

Circular Knitting Machine with a Rotatably Disposed Dial

The invention relates to a circular knitting machine of the type specified in the preamble of claim 1.

Circular knitting machines of this type are known in numerous variants (e.g. EP 0 436 313, B1, DE 195 11 949 A1, PCT WO 02/053817 A1). They are generally configured as circular rib knitting machines, which besides a rotatably disposed dial also have a likewise rotatably disposed needle cylinder. For the rotatable mounting of the dial, the frame is provided with a fixedly arranged dial cam support, in which a dial cam shaft is rotatably disposed that serves to drive the dial and is connected to the dial by means of a rigid support ring, for example. A dial cam, which has dial cam parts and serves to control the movements of dial needles disposed to be radially displaceable in the dial, is fastened to the dial cam support. In addition, the dial cam can have patterning attachments for selective selection of the dial needles to the 2-way technique (knitting, non-knitting) or the 3-way technique (knitting, tucking, non-knitting).

A critical size of such machines is a spacing between the undersides of the dial cam parts and the upper edges of the dial webs that is measured parallel to the common rotational axis of the dial and the needle cylinder, and is referred to hereafter in short as gap dimension. Particularly when the dial needles are selected for knitting or tucking by means of electromagnets, even small changes in this gap dimension can lead to a defective selection of the dial needles. It has been found that one reason for undesirable changes in the gap dimension lies in the mounting of the dial cam shaft in the dial cam support. The dial cam shaft is normally disposed in the dial cam support by means of groove ball bearings or the like, which are available on the market only with an unavoidable axial bearing clearance. In consequence, frequently unacceptable fluctuations in the gap dimension result, in particular in the case of large dial diameters and fine gauges as well as under the effect of temperature fluctuations during the operation of the circular knitting machine. While these fluctuations are only in the μm range, they can nevertheless mean that a fault-free electromagnetic selection of the dial needles is not possible.

Embodiments of the invention seek to configure the circular knitting machine of the aforementioned type so that a reliable, in particular also electromagnetic, selection of the dial needles is possible in spite of the described mounting of the dial cam shaft.

In accordance with an aspect of the present invention, there is provided a circular knitting machine with a frame, a rotatably disposed dial, a dial cam support, which is mounted in the frame and to which a dial cam can be fastened, and a dial cam shaft, which is disposed rotatably and coaxially in the dial cam support and is intended for driving the dial, characterised in that the dial is disposed rotatably and coaxially and with an adjustable bearing clearance on the dial cam support.

Embodiments of the invention provide the advantage that the dial is supported directly on the dial cam support by means of a bearing acting as a fixed bearing that is adjustable to a preselected bearing clearance. A virtually constant gap dimension may be assured as a result of this. Since, moreover, the transmission of the rotational movement from the dial cam shaft to the dial occurs by means of a spring plate, slight axial displacements of the dial cam shaft may be compensated without the axial position of the dial, and thus the desired gap dimension, being influenced by this.

Further advantageous features of the invention are evident from the sub-claims.

The invention is explained in more detail below on the basis of an exemplary embodiment in association with the attached drawings.

- Figure 1 schematically shows the parts of a circular knitting machine provided with a dial that are important for understanding of the invention;
- Figure 2 shows a detail of the circular knitting machine according to Figure 1;
- Figure 3 shows an exemplary embodiment of the invention in a simplified representation compared to Figure 1; and
- Figure 4 shows an enlarged detail of Figure 3 in the region of a bearing.

Figure 1 shows a usual circular knitting machine with a frame 1, of which only a vertical support column is shown in Figure 1. A fixed lower support ring (not shown), in which a needle cylinder 2 is disposed to be rotatable around a rotational axis 3 and can be set in rotation using a usual drive motor, is fastened in the frame 1. Usual knitting needles 4, which are moved in the usual manner by a cylinder cam 5, are disposed to be axially displaceable in the needle cylinder 2.

In an upper part of the circular knitting machine, the support columns of the frame 1 are connected by an upper support ring 6 that has a bearing bush 7, which is coaxial to the rotational axis 3 and in which a hollow cylindrical part 8a of a fixed dial cam support 8 is arranged. On an upper end the part 8a has an external thread section, which is screwed into an internal thread section of an adjusting wheel 9 disposed to be axially non-displaceable, but rotatable in the support ring 6. The part 8a and thus the entire dial cam support 8 can be

shifted parallel to the rotational axis 3 in the usual manner by rotating the adjusting wheel 9.

