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# (54) KNITTING NEEDLE

STRICKNADEL

AIGUILLE À TRICOTER

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(73) Proprietors:
- **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)**

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## 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 A 1, 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. US2111476A discloses a stitch transfer mechanism for knitting machines. Particularly, it particularly discloses an improved dial needle for use upon rib knitting machines capable of transferring stitch loops from cylinder needles to dial needles, and vice versa. The primary object is the provision of an improved knitting machine needle, which may be either of the dial or cylinder type, having an improved stitch loop expanding eye and associated stitch loop extending shoulder thereon capable of expanding and extending a stitch loop so that it may be transferred to a complementary needle of another set of needles, without the use of transfer bits or other relatively movable parts. EP1627943A1 discloses a transfer needle with an element mounted for sliding movement in the longitudinal direction relative thereto.

## SUMMARY

**[0009]** In order to overcome the deficiencies of the prior art, an objective of the present invention is to provide a knitting needle. The present invention, as defined in claim 1, adopts the following technical solution.

**[0010]** The knitting needle is provided for 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 set on a bottom surface of the recess, 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 fixedly connected to the bottom surface of the recess by welding to form a fixed connecting end; and
a hook insertion slot, formed by an inner cavity between the protrusion and the bottom surface of the recess.

**[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 fixed 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 suitable to be located in a depression at a corresponding side of the needle groove.

**[0012]** During loop transfer, when a 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, and moves to a position between the deformation surface and the bottom surface of the recess, the deformation surface is configured to be elastically deformed to drive the protrusion to expand outward, such that 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]** Preferably, 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]** Preferably, 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]** Preferably, 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]** Preferably, the bottom 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]** Preferably, 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]** Preferably, the front end of the hook 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]** Preferably, the deformation surface and the protrusion correspond to positions of a front portion of the shank and a back portion of the stem, respectively. The front portion 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]** Preferably, 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.

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

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

## 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. The front portion 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, the bottom of the flat spring is not raised and is in a flat state, higher than the bottom of the shaft. A back portion of the flat spring is connected to a bottom surface 1331 of the recess 133 by 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 21 of the knitting needle 2, as shown in FIG. 11. The hook 21 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). The bottom 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 bottom 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 21 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 bottom 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 portion 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 21 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 Embodiments 3 and 5, 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 $\delta$ 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 top 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 bottom 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 bottom 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 inserted 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 22 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 141 connected to the front portion 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 bottom 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 portion 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 recess on 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.

**Claims**

**1.** A knitting needle (1), provided for a needle groove (911) of a front or back needle bed (91) of a flatbed knitting machine, and cooperative with another knitting needle (2) in a corresponding needle groove (921) of a back or front needle bed (92), wherein the knitting needle (1) comprises:

a hook (11);
a latch (12), provided at a back side of the hook (11), and rotatable to close the hook (11);
a shaft (13), comprising a stem (131) and a shank (132) arranged in sequence in a back portion of the hook (11), the shank (132) being wider than the stem (131);
a recessed first transfer portion (15), formed at a joint of the stem (131) and the shank (132);
a recess (133), provided in one side of the shaft (13);
a flat spring (14) set on a bottom surface (1331) of the recess (133), having a front portion bent outward in a length direction of the shaft (13) to form a protrusion (141) and a back portion fixedly connected to the bottom surface (1331) of

the recess (133) by welding to form a fixed connecting end (145); and
a hook insertion slot (1411), formed by an inner cavity between the protrusion (141) and the bottom surface (1331) of the recess (133);
**characterized in that**:

the flat spring (14) is provided with a recessed second transfer portion (143);
the flat spring (14) is further provided with a deformation surface (142) located between a back side of the protrusion (141) and a front side of the fixed connecting end (145);
the 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), wherein the portion exposed outside the recess (133) is elastically pressed into the recess (133) by the needle groove (911) or is suitable to be located in a depression at a corresponding side of the needle groove (911); and
during loop transfer, when a hook (21) of another knitting needle (2) in the corresponding needle groove (921) is inserted into a position between the flat spring (14) and the shaft (13) through the hook insertion slot (1411), and moves to a position between the deformation surface (142) and the bottom surface (1331) of the recess (133), the deformation surface (142) is configured to be elastically deformed to drive the protrusion (141) to expand outward, such that a loop hung on the recessed first transfer portion (15) and the recessed second transfer portion (143) is stretched.

2. The knitting needle (1) according to claim 1, **characterized in that** the deformation surface (142) is a bending surface, wherein the bending surface is bent outward.

3. The knitting needle (1) according to claim 1, **characterized in that** the deformation surface (142) is a flat surface.

4. The knitting needle (1) according to any one of claims 2 to 3, **characterized in that** a slot depth (h) formed between a top end surface (14111) and a bottom end surface of the hook insertion slot (1411) is smaller than a thickness of the hook (11); and a lower end of the hook insertion slot (1411) is provided with a needle groove guide portion for easy insertion of the hook (11), and/or a front end of the hook (11) is provided with a hook guide portion for easy insertion into the hook insertion slot (1411).

5. The knitting needle (1) according to claim 4, **characterized in that** a lower end of the flat spring (14) protrudes downward at a position corresponding to a front side of the recessed second transfer portion (143) to form a latch opening portion (144) for opening the latch of the knitting needle entering the hook insertion slot (1411).

6. The knitting needle (1) according to claim 5, **characterized in that** the needle groove guide portion is an inclined surface (14113), wherein the inclined surface (14113) is provided on the bottom surface (1331) of the recess (133), located at the lower end of the hook insertion slot (1411), and inclined backward, such that a lower end opening of the hook insertion slot (1411) is shaped as a bell mouth for easy insertion of the hook (11).

7. The knitting needle (1) according to claim 5, **characterized in that** the front end of the knitting needle (1) 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 (h).

8. The knitting needle (1) according to claim 7, **characterized in that** the deformation surface (142) and the protrusion (141) correspond to positions of a front portion of the shank (132) and a back portion of the stem (131), respectively; and a front side of the deformation surface (142) protrudes upward from the back side of the protrusion (141) in a width direction, such that the recessed second transfer portion (143) is located at a joint of the deformation surface (142) and the protrusion (141).

9. The knitting needle (1) according to claim 8, **characterized in that** the deformation surface (142) is longer than the protrusion (141).

**Patentansprüche**

1. Eine Stricknadel (1), die für eine Nadelrinne (911) eines vorderen oder hinteren Nadelbetts (91) einer Flachstrickmaschine vorgesehen ist und mit einer anderen Stricknadel (2) in einer entsprechenden Nadelrinne (921) eines hinteren oder vorderen Nadelbetts (92) zusammenwirkt, wobei die Stricknadel (1) umfasst:

einen Haken (11);
eine Zunge (12), die an einer Rückseite des Hakens (11) vorgesehen ist und drehbar ist, um den Haken (11) zu schließen;
einen Schaft (13), der einen Schenkel (131) und einen Hals (132) umfasst, die in einem hinteren Abschnitt des Hakens (11) aufeinanderfolgend

angeordnet sind, wobei der Hals (132) breiter ist als der Schenkel (131);
ein eingesenkter erster Übertragungsabschnitt (15), der an einer Verbindung des Schenkels (131) und des Halses (132) gebildet ist;
eine Aussparung (133), die in einer Seite des Schafts (13) vorgesehen ist;
eine Flachfeder (14), die auf einer Bodenfläche (1331) der Aussparung (133) angeordnet ist und einen vorderen Abschnitt, der in Längsrichtung des Schafts (13) nach außen gebogen ist, um einen Vorsprung (141) auszubilden, und einen hinteren Abschnitt auszubilden, der durch Schweißen fest mit der Bodenfläche (1331) der Aussparung (133) verbunden ist, um ein befestigtes Endstück (145) auszubilden; und
einen Hakeneinführschlitz (1411), der durch einen inneren Hohlraum zwischen dem Vorsprung (141) und der Bodenfläche (1331) der Aussparung (133) ausgebildet wird;
**dadurch gekennzeichnet, dass**:

