



(11)

EP 4 083 286 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

02.11.2022 Bulletin 2022/44

(51) International Patent Classification (IPC):

D04B 7/04 (2006.01) D04B 35/04 (2006.01)

(21) Application number: **20913491.5**

(86) International application number:

PCT/CN2020/141550

(22) Date of filing: **30.12.2020**

(87) International publication number:

WO 2021/143532 (22.07.2021 Gazette 2021/29)

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA ME

Designated Validation States:

KH MA MD TN

(30) Priority: **14.01.2020 CN 202010035779**

21.01.2020 CN 202010068906

10.08.2020 CN 202010794757

20.11.2020 CN 202011314294

(71) Applicants:

- **Feng, Jialin**
Jiangsu 210018 (CN)

- **Feng, Tianyuan**

Jiangsu 210018 (CN)

- **Wu, Youqun**

Nanjing, Jiangsu 210018 (CN)

(72) Inventors:

- **Feng, Jialin**

Jiangsu 210018 (CN)

- **Feng, Tianyuan**

Jiangsu 210018 (CN)

- **Wu, Youqun**

Nanjing, Jiangsu 210018 (CN)

(74) Representative: **Bayramoglu et al.**

Mira Office

Kanuni Sultan Süleyman Boulevard 5387

Street Beytepe, floor 12, no:50

06800 Cankaya, Ankara (TR)

(54) **KNITTING NEEDLE**

(57) A knitting needle (1) includes a hook (11), a latch (12), a shaft (13) provided with a first transfer portion (15), and a flat spring (14) provided with a second transfer portion (143) and having a front portion bent outward to form a protrusion (141) and a back portion connected to a bottom surface (1331) of a recess (133) to form a connecting end. A deformation surface (142) and the protrusion (141) are not exposed outside the recess (133), or the deformation surface (142) and the protrusion (141) have a portion exposed outside the recess (133), where the portion exposed outside the recess is elastically pressed into the recess (133) by a needle groove or is located in a depression at a corresponding side of the needle groove. The deformation surface (142) is elastically deformed to drive the protrusion (141) to expand outward, such that a loop hung on the first transfer portion (15) and the second transfer portion (143) is stretched. In addition, the deformation surface (142) and the protrusion (141) sink into the recess (133) in a natural state or when pressed by the needle groove, which reduces the overall width of the knitting needle (1). Thus, more knitting needles (1) can be provided on a needle plate in a transverse direction to adapt to high-density knitting of a flatbed knitting machine. Furthermore, the portion of

the deformation surface (142) and the protrusion (141) exposed outside the recess (133) is located in the depression at the corresponding side of the needle groove to meet different knitting needs.

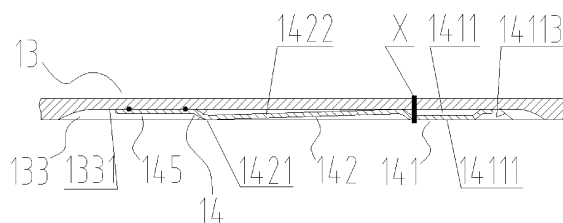


FIG. 3

EP 4 083 286 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to knitting needles, and in particular, to a knitting needle for a flatbed knitting machine.

BACKGROUND

[0002] The flatbed knitting machine includes symmetrical front and back needle beds, which are provided with corresponding needle grooves and knitting needles in the needle grooves. As shown in FIGS. 43 and 44, the knitting needle is generally provided with a hook A1, a latch A2, and a shaft A3. The latch A2 is provided at a back side of the hook A1 and is rotatable to close the hook A1. The shaft A3 includes a stem A31 and a shank A32, which are sequentially arranged in a back portion of the hook. The shank A32 extends upward in a width direction from a back side of the stem and thus is wider than the stem. A recessed first transfer portion A4 is formed at a joint of a front side of the shank and the back side of the stem.

[0003] During knitting, the knitting needle moves up and down along the needle groove, such that a loop on the knitting needle moves relative to the knitting needle. When moving to a position corresponding to the latch, the loop drives the latch to rotate, thereby closing or opening the latch.

[0004] During loop transfer, the two knitting needles in the corresponding needle grooves of the front and back needle beds are required to cooperate with each other to realize the loop transfer. For example, to transfer a loop from the knitting needle in the needle groove of the front needle bed to the corresponding knitting needle of the back needle bed, the knitting needle on the back needle bed needs to be inserted into the loop on the aforementioned knitting needle of the front needle bed. To ensure reliable insertion, a flat spring A5 with a protrusion A51 is provided at one side of the shaft of the knitting needle. When the loop moves to the protrusion of the flat spring, the loop is stretched by the protrusion, such that the corresponding knitting needle can be inserted into the stretched loop.

[0005] The flat spring of the prior knitting needle is accommodated in a recess in one side of the shaft, and the flat spring is basically wholly bent in the length direction of the knitting needle to form a trapezoidal protrusion A51, as shown in FIG. 44. The protrusion A51 has an inner cavity forming a hook insertion slot A511, a back portion of the protrusion A51 connected to a bottom surface of the recess to form a connecting end A512, and a lower end of the front side of the protrusion A51 touching the shaft. The flat spring straddles the stem A31 and the shank A32 and has a wide section and a narrow section, and a portion corresponding to the shank A32 is wider than a portion corresponding to the stem A31. A recessed

second transfer portion A52 is formed at a joint of the wide section and the narrow section, and a position of the second transfer portion A52 corresponds to a position of the first transfer portion A4.

[0006] During loop transfer, the loop on the knitting needle slides from a front inclined surface A51b of the protrusion to a position, corresponding to the first and second transfer portions, on a top end surface A51a of the protrusion A51, thereby being stretched. For this reason, the protrusion must be higher than a corresponding side surface of the shaft. The knitting needle corresponding to the aforementioned knitting needle is inserted into the hook insertion slot A511 from below the hook insertion slot and is inserted into the loop that is hung on the aforementioned knitting needle. During this process, the knitting needle of the back needle bed moves relative to the length direction of the knitting needle of the front needle bed. Therefore, the hook insertion slot must be long enough to provide a movement space of an appropriate length. In addition, in order to make the loop easily slide from the front inclined surface A51b to the top end surface A51a of the protrusion to realize loop stretching, the front inclined surface is required to be gradual or have a small inclination. Likewise, in order to make the loop easily slide from a back inclined surface A51c to the top end surface A51a, the back inclined surface A51c is also required to have a small inclination. However, in such a design, the protrusion will be excessively long, resulting in poor rigidity. The protrusion will be easily deformed when the loop is drawn obliquely or transversely, which will hinder the insertion of the knitting needle, thereby reducing the reliability of insertion. If the back inclined surface has a large inclination, it is difficult for the loop to slide from the back inclined surface to the top end surface of the protrusion, causing the loop to be "hindered". To increase the rigidity of the flat spring and avoid "hindering" of the loop, the protrusion is required to have an enough height. In addition, during loop transfer, when returning to the root of the stem, the loop will be hung on the protrusion, thereby causing the loop to be overstretched, making it unsuitable for high-density knitting.

[0007] These knitting needles with flat springs in the prior art also have the following problems. The protrusion of the flat spring is always higher than the corresponding side surface of the knitting needle, so the knitting needle occupies a large space. To accommodate the protrusion, it is necessary to prepare a groove matched with the protrusion in the steel sheet forming the wall of the needle groove. This process makes steel sheet processing and needle plate mounting complicated and leads to low production efficiency and high cost. Besides, the grooved steel sheet is not suitable for making a fine-gauge needle plate, thereby failing to be adapted to fine-gauge knitting.

[0008] In addition, when the prior knitting needle performs loop transfer, the latch of the knitting needle to receive the loop may not be opened by the lower end of the hook insertion slot or the lower end of the shaft of the knitting needle that cooperates with it to transfer the loop.

Instead, it is usually opened by the loop to be transferred. When the latch of the knitting needle is opened by the loop, the front end of the latch is often poked into the knitting thread composed of multiple strands of yarn, resulting in a "single yarn" problem to cause a flaw in the fabric.

SUMMARY

[0009] In order to overcome the deficiencies of the prior art, an objective of the present disclosure is to provide a knitting needle. The present disclosure adopts the following technical solution.

[0010] The knitting needle is provided in a needle groove of a front or back needle bed of a flatbed knitting machine, and is cooperative with another knitting needle in a corresponding needle groove of a back or front needle bed, where the knitting needle includes:

- a hook;
- a latch, provided at a back side of the hook, and rotatable to close the hook;
- a shaft, including a stem and a shank arranged in sequence in a back portion of the hook, the shank being wider than the stem;
- a recessed first transfer portion, formed at a joint of the stem and the shank;
- a recess, provided in one side of the shaft;
- a flat spring, provided with a recessed second transfer portion, and having a front portion bent outward in a length direction of the shaft to form a protrusion and a back portion connected to a bottom surface of the recess to form a connecting end; and
- a hook insertion slot, formed by an inner cavity of the protrusion.

[0011] The flat spring is further provided with a deformation surface located between a back side of the protrusion and a front side of the connecting end. The deformation surface and the protrusion are not exposed outside the recess, or the deformation surface and the protrusion have a portion exposed outside the recess, where the portion exposed outside the recess is elastically pressed into the recess by the needle groove or is located in a depression at a corresponding side of the needle groove.

[0012] During loop transfer, the hook of another knitting needle in the corresponding needle groove is inserted into a position between the flat spring and the shaft through the hook insertion slot, such that the deformation surface is elastically deformed to drive the protrusion to expand outward, and a loop hung on the first transfer portion and the second transfer portion is stretched.

[0013] In the present disclosure, the flat spring of the knitting needle is provided with the deformation surface. During loop transfer, the knitting needle inserted between the flat spring and the shaft causes the deformation surface to be elastically deformed to rotate outward, to drive

the protrusion to expand outward, such that the loop hung on the first transfer portion and the second transfer portion is stretched. This design achieves the purpose of loop stretching. In addition, it can reduce the length of the protrusion, increase the rigidity of the protrusion, and improve the stability of the hook insertion slot formed by the inner cavity of the protrusion. Furthermore, through the structural arrangement of the deformation surface and the protrusion, the deformation surface and the protrusion can sink into the recess at one side of the shaft in a natural state or when pressed by the needle groove. That is, the whole flat spring is arranged in the needle groove without any portion exposed outside the recess, thereby reducing the overall width of the knitting needle, such that more knitting needles can be provided on a needle plate in a transverse direction to adapt to the high-density knitting of the flatbed knitting machine and to facilitate placement of the knitting needles in the needle grooves. Both or either of the deformation surface and the protrusion may have a portion exposed outside the recess, and the portion exposed outside the recess is located in the depression provided at the corresponding side of the needle groove, so as to meet different knitting needs.

[0014] The present disclosure further adopts the following technical solution.

[0015] The deformation surface is a bending surface that is bent outward. At least one outer end portion higher than the lower ends of the protrusion and located at the front side of the connecting end, and an inclined portion between the front side of the outer end portion and the back side of the protrusion, are formed by bending. Thus, there is a space between the deformation surface and the bottom surface of the recess, which facilitates the elastic deformation of the deformation surface.

[0016] The deformation surface is a flat surface, and the flat surface may touch the bottom surface of the recess, or the deformation surface may be at a certain angle with the bottom surface of the recess.

[0017] A slot depth formed between a top end surface and a bottom end surface of the hook insertion slot is smaller than a thickness of the hook. A lower end of the hook insertion slot is provided with a needle groove guide portion for easy insertion of the hook, and/or a front end of the hook is provided with a hook guide portion for easy insertion into the hook insertion slot. By reducing the slot depth, i.e. reducing the height of the protrusion, the rigidity of the protrusion is further increased. When the slot depth is less than the thickness of the hook, the needle groove guide portion and/or the hook guide portion ensure that the hook is smoothly guided into the hook insertion slot. The insertion of the hook with a thickness greater than the slot depth causes the deformation surface of the flat spring to be elastically deformed to rotate outward, thereby driving the protrusion to expand outward.

[0018] A lower end of the flat spring protrudes downward at a position corresponding to a front side of the

second transfer portion to form a latch opening portion for opening the latch of the knitting needle entering the hook insertion slot. This design avoids the "single yarn" problem that may occur when the latch is opened by the loop moving relative to the knitting needle during loop transfer.

[0019] The needle groove guide portion is an inclined surface, where the inclined surface is provided on the bottom surface of the recess, located at the lower end of the hook insertion slot, and inclined backward, such that a lower end opening of the hook insertion slot is shaped as a bell mouth for easy insertion of the hook. This design facilitates the hook to be smoothly guided into the hook insertion slot.

