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(54) DEVICE AND METHOD FOR PICKING UP TUBULAR KNITTED ARTICLES FROM CIRCULAR KNITTING MACHINES

VORRICHTUNG UND VERFAHREN ZUM AUFNEHMEN VON SCHLAUCHFÖRMIGEN
STRICKWAREN VON RUNDSTRICKMASCHINEN

DISPOSITIF ET PROCÉDÉ POUR PRÉLEVER DES ARTICLES TRICOTÉS TUBULAIRES À PARTIR
DE MACHINES À TRICOTER CIRCULAIRES

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Description

Technical Field

[0001] The present invention relates to methods and machines for producing tubular knitted articles, especially socks and stockings.

Background Art

[0002] For producing tubular articles, especially socks, circular knitting machines are used; these machines knit the article starting from the elastic edge up to the opposite end defining the edges that, once sewn or linked together, form the toe of the sock. In the traditional machines, once the article has been knitted it is unloaded with the open toe, and the articles coming from one or more circular knitting machines are then transferred to a sewing machine. An operator picks single articles up, holding them at the toe end, and introduces them into the sewing machine to close the end of the toe still open after the knitting on the circular knitting machine. This traditional method implies a strong workforce and therefore high production costs.

[0003] Circular knitting devices and machines have been proposed, wherein the tubular article is automatically picked up from the needle cylinder of a circular knitting machine and automatically transferred to a linking or sewing machine outside the circular knitting machine. WO2004/035894 discloses a device for automatically transferring and sewing or linking the toe of a tubular article produced with a circular knitting machine.

[0004] WO2010/086708 discloses a different, simpler and more efficient system for transferring the tubular article from the circular knitting machine to the sewing machine.

[0005] In these known systems, a pick-up device for the tubular article is provided, comprising a plurality of pick-up hooks arranged according to a circular ring subdivided into two half-rings that can be overturned one on top of the other. The pick-up device is positioned coaxially with the needle cylinder of the circular knitting machine, arranging the pick-up hooks so that they can receive the tubular article. In WO2004/035894, the pick-up device is so designed that each single stitch of the last course engaged by a respective needle of the cylinder of the circular knitting machine is transferred onto a respective pick-up hook. It is therefore possible to link the tubular knitted article outside the circular knitting machine. The article thus obtained has high quality but the linking process is complex and long-lasting; furthermore, the pick-up device for the tubular article is particularly complex and expensive.

[0006] The machine disclosed in WO2010/086708 has a pick-up device with a plurality of fixed pick-up hooks entering the last stitches of the tubular article when the last course of stitches of said tubular article is still engaged by the needles of the circular knitting machine.

The pick-up movement of the hooks is obtained by putting the pick-up device near to the stitch formation plane with a movement parallel to the axis of the needle cylinder, so that the hooks enter the fabric of the tubular knitted article. In a subsequent step, the stitches of the last course are removed from the needles and the tubular knitted article remains engaged with the pick-up hooks of the pick-up device that removes the article from the needle cylinder and transfers it to an external sewing or linking machine.

[0007] The Italian patent application PI2007A000091 discloses a circular knitting machine with a pick-up device provided with a plurality of fixed pick-up hooks arranged according to a circular arrangement having a diameter which is smaller than the diameter of the circular needle bed formed by the needles of the cylinder of the circular knitting machine. The tubular article is transferred from the needle cylinder to the hooks ring by removing the last course of stitches from the needles so that, due to the elasticity of the yarn with which the last course of stitches has been formed, the latter contracts and is engaged by the pick-up hooks.

[0008] US6591637 discloses a device for picking-up a tubular knitted article from the needles of a cylinder of a circular knitting machine and for closing the toe of the article by sewing or linking it.

[0009] US5551260 discloses a method and a device for picking-up individual stitches from the needles of the cylinder of a circular knitting machine and for sewing or linking these stitches together, overturning a half-ring of pick-up hooks on top of a complementary half-ring of hooks.

[0010] US1188125 and US1068853 disclose further mechanisms for picking-up the stitches from the needles of a circular knitting machine and for overturning two semi-courses of stitches to perform the linking.

[0011] All these systems have inconveniences due to the complexity of the devices for handling the tubular knitted article or due to low reliability.

[0012] In particular, the picking-up of single stitches of the last course from the needles of the needle cylinder by means of pick-up hooks, the overturning of two semi-courses onto each other through a 180° rotation of two semi-arcs of hooks, and the subsequent linking of the stitches still held by the pick-up hooks, are very complex operations as they require very precise mechanical members. An even small deformation of the pick-up hooks makes the subsequent linking very difficult or even impossible, due to very strict mechanical tolerances.

[0013] WO2014/167047 discloses a method and a device for producing tubular knitted articles, especially socks and stockings, wherein, once the article has been knitted, it is removed from the needle cylinder by means of a pick-up device arranged coaxially above the needle cylinder. A plurality of pick-up hooks cooperate with the needles to engage the tubular article. In order to obtain a simpler and more reliable system, easy to manufacture and maintain, the hooks are configured and arranged,

as to be inserted between pairs of consecutive, i.e. adjacent, needles of the needle cylinder. The hooks engage the sinker loops, i.e. the stitches of the tubular articles formed between consecutive needles. Subsequently, the needle stitches, i.e. the last stitches formed by the needles, are removed from the needles.

[0014] This innovative device allows to implement a much easier method for picking-up an article, with respect to the prior art methods. However, it is possible further to improve the device and method for picking-up tubular articles from the needle cylinder of the circular knitting machine, which produced them.

Summary of the Invention

[0015] According to one aspect, a pick-up device for picking-up tubular knitted articles from a needle cylinder of a circular knitting machine according to claim 1 is disclosed, comprising a circular ring with a symmetry axis, divided into two half-rings. The two half-rings are configured and arranged to overturn one onto the other about an overturning axis approximately orthogonal to the symmetry axis of the circular ring. Each half-ring is provided with a respective plurality of pick-up hooks. Each pick-up hook comprises a pick-up spike extending approximately radially towards the symmetry axis. Each pick-up spike is movable with respect to the respective half-ring between a first, idle position and a second, active position of engagement with the tubular knitted article. The second, active position of the pick-up spike is nearer to the symmetry axis than the first, idle position. In order to align the end edge of the tubular knitted article and to facilitate the picking-up thereof from the needle cylinder of the circular knitting machine, each pick-up hook, or at least some of them, comprises an abutment surface for the toe end of the tubular knitted article. The abutment surface extends approximately radially towards the symmetry axis. Advantageously, the abutment surface projects radially towards the symmetry axis beyond the corresponding pick-up spike, i.e. by a distance greater than the radial length of the respective pick-up spike. The abutment surface is spaced from the respective pick-up spike, so that in the second active position the pick-up spike and the abutment surface are arranged on opposite sides of an end edge of the tubular knitted article. The abutment surface is configured and arranged for abutting and positioning the open toe of the tubular knitted article there against, thus aligning the open toe on a plane substantially orthogonal to the symmetry axis of the circular ring.

[0016] The circular ring may rotate around its own symmetry axis, which in this case is also a rotation axis.

[0017] In some embodiments, the pick-up spike and the abutment surface of each pick-up hook extend radially along the movement direction of the pick-up hook when the latter is actuated to engage the tubular knitted article. In some embodiments, the pick-up hooks are so mounted on the respective half-ring as to pivot around a respective pivoting axis. The pick-up hooks can therefore

move on a radial plane containing the symmetry axis of the circular ring. The pivot axis of each hook may be substantially horizontal, i.e. substantially at 90° with respect to the symmetry axis of the circular ring. The pick-up spike and the abutment surface of each pick-up hook extend approximately transversally to the pivoting axis of the pick-up hook with respect to the half-ring.

[0018] When the pick-up hooks are provided with a pivoting movement, the abutment surface can have at least a curved portion with circular cross-section with a center approximately lying on the pivoting axis of the respective pick-up hook.

[0019] In other embodiments, the pick-up hooks may be mounted so as to slide radially on the respective half-ring according to a direction approximately orthogonal to the symmetry axis of the circular ring.

[0020] For better holding the stitches, for each pick-up hook a closure latch may be provided, configured and arranged to co-act with the respective pick-up hook to engage sinker loops of the tubular knitted article. In some embodiments, the closure latches may be mounted fixed with respect to the circular ring. In other embodiments, for greater effectiveness, the latches may be mounted movable with respect to the circular ring.

[0021] According to a further aspect, a system according to claim 14 is provided comprising:

- a circular knitting machine having a needle cylinder provided with a plurality of needles forming a circular needle bed, and control cams for the raising and the lowering of the needles;
- a pick-up device as described above;
- a closing device, configured and arranged to cooperate with the pick-up device to close a toe of a tubular knitted article while the tubular knitted article is engaged by the pick-up device.

[0022] In some embodiments, the circular knitting machine comprises a motor to control the rotation of the needle cylinder and a central control unit to synchronize the rotation movement of the needle cylinder and the rotation movement of the pick-up device or, more precisely, of the circular ring of pick-up hooks and any closure latches thereof. The pick-up device may comprise a further motor to control the rotation of the circular ring around its rotation axis.

[0023] According to a further aspect, a method for producing a tubular knitted article with a circular knitting machine according to claim 18 is provided, the machine comprising a needle cylinder with a circular needle bed for knitting the tubular article. The method comprises the steps of:

- a) knitting the tubular knitted article starting from an edge and ending with an open toe;
- b) arranging a pick-up device coaxially with the needle cylinder; the pick-up device comprising a circular ring with a symmetry axis, divided into two half-rings,

configured and arranged to over-turn one on top of the other, each half-ring being provided with a respective plurality of pick-up hooks, each of which comprises a pick-up spike extending approximately radially towards the symmetry axis and at least some of which comprise a respective abutment surface, which extends approximately radially towards the symmetry axis, said abutment surface being spaced from the respective pick-up spike;

c) raising the tubular knitted article from the needle cylinder towards the pick-up device, keeping the tubular knitted article engaged by the needles of the needle cylinder;

d) positioning the open toe of the tubular knitted article against the abutment surfaces of the pick-up hooks, aligning the open toe on a plane substantially orthogonal to a rotation axis of the needle cylinder;

e) engaging the tubular knitted article by moving the pick-up hooks towards the symmetry axis, while a last course of stitches is engaged by the needles, a first portion of the open toe of the tubular knitted article being engaged by the pick-up hooks of a first half-ring and a second portion of the open toe of the tubular knitted article being engaged by the pick-up hooks of the second half-ring; the open toe being positioned between the pick-up spikes and the abutment surfaces of the pick-up hooks;

f) removing the stitches of the last course from the needles after the pick-up hooks have engaged the tubular knitted article;

g) removing the tubular knitted article from the needle cylinder by means of the pick-up device;

h) overturning the two half-rings one on top of the other, bringing the pick-up hooks of one half-ring opposite to the pick-up hooks of the other half-ring;

i) joining the first portion and the second portion of the toe of the tubular knitted article together, thus closing the toe of the tubular knitted article;

j) after the toe has been closed, removing the tubular knitted article from the pick-up device.

[0024] Further advantageous features and embodiments of the method and device according to the present invention are described hereunder, with reference to the attached drawings, and in the appended claims, which form an integral part of the present description.

Brief description of the drawings

[0025] A more complete appreciation of the disclosed embodiments of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Figs 1 to 18 show a circular knitting machine and a pick-up device of the tubular article, knitted on the

circular knitting machine, in several operating steps of the pick-up process;

Fig. 19 schematically shows the method of picking-up the sinker loops by means of the pick-up hooks of the pick-up device;

Fig. 20 shows the pick-up device and the device for closing the toe, in a section containing the rotation axis and the overturning axis of the two half-rings, in a position where the toe of the tubular knitted article is sewed;

Figs. 21A and 21B are an enlargement of the portion indicated with XXI in Fig. 20;

Fig. 22 is an enlargement of a modified embodiment, limited to the area of the circular needle bed of the cylinder and of the hooks and latches of the pick-up device;

Figs. 23 and 24 are enlargements of the ends of a pick-up hook and of the respective closure latch, in two different positions during the picking-up of the edge of the open toe of the article;

Fig. 25 is an enlargement of the upper edge of the suction tube according to XXV-XXV of Fig. 22;

Figs. 26A to 26C show, in four different operating positions, a pair of pick-up members formed by a pick-up hook and a closure latch in a different embodiment;

Figs. 27A to 27C show, in three operating positions, a pair of pick-up members formed by a pick-up hook and a closure latch in a further embodiment;

Figs. 28 and 29 are further embodiments of a pair of pick-up members formed by a pick-up hook and the respective closure latch;

Figs. 30 and 31 are isometric views of the pick-up device with the respective support frame and the two half-rings overturned one onto the other in an arrangement for sewing or linking the toe;

Fig. 32 is a lateral view of a pick-up hook isolated in an embodiment;

Fig. 33 is a front view according to XXXIII-XXXIII of Fig. 32;

Figs. 34 and 35 show an enlargement of the interaction area between the needles of the needle cylinder of the circular knitting machine and the pairs of pick-up hooks and closure latches in two different embodiments; and

Figs. 36A to 36K show an operating sequence of a pick-up device during the step of picking-up the tubular article from the needles of the needle cylinder of the circular knitting machine, in a further embodiment.

Detailed description of an embodiment

[0026] The following detailed description of the exemplary embodiments refers to the accompanying drawings. The same reference numbers in different drawings identify the same or similar elements. Additionally, the drawings are not necessarily drawn to scale. Also, the

following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims.

[0027] Reference throughout the specification to "one embodiment" or "an embodiment" or "some embodiments" means that the particular feature, structure or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrase "in one embodiment" or "in an embodiment" or "in some embodiments" in various places throughout the specification is not necessarily referring to the same embodiment(s). Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments.

[0028] A first embodiment of the pick-up device and of the operating process will be initially described with reference to Figs. 1 to 18.

[0029] Fig. 1 shows as a whole a circular knitting machine 1, comprising a needle cylinder 3 provided with a circular bed of needles 5. Each needle 5 slides in a respective groove 2 provided in the needle cylinder 3. A cam mantle 7 is associated to the needle cylinder 3, the cam mantle being represented only schematically in Fig. 1 and known to those skilled in the art. Controlling jacks, not shown, can be associated to the needles 5, the jacks sliding inside grooves 2. The cams of the cam mantle 7 control the lifting and lowering of the needles 5 and of the jacks.

[0030] The needle cylinder 3 is shown in a cross section according to a vertical plane, containing the rotation axis A-A of the needle cylinder 3.

[0031] Number 9 schematically indicates a motor for rotating the needle cylinder 3 around the substantially vertical rotation axis A-A. The needle cylinder 3 may be carried by a base 11, to which a column 13 may also be connected, the column supporting a dial 17 through a frame 15. The dial 17 may present known knitting members (hooks and cams), which can co-act with the needles 5 of the needle cylinder 3 of the circular knitting machine 1 for knitting a tubular knitted article M, for example a stocking or a sock.

[0032] The frame 15 may be raised according to arrow f15 in order to move the dial 17 away from the needle cylinder 3 so that the upper part or head of the needle cylinder 3 can be accessed by a pick-up device 21 (Fig. 4 and following) for picking up the tubular article M knitted on the circular knitting machine 1.

[0033] Coaxially with and inside the needle cylinder 3 a suction tube 4 may be provided, which sucks the tubular knitted article M, for example a sock or a stocking, during knitting. The upper portion of the suction tube 4 may be flared and have a substantially conical shape 4A (see enlargements of Fig. 3 and of Fig. 5).

[0034] Fig. 2 and the enlargement of Fig. 3, which illustrate an enlargement of the area indicated with III in Fig. 2, show the circular knitting machine 1 after the tubular knitted article M has been knitted. The tubular knitted

article has a lower edge B, for example an elastic edge, at one end and a second edge at the opposite end. The second edge defines a toe P (see in particular the enlargement of Fig. 3) of the tubular knitted article M. The toe P is open and still engaged by the needles 5, which knitted the tubular article M. Then, the toe P shall be sewed or linked, to obtain the finished tubular knitted article.

[0035] The dial 17 has been lifted, thus leaving free space above the needle cylinder 3 of the circular knitting machine 1.

[0036] The enlargement of Fig. 3 shows, in addition to one of the needles 5 of the needle cylinder 3, also one of the sinkers 6, interposed between adjacent needles 5 and co-acting with the needles 5 to knit the article. In a known manner, the sinkers 6 are provided with heels 6T, with which sinker cams (not shown) co-acts, these sinker cams being housed in a case 8 arranged in the upper part of the needle cylinder 3.

[0037] Fig. 4 shows the circular knitting machine 1 and the pick-up device 21, which in the meantime has been arranged above the needle cylinder 3 and coaxial therewith. Fig. 5 shows an enlargement of the portion indicated with V in Fig. 4 of the pick-up device 21 and of the needle cylinder 3. Figs. 5A and 5B show enlarged local cross-sections according to the lines A-A and B-B of Fig. 5.

[0038] The pick-up device 21 is supported by a movable frame 22, schematically illustrated in Fig. 4 and shown in greater detail in Figs. 30 and 31, with reference to which further details of the pick-up device 21 will be described. The movable frame 22 moves the pick-up device 21 between the circular knitting machine 1 and a closure device (for example a sewing machine or a linking machine), preferably with a horizontal-only movement, without the need to move the pick-up device 21 in vertical direction, thus obtaining a particularly simple configuration of the pick-up device 21. The movement of the frame 22 may be controlled by means of an electric motor, a hydraulic motor, a linear actuator, for instance a cylinder-piston actuator, or by means of any other suitable mechanism.

[0039] In its general configuration, the pick-up device 21 may be designed analogously to what already described for example in WO 2014/167047; however, it significantly differs from this known solution as regards the shape of the members cooperating with the needles 5 of the needle cylinder 3 of the circular knitting machine 1 in the step of picking-up and transferring the tubular knitted article M. The pick-up process of the tubular knitted article M is also different.

[0040] In general, the pick-up device 21 comprises a circular ring 23 provided with a circular arrangement of pick-up members for picking up the tubular knitted article M from the needle cylinder 3, as described below.

[0041] In some embodiments, the circular ring 23 rotates around a rotation and symmetry axis B-B that, in the position of Fig. 4, is coaxial with the rotation axis A-A of the needle cylinder 3 of the circular knitting machine

1.

[0042] The circular ring 23 is divided into two first half-rings 23A, 23B hinged about an axis C-C, substantially horizontal and substantially orthogonal to the rotation axis B-B of the circular ring 23.

[0043] As can be seen in particular in the enlargement of Fig. 5, each half-ring 23A, 23B comprises a respective series of grooves 27 substantially parallel to the rotation axis B-B. The grooves 27 define housing and guiding seats for pick-up members for the tubular knitted article M. The pick-up members are configured and arranged to engage the tubular knitted article M and remove it from the needle cylinder 3, as it will be better described below. The pick-up members are indicated as a whole with 29.

[0044] In the illustrated embodiment, the pick-up members 29 comprise a plurality of pick-up hooks 31 and a plurality of closure latches 33, which may be configured in various manners according to different embodiments, as will be better described below. A closure latch 33 is associated to each pick-up hook 31. In practical embodiments, a pick-up hook 31 and a closure latch 33 can be housed in each housing seat 27.