die Flachfeder (14) mit einem vertieften zweiten Übertragungsabschnitt (143) versehen ist;
die Flachfeder (14) ist ferner mit einer Verformungsfläche (142) versehen, die sich zwischen einer Rückseite des Vorsprungs (141) und einer Vorderseite des befestigten Endstücks (145) befindet; die Verformungsfläche (142) und der Vorsprung (141) liegen außerhalb der Aussparung (133) nicht frei, oder die Verformungsfläche (142) und der Vorsprung (141) weisen einen außerhalb der Aussparung (133) freiliegenden Abschnitt auf, wobei der außerhalb der Aussparung (133) freiliegende Abschnitt durch die Nadelrinne (911) elastisch in die Aussparung (133) gedrückt wird oder sich in einer Vertiefung an einer entsprechenden Seite der Nadelrinne (911) befindet; und
während des Maschenübergangs, wenn ein Haken (21) einer anderen Stricknadel (2) in der entsprechenden Nadelrinne (921) durch den Hakeneinführschlitz (1411) in eine Position zwischen der Flachfeder (14) und dem Schaft (13) eingeführt wird und sich in eine Position zwischen der Verformungsfläche (142) und der Bodenfläche (1331) der Aussparung (133) bewegt, wobei die Verformungsfläche (142) so konfiguriert ist, dass sie elastisch verformt wird, um den Vorsprung (141) zum Ausdehnen nach außen anzutreiben, so dass eine Schlaufe, die an dem eingesenkten ersten Übertragungsabschnitt (15) und an dem eingesenkten zweiten Übertragungsabschnitt (143) hängt, gedehnt wird.

**2.** Stricknadel (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verformungsfläche (142) eine Biegefläche ist, wobei die Biegefläche nach außen gebogen ist.

**3.** Stricknadel (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verformungsfläche (142) eine flache Oberfläche ist.

**4.** Stricknadel (1) nach einem der Ansprüche 2 bis 3, **dadurch gekennzeichnet, dass** eine Schlitztiefe (h), die zwischen einer oberen Endfläche (14111) und einer unteren Endfläche des Hakeneinführschlitzes (1411) ausgebildet ist, kleiner ist als eine Dicke des Hakens (11 ; und ein unteres Ende des Hakeneinführschlitzes (1411) mit einem Nadelrinnen-Führungsabschnitt für das einfache Einführen des Hakens (11) versehen ist und/oder ein vorderes Ende des Hakens (11) mit einem Hakenführungsabschnitt für das einfache Einführen in den Hakeneinführschlitz (1411) versehen ist.

**5.** Stricknadel (1) nach Anspruch 4, **dadurch gekennzeichnet, dass** ein unteres Ende der Flachfeder (14) an einer Position, die einer Vorderseite des eingesenkt angeordneten zweiten Übertragungsabschnitts (143) entspricht, nach unten hervorsteht, um einen Zungenöffnungsabschnitt (144), der das Öffnen der Zunge der in den Hakeneinführschlitz (1411) eintretenden Stricknadel ermöglicht.

**6.** Stricknadel (1) nach Anspruch 5, **dadurch gekennzeichnet, dass** der Nadelrinnen-Führungsabschnitt eine geneigte Oberfläche (14113) ist, wobei die geneigte Oberfläche (14113) auf der Bodenfläche (1331) der Aussparung (133) vorgesehen ist, die sich am unteren Ende des Hakeneinführschlitzes (1411) befindet, und nach hinten geneigt ist, so dass eine Öffnung am unteren Ende des Hakeneinführschlitzes (1411) als glockenförmige Öffnung ausgebildet ist, um das Einführen des Hakens (11) zu erleichtern.

**7.** Stricknadel (1) nach Anspruch 5, **dadurch gekennzeichnet, dass** das vordere Ende der Stricknadel (1) in Dickenrichtung als Bogen oder Trapez geformt ist, das sich allmählich von schmal nach breit verbreitert, wobei der schmalste vordere Abschnitt schmaler als die Schlitztiefe (h) ist.

**8.** Stricknadel (1) nach Anspruch 7, **dadurch gekennzeichnet, dass** die Verformungsfläche (142) und der Vorsprung (141) den Positionen eines vorderen Abschnitts des Halses (132) bzw. eines hinteren Abschnitts des Schenkels (131) entsprechen; und eine Vorderseite der Verformungsfläche (142) von der Rückseite des Vorsprungs (141) in einer Breitenrichtung nach oben hervorsteht, so dass sich der

eingesenkte zweite Übertragungsabschnitt (143) an der Verbindungsstelle der Verformungsfläche (142) und des Vorsprungs (141) befindet.

**9.** Stricknadel (1) nach Anspruch 8, **dadurch gekennzeichnet, dass** die Verformungsfläche (142) länger ist als der Vorsprung (141).

**Revendications**

**1.** Aiguille à tricoter (1), prévue dans une rainure d'aiguille (911) d'une fonture avant ou arrière (91) d'une machine à tricoter à plat, et coopérant avec une autre aiguille à tricoter (2) dans une rainure d'aiguille (921) correspondante d'une fonture arrière ou avant (92), dans laquelle l'aiguille à tricoter (1) comprend :

un crochet (11) ;
un clapet (12), prévu sur un côté arrière du crochet (11), et pouvant tourner pour fermer le crochet (11) ;
un arbre (13), comprenant une tige (131) et un fut (132) disposés en séquence dans une partie arrière du crochet (11), le fut (132) étant plus large que la tige (131) ;
une première partie de transfert évidée (15), formée au niveau d'un jonction de la tige (131) et du fut (132) ;
un évidement (133), prévu d'un côté de l'arbre (13) ;
un ressort plat (14) disposé sur une surface inférieure (1331) de l'évidement (133), ayant une partie avant courbée vers l'extérieur dans une direction de longueur de l'arbre (13) pour former une saillie (141) et une partie arrière reliée de manière fixe à la surface inférieure (1331) de l'évidement (133) par soudage pour former une extrémité de liaison fixe (145) ; et
une fente d'insertion de crochet (1411), formée par une cavité interne entre la saillie (141) et la surface inférieure (1331) de l'évidement (133) ;
**caractérisée en ce que** :

le ressort plat (14) est pourvu d'une deuxième partie de transfert évidée (143) ;
le ressort plat (14) est en outre pourvu d'une surface de déformation (142) située entre un côté arrière de la saillie (141) et un côté avant de l'extrémité de liaison fixe (145) ; la surface de déformation (142) et la saillie (141) ne sont pas exposées à l'extérieur de l'évidement (133), ou la surface de déformation (142) et la saillie (141) ont une partie exposée à l'extérieur de l'évidement (133), dans laquelle la partie exposée à l'extérieur de l'évidement (133) est pressée élastiquement dans l'évidement (133) par la rainure d'aiguille (911) ou est susceptible d'être située dans une dépression au niveau d'un côté correspondant de la rainure d'aiguille (911) ; et
pendant le transfert de boucle, lorsque le crochet (21) d'une autre aiguille à tricoter (2) dans la rainure d'aiguille (921) correspondante est inséré dans une position entre le ressort plat (14) et l'arbre (13) à travers la fente d'insertion de crochet (1411), et se déplace vers une position entre la surface de déformation (142) et la surface inférieure (1331) de l'évidement (133), la surface de déformation (142) est configurée pour se déformer élastiquement pour entraîner la saillie (141) à se dilater vers l'extérieur, de telle sorte qu'une boucle suspendue sur la première partie de transfert évidée (15) et la deuxième partie de transfert évidée (143) est étirée.

**2.** Aiguille à tricoter (1) selon la revendication 1, **caractérisée en ce que** la surface de déformation (142) est une surface de flexion, dans laquelle la surface de flexion est courbée vers l'extérieur.

**3.** Aiguille à tricoter (1) selon la revendication 1, **caractérisée en ce que** la surface de déformation (142) est une surface plate.

**4.** Aiguille à tricoter (1) selon l'une quelconque des revendications 2 à 3, **caractérisée en ce que** une profondeur de fente (h) formée entre une surface d'extrémité supérieure (14111) et une surface d'extrémité inférieure de la fente d'insertion de crochet (1411) est inférieure à une épaisseur du crochet (11) ; et une extrémité inférieure de la fente d'insertion de crochet (1411) est pourvue d'une partie de guidage de rainure d'aiguille pour une insertion facile du crochet (11), et/ou une extrémité avant du crochet (11) est pourvue d'une partie de guidage de crochet pour une insertion facile dans la fente d'insertion de crochet (1411).

