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(54) **Needle selecting apparatus for a circular knitting machine**

(57) An intermediate needle raising jack 4 is interposed between a latch needle and a selector jack 5 in each of a circular series of slots in a rotary cylinder of a circular knitting machine. The needle raising jack 4 is rockable about a pivot point 44 thereof on a bottom surface of the respective slot and is also movable lengthwise of the slot, while the selector jack 5 is only rockable in the slot 2. The selector jacks 5 are pattern-controlled to selecting and non-selecting positions, thereby to position the needle-raising jacks 4 in raising and non-raising positions. A cam 34 acts on the needle-raising jacks 4 to urge their pivot points 44 yieldingly into contact with the bottom surface 2*a* of the slots 2 while they are being rocked by way of their butts 12 and a magnetic unit 36 retains the selector jacks 5 yieldingly in their non-selecting positions while a selection is being made among same by means 19.

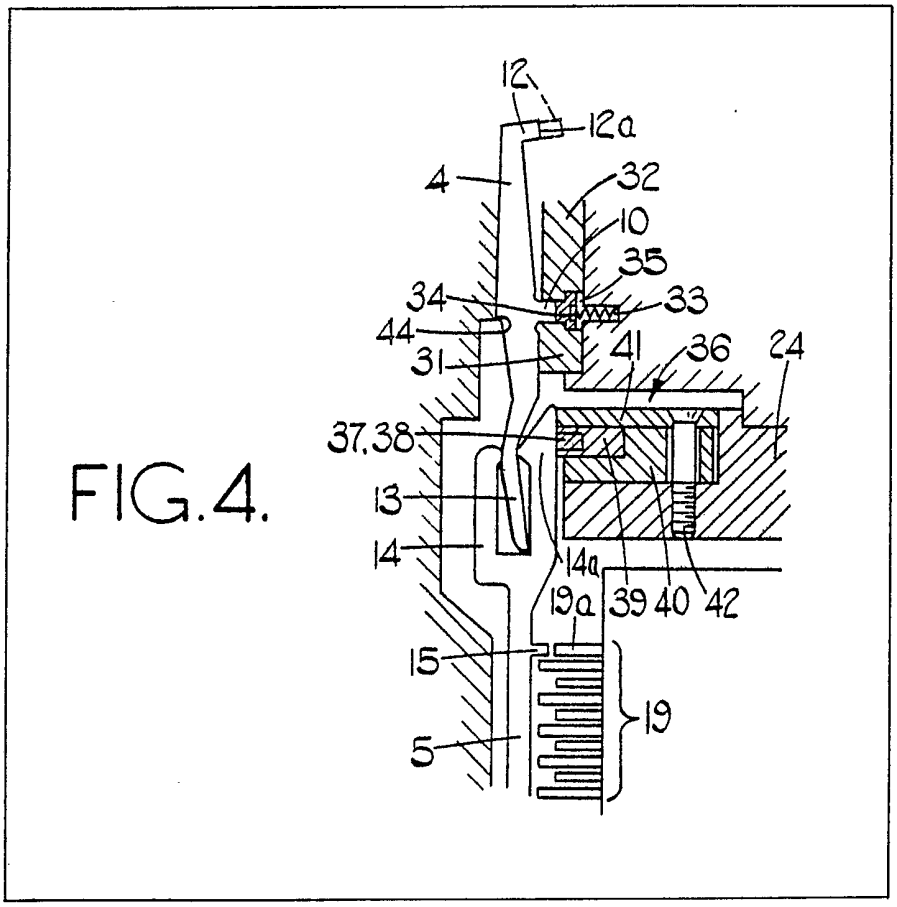

FIG.4.

