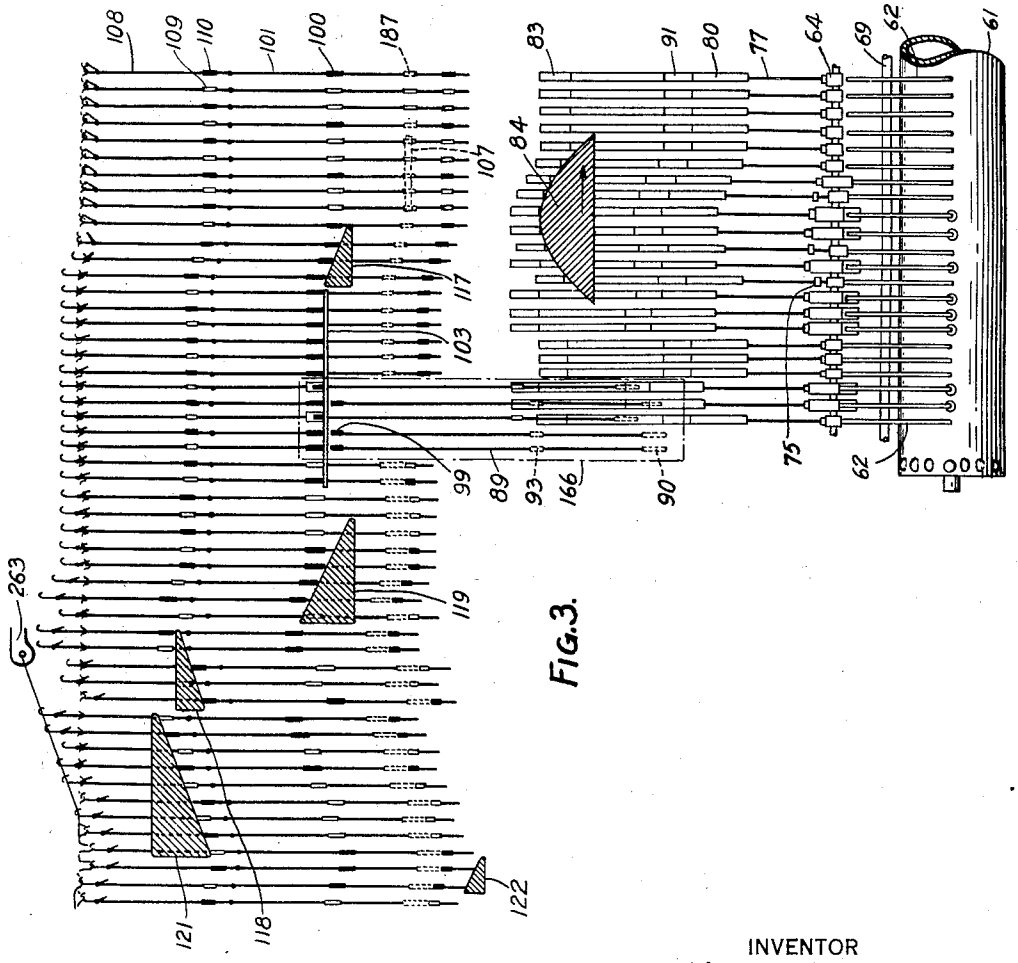


FIG.3.

INVENTOR
VINCENT LOMBARDI
BY Bennett K. Jackson
ATTORNEY

Feb. 7, 1933. V. LOMBARDI 1,896,635

KNITTING MACHINE

Filed Jan. 19, 1931 4 Sheets-Sheet 4

FIG. 6.

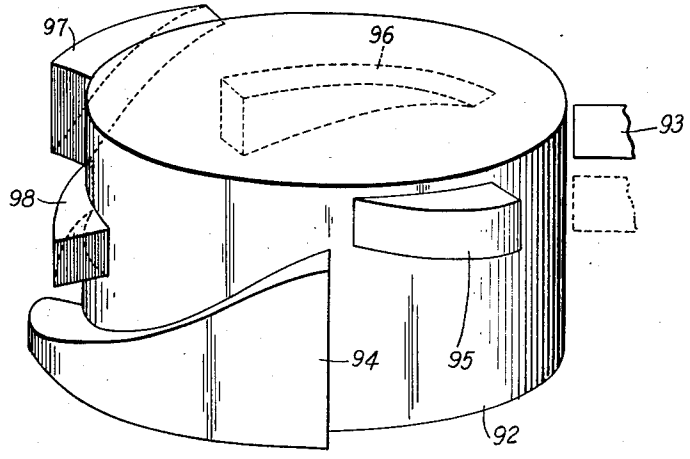


FIG. 7.