**5.** Aiguille à tricoter (1) selon la revendication 4, **caractérisée en ce qu'**une extrémité inférieure du ressort plat (14) fait saillie vers le bas à une position correspondant à un côté avant de la deuxième partie de transfert évidée (143) pour former une partie d'ouverture de clapet (144) pour ouvrir le clapet de l'aiguille à tricoter entrant dans la fente d'insertion de crochet (1411).

**6.** Aiguille à tricoter (1) selon la revendication 5, **caractérisée en ce que** la partie de guidage de rainure d'aiguille est une surface inclinée (14113), dans laquelle la surface inclinée (14113) est prévue sur la surface inférieure (1331) de l'évidement (133),

située à l'extrémité inférieure de la fente d'insertion de crochet (1411), et inclinée vers l'arrière, de telle sorte qu'une ouverture d'extrémité inférieure de la fente d'insertion de crochet (1411) est sous la forme d'un évasement pour une insertion facile du crochet (11).

**7.** Aiguille à tricoter (1) selon la revendication 5, **caractérisée en ce que** l'extrémité avant de l'aiguille à tricoter (1) dans une direction d'épaisseur est sous la forme d'un arc ou d'un trapèze qui est s'élargit graduellement d'étroit à large, avec une partie avant la plus étroite plus étroite que la profondeur de fente (h).

**8.** Aiguille à tricoter (1) selon la revendication 7, **caractérisée en ce que** la surface de déformation (142) et la saillie (141) correspondent à des positions d'une partie avant du fut (132) et d'une partie arrière de la tige (131), respectivement ; et un côté avant de la surface de déformation (142) fait saillie vers le haut depuis le côté arrière de la saillie (141) dans une direction de largeur, de telle sorte que la deuxième partie de transfert (143) est située au niveau d'une jonction de la surface de déformation (142) et de la saillie (141).

**9.** Aiguille à tricoter (1) selon la revendication 8, **caractérisée en ce que** la surface de déformation (142) est plus longue que la saillie (141).