[0020] The front end of the knitting needle is shaped as an arc or a trapezoid that is gradually widened from narrow to wide, with a narrowest front portion narrower than the slot depth. This design enables the front end of the hook to be inserted into the hook insertion slot easily and smoothly.

[0021] The deformation surface and the protrusion correspond to positions of a front portion of the shank and a back portion of the stem, respectively. A front side of the deformation surface protrudes upward from the back side of the protrusion in a width direction, such that the second transfer portion is located at a joint of the deformation surface and the protrusion. This design minimizes the length of the protrusion and increases the rigidity of the protrusion. Through the elastic deformation of the deformation surface, a space for the movement of the knitting needle is formed between the deformation surface and the bottom surface of the recess, which makes up for the movement space shortened by the reduction of the length of the protrusion. Therefore, during loop transfer, when the loop returns to the root of the stem, the loop is hung at a position corresponding to the first transfer portion and the second transfer portion, and will not be hung on the protrusion. In this way, the loop will not be stretched too much. This design is particularly suitable for high-density knitting, and can achieve uniform-density knitting, thereby ensuring knitting quality.

[0022] The deformation surface is longer than the protrusion. The deformation of the deformation surface is deformation of outward rotation, so the amount of elastic deformation is increased by increasing the length of the deformation surface, thereby improving the loop stretching effect.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a structural view showing needle beds and needle grooves corresponding to knitting needles on a flatbed knitting machine in the related art.

FIG. 2 is a structural view of a knitting needle in Embodiment 1.

FIG. 3 is a top-view partial sectional view of the knit-

ting needle shown in FIG. 2.

FIG. 4 is a sectional view of the knitting needle in Embodiment 1 along line A-A in the front view shown in FIG. 2.

FIG. 5 is a sectional view of the knitting needle in Embodiment 1 along line B-B shown in FIG. 2.

FIG. 6 is a schematic view showing that a hook of a knitting needle 2 is inserted into a hook insertion slot of a knitting needle 1 during loop transfer in Embodiment 1.

FIG. 7 is an M-direction view of the two knitting needles in a knitting state as shown in FIG. 6, where when the hook of the knitting needle 2 is inserted into the hook insertion slot of the knitting needle 1, a deformation surface of the knitting needle 1 is deformed to rotate outward to drive a protrusion to expand outward.

FIG. 8 is a schematic view showing that the hook of the knitting needle 2 with a latch closed enters a loop on the knitting needle 1 from the hook insertion slot in Embodiment 1.

FIG. 9 is a schematic view showing that the latch of the knitting needle 2 is opened by the loop on the knitting needle 1 in Embodiment 1.

FIG. 10 is an M1-direction view of the two knitting needles in the knitting state as shown in FIG. 8, where the knitting needle 2 is moved to a position between the deformation surface and a bottom surface of a recess.

FIG. 11 is a schematic view showing that the knitting needle 2 is completely inserted into the loop in Embodiment 1.

FIG. 12 is a schematic view showing that the hook 2 of the knitting needle 2 carries the loop to move out of a flat spring in Embodiment 1.

FIG. 13 is a schematic view showing that the loop is completely moved from the knitting needle 1 to the knitting needle 2 in Embodiment 1.

FIG. 14 is a sectional view of the knitting needle in Embodiment 2 along line A-A in the front view shown in FIG. 2.

FIG. 15 is a sectional view of the knitting needle in Embodiment 2 along line B-B shown in FIG. 2.

FIG. 16 is a structural view of a knitting needle in Embodiment 3.

FIG. 17 is a sectional view of the knitting needle along line E-E shown in FIG. 16.

FIG. 18 is a schematic view showing that a latch 22 of the knitting needle 2 is opened by a latch opening portion in Embodiment 3.

FIG. 19 is a schematic view showing that the knitting needle 2 is completely inserted into the loop in Embodiment 3.

FIG. 20 is a schematic view showing that the hook 2 of the knitting needle 2 carries the loop to move out of the flat spring from a lower end of a front side of the protrusion in Embodiment 3.

FIG. 21 is a schematic view showing that the loop is

completely moved from the knitting needle 1 to the knitting needle 2 in Embodiment 3.

FIG. 22 is a top-view partial sectional view of the knitting needle in Embodiment 4.

FIG. 23 is a schematic view showing that the deformation surface of the knitting needle is elastically deformed to rotate outward to drive the protrusion to expand outward in Embodiment 4.

FIG. 24 is a structural view of a knitting needle in Embodiment 5.

FIG. 25 is a top-view partial sectional view of the knitting needle shown in FIG. 24.

FIG. 26 is a schematic view showing that the hook of the knitting needle 2 enters a position between the deformation surface and the bottom surface of the recess of the knitting needle 1 in Embodiment 5.

FIG. 27 is an O-direction view in the state shown in FIG. 26, where the deformation surface of the knitting needle 1 is elastically deformed to rotate outward with a larger magnitude when the hook of the knitting needle 2 enters a position between the deformation surface of the knitting needle 1 and the bottom surface of the recess.

FIG. 28 is a schematic view showing that the knitting needle 2 is completely inserted into the loop in Embodiment 5.

FIG. 29 is a schematic view showing that the hook 21 of the knitting needle 2 carries the loop to move out of the flat spring from a lower end of a front side of the protrusion in Embodiment 5.

FIG. 30 is a schematic view showing that the loop is completely moved from the knitting needle 1 to the knitting needle 2 in Embodiment 5.

FIG. 31 is a schematic view showing that the flat spring is not elastically deformed to rotate outward when the hook of the knitting needle 2 is inserted into the hook insertion slot of the knitting needle 1 in Embodiment 6.

FIG. 32 is a schematic view showing that the flat spring is elastically deformed to rotate outward when the hook of the knitting needle 2 is inserted into a position between the deformation surface and the bottom surface of the recess of the knitting needle 1 in Embodiment 6.

FIG. 33 is a top-view partial sectional view of the knitting needle in Embodiment 7.

FIG. 34 is a schematic view showing that a portion of the flat spring of the knitting needle exposed outside the recess, as shown in FIG. 33, is elastically pressed in the recess when being restrained by the needle groove.

FIG. 35 is a partial sectional view of the knitting needle in a direction perpendicular to the needle bed in Embodiment 9 (the deformation surface and the protrusion of the flat spring are exposed outside the recess).

FIG. 36 is a schematic view showing that a portion of the flat spring of the knitting needle exposed out-

side the recess, as shown in FIG. 35, is elastically pressed in the recess when being restrained by the needle groove.

FIG. 37 is a partial sectional view of the knitting needle in the direction perpendicular to the needle bed in Embodiment 10 (the flat spring is exposed outside the recess).

FIG. 38 is a schematic view showing that a portion of the flat spring of the knitting needle exposed outside the recess, as shown in FIG. 37, is elastically pressed in the recess when being restrained by the needle groove.

FIG. 39 is a partial sectional view of the knitting needle in the direction perpendicular to the needle bed in Embodiment 11.

FIG. 40 is a schematic view showing that a portion of the flat spring of the knitting needle exposed outside the recess, as shown in FIG. 39, is elastically pressed in the recess when being restrained by the needle groove.

FIG. 41 is a structural view of a knitting needle in Embodiment 12.

FIG. 42 is a partial sectional view of the knitting needle in the direction perpendicular to the needle bed in Embodiment 12.

FIG. 43 is a structural view of a prior knitting needle.

FIG. 44 is a top-view partial enlarged view of the knitting needle shown in FIG. 43.

30 DETAILED DESCRIPTION OF THE EMBODIMENTS

[0024] The present disclosure is described in further detail below with reference to the drawings and embodiments. Specifically, embodiments 1 to 6 correspond to technical solutions submitted for the first priority (January 21, 2020) of the present application, which are the same as those submitted in the first application (January 14, 2020), where the deformation surface and the protrusion of the flat spring sink into the recess in one side of the shaft and are not exposed outside (or not protruded out) of the recess (or a corresponding side surface of the shaft). Embodiments 7 to 11 correspond to the technical solutions submitted for the second priority (August 10, 2020) and added relative to the first application, where the deformation surface and the protrusion of the flat spring may be exposed outside the recess, but the exposed portion can be pressed into the recess by the needle groove. Embodiment 12 corresponds to the technical solution submitted by the present application for the third priority and added relative to the technical solutions submitted for the first priority and the second priority, where the deformation surface and the protrusion of the flat spring may be exposed outside the recess, and the exposed portion can be accommodated in the depression provided at the corresponding side of the needle groove.

[0025] As shown in FIG. 1, knitting needles are arranged in corresponding needle grooves of a front needle bed 91 and a back needle bed 92 of a flatbed knitting

machine. If any needle groove 911 of the front needle bed 91 is provided with a knitting needle 1, then a knitting needle 2 is provided in a needle groove 921 of the back needle bed 92 corresponding to the needle groove 911. The knitting needle 1 and the knitting needle 2 have exactly the same structure, and the knitting needle 1 and the knitting needle 2 are required to cooperate with each other to perform loop transfer. The following embodiments take the knitting needle 1 as an example to illustrate the structure of the knitting needle of the present disclosure.

Embodiment 1

[0026] As shown in FIGS. 2 and 3, the knitting needle 1 includes a hook 11, a latch 12, and a shaft 13 including a stem 131 and a shank 132. These elements are all found in the prior knitting needles. The shank 132 is wider than the stem 131, and a recessed first transfer portion 15 is formed at a joint of the shank 132 and the stem 131. A recess 133 is provided in a side of the shaft of the knitting needle 1. The recess 133 straddles the corresponding side surfaces of the stem 131 and the shank 132. A flat spring 14 sinks into the recess 133. The flat spring 14 has a wide portion and a narrow portion, and a recessed second transfer portion 143 is formed at a joint of the wide portion and the narrow portion. The position of the second transfer portion 143 corresponds to the position of the first transfer portion 15. Further, in this embodiment, a deformation surface and a protrusion correspond to positions of a front portion of the shank and a back portion of the stem, respectively. A front side of the deformation surface protrudes upward in a width direction from a back side of the protrusion, such that the second transfer portion is located at a joint of the deformation surface and the protrusion. During loop transfer, when the transferring knitting needle is completely out of the needle groove (FIGS. 8 and 9), a loop X is hung at the position corresponding to the first transfer portion and the second transfer portion, such that the loops hung on the stem are adapted to the original loop density without being excessively large. This design is particularly suitable for high-density knitting.

[0027] In this embodiment, a lower end of the flat spring is not raised and is in a flat state, higher than a lower end of the shaft. A back portion of the flat spring is connected to a bottom surface 1331 of the recess 133 by typically welding to form a connecting end 145. A front portion of the flat spring is bent outward in a length direction of the shaft to form a protrusion 141. A lower end of a front side of the protrusion touches the bottom surface 1331 of the recess, and an inner cavity of the protrusion 141 forms a hook insertion slot 1411.

[0028] In the present disclosure, a deformation surface 142 is further provided between a back side of the protrusion and a front side of the connecting end. The elastic deformation of the deformation surface drives the protrusion to expand outward so as to achieve the purpose of

stretching the loop. In order to make the protrusion expand outward to a desired extent, the deformation surface in this embodiment is designed as follows. The deformation surface 142 is formed by a triangular bending to form an outer end portion 1421 and an inclined portion 1422 of a bending point (if necessary, it may also be formed by multiple triangular bending to form multiple bending points). The outer end portion 1421 is higher than the lower ends of the protrusion 141 and located at the front side of the connecting end 145. The inclined portion 1422 is located between a front side of the outer end portion 1421 and the back side of the protrusion and is inclined from the outside to the inside, such that there is a space between the deformation surface 142 and the bottom surface 1331 of the recess. A top end surface 14111 of the protrusion 141, and an outermost end of the deformation surface 142, i.e. the outer end portion 1421, are not protruded (not exposed) out of an outermost side surface of the shaft, that is, they are not higher than a most protruding surface of the corresponding side of the shaft.

