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(54) **COMPOUND NEEDLE FOR FLAT KNITTING MACHINE**

(57) The present invention discloses a compound needle in a flat knitting machine comprising a main needle (1) and a needle sleeve (2) adapted to sleeve on the main needle. A needle hook (11) is disposed at the head of the main needle (1). The top end of the needle sleeve is provided with an apex angle (21). A first fastener (26) and a second fastener (27) are disposed on one side, facing the main needle, of the needle sleeve. A first concave surface (16) and a second concave surface (17) are formed on the front side and the rear side of the main needle in sections. The first fastener (26) and the second fastener (27) are respectively fastened on the first and the second concave surface (16,17). The side, facing the needle sleeve, of the main needle props against and cooperates with the side, facing the main needle, of the needle sleeve each other, such that when the needle sleeve moves, the apex angle (21) moves from accommodating grooves of the main needle to close the needle hook (11) of the main needle. Loops on the compound needle of the present invention have small knocking-over resistance, small clearing stroke and fast knitting speed. The compound needle can guide a knitting needle of the corresponding position to reach a needle turning position, thereby realizing reliable needle turning, accompanied with simple and agile actions. The compound needle slides in the needle groove stably and the fabric surface is flat.

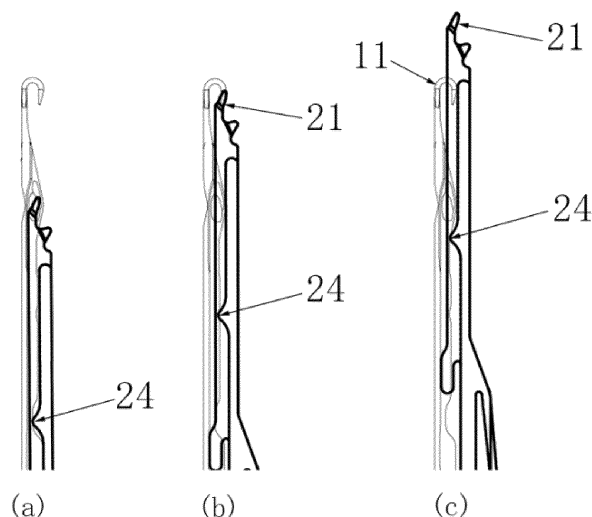


FIG. 7

Description

TECHNICAL FIELD

[0001] The present invention belongs to the technical field of knitting machinery, in particular to a compound needle in a flat knitting machine.

BACKGROUND

[0002] At present, compound needles are used on flat knitting machines more and more widely. Better actions are completed through the mutual movements of various components in the compound needle, but the structure is complicated, which increases the processing difficulty to some extent, increases the scrap rate, and increases the production cost. A latch needle in the prior art has a needle latch that is rotatable on a needle bar. Actions of looping, knocking-over, tucking, clearing, needle turning, needle connecting and the like of a loop by the needle latch are completed by opening and closing of the needle latch in combination with a main needle and yarns. Since the rotation of the needle latch requires space, a reed is disposed at a needle turning position of the main needle, such that the latch needle requires a larger vertical stroke to complete these knitting functions. In addition, the opening action of the needle latch also needs to be completed by means of a hairbrush or yarns. If the hairbrush is not appropriate or the installation position is not in place, defects such as missing needles are likely to occur, and the life and installation accuracy requirements on the hairbrush are relatively high.

[0003] In the applicant's previous application No. 2018100430370, there is disclosed a compound needle for a flat knitting machine. The compound needle comprises a main needle and a needle sleeve sleeving the main needle. The main needle is divided into three parts: a head portion, a middle portion and a tail portion, wherein the head portion has a needle hook, a stop end is disposed at a junction between the middle portion and the tail portion, an elongated limiting bar is disposed on the right side of the middle portion of the main needle, and the limiting bar and the front end of the middle portion form a U-shaped structure; the right side of the junction between the head portion and the middle portion of the main needle protrudes outwards to form a bump, and the left side thereof relative to the right side is bent inwards to form an inwards-recessed make-way groove; an inwards-recessed needle groove is respectively formed in the front side and the rear side of the bump; the needle sleeve is divided into a front section, a main section and a tail section, wherein the front section and the tail section are of a hollow structure respectively; the needle sleeve is mounted at the middle portion of the main needle; the main section of the needle sleeve is placed at an opening of the U-shaped structure of the main needle; the front section of the needle sleeve is provided with a sharp apex angle; the rear side of the apex angle is recessed inwards

to form a wiring groove which extends backwards and protrudes outwards to form a limiting end; a first trajectory surface is formed on one side, facing the needle sleeve, of the middle portion of the main needle, and a second trajectory surface is formed on one side, facing the main needle, of the main section of the needle sleeve; when the needle sleeve moves along the main needle, the first trajectory surface cooperates with the second trajectory surface, such that when the needle sleeve moves, the apex angle moves from the needle groove position of the main needle to close the needle hook of the main needle.

[0004] The compound needle having such a structure can complete the actions of clearing, looping, needle turning, needle connecting and the like of a loop by virtue of the cooperation of the main needle and the needle sleeve, thereby being capable of substituting for a needle latch. However, the structure of this main needle is too complicated, and the requirement on the processing precision of the main needle and the needle sleeve is high. Meanwhile, the apex angle of the needle sleeve is inclined toward the main needle, so that when the apex angle closes the hook, the width of the closed position is increased, and therefore, the passing loop becomes large, which affects the knitting effect.

SUMMARY

[0005] An objective of the present invention is to provide a compound needle in a flat knitting machine, which has a simple structure and completes clearing, looping, needle turning, needle connecting and other actions of a loop, instead of a latch needle and a main needle.

[0006] To fulfill this objective, the technical solution of the present invention is as follows: a compound needle in a flat knitting machine comprises a main needle and a needle sleeve sleeving the main needle; the main needle is elongated, and a needle hook is disposed at the head of the main needle, wherein a direction in which the needle hook is bent is defined as a right side, and a direction opposite to the direction in which the needle hook is bent is defined as a left side; two planes of the main needle are defined as front and back sides; the main needle is provided with a lug boss that protrudes outwards and is positioned below the needle hook; an inwards-recessed accommodating groove is respectively formed in front and rear sides of the lug boss; the left side of the main needle is bent inwards to form an inwards-recessed make-way groove, wherein, the top end of the needle sleeve is provided with an apex angle which is of a hollow structure; a first fastener and a second fastener are disposed on one side, facing the main needle, of the needle sleeve; a first concave surface and a second concave surface are formed on the front side and the rear side of the main needle in sections; the first fastener and the second fastener are respectively fastened on the first concave surface and the second concave surface of the main needle; the side, facing the needle sleeve, of the main needle props against and co-

operates with the side, facing the main needle, of the needle sleeve each other, such that when the needle sleeve moves, the apex angle moves from the accommodating grooves of the main needle to close the needle hook of the main needle.