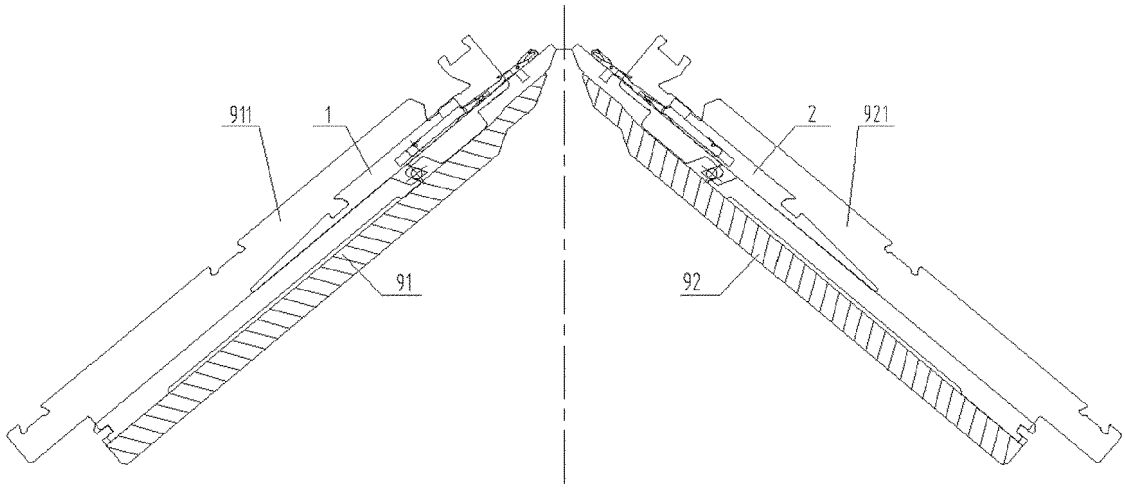


FIG. 1

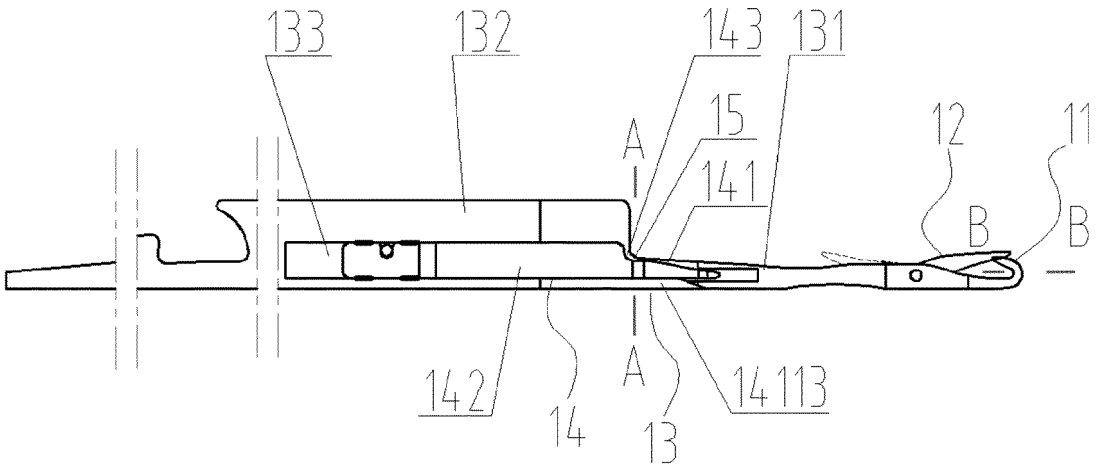


FIG. 2

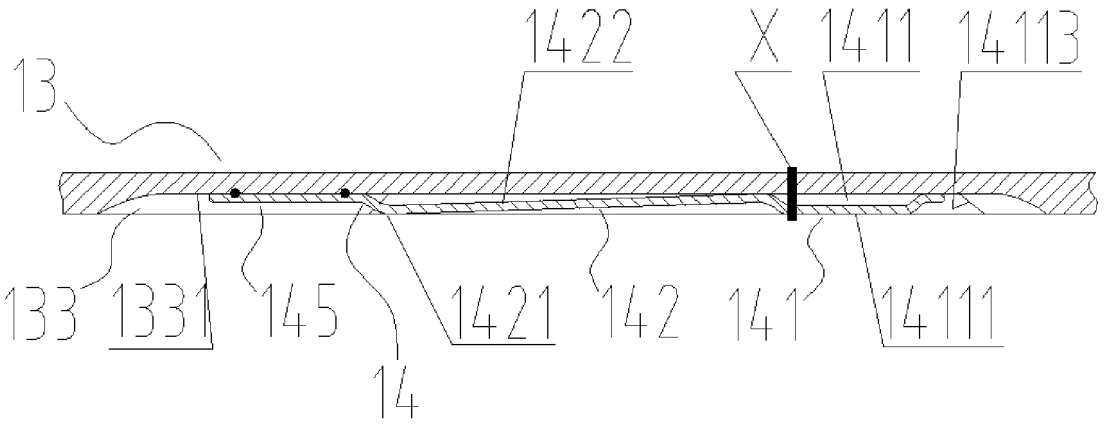


FIG. 3

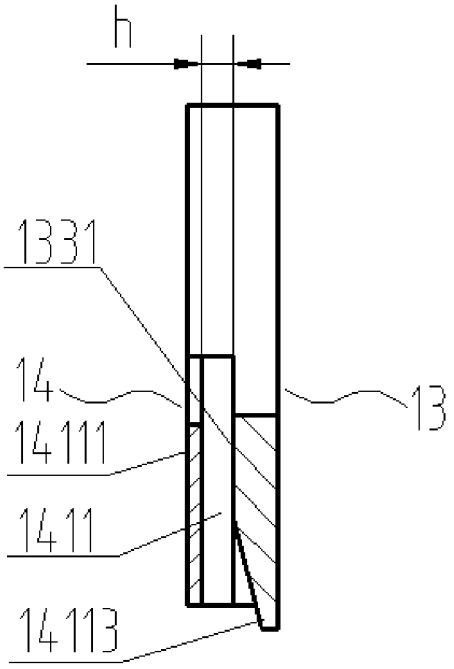


FIG. 4

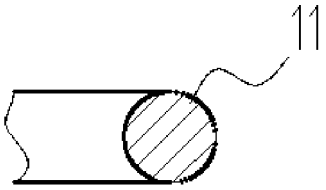


FIG. 5

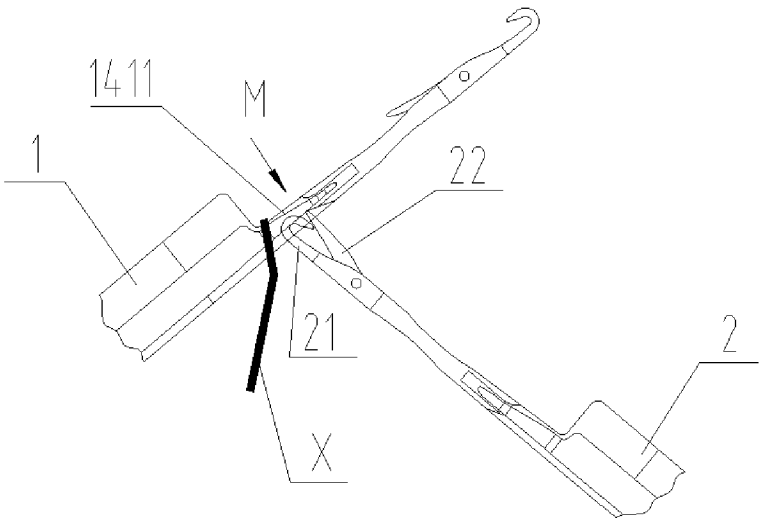


FIG. 6

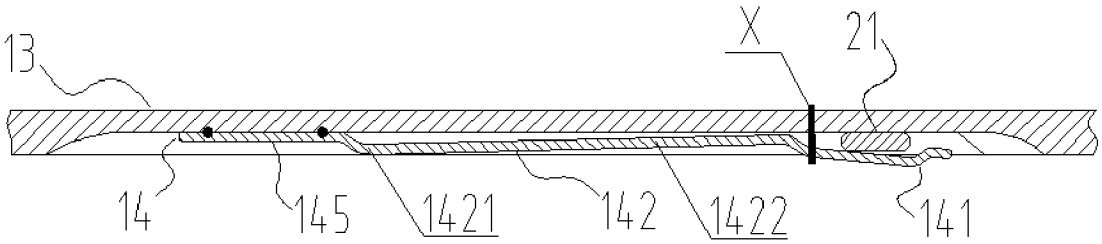


FIG. 7

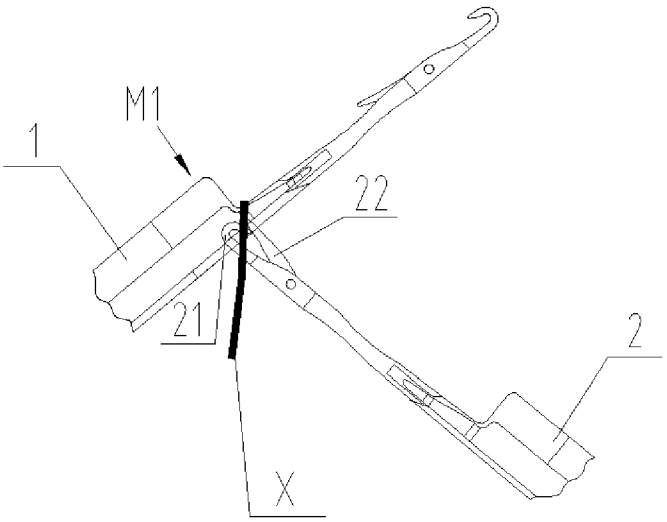


FIG. 8

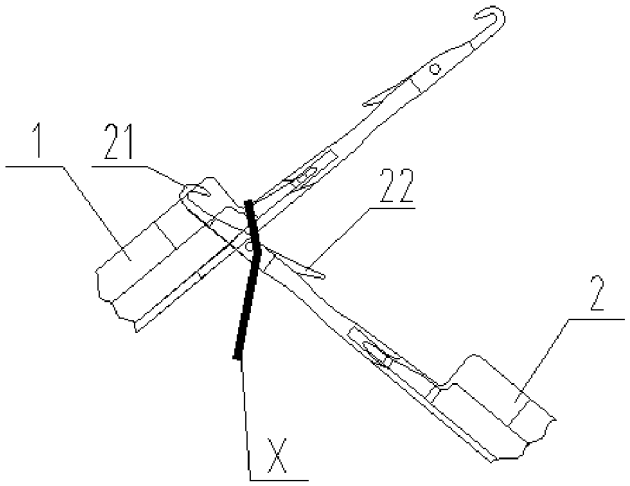


FIG. 9

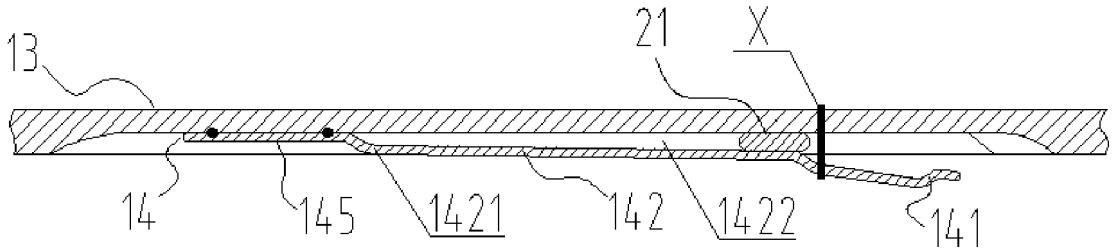


