

[54] CONTROL MECHANISM FOR CIRCULAR KNITTING MACHINE WITH ROTATING NEEDLE CARRIER

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[58] Field of Search..... 66/50 R, 50 B, 25, 115

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[57] ABSTRACT

A pattern control mechanism for a circular knitting machine with a rotating needle carrying cylinder, in which the needles are controlled at a pattern position by means of a plurality of electromagnetically controlled pattern devices, each needle being provided with an associated needle jack having control feet which follow each other in sequence in a stepwise manner, the needle jacks being slidable in the needle cylinder and being selectively swingable; at the pattern selection point all of the needle jacks with their control feet are carried past a ramp-like cam which swings the needle jacks into a first position, in which they cooperate with their jack-advancing cam. A plurality of radially inwardly yieldably biased slide members are provided for swinging the respective jacks into a second position wherein they do not cooperate with such cam. Every slide means is provided with a magnetic holding mechanism which retains the respective slide means in an outer, retracted position, the returning force which opposes the magnets being less than the holding strength of the magnets. The respective slide members are retracted by magnet slide retracting feet mounted on the cylinder so as to retract the magnet armature into proximity with the pole piece of the magnet. If the magnet is then energized by a pattern control mechanism, the slide members remains retracted and thus the respective needle jack remains swung outwardly in operative position. If the magnet is not energized, the needle jack is swung inwardly into inoperative position by the slide members.

8 Claims, 7 Drawing Figures

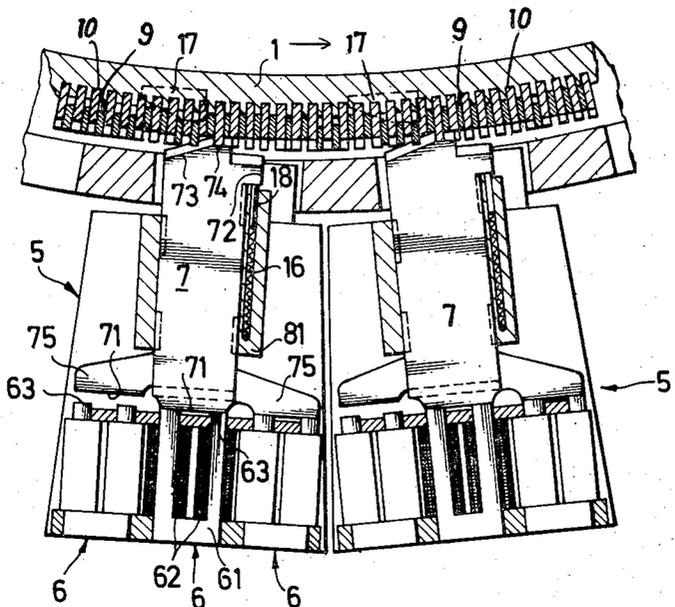
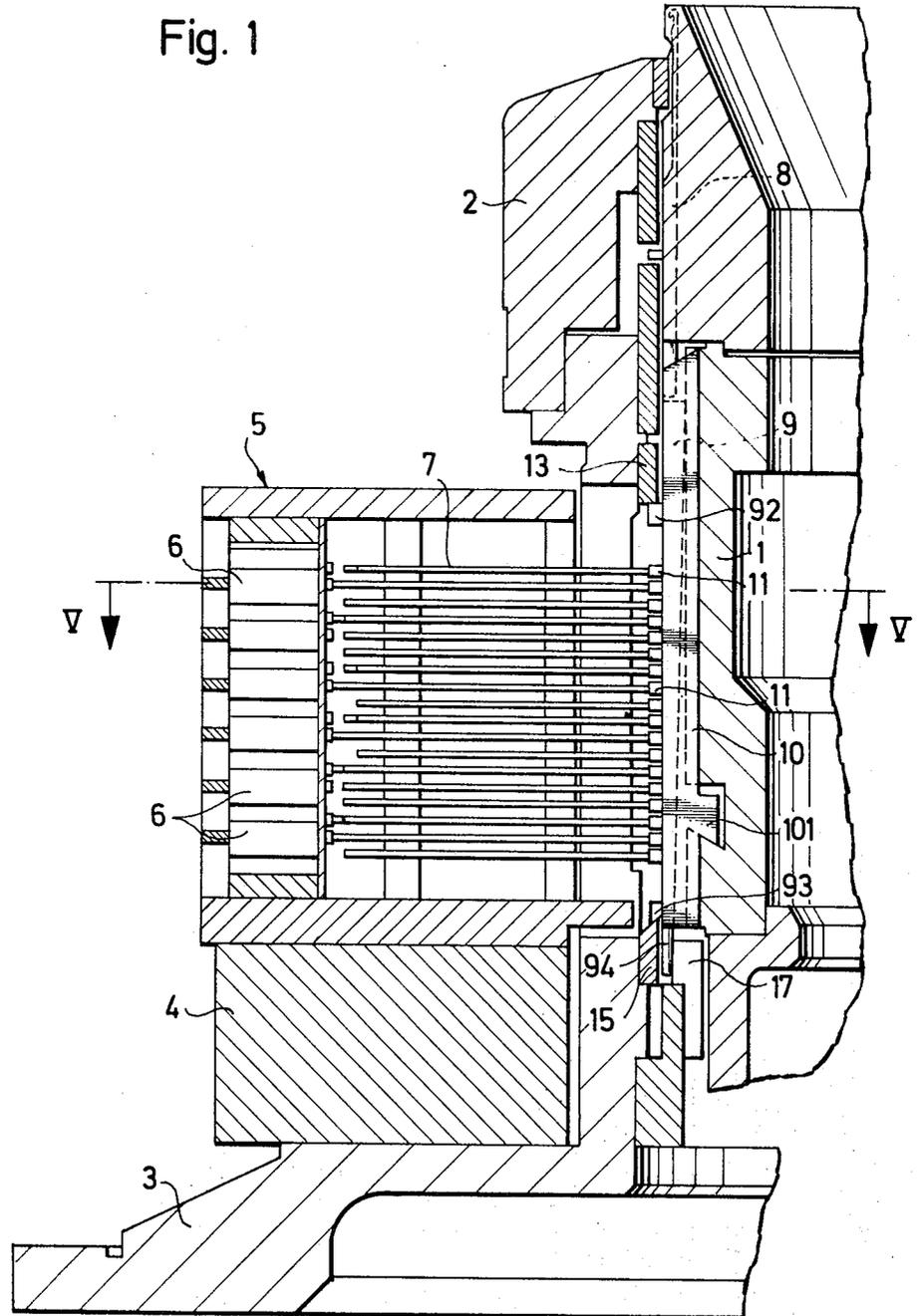