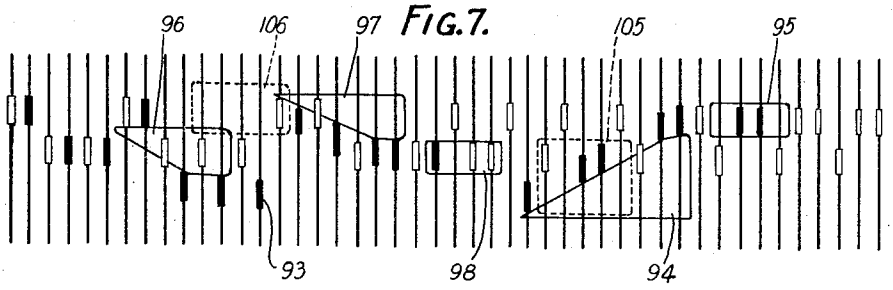


FIG. 8.

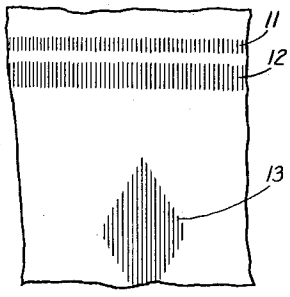


FIG. 9.

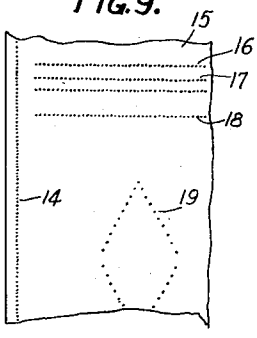
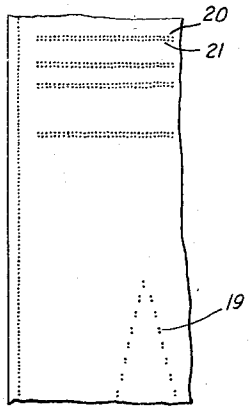


FIG. 10.



INVENTOR
VINCENT LOMBARDI
BY Bennett K. Jackson
ATTORNEY

Patented Feb. 7, 1933 1,896,635

UNITED STATES PATENT OFFICE

VINCENT LOMBARDI, OF BROOKLYN, NEW YORK

KNITTING MACHINE

Application filed January 19, 1931. Serial No. 509,656.

This invention relates to knitting machines and constitutes a division in part of my patent application Serial No. 473,212 filed August 5th, 1930, Patent Number 1,866,945.

An object of this invention is to provide improved control apparatus for a knitting machine which is simple in construction, readily adjustable, capable of a wide variety of uses, and adapted for ready and efficient operation.

A more specific object is to provide an improved pattern control mechanism capable of being operated by a simple type of pattern—determining medium, such as a perforated strip of paper, in which a change in the characteristics of said medium is required only when a change is desired in said mechanism.

The invention accordingly comprises the features of construction, combinations of elements, and arrangements of parts, which will be exemplified in the constructions hereinafter set forth and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of this invention, reference is made to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a sectional view of a portion of a knitting machine embodying the pattern control mechanism of this invention;

Fig. 2 is a top view of a pattern control drum employed in the mechanism of Fig. 1;

Fig. 3 shows in schematic form a portion of the needle lay-out along with the controlling cams and pattern control mechanism of this invention;

Figs. 4 and 5 are schematic representations to accompany Fig. 3 to show the various elements involved in controlling a needle in accordance with the characteristics of a pattern medium;

Fig. 6 represents a drum cylinder carrying cams and used in the mechanism of Fig. 1;

Fig. 7 is a schematic lay-out of the cams on the cylinder of Fig. 6;

Fig. 8 represents a knitted fabric having a pattern of the type that may be produced by the use of the mechanism of this invention;

Fig. 9 illustrates one type of paper pattern that may be employed to produce the fabric of Fig. 8; and

Fig. 10 illustrates an alternative type of paper pattern.