FIG. 10

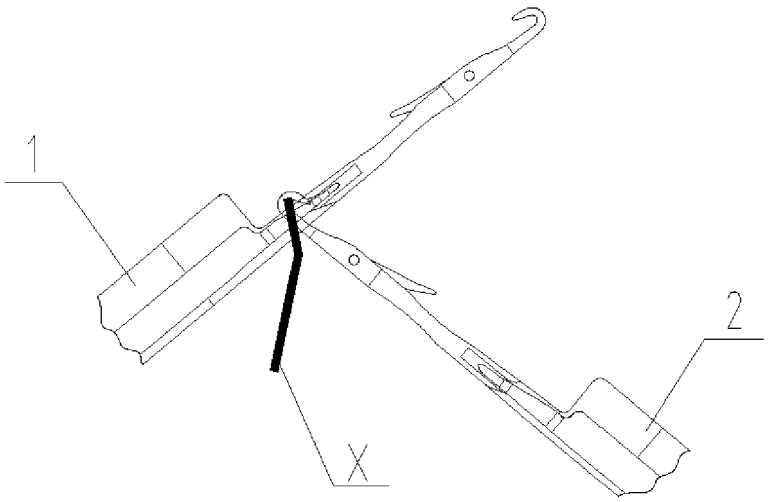


FIG. 11

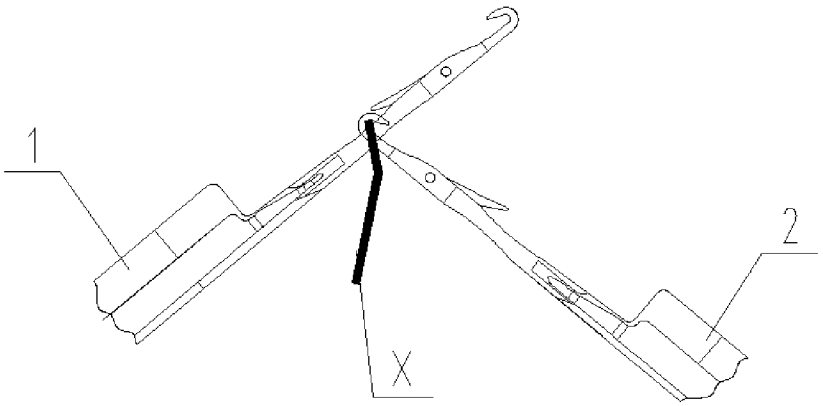


FIG. 12

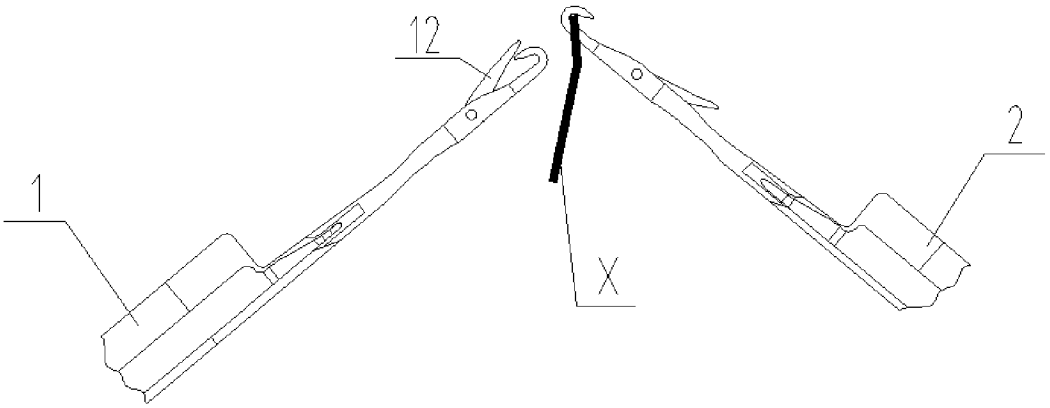


FIG. 13

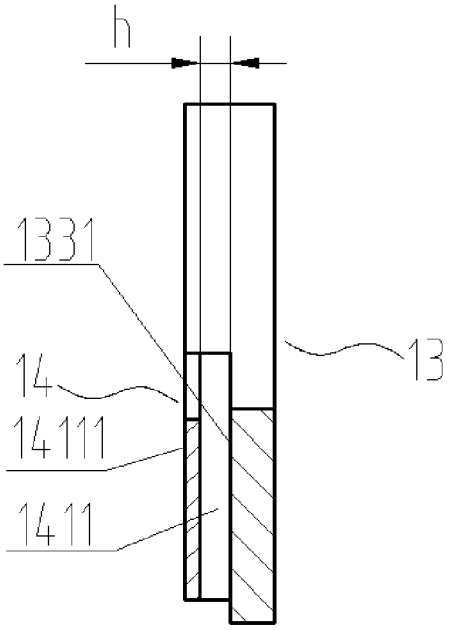


FIG. 14

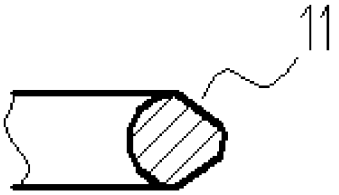


FIG. 15

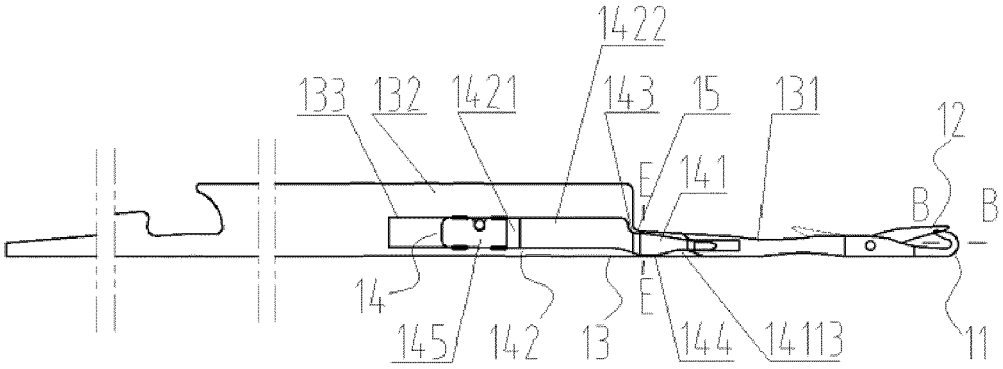


FIG. 16

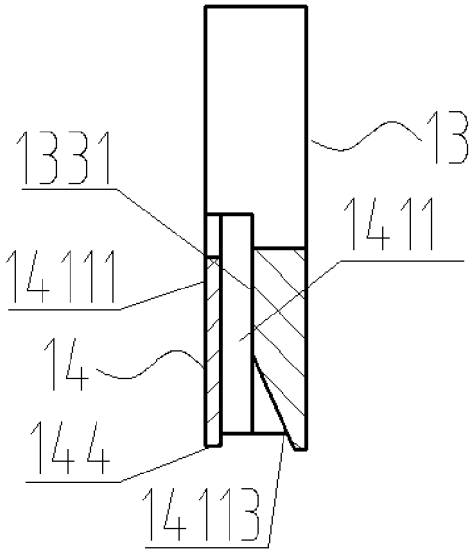


FIG. 17

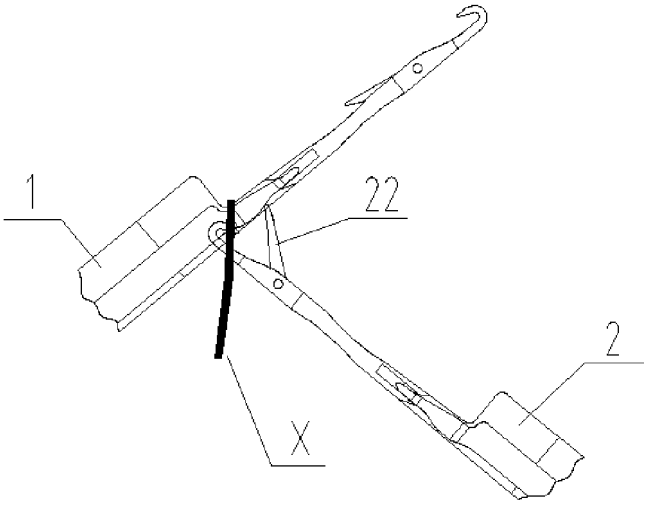


FIG. 18

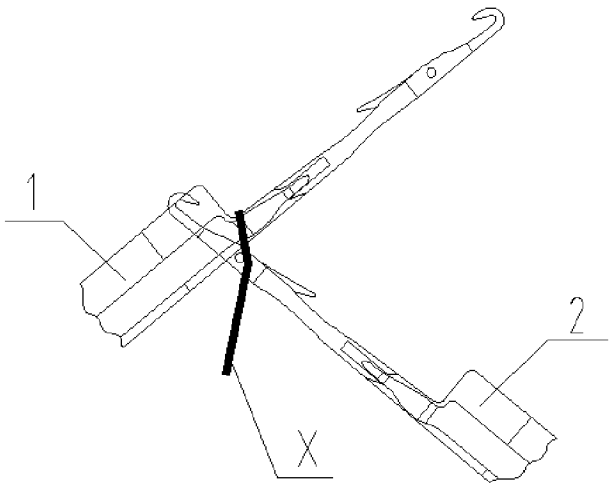


