

KNITTING MACHINE PARTS AND METHOD FOR PRODUCTION

THEREOF

[0001] The invention refers to a knitting machine part and a method for produc-
5 tion thereof. The knitting machine part has multiple tool guides that are arranged
along a straight line next to each other or that are arranged in a circumferential
direction about an axis next to each other. The knitting machine part can be a
knitting cylinder, a needle bed of a flat bed knitting machine, a rib disc or a
sinker ring. Particularly it can either be a cylinder for a Single-Jersey machine as
10 well as a cylinder for a Double-Jersey machine.

[0002] Such knitting machine parts are subject to wear during operation of a
knitting machine. Particularly where knitting tools are moved in tool guides in a
movement direction and the knitted fabric applies a force on the knitting tool
15 concurrently that has to be supported by the knitting part or the tool guide, wear
can occur.

[0003] Due to this stress and in order to reduce wear, at least sections or areas of
the tool guides are hardened. First the knitting machine part is manufactured
20 from a non-hardened metallic material and is subsequently hardened at least in a
section. Because the at least one hardened section of the knitting machine part
cannot be machined or only with high efforts.

[0004] One possibility of hardening is the induction hardening (e.g. GB 735 378 A). During induction hardening the workpiece to be hardened is heated by induction and quickly cooled subsequently, whereby the hardness of the material is increased.

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[0005] The induction hardening of a knitting machine part is not easy due to its size. Depending on the used method, hardening of the knitting machine part in sections can result in that sections hardened before are tempered again due to the hardening of directly adjacent areas. Due to this tempering the hardness is reduced and the goal of hardness increase is not uniformly achieved everywhere.

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[0006] Thus, it can be considered as object of the present invention to provide a knitting machine part and a method for production thereof that allows a reduced wear at all tool guides.

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[0007] This object is solved by a knitting machine part according to features of claim 1 as well as a method for manufacturing with the features of claim 15.

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[0008] The knitting machine part has multiple tool guides. Each tool guide is configured to guide a knitting tool in a movement direction along the respective tool guide. Exactly one knitting tool is preferably assigned to each tool guide. The knitting machine part can comprise a first group of tool guides and a second group of tool guides. For example, circular knitting cylinders can have tool guides for knitting machine needles in the circumferential area and tool guides

for sinkers at an axial end. A knitting machine part can thus comprise tool guides for a single group and/or type of knitting tools (e.g. in the case of a Double-Jersey cylinder) or for at least two groups and/or types of knitting tools (e.g. in the case of Single-Jersey cylinders).

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[0009] Each tool guide has a hardened section with a hardness that is larger than the hardness of at least one another non-hardened section of the tool guide. The tool guide is thus not hardened everywhere, but only in the respective hardened section that is subject to particular high stress during operation of the knitting machine. In this particular stressed section the hardness is increased in order to reduce the wear of the knitting machine part.

[0010] The majority of the present hardened sections is obtained by at least partly hardening the knitting machine part manufactured from a non-hardened metallic material. These hardened sections are integral sections that are configured integrally without seam or connection location with the at least one non-hardened section of the assigned tool guide respectively. Only a remarkably smaller number of the hardened sections is configured as non-integral section in each case. In a non-integral section at least one or exactly one separate hardened component is arranged for forming the hardened section that is fixedly connected with the knitting machine part. This connection is preferably carried out by an adhesive bond or a substance bond.

[0011] Preferably at most 10% or at most 5% or at most 2% or less than 1% of all hardened sections are configured as non-integral sections with a separate component, whereas all of the remaining hardened sections are configured as integral sections. For example, also at most 0.1% or at most 0.2% of the hardened sections can be configured as non-integral sections.

[0012] If due to the hardening of the manufactured knitting machine part a sufficient hardness of the section to be hardened cannot be achieved in one or more tool guides, a hardened separate component is attached there. The effort for re-machining and arranging of the separate component is high. The preferred inductive hardening of the tool guides after manufacturing of the knitting machine part from non-hardened material is remarkably more economic. However, depending on the used method and the used device therefore, the desired hardness can possibly not be achieved in each tool guide. At these tool guides separate hardened components are arranged selectively at the knitting machine part. In doing so, in total an effective manufacturing of the knitting machine part is possible and it is guaranteed that each tool guide comprises a hardened section with the required material hardness in order to keep the wear of the knitting machine part low.