Fig. 1 discloses a sectional view of a knitting machine of the circular type embodying the present invention. The more general details of the machine are disclosed in my application Serial No. 473,212 filed Aug. 5, 1930 of which this is a division in part and to which reference is made. The present invention in its more specific aspects is concerned with the pattern drum rotating around the needle cylinder for controlling the needles in accordance with the characteristics of a pattern medium.

The apparatus for enabling the knitting of the needles to be automatically determined by the pattern medium such as a perforated paper pattern strip 60 will now be described.

The controlling apparatus immediately adjacent the pattern strip 60 is quite similar to the apparatus disclosed in my prior patent application Serial No. 320,111, filed Nov. 17, 1928, Patent No. 1,792,647 to which reference is made. The pattern strip 60 is mounted on a rotatable drum 61 mounted on a stationary part of the machine and arranged by suitable apparatus to be given a step-by-step movement at proper intervals. Two sets of pivoted levers, 63, 64 are associated with the pattern sheet. The fingers 62 of the set of levers 63 are adapted to be periodically raised away and subsequently lowered to either contact with the pattern sheet or pass through perforations therein. A rotating cam 71 periodically lifts the arm 70, pivoted at its upper end, to cause the rod 69, to rotate each lever 64 a small distance in a clockwise direction, which will cause one end 72 of the lever to raise the fingers 62 away from the pattern. These fingers are normally biased by springs 68 inside the housing 67. If a finger 62 is resting at any particular time on top of the paper pattern the other end of lever 63 is against shoulder 66, but if finger 62 should find a hole in the pattern the opposite end of

that lever 63 would rest against shoulder 65. The lower end of each lever 64 is apertured through which a small hollow rod 81 passes, having an adjustable stop 75 on one end and an adjustable nut 74 on the other end. A spring 73 tends to keep end 76 of the lever against the stop 75. A wire 77 passing through the tube 81 and fastened by a set screw in stop 75 leads to a bell crank lever 78 pivoted at the point 78. The other arm of this bell crank lever 79 rests in a socket in the lower end of a vertical jack 80 which is located in an external slot of the stationary cylinder 82.

The upper end of each jack 80 has cam projection 83 so that the jacks 80 may be periodically raised by a rotating cam 84. It will be apparent that after the passage of cam 84 each jack 80 corresponding to a finger which found a perforation in the pattern sheet will remain elevated while those jacks 80 corresponding to fingers finding no holes will be lowered again due to the action of springs 73.

The pattern determining actuations of jacks 80 are transferred to the needle jacks by a special mechanism 166 mounted for movement around the needle cylinder, part of the mechanism rotating on its axis in response to this movement. Mounted on the rotating dial 85 which moves around the needle cylinder is a fixed shaft 86. Suitably supported at the upper and lower ends of this shaft are two similar drums 87, 88 which are freely rotatable about the shaft 86. Each of these drums 87, 88 is slotted in its external surface and slidable elements 89 rest in corresponding slots in both drums. The lower end of each element 89 has a projection 90 which is adapted at times to contact with the part 91 of one of the jacks 80.

A cam cylinder 92 is mounted on shaft 86 in a non-rotatable manner and the details thereof are disclosed more particularly in Fig. 6 to which reference is made. Several cams are mounted on the cylinder 92 which cooperate with projections 93 on the slidable elements to give desired actuations thereto. If we assume an element 89 with its projection 93 in its upper and inner position, having been pushed in by a jack 80 it will ride on top of cam 96 but will be lowered by cam 97 and then pushed outwardly by cam 98 so that it is left in its lowered and outer position until a change is desired, when the said change will be made by the pattern sheet 60. The said projection 93 has therefore been changed from an upper and inner position to its lower and outer position. On the other hand, if we assume an element 89 with its projection 93 in its lowered and inner position, the said element 89 will be further lowered by cam 96 and will not be affected by cam 98 but will be raised by cam 94 and then pushed outwardly by cam 95 to its upper and outer position. Once the slidable element 89 has been given a selective inner setting by pattern sheet 60, the rotation of the slidable element around the cam cylinder 92 will cause the cams on cylinder 92 to raise those elements 89 that were previously in a lowered position and will lower those that were previously in a raised position. This means that the slidable elements once they have been selectively set and operated upon by cam cylinder 92 will continue to have that setting until a different setting is desired, i. e.: the elements 89 do not have to be set for each revolution around the needle cylinder as long as no change in the pattern is desired. For example if one projection 93 is in its upper and outer position because its corresponding finger 62 found a hole in pattern 60, it will remain in its upper position until its corresponding finger 62 encounters another hole in the pattern (which may not occur until the cylinder 61 has been stepped several times), whereupon it will be pushed in by jack 80 and then changed to a lowered position by cam cylinder 92. It will now remain in a lowered and outer position until its finger 62 encounters another hole later in the pattern sheet 60 whereupon the projection 93 will be pushed in by its jack 80 and then changed to its upper position by cam cylinder.