Fig. 1



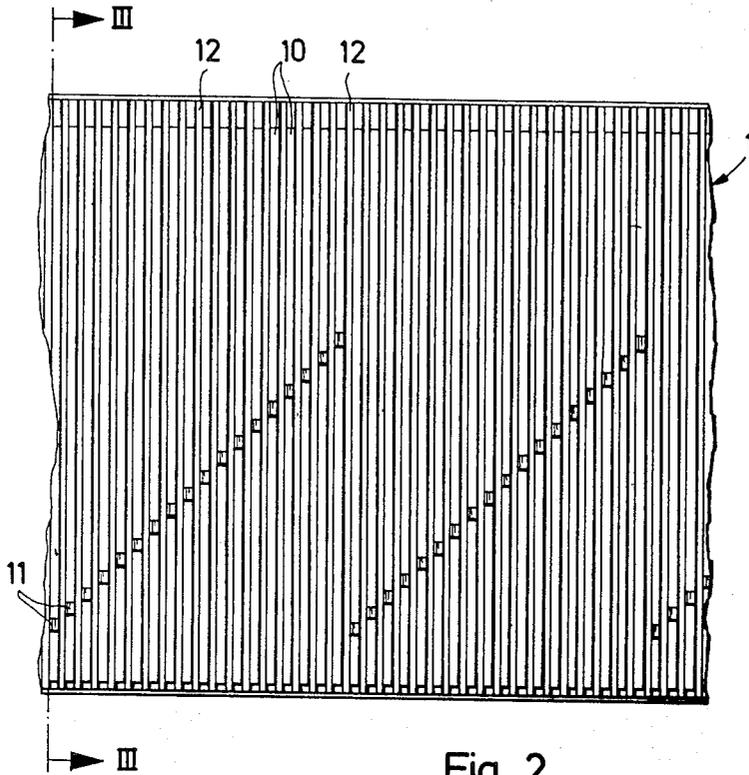


Fig. 2

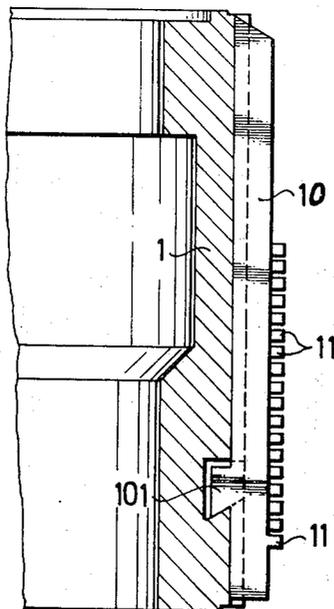


Fig. 3

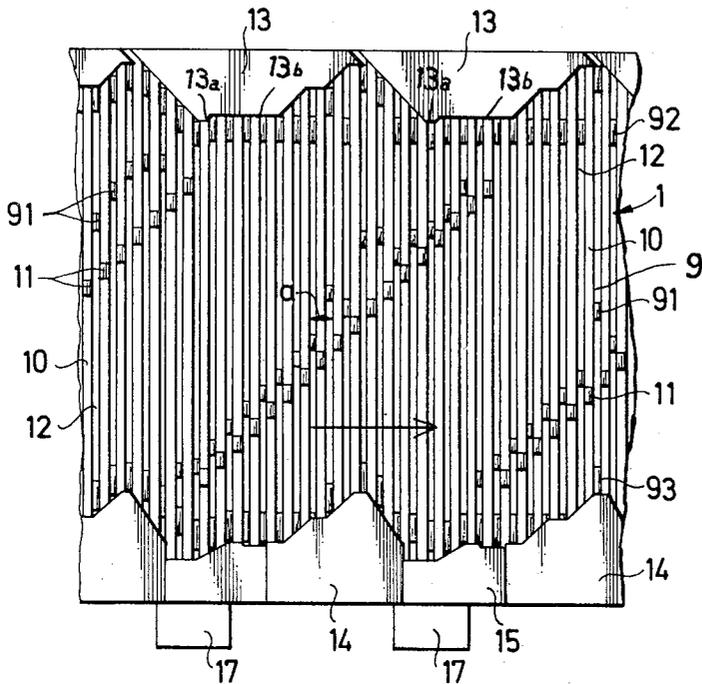


Fig. 4

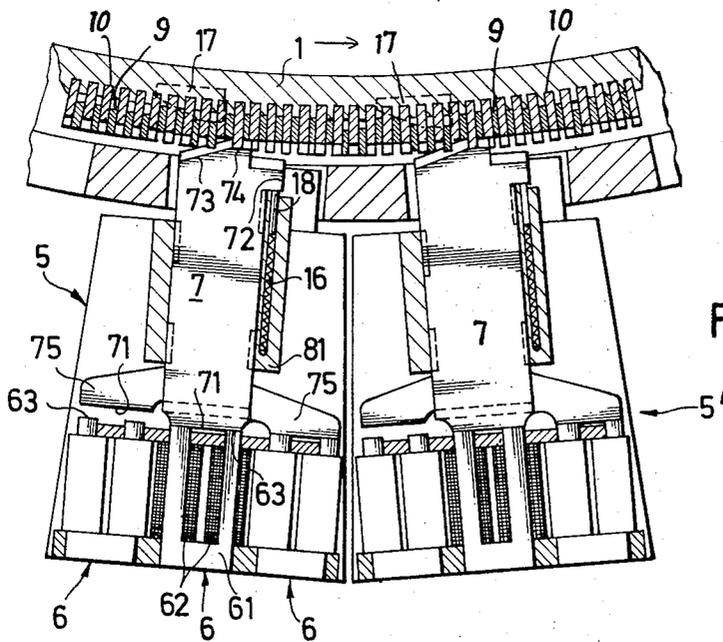


Fig. 5

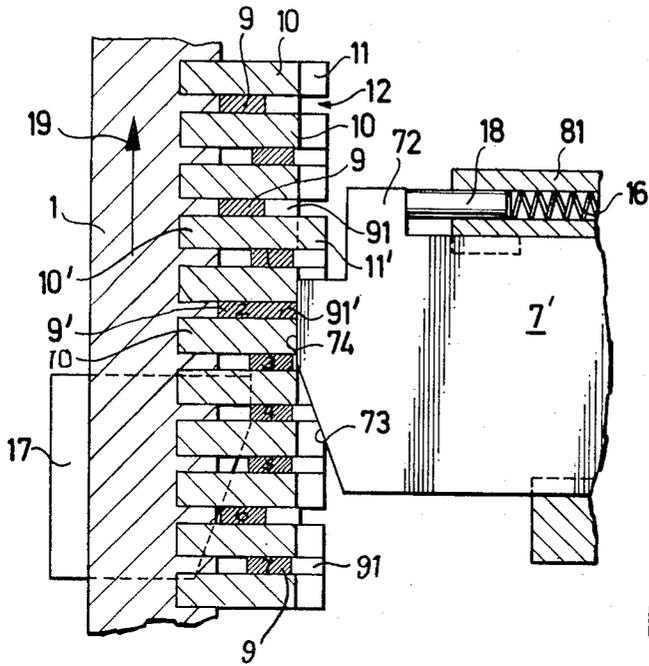


Fig. 7

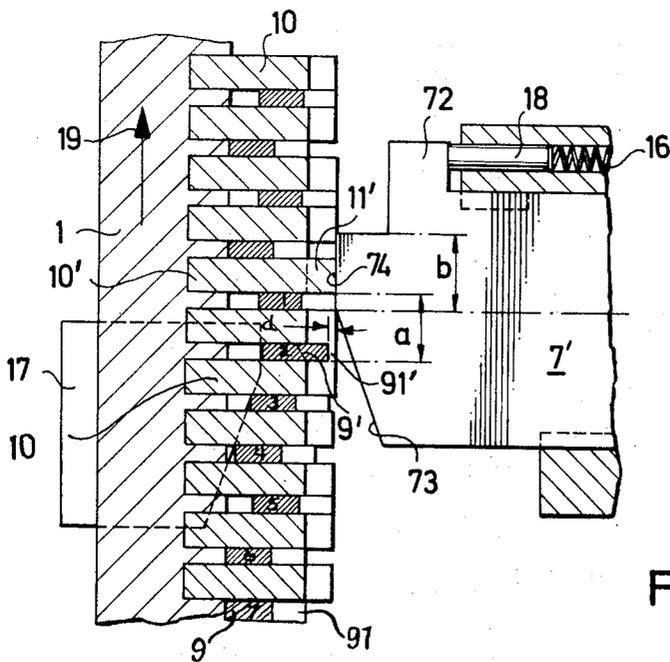


Fig. 6

CONTROL MECHANISM FOR CIRCULAR KNITTING MACHINE WITH ROTATING NEEDLE CARRIER

SPECIFICATION

This invention is an improvement upon that disclosed and claimed in applicant's prior U.S. application Ser. No. 77,226 filed Oct. 1, 1970.

This invention relates to a pattern arrangement for circular knitting machines with rotating needle carrier cylinders, in which the selection of needles is made at a selection point by means of several selecting devices that are actuated electromagnetically in accordance with a predetermined desired pattern. Needle jacks are disposed in longitudinally extending channels in the needle cylinder; such needles being adjustable longitudinally of the cylinder and pivotable to a limited degree so as selectively to actuate the needles, each needle jack being associated with its respective needle. The needle jacks are provided with pattern feet, the pattern feet being arranged on the needle cylinder en echelon. In