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[0013] Indeed it is known from the prior art to arrange harder materials in recesses at a knitting machine part in order to locally harden the knitting machine part (e.g. GB 1 347 272 A). However, the manufacturing effort for such an approach is enormously high, which increases the costs for the knitting machine

part remarkably. On the contrary, according to the invention as most as possible hardened sections are formed as integral sections by hardening of the first non-hardened metallic material. In these integral sections no additional material or component is arranged for increasing the hardness. Only where depending on
5 the method no sufficient hardness can be achieved, a few hardened sections are formed by arranging of a separate hardened component. The components can be stocked in an already hardened condition and can be arranged in or at a tool guide for forming a hardened section, if required.

10 [0014] It is advantageous, if each non-integral section comprises exactly one separate component. In doing so, the effort for forming the hardened sections that are configured as non-integral sections can be minimized.

[0015] Preferably each tool guide has a support surface for the knitting tool.
15 Particularly at least a part of the support surface is arranged in the respective hardened section. The part of the support surface arranged in the hardened section forms a hardened surface section. The hardened surface section can be created in the integral section by hardening of the material and thus by microstructural transformation. The hardened surface section can be formed by a component
20 surface of the arranged component in a non-integral section.

[0016] It is preferred, if the component surface that forms the hardened surface section has a surface width in transverse direction orthogonal to the movement direction of the knitting tool that is smaller than the tool width of the knitting

tool. In doing so, it can be avoided that thread sections guided at the knitting tool get into contact with the transition location between the hardened component and the adjoining less hard material of the knitting machine part. This configuration is particularly of importance, if the component is inserted as insert
5 into a recess and thus an interface or edge is provided between the inserted component and the recess in transverse direction adjacent to the component surface or to the hardened surface section.

[0017] The surface width should preferably have an amount of at least 80% of
10 the tool width.

[0018] In a preferred embodiment each tool guide has two side webs that limit a guide channel having a channel width for guiding the knitting tool in transverse direction orthogonal to the movement direction of the knitting tool. The channel
15 width thereby is the width of the guiding channel between the two facing side web surface sections that serve to guide the knitting tool. For example, the channel width can be the minimum width of the guiding channel between the side webs.

20 [0019] It is preferred, if a difference between the channel width and the tool width leads to a guide play and the sum of the surface width and the guide play is smaller than the tool width. As an alternative or in addition, the surface width is smaller than the channel width. Due to these measures, the avoidance of the contact between a thread section guided at the knitting tool and the transition

location between the component and the adjoining sections of the knitting machine part can be improved.

[0020] In a preferred embodiment the guide play can have an amount up to
5 about 0.07 mm, however, is usually smaller than 0.1 mm.

[0021] Preferably the at least one component is inserted in each non-integral section in a reception recess. The component can thus be configured as insert part. The component can be completely arranged within the reception recess or
10 can partly project from the reception recess.

[0022] In a preferred embodiment the knitting machine part can be continuously ring-shaped in a circumferential direction and can form a ring-shaped disc or a cylinder or hollow cylinder. Thereby the tool guides can be arranged substantial-
15 ly parallel to the axis and/or radially to the axis. For example, a group of tool guides can be orientated axially and another group of tool guides can orientated radially.

[0023] For example, one group of tool guides can be configured to guide knitting needles. Another group of tool guides can be configured to guide sinkers.
20 The two groups can be provided at the same or at different knitting machine parts.

[0024] The knitting machine part discussed above is manufactured as follows:

[0025] First, the knitting machine part with the tool guides is manufactured from a non-hardened metallic material. Subsequently at least a section of the knitting machine part is hardened by using a hardening method in order to create a hardened section at least for the majority of tool guides in each case that transitions as integral section without seam or connection location in the adjoining non-hardened material of the knitting machine part. For example, the hardening can be carried out by induction hardening.

10 [0026] Subsequently one or more insufficiently hardened sections of one or more tool guides are identified. In these insufficiently hardened sections a reception recess is created and one separate component is inserted into each reception location respectively. Components are fixedly connected with the respective reception location, e.g. by means of an adhesive bond.