[0029] As shown in FIG. 4, a slot depth h is formed between an inner side of the top end surface 14111 and a bottom end surface (i.e., the bottom surface 1331 of the recess) of the hook insertion slot 1411, and the slot depth h is smaller than a thickness of the hook. A lower end of the hook insertion slot 1411 is provided with a needle groove guide portion which facilitates the insertion of the hook. The guide portion is an inclined surface 14113 provided at the lower end of the hook insertion slot. The inclined surface 14113 is inclined backward from the bottom surface 1331 of the recess, such that a lower end opening of the hook insertion slot is shaped as a bell mouth. A front end of the hook of the knitting needle is shaped as an arc that is gradually widened from narrow to wide. As shown in FIG. 5, it is obvious that a narrowest portion of the front end is smaller than the slot depth to form a hook guide portion, which facilitates the front end of the hook to be inserted into the hook insertion slot. During loop transfer, a corresponding knitting needle (e.g. the knitting needle 2) that cooperates with a knitting needle (e.g. the knitting needle 1) currently holding a loop is inserted into the hook insertion slot of the knitting needle 1, such that the deformation surface is elastically deformed to rotate relative to the bottom surface of the recess, to drive the protrusion to expand outward to achieve the purpose of stretching the loop on the knitting needle 1.

[0030] As shown in FIGS. 6 and 7, during loop transfer, the knitting needle 1 holding the loop to be transferred moves upward along the needle groove, and the loop X on the knitting needle 1 moves relatively to the positions of the first transfer portion 15 and the second transfer portion. The knitting needle 2 is inserted into the hook insertion slot 1411 via the needle groove guide portion from the lower portion of the protrusion 141 of the knitting needle 1. The hook portion of the knitting needle 2 causes the deformation surface of the knitting needle 1 to be deformed to rotate outward, and drives the protrusion of

the knitting needle 1 to expand outward, such that the loop X is stretched. At this time, the latch 22 of the knitting needle 2 is possible to touch the lower end of the hook insertion slot 1411 to be opened, or not touch the lower end of the hook insertion slot 1411 to not be opened. If the latch is opened, please refer to Embodiment 3. If the latch is not opened, when the hook of the knitting needle 2 enters the loop X through the hook insertion slot 1411, the loop X touches the closed latch 22 of the knitting needle 2, as shown in FIG. 8. As the knitting needle 2 moves upward relative to the knitting needle 1 along the needle groove, the loop X opens the latch 22, as shown in FIG. 9. The knitting needle 2 moves to a position between the deformation surface and the bottom surface of the recess, as shown in FIG. 10. The two knitting needles continue to move in cooperation, and the loop X completely enters the hook 22 of the knitting needle 2, as shown in FIG. 11. The hook 2 carries the loop X to move out of the flat spring from the lower end of the front side of the protrusion 141, as shown in FIG. 12. Then, the loop X closes the latch 12 of the knitting needle 1, such that the loop X is completely moved out of the knitting needle 1 and completely transferred to the knitting needle 2, as shown in FIG. 13.

Embodiment 2

[0031] As shown in FIGS. 2 and 3, the knitting needle of this embodiment has basically the same structure as that of Embodiment 1, with the exception that the lower end of the hook insertion slot 1411 formed by the inner cavity of the protrusion 141 of the flat spring 14 is not provided with a needle groove guide portion. For example, the inclined surface 14113 inclined backward from the bottom surface 1331 of the recess is not provided on the bottom end surface (i.e. the bottom surface 1331 of the recess) of the hook insertion slot 1411, as shown in FIG. 14. In order for the smooth insertion of the corresponding knitting needle (e.g. the knitting needle 2), in this embodiment, the front end of the hook of the knitting needle is shaped as a trapezoid that is gradually widened from narrow to wide, with a narrowest portion smaller than the slot depth, and the front end is tapered, as shown in FIG. 15, which is convenient for hook insertion.

[0032] In this embodiment, the other structures of the knitting needle 1 and the process of cooperating with the knitting needle 2 during loop transfer are the same as those in Embodiment 1, and will not be repeated here.

Embodiment 3

[0033] As shown in FIG. 16, the knitting needle 1 of this embodiment has the same hook 11, latch 12 and shaft 13 as those of Embodiment 1. Likewise, the flat spring 14 sinks into the recess 133 in one side of the shaft, and the recess 133 straddles the corresponding side surfaces of the stem 131 and the shank 132. The flat spring 14 is provided with a protrusion 141 and a

deformation surface 142 at a back side of the protrusion. The structure of the deformation surface 142 is the same as that of Embodiment 1, that is, the deformation surface 142 has an outer end portion 1421 and an inclined portion 1422, as shown in FIG. 3 in Embodiment 1. Likewise, the top end surface of the protrusion 141 and the most protruding portion (i.e. the outer end portion 1421) of the deformation surface 142 are not protruded out of the outermost surface of the corresponding side of the shaft. The lower end of the front side of the protrusion touches the bottom surface 1331 of the recess, and the inner cavity of the protrusion 141 forms the hook insertion slot, and the slot depth is smaller than the thickness of the hook (FIG. 4). However, the lower end of the flat spring 14 is not in a flat state, but protrudes downward at a position corresponding to the front side of the second transfer portion to form a latch opening portion 144. The latch opening portion 144 is not lower than the lower end of the shaft 13, and is configured to open the latch of the knitting needle entering the hook insertion slot. This design solves the problem that the latch of the knitting needle to be inserted into the loop cannot be reliably opened when the knitting needle is inserted into the hook insertion slot of the knitting needle carrying the loop, thereby effectively preventing the "single yarn" problem. The lower end of the hook insertion slot 1411 formed by the inner cavity of the protrusion 141 is provided with a needle groove guide portion formed by the inclined surface 14113 inclined backward from the bottom surface 1331 of the recess, such that the lower end opening of the hook insertion slot 1411 is shaped as a bell mouth for easy insertion of the hook, as shown in FIG. 17. The front end of the hook is also shaped as an arc, as shown in FIG. 5, such that the hook can be easily inserted into the hook insertion slot. In this embodiment, other structures of the knitting needle, such as the first transfer portion, the second transfer portion, and the connection mode between the flat spring and the shaft, are the same as those in Embodiment 1, and thus will not be repeated here.

[0034] In this embodiment, during loop transfer, after the knitting needle 2 is inserted into the needle groove guide portion from below the hook insertion slot 1411 of the knitting needle 1, the latch 22 touches the latch opening portion 144 protruding downward and is thus opened, as shown in FIG. 18. When the hook of the knitting needle 2 is inserted into the hook insertion slot 1411, the deformation surface of the flat spring of the knitting needle 1 is deformed to rotate outward, thereby driving the protrusion to expand outward, such that the loop X is stretched, as shown in FIG. 7. Subsequently, the knitting needle 1 and the knitting needle 2 move with each other according to a set program. The hook 21 of the knitting needle 2 with the latch 22 open enters the loop X hung on the first transfer portion and the second transfer portion. Therefore, the knitting needle 2 is completely inserted into the loop X, as shown in FIG. 19. Then, the hook 2 of the knitting needle 2 carries the loop X to move out of the flat

spring from the lower end of the front side of the protrusion 141, as shown in FIG. 20. The loop X moves relative to the stem and closes the latch 12 of the knitting needle 1. Then the loop X moves out of the knitting needle 1 and falls completely on the knitting needle 2, as shown in FIG. 21.

Embodiment 4

[0035] As shown in FIGS. 16 and 17, the knitting needle of this embodiment has basically the same structure as that of Embodiment 3, and differs from Embodiment 3 only in the bending structure of the flat spring 14.

[0036] In this embodiment, the flat spring 14 of the knitting needle is bent in a trapezoidal shape to form an outer end portion 1421 with a bending surface, and the outer end portion 1421 is higher than the lower ends of the protrusion and is located at the front side of the connecting end, as shown in FIG. 22. During loop transfer, the knitting needle 2 is inserted into the hook insertion slot 1411 of the knitting needle 1 carrying the loop X. The deformation surface 142 of the knitting needle 1 is deformed to rotate outward to drive the protrusion 141 to expand outward, such that the loop X is stretched, as shown in FIG. 23. In this embodiment, the following transfer process is shown in FIGS. 17 to 21: during the loop transfer of the knitting needle, the latch opening portion 144 opens the latch, the hook 21 enters the loop X and is completely inserted into the loop X, then the loop X is removed by the knitting needle 2 and falls completely on the knitting needle 2.

Embodiment 5

[0037] As shown in FIGS. 24 and 25, the knitting needle of this embodiment has the same hook 11, latch 12 and shaft 13 as those of Embodiment 1. Likewise, the flat spring 14 sinks into the recess 133 in one side of the shaft. The flat spring 14 is provided with the protrusion 141, the deformation surface 142 at the back side of the protrusion, and the latch opening portion 144 protruding downward at a position corresponding to the front side of the second transfer portion. The latch opening portion 144 is flush with the lower end of the shaft 13, and is configured to open the latch of the knitting needle entering the hook insertion slot. The top end surface of the protrusion 141 does not protrude out of the outermost surface of the corresponding side of the shaft. The inner cavity of the protrusion 141 forms the hook insertion slot 1411, and the slot depth h is smaller than the thickness of the hook (FIG. 4). The lower end of the hook insertion slot 1411 is provided with the inclined surface 14113 inclined backward from the bottom surface 1331 of the recess to form the needle groove guide portion, and the lower end opening of the hook insertion slot 1411 is shaped as a bell mouth for easy insertion of the hook.

[0038] The difference between the flat spring 14 in this embodiment and Embodiment 3 is that the deformation

surface is not bent. The deformation surface is a flat surface extending backward from the back side of the protrusion and touches the bottom surface 1331 of the recess 133. The front side of the deformation surface protrudes upward in the width direction from the back side of the protrusion, such that the second transfer portion is located at the joint of the deformation surface and the protrusion. In this way, the knitting needle 2 inserted into the inner side of the protrusion moves at the hook insertion slot and between the deformation surface and the bottom surface of the recess. As the knitting needle 2 is inserted into the hook insertion slot, the deformation surface is deformed to rotate. On this basis, the knitting needle 2 enters the position between the deformation surface and the bottom surface of the recess 133 from the hook insertion slot to increase the deformation amount. This structure is applicable for knitting that requires a large amount of loop stretching. In this embodiment, other structures of the knitting needle, such as the first transfer portion and the connection mode between the flat spring and the shaft, are the same as those in Embodiment 3, and thus will not be repeated here.

[0039] In this embodiment, during loop transfer process, when the knitting needle 2 is inserted into the hook insertion slot 1411 via the needle groove guide portion of the knitting needle 1, the latch 22 touches the latch opening portion 144 protruding downward and is thus opened, as shown in FIG. 18. Meanwhile, since the hook 21 of the knitting needle 2 is inserted into the hook insertion slot 1411 of the knitting needle 1, the deformation surface of the flat spring of the knitting needle 1 is deformed to rotate outward, to drive the protrusion to expand outward, such that the loop X is stretched. Subsequently, the knitting needle 1 and the knitting needle 2 move with each other according to a set program. The hook of the knitting needle 2 with the latch open enters a position between the deformation surface and the bottom surface of the recess 133 from the hook insertion slot, and then enters the loop X hung on the first transfer portion and the second transfer portion, as shown in FIG. 26. At this time, the deformation surface is deformed to rotate outward again, which increases the magnitude of the rotational deformation, as shown in FIG. 27, such that the loop X is stretched again. The hook 21 of the knitting needle 2 is completely inserted into the loop X, as shown in FIG. 28. Then, the hook 2 carries the loop X to move out of the flat spring from the lower end of the front side of the protrusion 141, as shown in FIG. 29. The loop X closes the latch 12 of the knitting needle 1 and thus moves completely out of the knitting needle 1, as shown in FIG. 30.

Embodiment 6

[0040] On the basis of Embodiment 3, in this embodiment, the slot depth h formed between the top end surface 14111 and the bottom end surface (i.e. the bottom surface 1331 of the recess) of the hook insertion slot

1411 is not less than the thickness δ of the hook. The other structures of this embodiment are the same as those of Embodiment 5. In this case, when the hook 21 of the knitting needle 2 is inserted into the hook insertion slot 1411, the flat spring 14 may not be elastically deformed to rotate outward, as shown in FIG. 31. However, when the knitting needle 2 moves from the hook insertion slot to a position between the deformation surface and the bottom surface of the recess, the deformation surface 142 is elastically deformed to rotate outward to drive the protrusion 141 to expand outward, such that the loop X on the first transfer portion and the second transfer portion is stretched, as shown in FIG. 32.

