

A knitting machine and a yarn changer

This invention relates to a knitting machine and a yarn changer of the kind set forth in the pre-characterizing parts of claims 1, 13 and 16.

Knitting machines and yarn changers of this kind are known (EP 0 319 444 A2). These and other known knitting machines and yarn changers (DE-PS 958 237, DE 2 024 241 C3, DE 2 710 044 A1, DE 2 805 779 A1, DE 3 129 724 A1, DE 3 325 102 C2) are characterized by many individual parts, which lead to wear and proneness to faults in operation. Moreover, a problem as yet unsolved consists in that the known yarn changers, also called stripers, are inclined to make loud rattling noises, in the form of the known clicks and rattles, on account of the constant switching movements and the many parts participating therein, even during periods in which there is actually no yarn changing taking place. Finally known circular knitting machines as fitted with yarn changers are in particular often so constructed that large parts of the working area of the machine are covered by the yarn changers, so that the normal work arising there is greatly hindered or impeded. This is very much the case when circular knitting machines with needle cylinders and dials are involved.

The invention is therefore based on the object of so arranging a knitting machine and a yarn changer of the kinds initially referred to that they consist of fewer moving parts, facilitate fitting a space-saving selector mechanism and can be optimised in relation to the development of noise.

The characterizing features of claims 1, 13 and 16 serve to meet this object.

The invention leads to the advantages that only a single control cam track is required to control the opener and closer. The number of parts is thus greatly reduced, which leads to less wear and proneness to faults. Furthermore the parts to be controlled by the selector apparatus can operate directly on the associated functional parts, instead of through intervening lever mechanisms. Moreover the invention facilitates such a design of the yarn changer that the functional parts only have to move when a yarn change is actually required, so that the usual noises largely disappear.

Further advantageous features of the invention appear from the dependent claims.

The invention will now be explained in more detail in conjunction with the accompanying drawings of embodiments, in which:

Figure 1 is a partially cut-away side view of a circular knitting machine according to the invention;

Figure 2 is a plan view of the circular knitting machine of Figure 1;

Figure 3 is the front view of a yarn changer according to the invention;

Figure 4 is a side view of the yarn changer of Figure 3;

Figures 5 to 8 show a yarn finger of the yarn changer according to Figures 3 and 4 to a larger scale and with a yarn clamp open, respectively in a front view, a side view and a rear view, as well as in a cross-section;

Figure 9 is a view of the yarn finger corresponding to Figure 6, with the yarn clamp closed;

Figures 10 to 14 are views corresponding to Figure 4 showing the manner of operation of the yarn changer according to the invention;

Figures 15 to 17 show a second embodiment of a yarn changer according to the invention in views corresponding to Figures 4, 3 and 13, wherein Figure 16 is a section along the line XVI-XVI of Figure 15;

Figure 18 is a view corresponding to Figure 1 of a rib circular knitting machine in accordance with the invention;

Figure 19 is a schematic front view of the rib circular knitting machine according to Figure 18 in the region of the dial; and

Figure 20 is a radial, vertical section through the circular knitting machine of Figure 18 in the region of the dial.

The circular knitting machine according to Figure 1 includes a needle cylinder 1 with a vertical axis of rotation, with knitting implements 2 mounted to move axially therein, and a coaxial sinker ring 3 with sinkers 4 mounted to move radially therein. In order to control the up and down movement of the knitting implements 2 and the radial to and fro movement of the sinkers 4, these are provided in known manner with butts, not shown, on which cam parts act, these being fitted in a cam box ring 5 surrounding the needle cylinder 1 and a cam ring 6 mounted above the sinker ring 3.

The needle cylinder 1 is supported coaxially on a support ring 9, which is

mounted rotatably in a base plate 10 of a frame, not shown, and is provided with teeth on its outer periphery. The teeth are in mesh with a gearwheel 11 which is fitted on a drive shaft 12 mounted rotatably in the frame. As against this, the cam box ring 5 and the cam ring 6 are mounted on a cam box plate 13 arranged stationary in the frame and coaxial with the needle cylinder 1. The drive shaft 12 is connected to a drive source, not shown, for the knitting machine. The arrangement can naturally also be such that the needle cylinder 1 and the sinker ring 3 are stationary, while the cam box ring 5 and the cam ring 6 are mounted rotatably in the frame and are coupled to the drive shaft 12.

An annular support 14 is fixed in position in a part of the frame lying above the needle cylinder 1 and a support ring 16 is rotatably mounted coaxial with the needle cylinder 1 on the support 14 by means of bearings 15. The support ring 14 is provided with teeth round its periphery, which mesh with a pinion 17 which is fixed on the drive shaft 12, which passes through a column 18 of the frame fixed to the support 14 and also serves to drive the support ring 16 with speed of rotation corresponding to that of the cylinder. A stationary cover ring 19 is fixed to the frame above the support ring 16. In the case in which the needle cylinder 1 is stationary, the support ring 16 is stationary, whereas the support 14 is arranged rotatably.