The pattern sheet 60 is therefore of novel design in that a hole is inserted therein along a line parallel to its length only when a change in the knitting of a particular needle is desired. Thus, for example the first hole in such a row under one finger 62 may mean that its needle will knit. This needle will continue to knit until a second hole appears in the pattern under said finger thereupon the said needle will interlock and continue to interlock until a third hole appears. This reduces considerably the number of holes required in a pattern sheet to produce a given pattern.

The manner in which the cams on cylinder 92 operate is illustrated schematically in Fig. 7. The projections 93 that are in their inward positions are shown as solid rectangles in Fig. 7, while the unfilled rectangles 93 represent projections 93 in their outer positions.

Each element 89 at its upper end has a projection 99 which is adapted to contact with a projection 100 on a needle jack 101 to push the needle jack inwardly into its slot in the needle cylinder 102 providing the said element 89 is in its raised position. If however any element 89 is in its lowered position it will not actuate its corresponding needle jack. The upper and lower positions of projections 99 are separated by a thin semi-annular plate 103 which insures that at the time each element 89 is adjacent the needle jacks there will be no danger that some slidable elements 89 will be at an undesired height. This plate

103 does not rotate with the drums 87, 88 but is stationary in the designated position as it is carried with the shaft 86 around the needle cylinder 102.

The outer projections 104 on the slidable elements 89 may be used at times in connection with the setting of the elements 89 by the manually operated cams 105 and 106, see Figs. 1, 2, and 7. If cam 106 is screwed in to be in operative position, it will contact with butts 104 on all slidable elements 89 in an upper position so that all those projections 93 which before the actuation by cam 106 were in their upper outer positions will be placed in their lower outer positions by the subsequent operation of cams 97 and 98. Those projections 93 which at the time of the placing of cam 106 into operation were in their lower outer position will of course remain there and those that happened to be in their lower inner positions will be raised by cams 94, 95 to their upper outer positions where they will be immediately actuated by cams 106, 97, 98 and ultimately brought to a lower outer position. This means that when cam 106 is operative all projections 93 will be placed in their lower outer positions. By a similar operation it will be apparent that cam 105 when placed in the path of projections 104 will cause all projections 93 to be in their upper outer positions. Hence with cam 106 operative all needle jacks 101 will remain out of their slots and by apparatus to be described later will cause all needles to knit loops, while if cam 105 is made operative all needle jacks 101 will be pushed into their slots and all needles will produce the interlock fabric.

It is of course to be assumed that in the needle cylinder 102 of Fig. 1 above the jacks 101 are needles (not shown) which needles are suitably controlled in their knitting operations by whether or not the jack 101 for each needle is pushed inwardly by the pattern drum 166 or is permitted to remain in an outward position. The exact manner in which this may be accomplished is described in my patent application Serial No. 473,212.

For simplicity it will be assumed that the disclosed machine has only two yarn feeds (only one of which is shown in Fig. 3) and that the machine is capable of producing an interlock fabric of the type shown in my U. S. Patent No. 1,426,576. Alternate needles preferably have long butts while the remaining needles have short butts.