[0045] In advantageous embodiments, the closure latches 33 and the pick-up hooks 31 may be made of cut metal sheet and thus may have a reduced thickness, so that the pick-up hooks 31 can be inserted between pairs of adjacent needles 5.

[0046] As illustrated in the enlargement of Fig. 5, in some embodiments, each pick-up hook 31 comprises a body 31A ending, at the bottom, with a head provided with a pick-up spike 31B. The pick-up spikes 31B cooperate with the stitches of the tubular knitted article M in the way described below, in order to pick-up the tubular knitted article M and then transfer it from the circular knitting machine 1 to the closure device which closes the toe of the tubular knitted article M.

[0047] The pick-up spikes 31B face the symmetry and rotation axis B-B of the circular ring 23 of the pick-up device 21. In order to pick-up the tubular knitted article M and transfer it from the needle cylinder 3 to the pick-up device 21, each pick-up hook 31 is arranged with the pick-up spike 31B thereof between two consecutive, i.e. adjacent, needles 5, to engage a respective sinker loop. The closure latch 33 is used to firmly block the sinker loop on the pick-up hook 31, as will be clearly apparent below.

[0048] Fig. 5 shows a single pick-up hook 31, but it should be understood that the device 21 is provided with a plurality of pick-up hooks 31 circularly arranged along the circular ring 23 rotating around the symmetry and rotation axis B-B. Advantageously, the amount of pick-up hooks 31 is such as it is possible to insert a pick-up hook 31 between each pair of needles 5 of the needle cylinder 3 of the circular knitting machine 1.

[0049] In some embodiments, the pick-up hooks 31 are mounted on the circular ring 23 by means of a semicircular spring 35. In practice, each half-ring 23A, 23B has an own semicircular spring 35 which blocks the re-

spective pick-up hooks 31.

[0050] In embodiments described herein, each pick-up hook 31 is mounted in the respective housing seat 27 so as to be able to pivot according to the double arrow f31 as shown in Fig. 5. The pivoting movement is controlled by cams mounted on the pick-up device 21, these cams gradually acting on the pick-up hooks 31 during the rotation of the circular ring 23 around the symmetry and rotation axis B-B, as described in greater detail below.

[0051] A further semicircular spring 37 for each half-ring 23A, 23B of the pick-up device 21 is used to mount a corresponding plurality of closure latches 33. Each closure latch 33 may be mounted sliding according to the double arrow f33 inside the respective housing seat 27.

[0052] In the illustrated embodiment, each closure latch 33 and respective pick-up hook 31 are mounted coplanar with each other in the respective housing seat 27, on a plane passing through the housing seat 27 and containing the symmetry and rotation axis B-B of the circular ring 23. An end part, or distal end, 33A of the closure latch 33, projecting downwards from the respective seat 27, may be folded with respect to the lying plane of the remaining portion of the closure latch 33 and of the corresponding pick-up hook 31, so as to be arranged adjacent to the corresponding end portion of the respective pick-up hook 31, as shown in Fig. 5 and in the cross-sections of Figs. 5A and 5B. The end part 33A of the closure latch 33 projects downwards from the housing seat 27, wherefrom also part of the pick-up hook 31, in particular the pick-up spike 31B thereof, projects.

[0053] By arranging each pick-up hook 31 and the respective closure latch 33 coplanar with each other in the housing seat 27, the housing seats 27 may have a limited tangential dimension, substantially corresponding to the thickness of the respective pick-up hook 31. In this way, it is possible to arrange a high number of housing seats 27 and thus of pairs of pick-up hook 31 and respective closure latch 33 in the rotating circular ring 23, in order to pick-up tubular knitted articles M from high-fineness knitting machines 1, i.e. machines with a high number of needles 5 per length unit of the circular needle bed.

[0054] In embodiments described herein, in the lower part, adjacent to or in proximity of the pick-up spike 31B, each pick-up hook 31 has an appendix 39 which projects from the main body 31A of the pick-up hook 31 on the same side as the pick-up spike 31B, i.e. radially inwards, directed towards the symmetry and rotation axis B-B of the rotating circular ring 23 of the pick-up device 21.

[0055] In the illustrated embodiment, the length of each appendix 39 in the radial direction is larger than, approximately twice, the length in radial direction of the pick-up spike 31B.

[0056] In embodiments described herein, the appendix 39 of each pick-up hook 31 has a lower edge (i.e. an edge facing the needle cylinder 3 of the circular knitting machine 1 when the pick-up device 21 is in coaxial position with respect to the needle cylinder 3) defining an

abutment surface 39S for the tubular knitted article M. As will be clearly apparent from the description of the pick-up cycle of the tubular knitted article M, the abutment surface 39S is used to horizontally align the edge forming the open toe P of the tubular knitted article M in the pick-up step. Practically, all the edges forming the surfaces 39S of the appendixes 39 of the pick-up hooks 31 are arranged to form an annular surface extending around the rotation axis B-B of the rotating circular ring 23.

[0057] In the embodiment illustrated in Figs. 1 to 19, the abutment surface 39S extends substantially cylindrically, i.e. has a circular transversal cross-section, whose center approximately coincides with a pivoting axis D-D of the respective pick-up hook 31 with respect to the housing seat 27. The pivoting axis D-D is substantially defined by the center of the semi-annular spring 35 and is oriented at 90° with respect to the symmetry and rotation axis B-B of the rotating circular ring 23 on which the pick-up hooks 31 are mounted.

[0058] In the embodiment illustrated in Figs. 1 to 19, the end part 33A of the closure latch 33 presents an edge 33B orientated radially outwardly, which may have a curved shape, particularly a concave shape. In some embodiments, the edge 33B may have a profile according to a portion of a circumference lying in a vertical plane, in order to prevent interferences between the closure latch 33 and a needle of a sewing or linking machine used to close the toe P of the tubular knitted article M in the final step of the toe closing cycle.

[0059] Having briefly described the main components of the circular knitting machine 1 and of the pick-up device 21, a method of picking up a tubular article M knitted by the circular knitting machine 1 will now be described with reference to Figs. 1 to 19.

[0060] As mentioned above, in Fig. 1 the circular knitting machine 1 is shown in the position in which it is arranged once knitting of the tubular article M has been completed. The dial 17 is still close to the head or upper part of the needle cylinder 3. The last course formed by the needles 5 of the needle cylinder 3 is still engaged by the needles 5, which are in a lower position. Practically, one needle loop is engaged by each needle 5 of the needle cylinder 3, the needle loop having been formed in the last revolution of the needle cylinder 3. Between consecutive or adjacent needles, sinker loops are arranged, which are yarn loops joining consecutive needle loops and formed by the respective sinkers 6 interposed between the needles 5 of the needle cylinder 3.

[0061] In the following step (Figs. 2 and 3) the dial 17 is lifted, leaving free space to introduce the pick-up device 21, as shown in Fig. 4. Fig. 5 shows one of the needles 5 of the needle circular bed formed on the needle cylinder 3, with its end hook 5A and a latch 5B hinged, at 5C, to the stem 5D of the needle 5. Just by way of nonlimiting example, the latch 5B is shown open, but it may actually be in closed position, i.e. lifted and resting against the tip of the hook 5A of the needle 5. MA schematically indicates the last needle loop knitted by the needle 5. The

needle loops MA engaged by the needles 5 of the needle cylinder 3 form the last course of the tubular knitted article M.

[0062] In Fig. 5 the pick-up members 29 are in an idle position, at a greater height than the height of the needles 5 and the sinkers 6 of the needle cylinder 3. The closure latches 33 are in the upper position, retracted in the seats 27, while the pick-up hooks 31 are in open position, i.e. with the pick-up spikes 31B in the outermost radial position with respect to the rotation axis B-B of the rotating circular ring 23.

[0063] Figs. 6, 7 and 8 show the subsequent step. Fig. 6 shows the needle cylinder 3 and of the pick-up device 21; Fig. 7 shows an enlargement of the detail indicated with VII in Fig. 6; and Fig. 8 shows an enlargement of the detail indicated with VIII in Fig. 7. In these figures it is clearly apparent that, through the cams of the cam mantle 7, schematically represented in Fig. 1, by rotating the needle cylinder 3 around the rotation axis A-A thereof by means of the motor 9, the needles 5 are gradually lifted from the lower position illustrated in Figs. 4 and 5 to the upper position, i.e. the position where they are completely extracted from the grooves 2 of the needle cylinder 3.

[0064] The upward movement (arrow f5 in Fig. 7) of the needles 5 is such that in the completely lifted condition, the hooks 5A of the needles 5 are at a greater height than the height of the abutment surface 39S (Fig. 8) formed by each appendix 39 of the pick-up hooks 31.

[0065] During the lifting movement according to the arrow f5, each needle 5 draws the respective needle loop MA by means of friction between the yarn forming the loop and the stem 5D of the needle 5. In this way, the gradual sequential lifting of all the needles 5 during the rotation of the needle cylinder 3 bring the whole annular edge of the tubular knitted article M, defining the open toe P, against the abutment surfaces 39 defined by the appendixes 39.

[0066] In practice, thanks to the length of the extraction movement of each needle 5, controlled by the needle lifting cams, all the needle loops MA are brought at a height corresponding to the abutment surface 39S of the pick-up hooks 31. The lifting movement of the tubular knitted article M stops when abutting against the abutment surface 39S, while the needles 5 continue lifting up to the maximum raised position, i.e. the position of maximum extraction, shown in Fig. 7.

[0067] Fig. 8 is an enlargement of one of the pick-up hooks 31 with the respective appendix 39. S indicates the reference toroidal surface (i.e. extending annularly around the rotation axis A-A of the needle cylinder and around the symmetry and rotation axis B-B of the rotating circular ring 23 comprised of the two half-rings 23A, 23B), against which the whole edge defining the toe P of the tubular knitted article M abuts when the needles 5 are lifted.

[0068] When all the needles 5 of the needle cylinder 3 have been lifted, the edge defining the open toe P, still engaged by the needles 5, is aligned to the surface S.

The lifting movement of the needles 5 is such that the latches 5B of the needles open and move above the height at which the needle loops MA stop.

[0069] In some embodiments, in order to facilitate the lifting of the tubular knitted article M in this step, it is possible to lift axially also the suction tube 4, which is arranged inside the needle cylinder 3 and coaxial with it, as shown in particular in the enlargement of Fig. 7.

[0070] Figs. 9 and 10 show the closing step of the pick-up hooks 31. Fig. 10 is an enlargement of the detail indicated with X in Fig. 9. Fig. 11 is an enlargement of the detail indicated with XI in Fig. 10. During the closing step of the pick-up hooks 31, the hooks are pivoted radially inwardly, making the pick-up spikes 31B of the pick-up hooks 31 engage the sinker loops arranged between the needle loops MA engaged by consecutive needles 5 of the needle cylinder 3.

[0071] Figs. 12, 13 and 14 show the subsequent step, wherein the needles 5 of the needle cylinder 3 start their descent, discharging the needle loops MA. Fig. 12 shows the set of the pick-up device 21 and of the needle cylinder 3; Fig. 13 shows an enlargement of the detail indicated with XIII in Fig. 12; and Fig. 14 shows an enlargement of the detail indicated with XIV in Fig. 13. In the relative movement between needles 5 and needle loops MA, these latter slide on the stem 5D of the respective needle 5 causing the closure of the latches 5B, so that the loops MA pass over the latches 5B and are removed from the needle.

[0072] Before lowering the needles by means of the cams mantle 7, it may be advantageous to close the closure latches 33, sliding them downwards according to the arrow f33, as can be seen by comparing Figs. 7 and 10; in Fig. 10 the closure latch 33 is at a lower height than the height of Fig. 7. In this way, the sinker loops, which are engaged by the pick-up spikes 31B of the single pick-up hooks 31, remain firmly fastened between the closure latch 33 and the pick-up hook 31, and more exactly between the lower end part 33A of each latch 33 and the pick-up spike 31B of the respective pick-up hook 31.

[0073] In Figs. 15, 16 and 17, the downward movement of the needles 5 has been completed. Fig. 16 shows an enlargement of the detail indicated with XVI in Fig. 1, while Fig. 17 shows an enlargement of the detail indicated with XVII in Fig. 16. The head of the needles 5, and thus their hooks 5A, are arranged under the respective sinkers 6.

[0074] In Fig. 18 the pick-up device 21 has started the transferring movement thereof according to arrow f21 from the circular knitting machine 1 towards a closure device, for example a sewing or linking device, where (in an essentially identical way to what already described for example in WO 2014/167047) the stitches of the last courses formed around the toe P of the tubular knitted article M are joined, after having overturned the two half-rings 23A, 23B one on top of the other.

[0075] Fig. 19 schematically shows a greatly enlarged

portion of knitted fabric and the arrangement of the needles 5 and of the pick-up hooks 31 during transfer of the tubular knitted article M from the circular knitting machine 1 to the pick-up device 21. Fig. 19 schematically shows some needles 5 that, with their stems, still engage needle loops MA, the last loops formed by the knitting process.

[0076] The sinker loops MP, each of which is arranged between pairs of consecutive needle loops MA, are engaged by the respective pick-up hooks 31. MR indicates as a whole the last course of stitches formed by the needles 5 of the circular knitting machine 1. The diagram of Fig. 19 illustrates the ideal situation, where each pick-up hook 31 has engaged the last sinker loop MP of each column CP of sinker loops, i.e. each pick-up hook 31 has engaged the sinker loop arranged between the needle loops MA of two consecutive needles 5, between which the pick-up hook 31 has been inserted. This ideal situation might not occur in reality, due to the non-rigid nature of the knitted fabric, with the consequence that in some cases the pick-up hook 31 may engage one or more sinker loops of the inner courses. However, this doesn't affect the operation of the device, neither the quality of the final product.

[0077] Just by way of example, Figs. 20, 21A and 21B show a detail of a closure device for closing the toe by linking or sewing, which co-acts with the pick-up device 21. Fig. 20 is a cross-section along a vertical plane containing the symmetry and rotation axis B-B and the overturning axis C-C of the two half-rings 23A, 23B. Figs. 21A and 21B show respective enlargements of the area indicated with XXI in Fig. 20. Fig. 21A shows an isometric view and Fig. 21B shows a plan view of the area XXI wherein the sewing device, indicated as a whole with 41, is arranged. Number 43 and 45 indicate two sewing or linking needles of the closure device 41. In the detail of Figs. 21A and 21B, the closure latches 33 have, by way of example, a different shape than the closure latches 33 illustrated in Figs. 2 to 18, but they perform the same function as the closure latches described with reference to Figs. 2 to 18.

[0078] The sewing or linking operations are known per se and described also in WO 2014/167047 and do not require detailed description herein. It shall be only noted that, having overturned the two half-rings 23A, 23B of the pick-up device 21 one on top of the other, the pick-up hooks 31 of one half-ring are arranged opposite the pick-up hooks 31 of the opposite half-ring, and thus the needle loops of a final half-course (engaged by the pick-up hooks 31 of a half-ring 23A) are arranged opposite the needle loops of the complementary final half-course (engaged by the pick-up hooks 31 of the other half-ring 23B). Sewing or linking by means of the needles 43 and 45 is performed on these needle loops and eventually on the loops of the adjacent courses, thus obtaining the closure of the toe P of the tubular knitted article M.

[0079] Also in Figs. 21A and 21B the closure latches 33 have a curved edge 33B, with an arched concave profile. This profile allows the needle 43 to move forward

the sliding seats of the pick-up hooks 31 and of the closure latches 33 without hitting these latter during the sewing or linking movement. Therefore, a better quality sewing is obtained.

[0080] In practice, during the closure by means of sewing or linking of the loops MA of the tubular knitted article M, the needle 43, which has curved and preferably circular shape, moves with reciprocating rotatory motion (arrow f43, Fig. 21A) controlled for example by a shaft 43A (Fig. 21A), along a circular trajectory, adjacent and approximately parallel to the curved edge 33B of the closure latches 33. The curved edge 33B is preferably shaped as an arc of circumference, with a center coinciding with the center of the circular trajectory performed by the needle 43.

[0081] Before overturning the two half-rings 23A, 23B and sewing or linking the two opposite half-courses of stitches surrounding the toe P, the tubular knitted article M may be everted, bringing outwards the originally inner surface of the tubular knitted article and vice versa, for example by suction from the center of the pick-up device 21, as already known per se and described for example in WO 2014/167047, which should be referred to for further details.

[0082] As mentioned above, in advantageous embodiments, the operations described above for transferring the tubular knitted article M from the needles 5 of the needle cylinder 3 to the pick-up hooks 31 are performed gradually by rotating synchronously the needle cylinder 3 and the circular ring 23 supporting the pick-up hooks 31 and the closure latches 33. In this way it is possible to transfer the stitches in a gradual manner, by lifting gradually and in sequence the needles 5 during the rotation of the needle cylinder 3 through a suitable lifting cam, and engaging the sinker loops that are thus lifted through gradual and sequential pivoting of the single pick-up hooks 31 and lowering of the respective closure latches 33 through cams supported by the pick-up device 21 and described below with reference to Figs. 30 and 31. Also the lowering of the needles 5 of the needle cylinder 3 may occur in a gradual manner through cams actuation, while the needle cylinder 3 and the circular ring 23 rotate synchronously around the coinciding axes A-A and B-B.

[0083] In advantageous embodiments, the rotation of the circular ring 23 supporting the seats 27 with the pick-up members 29 may be controlled by an autonomous motor 10, in addition to, and different than, the motor 9 which rotates the needle cylinder 3, schematically illustrated in Fig. 4 and better described below with reference to Figs. 30 and 31.

[0084] As schematically indicated in Fig. 4, the motor 9 for the rotation of the needle cylinder and the motor 10 for the rotation of the circular ring 23 may be functionally connected to a control unit 12, which maintains the synchronization of the rotation of these motors. The connection between the motors 9, 10 and the control unit 12 may be provided through a wired or a wireless system.

[0085] In this way, it is possible to start rotation of the circular ring 23 of the pick-up device 21 before the step of transferring the tubular knitted article M from the needle cylinder 3 to the pick-up device 21. When the pick-up device 21 and the needle cylinder 3 are arranged coaxial with each other, as illustrated in Fig. 4, they can already rotate synchronously, so that the gradual lifting step of the needles 5 by means of the cams of the mantle 7 of the needle cylinder 3 can be started promptly, thus decreasing the time necessary for transferring the tubular knitted article M to the pick-up device 21.

[0086] Thanks to gradual transferring of the tubular knitted article M by means of sequential lifting of the needles 5 through the cams of the mantle 7 of the needle cylinder 3 and the simultaneous gradual engaging of the sinker loops by means of the pick-up spikes 31B of the pick-up hooks, and the subsequent lowering of the needles 5 and the removing of the needle loops MA, the transferring operations are gradual and, thus, do not excessively stress the mechanical members nor the knitted fabric, resulting in a more regular and uniform transferring.

[0087] Figs. 22 to 25 show a different embodiment of the pick-up members 29. In particular, Fig. 22 shows an enlargement of the area where the tubular knitted article M is transferred from the needle cylinder 3 to the pick-up device 21 once knitting is finished. In Fig. 22, the needles 5 are in the maximum lifting position, and the edge delimitating the open toe P of the tubular knitted article M is abutting the surface 39S of the pick-up hooks 31, as shown in greater detail in the enlargements of Figs. 23 and 24.