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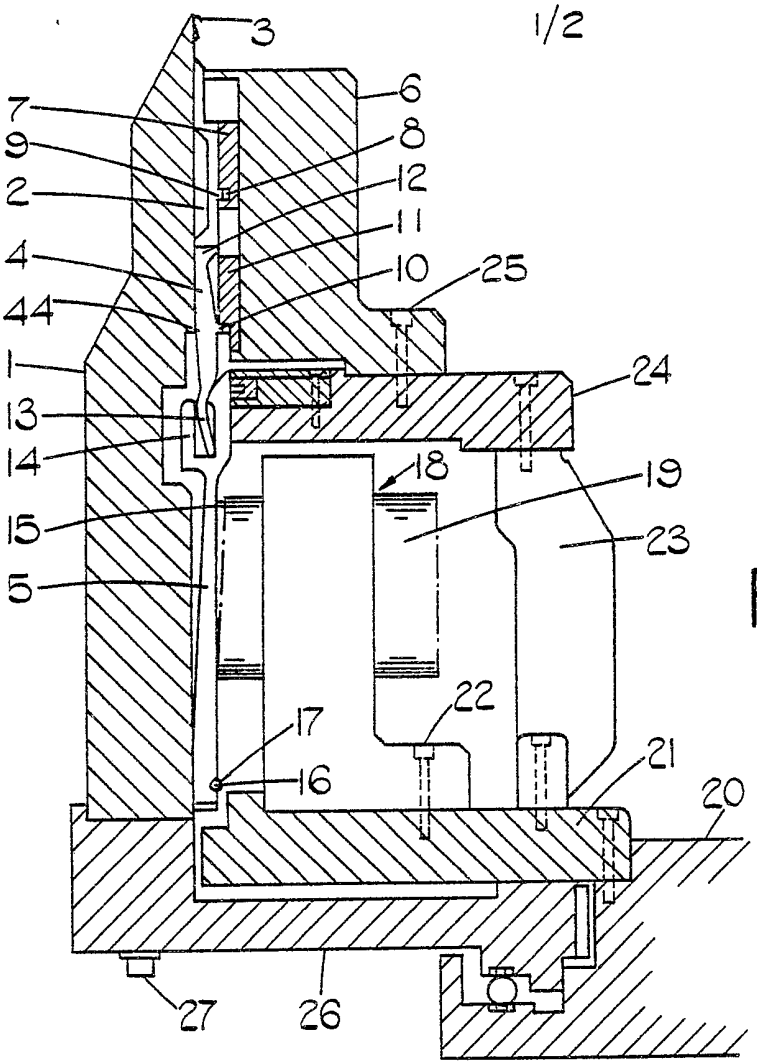

FIG. 1.

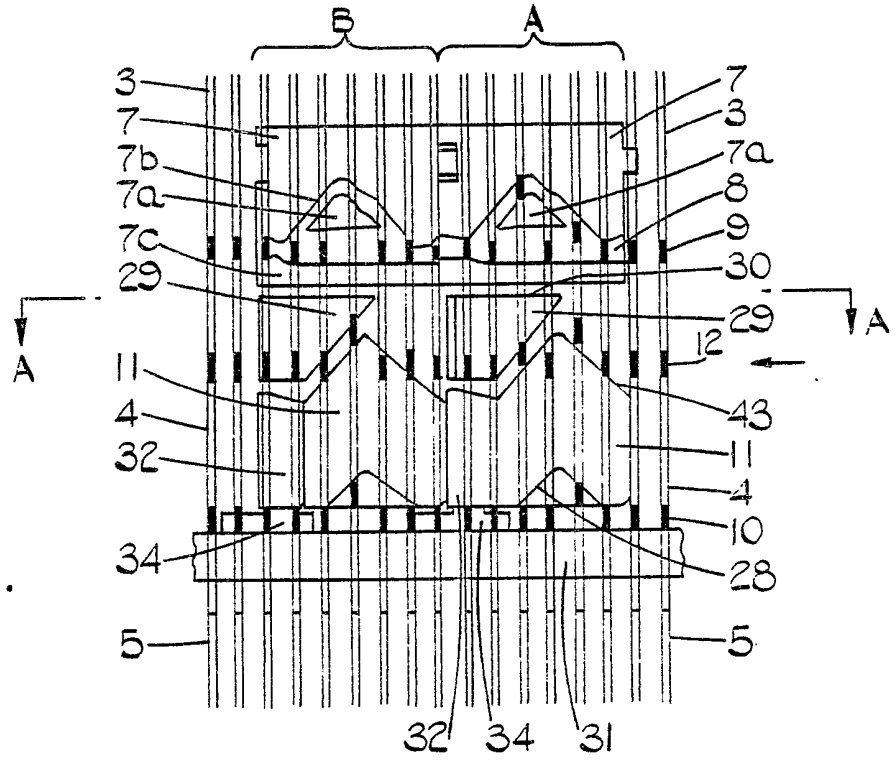

FIG. 2.