A top view of the pattern mechanism 166 is disclosed in Fig. 2, wherein it is shown that the upper part of drum 88 has a plurality of ridges 237 for forming a tooth rack or gear, each tooth fitting into the space between adjacent needle jacks 101. The slidable elements 89 previously described fit in the slots between adjacent teeth 237 so that the meshing of teeth 237 and needle jacks 101 insures that each slidable element 89 will actuate, when desired, its corresponding needle jack 101. The two drums 87, 88 are positively rotated by the meshing of gear 238 integral with drum 87 and a tooth rack 230 mounted on the stationary cylinder, (see Fig. 1). The passage of the pattern drum 166 around the needle cylinder is secured by the tooth rack 231 mounted below the dial 85 and driven by a suitable source of power.

There now remains to be described the schematic view of the needle lay-out as shown in Fig. 3. The condition of the needles at the extreme right of Fig. 3 represents their positions immediately after the passage of a yarn carrier and after all needles have been retracted, so as to place all parts in condition to receive pattern determinations prior to the passage of the next yarn carrier. In the preferred form of this invention alternate needles have long butts while the remaining needles have short butts. This is shown in Fig. 3 where needle 109 is a short butt needle and needle 110 is a long butt needle.

With the parts in the position shown in Fig. 3, the levers 62 are now raised, the pattern paper cylinder 61 stepped one step and the levers 62 brought down again against the paper pattern or through holes therein, for example as shown for the cylinder 61 in the figure. After this new setting of fingers 62, cam 84 passes along in the direction of the arrow advancing all slidable elements 80, some of which will remain advanced while others will be subsequently retracted by springs 73, depending on whether or not the corresponding finger 62 encountered a perforation in the pattern. A rotating cam 107, suitably mounted on a cam cylinder operates at about the same time as cam 84 to contact with butts 187 and to push outwardly the lower ends of all the needle jacks 101 in order that they may be later selectively actuated. A rotating cam 117 then raises all needle jacks 101 to cause all needles to be partially raised to interlock position. This causes all the cam surfaces 100 to ride on top of the separating plate 103 when the rotatable pattern drum 166 now passes the needle jacks.

Each needle jack 101 is now selectively actuated by the upper ends of slidable elements 89 in accordance with the settings previously introduced by the last passage of drum 166 over the jacks 80; at the same time the lower ends of the drum elements 89 are receiving pattern determinations for subsequently controlling the needles in the order they are encountered after the new actuations of the lower ends of elements have been transferred to the upper ends of said elements. That is, while drum 166 is passing over the needle section shown, the pattern actuations impressed on the needles of that section are not those being given at that instant to the

lower ends of elements 89, but correspond to the settings of the said lower ends on their prior passage over that section. The manner in which the upper ends control the needle jacks and the manner in which the lower ends are controlled by the jacks 80 have been described in connection with Fig. 1.

It follows therefore that slidable elements 89 will push inwardly certain of the needle jacks of the needle section shown, while allowing others to remain in their outer positions.

The needle jacks will next be controlled by cam 119 to raise to knitting position those needles whose jacks have remained in an outward position after being controlled by drum 166. The long butt needles that were previously raised to interlock position are now lowered by cam 118, although cam 118 does not actuate any long butt needle that has been raised to full knitting position. Cam 121 then lowers all needles to a sub-normal position, after which they are raised to their normal retracted position by the cam 122. This completes the cycle of operations for the needles of the disclosed needle section as far as yarn feed 263 is concerned and it is evident that a similar description applies to the control of the needles of the other sections of the machine.

Figs. 4 and 5 have been placed alongside Fig. 3 in order to aid in the identity of the various parts shown only schematically in Fig. 3. Fig. 4 shows an element 80 in a retraced position caused by the absence of a hole in the paper pattern for its finger 62 while Fig. 5 shows an element 80 in an advanced position caused by the presence of a hole in the paper pattern for its controlling finger 62.

Fig. 8 illustrates schematically a type of fabric that can be produced by the machine of this invention. It is assumed to be of the interlock type as disclosed in my U. S. Patent No. 1,426,576 patented Aug. 22, 1922. It is assumed to be made of yarn of two colors, black and white. The black line portions 11, 12 and 13 represent loops of black yarn with the white yarn interlocked in the rear of the fabric while the white portions between the portions 11, 12 and 13 represent loops of white yarn with the black yarn interlocked in the rear of the fabric.