At least one, but preferably a plurality, of yarn changers are fixed on the support 14, each having at least two and preferably four yarn fingers 22, from each of which at least one yarn 23 can be fed from a supply spool, not shown, through a run-in eye 24, into a yarn guide 25, in order to be presented therefrom to the hooks of the knitting implements 2.

Knitting machines of this kind are generally known (e.g. EP 0 319 444 A2) and do not therefore need to be explained in more detail.

Figure 2 shows first and foremost the support ring 16, the partially broken away cover ring 19 and the drive pinion 17, the axis of rotation of the support ring 16 and the needle cylinder 1, not visible, being indicated by the reference numeral 26. The parts shown in broken lines in Figure 2 are arranged below the support ring 16, in accordance with Figure 1. For simplicity, only two needle changers 21 are shown, which are arranged distributed with a small spacing around the axis of

rotation 26 and are each associated in a manner known per se with a knitting system, although fewer yarn changers 21 than knitting systems can naturally be provided.

According to Figures 3 and 4, each yarn changer 21 includes an oblong, substantially rectilinear housing formed in substance from two parallel side plates 27 and 28. The side plate 27 is removed in Figure 4, in order to give a view of the interior of the housing. The side plates 27 and 28 have a substantially rectangular shape but are provided in a lower, front part with a cut-out 29 and in an upper, front part with extensions 30 and 31. The extensions 31 are connected by a mounting block 32, through which passes a mounting screw 33. This serves to fix the yarn changer 21 to the support 14 after hanging the extension 30 on a corresponding, surrounding projection 34 provided on the support 14. A longitudinal axis 37 (Figure 3) of the housing is vertical, i.e. parallel to the direction of movement of the knitting implements 2 and preferably parallel to the axis of rotation of the needle cylinder 1. Moreover the side plates 27, 28 are connected together but held spaced apart by a plurality of studs or the like arranged parallel to one another and fixed to the plates by rivets or the like, with spacers 35, 36 fitted over the studs, the studs serving at the same time for pivotal mounting of other parts, as will be explained fully below.

One of the studs 38 serves for pivotal mounting of plate-form, single armed pivoted levers 39 of the yarn fingers 22. The pivoted levers 39 are provided with respective noses 40 at their front ends, which noses project into slots 41 extending parallel to the longitudinal axis 37 and formed in a plate 42 arranged transverse to the side plates 27, 28 and serve at the same time as a guide for the pivoted levers 39. The pivoted levers 39 are each so biased by a spring 43 that their noses 40 bear against the upper bounding edges of the slots 41 in a datum position.

Each pivoted lever 39 is articulated to an associated selector lever 45, which is arranged substantially parallel to the longitudinal axis 37 and above the pivoted lever 39 and whose upper end projects outwardly above the house of the yarn changer 21 in a datum position, but especially in a working position to be explained below. Each selector lever 45 is biased by a spring 46, which tends to pivot it transverse to the longitudinal direction and radially inwards with reference to the

circular knitting machine according to Figures 1 and 2. The springs 46 in the form of compression springs are mounted in blind bores 47, which are formed in a block 48 connecting the front, upper ends of the side plates 27, 28 and are directed towards the selector levers 45. The block 48 also includes guide slots for the upper ends of the selector levers 45.

A gearwheel 48 is rotatably mounted on a further stud connecting the side plates 27, 28 and meshes with two parallel racks 49 and 50. The rack 49 is formed on the edge to the left in Figure 4 of a control member 51 in the form of a slider and the rack 50 on the edge to the right in Figure 4 of a slider 52. The upper end of the control member 51 projects in a datum position upwardly out of the housing of the yarn changer 21. Both sliders 51, 52 extend and are movable substantially parallel to the longitudinal axis 37 and are guided for this by suitably arranged slots on studs 53, 54. The one end of a lever 55 is articulated to the lower end of the control member 51, while the slider 52 is connected, preferably fixedly at its lower end to an arm 56. A closer 57 is fixed on the other end of the lever 55 and is normally biased radially outwards against a stop 59 by a spring 58 engaging the lever 55, but can be swung clockwise radially inwardly against the force of the spring 58, until it bears against a stop 60. On the other hand an opener 61 is fixed on the lower end of the arm 56 and is arranged always substantially parallel to the longitudinal axis 37. The spring 58 further holds the slider 51 in its uppermost position in Figure 4 in a datum position, but holds the slider 52 in its lowermost position in Figure 4. Moreover, the parts 48 to 54 form a reverse-coupling mechanism serving for common actuation of the closer 57 and opener 61.

The gearwheel 48, the sliders 51 and 52, the lever 55 and the arm 56 are advantageously of flat form and mounted directly against the side plate 28, so that they cannot hinder the movements of the other parts. However, the closer 57 advantageously consists of a plate arranged transversely to the lever 55 and extending over the whole width of the housing, being provided with an opening 62 through which the pivoted levers 39 pass and being fixed at one end on the lever 55. The opener 61 correspondingly consists advantageously of an angle bracket fixed on the arm 56, one limb being arranged in extension of the arm 56 and the other limb being arranged perpendicular thereto and to the side plate 28 and formed

as a bar 63 extending over all the pivoted levers 45.