[0088] In this embodiment, each closure latch 33 has in the distal portion, i.e. the portion facing the needle cylinder 3, a spike 33Y facing the fabric of the tubular knitted article M. As it can be seen by comparing Figs. 23 and 24, while transferring of the tubular knitted article M from the needles 5 of the needle cylinder 3 to the pick-up device 21, the closure latches 33 are moved downwards according to the arrow f33, making the spikes 33Y penetrate through the fabric of the tubular knitted article M adjacently to the last course of needle loops MA still engaged by the stems 5D of the needles 5. After the lowering of the closure latches 33 according to f33, the pivoting movement of the pick-up spikes 31B of the pick-up hooks 31 according to f31 is performed radially inwards, thus ensuring optimal picking-up of the edge of knitted fabric surrounding the toe P.

[0089] In order to facilitate penetration of the spikes 33Y of the closure latches 33 through the knitted fabric of the tubular knitted article M, in some embodiments the suction tube 4 may have a comb-shaped upper end portion 4A, as shown in the enlarged detail of Fig. 22, with recesses or slots 4B, into which the end portions of the closure latches 33, in particular the spikes 33Y, may insert.

[0090] Figs. 26A to 26C show a different embodiment of the pick-up members 29, in three positions during the

pick-up cycle of a sinker loop. The pick-up members 29 comprise pairs, each of which is formed by a pick-up hook 31 and a closure latch 33. Equal numbers indicate equal or equivalent parts to those illustrated with reference to the previous figures. In the embodiment of Figs. 26A to 26C, each pick-up hook 31 and closure latch 33 is formed by a respective cut metal sheet and may be held circumferentially around the rotation axis B-B of the rotating circular ring 23 by means of semi-annular springs 35. In this embodiment, the closure latch 33 and the pick-up hook 31 are arranged adjacent to each other in the respective housing seat 27 (not shown in the figure), and not coplanar (only as regards the portion housed in the housing seat 27) on a same radial plane containing the axis B-B, as described with reference to Figs. 1 to 18. The embodiment of Figs. 26A to 26C is constructively easier, but requires a greater tangential dimension of the housing seats 27 for the pick-up members 29. In fact, the tangential dimension of the housing seats 27 shall be equal to at least the sum of the thicknesses of the metal sheets forming the pick-up hook 31 and the closure latch 33.

[0091] The end part 33A of the closure latch 33 is provided with a distal end, wherein a recess 33X is provided. As it is clear from the sequence of Figs. 26A to 26C, the recess 33X cooperates with the nip, indicated by 31X, formed at the base of the pick-up spike 31B of the respective pick-up hook 31. This ensures a better picking-up of the yarn forming the sinker loop which remains engaged by the pick-up members 29.

[0092] Figs. 27A, 27B and 27C show an embodiment similar to the one of Figs. 26A to 26C, with a different shape of the recess 33X, that has the same purpose of the recess 33X of Figs. 26A to 26C.

[0093] Fig. 28 is a further embodiment of a pair of pick-up members 29 comprising a pick-up hook 31 and a closure latch 33. In this embodiment, the closure latch 33 has, along its edge facing radially outwards with respect to the rotation axis B-B of the rotating circular ring 23, a concave edge portion, indicated with 33B, whose profile may advantageously be shaped as an arc of a circumference, for the purposes already described with reference to Figs. 21A, 21B. This portion of the concave edge 33B is provided in the distal portion 33A of the closure latch 33, i.e. the portion adjacent to the distal portion forming the pick-up spike 31B of the pick-up hook 31. The portion of concave edge 33B is used to more efficiently prevent any risks of collision between the needle 43 (Figs. 21A, 21B) of the sewing or linking machine 41 during the sewing or linking step of the end stitches of the tubular knitted article M.

[0094] Fig. 29 is a further embodiment of the pick-up members 29 comprising, in each seat 27 of the half-rings 23A, 23B, a pick-up hook 31 and a closure latch 33. In this embodiment, the closure latch 33 is devoid of concave edge 33B and has a recess 33X, whose shape is slightly different with respect to what illustrated for example in Fig. 27.

[0095] Figs. 30 and 31 show isometric views of the frame 22 for supporting and moving the pick-up device 21, as well as the pick-up device 21 with the half-rings 23A, 23B overturned one onto the other in the arrangement for closing the toe of the tubular article M. In the illustrated embodiment, the frame 22 is supported on a vertical column 81 and rotates with respect to the axis thereof to transfer the pick-up device 21 from the position coaxial with the needle cylinder 3 of the circular knitting machine to the closure device 41 for closing the toe of the tubular knitted article M.

[0096] The frame 22 may support the motor 10, which, in this embodiment, rotates the circular ring 23 with the pick-up members 29 around the symmetry and rotation axis B-B. The motion is transmitted from the motor 10 to the circular ring 23 by means of a kinematic transmission which may comprise a toothed belt 83 (Fig. 31) driven about a drive pulley 85 and a gear wheel 87. The gear wheel may be keyed on a cylindrical support 89, rotatably supported on the frame 22. The gear wheel 87 and the cylindrical support 89 rotate around the symmetry and rotation axis B-B of the circular ring 23. A group of cams, schematically indicated with 91 in Fig. 30, may be housed in the lower part of the frame 22, the cams acting on the pick-up hooks 31 and on the closure latches 33 when the circular ring 23 rotates around the symmetry and rotation axis B-B, integrally to the cylindrical support 89, driven in rotation by means of the gear wheel 87 actuated by the motor 10. As described above, the group of cams 91 controls the pivoting and translating movements of the pick-up hooks 31 and of the latches 33 during the steps of picking-up and subsequently releasing the tubular knitted article M.

[0097] Number 93 indicates an actuator, for example an electric motor or a pneumatic or hydraulic actuator which controls, through a bracket 95, the rotation of the half-ring 23B which can be overturned (arrow f23) on top of the half-ring 23A.

[0098] In some embodiments, the pick-up hook 31 may be provided with a curved or bent, i.e. non-planar, metal sheet, so as to impart an elastic deformation to the pick-up hook 31, and thus an elastic preload, when the hook is mounted in the respective housing seat 27. Figs. 32 and 33 show an embodiment of this type. Fig. 33 illustrates a view of the pick-up hook 31 according to a radial direction XXXIII-XXXIII, and clearly shows the curved shape of the metal sheet forming the pick-up hook 31. The cut metal sheet forming the pick-up hook 31 has an intermediate curvature so that, when the hook is inserted in the narrow housing seat 27, whose tangential dimension is smaller than the camber F (Fig. 33) formed by the curved metal sheet of the pick-up hook 31, this latter is elastically preloaded and presses against the opposite radial walls of the housing seat 27, or on one hand against one of the radial walls of the housing seat 27 and on the other hand against the closure latch 33 associated to the pick-up hook 31 in the same housing seat, depending on whether the pick-up hook 31 and the closure latch are

coplanar or adjacent to one another in the housing seat 27.

[0099] Figs. 34 and 35 show, in a view according to a radial direction, a portion of the circular bed of needles 5, wherein the needles are lifted and interposed between pairs of pick-up members 29, each of which comprises a closure latch 33 and a respective pick-up hook 31. In Fig. 34, the closure latch 33 and the pick-up hook 31 are adjacent to each other, i.e. arranged one aside the other in tangential direction in the respective housing seat provided in the rotating circular ring 23. The tangential dimension (DT) of the housing seat 27 of the pair closure latch 33/pick-up hook 31 is equal to at least the sum of the thicknesses of the metal sheets forming these two members 31 and 33.

[0100] Vice versa, Fig. 35 shows an arrangement, wherein the closure latch 33 is arranged coplanar with the pick-up hook 31 in the housing seat 27. The end portion 33A of the closure latches 33 is folded at 33P so as to move outside the lying plane of the respective pick-up hook 31 and flank the pick-up spike 31B of the pick-up hook 31 in the area wherein the two members shall co-act in order to engage the tubular knitted article M.

[0101] In the embodiments described hereinbefore, the pick-up hook 31 is provided with a pivoting movement around a horizontal axis D-D, oriented at 90° with respect to the rotation axis B-B of the circular ring 23, in order to move the pick-up spike 31B to engage the sinker loop between two consecutive needles 5 of the needle cylinder 3 of the circular knitting machine 1. Vice versa, the closure latch 31 is provided with a translation movement substantially parallel to the rotation axis B-B of the circular ring 23. In other embodiments, the movement of the pick-up hooks 31 may be different, for example it may be a translation movement in a radial direction instead of a rotation movement.

[0102] The sequence of Figs. 36A to 36K shows, schematically and in an axonometric view, an embodiment with pick-up hooks 31 provided with a radial translation movement. The figures show only a portion of the circular bed of needles 5 and a portion of the rotating circular ring 23 of the pick-up device 21. Number 27 indicates the housing seats of the pairs of pick-up members 29. Each pair of pick-up members 29 comprises a pick-up hook 31 and a closure latch 33, as in the embodiments described hereinbefore. The closure latch 33 is provided with a translation movement according to f33, parallel to the rotation axis B-B of the rotating circular ring 23. Vice versa, and contrarily to what described in the embodiments described hereinbefore, the pick-up hook 31 are provided with a radial movement according to the double arrow f31 in order to be extracted from and retracted in the rotating circular ring 23.

[0103] In Fig. 36A, the needles 5 of the needle cylinder (not shown) are in a lower position, wherein the needle loops MA are engaged by the needles 5 and the latches 5B are closed. The pick-up hooks 31 have been extracted from the respective seats 27 of the pick-up device 21,

which is arranged coaxially to the circular bed of needles 5. For the sake of clarity, the sequence of Figs. 36A to 36K shows one single pair of pick-up members 29, but it should be understood that a similar pair of pick-up members 29 is housed in each housing seat 27 of the rotating circular ring 23.

[0104] Figs. 36B, 36C show the lifting movement of the needles 5 according to the arrow f5, the needles moving to such a height that the knitted fabric of the tubular knitted article M interferes with the abutment surface 39S. In this case the abutment surface 39S is not formed on an appendix projecting from the main body 31A of the pick-up hook 31, but by the downwardly facing edge of the main body 31A.

[0105] In Fig. 36D, the pick-up hook 31 is moving radially inwards to engage the sinker loop formed between the two adjacent needles 5, between which the pick-up hook 31 is arranged.

[0106] Fig. 36E shows the step where the closure latch 33 is moved axially downwards according to the arrow f33 in order to close the sinker loop between the closure latch 33 and the pick-up spike 31B of the pick-up hook 31.

[0107] Figs. 36F to 36H show the step of subsequent further lifting of the needles 5 until the latch 5B is moved above the needle loops MA. This further lifting may be performed at the same time as, or before, the radial inwards movement of the pick-up hook 31.

[0108] Figs. 36I, 36J, and 36K show the subsequent downwards movement of the needles 5, still indicated by the arrow f5, which results in the removal of the needle loops MA from the needles 5. In Fig. 36K the needle loops MA have been removed from the needles 5 which continue their downwards movement, thus clearing the space surrounding the pick-up device 21, thus allowing this latter to move towards the sewing or linking device 41, without requiring to move the pick-up device 21 vertically.

[0109] While in the embodiments described with reference to the attached figures, a circular ring 23 rotating around the axis B-B is provided, in order to actuate the pick-up members in a gradual and sequential manner through appropriate cams, in other embodiments the circular ring 23 may be non-rotating, but rather fixed with respect to a support of the pick-up device. In this case, the actuation of the pick-up hooks 31 and of the closure latches 33 may occur for example by means of annular cams that actuate simultaneously all the pick-up hooks 31 and all the closure latches 33 at the same time.

[0110] However, as it has been observed above, the use of a circular ring 23 rotating around an axis B-B and of control cams, which, during the rotation, act sequentially onto the pick-up hooks 31 and the closure latches 33, is particularly advantageous for example with regards to the reduction of the stress on the mechanical parts and on the fabric (yarn and knitted fabric), and it is also preferable with regards to the operating speed and to the regular operation.

[0111] The advantages of a pick-up device with a ro-

tating circular ring, in particular the advantages of a pick-up device provided with a circular ring rotating synchronously with the needle cylinder 3 of the circular knitting machine 1, may be used also with a different embodiment of the pick-up hooks and of the closure latches, of the type for instance illustrated in WO2014/167047. Moreover, two electric motors operating synchronously to rotate the circular ring 23 and the needle cylinder 3 and an arrangement of control cams controlling the pick-up members to actuate them gradually, may be used also in different types of pick-up devices, for example designed to pick-up the needle loops by means of single pick-up hooks directly from the head of the needles of the needles circular bed of the knitting machine 1, as described in WO2004/035894.

Claims

1. A pick-up device (21) for picking-up a tubular knitted article (M) from a needle cylinder (3) of a circular knitting machine (1), the device comprising a circular ring (23) with a symmetry axis (B-B), which is divided into two half-rings (23A, 23B) configured and arranged to overturn over each other around an overturning axis (C-C) approximately orthogonal to the symmetry axis (B-B) of the circular ring (23); wherein each half-ring (23A, 23B) is provided with a respective plurality of pick-up hooks (31); wherein each pick-up hook (31) comprises a main body (31A) and a pick-up spike (31B) extending from the main body (31A) approximately radially towards the symmetry axis (B-B); wherein each pick-up spike (31B) is movable with respect to the respective half-ring (23A, 23B) between a first idle position and a second active position of engagement with the tubular knitted article (M), the second active position being nearer to the symmetry axis than the first idle position; **characterized in that** at least some of the pick-up hooks (31) comprise a respective integrally formed abutment surface (39S) for abutting a toe end of the tubular knitted article, which extends approximately radially towards the symmetry axis (B-B) over a distance greater than the radial length of the respective pick-up spike (31B), said abutment surface (39S) being spaced from the respective pick-up spike (31B) such that in the second active position the pick-up spike (31B) and the abutment surface (39S) are positioned on opposite sides of a final edge of the tubular knitted article (M).
2. Pick-up device according to claim 1, wherein the circular ring (23) is rotatable around the symmetry axis (B-B).
3. Pick-up device according to claim 1 or 2, wherein the abutment surface (39S) of each pick-up hook (31) is formed by the main body of the pick-up hook

(31) or projects therefrom.

4. Pick-up device according to claim 1, 2 or 3, wherein the pick-up spike (31B) and the abutment surface (39S) of each pick-up hook (31) lie on a radial plane containing the symmetry axis (B-B).
5. Pick-up device according to one or more of the previous claims, wherein the pick-up hooks (31) are mounted on the respective half-ring (23A, 23B) so as to pivot around a respective pivoting axis (D-D); and wherein the abutment surface (39S) preferably has at least one curved portion with a circular shape having a center approximately lying on the pivoting axis (D-D) of the respective pick-up hook (31).
6. Pick-up device according to one or more of claims 1 to 4, wherein the pick-up hooks (31) are mounted so as to slide radially on the respective half-ring (23A, 23B) according to a direction approximately orthogonal to the symmetry axis (B-B) of the circular ring (23).
7. Pick-up device according to one or more of the previous claims, further comprising a closure latch (33) for each pick-up hook (31), the closure latch (33) being movable, preferably with a movement substantially parallel to the symmetry axis (B-B) of the circular ring (23), between a first, rest position, in which the end part (33A) of the closure latch (33) preferably overlaps the abutment surface (39S) of the respective pick-up hook (31), and a second position where an end part (33A) of the closure latch (33) co-acts with the pick-up spike (31B) of the respective pick-up hook (31).
8. Pick-up device according to claim 7, wherein the end part (33A) of each closure latch (33) has a recess (33X) oriented radially outwardly with respect to the symmetry axis (B-B) of the circular ring (23).
9. Pick-up device according to one or more of claims 8 to 11, wherein the half-rings (23A, 23B) comprise respective housing seats (27), a pick-up hook (31) and the respective closure latch (33) being arranged in each housing seat (27); wherein preferably each pick-up hook (31) is formed by a non-planar metal foil, and is mounted in a respective housing seat (27) provided in the half-ring (23A, 23B) through elastic deformation, to take a substantially planar shape; and wherein each pick-up hook (31) and the respective closure latch (33) are mounted in the housing seat (27) adjacent to each other according to a tangential direction around the symmetry axis (B-B) of the circular ring (23); and wherein, when the pick-up hook (31) is mounted in the housing seat (27), the metal foil can be elastically deformed so as to elastically press against the respective closure latch.

10. Pick-up device according to claim 9, wherein each pick-up hook (31) and the respective closure latch (33) are mounted in the housing seat (27) coplanar with each other on a substantially radial plane containing the symmetry axis (B-B) of the circular ring (23); wherein the pick-up spike (31B) of each pick-up hook (31) and an end part (33A) of each closure latch (33) project from the respective housing seat (27); and wherein the end part (33A) of the closure latch (33) is bent so as to be outside said substantially radial plane and adjacent to the pick-up spike (31B) of the respective pick-up hook (33).
11. Pick-up device according to one or more of claims 7 to 10, wherein the closure latch (33) has an end part (33A), adjacent to the pick-up spike (31B) of the respective pick-up hook (31), with a curved edge (33B) oriented radially outwardly with respect to the symmetry axis (B-B) of the circular ring (23).
12. Pick-up device according to one or more of claims 7 to 11, wherein at least some closure latches (33) have spikes (33Y) configured and arranged to penetrate the fabric of the tubular knitted article (M), and oriented preferably approximately parallel to the symmetry axis (B-B) of the circular ring (23).
13. Pick-up device according to one or more of the previous claims, comprising a motor (10) to control the rotation of the circular ring (23) around the symmetry axis (B-B).
14. A system comprising:
- a circular knitting machine (1) having a needle cylinder (3) provided with a plurality of needles (5) forming a circular needle bed, and control cams (7) to control raising and lowering of the needles (5);
 - a pick-up device (21) according to one or more of the previous claims;
 - a closing device (41), configured and arranged to co-act with the pick-up device (21) to close a toe (P) of a tubular knitted article (M) while said tubular knitted article (M) is engaged by the pick-up device (21).
15. System according to claim 14, wherein: the circular knitting machine (1) comprises a motor (9) to control the rotation of the needle cylinder (3); the pick-up device (21) comprises a rotation mechanism to control the rotation of the circular ring (23) around the symmetry axis (B-B) in synchronism with the rotation of the needle cylinder (3); wherein the rotation mechanism preferably comprises a further motor (10) and the system comprises a central control unit (12) adapted to synchronize the rotation movement of the needle cylinder (3) around the rotation axis (A-A) of the needle cylinder (3) and the rotation movement of the circular ring (23) around the symmetry axis (B-B) of the circular ring (23).
16. System according to claim 14 or 15, wherein the pick-up device (21) comprises control cams (91) for controlling the pick-up members (29); and wherein said control cams control the movement of the pick-up members (29) in synchronism with the lifting and lowering movement of the needles (5) of the circular knitting machine (1).
17. System according to claim any one of claims 14 to 16, wherein the pick-up members (29) of the pick-up device (21) are configured and arranged to be inserted between consecutive needles (5) of the needle cylinder (3) and to engage sinker loops (MP) of a tubular knitted article (M) formed by the needle cylinder (3).
18. A method for manufacturing a tubular knitted article (M) by means of a circular knitting machine (1) comprising a needle cylinder (3) with a circular bed of needles (5); said method comprising the steps of:
- a) knitting the tubular knitted article (M) starting from an edge (B) and ending with an open toe (P);
 - b) arranging a pick-up device (21) coaxially with the needle cylinder (3); the pick-up device (21) comprising a circular ring (23) with a symmetry axis (B-B), divided into two half-rings (23A, 23B) configured and arranged to be overturned one on top of the other around an overturning axis (C-C) approximately orthogonal to the symmetry axis (B-B) of the circular ring (23), each half-ring being provided with a respective plurality of pick-up hooks (31), each of which comprises a main body (31A) and a pick-up spike (31B) extending from the main body (31A) approximately radially towards the symmetry axis (B-B) and at least some of which comprise a respective integrally formed abutment surface (39S), which extends approximately radially towards the symmetry axis (B-B) over a distance greater than the radial length of the respective pick-up spike (31B), said abutment surface (39S) being spaced from the respective pick-up spike (31B);
 - c) raising the tubular knitted article (M) from the needle cylinder (3) towards the pick-up device (21), keeping the tubular knitted article (M) engaged by the needles (5) of the needle cylinder (3);
 - d) positioning the open toe (P) of the tubular knitted article (M) against the abutment surfaces (39S) of the pick-up hooks (31), aligning the open toe (P) on a plane substantially orthogonal to a rotation axis (A-A) of the needle cylinder (3);