One form of paper pattern that may produce the fabric of Fig. 8 is shown in Fig. 9. The holes 14 on the edge of the paper sheet are intended to receive the sprocket teeth on the cylinder 61 and the distance between two adjacent holes of this row is the distance the paper would be normally moved for each yarn feed passing the jacks 80. The fabric of Fig 8. however is a two color interlock fabric so that when a change is desired for say a black yarn feed it follows that there must also be a change for the immediately following white yarn feed, for example to change the black yarn from loops to interlock and the white yarn from interlock to loops. Therefore when a row of holes appears in the paper pattern of Fig. 9 for the fingers 61 for controlling the needles for a black yarn feed, the same row of holes may be utilized to exercise the desired control for the next white yarn feed, since the presence of a hole in the pattern means a change either from interlock to loops or from loops to interlock. This means that the paper pattern of Fig. 9 is advanced only for every other yarn feed. The upper portion 15 of the pattern has no holes and it is assumed that the machine is knitting white loops with the black yarn interlocked as shown in the upper portion of the fabric of Fig. 8. As soon as the fingers 61 encounter the holes in row 16 the change means a reversal for both the black and the white yarns and the black yarn is looped and the white interlocked and no more holes are required in the pattern until another reversal is desired; this gives the black portion 11 of the fabric. As soon as the fingers 61 reach row 17 the next reversal takes place and white loops are knitted until row 18 is reached whereupon black loops are knitted again. That is each needle will knit say black loops until its controlling fingers 61 hits a hole, whereupon it will knit white loops and continue to knit white loops until its controlling finger 61 hits another hole. It will be apparent that this simplifies greatly the character of the paper pattern required to produce a complicated pattern in a multicolor fabric. Thus the holes 19 defining the outline of a diamond are all that are needed to produce the solid black diamond 13 in the knitted fabric.

The paper pattern of Fig. 10 will also produce the fabric of Fig. 8 but it is assumed for this paper pattern that the paper is advanced for each yarn feed. This requires two sets of holes 20 and 21 to do the same work as is accomplished by the single row 16 of Fig. 9. A duplication of the holes is also shown in the other parts of Fig. 10 over that of Fig. 9 for the same reason.

While only one embodiment of the invention has been disclosed above it is to be understood that the invention may possess widely different forms without departing in any wise from the spirit of this invention as defined in the appended claims.

What is claimed is:

1. A knitting machine comprising a circular row of needles, a pattern sheet having rows of similar perforations therein, a pattern drum rotating around said needles and simultaneously rotating on its own axis, adjustable elements supported by said drum, and means comprising one of said elements and responsive to one of said perforations in one row for partially advancing one of said

needles and subsequently responsive to another perforation in said one row for fully advancing said one needle.

2. A knitting machine comprising a row of yarn controlling elements, and controlling means for said elements comprising a drum having adjustable jacks thereon arranged in a circular path around the axis of said drum, cam means located inside said path for controlling said jacks, and means for rotating said drum around its own axis and for moving said drum past said row.

3. A knitting machine comprising a row of yarn controlling elements, spaced drums on a common axis, adjustable jacks jointly supported by a plurality of said drums for controlling said elements, cam means spaced between said drums and inside the circle of said elements for controlling said jacks, and means for rotating said drums on their common axis and for moving said drums along said row.

4. A knitting machine comprising a circular row of needles, adjustable elements arranged in a circular path, for controlling said needles, spaced means for supporting said elements in an adjustable manner, means for moving said spaced means around said needle row and for rotating said spaced means in response to said movement, and cam means located between said spaced means and inside the circle of said elements for controlling said elements.

5. A knitting machine comprising a circular row of yarn controlling elements, a plurality of spaced rotatable members each containing a plurality of slots, adjustable jacks each extending from a slot in one member to a slot in another member, means for rotating said members around their common axis and for moving said members along said row, said elements being responsive to said jacks, each of said jacks being capable of assuming an advanced or a retracted position, pattern means for actuating said jacks in both of said positions, and cam means located inside the circle of said jacks for subsequently causing a change in the positions of said jacks.

6. A knitting machine comprising a circular row of needles, a plurality of spaced rotatable members each containing a plurality of slots, adjustable jacks each extending from a slot in one member to a slot in another member, means for rotating said members around their common axis and for moving said members around said row, said needles being responsive to said jacks, each of said jacks being capable of assuming an advanced or a retracted position, pattern means for actuating one jack that is in an advanced position and for similarly actuating a second jack that is in a retracted position, and cam means inside the circle of said jacks for subsequently causing the retraction of said one jack and the advancement of said second jack.