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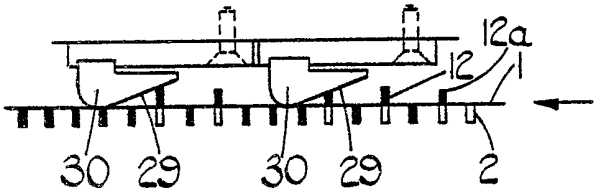

FIG.3.

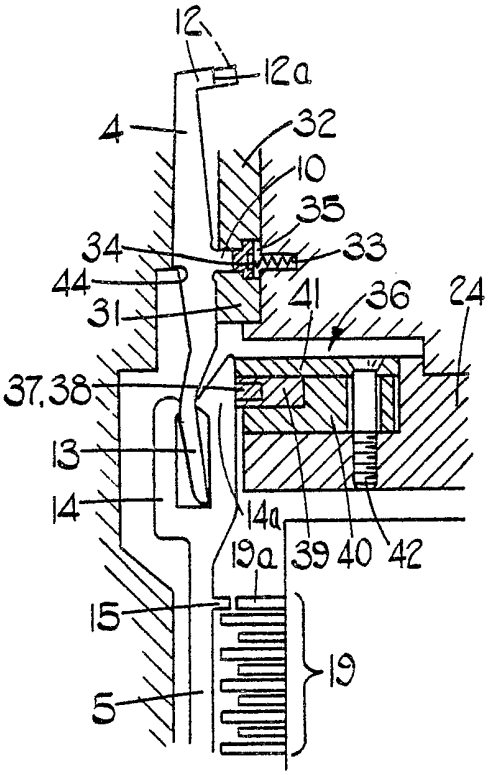

FIG.4.

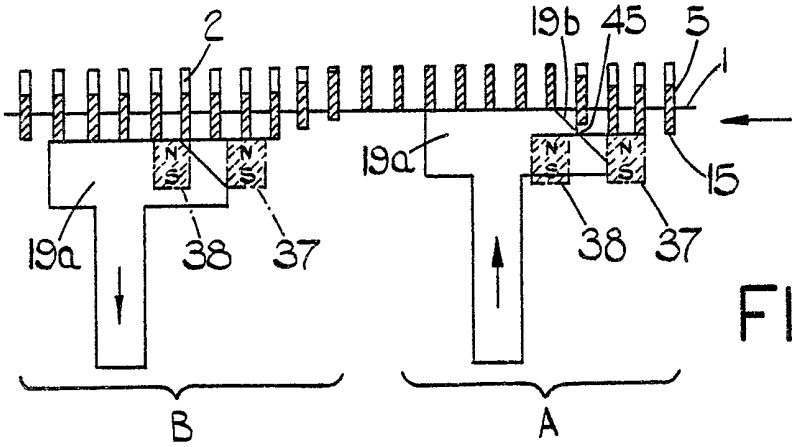

FIG.5.

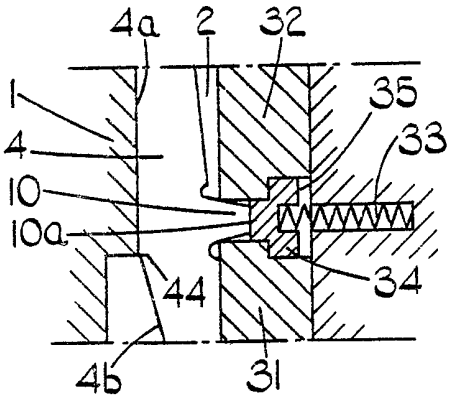

FIG.6.