[0007] Preferably, a trajectory surface is formed on one side, facing the needle sleeve, of the main needle; a salient point is formed on one side, facing the main needle, of the needle sleeve; the salient point cooperates with the trajectory surface on the main needle, such that when the needle sleeve moves along the main needle, the apex angle moves from the accommodating grooves of the main needle to close the needle hook of the main needle.

[0008] Preferably, the trajectory surface of the main needle is positioned below the lug boss and consists of a plurality of smooth concave surfaces and convex surfaces; the trajectory surface is provided with a first notch and a second notch; the salient point on the needle sleeve moves along the trajectory surface; when the apex angle of the needle sleeve is located in the accommodating groove of the main needle, the salient point is positioned at the second notch; when the apex angle of the needle sleeve moves upwards to close the needle hook of the main needle, the salient point is positioned at the first recess.

[0009] Preferably, a second salient point is formed on one side, facing the main needle, of the tail end of the needle sleeve; the second salient point props against and moves vertically along the right side of the bottom of the main needle.

[0010] Preferably, a salient point is formed in one side, facing the needle sleeve, of the main needle; a trajectory surface is formed on one side, facing the main needle, of the needle sleeve; the salient point cooperates with the trajectory surface, such that when the needle sleeve moves along the main needle, the apex angle moves from the accommodating grooves of the main needle to close the needle hook of the main needle.

[0011] Preferably, a first trajectory surface is formed on one side, facing the needle sleeve, of the main needle, and a second trajectory surface is formed on one side, facing the main needle, of the needle sleeve; the first trajectory surface props against and cooperates with the second trajectory surface each other, such that when the needle sleeve moves along the main needle, the apex angle moves from the needle groove position of the main needle to close the needle hook of the main needle.

[0012] Preferably, a bending direction of the apex angle at the top end of the needle sleeve is consistent with a tilting direction of the tip of the needle hook, that is, the apex angle is bent towards one side facing away from the main needle; the lower side of the apex angle of the needle sleeve is recessed inwards to form a wiring groove that extends downwards and protrudes outwards to form a limiting end.

[0013] Preferably, an elastic sheet is disposed on one side, facing away from the main needle, of the needle sleeve and is of an elongated broken line shape.

[0014] Preferably, the needle sleeve is composed of an intermediate sheet and two side sheets; the apex angle at the top end of the needle sleeve consists of two side sheets; one side, facing the main needle, of each of two side sheets extends outwards to form two clamping strips; the corresponding clamping strips on the two side sheets form the first fastener and the second fastener.

[0015] Preferably, the intermediate sheet and the two side sheets of the needle sleeve are assembled and molded after being machined separately, or the intermediate sheet and the two side sheets are integrally machined and molded directly.

[0016] The first fastener and the second fastener on the needle sleeve are positioned at the middle part and the tail end of the needle sleeve respectively; the front side and the rear side of a position where the trajectory surface of the main needle is located are recessed inwards to form a first concave surface; the first fastener is in tight contact with the first concave surface on the front side and the rear side of the main needle; the tail end of the main needle is provided with a stop end; the front side and the rear side above the stop end are recessed inwards to form a second concave surface; the second fastener is in tight contact with the second concave surface on the front side and the rear side of the main needle.

[0017] The apex angle at the head of the needle sleeve is of a hollow structure, which can guide a knitting needle at the corresponding position to reach a needle turning position, thereby realizing the needle turning action which is simple and convenient. Compared with the traditional latch needle, the compound needle has the characteristics that a bending direction of the apex angle of the needle sleeve is consistent with a tilting direction of the tip of the needle hook, and the width of the closed position of the needle sleeve and the needle hook is reduced, thereby reducing the knocking-over resistance of the loop, and reducing the size of the knocked-over loop. In addition, the design in which the needle hook is opened or closed by sliding the needle sleeve also reduces the clearing stroke of the loop, thereby improving the knitting speed of a fabric and improving the production efficiency.

[0018] An elastic sheet is disposed above the needle sleeve and is integrally molded with the intermediate sheet of the needle sleeve. This elastic sheet is flexible rather than rigid, and is thus not prone to brakeage. Under the action of the elastic sheet, the compound needle is always under a pressed state within a needle groove of a needle bed to prevent the needle sleeve from warping upwards; in the needle turning position and the clearing position, there is a reverse buckling function. The needle sleeve slides under the simultaneous action of pressing and reverse buckling, such that the double insurance ensures that the compound needle stably slides in the needle groove.

[0019] An open slot structure is formed on one side, facing the main needle, of the needle sleeve. The middle section of each of two sidewalls of the open slot structure

is provided with a notch. Each of the first fastener and the second fastener is formed at the upper end and the lower end of each of the two sidewalls. An inwards-recessed concave surface is respectively formed on the middle part and the tail part of the main needle. In order to reduce the frictional force of the needle sleeve sliding on the main needle, the two sidewalls of the open slot of the needle sleeve are hollowed out, so that the upper and lower ends of the two sidewalls form oppositely bent clamping strips. The clamping strips in corresponding positions form a fastener. The clamping strips and the two side sheets of the needle sleeve are molded integrally. The fastener is part of the needle sleeve. The needle sleeve sleeves the main needle by the cooperation of the fasteners and the concave surfaces. The needle sleeve slides on the concave surface by the fastener, so that the needle sleeve moves vertically relative to the main needle, thereby closing the needle hook.

[0020] In addition, the trajectory contact between the needle sleeve and the main needle can be achieved by point-surface fit or a surface-surface fit. The needle sleeve is provided with a salient point and the main needle is provided with a trajectory surface, or the needle sleeve is provided with a trajectory surface and the main needle is provided with a salient point. The two principles are the same, i.e., mainly residue in that the salient point moves vertically along the trajectory surface. The salient point is used to support the needle sleeve to slide in a pressed state, to reduce the contact area, thereby reducing the frictional force and facilitating smooth sliding of the needle sleeve in the needle groove. In the course of clearing, the tail of the needle sleeve comes into contact with the stop end of the main needle. At this time, the two side sheets at the head of the needle sleeve are embedded in the accommodating grooves of the main needle, which is beneficial to stabilize the size of the loop. The needle sleeve has the same width as the main needle, which not only ensures the strength, but also ensures stable sliding in the needle groove, and is beneficial to stable knitting of a fabric and flattening of the fabric surface.