According to Figures 5 to 9, each yarn finger 22 includes a straight, rod-shaped finger body 65, which is fixed at its upper end in Figures 5 to 9 on to the associated pivoted lever 39. A guide body 66 is slidably guided on each finger body 65. The finger body 65 has a U-shaped recess 67 at its lower end, through which the yarn 23 (Figures 1, 6 and 9) can run and whose lower edge is formed as a cutting edge 68 (Figure 5). The guide body 66 carries a cutting element 69 which cooperates with the cutting edge 68 on one side of the finger body 65 and, on the other side, a clamp element 71 which is pressed against the finger body 65 by a pressure spring 70. The guide body 66 consists for example of a hollow block receiving the finger body 65 with sliding fit and which has window-like openings 72 in its front and rear walls, which serve to receive projections 73, 74 and 75 in interlocking manner, these projecting perpendicularly from the upper ends of the cutting and clamping elements 69, 71 and the pressure spring 70. This provides simple assembly of the various parts and reliable entrainment of the cutting and clamping elements 69, 71. Moreover the guide body 66 has a projection 76 on the side associated with the cutting element 69, this projection cooperating with the bar 63 of the opener 61 (Figure 4) and has a projection on its side associated with the clamping element 71, this projection cooperating with the closer 57.

Moreover it is clear that the yarn changer 21 according to Figures 3 to 9 has as many yarn fingers 22 and selector levers 45 arranged side by side as there are different yarns 23 to be fed. In the embodiment there are four each of the yarn fingers 22 and selector levers 45 but it is self-evident that more or less yarn fingers 22 and selector levers 45 could be provided.

A guide body 78 (Figure 4) is fitted on the upper end of the housing of the yarn changer, between the two side plates 27 and 28, four control pins 79 being guided therein with a sliding fit parallel to the longitudinal axis 37. The guide body 78 moreover serves to support the upper part of the control member 51 slidably. The control pins 79 abut four associated pre-selector levers 80 respectively, which are pivotally mounted on a further stud 81 extending between the side plates 27, 28 and extend in Figure 4 substantially horizontally, i.e. perpendicular to the selector levers 45. The pre-selector levers 80 are biased clockwise into a datum position by

springs 82 engaging their rear ends and are held in abutment with the lower ends of the associated control pins 79 projecting out of the guide body 78, the upper ends of the pins projecting upwardly out of the guide body 78.

The front ends 83 of the pre-selector levers 80 bear in their datum position on stop pins 84, which are fixed on the associated selector levers 45 and project to the sides of these, so that they are retained in the datum position seen in Figure 4 against the force of the springs 46.

As Figures 3 and 4 show, the described parts of the yarn changer preferable consist of stampings which are made out of comparatively thin sheet metal. The wide sides of the levers 39, 45, 80 etc. and the sliders 51, 52 lie parallel to the side plates 27 and 28, so that all parts associated with each yarn finger 22 lie directly beside or over one another and form a sub-assembly which serves for selection of a yarn 23. On the other hand the parts 48, 51, 52, 55, 57 and 61 are only provided once and are associated in common with all sub-assemblies. It is thus possible to make a very space-saving, compact yarn changer, which makes it possible to fit e.g. 48 yarn changers 21 round the periphery of a conventional 30" circular knitting machine.

A number of guide laminae 86 are arranged in the lower part of the housing according to Figures 3 and 4, between and parallel to the side plates 27 and 28, being fixed and held spaced from one another by studs 87, 88 and 89 passing therethrough and spacers 36 fitted on the studs. These guide laminae 86 provide lateral guidance for the yarn fingers 22, largely free from wobble even with larger tolerances, during their pivotal movements, and can if required be provided with lower recesses 90 in which lie the yarns 23 just being worked handled by the circular knitting machine.

As shown in Figures 1 and 2 in particular, a selector apparatus 91 is mounted on the support ring 16; it has a number of control magnets 92 corresponding to the number of yarn fingers 22 and control pins 79 and arranged offset in the radial direction in correspondence with the control pins 79. The control magnets 92 are in the form of solenoids and are each provided with a horizontally and radially reciprocating plunger 93, which is articulated to a lever 94, which projects through a recess, not shown specifically, into a region arranged below the

support ring 16, and there carries a control cam 95 and is pivotally mounted in a middle part by means of a pin 96 fixed on the support ring 16. The control cam 95 is arranged in the radial direction e.g. with the plunger 93 extended, above and in the working range of an associated control pin 79 and with the plunger 93 retracted outside the working range of the associated control pin 79. The arrangement can naturally be inverted so that only retracted plungers 93 act on the control pins 79. Accordingly, with rotation of the support ring 16 together with the needle cylinder 1 in the direction an arrow v (Figure 2), only those control cams 95 come into the working range of associated control pins 79 as are selected by appropriate control of the control magnets 92. The current supply to the control magnets is effected by means of conductors 97, which are fed in a manner known per se from a pattern device, not shown, via slip rings 98, which extend coaxially round the axis of rotation 26 in the centre of the circular knitting machine and are sensed by sliding brushes 99 connected to the conductors 97. Moreover it is possible to arrange the individual magnets 92 one after the other in the peripheral direction in accordance with Figure 2, in which case the control signals have to be applied with a corresponding offset in time.