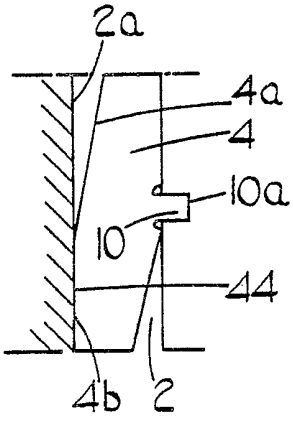

FIG.7.

SPECIFICATION

Needle selecting apparatus for a circular knitting machine

The present invention relates to the art of knitting, and more particularly to needle selecting apparatus for a circular knitting machine.

Mechanical needle selecting apparatus for a multi-feed circular knitting machine, is known wherein a first, needle raising jack is interposed between a latch needle and a second, selector jack in each of a circular series of needle cylinder slots. The first jacks are both rockable and lengthwise movable in the cylinder slots, while the second jacks are only rockable therein. The jacks are pivotably interconnected so that, when selected ones of the second jacks are rocked radially inwardly of the slots from a non-selecting to a selecting position by pattern cams of patterning means, then corresponding selected ones of the first jacks are rocked radially outwardly of the slots from a non-raising to a needle raising position. Such selected first jacks in the needle raising position are then moved lengthwise in the needle slots by cam action to raise corresponding needles from welt to latch clearing level. Thereafter such selected first jacks are moved lengthwise in the needle slots in the opposite direction to their base position by cam action and are also rocked by cam action radially inwardly of the needle slots to their non-raising position. Such rocking movement of the selected first jacks to the non-raising position acts to rock the selected second jacks radially outwardly of the needle slots to their non-selecting position, wherein the second jacks are in a common position for a new selection thereof. The selectively raised needles are lowered by the stitch cam to welt level so that the needles are in a common position for a new selection thereof.

The above-described needle selecting apparatus is subject to faulty needle selection, particularly when used on multi-feed rotary cylinder circular knitting machines having a relatively large number of feeds and which are operated at relatively high speeds. The faulty needle selection is due to improper and non-uniform positioning of the jacks during the machine operation. With the larger number of feeds on the machine, the needle and jack operating cams are more sharply angled as less space is available for each of the feeds. The more sharply angled jack operating cams moving at higher machine speeds cause the first jacks to reciprocate and to rock at accordingly increased speeds as a result of the increased forces acting thereon. The quicker reversal of the increased forces, and of the jack positions, results in the jacks not always being fully bottommed in the needle slots when the jacks are rocked to non-raising and to needle raising positions so that faulty needle selection results. Further, since the jacks are interconnected, improper positioning of the first jacks causes the second jacks not always to be in their proper non-selecting position with resulting faulty selection of the second jacks by the pattern cams, and with faulty selection of the first jacks and of the needles.

It is an object of the present invention to provide needle selecting apparatus for a circular knitting machine wherein there is exact and stable needle selection.

According to a first aspect of the present invention, there is provided needle selecting apparatus for a circular knitting machine having a circular series of latch needles individually movable in a circular series of slots formed in a circular needle bed, the apparatus comprising a circular series of rocking jacks each of which is operable to move a respective one of said needles, each rocking jack having a rocking point and being rockable on a bottom surface of a respective one of said slots between a needle moving position and a non-needle moving position, a circular series of selector jacks each of which is operatively related to a respective one of the rocking jacks and which is movable between a selecting position and a non-selecting position with respect thereto, a first cam arranged to rock the rocking jacks to their non-needle raising positions thereby causing the rocking jacks to move the selector jacks to their non-selecting positions, mechanical patterning means for moving the selector jacks to their selecting positions thereby causing the selector jacks to move the rocking jacks to their needle moving positions, a second cam arranged to act upon the rocking jacks to urge the rocking points thereof into contact with said bottom surfaces of said slots while the rocking jacks are being rocked to their non-needle raising positions by the first cam, and magnetic means acting upon the selector jacks to retain same in their non-selecting positions while selected ones thereof are moved to their selecting positions by the patterning means.

According to a second aspect of the present invention, there is provided needle selecting apparatus for a circular knitting machine, comprising a circular series of selector jacks individually movable between selecting and non-selecting positions, mechanical patterning means for moving selected jacks from their non-selecting positions to their selecting positions, and magnetic means acting upon the jacks to retain same in their non-selecting positions while selected ones thereof are moved to their selecting position by the patterning means.