[0021] According to the compound needle of the present invention, the needle hook is opened or closed by sliding of the needle sleeve on the main needle, such that the interaction between the needle sleeve and the main needle completes the actions of looping, knocking-over, tucking and clearing instead of the traditional latch needle, thereby realizing capturing and discharge of a looped yarn. When the needle hook is closed, the apex angle at the head of the needle sleeve first passes over the needle hook for a certain distance, ensuring that the head of the needle sleeve does not collide with the tip of the needle hook, and then runs downward to prevent the tip of the needle hook from being deformed. The two side sheets of the apex angle of the needle sleeve wrap the needle hook. The upper surface of the head of the needle sleeve is flush with the upper surface of the needle hook, i.e., the upper surface of the apex angle forms a smooth circular arc structure with an outer curved surface of the

needle hook, which reduces the knocking-over resistance of the loop, stabilizes the loop size, and improves the fabric quality.

5 BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The description is further described in detail below in conjunction with the accompany drawings and the embodiments of the present invention.

FIG. 1 is a structural schematic diagram of the present invention;

FIG. 2 is structural schematic diagram of a main needle of the present invention;

FIG. 3 is a side view of FIG. 2;

FIG. 4 is a structural schematic diagram of a needle sleeve of the present invention;

FIG. 5 is an internal schematic diagram of the needle sleeve of the present invention; (after one side sheet is removed)

FIG. 6 is a schematic diagram showing a state of the present invention;

FIG. 7 is a partially enlarged diagram of FIG. 6;

(a) shows a state in which the needle sleeve is hidden in a needle groove of the main needle;

(b) shows a state in which the needle sleeve closes the needle hook of the main body;

(c) shows a state in which the needle sleeve passes over the main needle and is located in a needle turning position;

FIG. 8 is a state diagram of a knitting process of the present invention; and

FIG. 9 is a state diagram of a needle turning process of the present invention.

[0023] Reference symbols in drawings represent the following components: main needle 1; needle hook 11; lug boss 12; make-way groove 13; accommodating groove 14; trajectory surface 15; first notch 151; second notch 152; first concave surface 16; second concave surface 17; stop end 18; needle sleeve 2; apex angle 21; wiring groove 22; limiting end 23; first salient point 24; second salient point 25; first fastener 26; second fastener 27; elastic sheet 28.

DETAILED DESCRIPTION

Embodiment 1

[0024] Referring to drawings, the compound needle of the present embodiment comprises a main needle 1 and a needle sleeve 2 sleeving the main needle. The main needle 1 is elongated, and a needle hook 11 is disposed at the head of the main needle. Now, a direction in which the needle hook is bent is defined as a right side, and a direction opposite to the direction in which the needle hook is defined as a left side; two planes of the main needle are defined as front and back sides; a lug boss 12 that protrudes outwards and is positioned below the needle hook is disposed on the right side of the main needle, and the left side, opposite to the right side, of the main needle is bent inwards to form an inwards-recessed make-way groove 13, such that the size of a range in which the loop slides on the main needle is kept within a certain range to facilitate the movement of the loop on the main needle. An inwards-recessed accommodating groove 14 is formed in the front side and the rear side of the lug boss and used for placing the apex of the needle sleeve.

[0025] The lug boss 12 extends downwards to form a trajectory surface 15. The trajectory surface 15 consists of a plurality of smooth concave surfaces and convex surfaces. The trajectory surface is uneven depending on the movement requirements of the needle sleeve. The upper side of the trajectory surface adjoins to the lug boss. A first notch 151 is formed close to the middle position of the trajectory surface, and a second notch 152 is formed in the bottom of the trajectory surface. The front side and the rear side of the position where the trajectory surface of the main needle is located are recessed inwards to form a first concave surface 16. The thickness of the main needle at the first concave surface becomes smaller, and the thickness of the lower side of the first concave surface is a normal thickness of the main needle. A stop end 18 is disposed at the tail end of the main needle. A position close to the stop end is recessed inwards to form a second concave surface 17. The thickness of the main needle at the second concave surface becomes smaller.

[0026] The needle sleeve 2 is composed of an intermediate sheet and two side sheets. The intermediate sheet and the two side sheets may be assembled into the needle sleeve after being machined separately, or may be integrally machined and molded directly, for example, milled directly by a lathe. A sharp apex angle 21 is disposed on the top end of the needle sleeve. The apex angle is of a hollow structure consisting of two side sheets. One side, facing the main needle, of the needle sleeve 2 is of an open slot structure, and the remaining portions are of a solid structure respectively. A bending direction of the apex angle 21 at the top end of the needle sleeve is consistent with a tilting direction of the tip of the needle hook 11, that is, the apex is bent towards one

side facing away from the main needle. The lower side of the apex angle 21 of the needle sleeve is recessed inwards to form a wiring groove 22 that extends downwards and protrudes outwards to form a limiting end 23.

[0027] Salient points are formed in one side, facing the main needle, of the needle sleeve. The first salient point 24 is located on the middle section of the needle sleeve and props against the trajectory surface on the main needle. The second salient point 25 is located on the tail end of the needle sleeve and props against the right side of the tail end of the main needle. The two salient points are used to support the needle sleeve to slide in a pressed state, to reduce the contact area, thereby reducing the frictional force and facilitating smooth sliding of the needle sleeve in the needle groove.

[0028] The open slot of the needle sleeve is composed of two side sheets, or that is to say, the portions, exceeding the intermediate sheet, of the two side sheets form an open slot, and the exceeding portions of the two side sheets are two sidewalls of the open slot. In order to reduce the frictional force generated by the needle sleeve sliding on the main needle, the middles of the two sidewalls of the open slot are hollowed out, leaving only the upper and lower ends. It is manifested that each of two side sheets extends outwards towards one side of the main needle to form two clamping strips, and two clamping strips on the same side sheet are of oppositely bent structures, which not only reduces the contact area between the needle sleeve and the main needle, but also ensures the movement stability of the needle sleeve. The corresponding clamping strips on the two side sheets form a first fastener 16 and a second fastener 17 which are buckled on the first concave surface 16 and the second concave surface 17 on the main needle respectively and slide on the two concave surfaces. Therefore, each of the so-called clamping strips is a part of each of two side sheets of the needle sleeve, and the first fastener 26 and the second fastener 27 are integrally molded with the side sheets of the needle sleeve.

