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(54) **CIRCULAR KNITTING MACHINE**

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ABSTRACT

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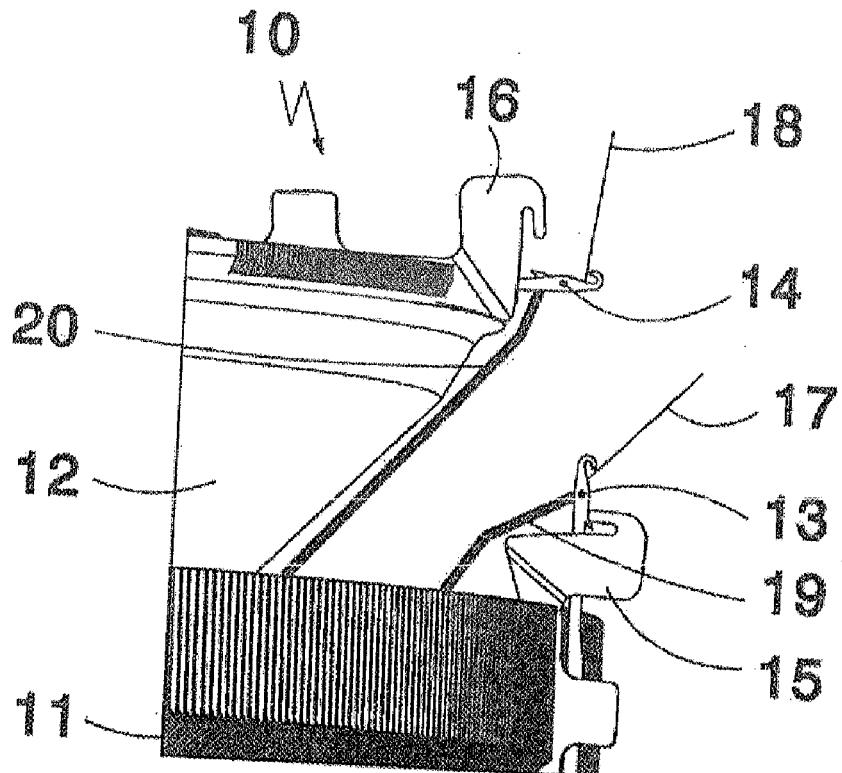
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A circular knitting machine with a needle cylinder (11), in which cylinder needles (13) are mounted to be longitudinally displaceable, and a dial (12), in which rib dial needles (14) are mounted to be radially displaceable, wherein auxiliary elements (15), in particular sinkers, associated with the cylinder needles (13) and auxiliary elements (16), in particular sinkers, associated with the rib dial needles (14), as well as separate thread feeds to the cylinder needles (13) and to the rib dial needles (16) are provided, wherein separate tubular knits (19, 20) can be produced simultaneously or one after the other with the cylinder needles (13) and with the rib dial needles (14).