According to a third aspect of the present invention, there is provided needle selecting apparatus for a circular knitting machine having a circular needle bed, the apparatus comprising a circular series of rocking jacks each of which is disposed in a respective one of a circular series of slots formed in said needle bed, each rocking jack having a rocking point and being rockable about same on a bottom surface of said respective slot, a first cam acting upon the jacks to rock same, and a second cam acting upon the jacks to urge the rocking points thereof into contact with said bottom surfaces of said slots while the jacks are being rocked by the first cam.

The second cam can thus urge the rocking points of the rocking jacks into yielding contact with the bottom of the needle slots, such that uniform rocking of the jacks about their rocking points is achieved, such uniform rocking of the rocking jacks to their non-needle raising positions will cause the related selector jacks to be rocked to uniform non-selecting positions. In addition, the magnetic means retains the selector jacks in uniform non-selecting positions while selected ones thereof are rocked by the patterning means to their selecting positions.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a sectional view of a rotary cylinder multi-feed circular knitting machine which incorporates needle selecting apparatus according to the present invention;

Fig. 2 is a schematic view of cams at each of an adjacent pair of feeds of the machine for moving jacks and needles thereof;

Fig. 3 is a view taken on the line A—A in Fig. 2, showing needle raising jacks being rocked radially inwardly in needle cylinder slots of the machine to a non-raising position;

Fig. 4 is an enlarged view of a portion of Fig. 1, showing the needle raising jacks in the non-raising position and with selector jacks in a non-selecting position;

Fig. 5 is a schematic view of a selection being made upon a selector jack by a pattern cam of patterning means at each of a pair of adjacent feeds of the machine, the selector jack being yieldingly retained in a non-selecting position by a pair of magnets;

Fig. 6 is an enlarged view of a portion of Fig. 4 showing the needle raising jacks in a non-raising position; and

Fig. 7 is a similar view to Fig. 6 with the needle raising jacks shown in a needle raising position.

The drawings show a multi-feed circular knitting machine having needle selecting apparatus at the feeds thereof. The apparatus will first be described without reference to the present invention to explain the cause of the faulty needle selection which occurs in conventional knitting machines of this type, and then the improvements provided by the invention to overcome the faulty needle selection will be described.

A needle selecting apparatus or device is shown (Fig. 1) in a multi-feed circular knitting machine having a rotary cylinder 1 in which a circular series of vertical slots 2 is provided. In each slot 2 there is disposed a reciprocating latch needle 3, a rocking and reciprocating needle raising jack 4, and a rocking selector jack 5. Pattern selecting means, shown at 18, is provided at each feed of the machine. Screws 22 secure the pattern selecting means to a lower plate ring 21 with the latter being fixed to a base plate 20. Spaced brackets 23 are interposed between the lower plate ring 21 and an upper plate ring 24, and a cam ring 6 is secured to the upper ring 24 by screws 25. A rotary gear ring 26 is secured to the needle cylinder by screws 27. Operating cams are provided for the needles and the needle raising jacks at each feed of the machine: the cams at each of two adjacent feeds are shown individually bracketed at A and B in Fig. 2. The cams are supported on the inner face of the cam ring 6.

The needle raising jacks 4, of flat stock and of elongated shape, each have an upper butt 12 extending laterally from one edge thereof, a lower supporting butt 10 spaced from the upper butt and extending in the same direction, an angle-faced rocking point 44 on the other edge substantially opposite to butt 10, and a tail portion 13, the latter being individually disposed in and movable lengthwise between U-shaped arms 14 and 14*a* at the upper end of the lengthwise extending needle selector jacks 5. The jacks 4 are intended to rock about their rocking points 44 with the latter in contact with a bottom surface 2*a* of the needle slots 2. However, as will be explained, the rocking points are not always in contact with the bottoms of the needle slots when the jacks are rocked. When the jacks are in the position shown in Figs. 4 and 6, an edge 4*a* thereof should be in contact with the slot bottom 2*a*, with the jacks then being in a non-raising position in which their butts 12 are fully withdrawn into the slots 2, as shown in full lines in Fig. 4. When the jacks are in the position shown in Fig. 7, an edge 4*b* thereof should be in contact with the slot bottom 2*a*, the jacks then being in a needle raising position in which their butts 12 extend outwardly of the slots 2, as shown in dotted lines in Fig. 4. The jacks are raised by their butts 12 and are lowered by their butts 10.