Embodiment 7

[0041] In this embodiment, the front view of the knitting needle is shown in FIG. 2, and the partial top-view structural diagram of the knitting needle in the natural state is shown in FIG. 33. In this embodiment, the deformation surface 142 is a bending surface formed by triangular bending outward. The bent end can be approximated as a bending point (the bent end protrudes from the side surface of the corresponding side of the shaft to form the outer end portion 1421). The deformation surface 142 and the protrusion 141 (with the top end surface 14111) both have a portion exposed outside the recess 133 in a natural state without external force, or one of the deformation surface 142 and the protrusion 141 has a portion exposed outside the recess 133 (not shown in the figure). If the bent end of the deformation surface 142 and the upper end surface of the protrusion 141 have a portion exposed outside the recess 133, when the portion exposed outside the recess 133 is restrained by the needle groove 911 (which corresponds to a wall 9111), the portion exposed outside the recess 133 is elastically pressed into the recess 133, as shown in FIG. 34. The loop transfer process of the knitting needle is shown in FIGS. 6, 8, 9, 11, 12, and 13.

Embodiment 8

[0042] As shown in FIG. 34, the knitting needle of this embodiment has the same basic structure as that of Embodiment 7, with the exception that in this embodiment, the lower end of the flat spring 14 is not in a flat state, but protrudes downward at a position corresponding to the front side of the second transfer portion to form the latch opening portion 144, as shown in FIG. 16. The latch opening portion 144 is not lower than the lower end of the shaft 13, and is configured to open the latch of the knitting needle entering the hook insertion slot. This design solves the problem that the latch of the knitting needle to be inserted into the loop cannot be reliably opened when the knitting needle is inserted into the hook insertion slot of the knitting needle carrying the loop, thereby effectively preventing the "single yarn" problem.

[0043] During loop transfer, the knitting needle 2 is in-

serted into the needle groove guide portion from below the hook insertion slot 1411 of the knitting needle 1. The knitting needle 1 moves upward, in other words, the knitting needle 2 moves downward relative to the knitting needle 1. Then, the latch 21 touches the latch opening portion 144 protruding downward and is thus opened, as shown in FIG. 18. For the loop transfer process, please refer to FIGS. 18 to 21.

Embodiment 9

[0044] As shown in FIGS. 16 and 36, the structure of the knitting needle of this embodiment is based on Embodiment 8, and differs from Embodiment 8 only in the bending structure of the flat spring 14.

[0045] As shown in FIG. 35, in this embodiment, the protrusion 141 of the flat spring 14 of the knitting needle is an arc-shaped protrusion. The deformation surface between the front side of the connecting end of the flat spring and the bottom surface of the recess and the back side of the protrusion 141 is a bending surface formed by bending outward in an arc shape. Due to the large radius of curvature of the arc, the bent end is approximately flat. Both or either of the deformation surface 142 and the protrusion 141 may be exposed outside the recess 133 in a natural state without external force, but the exposed portion can be elastically pressed in the recess, as shown in FIG. 36. The loop transfer process is shown in FIGS. 18 to 21.

Embodiment 10

[0046] As shown in FIGS. 16 and 36, the structure of the knitting needle of this embodiment is based on Embodiment 8, and differs from Embodiment 8 only in the bending structure of the deformation surface of the flat spring 14.

[0047] In this embodiment, the deformation surface 142 is a flat surface. The deformation surface 142 extends forward from the connecting end 145 to the back side of the protrusion 141 and touches the bottom surface 1331 of the recess 133. The protrusion 14 connected to the front side of the deformation surface 142 is exposed outside the recess 133, as shown in FIG. 37, but the exposed portion can be elastically pressed into the recess, as shown in FIG. 38. For the loop transfer process, please refer to FIGS. 18 to 21.

Embodiment 11

[0048] The knitting needle of this embodiment is basically the same as that of Embodiment 10, with the exception that the flat deformation surface 142 does not touch the bottom surface of the recess, and is slightly inclined outward relative to the bottom surface of the recess. The protrusion is exposed outside the recess 133, as shown in FIG. 39, but as the same as in the aforementioned embodiment, the exposed portion can also

be pressed into the recess 133 through elastic deformation, as shown in FIG. 40. For the loop transfer process, please refer to FIGS. 18 to 21.

Embodiment 12

[0049] The front view of the knitting needle of this embodiment is shown in FIG. 41. Similar to the structure of the knitting needle of Embodiment 3 shown in FIG. 16, in this embodiment, the lower end of the flat spring 14 is provided with a latch opening portion 144 protruding downward at a position corresponding to the front side of the second transfer portion 143. The deformation surface 142 of the flat spring 14 is a bending surface that is bent outward to form an outer end portion 1421, as shown in FIG. 42. In a natural state, the bending surface and the protrusion 141 both have a portion exposed outside the recess 133 of the shaft. For example, the outer end portion 1421 of the deformation surface 142 and the top end surface 14111 of the protrusion are both exposed outside the recess. The needle groove 911 configured to accommodate the knitting needle is provided with a depression 9113 in its side surface. When the knitting needle is accommodated in the needle groove 911, the portion of the deformation surface 142 and the protrusion 141 of the flat spring that is exposed outside the recess 133 is located in the depression 9113 in the side surface of the needle groove. In this way, the knitting needle is adapted to the knitting of a corresponding gauge. For the loop transfer process, please refer to FIGS. 18 to 21.

[0050] Of course, the portion of the flat spring exposed outside the recess is not limited to exposed portions of both the deformation surface and the protrusion, and may also be an exposed portion of either the deformation surface or the protrusion. However, any exposed portion is located in the depression 9113 in the side surface of the needle groove.

[0051] Similar to the other embodiments, in this embodiment, the position of the second transfer portion 143 of the flat spring 14 corresponds to the position of the first transfer portion 15 of the knitting needle. The deformation surface 142 and the protrusion 141 correspond to positions at the front portion of the shank and the back portion of the stem, respectively. The front side of the deformation surface protrudes upward in the width direction from the back side of the protrusion, such that the second transfer portion is located at the joint of the deformation surface and the protrusion. During loop transfer, when the transferring knitting needle is completely out of the needle groove (FIGS. 8 and 9), the loop X is hung at the position corresponding to the first transfer portion and the second transfer portion, and will not be hung on the protrusion. In this way, the loops hung on the stem are adapted to the original loop density without being excessively large, such that the knitting density is uniform and the knitting quality is ensured.

[0052] To sum up, in the present disclosure, the flat spring is provided with the deformation surface, and the

elastic deformation of the deformation surface drives the protrusion to expand outward for loop stretching. Therefore, the knitting needle has desired density adaptability. The elastic deformation of the deformation surface can make the flat spring pressed in the shaft, such that the overall width of the knitting needle is narrowed to adapt to high-density knitting. The elastic deformation of the deformation surface can also make the flat spring released out of the shaft to suit different knitting needs.

[0053] The present disclosure is not limited to the above-mentioned embodiments, and any technical solutions made according to the ideas of the present disclosure and containing the essential technical features provided by the present disclosure fall within the scope of protection of the present disclosure.

Claims

1. A knitting needle, provided in a needle groove of a front or back needle bed of a flatbed knitting machine, and cooperative with another knitting needle in a corresponding needle groove of a back or front needle bed, wherein the knitting needle comprises:

- a hook;
 - a latch, provided at a back side of the hook, and rotatable to close the hook;
 - a shaft, comprising a stem and a shank arranged in sequence in a back portion of the hook, the shank being wider than the stem;
 - a recessed first transfer portion, formed at a joint of the stem and the shank;
 - a recess, provided in one side of the shaft;
 - a flat spring, provided with a recessed second transfer portion, and having a front portion bent outward in a length direction of the shaft to form a protrusion and a back portion connected to a bottom surface of the recess to form a connecting end; and
 - a hook insertion slot, formed by an inner cavity of the protrusion;
- wherein:

the flat spring is further provided with a deformation surface located between a back side of the protrusion and a front side of the connecting end; the deformation surface and the protrusion are not exposed outside the recess, or the deformation surface and the protrusion have a portion exposed outside the recess, wherein the portion exposed outside the recess is elastically pressed into the recess by the needle groove or is located in a depression at a corresponding side of the needle groove; and

during loop transfer, the hook of another

- knitting needle in the corresponding needle groove is inserted into a position between the flat spring and the shaft through the hook insertion slot, such that the deformation surface is elastically deformed to drive the protrusion to expand outward, and a loop hung on the first transfer portion and the second transfer portion is stretched. 5
2. The knitting needle according to claim 1, wherein the deformation surface is a bending surface that is bent outward. 10
3. The knitting needle according to claim 1, wherein the deformation surface is a flat surface. 15
4. The knitting needle according to any one of claims 2 to 3, wherein a slot depth formed between a top end surface and a bottom end surface of the hook insertion slot is smaller than a thickness of the hook; and a lower end of the hook insertion slot is provided with a needle groove guide portion for easy insertion of the hook, and/or a front end of the hook is provided with a hook guide portion for easy insertion into the hook insertion slot. 20 25
5. The knitting needle according to claim 4, wherein a lower end of the flat spring protrudes downward at a position corresponding to a front side of the second transfer portion to form a latch opening portion for opening the latch of the knitting needle entering the hook insertion slot. 30
6. The knitting needle according to claim 5, wherein the needle groove guide portion is an inclined surface, wherein the inclined surface is provided on the bottom surface of the recess, located at the lower end of the hook insertion slot, and inclined backward, such that a lower end opening of the hook insertion slot is shaped as a bell mouth for easy insertion of the hook. 35 40
7. The knitting needle according to claim 5, wherein the front end of the knitting needle in a thickness direction is shaped as an arc or a trapezoid that is gradually widened from narrow to wide, with a narrowest front portion narrower than the slot depth. 45
8. The knitting needle according to claim 7, wherein the deformation surface and the protrusion correspond to positions of a front portion of the shank and a back portion of the stem, respectively; and a front side of the deformation surface protrudes upward from the back side of the protrusion in a width direction, such that the second transfer portion is located at a joint of the deformation surface and the protrusion. 50 55
9. The knitting needle according to claim 8, wherein the

deformation surface is longer than the protrusion.