[0029] An elongated elastic sheet 28 which is in a broken line shape is disposed on the right side of the needle sleeve. The elastic sheet and the intermediate sheet are integrally molded. One end of the elastic sheet is connected to the intermediate sheet, and the other end of the elastic sheet is suspended in a groove formed by the two side sheets. The suspended end under a pressed state may move in this groove to relieve the pressure. This elastic sheet is flexible rather than rigid, and is thus not prone to brakeage. Under the action of the elastic sheet, the compound needle is always under a pressed state within the needle groove to prevent the needle sleeve from warping upwards. In the needle turning needle and the clearing position, there is a reverse buckling function; the needle sleeve slides under the simultaneous action of pressing and reverse buckling, such that the double insurance ensures that the compound needle stably slides in the needle groove.

[0030] When the apex angle 21 of the needle sleeve

is located in the accommodating groove 14 of the main needle, the first salient point 24 of the needle sleeve is located at the second notch 152 in the bottom of the trajectory surface, and a distance between the main needle and the needle sleeve at this time is minimum. When the needle sleeve needs to be connected with a yarn, the apex angle 21 of the needle sleeve moves upwards, and the distance between the main needle and the needle sleeve 2 becomes larger. When the needle hook 11 is closed, the apex angle 21 at the head of the needle sleeve first passes over the needle hook for a certain distance, ensuring that the head of the needle sleeve does not come into contact with the tip of the needle hook, and then runs downward to prevent the tip of the needle hook from being deformed. The two side sheets of the apex angle of the needle sleeve wrap the needle hook. The upper surface of the head of the needle sleeve is flush with the upper surface of the needle hook, i.e., the upper surface of the apex angle forms a smooth circular arc structure with an outer curved surface of the needle hook, and the first salient point 24 of the needle sleeve in this case is located at the first recess 151 of the trajectory surface of the main needle.

[0031] As shown in FIG. 8, when knitting is required, a loop has been formed on the needle hook 11 of the main needle 1 (i); the triangle pushes the main needle to move upwards, and the needle sleeve opens the needle hook, and slides down to the stop end of the main needle (ii); when it is necessary to make a loop again, the main needle 1 runs upwards and the needle hook hooks a new yarn, and the old loop in this case is located above the head of the needle sleeve 2 (iii); the main needle 1 hooks the new yarn and moves down to the needle sleeve 2 to close the needle hook 11 (iv); the needle sleeve 2 in this case needs to move downwards together with the main needle 1, the yarn hooked by the main needle 1 forms a new loop, and meanwhile, the old loop on the needle sleeve 2 is disengaged from the needle hook as the main needle moves downwards (v).

[0032] As shown in FIG. 9, when the needle needs to be turned, the needle sleeve 2' on the compound needle B with the loops runs up to a needle turning position (S1); the main needle 1 and the needle sleeve 2 on the compound needle A connected with the loop move upwards, and the main needle 1 passes through the loop and passes through the hollow structure at the head of the needle sleeve 2', thereby ensuring that the tip of the needle hook of the main needle 1 exceeds the upper surface of the loop (S2); the needle sleeve 2' runs downwards to be disengaged from the loop, and the loop falls onto the main needle 1 of the compound needle A to complete the needle turning action (S3).

Embodiment 2

[0033] The compound needle of the present embodiment comprises a main needle and a needle sleeve sleeving the main needle; a lug boss that protrudes out-

wards is disposed on the right side of the main needle. An inwards-recessed accommodating groove is formed in the front side and the rear side of the lug boss respectively and used for placing the apex of the needle sleeve. A salient point is formed in one side, which extends downwards, of the lug boss. An uneven trajectory surface is formed on one side, facing the main needle, of the needle sleeve. The trajectory surface consists of a plurality of smooth concave surfaces and convex surfaces. The salient point on the main needle props against the trajectory surface on the needle sleeve. The main needle may be provided with an upper salient point and a lower salient point which are used for supporting the needle sleeve to slide under a pressed state, to reduce the contact area, thereby reducing the frictional force and facilitating smooth sliding of the needle sleeve in the needle groove. The trajectory surface of the needle sleeve is located on one side, facing the main needle, of the intermediate sheet. The trajectory surface is uneven depending on the movement requirements of the needle sleeve, thereby ensuring that the apex angle moves from the needle groove position of the main needle to close the needle hook of the main needle during the movement of the needle sleeve, or continues to move up to the needle turning position. Other structures are similar to those of the first embodiment and will not be described again.

Embodiment 3

[0034] The compound needle of the present embodiment comprises a main needle and a needle sleeve sleeving the main needle; a lug boss that protrudes outwards is disposed on the right side of the main needle. An inwards-recessed accommodating groove is formed in the front side and the rear side of the lug boss respectively and used for placing the apex of the needle sleeve. An uneven first trajectory surface is formed on one side, that extends downwards, of the lug boss, and an uneven second trajectory surface is formed on one side, facing the main needle, of the needle sleeve. By means of the mutual cooperation among the first trajectory surface fluctuating on the main needle, the bump on the main needle and the second trajectory surface fluctuating as well on the needle sleeve, the distance between the needle sleeve and the main needle is changed. When the apex angle of the needle sleeve is located at the needle groove position of the main needle, the distance between the needle sleeve and the main needle is minimum. Then, during the upward movement of the needle sleeve, as the convex position of the first trajectory surface is opposite to the convex position of the second trajectory surface, the distance between the needle sleeve and the main needle is increased, such that the needle hook of the main needle is placed in the apex angle of the needle sleeve to close the needle hook. When the needle sleeve continues to move upwards, the distance between the needle sleeve and the main needle is changed as well by the bump of the main needle and the second trajectory

surface, such that the needle sleeve reaches a needle turning position at the highest point. The trajectory surfaces are uneven depending on the movement requirements of the needle sleeve, thereby ensuring that the apex angle moves from the needle groove position of the main needle to close the needle hook of the main needle during the movement of the needle sleeve, or continues to move up to the needle turning position. Other structures are similar to those of the first embodiment and will not be described again.