FIG. 19

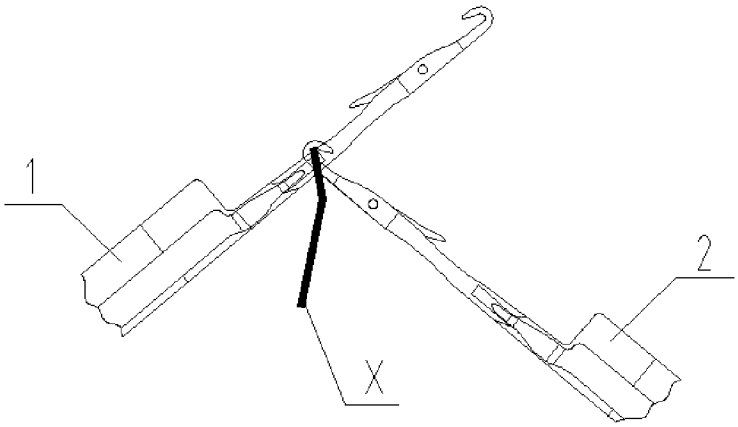


FIG. 20

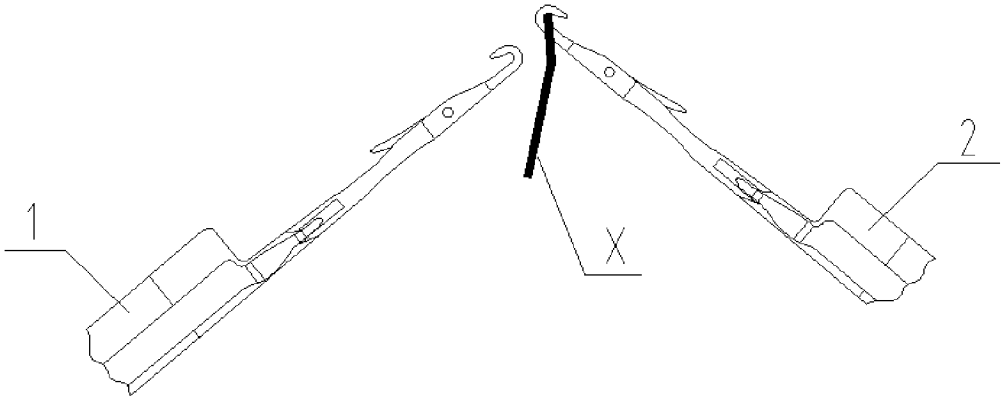


FIG. 21

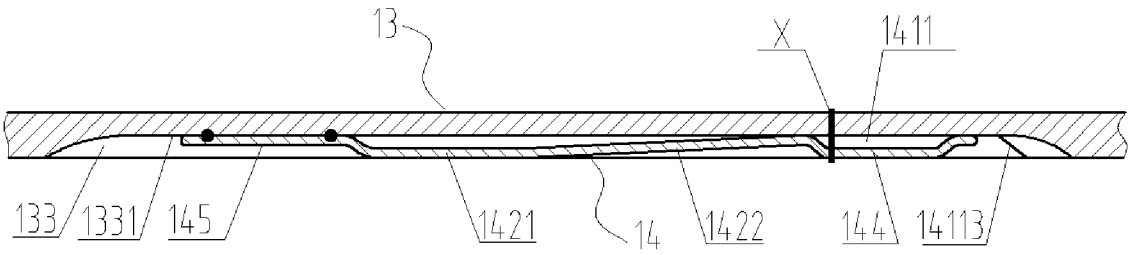


FIG. 22

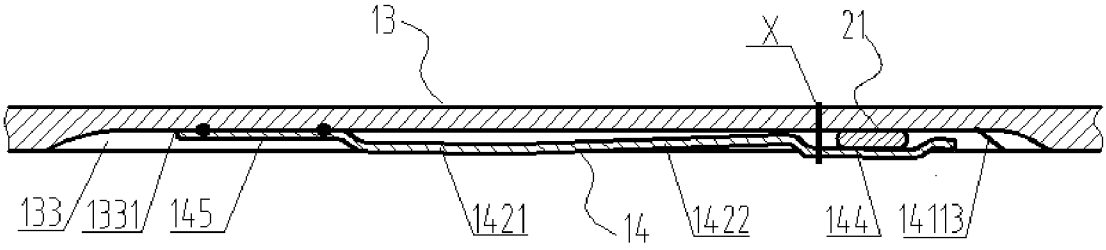


FIG. 23

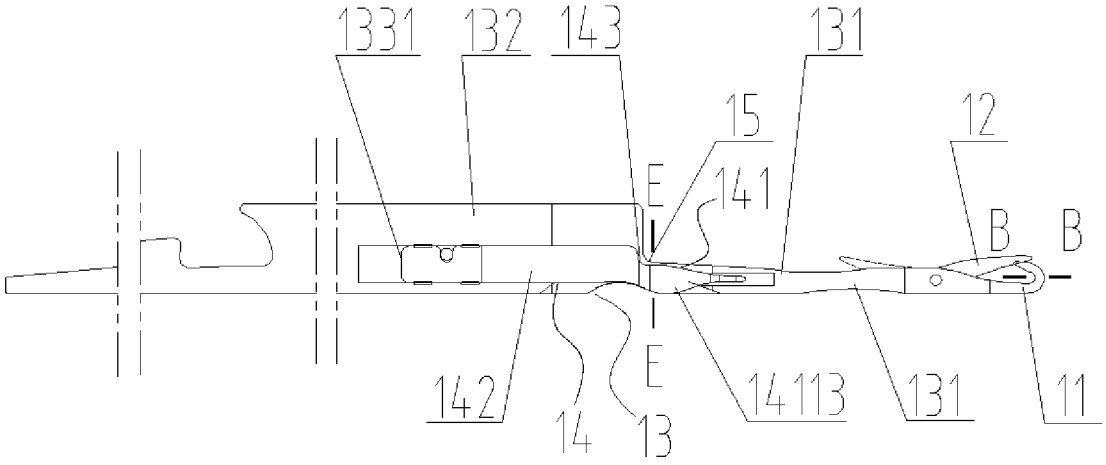


FIG. 24

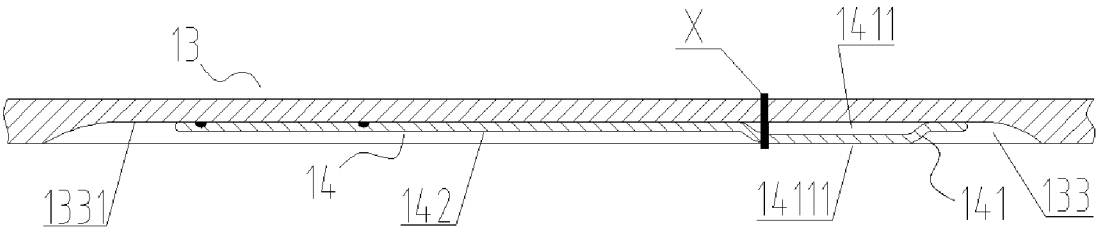


FIG. 25

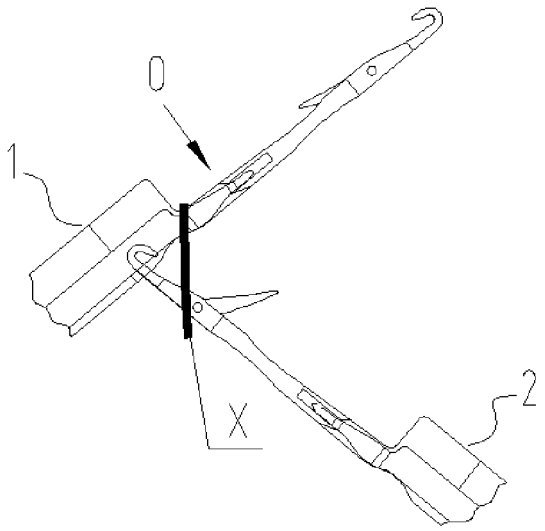


FIG. 26

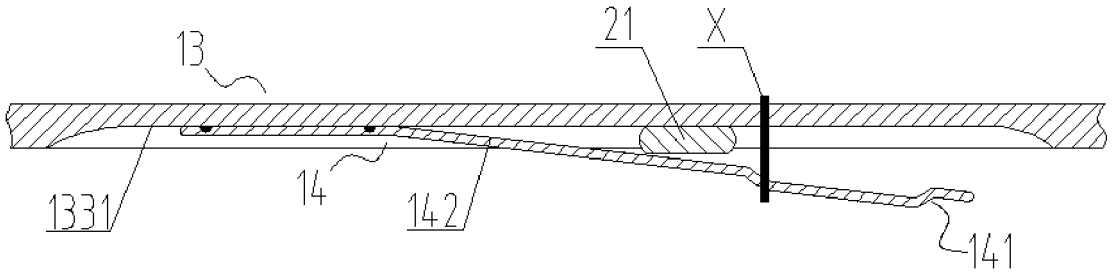


FIG. 27

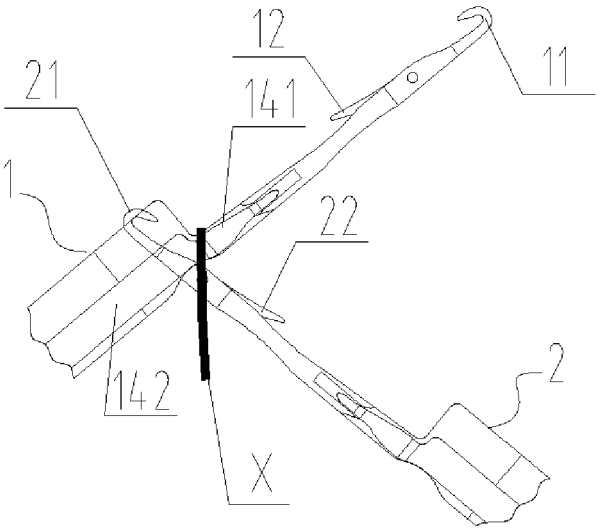


FIG. 28