Furthermore, Figure 2 in particular shows three cam tracks 101, 102 and 103, which are fitted on the underside of the support ring 16. The leading end of the cam track 101, in the direction of rotation (arrow v), which however trails behind the selector apparatus 91, is associated with the selector levers 45 (Figure 4), the subsequently beginning cam track 102 with the control member 51 and the last cam track 103 also with the selector levers 45.

Finally, a yarn catcher 104 fixed on the support ring 16 is shown schematically in Figure 2 and serves in a manner known per se to engage the yarn 23 offered by a selected yarn finger 22 above a bar 25a and lay it safely into a slot 105 (Figure 3) of the yarn guide 25 formed behind the bar 25a. As shown especially in Figure 1, the yarn catcher 104 is fixed on an arm 106 connected to the support ring 16 and is held closely above and behind the hooks of the knitting implements 2.

The manner of operation of the circular knitting machine and yarn changer described with reference to Figures 1 to 9 will now be explained in more detail with

reference to Figures 10 to 14, wherein parts additionally provided with the letter "a" are associated with a yarn 23a to be newly laid in and the parts additionally provided with the letter "b" are associated with an old yarn 23b still being worked.

In Figures 3 and 4 it is assumed that the yarn 23b among the four yarns 23a, 23b, 23c and 23d in all is being knitted and laid into the hooks of the knitting implements 2. Therefore, the yarn 23b lies according to Figure 4 (cf. also Figure 6) in the open recess 67 of a masked yarn finger 22 and in the recess 90 of the associated guide lamina 86. All other yarns assume the same clamped position as the yarn 23a in Figure 4 (cf. also Figure 9).

When a yarn change to e.g. the yarn 23a is to be made, the associated control magnet 92a (Figure 10) is firstly controlled during the rotation of the support ring 16 and thus the control cam 95a coupled thereto is arranged above the associated control pin 79a. The result of this is that, with further rotation of the support ring 16, the control pin 79a is gradually pushed down by a falling surface of the control cam 95a and the associated pre-selector lever 80a is swung anticlockwise into a pre-selection position and its end 83a is raised from the stop pin 84a of the associated selector lever 45a. The spring 46a thus becomes active and swings the selector lever 45a anticlockwise so far into an operating position that its upper end is offset radially inwardly from the upper ends of the other selector levers 45b etc. and is arranged above the housing in the region of the cam track 101 (Figure 2). The selection of the yarn 23a is thus prepared for and the associated control magnet 92a can change over its signal in order to make the following yarn changer in the direction of the arrow v operative. The pre-selection position is moreover held by the spring 46a.

Figure 11 shows that, with further rotation of the support ring 16, a downwardly rising section of the cam track 101 acts on the selector lever 45a located in the working position and presses this down. The actual yarn change is thereby initiated, in that on the one hand the associated yarn finger 22a is swung clockwise by the pivoted lever 39a and on the other hand the pre-selector lever 80a and the control pin 79a therewith are restored to the datum position by the spring 82a. The swinging of the yarn finger 22a results in the lower end of the associated finger body 65a being swung from a radially outward datum position relative to the

knitting implements 2 into a working position radially behind the backs and directly over hooks of the knitting implements 2. The old finger body 65a guiding the old yarn 23b is also visible in Figure 11. Through the swinging of the pivoted lever 39a its nose 40a is at the same time applied against a lower transverse web of the closer 57, whereby this is lifted off the abutment 59 and applied against the abutment 60. In this position the lower, free end of the closer 57 is located directly opposite the projection 77b of the guide body 66b. At the same time the yarn finger 22a is substantially vertical and so arranged that the bar 63 of the opener 61 is arranged directly under its projection 76a. The yarn catcher 104 is already arranged directly in front of the yarn 23a.

According to Figures 2 and 12, with further rotation of the support ring 16 in the direction of an arrow w (Figure 12), the yarn catcher 104 now comes ever further into a position in which it engages the yarn 23a held and offered up by the yarn finger 22a and with a falling curve 107 presses it deeper into the V-shaped slot 105 of the yarn guide 25, so that it can, like the yarn 23b be engaged by the hooks of the raised knitting implements 2. Accordingly both yarns 23a and 23b are knitted together in the region of a so-called change point. The yarn finger 22a is still held by the cam track 101 in the position seen in Figures 11 and 12.

With further rotation of the support ring 16, the cam track 102 comes gradually into the region of the upper end of the control member 51, so that this is pressed down in Figure 13 together with the closer 57 by a falling section of the cam track 102 and at the same time the slider 52 with the opener 61 is pulled up through the reverse-coupling mechanism 48 to 54. Through this on the one hand the guide body 66b of the yarn finger 22b is moved by means of the closer 57 acting on the projection 77b in the direction of the free end of the finger body 65b and the yarn 23b is thus cut and clamped (cf. also Figure 9). On the other hand the guide body 66a of the yarn finger 22a is pushed up by the bar 63 of the opener 61 engaging under the projection 76a of the guide body 66a and the clamped end of the yarn 23a is thus released. The yarn change is thereby concluded and it is now the yarn 23a which is knitted. By suitable determination of the spacing of the closer 57 and the bar 63 from the associated projections 77b and 76a in the position seen in Figure 11 the precise point in time at which the yarn in question is to be clamped

and released respectively can be determined.