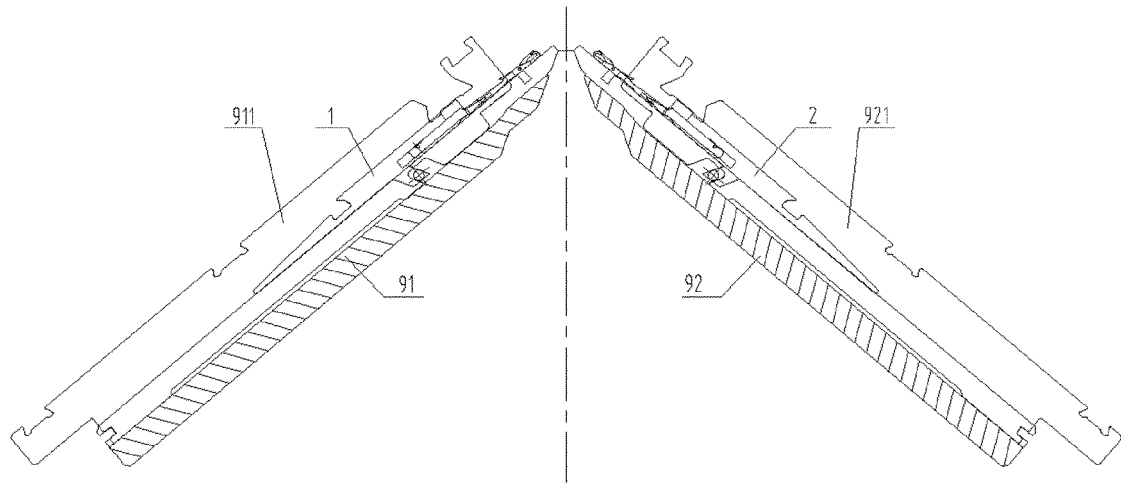


FIG. 1

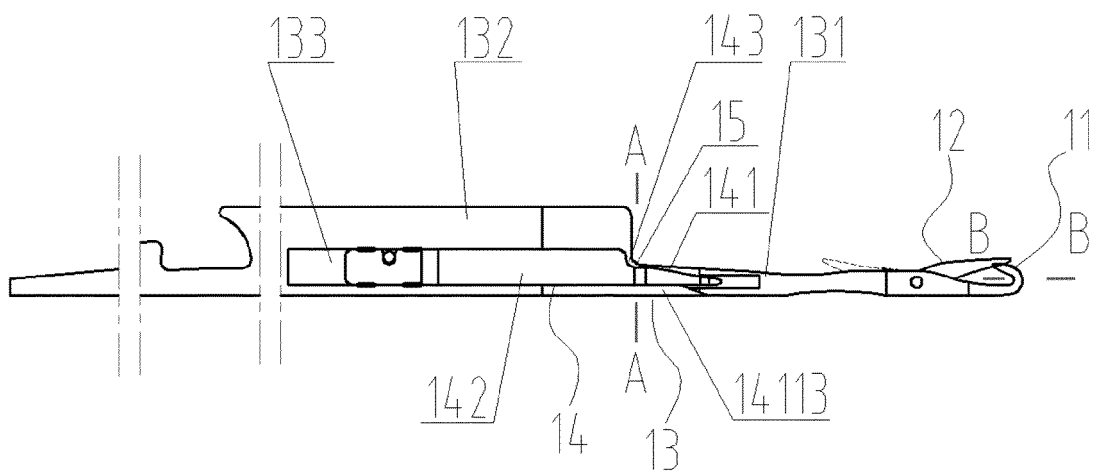


FIG. 2

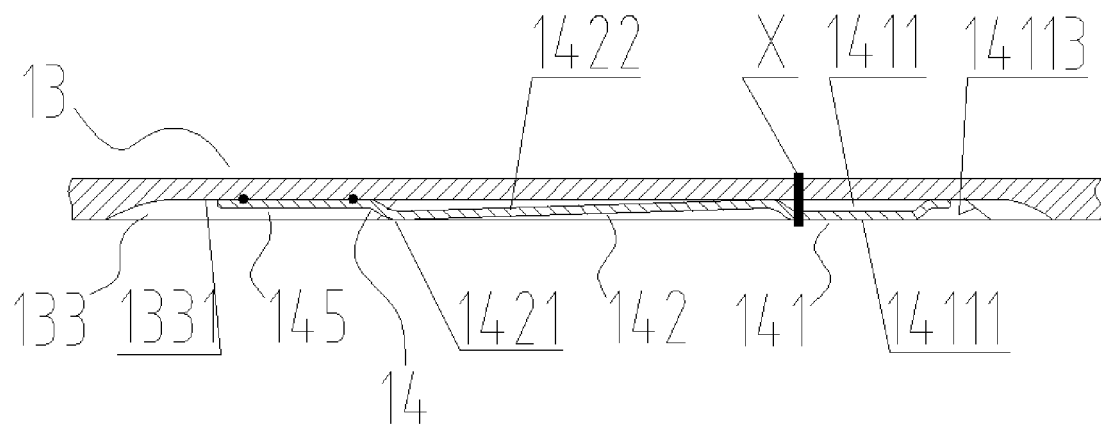


FIG. 3

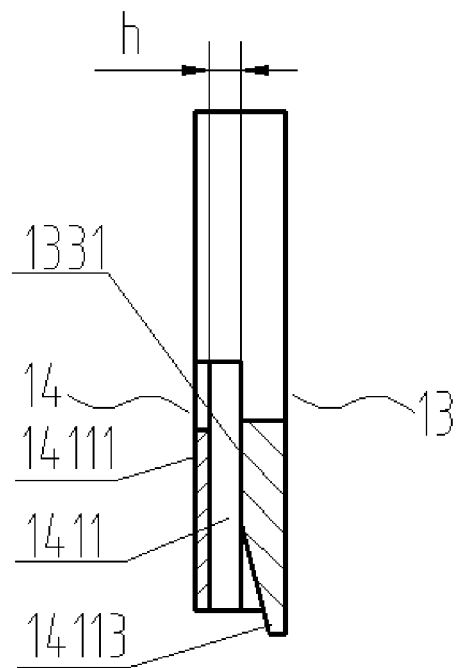


FIG. 4

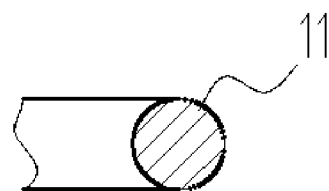


FIG. 5

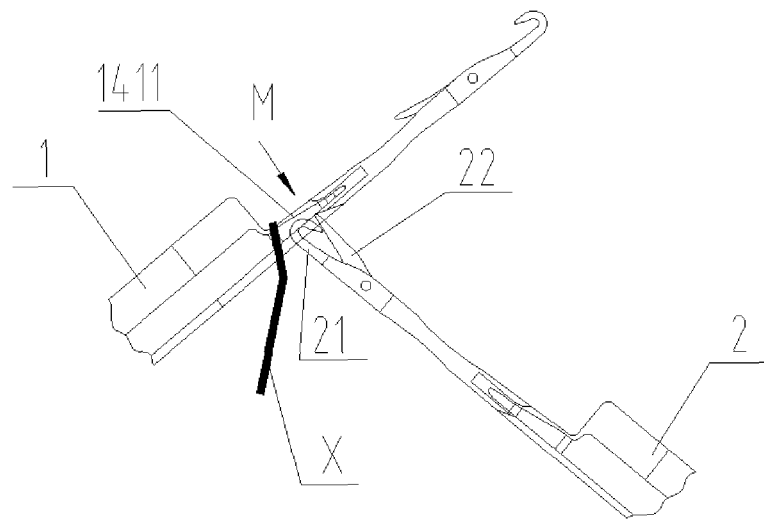


FIG. 6

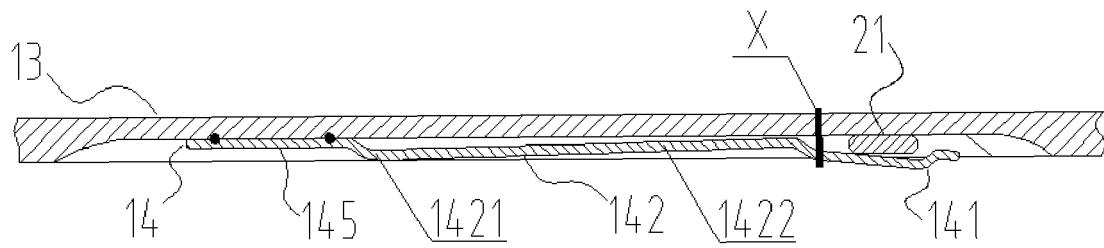


FIG. 7

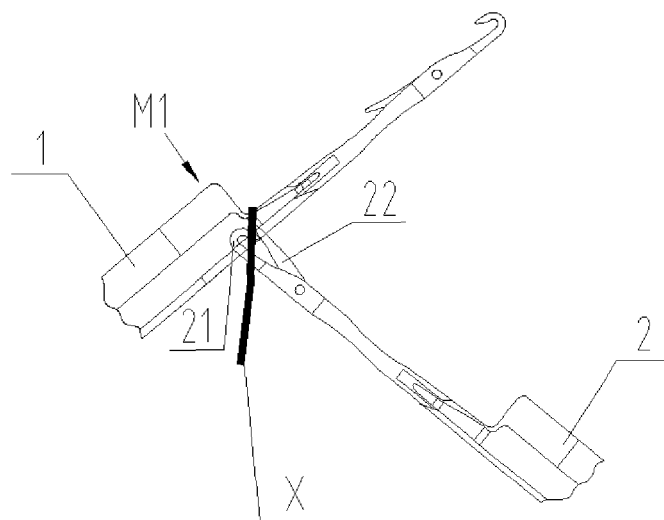


FIG. 8

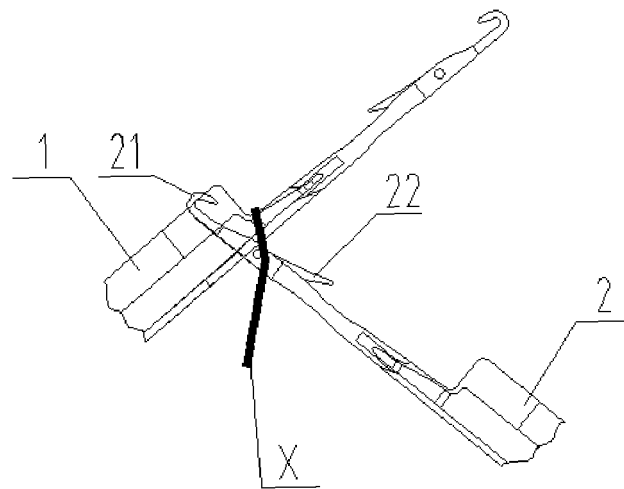


FIG. 9

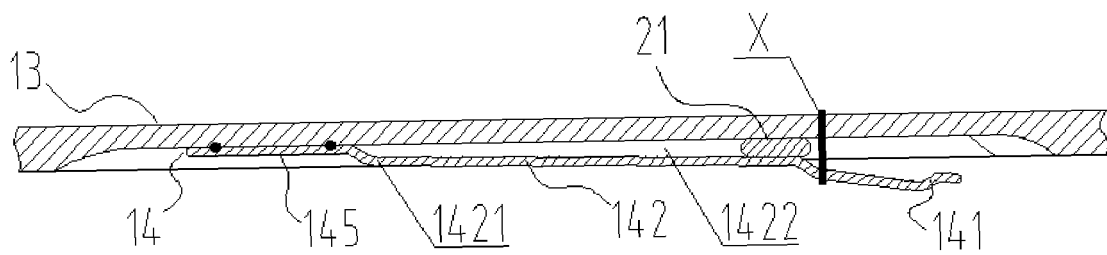


FIG. 10

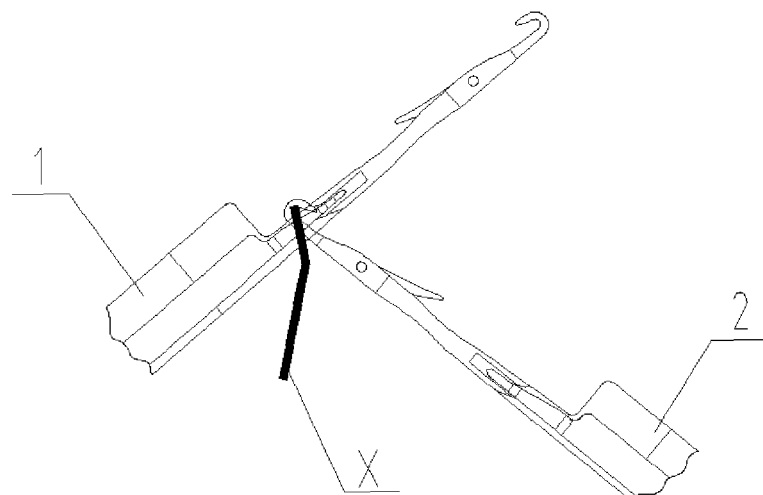


FIG. 11

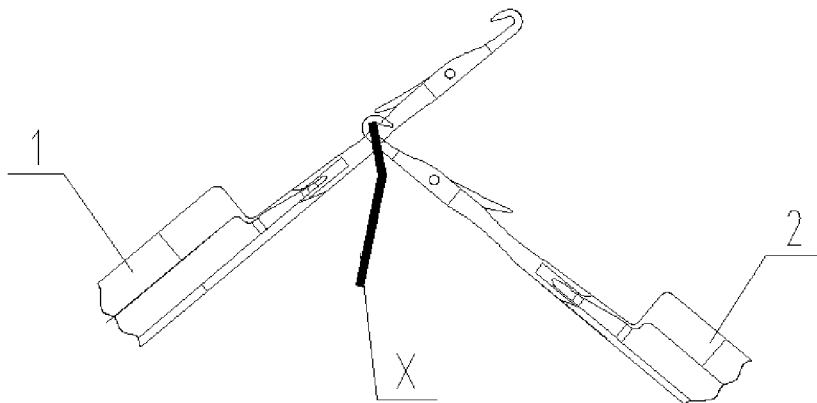


FIG. 12

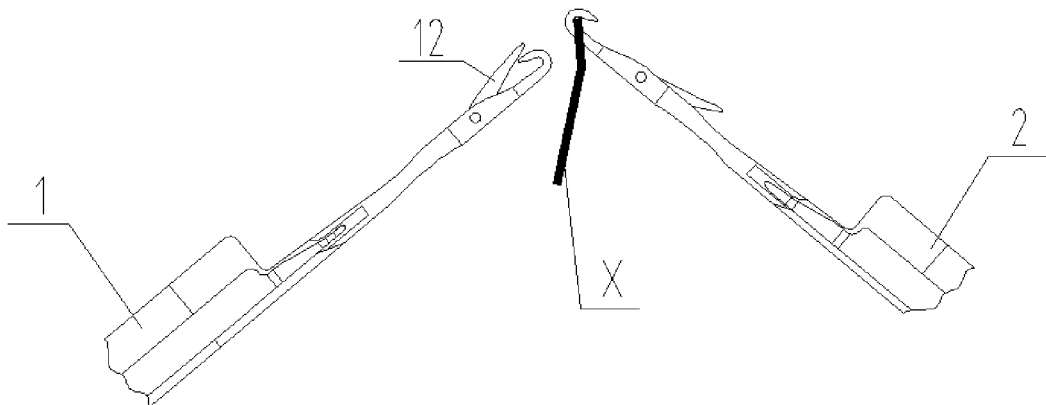


FIG. 13

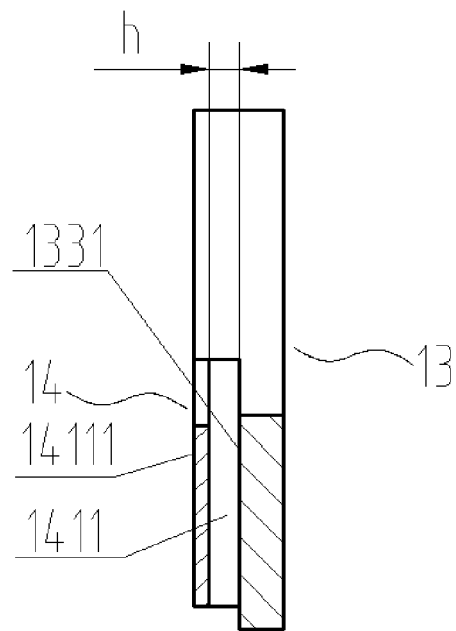


FIG. 14

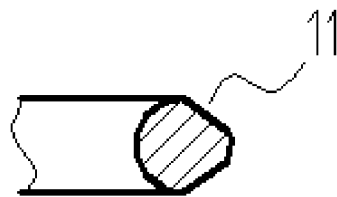


FIG. 15

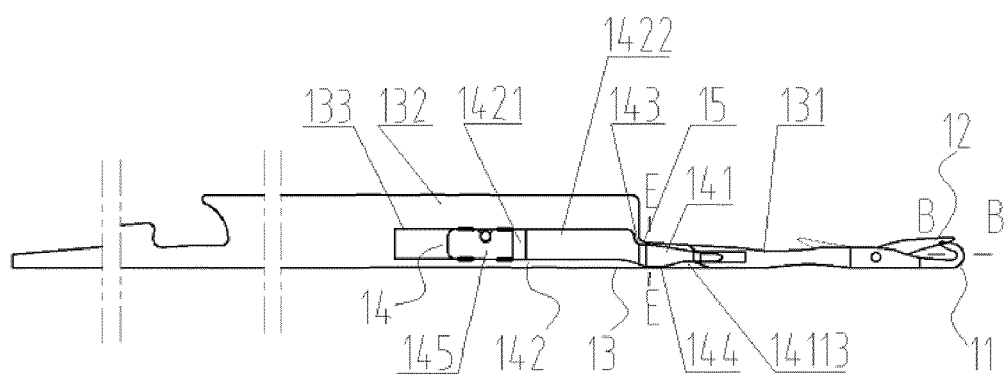


FIG. 16

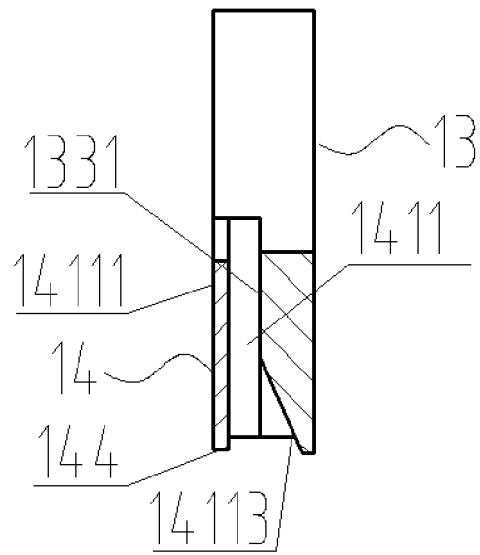


FIG. 17

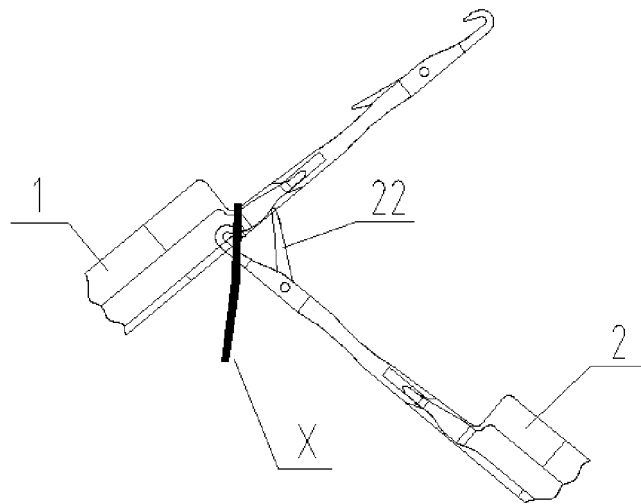


FIG. 18

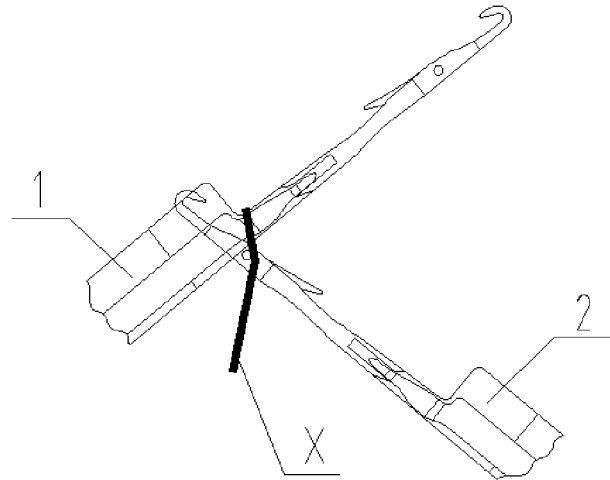


FIG. 19

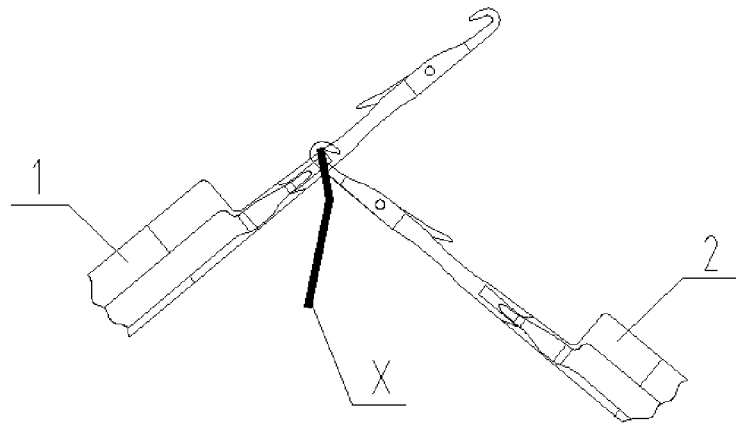


FIG. 20

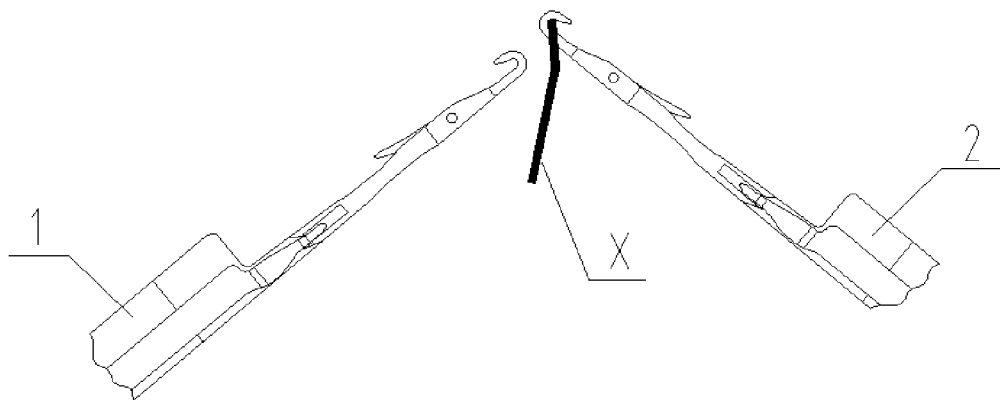


FIG. 21

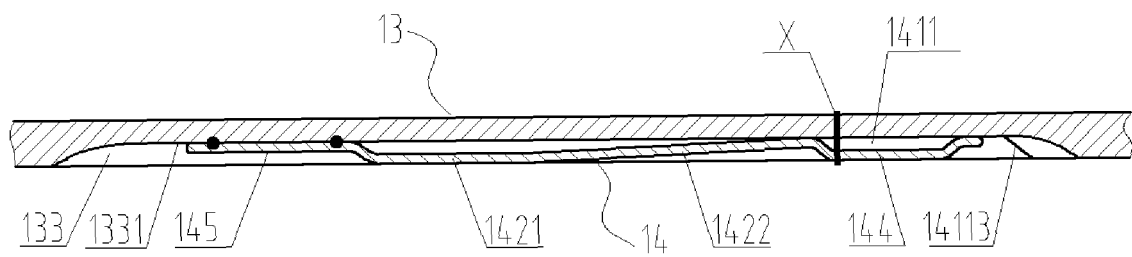


FIG. 22

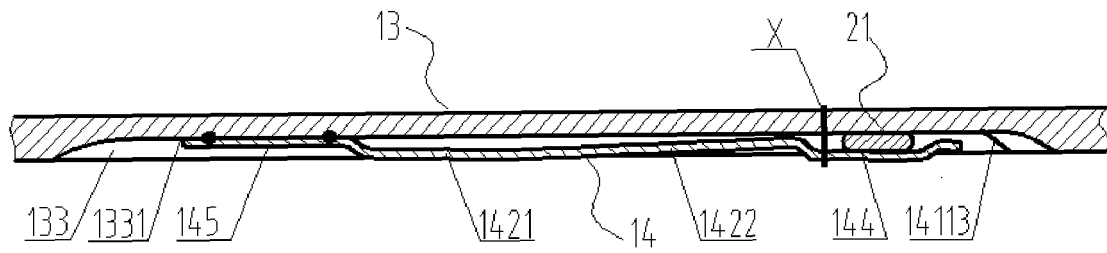


FIG. 23

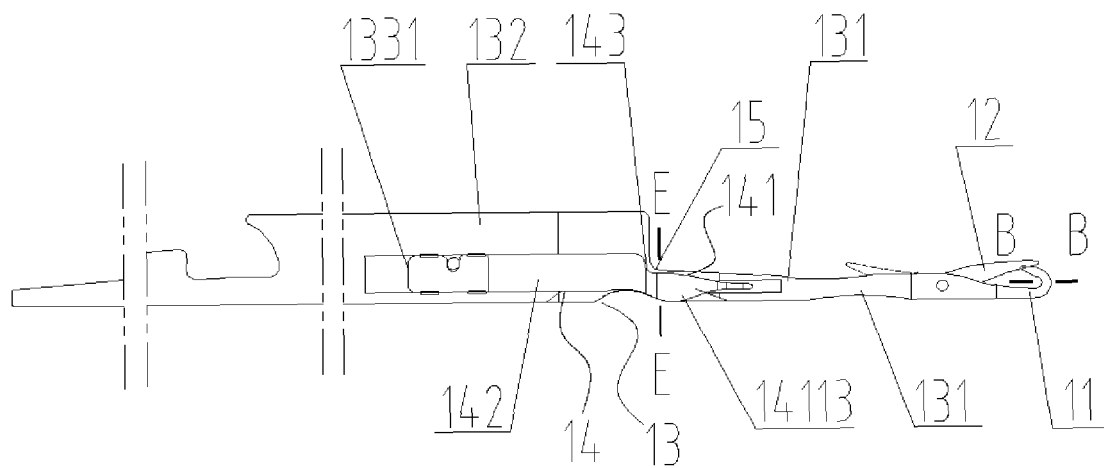


FIG. 24

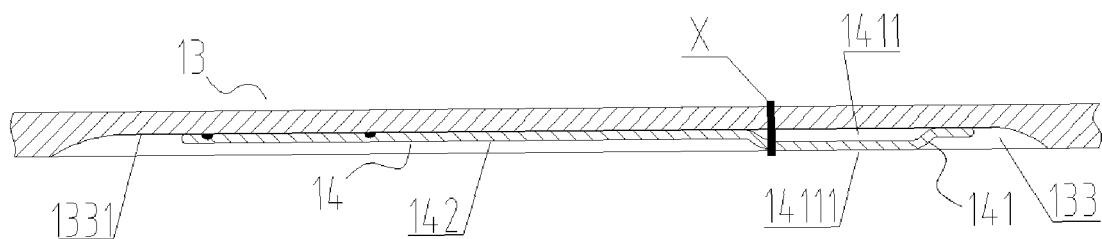


FIG. 25

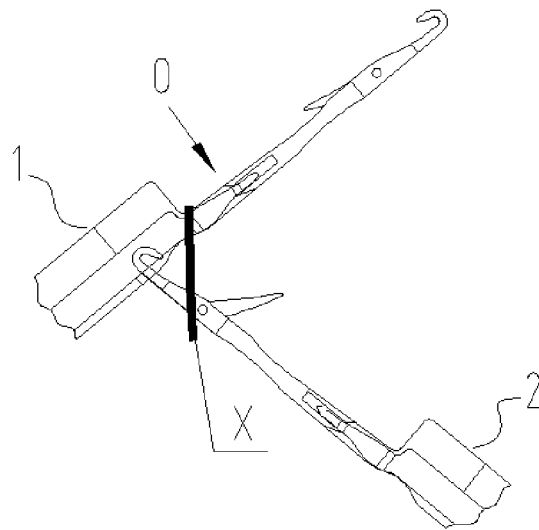


FIG. 26

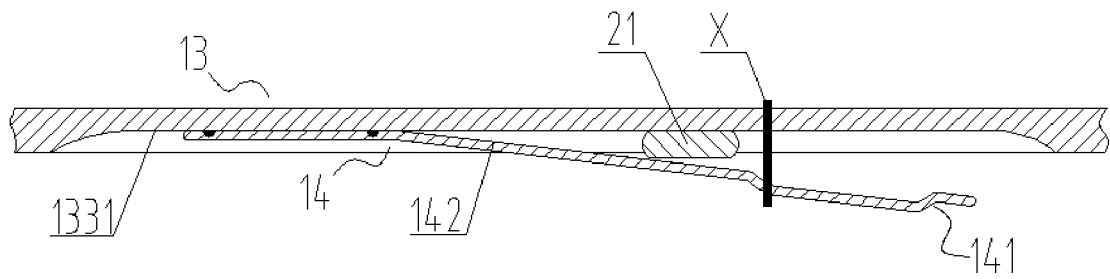


FIG. 27

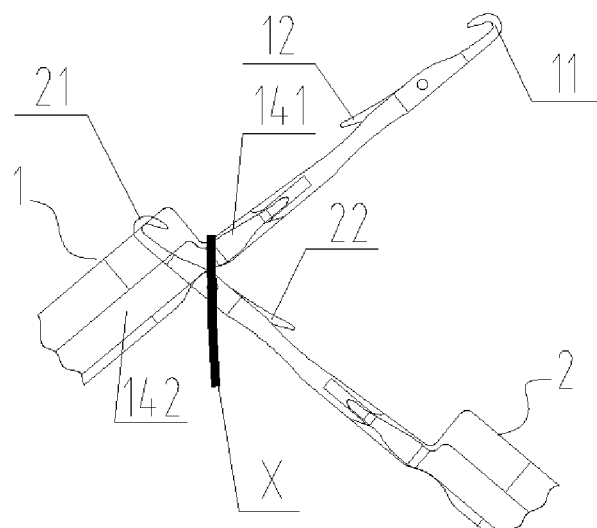


FIG. 28

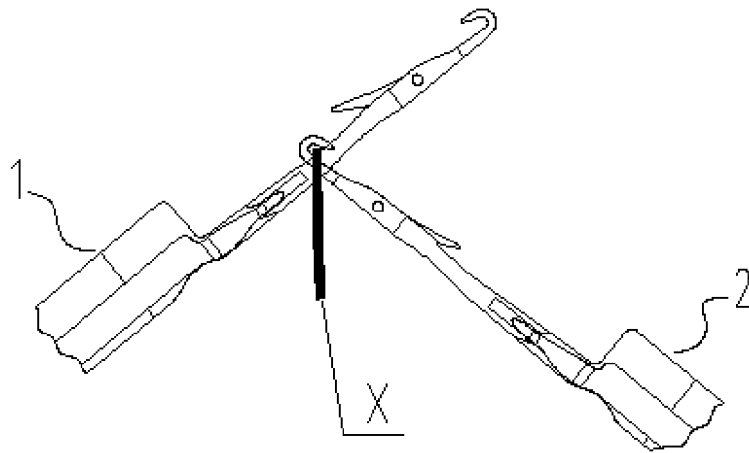


FIG. 29

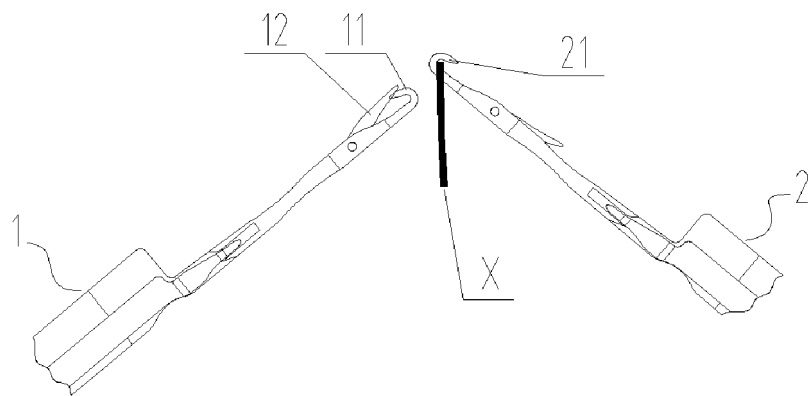


FIG. 30

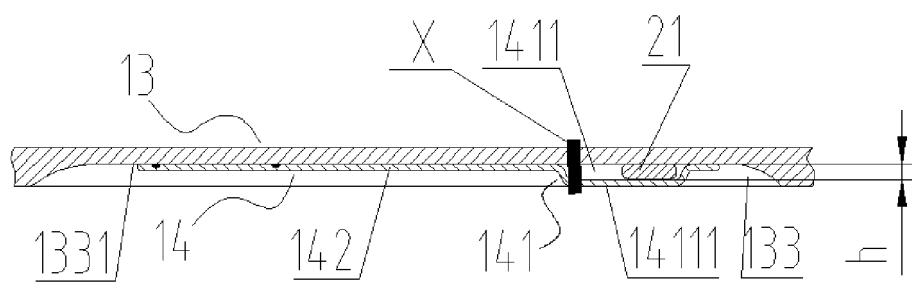


FIG. 31

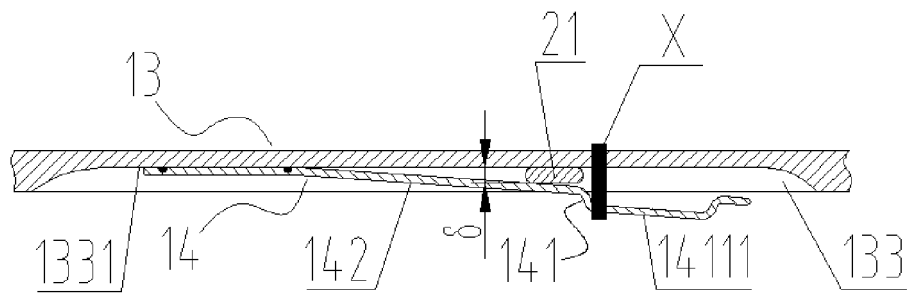


FIG. 32

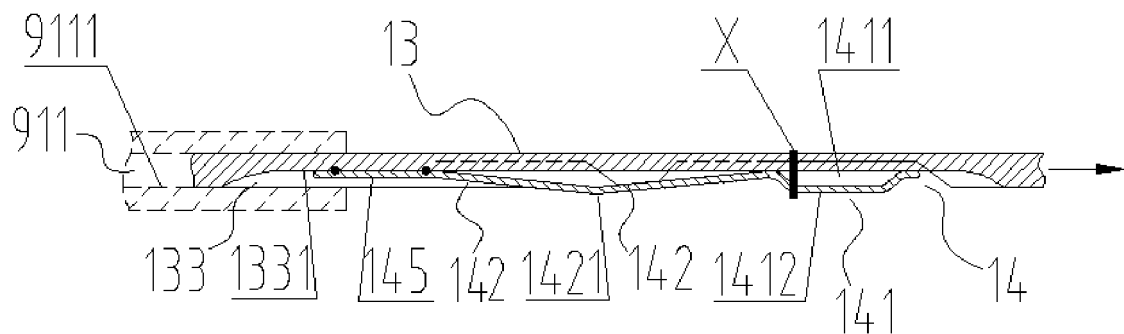


FIG. 33

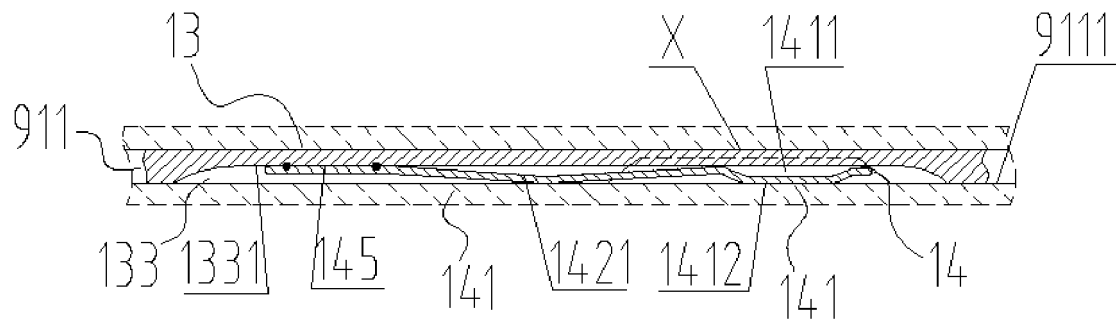


FIG. 34

