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PATTERN DEVICE FOR CIRCULAR KNITTING MACHINES
HAVING ROTARY NEEDLE CARRIERS

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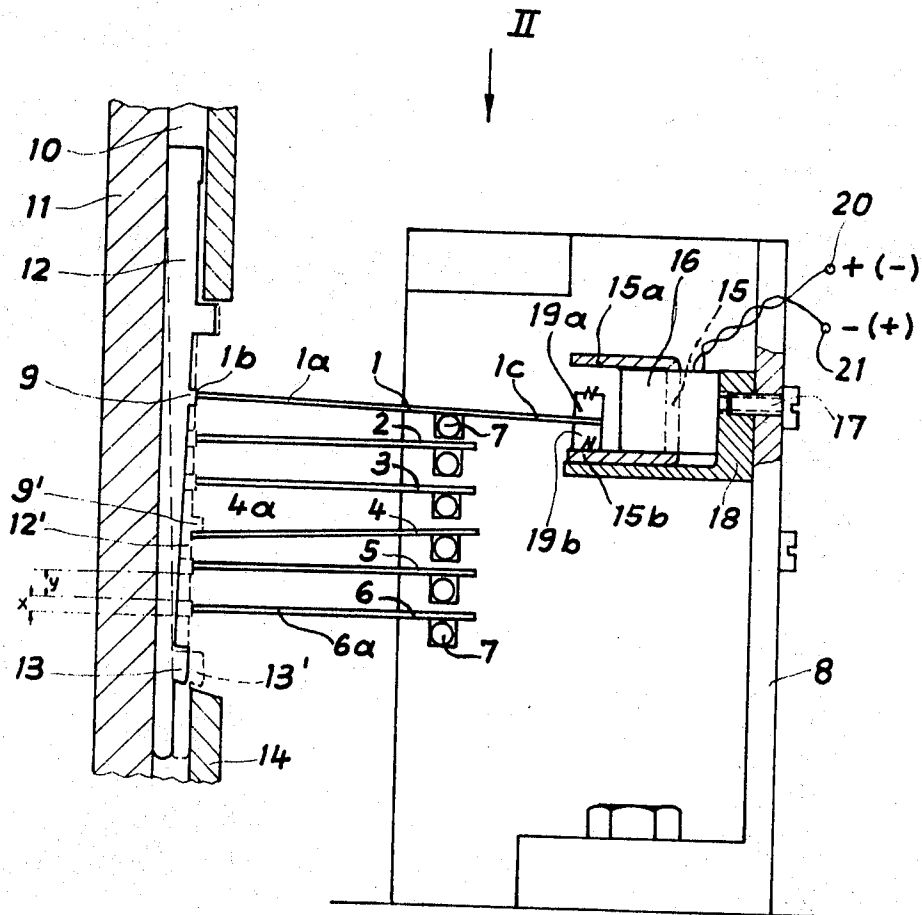


Fig. 1

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5 Claims

ABSTRACT OF THE DISCLOSURE

A pattern structure for a circular knitting machine. The machine includes a rotary needle carrier provided with a plurality of control plates or jacks which control the needles and which respectively have pattern feet. A plurality of armature means respectively coact with the pattern feet to control the positions of the control plates, and each armature means is supported for swinging movement immediate its ends, one end being adapted to engage a pattern foot and the other end carrying a permanent magnet means. A plurality of electromagnets respectively coact with the permanent magnet means, and each electromagnet includes a pair of opposed pole shoes between which a permanent magnet means is located and a direct current exciting coil which will control the polarity of the pole shoes depending upon the direction of the direct current. In this way with a single impulse of direct current it is possible to swing an armature means, and when the pulse of current terminates the permanent magnet means will maintain the armature means in the position to which it has been displaced.

CROSS-REFERENCE TO RELATED APPLICATION

A structure similar to that of the instant application is disclosed in U.S. patent application Ser. No. 617,577, filed Feb. 21, 1967, now U.S. Pat. No. 3,461,690.

BACKGROUND OF THE INVENTION

The present invention relates to pattern devices for circular knitting machines which have rotary needle carriers.

In particular, the present invention relates to that type of circular knitting machine where the selection of needles is carried out by means of electromagnetically actuated control members which, in accordance with a predetermined pattern, will control the positions of control plates or jacks which are carried by the rotary needle carrier.