With further rotation of the support ring 16, the end of the cam track 102 is reached next according to Figure 2, whereby the control member 51 and the slider 52 are moved back under the action of the spring 58 into their datum position according to Figure 4 or 14 and at the same time the closer 57 is swung back from the stop 60 to the stop 59. Then the end of the cam track 101 is also reached (Figure 2), so that the pivoted lever 39a and the selector lever 45a are swung back into the datum position according to Figure 10 under the action of the spring 43a.

Finally the cam track 103 (Figures 2 and 14) comes into the region of the upper end of the selector lever 45a and acts radially outwards thereon. The selector lever 45a is thereby swung back into the datum position against the pressure of the spring 46a, so that its stop pin 84a latches behind the end 83a, so that the starting condition of all parts is produced again.

As Figure 2 shows, the yarn change initiated by the selector apparatus 91 and carried out by the active sections of the cam track 102 and of the yarn catcher 104 can be effected within a region extending over a few knitting implements 2, the so-called change point, while the whole control region from the beginning of the selector apparatus 91 to the end of the cam track 103 can extend over a comparatively large region of e.g. half a revolution of the needle cylinder.

It is preferable that, under the action of the yarn catcher 104 (Figures 12, 13, 14), the newly laid in yarn 23a is pressed so deeply into the slot 105 of the yarn guide 25 that a yarn section located between this and the run-in eye 24 enters the recess 90a of the associated guide lamina 86a. The yarn 23a is thus so guided that it enters into the opened recess 67a of its finger body 65a when the yarn finger 22a (Figure 14) swings back and it is thus securely clamped and cut in the next yarn change.

Figures 15 to 17 show a second embodiment of a yarn changer 111 according to the invention at present believed to be the best, which corresponds in its construction and in its function essentially to the yarn changer 21 according to Figures 1 to 14, so that like parts are given the same reference numerals in Figures 15 and 17 and only the parts which are different are described below.

In the datum position of the parts seen in Figures 15 and 16, the selector

levers 45 are articulated to single armed pivoted levers 112, which are the same as the pivoted levers 39 apart from omission of the noses 40, are fixed to the yarn fingers 22 and fit on a stud 113 arranged transversely between the side plates 27, 28 (Figure 16). Instead of the reverse-coupling mechanism according to Figures 1 to 14 a reverse-coupling mechanism is provided which includes a control member 114 which consists of a bent wire or pivoted bow for example, which is so pivotally mounted within an upper, middle housing part between two studs 115 (Figure 6) mounted in the guide body 78 that it does not interfere with the movements of the other parts. A two-armed lever 116 serves for the pivotal mounting of the control member 114 (Figures 15, 16), and is pivotally mounted in a middle part on a stud 117, which is arranged transverse to the longitudinal axis 118 of the housing and perpendicular to the side plates 27, 28 and is fixed to these. The lever 116 carries a pin 119 at one end, on which an eye formed at the lower end of the pivoted bow 114 fits rotatably and carries a pin 120 at the other end, on which an opener 121 is rotatably mounted. A closer 122 is moreover pivotally mounted on the pin 119. The reverse-coupling mechanism is thus formed by the parts 114 to 120 in this embodiment. The opener 121 and the closer 122 each consist in this embodiment in a rectangularly bent wire, whose two ends are each bent into an eye rotatably mounted on the pin 119 or 120 and whose long arms are arranged parallel to the side plates 27, 28 and to the longitudinal axis 118. Lower transverse webs 123 and 124 respectively of the opener 121 and closer 122 extend over substantially the whole width of the housing and correspond to the bar 63 and the lower bounding edge of the closer 57 respectively (Figure 4).

The upper end of the control member 114 is so bent into a hook shape that it forms an entraining arm 126, which extends in accordance with Figure 16 transversely over the width of the housing and bears on the upper edges of all the selector levers 45 in a datum position. In order to assist this operation, a helical spring is fitted over the stud 119 and one end thereof bears on a pin 128 and the other end on the control member 114 in such a way that its entraining arm 126 is pressed against the upper ends of the selector levers 45.

The datum position of the parts seen in Figures 15, 16 is, as in Figure 4, ensured by springs 129, 130, which so pull the pivoted levers 112 against the upper

edges of the plate 42 and the two-armed levers 116 against a stop 131 that the opener 121 assumes its lowest position and the closer 122 its highest position.

The arrangement otherwise corresponds essentially to Figures 1 to 14.

The manner of operation of the yarn changer 111 according to Figures 15 and 16 appears especially from Figure 17, in which an older, knitting yarn 23c is to be replaced by a new yarn 23d and in which the parts associated with the yarn 23c are additionally given the letter "c" and the parts associated with the yarn 23d are additionally given the letter "d".