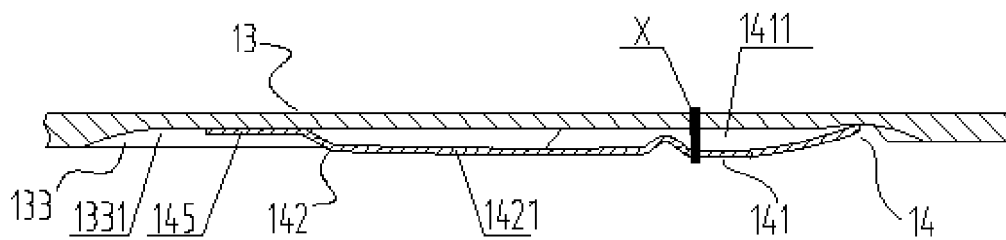


FIG. 35

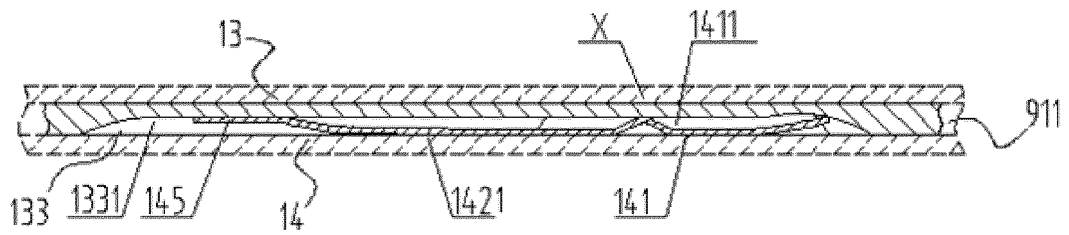


FIG. 36

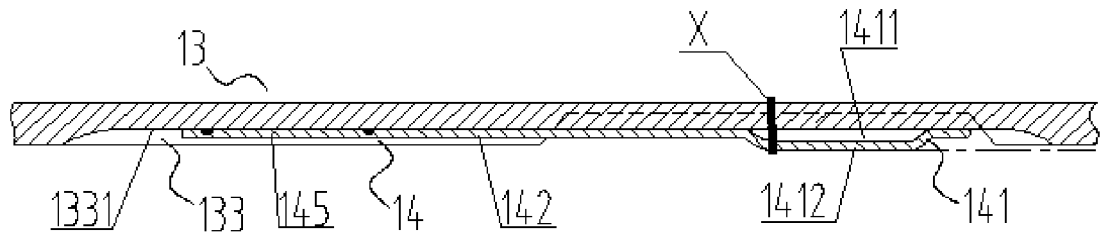


FIG. 37

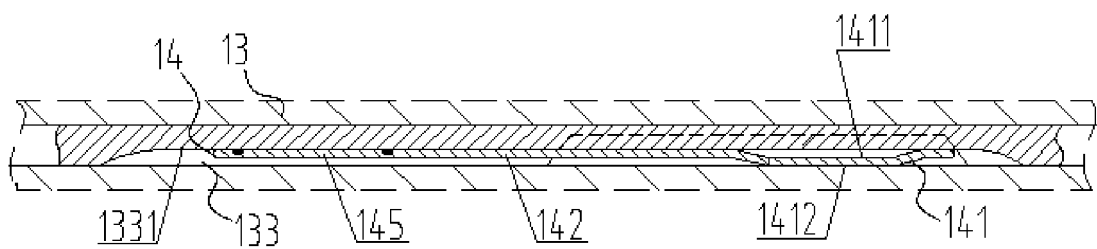


FIG. 38

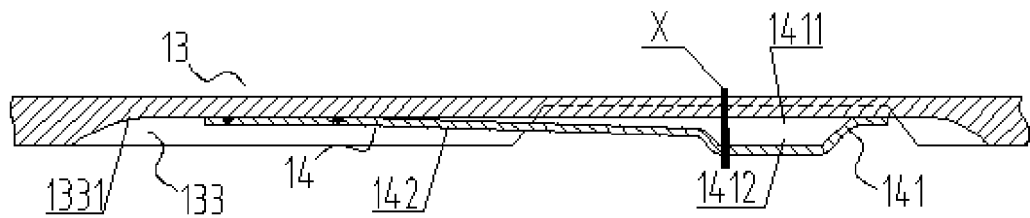


FIG. 39

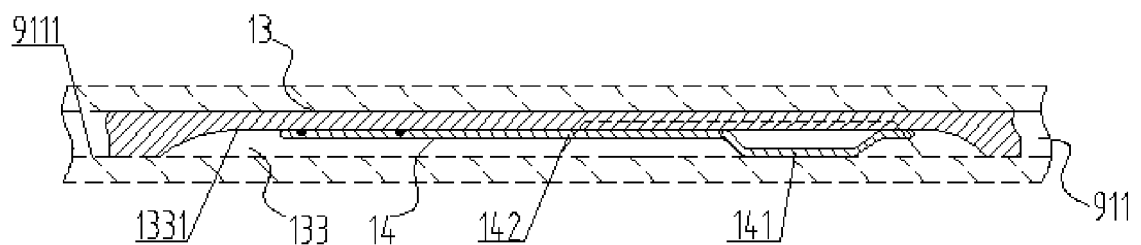


FIG. 40

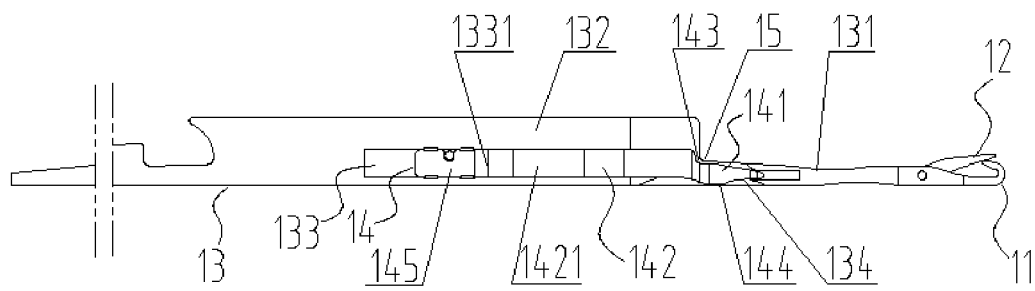


FIG. 41

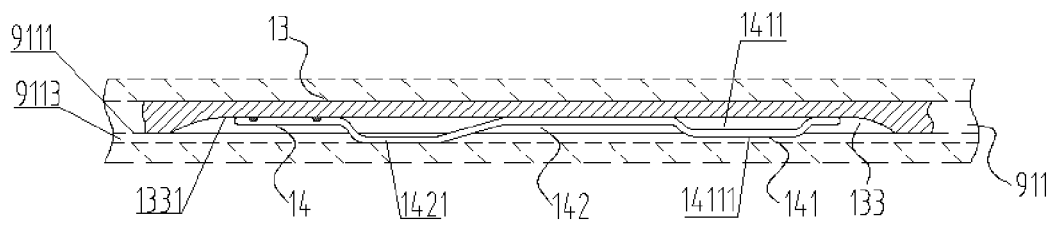


FIG. 42

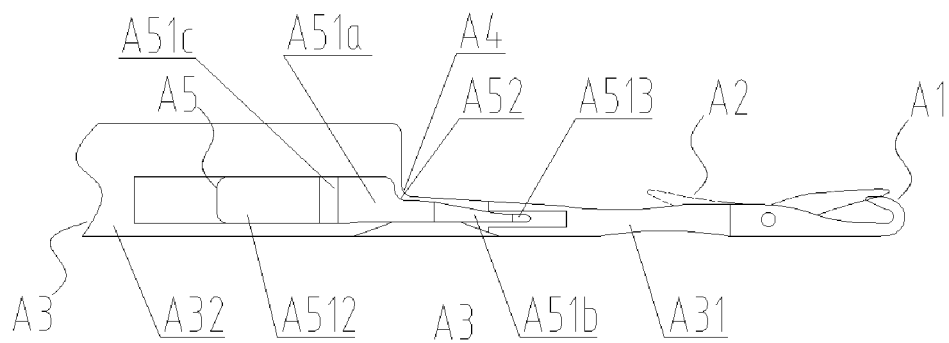


FIG. 43

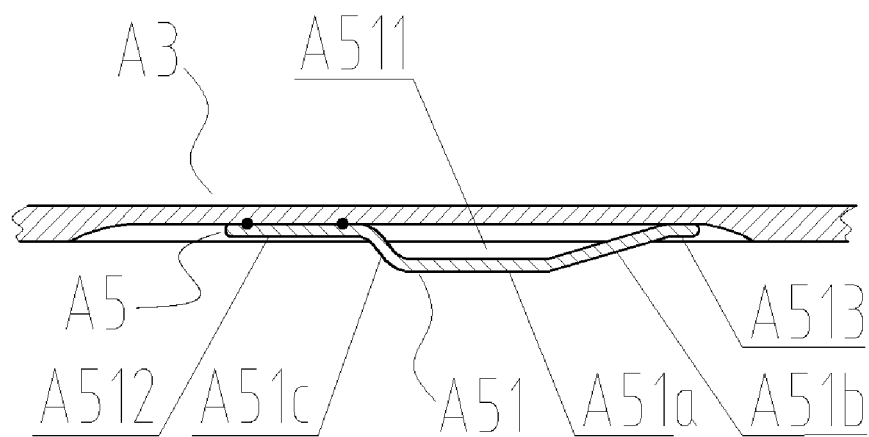


FIG. 44

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/141550

A. CLASSIFICATION OF SUBJECT MATTER D04B 7/04(2006.01)i; D04B 35/04(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC																								
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) D04B Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNPAT, WPI, EPODOC, CNKI: 冯加林, 横机, 横编, 凹槽, 扩圈, 移圈, flat-bed, flat w bed, transfer+, loop, stitch, needle, expand+, recess, groove																								
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>PX</td> <td>CN 111286863 A (FENG, Jialin et al.) 16 June 2020 (2020-06-16) description, "specific embodiments", and figures 1-36</td> <td>1-9</td> </tr> <tr> <td>PX</td> <td>CN 111793885 A (FENG, Jialin et al.) 20 October 2020 (2020-10-20) description, "specific embodiments", and figures 1-40</td> <td>1-9</td> </tr> <tr> <td>X</td> <td>CN 107354575 A (NANTONG GUANGYANG KNITTING NEEDLE CO., LTD.) 17 November 2017 (2017-11-17) description, paragraphs [0002]-[0015], and figures 1-2</td> <td>1-9</td> </tr> <tr> <td>X</td> <td>CN 207295091 U (NANTONG GUANGYANG KNITTING NEEDLE CO., LTD.) 01 May 2018 (2018-05-01) description, paragraphs [0002]-[0017], and figures 1-2</td> <td>1-9</td> </tr> <tr> <td>A</td> <td>CN 