The selector jacks 5 are used to rock the jacks 4 to their needle raising position. Each jack 5 has a single separate level butt 15 thereon with the total of such butts extending in stepped spiral relation on the adjoining jacks. These jacks are rockable about a spring band fulcrum 16 set in grooves 17 formed in the outer face of the needle cylinder and in the jacks. A stack of selecting cams 19, equal in number to the number of butts 15 are individually co-planar therewith, is provided at each feed of the machine, with individual ones of the cams being selectively positioned radially inwardly of the cylinder by suitable patterning means (not shown). When one of the selector jacks 5 is rocked radially inwardly from its non-selecting to its selecting position by its associated cam 19, the U-shaped portion 14 thereof acts on the tail portion 13 of the respective jack 4 to rock the latter about its pivot point 44 to its needle raising position. In this position the butt 12 of the jack 4 projects outwardly of the cylinder, as indicated in dotted lines, into the path of a cam face 43 of a cam 11 which raises the jack 4 and its associated needle from a welt position to a latch clearing position. In doing this, the tail portion 13 of the jack 4 moves upwardly in the U-shaped portion 14 of the jack 5. Thereafter, a cam face 28 of the cam 11 acts upon the butts 10 of the jacks 4 to lower the latter relative to the jacks 5, while a lateral cam face 29 of a cam 30 (see Fig. 3) acts upon

outer edges 12*a* of the butts 12 to rock the jacks 4 inwardly about their pivot points 44 to a non-raising position. This action withdraws the butts 12 inwardly of the needle slots and at the same time causes the tail portions 13 to rock the jacks outwardly to return the latter to their non-selecting position. Butts 4 on the needles 3 enter a pathway 8 between a stitch cam 7 and a guard cam 7*c* with the butts of the raised needles passing above a centre cam 7*a* to a latch clearing level and then being lowered by a face 7*b* of the stitch cam to a welt level. The butts 10 of the jacks 4 in the non-needle raising position travel in an idle path under the cam 11 and a further cam 32 and above a guide cam 31.

The apparatus, as above described, operates satisfactorily when the rocking points 44 of the jacks 4 are in contact with the bottom surfaces 2*a* of the needle slots 2 during rocking movement thereof by the cam 29 and lengthwise movement by the cam face 28, as the jacks are moved to the non-raising position. Such movement of the jacks 4 is transmitted to the interconnected jacks 5 to rock the latter to the non-selecting position. However, should jacks 4 not be in contact with the slot bottoms 2*a* in the above sequence of operations, the jacks 4 and 5 will not always be placed in proper relation to their operating cams and faulty needle selection will result. Such faulty needle selection is more likely to happen when the needle and jack operating cams are more sharply angled due to a larger number of feeds on the machine and when the machine operates at higher speeds. The result is a lack of predictable positioning and control of the jacks during their movements at higher speeds with resultant faulty needle selection.