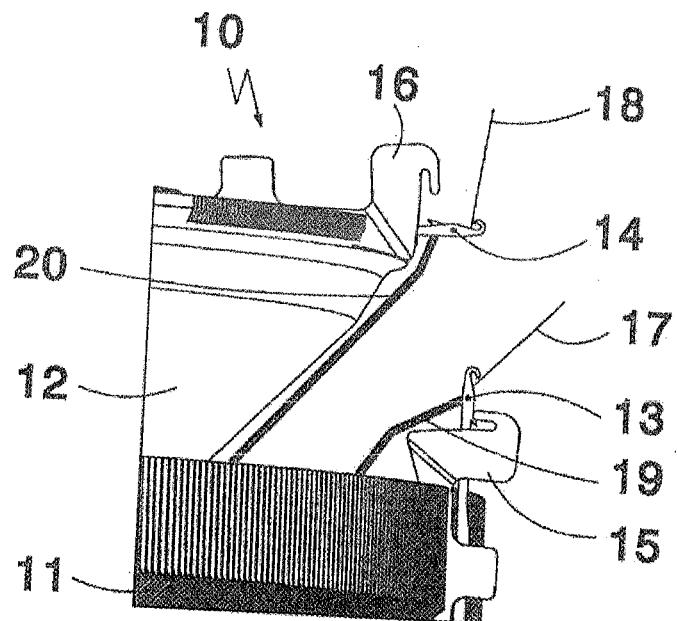


Fig. 1

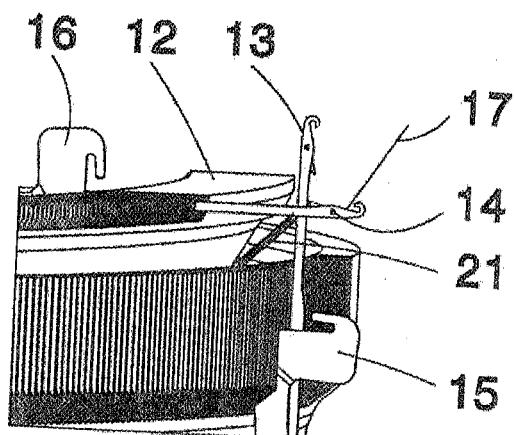


Fig. 2

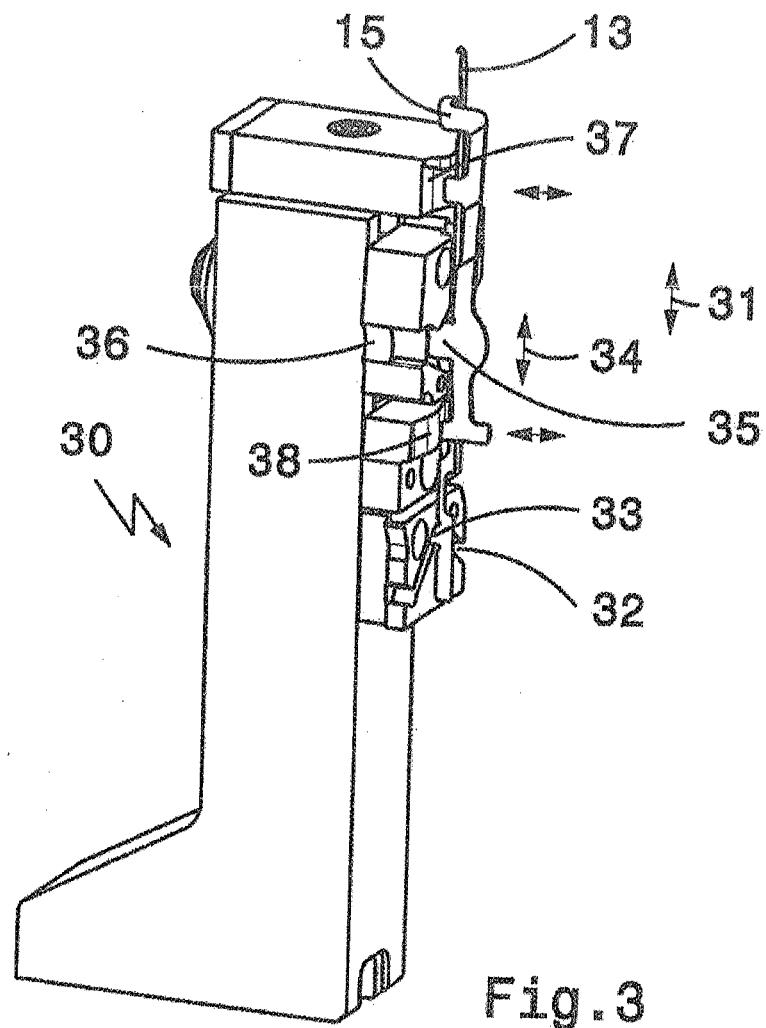
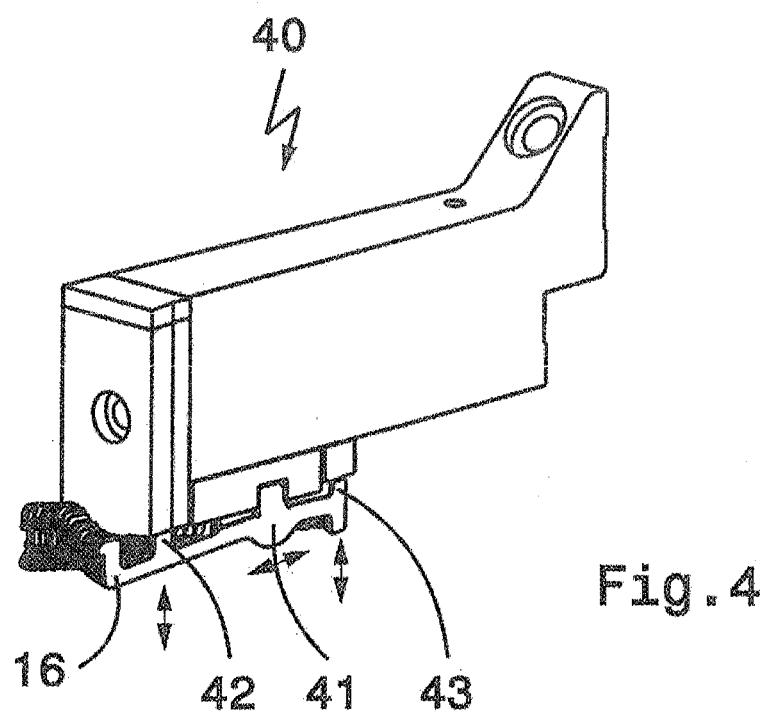