- e) engaging the tubular knitted article (M) by moving the pick-up hooks (31) towards the symmetry axis (B-B), while a last course of loops is engaged by the needles (5), a first portion of the open toe (P) of the tubular knitted article (M) being engaged by the pick-up hooks (31) of a first half-ring (23A) and a second portion of the open toe (P) of the tubular knitted article (M) being engaged by the pick-up hooks (31) of the second half-ring (23B); the open toe (P) being positioned between the pick-up spikes (31B) and the abutment surfaces (39S) of the pick-up hooks (31); wherein the abutment surface (39S) is spaced from the respective pick-up spike (31B) such that in the engaged position the pick-up spike (31B) and the abutment surface (39S) are positioned on opposite sides of a final edge of the tubular knitted article (M);
- f) removing the loops (MA) of the last course from the needles (5) after the pick-up hooks (31) have engaged the tubular knitted article (M);
- g) removing the tubular knitted article (M) from the needle cylinder (3) by means of the pick-up device (21);
- h) overturning the two half-rings (23A, 23B) one on the top of the other, bringing the pick-up hooks (31) of one half-ring in opposite position with respect to the pick-up hooks (31) of the other half-ring;
- i) joining the first portion and the second portion of the toe (P) of the tubular knitted article (M) together, thus closing the toe (P) of the tubular knitted article (M);
- j) after the toe (P) has been closed, removing the tubular knitted article (M) from the pick-up device (21).
19. Method according to claim 18, wherein the tubular knitted article (M) is engaged by the pick-up hooks (31) by inserting each pick-up hook (31) between two consecutive needles (5) of the needle cylinder (3) of the circular knitting machine (1), the pick-up hooks (31) engaging sinker loops (MP) between the needles (5) of the needle cylinder (3).
20. Method according to claim 18 or 19, wherein the step of raising the tubular knitted article (M) from the needle cylinder is performed by lifting the needles (5) of the needle cylinder (3) towards the pick-up device (21), the needles (5) drawing the tubular knitted article (M) towards the pick-up device (21).
21. Method according to one or more of claims 18 to 20, wherein the tubular knitted article (M) is raised by gradually lifting, by means of a control cam (7), the needles (5) of the needle cylinder (3), while the needle cylinder (3) is kept in rotation synchronously with the rotation of the circular ring (23) of the pick-up

device (21).

22. Method according to claim 21, wherein, during the gradual lifting of the needles (5), the pick-up hooks (31) are sequentially moved with respect to the circular ring (23), so as to gradually engage the tubular knitted article (M) as it is gradually raised by means of the needles (5); wherein preferably the circular ring (23) is placed into synchronous rotation with the needle cylinder (3) before positioning the pick-up device (21) coaxially to the needle cylinder (3), and wherein the transfer of the tubular knitted article (M) from the needle bed to the pick-up device (21) is performed gradually while the needle cylinder (3) and the circular ring (23) rotate synchronously, by acting through respective control cams (91, 7) upon the pick-up members (29) and preferably also upon the needles (5) of the needle cylinder (3).

Patentansprüche

1. Aufnahmevorrichtung (21) zum Aufnehmen einer schlauchförmigen Strickware (M) von einem Nadelzylinder (3) einer Rundstrickmaschine (1), wobei die Vorrichtung einen Kreisring (23) mit einer Symmetrieachse (B-B) aufweist, der in zwei Halbringe (23A, 23B) unterteilt ist, die ausgebildet und angeordnet sind, sich übereinander um eine Überslagachse (C-C) zu überschlagen, die etwa senkrecht zu der Symmetrieachse (B-B) des Kreisrings (23) ist, wobei jeder Halbring (23A, 23B) mit einer jeweiligen Anzahl von Aufnahmehaken (31) versehen ist, wobei jeder Aufnahmehaken (31) einen Hauptkörper (31A) und eine Aufnahmespitze (31B) aufweist, die sich von dem Hauptkörper (31A) etwa radial zu der Symmetrieachse (B-B) erstreckt, wobei jede Aufnahmespitze (31B) mit Bezug auf den jeweiligen Halbring (23A, 23B) zwischen einer ersten inaktiven Position und einer zweiten aktiven Position des Eingriffs mit der schlauchförmigen Strickware (M) bewegbar ist, wobei die zweite aktive Position näher an der Symmetrieachse als die erste inaktive Position ist, **dadurch gekennzeichnet, dass** mindestens einige der Aufnahmehaken (31) eine jeweilige integral ausgebildete Anlagefläche (39S) zur Anlage eines Zeheneendes der schlauchförmigen Strickware aufweist, die sich etwa radial zu der Symmetrieachse (B-B) über einen Abstand erstreckt, der größer ist als die radiale Länge der jeweiligen Aufnahmespitze (31B), wobei die Anlagefläche (39S) von der jeweiligen Aufnahmespitze (31B) so beabstandet ist, dass in der zweiten aktiven Position die Aufnahmespitze (31B) und die Anlagefläche (39S) an gegenüberliegenden Seiten einer fertigen Kante der schlauchförmigen Strickware (M) liegen.
2. Aufnahmevorrichtung nach Anspruch 1, wobei der

Kreisring (23) um die Symmetrieachse (B-B) drehbar ist.

3. Aufnahmevorrichtung nach Anspruch 1 oder 2, wobei die Anlagefläche (39S) jedes Aufnahmehakens (31) durch den Hauptkörper des Aufnahmehakens (31) gebildet ist oder davon vorsteht. 5
4. Aufnahmevorrichtung nach Anspruch 1, 2 oder 3, wobei die Aufnahmespitze (31B) und die Anlagefläche (39S) jedes Aufnahmehakens (31) auf einer radialen Ebene liegen, die die Symmetrieachse (B-B) enthält. 10
5. Aufnahmevorrichtung nach einem oder mehreren der vorstehenden Ansprüche, wobei die Aufnahmehaken (31) an dem jeweiligen Halbring (23A, 23B) montiert sind, um sie so um eine jeweilige Schwenkachse (D-D) zu schwenken, und wobei die Anlagefläche (39S) vorzugsweise mindestens einen gekrümmten Teil mit einer Kreisform mit einer Mitte aufweist, die etwa auf der Schwenkachse (D-D) des jeweiligen Aufnahmehakens (31) liegt. 15
6. Aufnahmevorrichtung nach einem oder mehreren der Ansprüche 1 bis 4, wobei die Aufnahmehaken (31) montiert sind, um radial auf dem jeweiligen Halbring (23A, 23B) entsprechend einer Richtung etwa senkrecht zu der Symmetrieachse (B-B) des Kreisrings (23) zu gleiten. 20
7. Aufnahmevorrichtung nach einem oder mehreren der vorstehenden Ansprüche mit ferner einer Verschlussverriegelung (33) für jeden Aufnahmehaken (31), wobei die Verschlussverriegelung (33) zwischen einer ersten Ruheposition, in der der Endteil (33A) der Verschlussverriegelung (33) vorzugsweise mit der Anlagefläche (39S) des jeweiligen Aufnahmehakens (31) überlappt, und einer zweiten Position, in der ein Endteil (33A) der Verschlussverriegelung (33) mit der Aufnahmespitze (31B) des jeweiligen Aufnahmehakens (31) zusammenwirkt, bewegbar ist, vorzugsweise in einer Bewegung im wesentlichen parallel zu der Symmetrieachse (B-B) des Kreisrings (23). 25
8. Aufnahmevorrichtung nach Anspruch 7, wobei der Endteil (33A) jeder Verschlussverriegelung (33) eine Ausnehmung (33X) aufweist, die radial nach außen mit Bezug auf die Symmetrieachse (B-B) des Kreisrings (23) orientiert ist. 30
9. Aufnahmevorrichtung nach einem oder mehreren der Ansprüche 8 bis 11, wobei die Halbringe (23A, 23B) jeweilige Aufnahmesitze (27) aufweisen, wobei ein Aufnahmehaken (31) und die jeweilige Verschlussverriegelung (33) in jedem Aufnahmesitz (27) angeordnet sind, wobei vorzugsweise jeder Auf-

nahmehaken (31) durch eine nicht ebene Metallfolie gebildet ist und in einem jeweiligen Aufnahmesitz (27) montiert ist, der in dem Halbring (23A, 23B) durch elastische Verformung vorgesehen ist, um eine im Wesentlichen ebene Form anzunehmen, und wobei jeder Aufnahmehaken (31) und die jeweilige Verschlussverriegelung (33) in dem Aufnahmesitz (27) angrenzend zueinander entsprechend einer Tangentialrichtung um die Symmetrieachse (B-B) des Kreisrings (23) montiert sind und wobei, wenn der Aufnahmehaken (31) in dem Aufnahmesitz (27) montiert ist, die Metallfolie elastisch verformt werden kann, um so gegen die jeweilige Verschlussverriegelung zu drücken.

10. Aufnahmevorrichtung nach Anspruch 9, wobei jeder Aufnahmehaken (31) und die entsprechende Verschlussverriegelung (33) in dem Aufnahmesitz (47) koplanar zueinander auf einer im Wesentlichen radialen Ebene montiert sind, die die Symmetrieachse (B-B) des Kreisrings (23) enthält, wobei die Aufnahmespitze (31B) jedes Aufnahmehakens (31) und ein Endteil (33A) jeder Verschlussverriegelung (33) von dem jeweiligen Aufnahmesitz (27) vorsteht und wobei der Endteil (33A) der Verschlussverriegelung (33) gebogen ist, um so außerhalb der im Wesentlichen radialen Ebene und angrenzend an die Aufnahmespitze (31B) des jeweiligen Aufnahmehakens (33) zu sein. 35
11. Aufnahmevorrichtung nach einem oder mehreren der Ansprüche 1 bis 10, wobei die Verschlussverriegelung (33) einen Endteil (33A) angrenzend an die Aufnahmespitze (31B) des jeweiligen Aufnahmehakens (31) aufweist, mit einer gekrümmten Kante (33B), die radial nach außen mit Bezug auf die Symmetrieachse (B-B) des Kreisrings (23) orientiert ist. 40
12. Aufnahmevorrichtung nach einem oder mehreren der Ansprüche 7 bis 11, wobei mindestens einige Verschlussverriegelungen (33) Spitzen (33Y) aufweisen, die ausgebildet und angeordnet sind, um in das Gewebe der schlauchförmigen Strickware (M) einzudringen, und die vorzugsweise etwa parallel zu der Symmetrieachse (B-B) des Kreisrings (23) orientiert sind. 45
13. Aufnahmevorrichtung nach einem oder mehreren der vorstehenden Ansprüche mit einem Motor (10) zur Steuerung der Drehung des Kreisrings (23) um die Symmetrieachse (B-B).
14. System mit:
 - einer Rundstrickmaschine (1) mit einem Nadelzylinder (3), der mit einer Anzahl von Nadeln (5) versehen ist, die ein kreisförmiges Nadelbett bilden, und mit Steuernocken (7) zur Steuerung

- des Anhebens und des Absenken der Nadeln (5),
einer Aufnahmevorrichtung (21) nach einem oder mehreren der vorstehenden Ansprüche, einer Schließvorrichtung (41), die ausgebildet und angeordnet ist, um mit der Aufnahmevorrichtung (21) zusammenzuwirken, um einen Zeh (P) einer schlauchförmigen Strickware (M) zu schließen, während die schlauchförmigen Strickware (M) von der Aufnahmevorrichtung (21) ergriffen wird.
15. System nach Anspruch 14, wobei: die Rundstrickmaschine (1) einen Motor (9) aufweist, um die Drehung des Nadelzylinders (3) zu steuern, wobei die Aufnahmevorrichtung (21) einen Drehmechanismus aufweist, um die Drehung des Kreistrings (23) um die Symmetrieachse (B-B) synchron mit der Drehung des Nadelzylinders (3) zu steuern, wobei der Drehmechanismus vorzugsweise einen weiteren Motor (10) aufweist und das System eine zentrale Steuereinheit (12) aufweist, die ausgebildet ist, um die Drehbewegung des Nadelzylinders (3) um die Drehachse (A-A) des Nadelzylinders (3) und die Drehbewegung des Kreistrings (23) um die Symmetrieachse (B-B) des Kreistrings (23) zu synchronisieren.
16. System nach Anspruch 14 oder 15, wobei die Aufnahmevorrichtung (21) Steuernocken (91) zur Steuerung der Aufnahmeelemente (29) aufweist und wobei die Steuernocken die Bewegung der Aufnahmeelemente (29) synchron mit der Hub- und Senkbewegung der Nadeln (6) der Rundstrickmaschine (1) steuern.
17. System nach einem der Ansprüche 14 bis 16, wobei die Aufnahmeelemente (29) der Aufnahmevorrichtung (21) ausgebildet und angeordnet sind, um zwischen aufeinanderfolgende Nadeln (5) des Nadelzylinders (3) eingebracht zu werden und um und Unteramaschen (MP) einer schlauchförmigen Strickware (M) zu ergreifen, die durch den Nadelzylinder (3) gebildet wird.
18. Verfahren zur Herstellung einer schlauchförmigen Strickware (M) mittels einer Rundstrickmaschine (1) mit einem Nadelzylinder (3) mit einem kreisförmigen Bett aus Nadeln (5), wobei das Verfahren die Schritte aufweist:
- a) Stricken der schlauchförmigen Strickware (M) beginnend von einer Kante (D) und endend mit einem offenen Zeh (P),
 - b) Anordnen einer Aufnahmevorrichtung (21) koaxial mit dem Nadelzylinder (3), wobei die Aufnahmevorrichtung (21) einen Kreistring (23) mit einer Symmetrieachse (B-B) aufweist, der in zwei Halbringe (23A, 23B) unterteilt ist, die aus-

gebildet und angeordnet sind, um einer am Oberteil des anderen um eine Überschlagachse (C-C) überschlagen zu werden, die etwa orthogonal zu der Symmetrieachse (B-B) des Kreistrings (23) ist, wobei jeder Halbring mit einer jeweiligen Anzahl von Aufnahmehaken (31) versehen ist, von denen jeder einen Hauptkörper (31A) und eine Aufnahmespitze (31B) aufweist, die sich von dem Hauptkörper (31A) etwa radial zu der Symmetrieachse (B-B) erstreckt, und wobei einige von ihnen eine jeweilige integral ausgebildete Anlagefläche (39S) aufweisen, die sich etwa radial zu der Symmetrieachse (B-B) über einen Abstand erstreckt, der größer als die radiale Länge der jeweiligen Aufnahmespitze (31B) ist, wobei die Anlagefläche (39S) von der jeweiligen Aufnahmespitze (31B) beabstandet ist,

c) Anheben der schlauchförmigen Strickware (M) von dem Nadelzylinder (3) zu der Aufnahmevorrichtung (21), Halten der schlauchförmigen Strickware (M) in Eingriff mit den Nadeln (5) des Nadelzylinders (3),

d) Positionieren des offenen Zehs (P) der schlauchförmigen Strickware (M) gegen die Anlageflächen (39S) der Aufnahmehaken (31), Ausrichten des offenen Zehs (P) an einer Ebene im Wesentlichen rechtwinklig zu einer Drehachse (A-A) des Nadelzylinders (3),

e) Ergreifen der schlauchförmigen Strickware (M) durch Bewegen der Aufnahmehaken (31) zu der Symmetrieachse (B-B), während eine letzte Reihe von Maschen durch die Nadeln (5) ergriffen wird, wobei ein erster Teil des offenen Zehs (P) der schlauchförmigen Strickware (M) durch die Aufnahmehaken (31) eines ersten Halbrings (23A) ergriffen wird und ein zweiter Teil des offenen Zehs (P) der schlauchförmigen Strickware (M) von den Aufnahmehaken (31) des zweiten Halbrings (23B) ergriffen wird, wobei der offene Zeh (P) zwischen den Aufnahmespitzen (31B) und den Anlageflächen (39S) der Aufnahmehaken (31) positioniert wird, wobei die Anlagefläche (39S) von der jeweiligen Aufnahmespitze (31B) beabstandet ist, sodass in der eingegriffenen Position die Aufnahmespitze (31B) und die Anlagefläche (39S) an entgegengesetzten Seiten einer fertigen Kante der schlauchförmigen Strickware (M) angeordnet sind,

f) Abnehmen der Maschen (MA) der letzten Reihe von den Nadeln (5), nachdem die Aufnahmehaken (31) die schlauchförmigen Strickware (M) ergriffen haben,

g) Abnehmen der schlauchförmigen Strickware (M) von dem Nadelzylinder (3) mittels der Aufnahmevorrichtung (21),

h) Überschlagen der beiden Halbringe (23A,

- 23B), einer über den Oberteil des anderen, Bringen der Aufnahmehaken (31) des einen Halbrings in gegenüberliegende Position mit Bezug auf die Aufnahmehaken (31) des anderen Halbrings,
- i) Verbinden des ersten Teils und des zweiten Teils des Zehs (B) der schlauchförmigen Strickware (M) zusammen, wodurch der Zeh (P) der schlauchförmigen Strickware (M) geschlossen wird,
- j) nach dem der Zeh (P) geschlossen ist, Abnehmen der schlauchförmigen Strickware (M) von der Aufnahmevorrichtung (21).
19. Verfahren nach Anspruch 18, wobei die schlauchförmige Strickware (M) von den Aufnahmehaken (31) durch Einbringen jedes Aufnahmehakens (31) zwischen zwei aufeinanderfolgende Nadeln (5) des Nadelzylinders (3) der Rundstrickmaschine (1) ergriffen wird, wobei die Aufnahmehaken (31) Unter- maschen (MP) zwischen den Nadeln (5) des Nadelzylinders (3) ergreifen.
20. Verfahren nach Anspruch 18 oder 19, wobei der Schritt des Anhebens der schlauchförmigen Strickware (M) von dem Nadelzylinder durch Anheben der Nadeln (5) des Nadelzylinders (3) zu der Aufnahme- vorrichtung (21) durchgeführt wird, wobei die Nadeln (5) die schlauchförmige Strickware (M) zu der Auf- nahmevorrichtung (21) ziehen.
21. Verfahren nach einem oder mehreren der Ansprü- che 18 bis 20, wobei die schlauchförmige Strickware (M) durch graduelles Anheben mittels eines Steu- ernockens (7) der Nadeln (5) des Nadelzylinders (3) angehoben wird, während der Nadelzylinder (3) in einer Drehung synchron mit der Drehung des Kreis- rings (23) der Aufnahmevorrichtung (21) gehalten wird.
22. Verfahren nach Anspruch 21, wobei während des graduellen Anhebens der Nadeln (5) die Aufnahme- haken (31) sequenziell mit Bezug auf den Kreisring (23) bewegt werden, um so graduell die schlauch- förmigen Strickware (M) zu ergreifen, wenn sie gra- duell mittels der Nadeln (5) angehoben wird, wobei vorzugsweise der Kreisring (23) in eine synchrone Drehung mit dem Nadelzylinder (3) vor der Positi- onierung der Aufnahmevorrichtung (21) koaxial zu dem Nadelzylinder (3) gebracht wird und wobei die Übertragung der schlauchförmigen Strickware (M) aus dem Nadelbett zu der Aufnahmevorrichtung (21) graduell durchgeführt wird, während der Nadelzyl- nder (3) und der Kreisring (23) synchron drehen, durch Wirkung durch die jeweiligen Steuernocken (91, 7) auf die Aufnahmeelemente (29) und vorzugs- weise auch auf die Nadeln (5) des Nadelzylinders (3).