The present invention provides an improvement in the needle selecting apparatus to control the positions of the jacks 4 and 5 accurately for exact and stable needle selection. The jacks 4, are caused to be bottomed in the needle slots by a cam 34 urged by a spring 33 and disposed below the cams 30 and 32 in the pathway between the cams 31 and 32 to act upon outer edges 10*a* of the butts 10 and thereby yieldingly urge the rocking points 44 of the jacks into contact with the bottom surfaces 2*a* of the needle slots. It will be noted that, as the jacks 4 are being returned to the non-raising position, they act to move the jacks 5 to the non-selecting position. The means to control the position of the jacks 5 include a magnetic retaining unit 36 disposed below the cam 35 and having a base 40, a non-magnetic insert 39 in the base, a hardened steel guide plate 41 above the base and a horizontally spaced pair of magnets 37 and 38 received within the insert 39. The unit 36 is itself secured in place in the plate 24 by a screw 42 extending through the plate 21 and the base 40 in threaded engagement with the plate. The relationship of the magnets to each other, to the pattern cams 19, and to the butts 15 on the jacks 5 is shown schematically in Fig. 5 as the butt 15 of one of the jacks 5 moves past the magnets and its associated cam (referenced 19*a*) at the feeds A and B. The magnets are arranged so that the poles thereof, either both North or both South, face in the same direction. The magnets are also arranged so that their inner faces are vertically aligned with the inner face of the guide plate 41, along which the arms 14*a* of the jacks 5 are in sliding contact as the jacks move past the units 36 at each feed of the machine with the jacks retained in the non-selecting position (shown in Fig. 4) by magnetic attraction. It may be noted that while the magnets act directly upon the jacks 5 to retain same in the non-selecting position, they also act indirectly upon the interconnected jacks 4 to retain the latter in the non-raising position. At feed A (Fig. 5), with the cam 19*a* in a forward or selecting position, a cam face 19*b* at about its midpoint 45 engages the butt 15 to rock the jack 5 into the needle selecting position and at the same time overcome the influence of the magnetic field upon same. At feed B (Fig. 5), the cam 19*a* in the same position in which the jack is held by the magnets. Similar action takes place upon the other butts, similar to 15, at other levels of jacks 5. Between feeds, those jacks 5 which are in the needle selecting position are returned to the non-selecting position by the jacks 4 as the latter are cammed into the non-raising position.

It will be understood that the present improvement is of value regardless of the number of feeds on the machine and regardless of the machine operating speed. Also it will be appreciated that the functions of the cam 34 and the magnets 37 and 38 are interrelated, in that while the cam acts to ensure proper positioning of the jacks 4 and 5 in the non-raising and non-selecting positions, respectively, the magnets then act to retain the jacks 5 yieldingly and momentarily in such position during each selection thereof and in which proper positioning of the jacks 5 is essential for accurate and stable needle selection.

CLAIMS

1. Needle selecting apparatus for a circular knitting machine having a circular series of latch needles individually movable in a circular series of slots formed in a circular needle bed, the apparatus comprising a circular series of rocking jacks each of which is operable to move a respective one of said needles, each rocking jack having a rocking point and being rockable on a bottom surface of a respective one of said slots between a needle moving position and a non-needle moving position, a circular series of selector jacks each of which is operatively related to a respective one of the rocking jacks and which is movable between a selecting position and a non-selecting position with respect thereto, a first cam arranged to rock the rocking jacks to their non-needle raising positions thereby causing the rocking jacks to move the selector jacks to their non-selecting positions, mechanical patterning means for moving the selector jacks to their selecting positions thereby causing the selector

jacks to move the rocking jacks to their needle moving positions, a second cam arranged to act upon the rocking jacks to urge the rocking points thereof into contact with said bottom surfaces of said slots while the rocking jacks are being rocked to their non-needle raising positions by the first cam, and magnetic means acting upon the selector jacks to retain some in their non-selecting positions while selected ones thereof are moved to their selecting positions by the patterning means.

2. Apparatus as claimed in claim 1, wherein the configuration of the rocking jacks remains the same as in conventional needle selecting apparatus of similar type.

3. Apparatus as claimed in claim 1 or 2 wherein the configuration of the selector jacks remains the same as in conventional needle selecting apparatus of similar type.

4. Apparatus as claimed in claim 1, 2 or 3, wherein the magnetic means comprises a pair of spaced magnets, the selector jacks are arranged to move past the magnets in their non-selecting positions, and the patterning means acts upon the selector jacks between the magnets to move selected ones thereof to their selecting positions.

5. Apparatus as claimed in any one of claims 1 to 4, wherein the rocking jacks have butts thereon and the second cam acts upon the butts to urge the rocking points of the jacks into contact with said bottom surfaces of said slots.

6. Needle selecting apparatus for a circular knitting machine, comprising a circular series of selector jacks individually movable between selecting and non-selecting positions, mechanical patterning means for moving selected jacks from their non-selecting positions to their selecting positions, and magnetic means acting upon the jacks to retain same in their non-selecting positions while selected ones thereof are moved to their selecting positions by the patterning means.