As in Figures 1 to 14 a control pin 79d, and with it a pre-selector lever 80d, are actuated by means of a selector apparatus, not shown but preferably corresponding to the selector apparatus 91 (Figure 1), whereby the associated selector lever 45d is applied against a stop 132 by the spring 46d. The selector lever 45d carries the entraining arm 126 with it and thus swings the control member 114 against the force of the helical spring 127 in the anticlockwise sense, into an operating position such that its upper end projects upwardly out of the housing and comes into the region of the cam track 102 (cf. also Figure 13).

After the selector lever 45d, the pivoted lever 112d and the associated yarn finger 22d have been swung as in Figures 11 and 12 by the cam track 101, the cam track 102 acts on the control member 114 and presses this substantially vertically down. The two-armed lever 116 is thereby swung clockwise through about 90°, until it bears at another side on the stop 131 again (cf. Figures 15 and 17). This results on the one hand in the opener 121 being raised with the guide body 66d and, on the other hand, the closer 122 being lowered and with it the guide body 66c, in order to free and cut and clamp the yarns 23d and 23c respectively in the manner described with reference to Figures 5 to 14. After the track 103 has passed by (Figure 14) all parts are swung back into the datum position according to Figure 15 by the springs 129d, 130 and 127.

A substantial advantage of the embodiment described with reference to Figures 15 to 17 lies in that, with the selector levers 45 in the datum position (Figure 15), the control member 114 also assumes a datum position, in which its upper end is arranged out of the range of the track 102. The opener 121 and closer 122 of all yarn changers present therefore remain unaffected thereby so long as no

yarn change takes place. On the contrary, the track 102 operates on the control member 51 in every revolution of the needle cylinder 1 in the embodiment according to Figures 1 to 14, so that the opener and closer 61, 57 execute a dead stroke in every needle cylinder revolution in which no yarn change is desired. This leads to increased wear and especially to greater creation of noise. In using the embodiment according to Figures 15 to 17 the creation of noise is minimal, since when no yarn change is effected, all parts stay at rest until a new yarn change is to be initiated.

A further substantial advantage of the yarn changers 21 and 111 is to be seen in that the selector levers 45 and control members 51 and 114 respectively to be actuated by the cam tracks 101, 102 and 103 act directly and not through additional levers or the like on the associated functional parts (yarn fingers 22, closers 57 or 122, openers 61 or 121). The working direction of the parts 45, 51 and 114 is preferably parallel to the longitudinal axis 37 or 118. In this way the total number of parts present is substantially reduced. Moreover, increased operating reliability results. Finally it is possible to make the whole yarn changer 21 or 111 very compact and narrow, so that more yarn changers can be arranged round the circumference of an ordinary circular knitting machine that heretofore.

A further substantial advantage of the yarn changers 21 and 111 according to the invention consists in that these are on the one hand arranged substantially above the circle of the knitting implements 2 and on the other hand are controlled by cam tracks 101, 102 and 103 which run above the housings of the yarn changers 21, 111. Accordingly there is enough space available on the circular knitting machine for the yarn changers 21, 111 not only to leave the working region of the circular knitting machine largely free but they can be used directly even with circular knitting machines which have a dial 134 schematically indicated in Figures 18 to 20, rotating together with the needle cylinder 1, instead of the sinker ring 3. The drive shaft 12 is guided above the pinion 17 by a stationary support disc 135 and provided with a further pinion 136 which is in mesh with a drive gearwheel 137, which is fixed on a further drive shaft 138 rotatably mounted in the centre of the circular knitting machine, coaxial with the axis of rotation 26. This drive shaft carries a support ring 139 in usual manner at its lower end, on which is mounted the dial

134, while the support disc 135 supports a carrier 140 for a conventional dial cam box 141.

In contrast to Figures 1 to 17, a yarn catcher 142 is integrated in the dial 134 in the embodiment according to Figures 18 to 20, since the space in which the radially inwardly arranged arm 106 otherwise runs (Figure 1) is here at least partially occupied by the dial cam box 141, so that the arm 106 would have to be shaped in a special way dependent on the specific type of machine, in order to be able to pass the yarn catcher 142 without hindrance behind the knitting implements 2. Through the variant according to the invention the yarn catcher 142 can be mounted without such an arm 106. As shown particularly by Figure 20, the yarn catcher 142 is fixed on a rearward retaining plate 143, on the rear side of which at least one mounting bar 144 is fixed. There are preferable a plurality of such mounting bars 144. These consist of long, flat parts like the shank of a needle or a jack selector and are mounted in place of a corresponding number of dial needles in the radial grooves 145 of the dial 134 receiving these. The mounting bars 144 moreover each have a downwardly projecting butt 146. These butts 146 are arranged in a groove 147 running in a circumferential direction, in order to prevent radial movements of the mounting bars 144. The groove 147 is only formed in the region of the change point, where the mounting bars 144 are to lie. In this manner it is possible to arrange the yarn catcher 142 closely behind those hooks of the knitting implements 2 of the needle cylinder 1 in which the old and new yarns 23 are laid in the region of the change point.