Revendications

1. Un dispositif (21) pour prélever un article tubulaire tricoté (M) à partir d'un cylindre à aiguilles (3) d'une machine à tricoter circulaire (1), le dispositif compre-
nant un anneau circulaire (23) ayant un axe de symétrie (B-B), qui est divisé en deux demi-anneaux (23A, 23B), configurés et agencés pour être retour-
nés l'un au-dessus de l'autre autour d'un axe de re-
tourne-ment (C-C) approximativement orthogonal à l'axe de symétrie (B-B) de l'anneau circulaire (23) ; dans lequel chaque demi-anneau (23A, 23B) est pourvu d'une pluralité respective de crochets de pré-
lèvement (31) ; dans lequel chaque crochet de pré-
lèvement (31) comprend un corps principal (31A) et une pointe de prélèvement (31B) s'étendant à peu près radialement du corps principal (31A) vers l'axe de symétrie (B-B) ; dans lequel chaque pointe de
prélèvement (31B) est déplaçable par rapport au demi-anneau respectif (23A, 23B) entre première po-
sition à vide et une seconde position active de venue en prise avec l'article tubulaire tricoté (M), la seconde position active étant plus proche de l'axe de symétrie que la première position à vide ;
caractérisé en ce qu'au moins certains des cro-
chets de prélèvement (31) comprennent une surface de butée respective d'un seul tenant (39S) pour venir en butée contre un extrémité de pointe d'un article tubulaire tricoté, lequel s'étend approximativement radialement vers l'axe de symétrie (B-B) sur une dis-
tance supérieure à la longueur radiale de la pointe de prélèvement (31B) respective, ladite surface de butée (39S) étant espacée de la pointe de préle-
vement respective (31B) de telle sorte que dans la se-
conde position active, la pointe de prélèvement (31B) et la surface de butée (39S) sont positionnées sur des côtés opposés d'un bord final de l'article tu-
bulaire tricoté (M).
2. Dispositif de prélèvement selon la revendication 1, dans lequel l'anneau circulaire (23) est rotatif autour de l'axe de symétrie (B-B).
3. Dispositif de prélèvement selon la revendication 1 ou 2, dans lequel la surface de butée (39S) de cha-
que crochet de prélèvement (31) est formée par le corps principal du crochet de prélèvement (31B) ou fait saillie à partir de celui-ci.
4. Dispositif de prélèvement selon la revendication 1, 2 ou 3, dans lequel la pointe de prélèvement (31B) et la surface de butée (39S) de chaque crochet de
prélèvement (31) s'étendent sur un plan radial con-
tenant l'axe de symétrie (B-B).
5. Dispositif de prélèvement selon l'une ou plusieurs des revendications précédentes, dans lequel les cro-
chets de prélèvement (31) sont montés sur le demi-

- anneau respectif (23A, 23B) de manière à pivoter autour d'un axe de pivotement respectif (D-D) ; et dans lequel la surface de butée (39S) a de préférence au moins une partie incurvée avec une forme circulaire ayant un centre se trouvant approximativement sur l'axe de pivotement (D-D) du crochet de prélèvement respectif.
6. Dispositif de prélèvement selon l'une ou plusieurs des revendications 1 à 4, dans lequel les crochets de prélèvement (31) sont montés de manière à coulisser radialement sur le demi-anneau respectif (23A, 23B) suivant une direction approximativement orthogonale à l'axe de symétrie (B-B) de l'anneau circulaire (23).
7. Dispositif de prélèvement selon l'une ou plusieurs des revendications précédentes, comprenant en outre un verrou de fermeture (33) pour chaque crochet de prélèvement (31), le verrou de fermeture (33) étant déplaçable, de préférence avec un mouvement sensiblement parallèle à l'axe de symétrie (B-B) de l'anneau circulaire (23), entre première position de repos, dans laquelle la partie d'extrémité (33A) du verrou de fermeture (33) recouvre de préférence la surface de butée (39S) du crochet de prélèvement respectif (31) et une seconde position dans laquelle une partie d'extrémité (33A) du verrou de fermeture (33) coopère avec la pointe de prélèvement (31B) du crochet de prélèvement respectif (31).
8. Dispositif de prélèvement selon la revendication 7, dans lequel la partie d'extrémité (33A) de chaque verrou de fermeture (33) comporte un évidement (33X) orienté radialement vers l'extérieur par rapport à l'axe de symétrie (B-B) de l'anneau circulaire (23).
9. Dispositif de prélèvement selon l'une ou plusieurs des revendications 8 à 11, dans lequel les demi-anneaux (23A, 23B) comprennent des sièges de logement respectifs (27), un crochet de prélèvement (31) et le verrou de fermeture respectif (33) étant agencés dans chaque siège de logement (27) ; dans lequel de préférence chaque crochet de prélèvement (31) est formé par une feuille métallique non plane et est monté dans un siège de logement respectif (27) prévu dans le demi-anneau (23A, 23B) par déformation élastique, afin de prendre une forme sensiblement plane ; et dans lequel chaque crochet de prélèvement (31) et le verrou de fermeture respectif (33) sont montés dans le siège de logement (27) l'un à côté de l'autre suivant une direction tangentielle autour de l'axe de symétrie (B-B) de l'anneau circulaire (23) ; et dans lequel, lorsque le crochet de prélèvement (31) est monté dans le siège de logement (27), la feuille de métal peut être déformée élastiquement de manière à appuyer élastiquement contre le verrou de fermeture respectif.
10. Dispositif de prélèvement selon la revendication 9, dans lequel chaque crochet de prélèvement (31) et le verrou de fermeture respectif (33) sont montés dans le siège de logement (27) de manière coplanaire l'un avec l'autre dans un plan sensiblement radial contenant l'axe de symétrie (B-B) de l'anneau circulaire (23) ; dans lequel la pointe de prélèvement (31B) de chaque crochet de prélèvement (31) et une partie d'extrémité (33A) de chaque verrou de fermeture (33) fait saillie depuis le siège de logement respectif (27) ; et dans lequel la partie d'extrémité (33A) du verrou de fermeture (33) est courbée de manière à être à l'extérieur dudit plan sensiblement radial et à côté de la pointe de prélèvement (31B) du crochet de prélèvement respectif (33).
11. Dispositif de prélèvement selon l'une ou plusieurs des revendications 7 à 10, dans lequel le verrou de fermeture (33) comporte une partie d'extrémité (33A), adjacente à la pointe de prélèvement (31B) du crochet de prélèvement respectif (31), avec un bord incurvé (33B) orienté radialement vers l'extérieur par rapport à l'axe de symétrie (B-B) de l'anneau circulaire (23).
12. Dispositif de prélèvement selon l'une ou plusieurs des revendications 7 à 11, dans lequel au moins certains verrous de fermeture (33) ont des pointes (33Y) configurées et agencées pour pénétrer dans le tissu de l'article tubulaire tricoté (M) et orientées de préférence approximativement parallèlement à l'axe de symétrie (B-B) de l'anneau circulaire (23).
13. Dispositif de prélèvement selon l'une ou plusieurs des revendications précédentes, comprenant un moteur (10) pour commander la rotation de l'anneau circulaire (23) autour de l'axe de symétrie (B-B).
14. Un système comprenant :
- une machine à tricoter circulaire (1) ayant un cylindre à aiguilles (3) pourvu d'une pluralité d'aiguilles (5) formant un lit d'aiguilles circulaires et des cames de commande (7) pour commander l'élévation et l'abaissement des aiguilles (5) ;
 - un dispositif de prélèvement (21) selon l'une ou plusieurs des revendications précédentes ;
 - un dispositif de fermeture (41), configuré et agencé pour coopérer avec le dispositif de prélèvement (21) pour fermer une extrémité (P) d'un article tubulaire tricoté (M) pendant que ledit article tubulaire tricoté (M) est en prise avec le dispositif de prélèvement (21).
15. Système selon la revendication 14, dans lequel : la machine à tricoter circulaire (1) comprend un moteur (9) pour commander la rotation du cylindre à aiguilles

- (3), le dispositif de prélèvement (21) comprend un mécanisme de rotation pour commander la rotation de l'anneau circulaire (23) autour de l'axe de symétrie (B-B) en synchronisation avec la rotation du cylindre à aiguilles (3) ; dans lequel le mécanisme de rotation comprend de préférence un moteur supplémentaire (10) et le système comprend une unité de commande centrale (12) apte à synchroniser le mouvement de rotation du cylindre à aiguilles (3) autour de l'axe de rotation (A-A) du cylindre à aiguilles (3) et le mouvement de rotation de l'anneau circulaire (23) autour de l'axe de symétrie (B-B) de l'anneau circulaire (23).
16. Système selon la revendication 14 ou 15, dans lequel le dispositif de prélèvement (21) comprend des cames de commande (91) pour commander les organes de prélèvement (29) ; et dans lequel lesdites cames de commande commandent le mouvement des organes de prélèvement (29) en synchronisation avec le mouvement d'élévation et d'abaissement des aiguilles (6) de la machine à tricoter circulaire.
17. Système selon l'une quelconque des revendications 14 à 16, dans lequel les organes de prélèvement (29) du dispositif de prélèvement (21) sont configurés et agencés pour être insérés entre des aiguilles consécutives (5) du cylindre à aiguilles (3) et pour venir en prise avec des boucles d'entremaille (MP) d'un article tubulaire tricoté (M) formé par le cylindre à aiguilles (3).
18. Un procédé pour fabriquer un article tubulaire tricoté (M) au moyen d'une machine à tricoter circulaire (1) comprenant un cylindre à aiguilles (3) avec un lit circulaire d'aiguilles (5) ; ledit procédé comprenant les étapes consistant à :
- a) tricoter l'article tubulaire tricoté (M) en commençant par un bord (B) et en terminant avec une extrémité ouverte (P) ;
 - b) agencer un dispositif de prélèvement (21) de manière coaxiale avec le cylindre à aiguilles (3) ; le dispositif de prélèvement (21) comprenant un anneau circulaire (23) avec un axe de symétrie (B-B), divisé en deux demi-anneaux (23A, 23B), configurés et agencés pour être retournés l'un au-dessus de l'autre autour d'un axe de retournement (C-C) à peu près orthogonal à l'axe de symétrie (B-B) de l'anneau circulaire (23), chaque demi-anneau étant pourvu d'une pluralité respective de crochets de prélèvement (31), dont chacun comprend un corps principal (31A) et une pointe de prélèvement (31B) s'étendant à partir du corps principal (31A) à peu près radialement vers l'axe de symétrie (B-B) et dont certains au moins comprennent une surface de butée (39S) respective d'un seul tenant, laquelle surface s'étend approximativement radialement vers l'axe de symétrie (B-B) sur une distance supérieure à la longueur radiale de la pointe de prélèvement respective (31B), ladite surface de butée (39S) étant espacée de la pointe de prélèvement respective (31B) ;
 - c) élever l'article tubulaire tricoté (M) du cylindre à aiguilles (3) vers le dispositif de prélèvement (21), maintenir l'article tubulaire tricoté (M) en prise avec les aiguilles (5) du cylindre à aiguilles (3) ;
 - d) positionner la pointe ouverte (P) de l'article tubulaire tricoté (M) contre les surfaces de butée (39S) des crochets de prélèvement (31), aligner la pointe ouverte (P) sur un plan sensiblement orthogonal à un axe de rotation (A-A) du cylindre à aiguilles (3) ;
 - e) mettre en prise l'article tubulaire tricoté (M) en déplaçant les crochets de prélèvement (31) vers l'axe de symétrie (B-B), pendant qu'au moins un dernier rang de mailles est en prise avec les aiguilles (5), une première partie de la pointe ouverte (P) de l'article tubulaire tricoté (M) étant en prise avec les crochets de prélèvement (31) d'un premier demi-anneau (23A) et une seconde partie de la pointe ouverte (P) de l'article tubulaire tricoté étant en prise avec les crochets de prélèvement (31) du second demi-anneau (23B) : la pointe ouverte (P) étant positionnée entre les pointes de prélèvement (31B) et les surfaces de butée (39S) des crochets de prélèvement (31) ; dans lequel la surface de butée (39S) est espacée de la pointe de prélèvement respective (31B) de telle sorte que dans la position en prise, la pointe de prélèvement (31b) et la surface de butée (39S) soient positionnées sur des côtés opposés d'un bord final de l'article tubulaire tricoté (M) ;
 - f) retirer les mailles (MA) du dernier rang d'aiguilles (5) après que les crochets de prélèvement (31) sont venus en prise avec l'article tubulaire tricoté (M) ;
 - g) retirer l'article tubulaire tricoté (M) du cylindre à aiguilles (3) au moyen du dispositif de prélèvement (21) ;
 - h) retourner les deux demi-anneaux (23A, 23B) l'un au-dessus de l'autre, amener les crochets de prélèvement (31) d'un demi-anneau en position opposée par rapport aux crochets de prélèvement (31) de l'autre demi-anneau ;
 - i) joindre la première partie et la seconde partie de la pointe (P) de l'article tubulaire tricoté (M) ensemble et fermer ainsi la pointe (P) de l'article tubulaire tricoté (M) ;
 - j) après que la pointe (P) a été fermée, retirer l'article tubulaire tricoté (M) du dispositif de prélèvement (21).

19. Procédé selon la revendication 18, dans lequel l'article tubulaire tricoté (M) est mis en prise par les crochets de prélèvement (31) en insérant chaque crochet de prélèvement (31) entre deux aiguilles consécutives (5) du cylindre à aiguilles (3) de la machine à tricoter circulaire (1), les crochets de prélèvement (31) venant en prise avec des boucles d'entremaille (MP) entre les aiguilles (5) du cylindre à aiguilles (3). 5
20. Procédé selon la revendication 18 ou 19, dans lequel l'étape d'élévation de l'article tubulaire tricoté (M) par rapport au cylindre à aiguilles est réalisée en soulevant les aiguilles (5) du cylindre à aiguilles (3) vers le dispositif de prélèvement (21), les aiguilles (5) tirant l'article tubulaire tricoté (M) vers le dispositif de prélèvement (21). 10 15
21. Procédé selon l'une ou plusieurs des revendications 18 à 20, dans lequel l'article tubulaire tricoté (M) est élevé en soulevant progressivement, au moyen d'une came de commande (7), les aiguilles (5) du cylindre à aiguilles (3), pendant que le cylindre à aiguilles (3) est maintenu en rotation synchronisée avec la rotation de l'anneau circulaire (23) du dispositif de prélèvement (21). 20 25
22. Procédé selon la revendication 21, dans lequel, durant le soulèvement progressif des aiguilles (5), les crochets de prélèvement (31) sont séquentiellement déplacés par rapport à l'anneau circulaire (23), de manière à venir en prise progressivement avec l'article tubulaire tricoté (M) à mesure qu'il est progressivement élevé au moyen des aiguilles (5) ; dans lequel l'anneau circulaire (23) est de préférence mis en rotation synchronisée avec le cylindre à aiguilles (3) avant de positionner le dispositif de prélèvement (21) de manière coaxiale avec le cylindre à aiguilles (3), et dans lequel le transfert de l'article tubulaire tricoté (M) du lit d'aiguilles au dispositif de prélèvement (21) est réalisé progressivement pendant que le cylindre à aiguilles (3) et l'anneau circulaire (23) tournent de manière synchronisée, en agissant à l'aide de cames de commande respectives (91, 7) sur les organes de prélèvement (29) et de préférence également sur les aiguilles (5) du cylindre à aiguilles (3). 30 35 40 45