accordance with the invention, at the selection point there are provided a plurality of holding magnets, one for each needle jack, the magnets being selectively energized in accordance with the pattern. Each magnet has associated therewith a radially reciprocal slide which is constantly urged radially inwardly by a spring and which is held outwardly, in opposition to the spring, by the magnet when the magnet is energized. As the needle cylinder rotates, the lower ends of the needle jacks encounter a fixed ramp-like cam disposed in advance of the slides, such fixed cam thrusting all of the needle jacks radially outwardly. Continued rotation of the needle cylinder brings the outwardly swung needle jacks to the location of the slides; the slides, if in their radially inward position, thrust the needle jacks radially inwardly so that they will not cooperate with further fixed cam members which thrust them and their respective needles upwardly on the needle cylinder so as to knit a stitch.

The present invention has among its objects the insuring of an accurate and safe shifting of the magnet slide into its outer, retracted position, the magnet slide then being held in such position by energization of the magnet. Such arrangement avoids the overenergization of the holding magnets with consequent heating, and eliminates the very exact manufacturing of the individual components which is necessary when the magnets are called upon both to move the slide means from their radially inner to their radially outer positions and to hold them in such latter positions.

The objects of the present invention are attained, with accuracy and without requiring unduly close manufacturing tolerances of the parts, by providing the needle cylinder with slide retracting feet, such slide retracting feet themselves being disposed en echelon in a row parallel to the row of pattern feet on the needle jacks, respective slide retracting feet being disposed in advance of and at the same level axially of the needle cylinder as a respective pattern foot on a needle jack. The slide retracting feet positively thrust the respective slide into their radially outward positions wherein the armatures of the magnet slide are close to the pole pieces and thus maybe retained if the respective magnet is energized. If this magnet is not energized, the slide returns to its radially inner position, where it engages the pattern foot of the respective needle jack and

thrusts such needle jack radially inwardly of its channel in the needle cylinder.