There are known pattern devices for knitting machines where selections are carried out in an electromagnetic manner in accordance with a predetermined preselected pattern. With devices of this type, as shown, for example, in German Pat. 438,387, there are arranged in the vicinity of the jacks or needle-controlling plates armatures of electromagnets which are energized to control the positions of the needle-controlling plates. Constructions of this type have the great disadvantage of situating the pattern feet so close to each other that those which are not to be selected are nevertheless located in the region of stray flux of the energized electromagnetic structure so that there is the danger that control plates adjoining those which are to be selected are also moved in an undesirable manner resulting in faulty pattern control of the knitting as well as in the possibility of damaging of the control plates.

In order to avoid this disadvantage with the known

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construction, a structure as shown in the above-referred to application, has already been provided where the armature of an electromagnet acts directly as a member for controlling the position of a control plate, this armature having for this purpose an inclined end surface on which a pattern foot of a control plate is adapted to ride so that the control plate will be swung into its guiding groove or trick of the rotary needle-carrier so that the pattern foot can be displaced to a location out of engagement with a knitting cam which otherwise would shift the control plate. With this construction each armature requires a pair of separate special electromagnets.

The provision of such a pair of separate special electromagnets is of a certain disadvantage in that it requires space to accommodate these electromagnets as well as the structure for controlling the same. Furthermore, the electromagnets must be maintained in a condition of constant energization for maintaining the armatures in their proper positions. Otherwise the armatures will, for example, as a result of rebounding, not be capable of remaining stably in the required positions.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide a construction which will avoid the above drawbacks.

In particular, it is an object of the invention to greatly improve the structure as shown in the above application by providing a construction which requires even less space while at the same time having a simplified electrical control structure and reducing the amount of energy which is required for operation.

In particular, it is an object of the invention to provide a construction where the armatures when displaced will not rebound and instead will reliably be maintained stably in the positions to which they are displaced, without, however, requiring constant energizing of electromagnets for this purpose.

In accordance with the present invention these objects are achieved by providing each armature at its end which is distant from the pattern feet with a permanent magnet structure situated between opposed pole shoes of an electromagnet which is excited in one direction or the other with direct current so as to control the polarity of the pole shoes. As an additional expedient, in order to reduce any tendency for rebounding of the armatures they are supported in accordance with the invention by a structure which eliminates all play in the supporting structure for the armatures.

The objects of the present invention also include the provision of a construction which can be readily adapted to existing machines so that it is not required to build entirely new machines to have the structure of the present invention.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1 is a schematic side elevation of a pattern structure of the invention, showing partly in section structures such as the needle cylinder and electromagnetic structure;

FIG. 2 is a top plan view of the structure of FIG. 1 as seen in the direction of arrow II of FIG. 1;

FIG. 3 is a sectional view, on an enlarged scale as compared to FIG. 2, taken through an adjustable bearing structure along line III of FIG. 2 in the direction of the arrow; and

FIG. 4 is a sectional elevation of another embodiment of a bearing structure for engaging an end of a shaft means of the invention.

PREFERRED EMBODIMENTS OF THE INVENTION

The pattern structure which is illustrated in a highly schematic manner in the drawings is used for the pattern selection of cylinder needles of a knitting system of a circular knitting machine. This structure includes, for example, six selecting armature means 1-6 in the form of swingable armature levers which are respectively turnable about shafts 7 on which the several levers are freely turnable without any play. These shafts are supported in a housing 8 composed of a plurality of plates, for example. Each of the adjusting armature means 1-6 includes an adjusting arm 1a, 1b, 1c, etc. which, as shown in FIG. 2, terminates at each arm in an inclined end surface, shown for the end surface 1b of the arm 1a, these inclined end surfaces being adapted to be engaged by the pattern feet 9 of the control plates or jacks 12 which are supported for movement in the guiding grooves or tricks 10 of the rotary needle-carrier means 11.

The several pattern feet 9 of the control plates 12 are arranged, in a manner known with mechanical pattern devices, at different elevations. In the illustrated example, the control plates 12 are arranged in groups of six wherein in each group the pattern feet are located successively at different elevations. Thus, for each group of six successive control plates 12 there are six pattern feet 9 located successively at different elevations and a separate armature means, of the several armature means 1-6, is provided for a particular one of the pattern feet 9. Thus, these pattern feet 9 of the successive plates 6 are offset with respect to each other in a stepwise arrangement so that in an unillustrated plan view, which is, however, shown in the above-mentioned application, the several pattern feet 9 of each group of six control plates are arranged along a helix which extends around the axis of the needle cylinder. In this way it is possible to provide a relatively large distance between successive control plates which are to be controlled by one of the armature means 1-6. As a result the rapidity with which the armature means must be actuated is reduced, so that the operations of the pattern device can be carried out with great reliability, which is of considerable significance. Each armature means can be adjusted in the period of time required for movement of one pattern foot at one elevation to the location previously occupied by the next pattern foot which is at the same elevation and which is six control plates distant from the first pattern foot, so that in accordance with the size of this time interval it is possible to provide relatively large switching tolerances for the structure which actuates the armature means, and such a construction also provides relatively large tolerances and the simplicity of the programming switch structure of the pattern device.