Fig. 3



CIRCULAR KNITTING MACHINE

[0001] Nowadays modern circular knitting machines reach speed factors (=diameter×number of revolutions) of up to SF=1500. However, there are limits to a further increase in the speed factor because of the high needle abrasion. The present speed factors can already only be reached by restricting the path of movement of the needles using relatively movable sinkers and the flattest possible rounded cams for the needle butts. Further optimisations can be achieved by appropriate needle geometry and the development of new needle materials. Nonetheless, reaching speed factors above SF=2000 is highly improbable.

[0002] The object forming the basis of the present invention is to further increase the productivity of known circular knitting machines with structurally simple measures.

[0003] The object is achieved by a circular knitting machine with a needle cylinder, in which cylinder needles are mounted to be longitudinally displaceable, and a dial, in which rib dial needles are mounted to be radially displaceable, which is characterised in that auxiliary elements, in particular sinkers, associated with the cylinder needles and auxiliary elements, in particular sinkers, associated with the rib dial needles, as well as separate thread feeds to the cylinder needles and to the rib dial needles are provided, and that separate tubular knits can be produced simultaneously or one after the other with the cylinder needles and with the rib dial needles.

[0004] With the circular knitting machine according to the invention tubular knits can be produced on the cylinder and on the dial at the same time, as a result of which productivity is doubled in comparison to conventional knitting machines. A knitting machine according to the invention would correspond to a conventional machine with a speed factor of SF=3000. In this case, the two tubular knits can be knitted identically or differently, e.g. in different colours. The thread feeds can be formed by a joint thread guide with multiple eyelets or by multiple separate thread guides.

[0005] However, it is also possible with the circular knitting machine according to the invention to produce the two tubular knits one after the other on the cylinder and on the dial.

[0006] This is particularly advantageous if different knits, in particular knits of different fineness, are to be produced with the cylinder needles and with the rib dial needles.

[0007] There also results a productivity advantage over conventional machines when knitting the two tubular knits one after the other, since the two qualities of tubular knits can be knitted one after the other and in any desired alternation without any interim refit of the machine.

[0008] Moreover, it is conceivable to use a dial with a smaller diameter than the needle cylinder, so that two knits of different diameter can be produced on the machine.

[0009] The circular knitting machine according to the invention can, of course, also be operated as a conventional machine, which produces a tubular knit only on the cylinder. The production of a knit exclusively on the dial is also possible.

[0010] The removal of the produced webs can be performed in different ways.