In the illustrative embodiment of the apparatus of the invention shown herein the needle cylinder is provided with longitudinally extending spaced parallel strips or guides set into channels in the needle cylinder proper, the needle jacks and needles being disposed between successive guide strips. Each guide strip has a slide retracting foot thereon, the retracting feet being disposed en echelon, parallel to the pattern feet on the needle jacks, and in advance of the pattern feet a distance which is sufficient to permit the slide to cooperate with the respective pattern feet on the needle jacks if the respective electromagnets are not energized. The radial height of the slide retracting feet is at least as great as the radial height of the pattern feet on the needle jacks when the needle jacks are pivoted radially outwardly by the fixed cams past which the needle cylinder rotates. Preferably the slide retracting feet extend radially outwardly a slight distance beyond the pattern feet on the needle jacks when the needle jacks are pivoted into their radially outer position.

The circumferential spacing between the slide retracting feet and the pattern feet on the needle jacks in the same plane transversely of the needle cylinder amounts to at least one needle division. Preferably, however, such spacing amounts to at least close to the length of the active portion of a ramp-like cam on the inner end of the slides. As we have seen above, the active portion of the slides is disposed somewhat downstream of the fixed cam which tilts the needle jacks radially outwardly.

Further characteristics and salient features of the invention will become apparent in the following description taken in connection with the drawings, the drawings showing more or less schematically a preferred embodiment of the apparatus in accordance with the invention.

In the drawings:

FIG. 1 is a fragmentary view in vertical radial section through the cam sleeve or mantle and the needle cylinder of a circular knitting machine incorporating the disclosed embodiment of the pattern control mechanism of the invention;

FIG. 2 is a view in side elevation of a development of a portion of the exterior of the needle cylinder provided with axially extending circumferentially spaced strip-like guide members provided with slide retracting feet, the needle jacks and needles being omitted for clarity of illustration;

FIG. 3 is a view in radial axial section through the needle cylinder, the section being taken along line 3-3 of FIG. 2;

FIG. 4 is a fragmentary view in elevation of a development of the needle cylinder, a cylinder carrying the guiding members shown in FIG. 3 and having needle jacks provided with pattern feet disposed between successive guide members, the view also showing the upper and lower cams which cooperate with the needle jacks to control their movement longitudinally of the needle cylinder, and the fixed cam shown at the bottom of the figure for tilting the needle jacks radially inwardly into their channels;

FIG. 5 is a fragmentary view in transverse section through the apparatus, the section being taken along line 5-5 of FIG. 1;

FIG. 6 is a view in transverse section on an enlarged scale of a portion of the apparatus shown in FIG. 5, the radially reciprocable slide members there shown being in its radially outer, inoperative position; and

FIG. 7 is a view similar to FIG. 6 of the apparatus with the parts in the position which they assume a short time after the needle cylinder has left the position thereof shown in FIG. 6, the slide members being shown in its radially inner, operative position.

Turning now to FIG. 1, there is shown a portion of a rotating needle cylinder 1, a fixed cylinder locking ring 2, and an outer, lower supporting ring 3 to which there is affixed a support 4. A pattern arrangement 5 is mounted upon the support 4 by a means (not shown) which permits the adjustment of the position of the pattern arrangement 5. The pattern arrangement 5 has a plurality (18 in this embodiment) of holding magnets 16 that are arranged in three vertical rows of 6 magnets each spaced circumferentially of the needle cylinder (FIG. 5) each magnet 6 cooperating with its individual slide members 7. The slide members 7 are arranged in a stack of 18 disposed radially of the needle cylinder, as shown. The magnets 6 may be individually energized according to the knitting pattern, so as to hold the respective slide members 7 in its radially outer position (FIG. 6) against the opposition of a coil compression spring 16. The arrangement and construction of the holding magnets 6 and of their reciprocable slide members 7 will be explained in detail in connection with FIG. 5.

The needle cylinder 1 is provided with a plurality of uniformly spaced axially extending vertical needle channels 12 formed between successive strip-like guiding members 10 which are mounted in channels in the needle cylinder proper. In the known manner, each of the needle channels 12 contains a knitting needle 8 at the top of the channel and a vertically reciprocable and tiltable needle jack 9 disposed below and acting upon the respective needle 8. The guide members 10 are retained in recesses in the needle cylinder 1 by means of a hook-like members 101 having a reentrant-angled lower surface fitting within a somewhat larger but similarly shaped socket in the root of the channel in the needle cylinder proper receiving the guide member 10. A hook-like member 101 retains the member 10 fixed with respect to the needle cylinder. On their radially outer vertical edges each of the guide members 10 has a slide retracting foot 11, each set of 18 consecutive guide members 10 having their feet 11 disposed en echelon, as shown in FIG. 2.