7. A knitting machine comprising a circular row of needles, a dial rotating around said row, pattern mechanism mounted on said dial, said mechanism comprising a plurality of spaced slotted members mounted for rotation about their own axis, adjustable jacks in said slots and jointly supported by said members for controlling said needles, a butt on one side of each jack, a second butt on the opposite side of each jack, pattern means for actuating said jacks through said first butts and cam means for actuating said jacks through said second butts.

8. A knitting machine comprising a needle cylinder, needles mounted in grooves in said cylinder, a dial mounted for rotation around said cylinder, a slotted member mounted on said dial and rotating on its own axis, adjustable jacks mounted in said slots for controlling said needles, movable elements mounted on a stationary part of said machine for controlling said jacks, said elements being equal in number to said jacks, a perforated pattern having a series of perforations corresponding to the control desired of each jack, and means whereby a first perforation for one jack will cause a definite setting of said one jack to cause one type of control of its needle, and whereby the next succeeding perforation for said one jack will cause a different setting of said one jack.

9. A knitting machine comprising a circular row of needles, a pattern drum mounted for movement around said row and rotating on its own axis in response to said movement, slidable jacks mounted in grooves in said drum said jacks being capable of longitudinal movement in a direction parallel to the axis of said drum to an advanced or retracted position and also capable of movement at right angles to said axis, pattern means for depressing one of said jacks occupying an advanced position and for depressing one of said jacks occupying a retracted position, and cam means operating on the side of the jacks adjacent said axis for causing said retracted jack to be advanced and for causing said advanced cam to be retracted.

10. A knitting machine comprising a circular row of needles, a pattern drum mounted for movement around said row and rotating in response to said movement for controlling said needles, movable elements on said drum, a pattern mechanism having different configurations thereon, means whereby the first occurrence of a given type of configuration in said mechanism will cause a specified movement of one of said elements and the second occurrence of said given type of configuration will cause a different movement of said one element, and cam means for actuating said one element between its control by said

first and said second occurrences of said given type of configuration.

11. A knitting machine comprising a row of needles divided into a plurality of groups for control purposes, a pattern sheet for said machine having a plurality of perforations arranged in said sheet in predetermined positions whereby a plurality of rows of perforations are present lengthwise of the sheet, and means whereby one of the perforations in one row causes one needle in each of said groups to be fully advanced while permitting other needles in each group to be partially advanced and the next succeeding perforation in said row causes said one needle in each group to be partially advanced while permitting other needles in each group to be fully advanced.

12. A knitting machine in accordance with claim 11 in which all of said perforations are of equal size.

13. A knitting machine comprising a row of needles divided into a plurality of groups for control purposes, a pattern sheet for said machine having a plurality of perforations arranged in said sheet in predetermined positions whereby a plurality of rows of perforations are present lengthwise of the sheet, means for giving said sheet a step-by-step movement, a plurality of fingers arranged to be periodically actuated towards said sheet to cause the extent of the movement of each finger to be determined by the presence or absence of a perforation in that portion of the sheet opposite the finger at that particular instant, and means whereby the passage of one finger through a perforation causes one needle in each of said groups to be partially advanced while permitting other needles in each group to be fully advanced and the passage of said one finger through the next succeeding perforation causes said one needle in each group to be fully advanced while permitting other needles in each group to be partially advanced.

14. A knitting machine comprising a circular row of needles divided into a plurality of groups for control purposes, pattern mechanism having different configurations thereon, pattern repeating means comprising movable elements for selectively actuating certain needles in one group in a certain manner and actuating other needles in said one group in a different manner and subsequently exerting the same selective control on corresponding needles of a second group, said selective actuations depending upon the relative positions of said movable elements, means whereby the first occurrence of a given type of configuration in said mechanism will cause a specified movement of one of said elements and the second occurrence of said given type will cause a different movement of said one element, and cam means for actuating said one element between said first and said second occurrences of said given type of configuration.

In witness whereof I have hereunto subscribed my name this 23rd day of December, 1930.

VINCENT LOMBARDI.