1470697 A (GROZ BECKERT KG) 28 January 2004 (2004-01-28) entire document</td> <td>1-9</td> </tr> <tr> <td>A</td> <td>CN 208414780 U (CHEN, Yiming) 22 January 2019 (2019-01-22) entire document</td> <td>1-9</td> </tr> <tr> <td>A</td> <td>GB 478969 A (M.B.C. VENDORS LTD. et al.) 27 January 1938 (1938-01-27) entire document</td> <td>1-9</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	PX	CN 111286863 A (FENG, Jialin et al.) 16 June 2020 (2020-06-16) description, "specific embodiments", and figures 1-36	1-9	PX	CN 111793885 A (FENG, Jialin et al.) 20 October 2020 (2020-10-20) description, "specific embodiments", and figures 1-40	1-9	X	CN 107354575 A (NANTONG GUANGYANG KNITTING NEEDLE CO., LTD.) 17 November 2017 (2017-11-17) description, paragraphs [0002]-[0015], and figures 1-2	1-9	X	CN 207295091 U (NANTONG GUANGYANG KNITTING NEEDLE CO., LTD.) 01 May 2018 (2018-05-01) description, paragraphs [0002]-[0017], and figures 1-2	1-9	A	CN 1470697 A (GROZ BECKERT KG) 28 January 2004 (2004-01-28) entire document	1-9	A	CN 208414780 U (CHEN, Yiming) 22 January 2019 (2019-01-22) entire document	1-9	A	GB 478969 A (M.B.C. VENDORS LTD. et al.) 27 January 1938 (1938-01-27) entire document	1-9
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																						
PX	CN 111286863 A (FENG, Jialin et al.) 16 June 2020 (2020-06-16) description, "specific embodiments", and figures 1-36	1-9																						
PX	CN 111793885 A (FENG, Jialin et al.) 20 October 2020 (2020-10-20) description, "specific embodiments", and figures 1-40	1-9																						
X	CN 107354575 A (NANTONG GUANGYANG KNITTING NEEDLE CO., LTD.) 17 November 2017 (2017-11-17) description, paragraphs [0002]-[0015], and figures 1-2	1-9																						