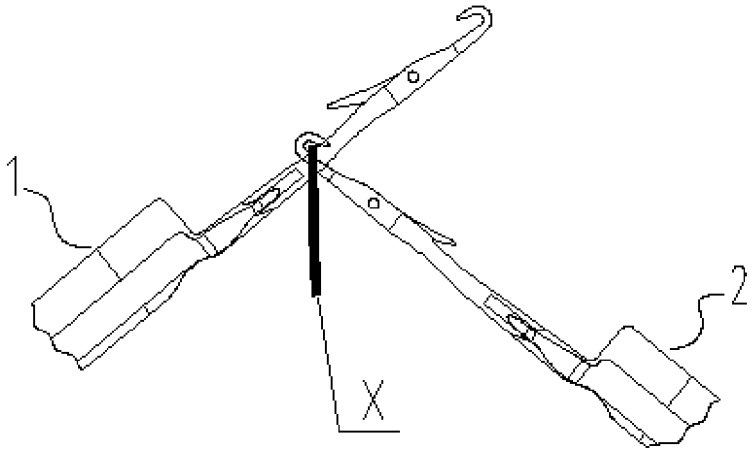


FIG. 29

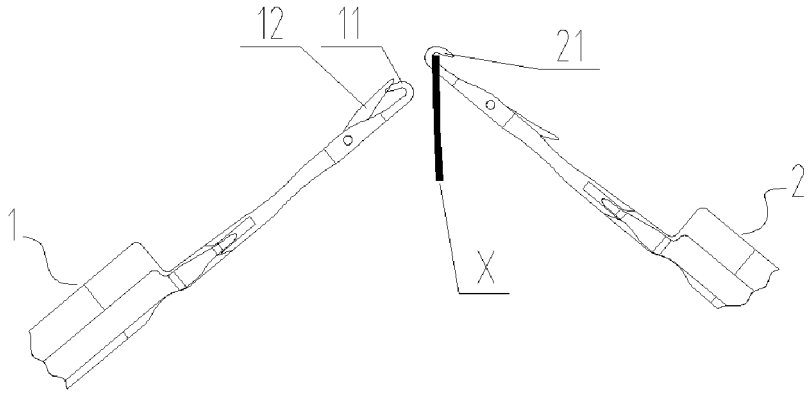


FIG. 30

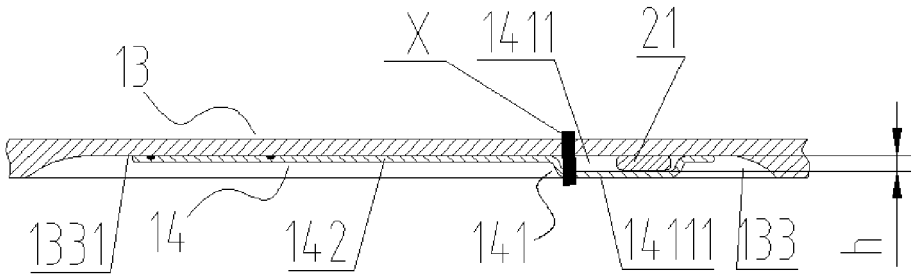


FIG. 31

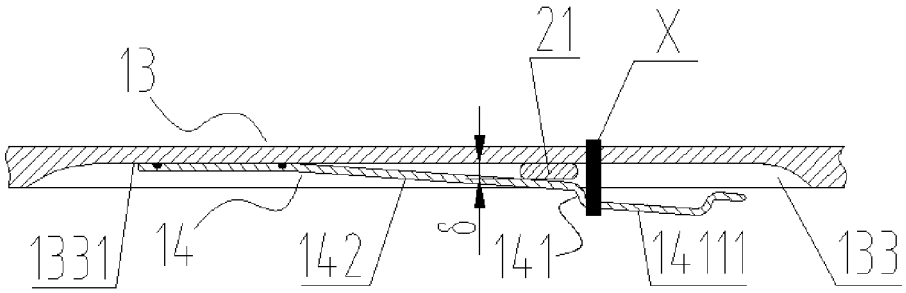


FIG. 32

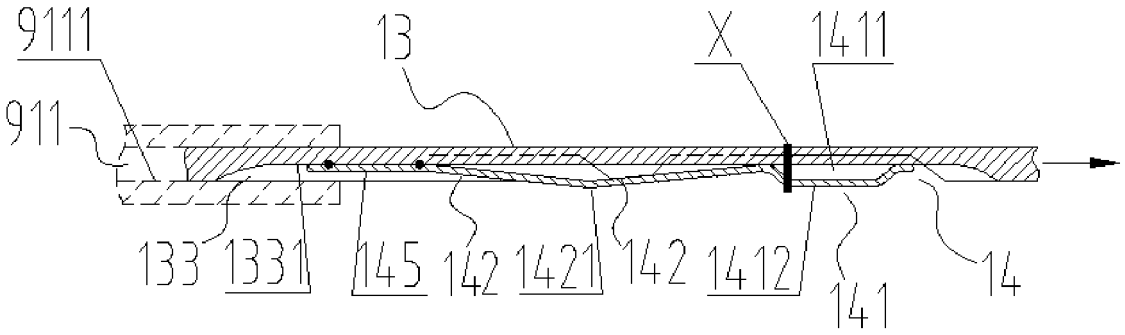


FIG. 33

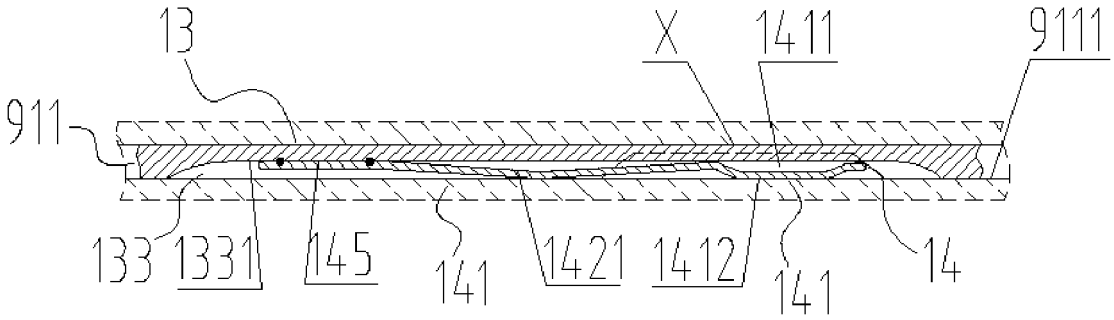


FIG. 34

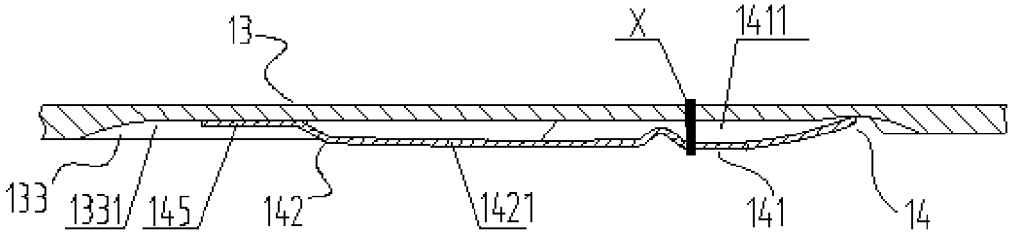


FIG. 35

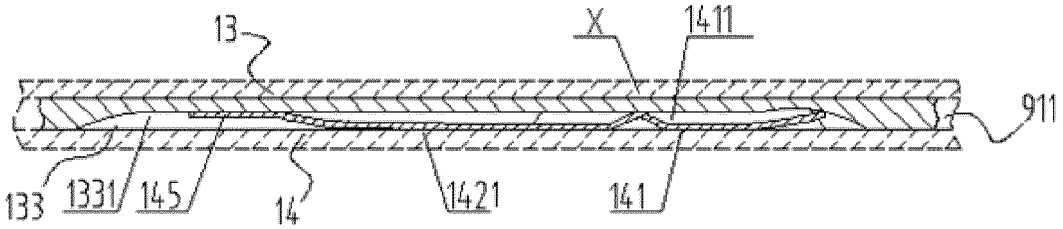


FIG. 36

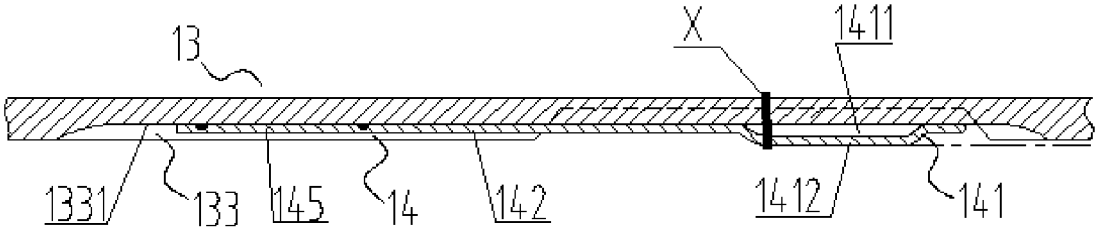


FIG. 37