[0011] Thus, the tubular knits formed by the cylinder needles and the rib dial needles can be removable jointly by a removal device or by separate removal devices.

[0012] Knitted webs produced simultaneously on the cylinder and on the dial lie one inside the other. A joint removal

device equipped with a spreader and with a cutting device on both sides can be provided for these. The produced knits can then be wound onto a double winder as four flat-lying webs.

[0013] Alternatively, a joint removal device can be provided, which has an open frame and a cutting device on one side. The two tubular knits lying one inside the other are cut open on one side and spread. They are then wound as two wide, flat-lying webs by a withdrawal winding roller.

[0014] However, the circular knitting machine can also have a removal device with an open frame and a removal device without an open frame. This allows one tubular knit to be wound up directly and the other tubular knit to be cut open, spread and wound as flat-lying web.

[0015] In contrast, in a further configuration of the circular knitting machine one or two folding devices are provided for the produced tubular knits. If four fabric webs are produced by cutting open the tubular knits on both sides, then four folding devices can also be provided.

[0016] All known techniques for circular knitting machines can be used for the stitch-foiling process on the needle cylinder and on the dial.

[0017] In a preferred embodiment of a circular knitting machine according to the invention, on a raising movement of the cylinder needles during stitch formation the associated auxiliary elements configured as sinkers perform a retraction movement and perform a raising movement on a withdrawing movement of the cylinder needles during stitch formation. Very high knitting speeds can be reached as a result of this relative movement between the needles and the auxiliary elements, since the needles only need to perform approximately half the reciprocating movement in comparison to machines with fixed sinkers or sinkers that move with the needles in the same direction.

[0018] This technique can also be applied in principle in the case of the dial. Thus, on a raising movement of the rib dial needles during stitch formation the associated auxiliary elements configured as sinkers perform a retraction movement and on a retraction movement of the rib dial needles during stitch formation the associated auxiliary elements perform a raising movement.

[0019] It is, of course, particularly preferred to provide this relative movement between the needles and the auxiliary elements both on the cylinder and on the dial. The machine can then be operated at maximum number of revolutions.

[0020] While the auxiliary elements are preferably configured as sinkers, latch needles, compound needles or bearded needles can be used as needles.

[0021] Further advantages can be achieved if cylinder cam segments are provided, which have needle cams for controlling the raising and withdrawing movement of the cylinder needles and sinker cams, with which the auxiliary elements for the cylinder needles can be caused to perform vertical movements and/or a swivelling movement around a horizontal axis. As a result, the auxiliary elements act as knock-over or holding-down sinkers and assure a reliable stitch formation.

[0022] Analogously, dial cam segments can be provided, which have needle cams for controlling the raising and retraction movement of the rib dial needles and sinker cams, with which the auxiliary elements for the rib dial needles can be caused to perform radial movements and/or a swivelling movement around a horizontal axis. Because of the necessary radial movement at least of the rib dial needles, the

configuration of the dial cam segments is clearly more complex than the configuration of the cylinder cam segments. This applies all the more, the smaller the diameter of the dial.

[0023] Preferably, the auxiliary elements are also mounted respectively in the needle cylinder and the dial. They can thus be controlled jointly with the needles of corresponding cylinder and/or dial cam segments. However, the auxiliary elements can also be mounted in separate devices like sinker rings. Control of the movement of the auxiliary elements in the dial by means of the dial cam segments is particularly demanding in this case. The auxiliary elements must be radially moved and swivelled.

[0024] In an alternative configuration of the machine the auxiliary elements can also be fixed knock-over bits. Cam parts or other drive devices for moving the auxiliary elements can be omitted in this configuration.

[0025] In addition, the cylinder needles and/or the rib dial needles can be configured as bearded needles and the associated auxiliary elements can be configured as beard-closing elements. Circular knitting machines with correspondingly configured cylinder needles are known, for example, from GB 188449 A1 or GB 114144 A1.