Claims

1. A compound needle in a flat knitting machine, comprising a main needle and a needle sleeve sleeving the main needle; the main needle is elongated, and a needle hook is disposed at the head of the main needle, wherein a direction in which the needle hook is bent is defined as a right side, and a direction opposite to the direction in which the needle hook is bent is defined as a left side; two planes of the main needle are defined as front and back sides; the main needle is provided with a lug boss that protrudes outwards and is positioned below the needle hook; an inwards-recessed accommodating groove is respectively formed in front and rear sides of the lug boss; the left side of the main needle is bent inwards to form an inwards-recessed make-way groove, wherein, the top end of the needle sleeve is provided with an apex angle which is of a hollow structure; a first fastener and a second fastener are disposed on one side, facing the main needle, of the needle sleeve; a first concave surface and a second concave surface are formed on the front side and the rear side of the main needle in sections; the first fastener and the second fastener are respectively fastened on the first concave surface and the second concave surface of the main needle; the side, facing the needle sleeve, of the main needle props against and cooperates with the side, facing the main needle, of the needle sleeve each other, such that when the needle sleeve moves, the apex angle moves from the accommodating grooves of the main needle to close the needle hook of the main needle.
2. The compound needle in a flat knitting machine according to claim 1, wherein a trajectory surface is formed on one side, facing the needle sleeve, of the main needle; a salient point is formed on one side, facing the main needle, of the needle sleeve; the salient point cooperates with the trajectory surface on the main needle, such that when the needle sleeve moves along the main needle, the apex angle moves from the accommodating grooves of the main needle to close the needle hook of the main needle.
3. The compound needle in a flat knitting machine according to claim 2, wherein the trajectory surface of the main needle is positioned below the lug boss and consists of a plurality of smooth concave surfaces and convex surfaces; the trajectory surface is provided with a first notch and a second notch; the salient point on the needle sleeve moves along the trajectory surface; when the apex angle of the needle sleeve is located in the accommodating groove of the main needle, the salient point is positioned at the second notch; when the apex angle of the needle sleeve moves upwards to close the needle hook of the main needle, the salient point is positioned at the first recess.
4. The compound needle in a flat knitting machine according to claim 2, wherein a second salient point is formed on one side, facing the main needle, of the tail end of the needle sleeve; the second salient point props against and moves vertically along the right side of the bottom of the main needle.
5. The compound needle in a flat knitting machine according to claim 1, wherein a salient point is formed on one side, facing the needle sleeve, of the main needle; a trajectory surface is formed on one side, facing the main needle, of the needle sleeve; the salient point cooperates with the trajectory surface, such that when the needle sleeve moves along the main needle, the apex angle moves from the accommodating grooves of the main needle to close the needle hook of the main needle.
6. The compound needle in a flat knitting machine according to claim 1, wherein a first trajectory surface is formed on one side, facing the needle sleeve, of the main needle, and a second trajectory surface is formed on one side, facing the main needle, of the needle sleeve; the first trajectory surface props against and cooperates with the second trajectory surface each other, such that when the needle sleeve moves along the main needle, the apex angle moves from the needle groove position of the main needle to close the needle hook of the main needle.
7. The compound needle in a flat knitting machine according to any one of claims 1 to 6, wherein a bending direction of the apex angle at the top end of the needle sleeve is consistent with a tilting direction of the tip of the needle hook, that is, the apex is bent towards one side facing away from the main needle; the lower side of the apex angle of the needle sleeve is recessed inwards to form a wiring groove that extends downwards and protrudes outwards to form a limiting end.
8. The compound needle in a flat knitting machine according to any one of claims 1 to 6, wherein an elastic

sheet is disposed on one side, facing away from the main needle, of the needle sleeve and is of an elongated broken line shape.

9. The compound needle in a flat knitting machine according to any one of claims 1 to 6, wherein the needle sleeve is composed of an intermediate sheet and two side sheets; the apex angle at the top end of the needle sleeve consists of two side sheets; one side, facing the main needle, of each of two side sheets extends outwards to form two clamping strips; the corresponding clamping strips on the two side sheets form the first fastener and the second fastener. 5 10
10. The compound needle in a flat knitting machine according to claim 9, wherein the intermediate sheet and the two side sheets of the needle sleeve are assembled and molded after being machined separately, or the intermediate sheet and the two side sheets are integrally machined and molded directly. 15 20

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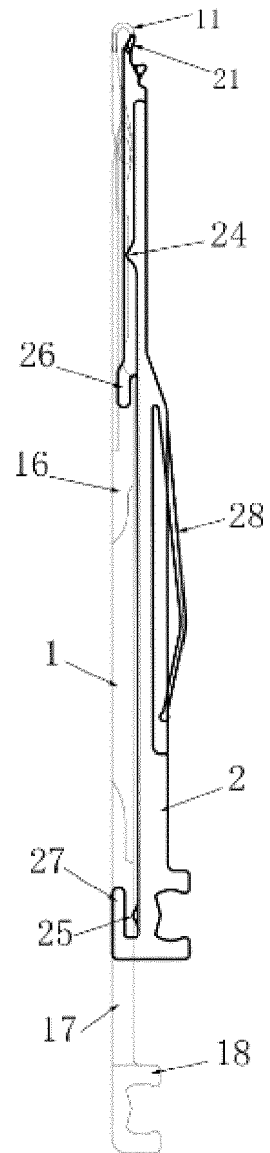