A needle jack 9 is disposed in each of the vertical channels formed between successive guide members 10 as shown in FIGS. 4 to 7, inclusive. As shown in FIG. 4, each of the needle jacks 9 has a pattern foot 91, the pattern feet being disposed en echelon parallel to the row of slide retracting feet 11 when the needle jacks are in their lower, retracted position, a pattern foot 91 on a needle jack 9 then lying in the same transverse plane as a slide retracting foot 11, such pattern foot 9 and slide retracting foot 11 being separated from each other by one guiding member 10 and one needle jack 9. See FIGS. 6 and 7 wherein a pattern foot 91' of a needle jack 9' and a slide retracting foot 11' of a guiding member 10' are disposed in the same transverse plane as the slide 7' there shown. It will be seen that the feet 9' and 11' are separated by one guiding member 10 and one needle jack 9.

As shown in FIG. 4, the needle jacks 9 are periodically raised during the rotation of the needle cylinder by the interaction of lower control feet 93 at the lower end of each of the needle jacks and stationary lower cams 15, 14; the needle jacks 9 and thus the needles connected thereto are lowered or retracted by the interaction of upper control feet 92 on the needle jacks with stationary similar upper cams 13 disposed around the needle cylinder. The cams 13 have lower "peak" portions or zones 13a which complete the retraction of the needle jacks, zones 13a being followed by horizontal zones 13b beneath which the feet 92 pass as the needle jacks travel through the selection station.

In FIG. 5 there are shown two consecutive similar pattern arrangements 5 and 5' which are arranged around the circumference of the needle cylinder. It will be understood that these are only two of the many pattern arrangements employed with the knitting machine. Since the two pattern arrangements shown are identical, it will suffice to describe arrangement 5. Each of the holding magnets 6 of arrangement 5 have a U-shaped core made of magnetic metal, the bight of the core being disposed radially outwardly of the needle cylinder. Each of the two legs of the core is provided with a field winding 62. The radially inner ends of the core form pole pieces 63 which interact with the outer ends of the respective slide members 7. The outer ends of the slide members 7 in the central row interact directly with their respective pole pieces. The outer ends of the other two rows of slide members 7 are provided with wings 75 some of which extend circumferentially in one direction and some in the other, the outer ends of wing 75 being provided with armature surfaces 71 as are the outer ends of the central row of slide members.

Each of the slide members 7 is provided with a radially extending guiding pin 18 affixed to a lateral projection 72 at the radially inner end of the slide member, there being a coil compression spring 16 with its radially inner end telescoped over the pin 18, the outer end of the spring being received in a spring seat in a fixed part 81 of the frame of the pattern arrangement 5. The spring 16 constantly urges the slide member 7 in a radially inner direction and retains it there unless the slide member is thrust radially outwardly and is retained in such radially outward position by energization of its respective magnet 6.

As indicated by arrows, the needle cylinder rotates in the direction from left to right in FIGS. 4 and 5 and in the direction from the bottom to the top in FIGS. 6 and 7. Each of the slide members 7 which has a vertical thickness somewhat less than the axial length of the feet 9 and 11 and is axially centered with respect thereto has a foot-entering ramp-like surface 73 which is inclined radially inwardly in the direction of rotation of the needle cylinder 1, and a straight or very slightly curved circumferential surface 74 which extends parallel to the other surfaces of the guide members 10, the needle jacks 9, and the feet on the guide members and needle jacks with which the slide member coacts. For clarity, in FIGS. 6 and 7 the slide members is designated 7', the guide member and the needle jack with which such slide member coacts are designated 10' and 9', respectively, and the feet on such elements are designated 11' and 91', respectively. It will appear that as the needle cylinder rotates in the indicated direction the foot 11' of guide member 10 first travels past the inclined surface 73 of slide member 7' advances into

engagement with a surface 74 of the slide member, and that needle jack 9' follows, the foot 91' thereon first travelling past the inclined surface 73 advancing into engagement with the substantially straight surface 74 of the slide member.