Figure 19 further shows a front view of three knitting systems lying adjacent one another, each with a yarn guide 25 having the slot 105, where a yarn changer 21 is shown schematically only in the knitting system farthest to the right. This feeds a yarn 23e shown with exaggerated thickness, which is arranged in the slot 105 of the associated yarn guide 25. Moreover, a yarn finger 22f (Figure 20) is swung into its working position, in which it offers a new yarn 23f, also shown with exaggerated thickness, in the described manner. This is then engaged by the yarn catcher 142 mounted on the dial or its obliquely extending curve 148 (Figure 19) arranged in Figure 19 directly in the middle knitting system and moving in the direction of an arrow x and is gradually laid into the slot 105 of the yarn guide 25,

as is indicated in Figure 20 by a broken line 150 between the yarns 23e, 23f and as fully explained with reference to Figures 5 to 14.

Figure 18 further shows the slip rings 98 indicated also in Figure 2, mounted on an outer wall of a sleeve 149 surrounding the drive shaft 138 and connected to the support disc 135, as well as the brushes 99 and the conductors 97 which lead to the control magnets 92.

The invention is not limited to the described embodiments, which can be modified in many ways. This applies in particular to the various parts of the yarn changers 21 and 111. For example, the closer 57 could be in the form of an L or U-shaped bow, like the closer 122. It would also be possible to fit the parts 51, 52 on both side plates 27, 28, to mount them on the studs 53, 54 and couple them by gearwheels 48 fitted on both sides. In addition reverse-coupling mechanisms of different forms could be provided and also the control members 51 could be so designed and arranged that they are only arranged in the working range of the track 102 when a yarn change is desired. Furthermore, it is possible to mount the opener and/or closer adjustably on the parts 52, 55 or 116, e.g. with the aid of slots, adjusting screws, eccentrics, or the like in order to be able to adjust the point in time at which they become active. It is further obvious that other, in particular mechanical pattern devices could be provided in place of the selector magnets 92. Moreover the described parts can be provided in combinations other than those shown. Finally the invention is not limited to circular knitting machines but can also be used with flat-bed knitting machines with suitable modifications.

CLAIMS

1. A knitting machine, comprising: at least one support (1,134) for slidably mounting knitting implements (2); a cam box (5, 141) for controlling the knitting implements (2); at least one yarn changer (21, 111) for feeding at least one selected yarn (23) to the knitting implements (2), each yarn changer being provided with at least two yarn fingers (22) which can swing to and fro between a datum position and a working position and have finger bodies (65) and guide bodies (66) slidably mounted thereon, each guide body having a cutting element (69) and a clamping element (71), and with a closer (57, 122) and opener (61, 121) both common to all the yarn fingers (22) for effecting reciprocating movement of the guide bodies (66); and means for acting on said yarn fingers (22) and the opener (61, 121) and closer (57, 122) in order to carry out yarn changes, characterized in that the opener (61, 121) and the closer (57, 122) are coupled together by a reverse-coupling mechanism (48-54; 114-120) controlled by a common cam track (102).
2. A knitting machine according to claim 1, characterized in that the reverse-coupling mechanism (48-54, 114-120) is under the control of a control member (51, 114) projecting upwardly out of the yarn changer (21, 111) and cooperating with the cam track (102).
3. A knitting machine according to claim 2, characterized in that the control member (51, 114) is biased by a spring (58, 130) into a position in which its upper end projects upwardly out of the yarn changer (21, 111).
4. A knitting machine according to any of claims 1 to 3, characterized in that the yarn fingers (22) are each operatively connected to a selector lever (45), the selector lever



(45) being biased by springs (43, 46, 129) into a working position, in which its upper end projects upwardly out of the yarn changer (21, 111).

5. A knitting machine according to claim 4, characterized in that said means for acting on said yarn fingers (22) comprises a selector apparatus (91) for selecting the selector levers (45) and cam tracks (101, 103) for acting on selected selector levers (45) disposed in a working position.

6. A knitting machine according to any of claims 1 to 5, characterized in that it is in the form of a circular knitting machine, which has a needle cylinder (1), and in that the selector apparatus (91) and cam tracks (101, 102, 103) are mounted on a support ring (16) arranged above the needle cylinder (1).

7. A knitting machine according to any of claims 4 to 6, characterized in that the yarn changer (21, 111) comprises at its upper end a number of pre-selector levers (80) corresponding to the number of selector levers (45) and slidably mounted control pins (79) bearing on the pre-selector levers for pre-selection of selected levers (45), wherein the pre-selector levers (80) are biased by springs (82) into a position in which the upper ends of the control pins (79) project upwardly out of the yarn changer (21, 111).

8. A knitting machine according to claim 7, characterized in that the control pins (79) can be moved in the direction of the pre-selector levers (80) by control cams (95) and the selector apparatus (91) comprises a number of control magnets (92) corresponding to the number of control pins (79) acting on the control cams (95).

9. A knitting machine according to any of claims 1 to 8, characterized in that a yarn catcher (104, 142) cooperating with at least one yarn guide (25) is provided to control the operation of laying in the yarn in yarn changes.