[0026] In a further preferred configuration of the circular knitting machine the dial can be height-adjustable and the auxiliary elements and the thread feed to the rib dial needles or the thread feed to the cylinder needles can be rendered inoperative, so that a fine rib tubular knit can be produced jointly with the cylinder needles and with the rib dial needles.

[0027] With the machine equipped in such a way doubled single-sided tubular knits or double-face knits such as fine rib knits can be produced. It is possible to convert the machine to different modes of operation without substantial expenditure in this case. Therefore, the customer has the choice between the production of single-face goods with high productivity or the production of double-face goods.

[0028] A possible exemplary embodiment of a circular knitting machine according to the invention is described in more detail below with reference to the drawing.

[0029] FIG. 1 is a schematic partial view of a needle cylinder and a dial of a circular knitting machine according to the invention;

[0030] FIG. 2 is a view corresponding to FIG. 1 of the circular knitting machine with lowered dial;

[0031] FIG. 3 is a detail view of a cylinder cam part of the circular knitting machine from FIG. 1;

[0032] FIG. 4 is a detail view of a dial cam part of the circular knitting machine from FIG. 1.

[0033] The detail view of a circular knitting machine 10 in FIG. 1 shows a needle cylinder 11 and a dial 12. Cylinder needles 13 are mounted to be longitudinally displaceable in the needle cylinder 11. Each needle 13 has an associated auxiliary element 15 in the form of a sinker for stitch formation. Analogously, rib dial needles 14 and associated auxiliary elements 16 in the form of sinkers are mounted in the dial 12.

[0034] A thread 17, 18 is fed respectively to both the cylinder needles 13 and to the rib dial needles 14. A first tubular knit 19 is produced from thread 17 by means of the cylinder needles 13. The rib dial needles 14 at the same time form a second tubular knit 20 from thread 18, which lies within the first tubular knit 19 and is removed together with this. Therefore, with the represented circular knitting

machine 10 double the amount of fabric can be produced at the same time as on conventional circular knitting machines. It is, of course, also possible to produce the tubular knits 19 and 20 one after the other. In this case, the tubular knits 19 and 20 can even be produced in different fineness qualities, patterns and colours.

[0035] While FIG. 1 shows the circular knitting machine 10 with a dial 12 raised in relation to the needle cylinder 11, machine 10 in FIG. 2 is represented with the dial 12 in a lowered position. The sinkers 15 and 16 are in a non-operating position. Only one thread 17 is fed, from which the cylinder needles 13 and the rib dial needles 14 jointly produce a fine rib tubular knit 21.

[0036] Thus, as a result of the vertical adjustability of the dial 12 in relation to the needle cylinder 11, separate tubular knits 19, 20 or a joint double-faced tubular knit 21 can be produced with the circular knitting machine either on the needle cylinder 11 or the dial 12.

[0037] FIG. 3 shows a detail drawing of a cylinder cam segment 30 of the circular knitting machine 10 from FIG. 1. The movements of the cylinder needles 13 and the sinkers 15 are controlled with the cam segment 15. A needle control cam 32, into which the needles 13 engage with a butt 33, is provided to control the vertical movements of the needles 13 in the direction of double arrow 31.

[0038] The sinkers 15 perform vertical movements in the direction of double arrow 34 as well as a swivelling movement around a butt 35. The butt 35 is mounted in a control cam 36, which controls the vertical movements. Upper and lower swivel cams 37, 38 are provided for the swivelling movement. In this case, the cam segment 30 is configured in such a way that the needles 13 and the sinkers 15 are movable relative to one another, i.e. the sinkers 15 are retracted during a raising movement of the needles 13 and raised and swivelled during a retraction movement of the needles 13. This leads to relatively small vertical movements of both the needles 13 and the sinkers 15, which allows very high machine speeds.

[0039] FIG. 4 shows a dial cam segment 40 of the circular knitting machine 10 from FIG. 1 configured in a similar manner to the cylinder cam segment 30. The rib dial needles and the associated control cam for their radial movements have been omitted from this drawing for reasons of clarity.