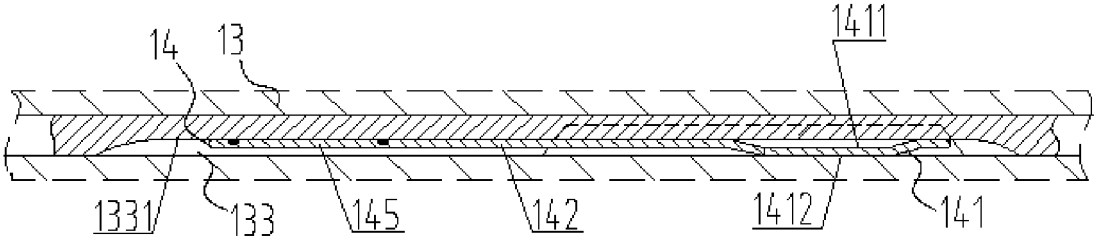


FIG. 38

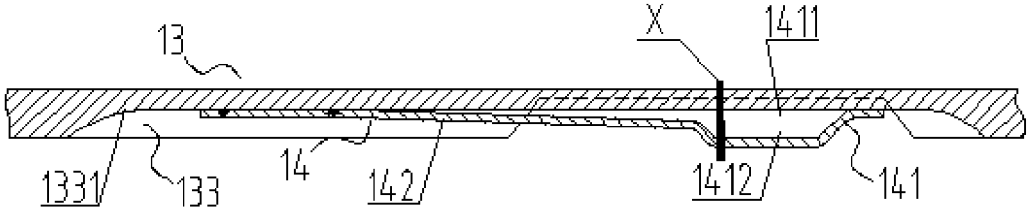


FIG. 39

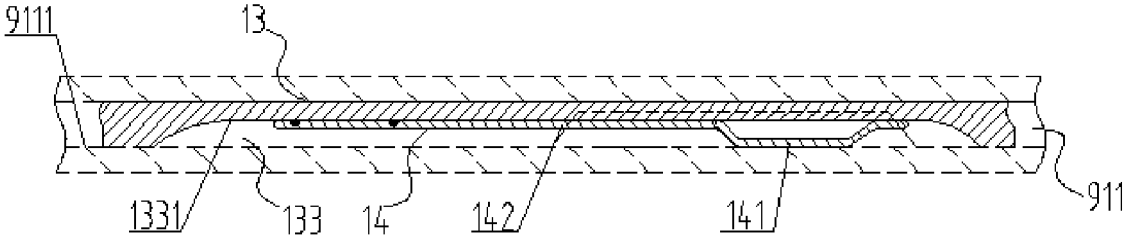


FIG. 40

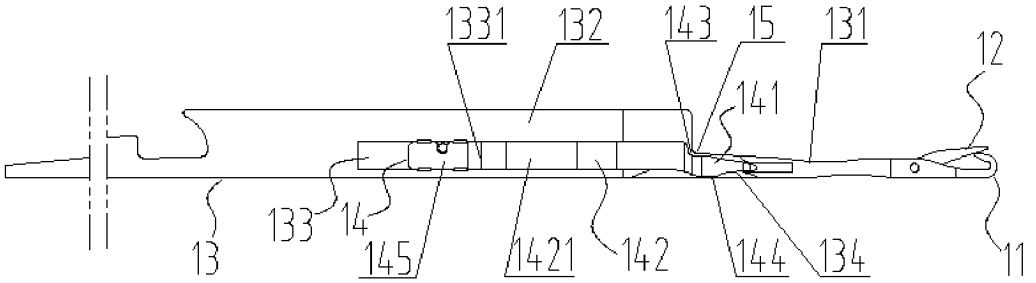


FIG. 41

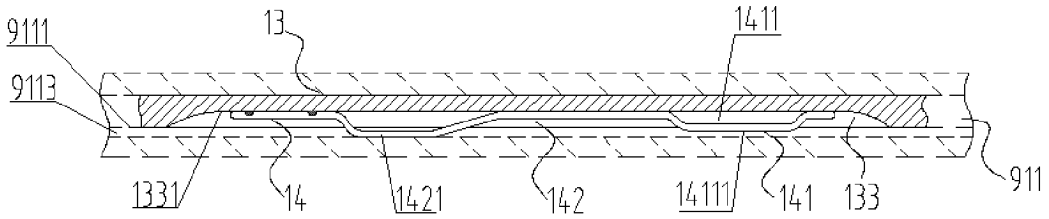


FIG. 42

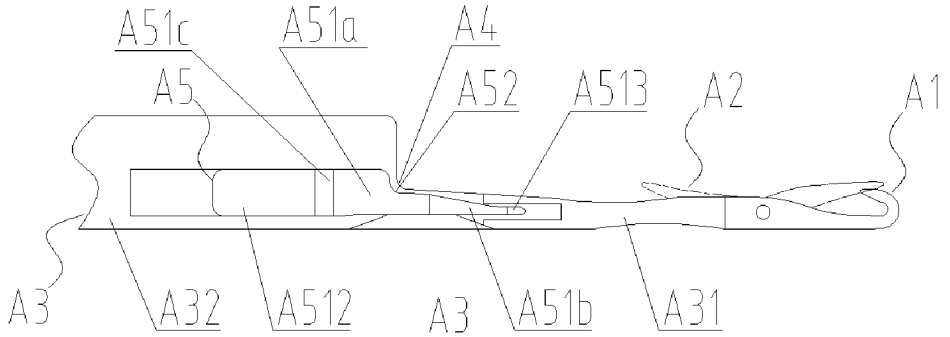


FIG. 43

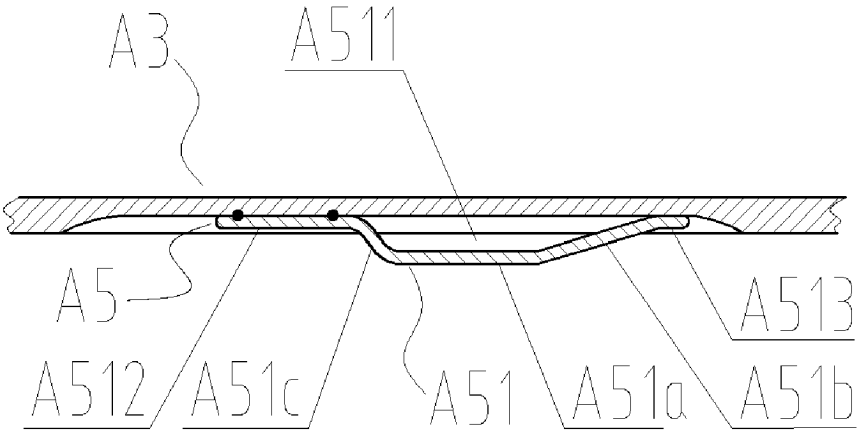


FIG. 44

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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- EP 1627943 A1 **[0008]**