15 [0027] Preferred embodiments of the invention yield from the dependent claims, the description and the drawings. In the following preferred embodiments of the invention are explained with reference to the attached drawings. The drawings show:

20 [0028] Figure 1 a schematic perspective illustration of a knitting machine part in the form of a circular knitting cylinder,

[0029] Figure 2 a schematic perspective illustration of a knitting machine part in form of a needle bed of a flat bed knitting machine,

[0030] Figure 3 a schematic illustration of a tool guide with a hardened section
5 configured as non-integral section,

[0031] Figure 4 a schematic illustration of a tool guide with a hardened section configured as integral section,

10 [0032] Figures 5 and 6 two embodiments of a knitting machine part respectively in perspective partial illustration, wherein two non-integral hardened sections are provided respectively,

[0033] Figure 7 another embodiment of two knitting machine parts in which
15 reception recesses for one hardened separate component are introduced respectively,

[0034] Figure 8 the embodiment of two knitting machine parts according to figure 7, wherein a hardened separate component is inserted in each of the reception
20 locations respectively,

[0035] Figure 9 a schematic illustration with view in movement direction on the knitting tools in a tool guide according to a knitting machine part of figure 8,

[0036] Figure 10 another embodiment of knitting machine parts with a tool guide for a knitting tool respectively that is formed by a sinker in a partially cut illustration and

5 [0037] Figure 11 a flow diagram of an embodiment for manufacturing a knitting machine part.

[0038] In figures 1 and 2 two exemplary embodiments of knitting machine parts 15 are perspectively illustrated. The knitting machine part 15 of figure 1 is a
10 knitting machine part 15 that is continuously ring-shaped in a circumferential direction U, e.g. a circular knitting cylinder. The embodiment of the knitting machine part 15 shown in figure 5 is a needle bed of a flat bed knitting machine. The knitting machine part 15 in terms of the present invention can also be rib discs, sinker rings or other knitting machine parts 15 that have multiple tool
15 guides 16 for guiding one knitting tool 17 in each case that is movable in a movement direction B. In figures 3 and 4 tool guides 16 for a knitting tool 17 are schematically illustrated, wherein the knitting tool 17 is exemplarily formed by a knitting machine needle. The knitting tool 17 can also be a sinker, as exemplarily shown in figure 10.

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[0039] For guiding the respective knitting tool 17 the tool guide 16 comprises two side webs 18 that are arranged with distance in a transverse direction Q orthogonal to the movement direction B in the described embodiments. The two side webs 18 limit a guide channel 19 arranged between the side webs 18. Ac-

cording to the example, the guide channel 19 is limited on one side orthogonal to the movement direction B of the knitting tool 17 and orthogonal to the transverse direction Q by a support surface 20 that is arranged at a base body 21 of the knitting machine part 15. The support surface 20 can also extend partly outside the guide channel 19. The side webs 18 extend away from the base body 21. On the side opposite the support surface 20 the guide channel 19 is open according to the example. In modified embodiments the guide channel 19 can also be at least partly closed opposite the support surface 20.

10 [0040] With view in movement direction B of the respective knitting tool 17 each guide channel 19 or each tool guide 16 has an end 22 that is assigned to a location or an area of the knitting machine part 15 in which the loop formation occurs. During loop formation the knitting tool 17 is moved in movement direction B along the tool guide 16 and is particularly moved or slid out of the respective tool guide 16 beyond the end 22 in order to catch a thread section or to form a loop in cooperation with other knitting tools outside the tool guide 16 or outside the guide channel 19.

20 [0041] In the area of this end 22 a knitting machine part 15 or the respective tool guide 16 is subject to particular high stress that can cause respective high wear. Thus, each tool guide 16 of the knitting machine part 15 comprises a hardened section 30 beginning at the end 22. In the hardened section 30 the material of the respective tool guide 16 has a greater hardness than in a non-hardened section 31 adjoining the hardened section 30. The material of the knitting machine part

15 or the tool guide 16 can be the same in the hardened section 30 and in the non-hardened section 31, however, comprise different micro-structures such that different hardnesses are obtained.

5 [0042] The hardened section 30 is configured as integral section 30a in the majority of the tool guides 16 of the knitting machine part 15. This means that the integral section 30a transitions without seam or connection location in the non-hardened section 31. In doing so, a transition zone 32 can be present between the hardened integral section 30a and the non-hardened section 31 in which the
10 hardness starting from the non-hardened section 31 increases up to the hardened section 30. In figure 4 the hardened integral section 30a is illustrated by cross-hatch. In the schematically illustrated transition zone 32 the crosshatch is illustrated with less density in order to schematically illustrate the hardness that reduces toward the non-hardened section 31.