5 A dial cam shaft 11 is rotatably disposed in the hollow cylindrical part 8a of the dial cam support 8 by means of bearings 10 consisting of deep groove ball bearings, for example. The dial cam shaft is arranged coaxially to the rotational axis 3 and is fixedly connected to a drive gear wheel 12 on an upper end projecting out of the part 8a. The drive gear wheel 12 meshes with a drive pinion 14 that sits on a drive shaft, which projects through the support columns and on which a drive pinion for the needle cylinder 2 is normally also fastened in order to synchronously drive the dial cam shaft 11 and the needle cylinder 2.

10 A section of a dial cam support ring 15, which is located radially on the inside and is fixedly connected to a dial 16 on a section lying radially on the outside in a usual manner or is made in one piece with this dial, is fastened to a lower end of the dial cam shaft 11 projecting out of part 8a. Usual dial needles 17 are disposed to be radially displaceable in the dial 16. A dial
15 cam 18, which is fastened to a support flange 8b of the dial cam support 8 arranged below the bearing bush 7 and extended radially to the part 8a, serves to radially move the dial needles 17.

20 As shown in Figure 2 in particular, usual cam parts 19 are fastened to the underside of the dial cam 18 and serve to control the movements of the dial needles 17. If a patterning selection of the dial needles 17 is desired, the dial cam 18 is additionally provided with selection elements (not shown) that have electromagnets, for example, so that an electromagnetic selection of the dial needles 17 can be conducted.

25 For a fault-free selection of the dial needles 17 it is desirable to keep a gap dimension a (Figure 2) as constant as possible during operation of the circular knitting machine, said gap dimension being defined between the upper edges of dial webs 16a, between which the dial needles 17 are disposed, and the undersides of the cam parts 19. Even slight deviations in the gap dimension a in the μm range from a preselected value can mean that a reliable selection of
30 the dial needles 17 is no longer possible. Such deviations can be caused, for example, by an unavoidable axial play in the bearings 10.

Circular knitting machines of the aforementioned type are well known to the person skilled in the art, and therefore explanation of further details is not necessary.

35 An exemplary embodiment of the circular knitting machine according to the invention is shown in Figures 3 and 4, in which the same references as in Figures 1 and 2 are given for the same parts. In contrast to Figures 1 and 2, the dial 16 is not configured rigidly on the dial cam support 15 or connected therewith here, but coupled to a support ring 21 fixedly connected to

the dial cam shaft 11 by means of an e.g. ring-shaped spring plate 20. A holding ring 22, which is fastened fixedly to the dial 16 by means of screws 23 and fixedly to the spring plate 20 by means of further screws 24, is preferably arranged between the spring plate 20 and the dial 16.

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According to Figure 4, a substantially U-shaped bearing groove 25a, which runs around the rotational axis 3 and in which a first part of a bearing 26 is arranged, is configured on an inner side of the support flange 8b or a cylindrical attachment thereof. The other part of this bearing 26 is arranged in further bearing grooves or recesses 25b and 25c, which are configured in an upper end section of the holding ring 22 and in the underside of a bearing ring 27 surrounding the rotational axis 3 in a coaxial manner. The bearing ring 27 is fastened to an upper side of the holding ring 22 by means of screws 24.

According to the invention, the bearing 26 is configured so that its axial bearing clearance, i.e. that parallel to the rotational axis 3, can be adjusted and therefore allows a sufficiently small axial play to be created to keep the fluctuations in the gap dimension a as small as possible, while still allowing a sufficiently smooth-running rotation of the bearing ring 27, and thus the holding ring 22 and the dial 16 supported by this, relative to the dial cam support 8.

20 The bearing 26 is preferably configured as a ball bearing, which has a number of bearing balls 28, which run on bearing surfaces formed by the bearing grooves 25a, 25b and 25c. It is most particularly advantageous if a wire ring ball bearing is used as bearing 26, which has, for example, four wire rings arranged in pairs opposite one another in the bearing grooves 25a, 25b and 25c, the bearing surfaces on which the bearing balls 28 run being configured on said rings. The bearing balls 28 expediently have a diameter that is larger than the spacing of the bearing surfaces 25b and 25c from one another, if the holding ring 22 and the bearing ring 27 lie on one another, so that the clearance between these bearing surfaces 25b, 25c or the spacing between the wire rings can be adjusted in the described manner by means of the screws 24 acting parallel to the rotational axis 3. In other words, it is only necessary to tension the holding ring 22 and the bearing ring 27 relative to one another by means of the bearing 26.