10. A knitting machine according to claim 9, characterized in that the yarn guide (25) has a rod (25a) and a slot (105) and the yarn catcher (104, 142) is provided with an incline (107, 148) for laying in the yarn (23) from above the rod (25a) into the slot (105).



11. A knitting machine according to claim 9 or 10, characterized in that it is in the form of a rib circular knitting machine and comprises a needle cylinder (1) and a dial (134) with grooves (145) for receiving knitting implements, and in that the yarn catcher (142) is fixed to at least one mounting bar (144) inserted in one of the grooves (145).

12. A knitting machine according to claim 11, characterized in that each mounting bar (144) is provided with a butt (146) which is mounted in a groove running in the circumferential direction of the dial (134) and prevents radial movements of the mounting bar (144).

13. A circular knitting machine with a needle cylinder (1) and a dial (134) for movably receiving knitting implements (2), a support (135) for a dial cam box (141) arranged above the dial (134), a dial driver (136, 137, 138) arranged above the support (135), at least one yarn changer (21, 111), a selector apparatus (91) for the yarn changer (21, 111) and cam tracks (101, 102, 103) for actuating the functional parts (45, 51, 114) of the yarn changer (21, 111), characterized in that a further support (14) for mounting the yarn changer (21, 111) and above this a support ring (16) rotatable relative thereto for mounting the selector apparatus (91) are arranged between the support (135) and the dial cam box (141).

14. A circular knitting machine according to claim 13, characterized in that a yarn catcher (104, 142) is associated with the yarn changer (21, 111) and is fixed on at least one mounting bar (144) which is mounted instead of a knitting implement in a groove (145) of the dial (134) provided therefor.

15. A circular knitting machine according to claim 13 or 14, characterized in that the cam tracks (101, 102, 103) are mounted on the support ring (16).

16. A yarn changer for knitting machines, with at least two yarn fingers (22) which can swing between a datum position and a working position and which each comprise a finger body (65) and a guide body (66) slidably mounted thereon with a



cutting element (69) and a clamping element (71), and with a closer (57, 122) and opener (61, 121), both common to all yarn fingers (22), for reciprocating movement of the guide bodies (66), characterized in that the opener (61, 121) and the closer (57, 122) are operatively coupled together by a reverse-coupling mechanism (48-54; 114-120).

17. A yarn changer according to claim 16, characterized in that the yarn fingers (22) are fixed on single-armed levers (39, 112), which are articulated to the lower ends of selector levers (45) arranged substantially parallel to the longitudinal axis (37, 118).

18. A yarn changer according to claim 17, characterized in that the selector levers (45) are biased by pre-selector levers (80) against the force of springs (46) into a datum position, and are swung into a working position after being released by the pre-selector levers (80), in which position their upper ends project upwardly out of the housing.

19. A yarn changer according to any of claims 16 to 18, characterized in that the reverse-coupling mechanism (48-54) comprises a control member (51) for controlling the movements of the opener (61) and the closer (57) and is biased by a spring (58) into a datum position in which the upper end of the control member (51) projects upwardly out of the housing and is arranged in a working position.

20. A yarn changer according to claim 19, characterized in that the reverse-coupling mechanism (48-54) comprises a gearwheel (48) which is in mesh with a rack (49) on the control member (51) and with a rack (50) parallel thereto on a slider (52), wherein the control member (51) is articulated to the closer (57) and the slider (52) is coupled to the opener (61).

21. A yarn changer according to any of claims 16 to 18, characterized in that the reverse-coupling mechanism (114-120) comprises a control member (114) for controlling the movements of the finger bodies (22) and is so biased by springs



(127, 130) into a datum position that the control member (114) is arranged in an inoperative position.

22. A yarn changer according to any of claims 16 to 18 and 21, characterized in that the reverse-coupling mechanism (114-120) comprises a two-armed lever (116), to one arm of which is articulated the control member (114) and the closer (122) and to whose other arm is articulated the opener (121).

23. A yarn changer according to claim 21 or 22, characterized in that the control member (114) is provided at its upper end with a transversely extending entraining arm (126) and is so biased by a spring (127) that the entraining arm (126) bears in its datum position on the selector levers (45) and is swung also into a working position against the force of the spring (127) by swinging any selector lever (45) into its working position.

24. A yarn changer according to claim 22 or 23, characterized in that the closer (122) and/or opener (121) is coupled adjustably to the lever (116).

25. A yarn changer according to any of claims 18 to 24, characterized in that the pre-selector levers (80) are arranged transverse to the longitudinal axis (37, 118) and hold the selector levers (45) in the datum position by front ends (83), and in that control pins (79) are associated with the pre-selector levers (80), with their upper ends projecting out of the housing and their lower ends bearing on the pre-selector levers (80) which are biased into a datum position by springs.

26. A yarn changer according to any of claims 16 to 25, characterized in that the yarn fingers (22) are each guided laterally between two guide laminae (86).

27. A yarn changer according to claim 26, characterized in that the guide laminae (86) are each provided with a recess (90) for guiding a yarn (23).