FIG. 1

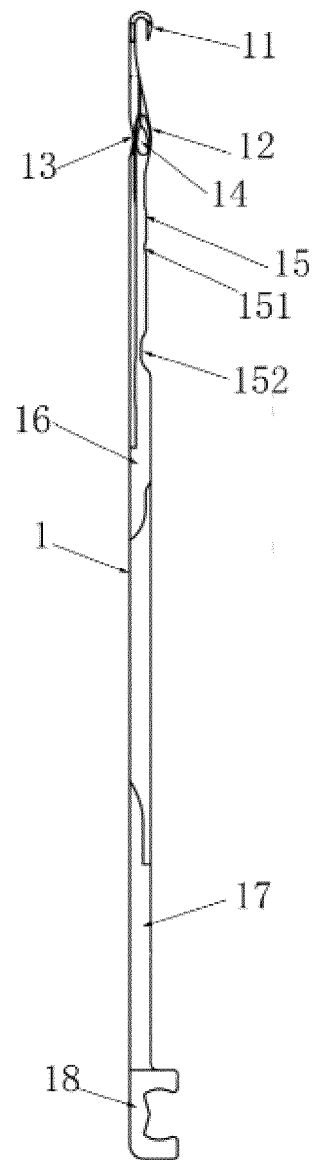


FIG. 2

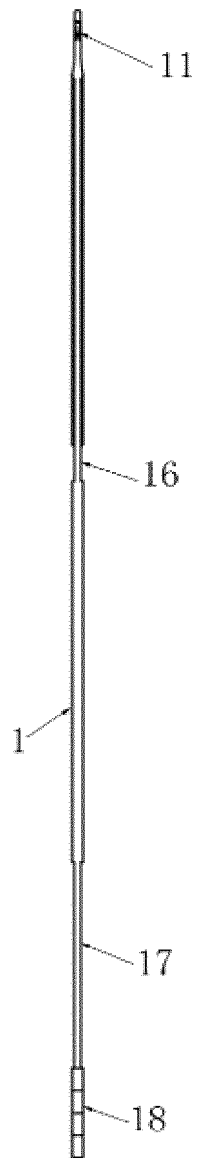


FIG. 3

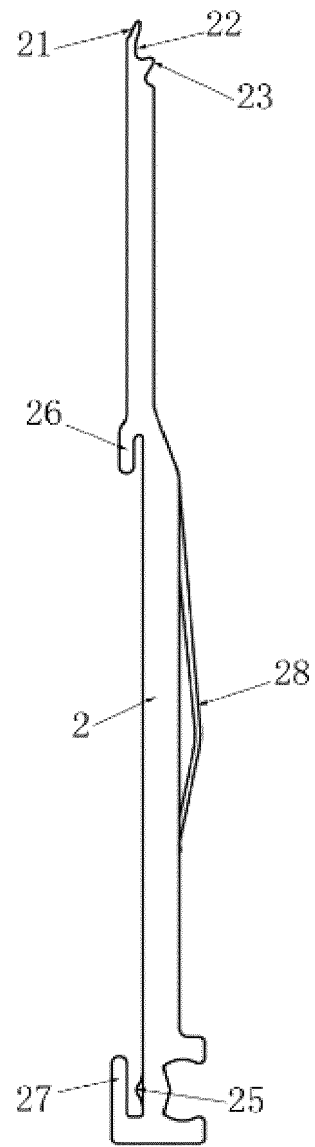


FIG. 4

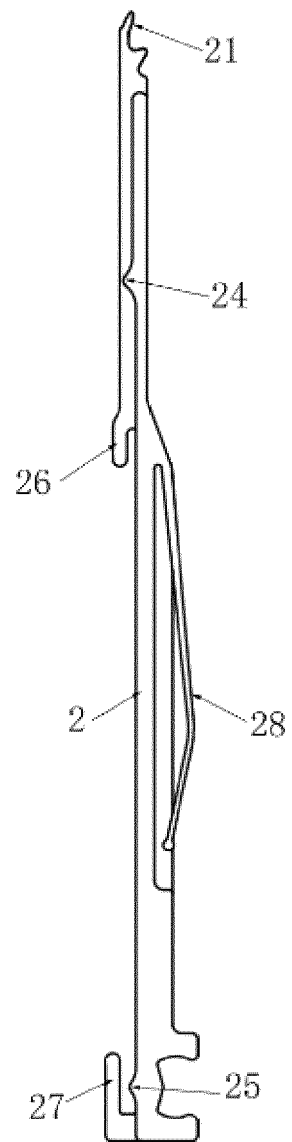


FIG. 5

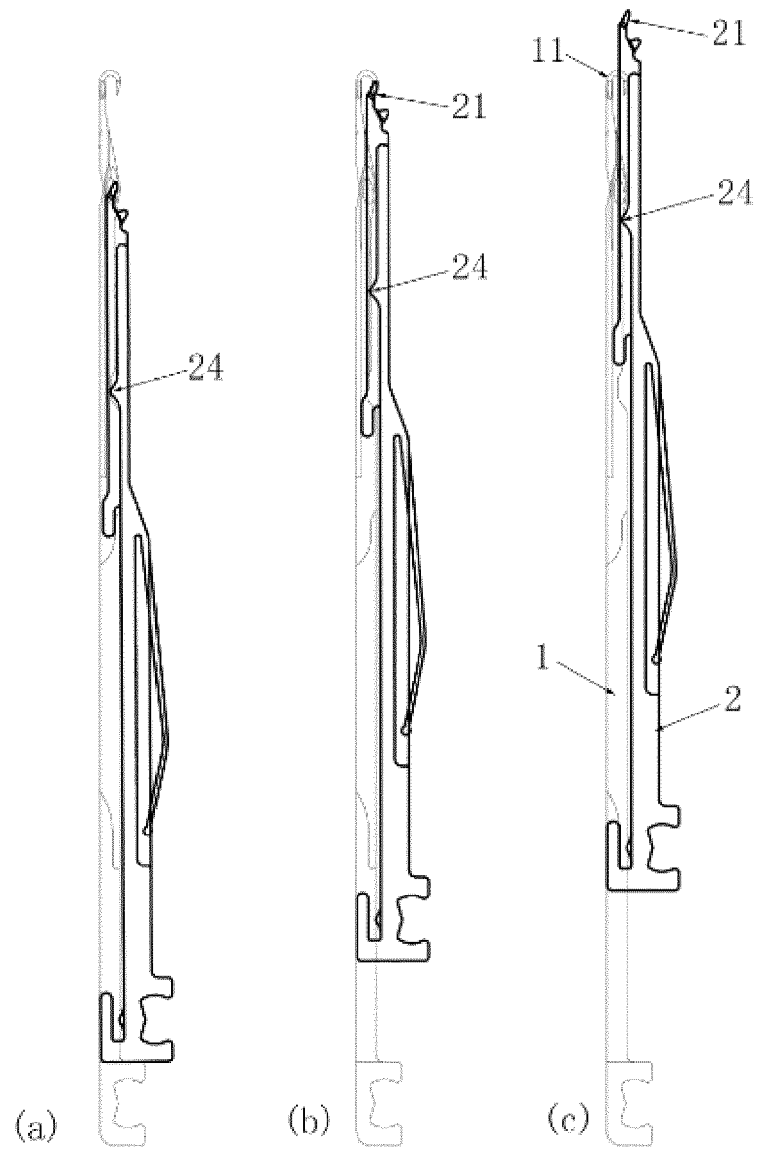


FIG. 6

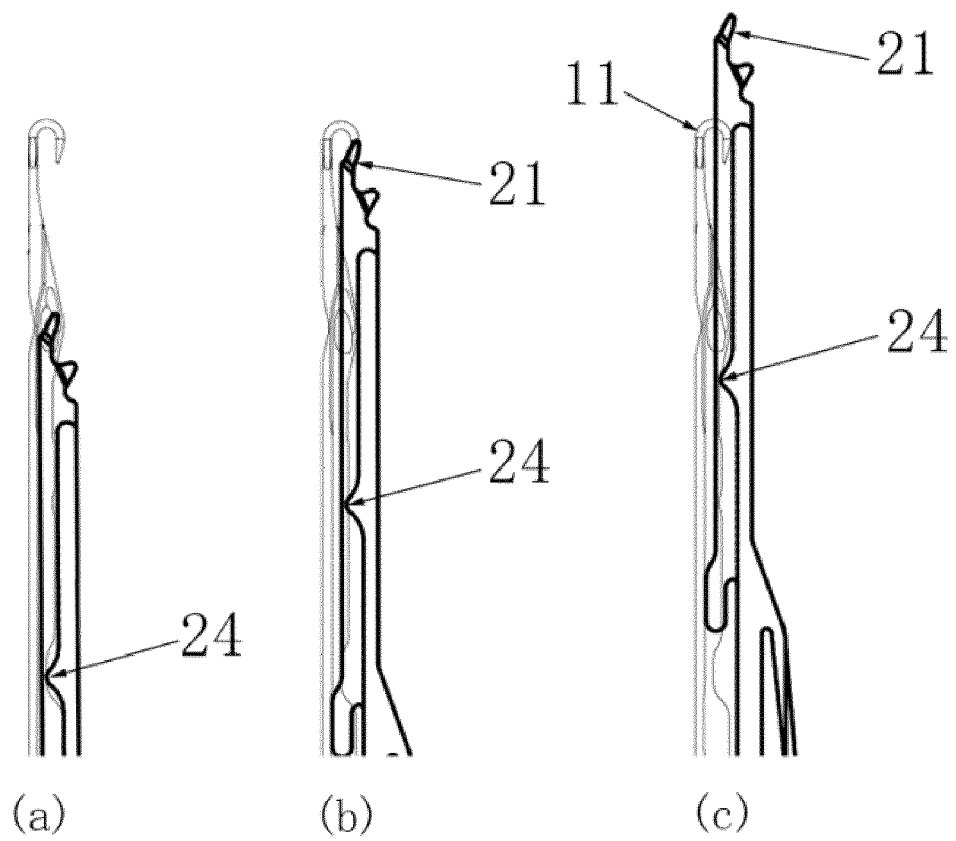


FIG. 7

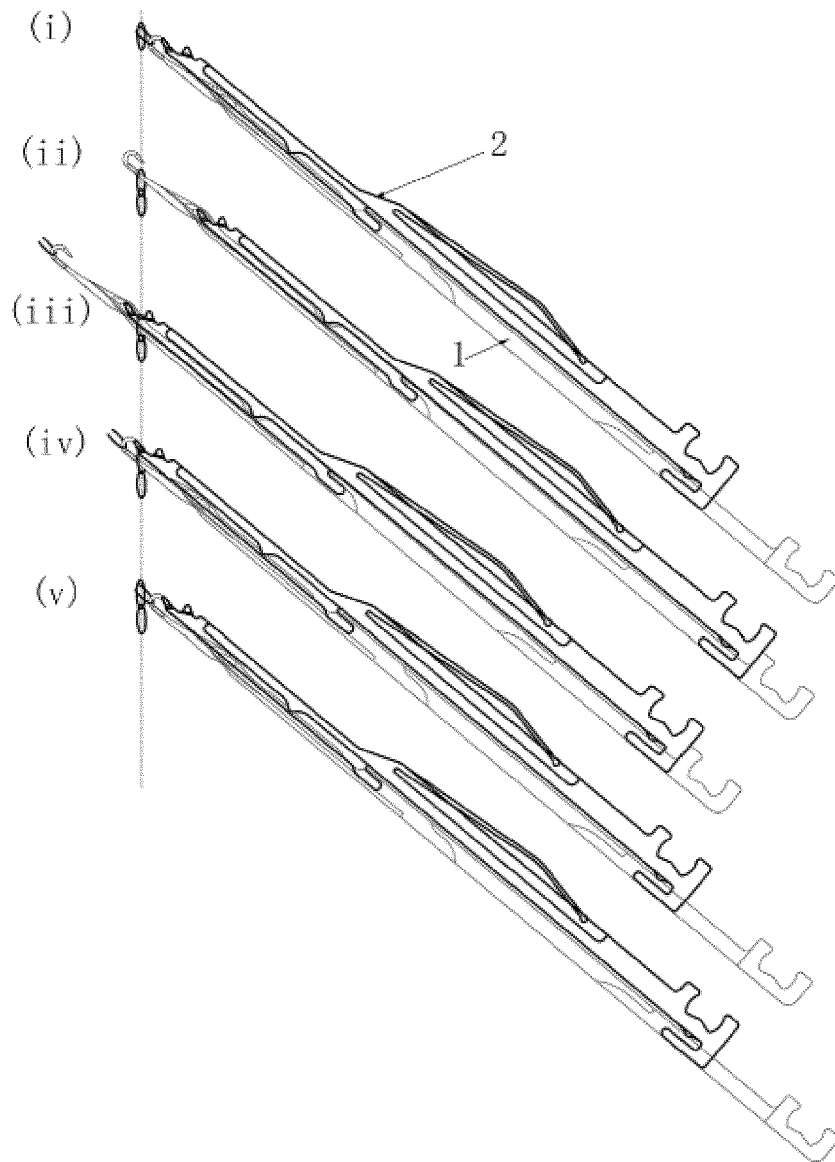


FIG. 8

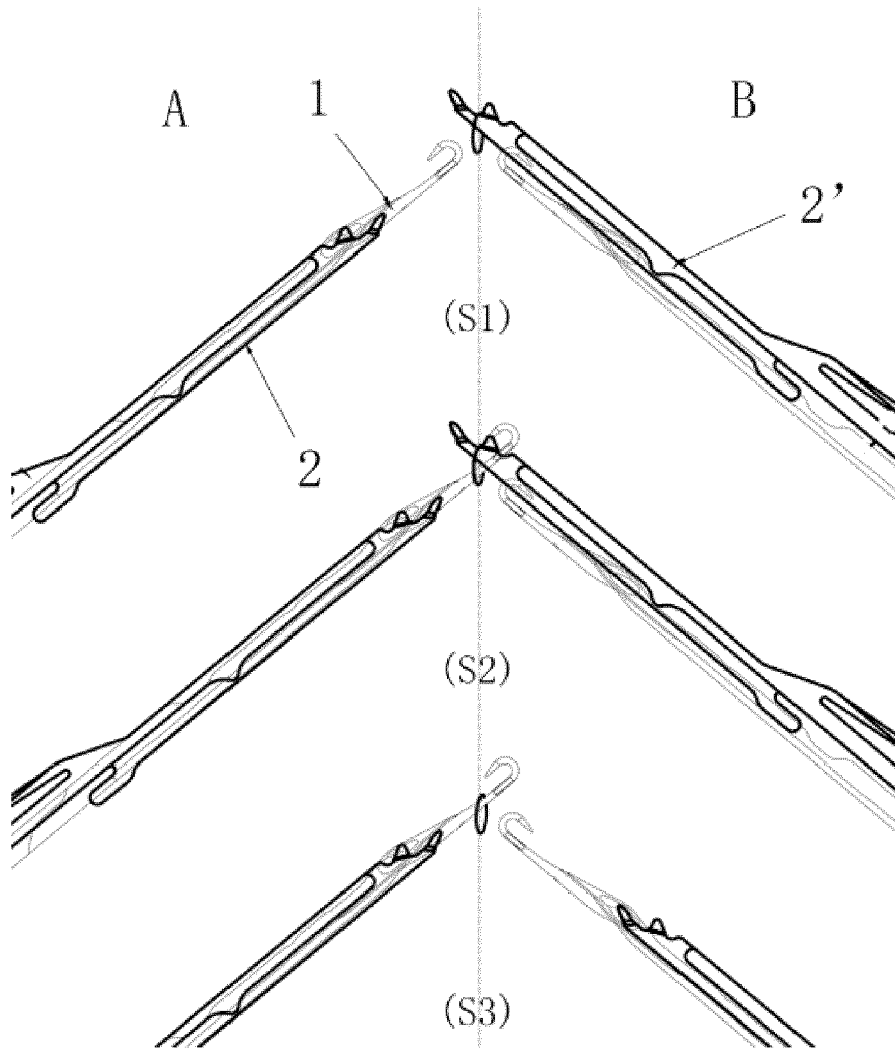


FIG. 9



EUROPEAN SEARCH REPORT

 Application Number
EP 20 15 9260

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35

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45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	FR 1 088 820 A (HOFFMANN AUGUST) 10 March 1955 (1955-03-10) * page 1, lines 1-14; figures 11-15 * * page 2, column 2, last paragraph * * page 3, column 1, paragraph 1-22 * -----	1-10	INV. D04B35/06
Y	US 2002/112509 A1 (BASEGGIO MARCELLO [CH] ET AL) 22 August 2002 (2002-08-22) * paragraphs [0020], [0022], [0025] - [0027]; figures 2-11 * -----	1-10	
Y	CN 108 035 063 A (NINGBO CIXING CO LTD) 15 May 2018 (2018-05-15) * paragraph [0018]; figures 2,3,4a * -----	1-10	
Y	WO 2006/062205 A1 (SHIMA SEIKI MFG [JP]; NAKAMORI TOSHINORI [JP]) 15 June 2006 (2006-06-15) * paragraph [0033]; figure 1 * -----	7	