In front of each selecting point or zone of the circular knitting machine which is formed by a pattern arrangement 5 there is a stationary cam 17 that cooperates with the lower ends 94 of the needle jacks 9, cam 17 shifting all of the needle jacks 9 radially to the outside of the needle cylinder as shown in FIGS. 6 and 7. As above explained, FIG. 7 shows the same structure as FIG. 6, but with the parts in the positions which they occupy a brief time after they have occupied the position of FIG. 6. In each Figure the seven lower-most needle jacks are numbered 1 to 7, inclusive, from top to bottom. In FIG. 6 needle jacks 4 and 3 are being pushed radially outwardly of the needle cylinder by the inclined ramp-like portion of cam 17, needle jack 2 is riding along the straight inner portion of the cam 17, and needle jack 7 remains in the position, spaced from the surface 74 of the slide member 7', into which it will be thrust by cam 17. In FIG. 6 the slide member 7' is in its radially outer position, having been thrust into such position by engagement of the surface 74 of the slide member with the radially outer surface of the foot 11' of the guiding member 10'. If the respective magnets 6 for slide members 7' should now be energized, it would hold a slide member 7' in the radially outer position of FIG. 6. The second of the seven lower needle jacks, designated 9' and bearing the pattern foot 91' in the position shown in FIG. 6 is held radially outwardly by the straight portion of the cam 17; only after the needle jack 9' has moved out from the zone of influence from cam 17 does it enter the zone of possible influence by the surface 74 of the slide member 7'. In order to prevent any unwanted action by the slide member 7' upon the foot 91' of the needle jack 9' as the needle cylinder passes from the position of FIG. 6 into the position of FIG. 7 the outer surface of the needle cylinder is ground so that the outer surfaces of the guiding members 10 are located a small distance radially outwardly of the outer surfaces of the pattern feet 91 of the needle jacks 9 when the needle jacks are thrust into their radially outer position by the cams 17. With the magnet 6 for the slide member 7' energized the slide member remains retracted into its radially outward position as shown in FIG. 6 and thus will not press the needle jack 9' radially inwardly even after the needle cylinder 1 has rotated sufficiently for the lower (FIG. 6) edge of the guide member 10' to clear the upper edge of the surface 74 of the slide member 7'. Thus the ejection foot 93 at the lower end of the needle jack 9 will be in position to interact with the ejection cam 15 (FIG. 1) to eject a knitting needle 8 upwardly upon rotation of the needle cylinder sufficiently for the foot 93 to engage cam 15. In FIG. 7 a needle cylinder 1 has rotated through such angle that the pattern foot 91' of the needle jack 9' has traveled a distance a . This has carried the slide member retracting foot 11' of the guide member 10' past the end of the surface 74 of slide member 7'. Thereupon, if the magnet 6 for the slide member 7' is not energized the slide member 7' moves radially inwardly under the influence of spring 16 so that the surface 74 of the slide member engages the pattern foot 91' or the needle jack 9' to push the needle jack 9' radially inwardly into the position

thereof shown in FIG. 7. In such position of the slide member a surface 74 thereof engages and slides along the outer surfaces of a guide member 11 and the outer surface of the pattern foot 91'. In such position of a needle jack 9', its lower foot 93 does not engage the cam 15 as it rotates there past, and so the needle 8 associated with needle jack 9' is then not ejected in a working stroke. In FIG. 6 it is to be noted that the distance a , above discussed, equals the distance b , which is the circumferential length of the surface 74 of the slide member 7.

If, during the rotation of the needle cylinder 1 in the direction 19 (FIG. 6 and 7) a holding magnet 6 is not energized when its slide member 7 is offered to it while the slide member retracting foot 11 operates through the surface 74, a slide member 7 is thrust radially inwardly into the position of FIG. 7 by the respective return spring 16 as soon as the foot 11' moves off the portion 74 of the slide member. In the radially inward movement of the slide member 7 the zone 74 thereof meets the swung-out pattern foot 91' of the needle jack 9' which, by means of the cam 17, has been brought to its maximum radially outward position, as can be seen in FIG. 6 and presses this pattern foot 91' with its needle jack 9' back into the guiding channel 12 again - this action can be seen in FIG. 7. As result, the ejection foot 93 of the needle jack 9' leaves the zone of influence of the ejection locking cam parts 14 and 15. The pattern jack and thus also the needle 8 associated therewith are not ejected, but remain in circulating position.