50

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Fig. 1

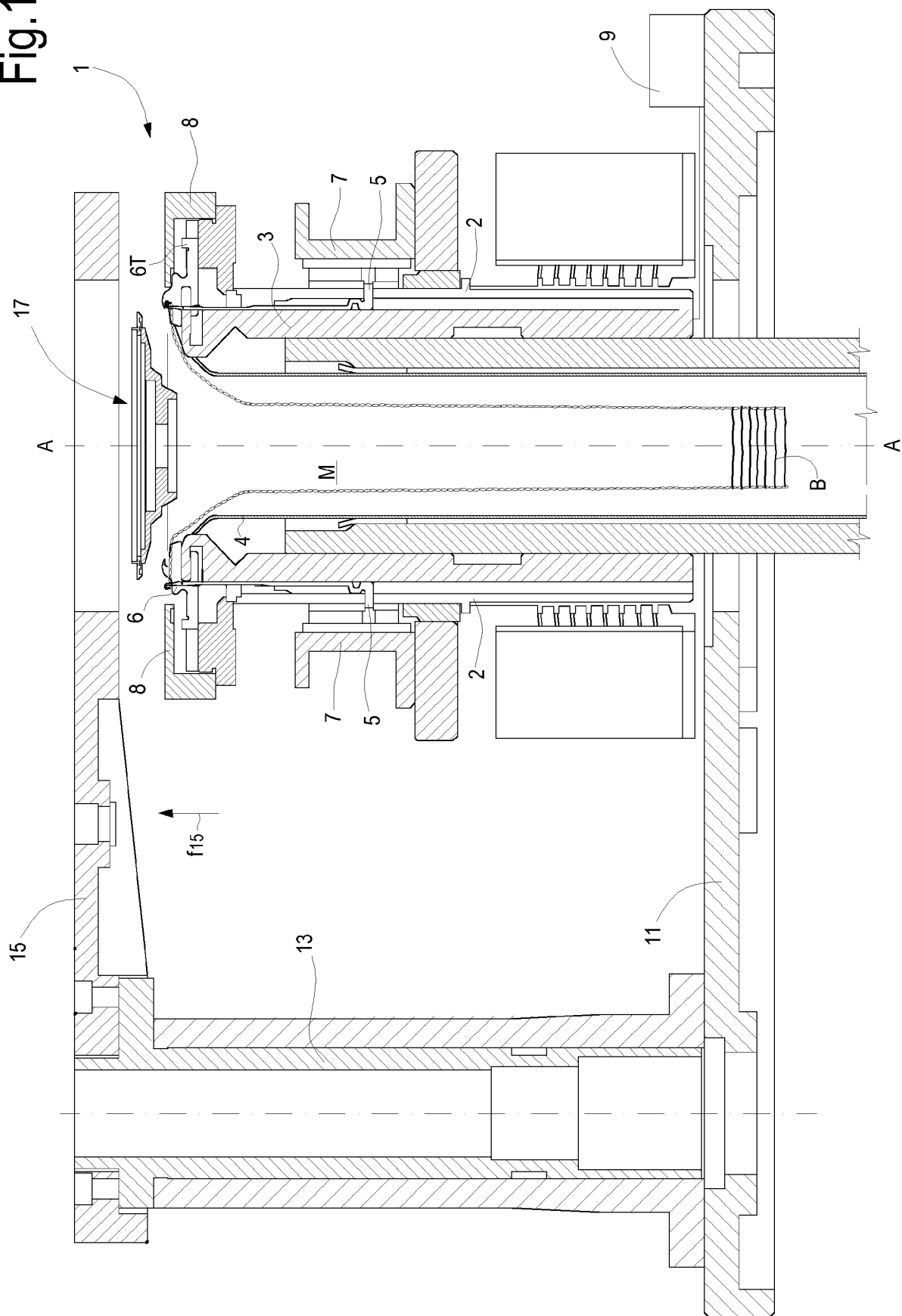


Fig.2

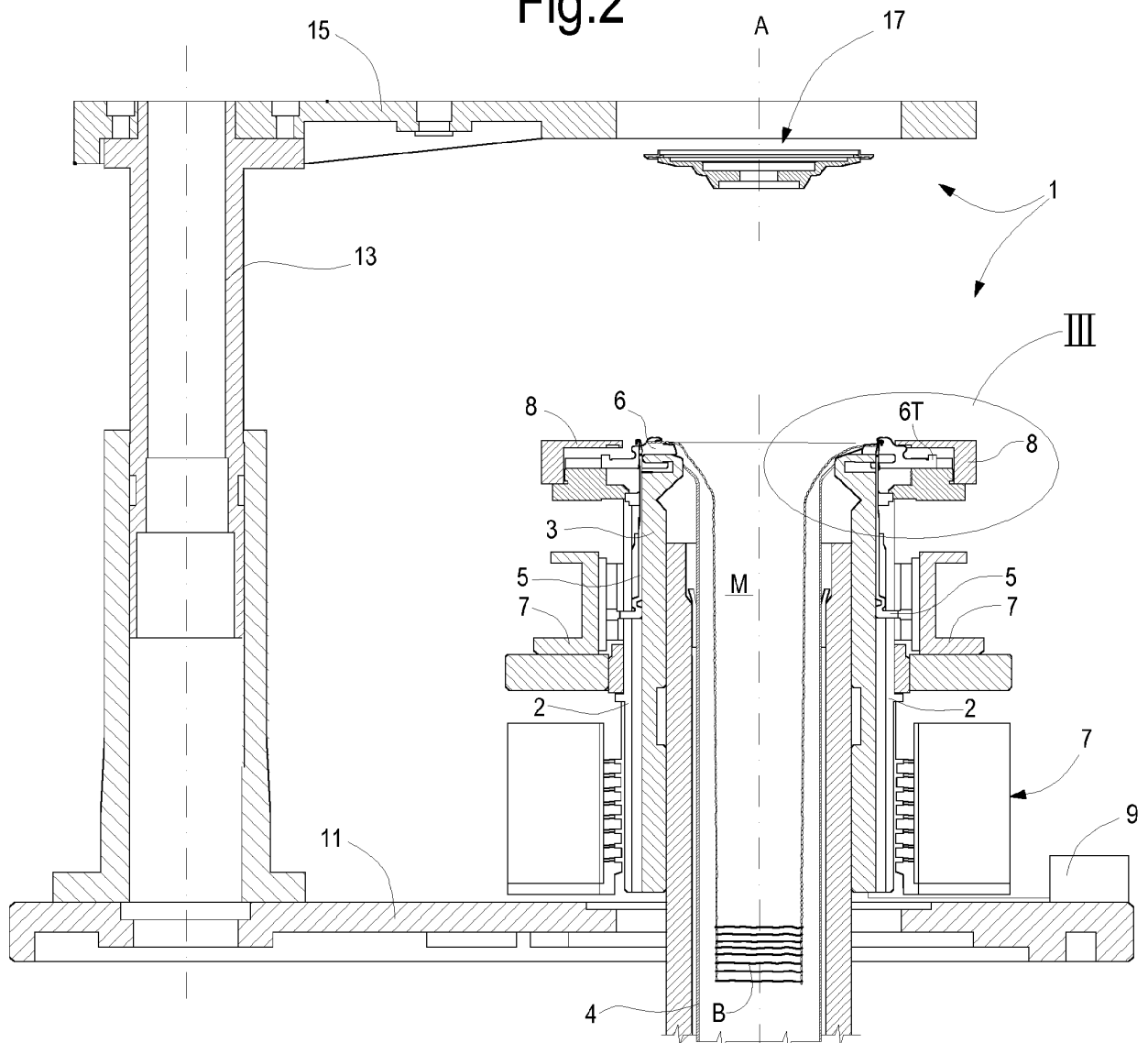


Fig.3

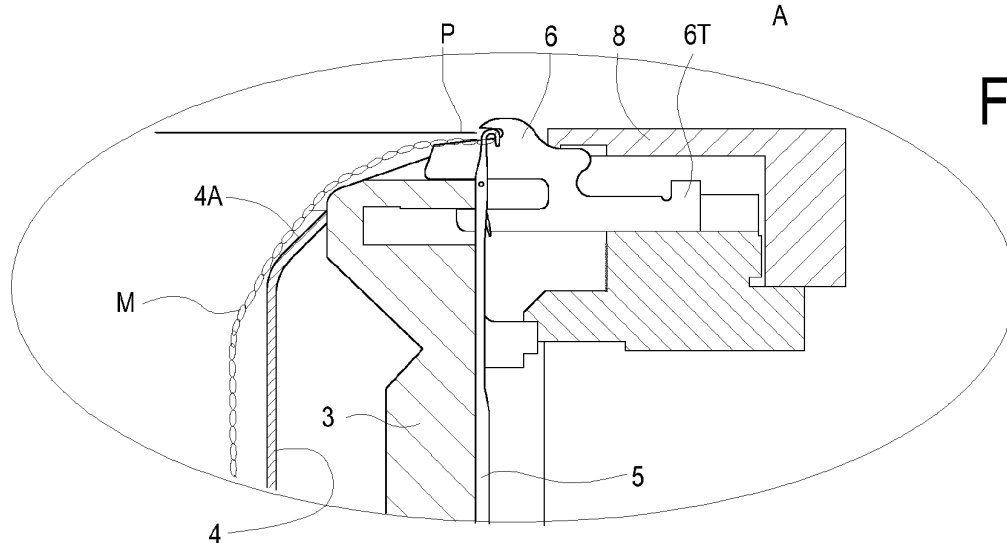
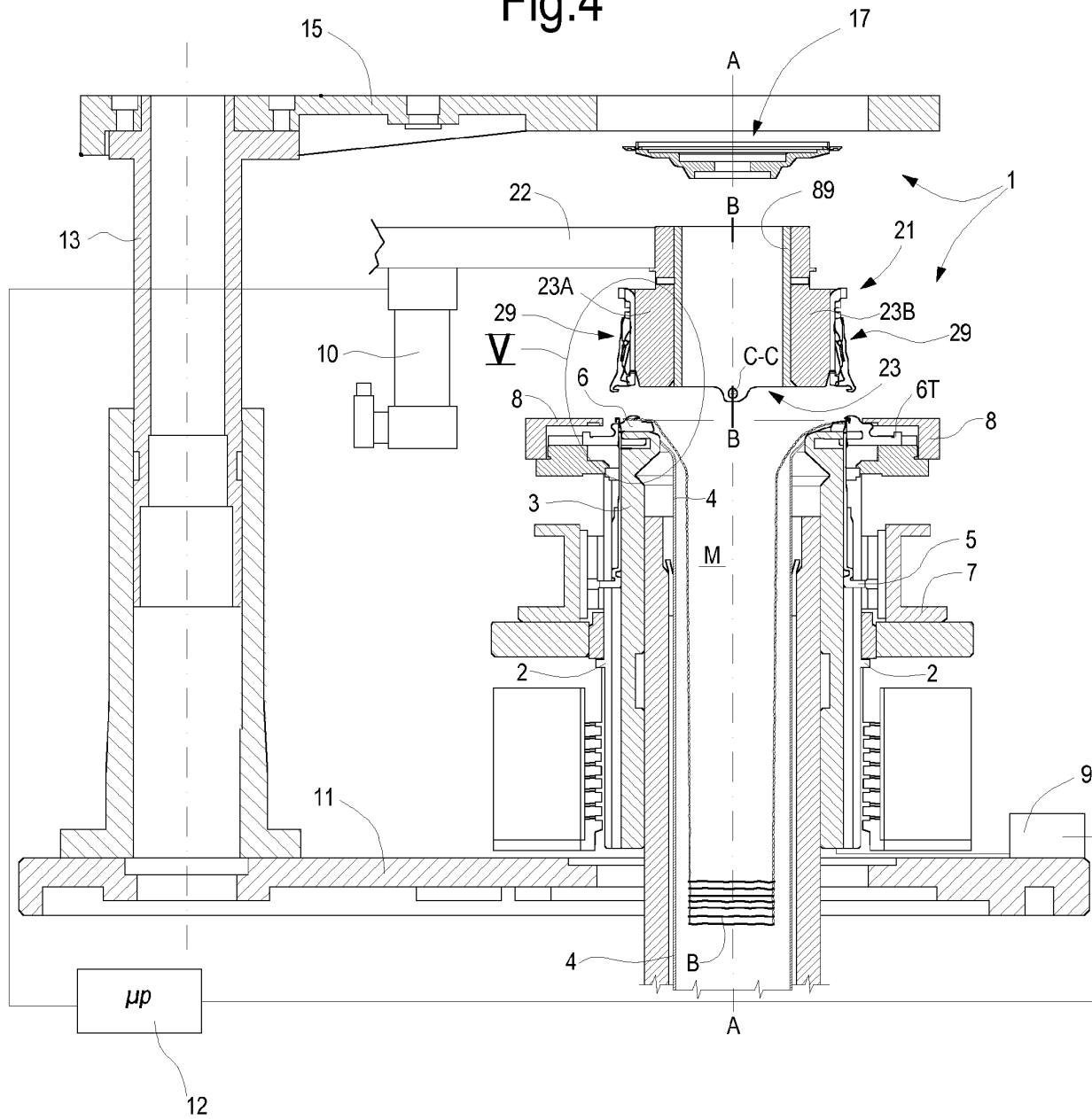