Y	EP 2 397 589 A2 (SHIMA SEIKI MFG [JP]) 21 December 2011 (2011-12-21) * paragraphs [0010], [0017], [0019]; figure 2 * -----	7	TECHNICAL FIELDS SEARCHED (IPC) D04B
Y	JP 2007 231448 A (SHIMA SEIKI MFG) 13 September 2007 (2007-09-13) * paragraphs [0022], [0023]; figure 7 * -----	8	
Y	EP 2 397 590 A2 (SHIMA SEIKI MFG [JP]) 21 December 2011 (2011-12-21) * paragraph [0029]; figures 1a-b,2b * -----	8	
Y	CN 203 333 962 U (NINGBO CIXING CO LTD) 11 December 2013 (2013-12-11) * paragraph [0017]; figures 1,2 * ----- -/--	9,10	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 2 June 2020	Examiner Messai, Sonia
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EUROPEAN SEARCH REPORT

Application Number
EP 20 15 9260

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 1 368 520 A2 (HOFMANN ULRICH [DE]) 10 December 2003 (2003-12-10) * paragraphs [0031], [0040]; figures 5,15-16 * -----	8	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 2 June 2020	Examiner Messai, Sonia
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 15 9260

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-06-2020

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15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 1088820	A	10-03-1955	NONE
US 2002112509	A1	22-08-2002	AT 310844 T 15-12-2005