All of the pattern feet respectively have the same width x , and between a pair of successive pattern feet there is the same elevational distance y as illustrated in FIG. 2 of U.S. Pat. No. 3,461,690. As is shown in FIG. 1, each control plate 12 has a lower butt or foot 13 by means of which it can be swung into the guiding groove or trick 10 of the needle cylinder 11. Normally, each foot 13 will be situated in an outer position to engage a control cam 14 so that when a foot 13 is in the dotted line position 13' shown in FIG. 1 the cams will coact with the control plates 12 to displace the latter for shifting needles. In this way when the butts 13 are in the dotted line position 13' the control plates will participate in the operations and will be displaced through predetermined working strokes so that the needles which are respectively controlled by these control plates will be displaced to their operating positions.

The positioning of the control plates 12 and thus of their butts 13 is brought about by way of the swingable armature means 1-6 of the pattern structure. In the position of the part shown in FIG. 1, the swingable armature means 1-3, 5 and 6 are in their operating

positions where their pattern-foot engaging arms are in the position for engaging the pattern feet 9 of the corresponding control plates 12 so that these pattern plates will be swung into the grooves 10 of the needle cylinder 11 to prevent these particular control plates from participating in the operations. Thus, in this way the thus-displaced control plates 12 cannot reach the next operating positions, and the needles which are respectively controlled thereby remain in the rest positions. The armature means 4, however, is illustrated in a rest position where its adjusting arm 4a is situated beneath the pattern foot 9' which it otherwise would engage, and thus the corresponding control plate 12' will have its pattern foot 9' pass over the arm 4a so as not to be displaced thereby. Thus, the control plate 12' which is shown in dotted lines together with its pattern foot 9' remains in its outwardly swung position so that the control butt 13' of this particular control plate 12' along its working stroke to place the needle controlled will be actuated by the cam means and will be displaced thereby in an operating position.

FIG. 2 shows in plan view the details of the armature means 1 which has its adjusting arm 1a situated in an operating position where its inclined end surface 1b will be engaged by the corresponding pattern foot 9, and of course each sixth pattern foot 9 which is situated at the elevation of the arm 1a will ride along the surface 1b thereof to be swung inwardly to prevent these particular control plates from entering into the knitting operations. This result is achieved because only every sixth control plate has a pattern foot 9 which is situated at the elevation of the inclined end 1b of the armature means 1. For the sake of simplicity of illustration the control arms of the remaining armature means are not illustrated. The several swingable armature means are preferably supported for swinging movement about axes which pass through their centers of gravity, respectively, and for this purpose the several armature means 1-6 are supported for swinging movement on shafts 7 which respectively extend without play through bores of the several armature means. The several armature means 1-6 have arms 1c, 2c, etc. which are directed oppositely to arms 1a, 1b, etc. The arms 2c and 3c are fragmentarily illustrated in FIG. 2 and the remaining arms of the lower armature means 4-6 are respectively situated beneath the arms 1c-3c shown in FIG. 2.

The arm 1c as shown in FIG. 1 extends between the pole shoes 15a and 15b of an electromagnet 15 which is provided with a direct-current exciting coil 16, and the remaining control arms of the armature means which are respectively distant from the pattern feet 9 respectively extended into the spaces between the opposed pole shoes of identical electromagnets 15. These pole shoes 15a and 15b of each electromagnet form the outer ends of a U-shaped core of the electromagnet 15, and by way of a screw 17 a bracket 18 is fixed to a wall of the housing 8 and carries an electromagnet 15. As is shown for the armature arm 1c, each armature means has at its arm which extends between the pole shoes of the electromagnet a permanent magnet means which in the illustrated example consists of a pair of permanent magnet plates 19a and 19b of relatively small size respectively fixed to opposed faces of the armature arm 1c, and of course the remaining armature arms which are respectively situated between the pole shoes are also provided with small permanent magnets 19a and 19b. It will be noted that these permanent magnets are arranged with their north poles directly away from each other and with their south poles directed toward each other. Thus, the permanent magnet means 19a, 19b has identical poles respectively directed toward the pole shoes 15a and 15b of the permanent magnet means, and these identical poles are north poles in the illustrated sample.