An advantage of this measure is that the bearing clearance can be adjusted so finely that the gap dimension a remains practically unchanged during the operation of the circular knitting machine and problems with the selection of the dial needles 17 are avoided.

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According to the invention, the spring plate 20 serves to compensate any axial fluctuations that could arise as a result of the bearings 10, any expansions or compressions due to temperature and as a result of other influences. Spring plate 20 is sufficiently rigid to bending in radial direction to be able to act as transmitter of the rotational movements from the dial

cam shaft 11 to the dial 16. However, the spring plate 20 can be deformed by at last a few μm in the axial direction, so that any axial displacements of the dial cam shaft 11 do not have any effect on the axial position of the dial 16 and the gap dimension a. Moreover, because of the elasticity of the spring plate 20 the dial 16 can readily follow any axial displacements of the dial cam support 8. In this case, the term "spring plate" is representative of all conceivable variants that allow the described function, irrespective of whether they are configured as circumferential rings, individual segments or in any other form.

The invention is not restricted to the described exemplary embodiment, which could be modified in a variety of ways. In particular, bearings 26 other than those described that also allow clearance-free seat can also be provided. Moreover, it would be conceivable to produce the holding ring 22 and the dial 16 in one piece and/or at least parts 21, 22 and/or 27 in a plurality of segments. In addition, it is possible for exact adjustment of the bearing clearance to insert spacer discs between the holding ring 22 and the bearing ring 27. Moreover, in place of the spring plate 20 other means can be provided to allow axial fluctuations and adjustments of the dial 16. For example, it would be possible to connect the holding ring 22 to the support ring 21 in an axially adjustable manner. In addition, it is clear that the dial cam support 8 together with the dial 16 can be axially adjusted by means of the adjusting wheel 9, as is desirable when a needle cylinder 2 is present for adjusting the stitch size, i.e. while the dial cam support 8 is fixed, it is disposed to be axially adjustable in the machine frame. Irrespective of this, however, it is absolutely immaterial for the purposes of the invention whether a circular knitting machine with or without a needle cylinder is concerned. Finally, it is understood that the different features can also be applied in combinations other than those described and represented.

Claims

1. Circular knitting machine with a frame, a rotatably disposed dial, a dial cam support, which is mounted in the frame and to which a dial cam can be fastened, and a dial cam shaft, which is disposed rotatably and coaxially in the dial cam support and is intended for driving the dial, characterised in that the dial is disposed rotatably and coaxially and with an adjustable bearing clearance on the dial cam support.
2. Circular knitting machine according to claim 1, characterised in that the dial is connected coaxially to the dial cam shaft by means of a spring plate.
3. Circular knitting machine according to claim 1, characterised in that the bearing contains a plurality of bearing balls, which, on one side, run on bearing surfaces of the dial cam support and, on the other side, on bearing surfaces associated with one another of a holding ring provided on the dial and a bearing ring connected thereto.
4. Circular knitting machine according to any of claims 1, 2 or 3, characterised in that the bearing is a wire ring roller bearing.
5. Circular knitting machine according to any of claims 1, 2 or 3, characterised in that the bearing clearance is adjustable by a screw connection between the holding ring and the bearing ring.
6. Circular knitting machine according to claim 3, characterised in that the dial is detachably connected to the holding ring.
7. Circular knitting machine according to claim 4, characterised in that the bearing surfaces are configured on wire rings, which are arranged in pairs opposite one another on the dial cam support, on the holding ring and on the bearing ring.

CIRCULAR KNITTING MACHINE WITH A ROTATABLY DISPOSED DIAL**Abstract**

A circular knitting machine is described with a frame (1), a rotatably disposed dial (16), a dial cam support (8) for a dial cam (18) mounted in the frame (1) and a dial cam shaft (11), which is disposed rotatably and coaxially in the dial cam support (8) and is intended for driving the dial (16). According to the invention, the dial (16) is disposed rotatably and coaxially on the
5 dial cam support (8) with adjustable bearing clearance and is preferably connected coaxially to the dial cam shaft (11) by means of a spring plate (20).

Figure 3