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[0043] The hardened sections 30 that are configured as integral sections 30a are present in most of the tool guides 16, preferably in at least 90% or at least 95% or at least 98% of the tool guides 16 of the knitting machine part 15. According to the example, for this the knitting machine part 15 is first manufactured from a
20 non-hardened material and subsequently hardened in the section adjoining the ends 22 of the tool guides 16 in order to form the multiple hardened integral sections 30a in a hardening process. For example, this hardening can be carried out by induction hardening using an inductor for heating and a cooling device for quick cooling. In doing so, a micro-structural transformation of the material

and thus an increased hardness can be achieved in the hardened integral section 30a.

[0044] In such a hardening process, depending on the kind of used method
5 and/or the used device, it can occur that at one or more but a few tool guides 16
no sufficient hardness can be achieved in the section adjoining the end 22. For
example, this can be caused in that the hardening of one or more adjacent tool
guides 16 results in tempering of an already hardened section, the hardness of
which thereby decreases again. This is particularly the case, if the knitting ma-
10 chine part 15 is a ring-shaped continuous component, whereby the inductor is
moved in circumferential direction U along the section of the tool guides 16 to
be hardened.

[0045] In such a case individual hardened sections 30 can be formed by hard-
15 ened non-integral sections 30b, as schematically illustrated in figures 3, 5, 6 and
8-10 for example. For forming such hardened non-integral sections 30b a hard-
ened separate component 33 is arranged at the location of the tool guide 16 at
which a higher hardness is desired. Preferably the hardened component 33 is
configured as insert part 34 and is inserted into a reception recess 35 at the tool
20 guide 16. Thereby the separate hardened component 33 can be completely ar-
ranged inside the reception recess 35 (figures 3, 5 and 8-10) or can be arranged
only partly inside the reception recess 35 and can project out of the reception
recess 35 (figure 6).

[0046] In the embodiment a reception recess 35 is created originating from the end 22 of a tool guide 16 that does not have a sufficient hardness adjacent to the respective end 22 and subsequently the already hardened separate component 33 is inserted into the reception recess 35 as insert part 34. In doing so, a non-
5 integral hardened section 30b is obtained that is formed by the separate component 33. Thus, the hardness changes in a step-like manner between the component 33 or the insert part 34 and the non-hardened section 31 or the at least non-sufficiently hardened section of the tool guide 16 adjoining thereto (figure 3). The hardened non-integral section 30b is thus defined by the form of the com-
10 ponent 33 and definitely limited without transition zone.

[0047] As it is exemplarily illustrated in figures 3 and 4, the support surface 20 extends into the respective hardened section 30 up to the end 22 of the tool guide 16 such that the support surface 20 forms a hardened surface section 36 in
15 the hardened section 30 respectively. In the hardened non-integral section 30b the hardened surface section 36 is formed by the component surface 37 of the arranged component 33 or the insert part 34 inserted into the reception recess 35.

[0048] The hardened surface section 36 of the support surface 20 can extend at least partly or completely in the guide channel 19 between the side webs 18 and/or can be arranged partly or completely outside of the guide channel 19 (figure 6).

[0049] The component 33 or the insert part 34 is connected to the base body 21 of the knitting machine part 15, preferably by adhesive bond or of another suitable manner, particularly by substance bond.

5 [0050] As is illustrated in figures 3 and 9, the component surface 37 that forms the hardened surface section 36 in a non-integral section 30b comprises a surface with bf that is smaller than the tool width bw of the knitting tool 17. The tool width bw of the knitting tool 17 is in turn smaller than the channel width bk of the guide channel 19.

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[0051] The difference between the channel width bk and the tool width bw forms a guide play between the knitting tool 17 and the tool guide 16. According to the example, the sum of the surface width bf and the guide play is smaller than the tool width bw. In figure 9 also the difference Δ between the surface
15 width bf and the tool width bw is illustrated.