In accordance with the particular polarity which is provided at the electromagnet 15 in accordance with the

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direction of flow of the direct current, as controlled by an unillustrated programming structure which does not form part of the present invention, either the permanent magnet 19b will be attracted to the pole shoe 15b, as shown in FIG. 1, or the permanent magnet 19a will be attracted to the pole shoe 15a. The coil 16 is connected to a pair of junctions 20 and 21 which can interchangeably be provided with positive or negative polarity, as indicated in FIG. 1, so that in this way the direction of flow of the direct current and the polarity of the pole shoes 15a and 15b can be controlled. It is to be noted that with this construction the armature means will stably remain in the position to which it is displaced. In other words, even after the impulse of direct current in the coil 16 terminates the armature means will remain in the position to which it has been displaced because of the action of the permanent magnet means. It will only be displaced to the other position when a direct current impulse of reverse polarity flows through the coil 16.

Of course, the other five armature means 2-6 are controlled in precisely the same way as the armature means 1 as described above and shown in the drawings. In order to be able to situate the several electromagnets in an exceedingly small space, they are stacked in three rows as indicated in FIG. 2 with the arms 1c, 2c, etc. of the successive armature means 1-6 correspondingly offset so as to be respectively situated between the pole shoes of the control magnets. In this way it becomes possible for all of the electromagnets to be situated in extremely small space even if the height of each electromagnet is greater than the vertical distance between a pair of successive armature means, this latter vertical distance being approximately equal to the sum of the width x of each pattern foot and the distance y in elevation from one pattern foot to the next higher or lower pattern foot. It is thus possible within the housing 8 to situate without difficulty more than six magnets for additional armature means with these additional electromagnets stacked and offset in a stepwise fashion with respect to each other, so that where more than six armature means are required a correspondingly larger number of different pattern positions can also be provided without difficulty.

Of course, when the number of pattern positions changes there will also be an increase in the distance between the successive control plates which are to be regulated by a given armature means, while the pattern feet have the same height and are controlled by a predetermined swingable armature means, so that for the controlling of the position of an armature means to displace the latter from one stable end position to another stable end position, there is provided for a particular rotary needle cylinder, which has the successive pattern feet of a given group of control plates arranged as described above, an additional space and more time for actuating the armature means. The use of a plurality of components of the above type is not a serious factor inasmuch as the armature means are in the form of simple stamped elements which are very inexpensive to manufacture and the electromagnets themselves are extremely inexpensive and of a small size since they are only required to carry an impulse of current for an extremely short time duration and because of the balanced support of each armature means it is only required for each electromagnet to exert an extremely small adjusting force.

In order to provide an accurate, maintenance-free bearing support for the several armature means which can automatically adjust itself in response to a spring action, and in order at the same time guarantee a quick reversal in the positions of the armature means from one of the end positions to the other end positions where they will be stably maintained, so as to avoid in this way a rebounding of the permanent magnet plates 19a and 19b of the armature arms at the pole shoes 15a and 15b, the several armature means of the invention are supported for rotary movement in a play-free manner.

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For this purpose the shaft 7 of each armature means terminates at its outer end in a pair of pointed tips 7a, as shown at an enlarged scale in FIGS. 3 and 4. Each of these tips is situated, as shown in FIGS. 2 and 3, in a bearing cap 23 provided with rotary ball bearing members 22, or, as shown in FIG. 4, it is possible to situate each tip 7a in a tapered recess of a bearing block 24.

One of the cups 23 at one end of each shaft 7 is supported by the support means 25 which is shown in FIG. 3, so that it is capable of axial shifting movement. This bearing support 25 includes, as shown in FIGS. 2 and 3, a bore 27 formed in a screw 26 which is threaded into a threaded bore of a wall of the housing 8, and the cap 23 is received in this bore 27 in which it is freely slidable. A compression spring 28 is situated in the bore 27 and urges the cap 23 at one end of the shaft 7 toward the opposed end of the shaft 7, and a lock nut 29 is carried by the screw 26 so that by loosening the lock nut it is possible to adjust the axial position of the screw 26 and thus adjust the force of the spring 28. Then the lock nut 29 is tightened so as to maintain the adjustment. In this way an adjusting means is provided for adjusting the spring force with which one of the bearing means at one end of the shaft 7 is urged toward the other of the bearing means. This construction provides a play-free support for each armature means, so that each armature means can swing without play.