7. Apparatus as claimed in claim 6, wherein the magnetic means comprises a pair of spaced magnets, the selector jacks are arranged to move past the magnets in their non-selecting positions, and the patterning means acts upon the selector jacks between the magnets to move selected ones thereof to their selecting positions.

8. Needle selecting apparatus for a circular knitting machine having a circular needle bed, the apparatus comprising a circular series of rocking jacks each of which is disposed in a respective one of a circular series of slots formed in said needle bed, each rocking jack having a rocking point and being rockable about same on a bottom surface of said respective slot, a first cam acting upon the jacks to rock same, and a second cam acting upon the jacks to urge the rocking points thereof into contact with said bottom surfaces of said slots while the jacks are being rocked by the first cam.

9. Apparatus as claimed in claim 8, wherein the rocking jacks have butts thereon and the second cam acts upon the butts to urge the rocking points of the jacks into contact with said bottom surfaces of said slots.

10. Needle selecting apparatus as claimed in claim 1 and substantially as hereinbefore described with reference to the accompanying drawings.

11. Needle selecting apparatus as claimed in claim 6 and substantially as hereinbefore described with reference to the accompanying drawings.

12. Needle selecting apparatus as claimed in claim 8 and substantially as hereinbefore described with reference to the accompanying drawings.

New claims or amendments to claims filed on 29th March 1982

New or amended claims:—

13. Needle selecting apparatus for a circular knitting machine having a circular series of latch needles individually movable lengthwise in a circular series of lengthwise extending slots formed in a circular needle bed, the apparatus comprising a circular series of selector jacks each of which is operatively related to a respective one of the needles and which is spaced therefrom lengthwise of the respective slot in the needle bed, the selector jacks being pivotally mounted at ends thereof remote from the needles for limited rocking movement only between selecting and non-selecting positions, a circular series of intermediate jacks each of which is operatively related to a respective one of the needles and the associated selector jack and which is interposed lengthwise between said needle and said selector jack in the respective slot of the needle bed, the intermediate jacks being rockable between needle raising and non-needle raising positions and also being movable lengthwise in the slots of the needle bed, the arrangement being such that when each intermediate jack is in its non-needle raising position the respective selector jack is in its non-selecting position and when each selector jack is in its selecting position the respective intermediate jack is in its needle raising position, a cam acting upon the intermediate jacks to rock same to their non-needle raising positions during which the intermediate jacks act upon and rock the selector jacks to their non-selecting positions, and at least one magnet acting upon such selector jacks to maintain same yieldingly in the non-selecting position, the selector jacks being acted upon by cams of a patterning mechanism to rock the selector jacks in their selecting positions during which the selector jacks overcome the force of said at least one magnet thereon and during which such jacks also act upon and rock the intermediate jacks to their needle raising positions thereby raising the needles, the force of said at least one magnet being the only force acting upon the selector jacks to retain same in their non-selecting positions.

14. Apparatus as claimed in claim 13 wherein each intermediate jack is rockable about a rocking point in contact with a bottom surface of the

respective slot, and means acts upon the intermediate jacks to urge the rocking points thereof into contact with said bottom surfaces.

15. Apparatus as claimed in claim 13 or 14, wherein a terminal portion of each selector jack nearest to the respective needle is provided with a lengthwise extending fork-shaped slot, and the respective intermediate jack extends into and is movable lengthwise of the fork-shaped slot.

16. Apparatus as claimed in claim 15 wherein locking movement of each intermediate jack in one direction causes rocking movement of the respective selector jack in the opposite direction, and rocking movement of each selector jack in the one direction causes movement of the respective intermediate jack in the opposite direction.

17. Apparatus as claimed in any one of claims 13 to 16, wherein the selector jacks are acted upon by two such magnets which are spaced apart, the selector jacks are moved past the magnets in their non-selecting positions, and the patterning mechanism acts upon the selector jacks between the magnets to move selected ones thereof to their selecting positions.

18. Needle selecting apparatus as claimed in claim 13 and substantially as hereinbefore described with reference to the accompanying drawings.

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