[0040] The cam segments 40 are arranged above the dial 12 and have a first control cam 41 for the radial movement of the sinkers 16 on their underside. The sinkers 16 also perform swivelling movements, which are controlled by a front and a rear swivel cam 41, 43. In this case, the centre of rotation for the swivelling movements lies in the control cam 41. The dial cam segments 40 are also configured in such a way that the rib dial needles 14 and the sinkers 16 perform relative movements in order to shorten the relative movements of the needles.

[0041] The circular knitting machine shown in FIGS. 1 to 4 is merely a possible exemplary embodiment of a circular knitting machine according to the invention. Compound needles or bearded needles could also be used in place of the shown latch needles 13 and 14. The auxiliary elements 15 and 16 do not have to be sinkers, instead they can also be configured as beard-closing elements, for example. Moreover, it is possible to arrange the auxiliary elements 15, 16

outside the needle cylinder **11** and the dial **12**. The simultaneous formation of knits on the needle cylinder and the dial is also possible with such variants.

1. A circular knitting machine, comprising:
 - a needle cylinder in which cylinder needles are mounted to be longitudinally displaceable;
 - a dial upon which rib dial needles are mounted to be radially displaceable;
 - first auxiliary elements embodying sinkers, associated with the cylinder needles;
 - second auxiliary elements embodying sinkers, associated with the rib dial needles; and
 - separate thread feeds to the cylinder needles and to the rib dial needles;wherein separate tubular knits can be produced simultaneously or one after the other with the cylinder needles and the rib dial needles.
2. The circular knitting machine according to claim 1, wherein identical knits or knits in different fineness, can be respectively produced with the cylinder needles and with the rib dial needles.
3. The circular knitting machine according to claim 1, wherein the tubular knits formed by the cylinder needles and the rib dial needles are removable jointly by a removal devise or by separate removal devices.
4. The circular knitting machine according to claim 3, further comprising a removal device equipped with a spreader and with a cutting device on both sides.
5. The circular knitting machine according to claim 3, further comprising a removal device with an open frame and a cutting device on one side.
6. The circular knitting machine according to claim 3, further comprising a first removal device with an open frame and a second removal device without an open frame.
7. The circular knitting machine according to claim 3, further comprising one, two or four folding devices for produced tubular knits.
8. The circular knitting machine according to claim 1, wherein on a raising movement of the cylinder needles during stitch formation, the associated first auxiliary elements embodying sinkers perform a retraction movement and that on a withdrawing movement of the cylinder needles

during stitch formation the associated first auxiliary elements perform a raising movement.

9. The circular knitting machine according to claim 1, wherein on a raising movement of the rib dial needles during stitch formation the associated second auxiliary elements embodying sinkers perform a retraction movement and that on a retraction movement of the rib dial needles during stitch formation the associated second auxiliary elements perform a raising movement.

10. The circular knitting machine according to claim 1, further comprising cylinder cam segments with needle cams for controlling the raising and withdrawing movement of the cylinder needles and sinker cams, with which the first auxiliary elements for the cylinder needles can be controlled to perform vertical movements, a swivelling movement or both around a horizontal axis.

11. The circular knitting machine according to claim 1, further comprising dial cam segments, which have needle cams for controlling the raising and retraction movement of the rib dial needles and sinker cams, with which the second auxiliary elements for the rib dial needles, can be controlled to perform radial movements, a swivelling movement or both around a horizontal axis.

12. The circular knitting machine according to claim 1, wherein the first and second auxiliary elements are mounted respectively in the needle cylinder and the dial or in separate devices.

13. The circular knitting machine according to claim 1, wherein the first and second auxiliary elements are fixed knock-over bits.

14. The circular knitting machine according to claim 1, wherein the cylinder needles, the rib dial needles or both are configured as bearded needles and the associated first and second auxiliary elements are configured as beard-closing elements.

15. The circular knitting machine according to claim 1, wherein the dial is height-adjustable and the first and second auxiliary elements and the thread feed to the rib dial needles or the thread feed to the cylinder needles can be rendered inoperative, so that a fine rib tubular knit can be produced jointly with the cylinder needles and with the rib dial needles.

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