Fig.4



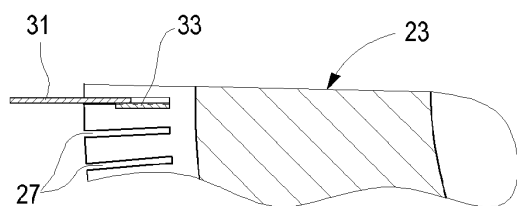


Fig.5A

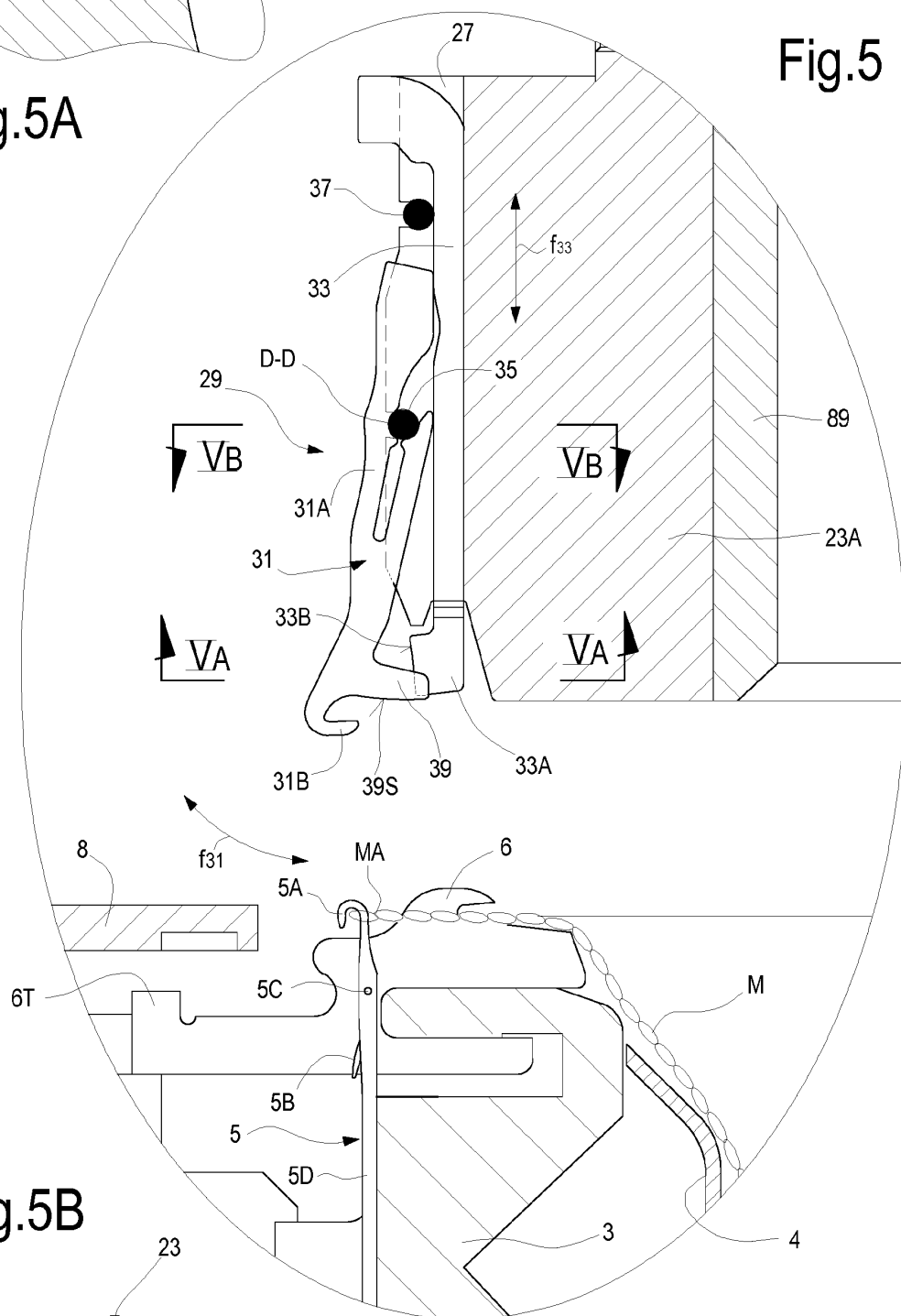


Fig.5

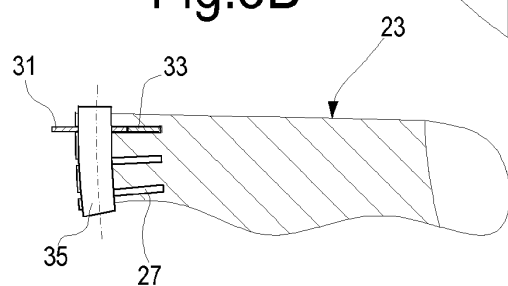


Fig.5B

Fig.6

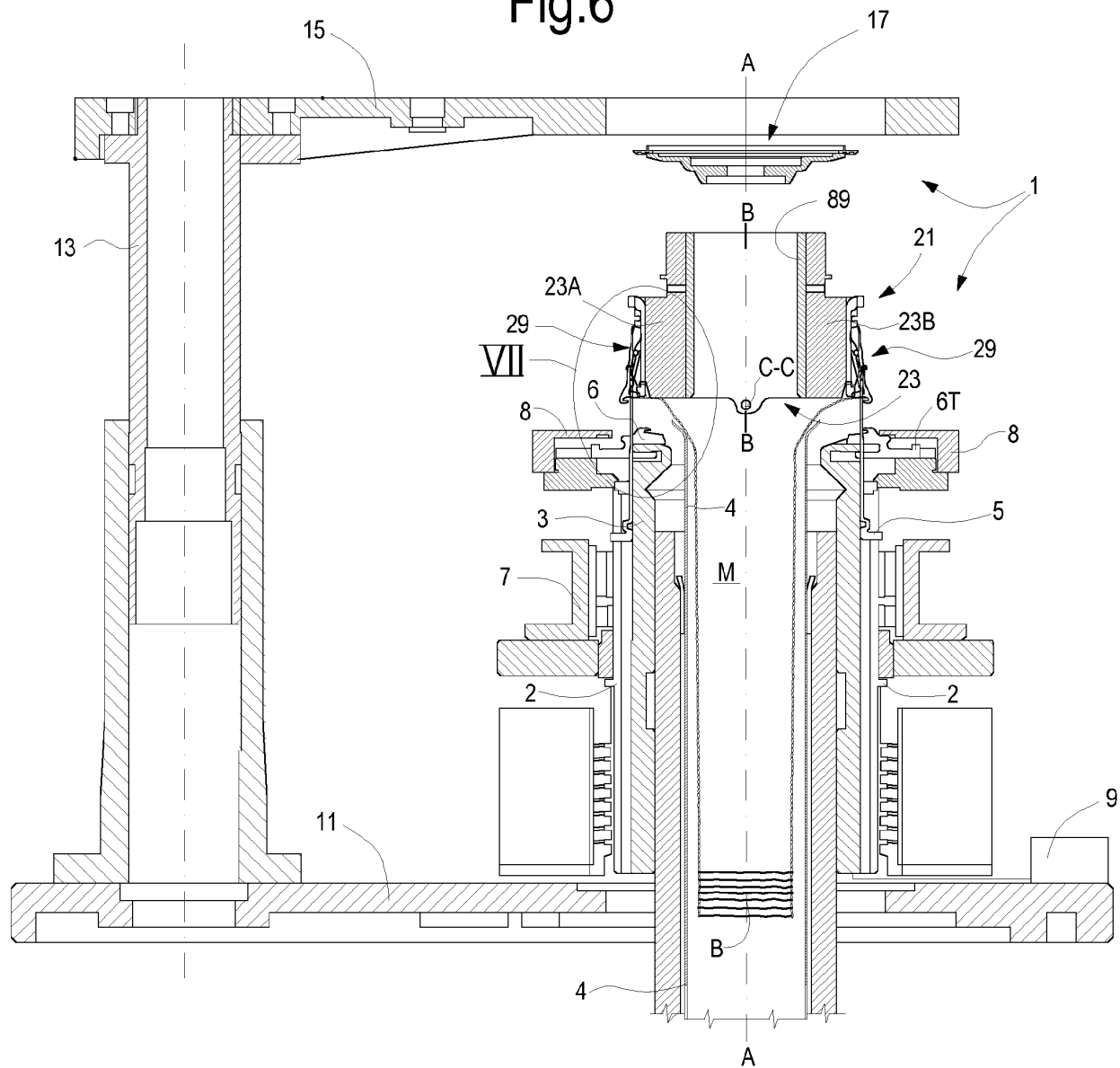


Fig.7

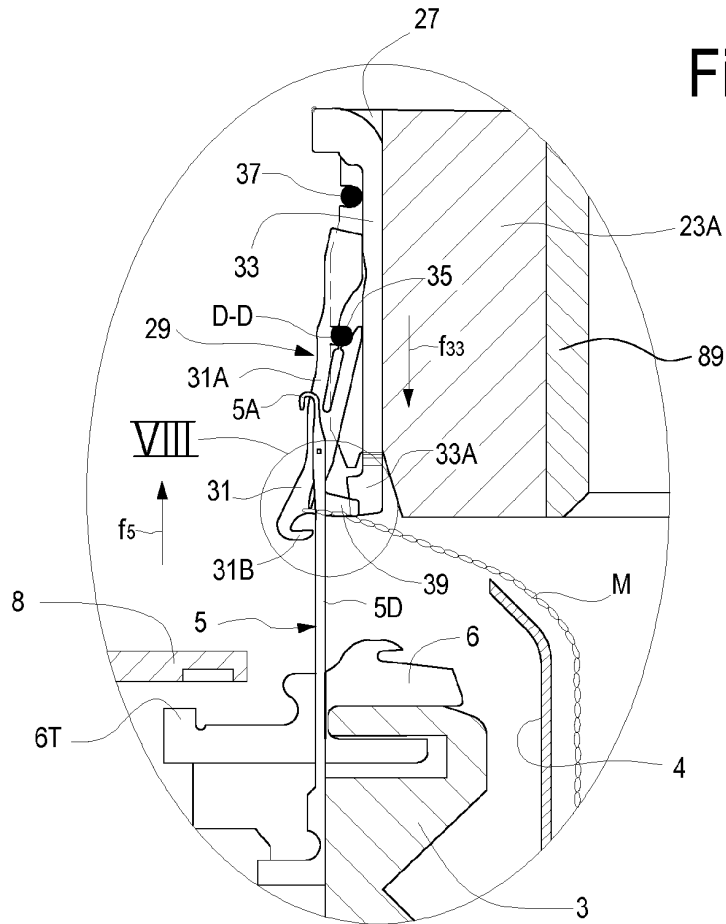


Fig.8

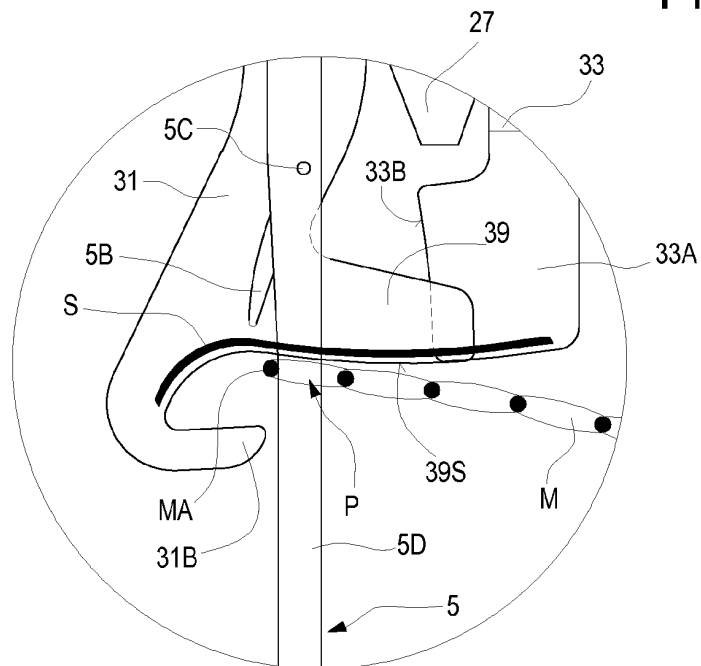


Fig.9

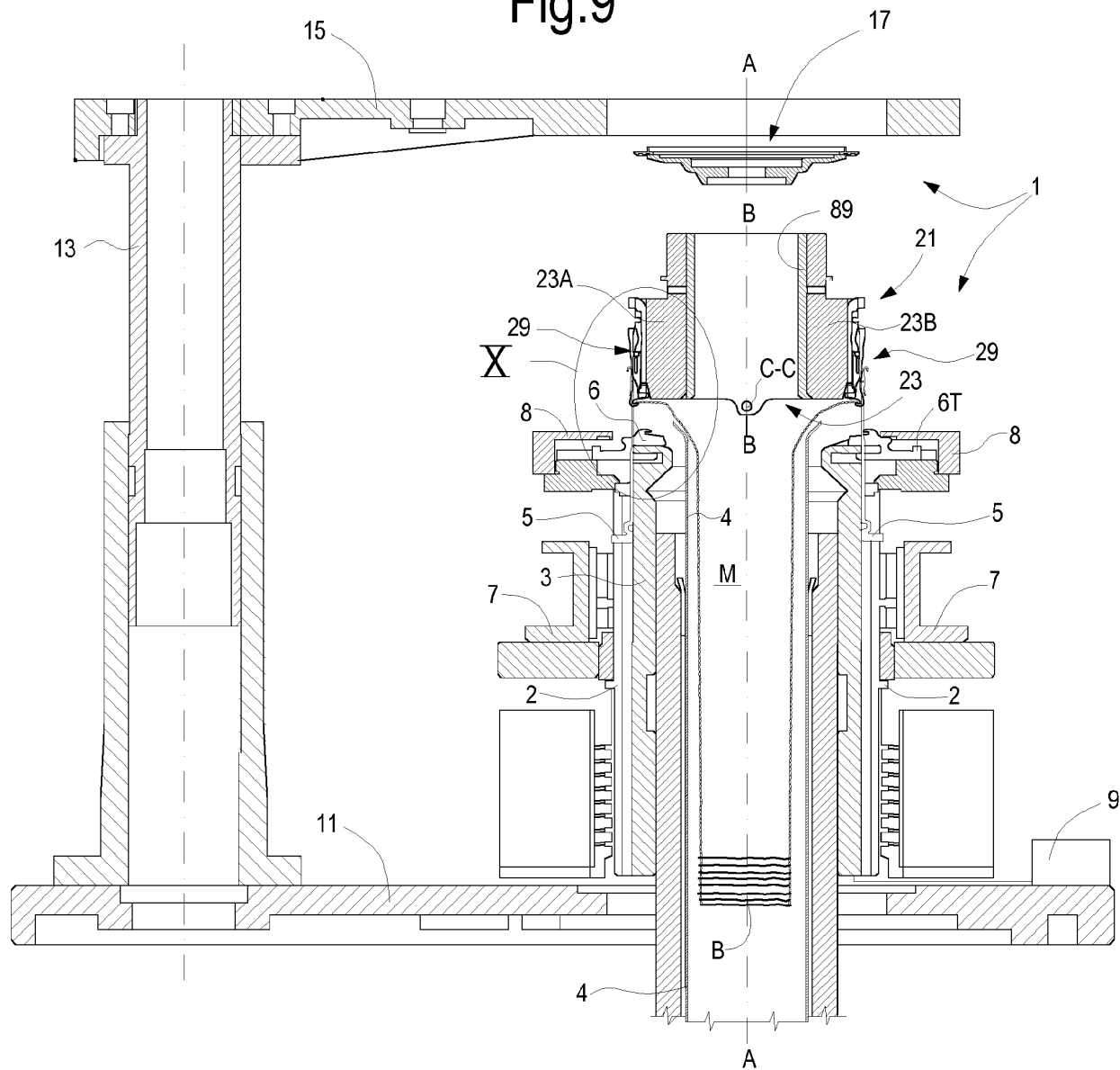


Fig.10

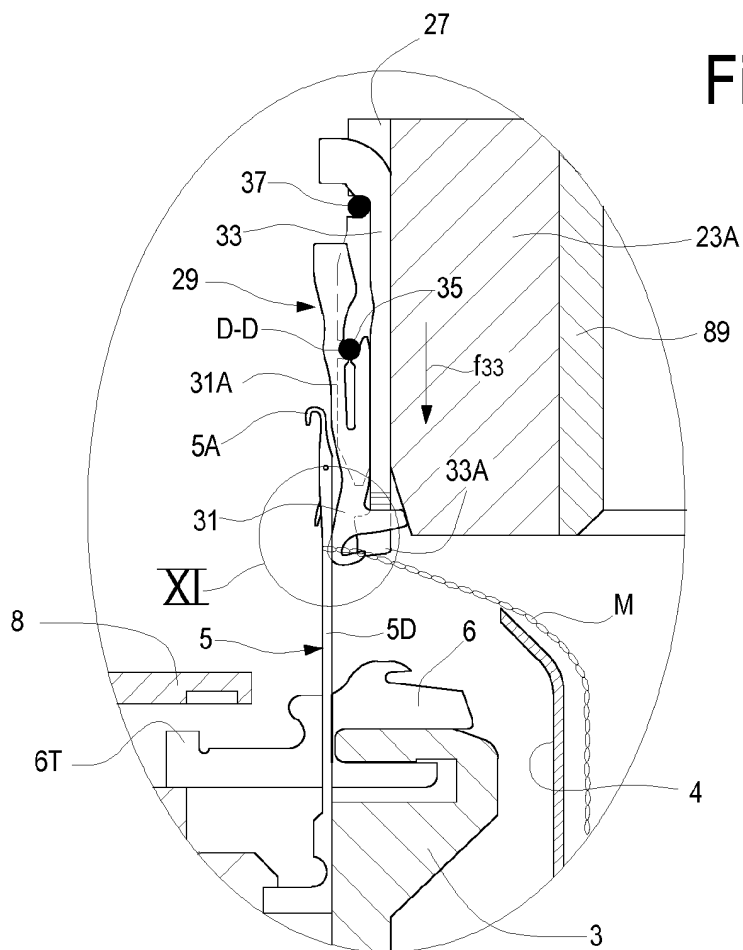


Fig.11

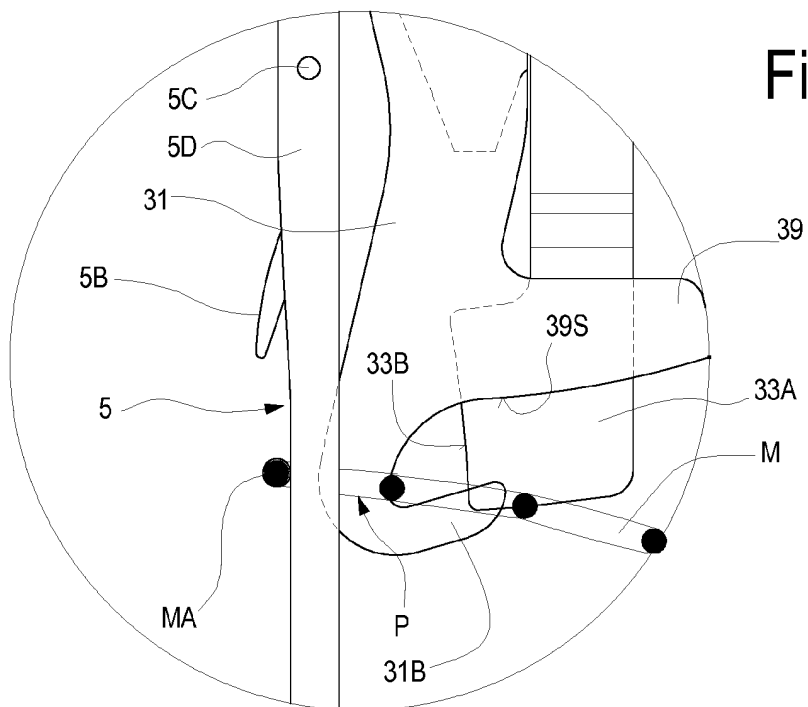


Fig.12