X	CN 207295091 U (NANTONG GUANGYANG KNITTING NEEDLE CO., LTD.) 01 May 2018 (2018-05-01) description, paragraphs [0002]-[0017], and figures 1-2	1-9																						
A	CN 1470697 A (GROZ BECKERT KG) 28 January 2004 (2004-01-28) entire document	1-9																						
A	CN 208414780 U (CHEN, Yiming) 22 January 2019 (2019-01-22) entire document	1-9																						
A	GB 478969 A (M.B.C. VENDORS LTD. et al.) 27 January 1938 (1938-01-27) entire document	1-9																						
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.																								
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>																								
Date of the actual completion of the international search 17 March 2021	Date of mailing of the international search report 30 March 2021																							
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																							

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2020/141550

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 111286863 A	16 June 2020	CN 111793885 A	20 October 2020
CN 111793885 A	20 October 2020	CN 111286863 A	16 June 2020
CN 107354575 A	17 November 2017	None	
CN 207295091 U	01 May 2018	None	
CN 1470697 A	28 January 2004	KR 100972521 B1	28 July 2010
		US 6807831 B2	26 October 2004
		DE 50307601 D1	16 August 2007
		KR 101014549 B1	16 February 2011
		EP 1375721 A1	02 January 2004
		JP 2004027472 A	29 January 2004
		JP 4108549 B2	25 June 2008
		KR 20100045429 A	03 May 2010
		DE 10227533 C1	11 December 2003
		KR 20030097698 A	31 December 2003
		EP 1375721 B1	04 July 2007
		CN 1304670 C	14 March 2007
		US 2003233853 A1	25 December 2003
CN 208414780 U	22 January 2019	None	
GB 478969 A	27 January 1938	None	

Form PCT/ISA/210 (patent family annex) (January 2015)