		BR 0200461 A 29-10-2002	
		CN 1372028 A 02-10-2002	
		DE 60207454 T2 20-07-2006	
		EA 200200181 A1 26-12-2002	
		EP 1233093 A1 21-08-2002	
		ES 2252417 T3 16-05-2006	
		FR 2821093 A1 23-08-2002	
		HK 1049030 A1 04-05-2007	
		JP 4121286 B2 23-07-2008	
		JP 2002294541 A 09-10-2002	
		KR 20020068278 A 27-08-2002	
		TW 553231 U 11-09-2003	
		US 2002112509 A1 22-08-2002	
CN 108035063	A	15-05-2018	NONE
WO 2006062205	A1	15-06-2006	CN 101072908 A 14-11-2007
		DE 112005003021 T5 25-10-2007	
		JP 4348286 B2 21-10-2009	
		JP 2006161230 A 22-06-2006	
		WO 2006062205 A1 15-06-2006	
EP 2397589	A2	21-12-2011	CN 102286842 A 21-12-2011
		EP 2397589 A2 21-12-2011	
		JP 5525344 B2 18-06-2014	
		JP 2012001858 A 05-01-2012	
		KR 20110138157 A 26-12-2011	
JP 2007231448	A	13-09-2007	JP 5057674 B2 24-10-2012
		JP 2007231448 A 13-09-2007	
EP 2397590	A2	21-12-2011	CN 102286843 A 21-12-2011
		EP 2397590 A2 21-12-2011	
		JP 5732316 B2 10-06-2015	
		JP 2012021252 A 02-02-2012	
		KR 20110138156 A 26-12-2011	
CN 203333962	U	11-12-2013	NONE
EP 1368520	A2	10-12-2003	BR 0208059 A 02-03-2004
		CN 1545579 A 10-11-2004	
		CZ 20032149 A3 14-01-2004	
		DE 10152856 C1 24-04-2003	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2018100430370 A [0003]