FIG. 4 illustrates a simpler embodiment for achieving a play-free bearing, and with this construction the bearing block 24 is fixed to a leaf spring 30 which at its end 30a is fixed by rivets 31 to a wall of the housing 8 and which at its other end 30b has a convexly curved surface freely pressing against the inner surface of a wall of the housing 8 so as to provide in this way a prestressing of the leaf spring so that there is a constant pressure of the bearing block 24 toward the left, as viewed in FIG. 4, along the axis of the shaft 7, to urge the latter at its opposite tip into a stationary bearing block 24 corresponding to that shown in FIG. 4.

Thus, with the above-described structure of the invention there is the advantage of requiring only a single electromagnet for actuating each armature means, while each armature means at its permanent magnet portion assumes in a stable manner one of the pair of opposed end positions in which the permanent magnet portion engages either one or the other of the pole shoes of the electromagnet. The electromagnet need not be constantly energized since a single impulse will be sufficient to displace the armature means which will then reliably remain in the adjusted position as a result of the action of the electromagnet, so that only a short current impulse is required for adjusting purposes.

As a result of the elimination of the requirement of a constant flow of current through the electromagnet means of the invention, the coils thereof can be very small while at the same time they are capable of being excited with a relatively strong current impulse which if it continued would result in overheating of the coil, but which does not have this result because of the short duration of the impulse.

The provision of the above-described play-free swingable support for each armature means reliably prevents undesirable rebounding of the armature means after it has been adjusted. Thus, the spring force which axially urges the bearing at one end of the shaft 7 toward the bearing at the other end thereof provides in a highly reliable manner a constant play-free seating for the ends of the shaft means 7 to eliminate any possibility of play and rebounding.

It is to be noted that with the structure of the invention the pattern device is mechanically very simple and can easily be added to existing machines which initially were designed for mechanically actuated pattern devices. The pattern device of the invention is not subject to any faulty operation and can be constructed and operated in

a practically maintenance-free manner, while at the same time being capable of being encased in a dust-tight manner within a suitable enclosure.

Furthermore, with the structure of the invention it is possible to control either cylinder needles or dial needles. When controlling cylinder needles the several armature means of the invention can be arranged one above the other along the outer casing of the needle cylinder, while in the case of dial needles the turning axes of the several armature means of the invention can be vertically arranged one after the other.

The pattern device of the invention is constructed in such a way that a change of the cam-controlling system and the control plate arrangement in known mechanical Jacquard pattern devices having pin wheels is not required. An electromechanically operating pattern device which is operated by a punched tape, a film strip, a magnetic strip or the like, which feeds signals to the programming device can be provided on existing machines which originally were provided with mechanical patterning structures for the circular knitting machine.

What is claimed is:

1. In a pattern device for a circular knitting machine rotary needle-carrier means carrying needle-controlling plates which respectively have pattern feet which respectively move along predetermined paths during rotation of said rotary needle-carrier means a plurality of armature means for respectively coacting with predetermined groups of said feet for controlling the positions of said plates each armature means having one end for engaging a pattern foot of a control plate and an opposed end distant therefrom support means supporting each armature means for swinging movement about a given axis between its opposed ends permanent magnet means having a pair of opposed permanent magnets with like poles respectively directed toward the pole shoes of each electromagnet carried by each armature means at said opposed end thereof and a plurality of electromagnets respectively coacting with said permanent magnet means of said armature means each electromagnet having a pair of opposed pole shoes between which a permanent magnet means is located and each electromagnet having an exciting coil adapted to be supplied with direct current so that in accordance with the direction of flow of the direct current one or the other of the pole shoes will be excited to attract said permanent magnet means of each armature means whereby a single impulse of direct current will displace each armature means from one posi-

tion to another position while after the impulse of current terminates the permanent magnet means will serve to stably maintain the armature in a position to which it has been displaced.

2. The combination of claim 1 and wherein said support means supports each armature means for swinging movement without play.

3. The combination of claim 2 and wherein each armature means has a pair of opposed portions beyond which a pair of shaft portions respectively extend along said axis and said support means including bearing engaging said shaft portions at outer extremities thereof to support said shaft portions for rotary movement without play said support means pressing one bearing axially toward the other.

4. The combination of claim 3 and wherein one of the shaft portions of each armature means is received in a stationary bearing of said support means and the other end portion being mounted in an axially shiftable bearing of said support means and spring means coacting with said axially shiftable bearing of said support means for urging the latter toward the other part thereof.

5. The combination of claim 4 and wherein an adjusting means coacts with said spring means for adjusting the force thereof.

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