The shifting of the slide member 7 in the direction of their respective holding magnets 6 is thus caused exclusively by the slide retracting feet 11 of the rigid guide members 10 of the needle cylinder. The pattern feet of the pattern jacks are, in contrast to those of applicant's prior patent application Ser. No. 77,226, completely relieved from such function. By means of surface grinding of the needle cylinder 1 which is provided with the guiding members 10, very small radial tolerances of the slide member retracting feet 11 can be obtained, and thus also a very accurate shifting of the slide member 7 in the direction toward the respective holding magnets 6. In this manner it is also insured that the slide member 7 are always thrust radially outwardly so that their outer, armature ends lie close to the pole pieces of the magnets and thus can be attracted and held with a rather low degree of energization of the field coils 62 of the magnets. Such holding of the slide member 7 continues until the energization of the magnet coils is interrupted and the slide member 7 is thrust radially inwardly into the position of FIG. 7 by the spring 16. Surface grinding of the needle cylinder 1 with the guide members 10 in place also insures that, when the needle jacks 9 and their pattern feet are accurately made there will exist the desired small difference d (FIG. 6) between the radial height of the outer surface of the pattern foot 91' of the needle jack 9' when the needle jack is thrust fully outwardly by the cam 17 and the outer surfaces of the feet 11 on the members 10.

Although the invention is illustrated and described with reference to one preferred embodiment thereof, it is to be expressly understood that it is in no way limited to the disclosure of such a preferred embodiment, but is capable of numerous modifications within the scope of the appended claims.

What is claimed is:

1. A pattern control mechanism for a circular knitting machine with a rotating needle cylinder, in which the needle selection is controlled at a pattern selecting position by means of a plurality of selectively energized electromagnetic selecting devices, each needle being provided with an associated needle jack which is slidable in the needle cylinder and is selectively swingable into and out of operative engagement with a stationary cam past which the jacks travel on the needle cylinder, each needle jack having at least one pattern foot, the pattern feet of the needle jacks following each other in sequence in a stepwise manner, a first ramp-like cam portion in advance of the pattern selecting position for successively swinging the needle jacks so that they lie in a first swung position, a plurality of slide members at the pattern selecting position, each of the slide members being selectively movable from a first, retracted position in which it does not substantially engage the pattern feet of the jacks when the jacks are in their first position, into a second, advanced position in which it engages the pattern foot of the respective jack when the latter is in its first position and thrusts such jack into a second swung position, the jacks in one of said swung positions thereof being disposed in the path of the stationary cam and in the other of said swung positions being disposed out of the path of the stationary cam, yieldable means for constantly urging all of the slide members toward their second, advanced position, means in advance of the pattern feet on the jacks for retracting the respective slide members into their first positions, said electromagnetic selecting devices including selectively energizable electromagnetic means at the pattern selecting position for retaining the slide members in their retracted position when the respective electromagnetic means are energized, said yieldable means then being overpowered by the energized electromagnetic means, the means for retracting the respective slide members comprises a plurality of second feet on the needle cylinder for retracting the slide members, said second feet being disposed stepwise in a manner similar to the first pattern feet on the needle jacks and in advance thereof, the needle cylinder is provided with a plurality of longitudinally extending channels parallel to the axis of rotation of the needle

cylinder, a needle and a needle jack being disposed in alignment in each of said channels, each of the channels being bounded by two longitudinally extending elongated guide members, said second feet for retracting the slide members being disposed on said guide members and projecting radially therefrom.

2. A control mechanism according to claim 1, wherein the corresponding first pattern feet and the second feet on the needle cylinder being spaced apart circumferentially of the needle cylinder by at least one needle and jack receiving channel.

3. A control mechanism according to claim 1, wherein the outer radial extent of said needle jacks when in said first swung position is slightly less than the outer radial extent of said guide members.

4. A control mechanism according to claim 1, wherein said second feet on the elongated guide members and said pattern feet on said jacks are disposed in the same plane and contiguous to each other are spaced at least one needle width from each other.

5. A control mechanism according to claim 1, wherein the slide members are disposed in a stack disposed in a radial axial plane of the needle carrier.

6. A control mechanism according to claim 5, wherein each of said slide members has a ramp-like surface disposed on the radially inner end thereof, said electromagnetic means being disposed to cooperate with the radially outer ends of the slide members.

7. A control mechanism according to claim 6, wherein the radially outermost portion of the first ramp-like cam portion terminates in a circumferential direction in advance of the radially innermost portion of each of the ramp-like surfaces of the slide members.

8. A control mechanism according to claim 7, wherein the ramp-like surface of each slide member has a first jack entering ramp portion and a second following innermost portion of at least substantially uniform radius relative to rotary movement of the needle cylinder, said second portion of each of the ramp-like surfaces having a circumferential length such that it spans at least one complete needle and jack receiving channel and a guide member contiguous thereto.

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