[0052] In a preferred embodiment the guide play between the knitting tool 17 and the tool guide 16 or the guide channel 19 can be about up to 0.07 mm. Preferably, the surface width bf can have an amount of at least 80% of the tool width
20 bw.

[0053] As can be schematically seen also in figure 9, the knitting tool 17, particularly the knitting machine needle, can be configured to guide a thread section 45 and to at least partly pull the thread section 45 in the guide channel 19. For

this the guide channel 19 can comprise a respective enlarged section adjoining to the end 22 in which thread cavities 46 are provided in the side webs 18 (compare particularly figures 7 and 8). This enlarged section does not serve to guide the knitting tool 17 and thus does not define the effective channel width b_k for
5 guiding the knitting tool 17.

[0054] In the embodiments of the knitting machine part, according to figures 1, 7 and 8, only one single group of tool guides 16 is provided for the knitting tools respectively. In modification thereto a knitting machine part 15 can also com-
10 prise a first group 50 and a second group 51 of tool guides 16. The tool guides of the first group 50 guide the assigned knitting tools 17 in a first movement direction B1 and the tool guides 16 of the second group 51 guide the assigned knitting tools 17 in a second movement direction B2. The first movement direc-
15 tion B1 and the second movement direction B2 can be orientated orthogonal to each other, for example, and have preferably a common transverse direction Q. For example, the first movement direction B1 can be orientated axially and the second movement direction B2 can be orientated radially, if the knitting machine part 15 or knitting machine parts 15 is/are configured in a ring-shaped manner in circumferential direction U about an axis.

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[0055] The two groups 50, 51 of the tool guides 16 can also be provided for different kinds of knitting tools, for example, wherein e.g. the first group 50 can be configured to guide knitting needles and the second group 51 can be configured to guide sinkers.

[0056] In figure 11 an embodiment of a method for manufacturing a knitting machine part 15 is illustrated.

[0057] In a first step S1 the knitting machine part 15 is manufactured from a non-hardened metallic material, such that a machining by cutting is possible. Preferably, the initially non-hardened knitting machine part consists of one single body.

[0058] After manufacturing of the non-hardened knitting machine part in the first step S1 a section of the non-hardened knitting machine part in the area of the ends 22 of the tool guides 16 is hardened (second step S2), such that at least at most of the tool guides 16 a hardened section 30 is formed as integral section 30a that transitions without seam or connection location in the adjoining non-hardened sections 31. The hardening of the knitting machine part 15 can be carried out as induction hardening for example.

[0059] Depending on the used method and the used device for hardening in the second step S2, it can occur that hardened section 30 having a sufficient hardness is not formed at each tool guide 16. In a third step S3 those tool guides 16 are identified that comprise an insufficiently hardened section. Usually these are few individual tool guides 16, e.g. one to five tool guides 16 of each group 50, 51 of tool guides 16.

[0060] In these insufficiently hardened sections identified in the third step S3 a reception recess 35 is created in each case in a fourth step S4, e.g. by milling. An already hardened separate component 33, that can also be referenced as insert part 34, is inserted in each reception recess 35 such that it is completely or partly arranged in the reception recess 35 (fifth step S5). This hardened component forms a hardened non-integral section 30b. A component surface 37 of the component 33 provides a hardened surface section 36 on which the assigned knitting tool 17 is placed in the tool guide 16. The component 33 or the insert part 34 is fixed in the reception recess 35 by use of an adhesive.

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[0061] The invention refers to a knitting machine part 15 for assembly in a knitting machine, as well as a method for manufacturing thereof. The knitting machine part 15 comprises a plurality of tool guides 16 for one knitting tool 17 respectively. Each tool guide has a hardened section 30. The majority of the hardened sections 30 are integrally configured without seam and connection location, such that they can be referenced as integral sections 30a that transition integrally in adjoining non-hardened sections 31. At least one hardened section 30 of the knitting machine part 15 is formed by a non-integral section 30b in that a hardened separate component 33 is arranged there that forms the non-integral section 30b. The component 33 can be configured as insert part 34 and can be inserted in a reception recess 35. The integral sections 38 are preferably formed by induction hardening of a knitting machine part 15 that is not yet hardened wherein in each insufficiently hardened section a separate hardened component 33 can be arranged in order to provide a hardened non-integral section 30b

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List of Reference Signs:

15	knitting machine part
16	tool guide
17	knitting tool
18	side web
19	guide channel
20	support surface
21	base body
22	end of tool guide
30	hardened section
30a	integral section
30b	non-integral section
31	non-hardened section
32	transition zone
33	component
34	insert part
35	reception recess
36	hardened surface section
37	component surface
45	thread section
46	thread cavity

50	first group of tool guides
51	second group of tool guides
B	movement direction
B1	first movement direction
B2	second movement direction
Q	transverse direction
S1	first step
S2	second step
S3	third step
S4	fourth step
S5	fifth step
U	circumferential direction

Claims:

1. Knitting part (15) with multiple tool guides (16) that are configured for guiding of a knitting tool (17) in each case that is movable in a movement direction (B),
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wherein each tool guide (16) comprises a hardened section (30) with a hardness that is larger than the hardness of another non-hardened section (31) of the tool guide (16),
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wherein the majority of the hardened sections (30) is configured as integral sections (30a) that are integrally configured with the assigned tool guide (16) respectively,

- 15 and wherein at least one hardened section (30) is configured as non-integral section (30b) that comprises at least one separate component (33) that is fixedly connected with the assigned tool guide (16).

2. Knitting machine part according to claim 1, characterized in that the
20 number of non-integral sections (30b) is at most 10% or at most 5% or at most 2% of all hardened sections (30).

3. Knitting machine part according to claim 1 or 2, characterized in that each non-integral section (30b) comprises exactly one separate component (33).

4. Knitting machine part according to any of the preceding claims, characterized in that each tool guide (16) comprises a support surface (20) for the knitting tool (17).

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5. Knitting machine part according to claim 4, characterized in that at least one section of the support surface (20) is arranged in the respective hardened section (30) and forms a hardened surface section (36).

10 6. Knitting machine part according to claim 5, characterized in that the hardened surface section (36) is formed by a component surface (37) of the component (33) in the non-integral sections (30b).

15 7. Knitting machine part according to claim 6, characterized in that the component surface (37) comprises a surface with (bf) in a transverse direction (Q) orthogonal to the movement direction (B) of the knitting tool (17) that is smaller than the tool width (bw) of the knitting tool (17).

20 8. Knitting machine part according to any of the preceding claims, characterized in that the tool guides (16) comprise two side webs (18) in each case that limit a guide channel (19) with a channel width (bk) in a transverse direction (Q) orthogonal to the movement direction (B) of the knitting tool (17).

9. Knitting machine part according to claim 7 and 8, characterized in that a difference between the channel width (bk) and the tool width (bw) results in a guide play and that the sum of the surface width (bf) and the guide play is smaller than the tool width (bw).

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10. Knitting machine part according to claim 8 or 9, characterized in that the surface width (bf) is smaller than the channel width (bk).

11. Knitting machine part according to any of the preceding claims, characterized in that the component (33) of each non-integral section (30b) is configured as insert part (34) that is inserted in a reception recess (35) of the knitting machine part (15).

12. Knitting machine part according to any of the preceding claims, characterized in that it is continuously ring-shaped in a circumferential direction (U).

13. Knitting machine part according to any of the preceding claims, characterized in that at least one group (50, 51) of the tool guides (16) is configured to guide knitting needles.

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14. Knitting machine part according to any of the preceding claims, characterized in that at least one group (50, 51) of the tool guides (16) is configured to guide sinkers.

15. Method for manufacturing of a knitting machine part (15) with multiple tool guides (16) that are configured to guide a knitting tool (17) that is movable in a movement direction (B) along the tool guide (16) respectively, comprising the following steps:

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- Manufacturing of a knitting machine part (15) of a non-hardened material (S1),

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- Hardening of a section of the knitting machine part (15) in order to create a hardened integral section (30a) at the majority of the tool guides (16) respectively (S2),

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- Identifying one or more insufficiently hardened sections of one or more tool guides (16) in which only an insufficient material hardness was created by the hardening of the knitting machine part (15) (S3),

- Creating of a reception recess (35) in each insufficiently hardened section respectively (S4),

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- Inserting of a separate component (33) in each reception recess (35) respectively and connecting each component (33) with the knitting machine part (15) for forming at least one hardened non-integral section (30b) (S5).

16. Method according to claim 15, characterized in that the hardening of the section of the knitting machine part (15) is carried out by induction hardening.