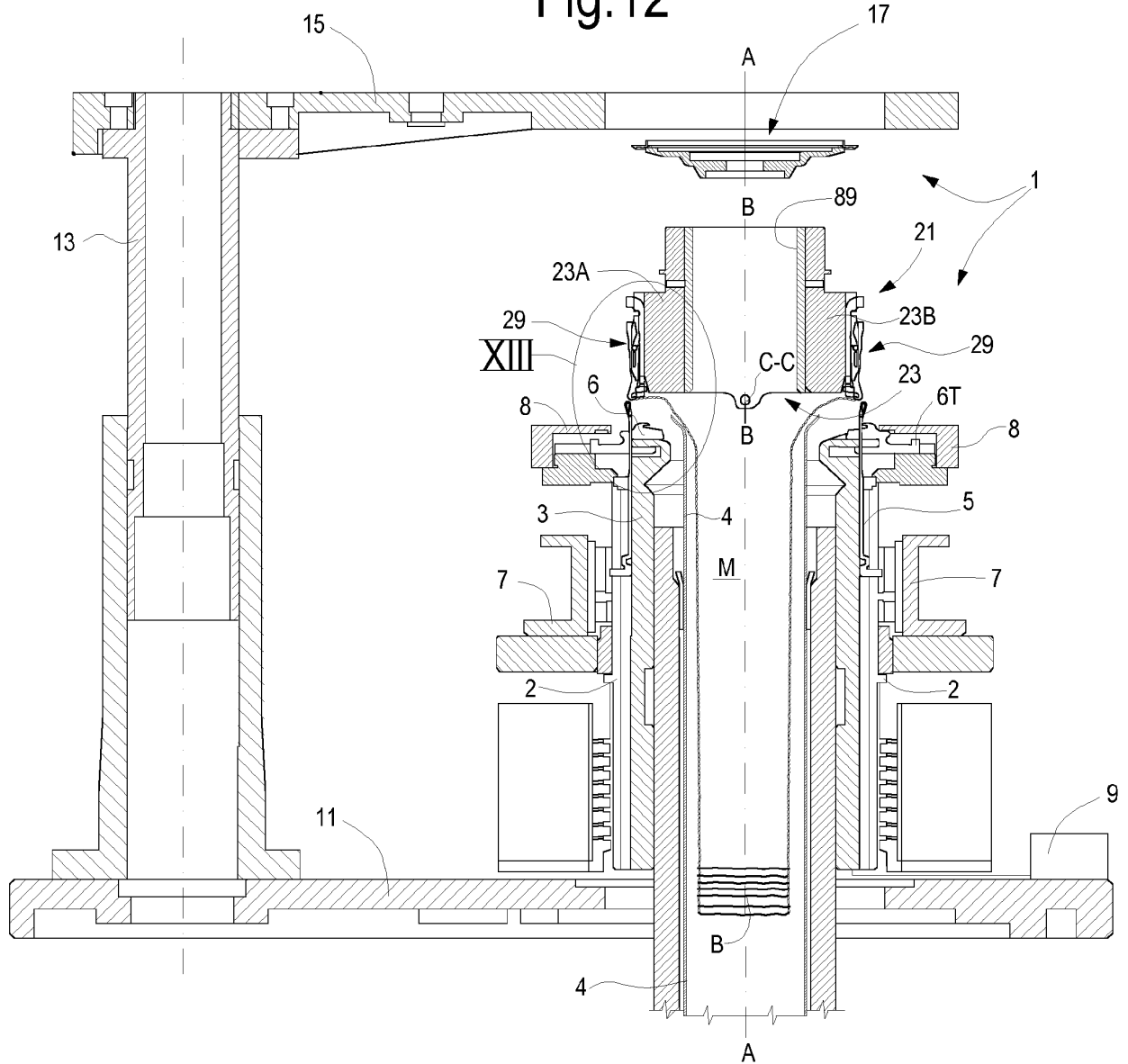


Fig.13

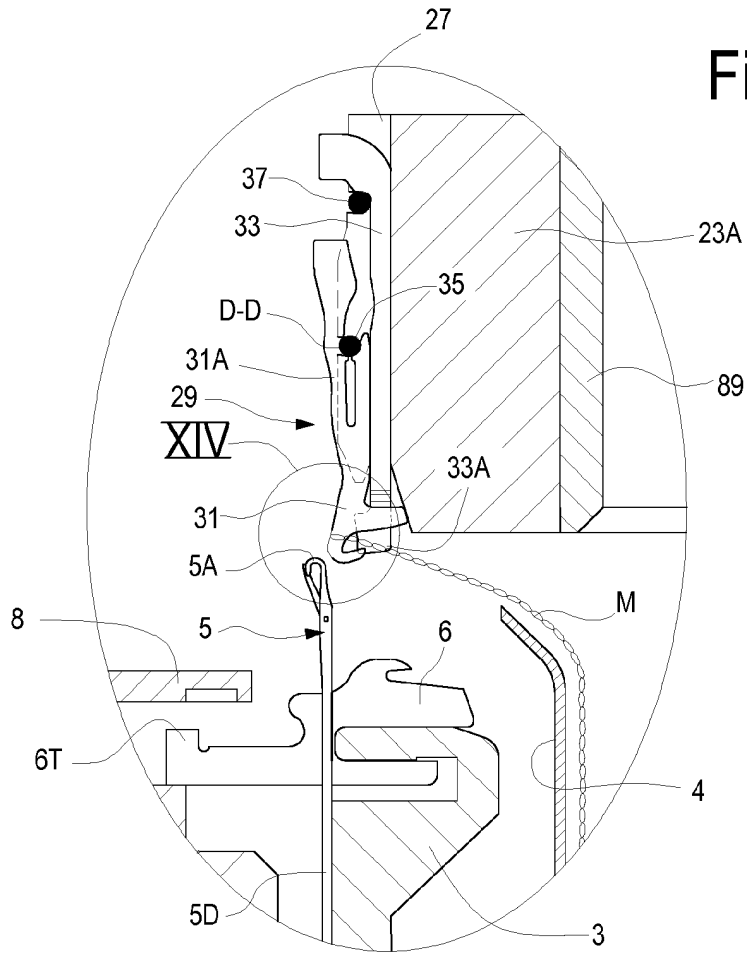


Fig.14

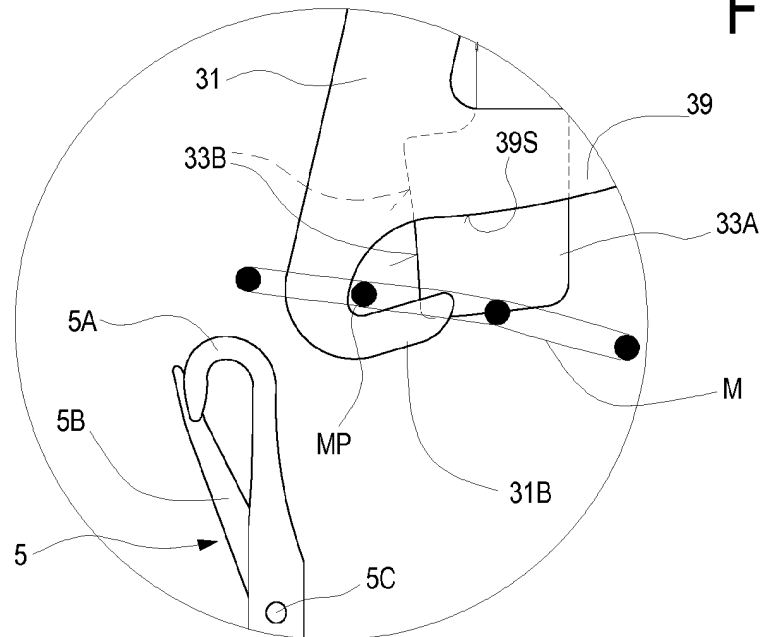


Fig.15

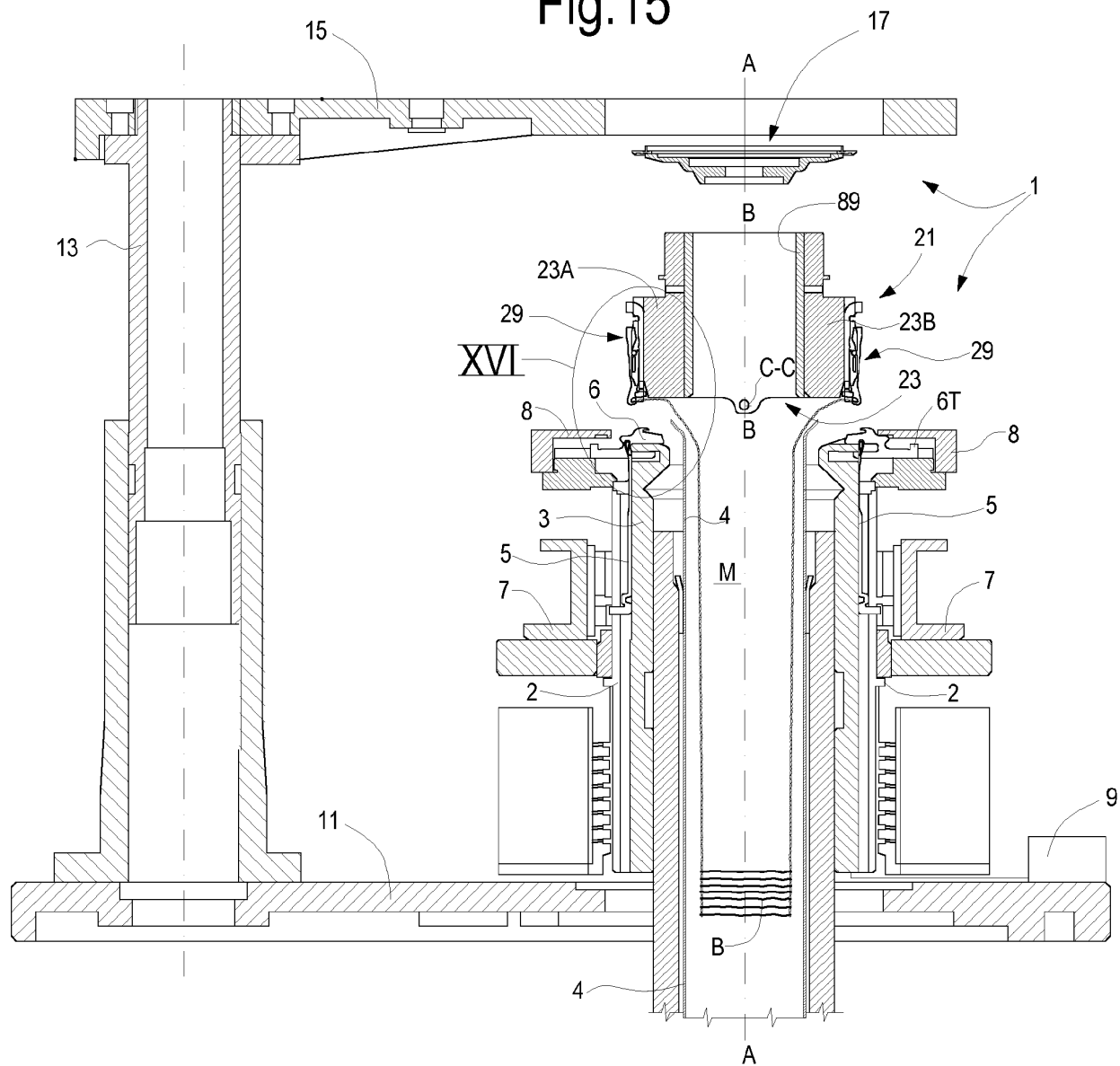


Fig.16

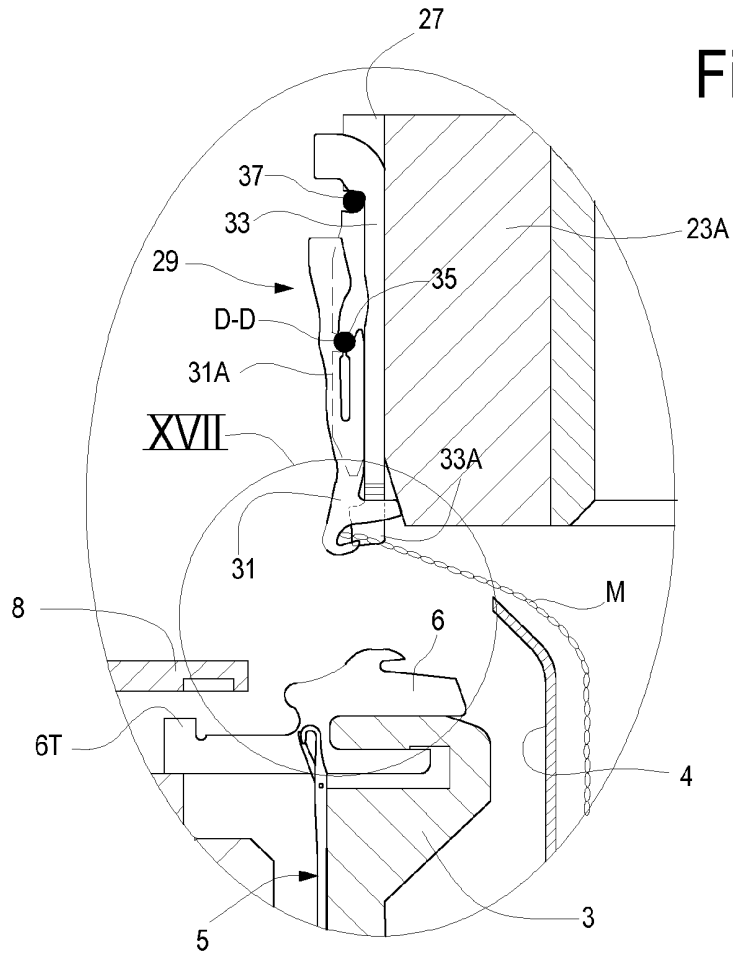


Fig.17

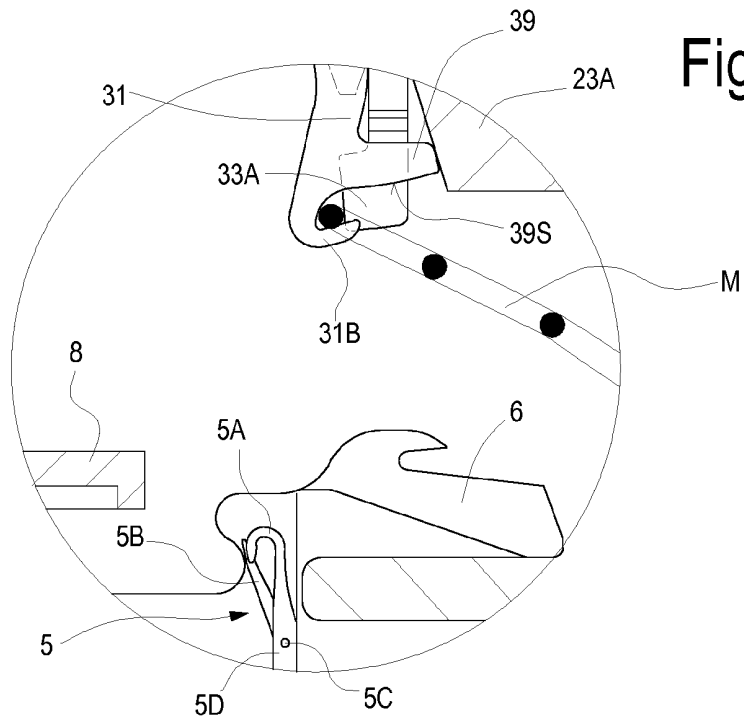


Fig.18

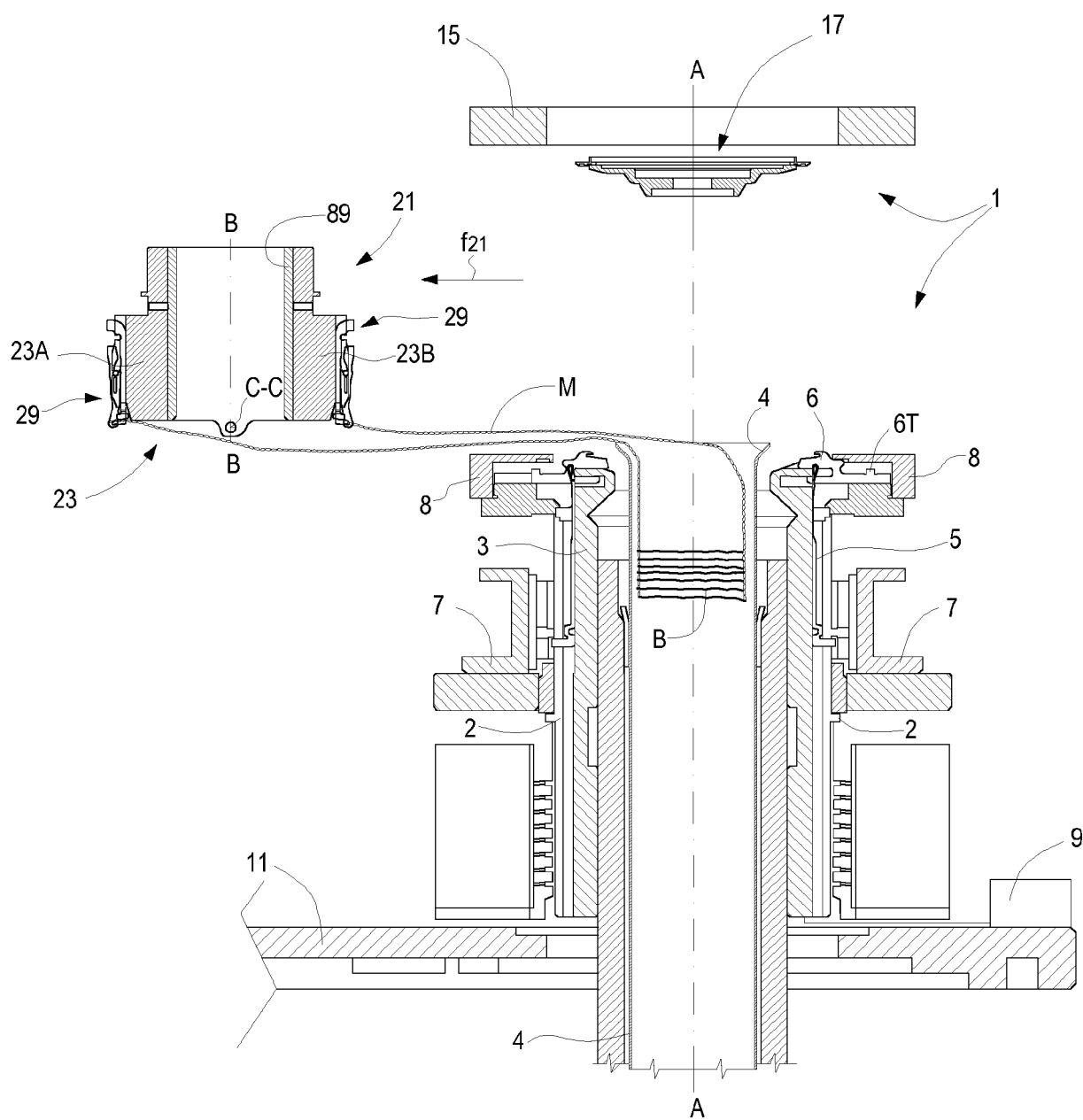


Fig.19

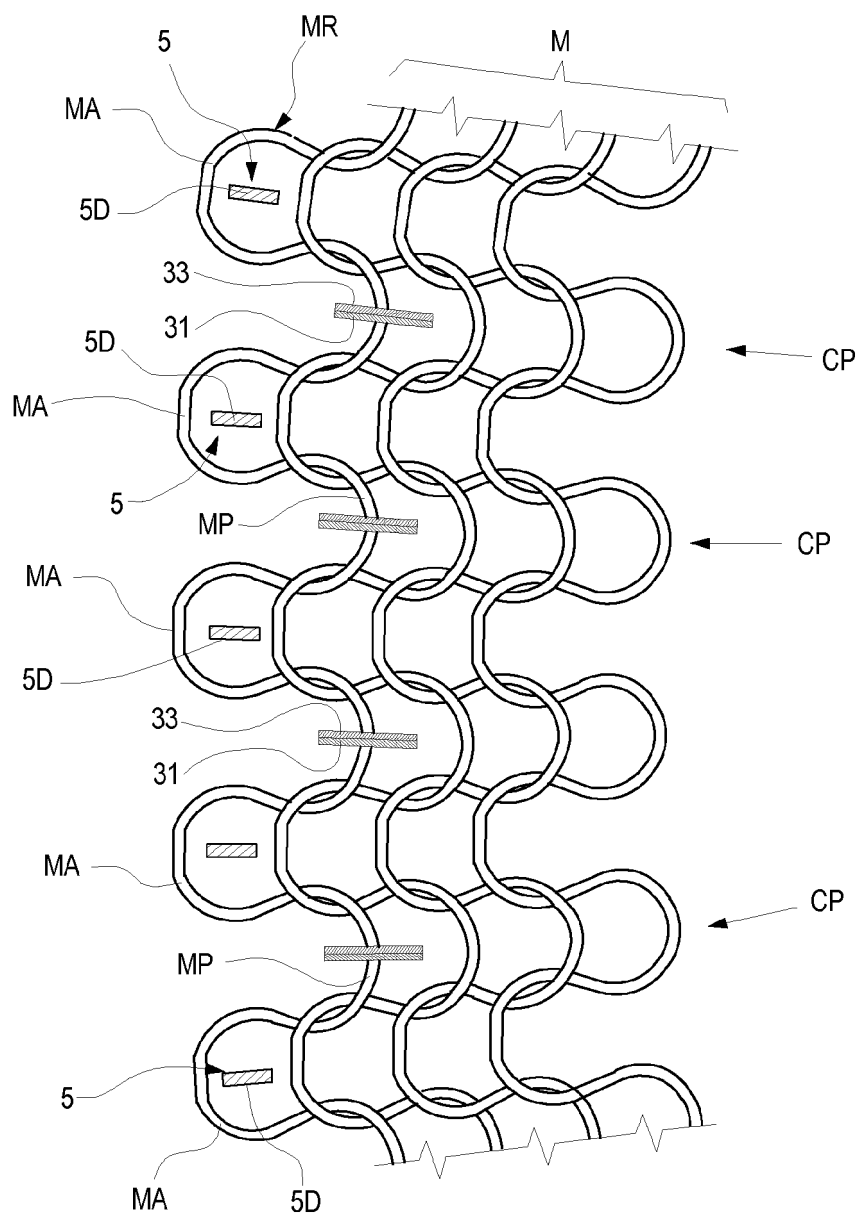


Fig.20

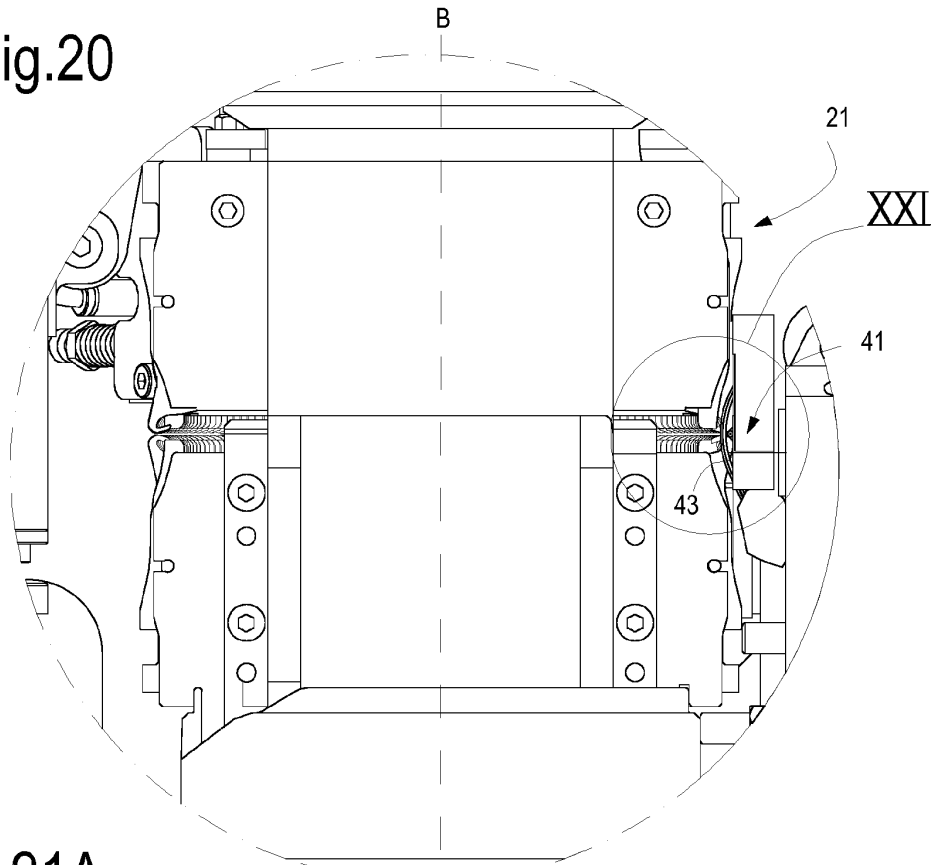


Fig.21A

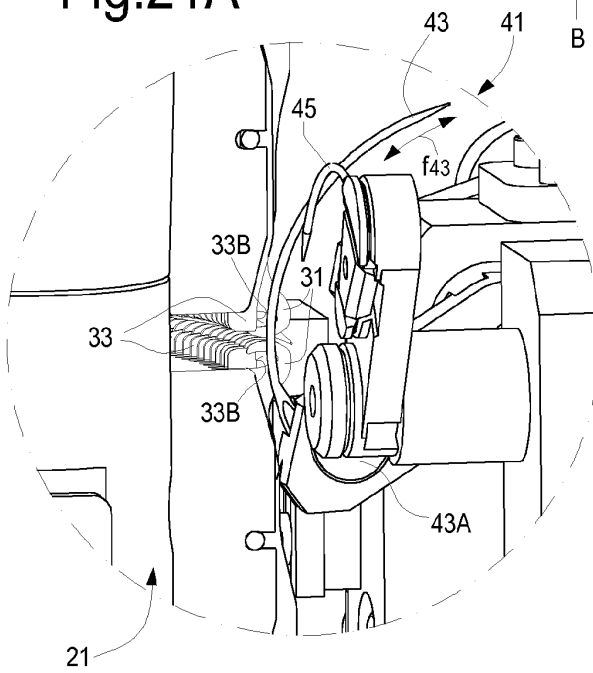


Fig.21B

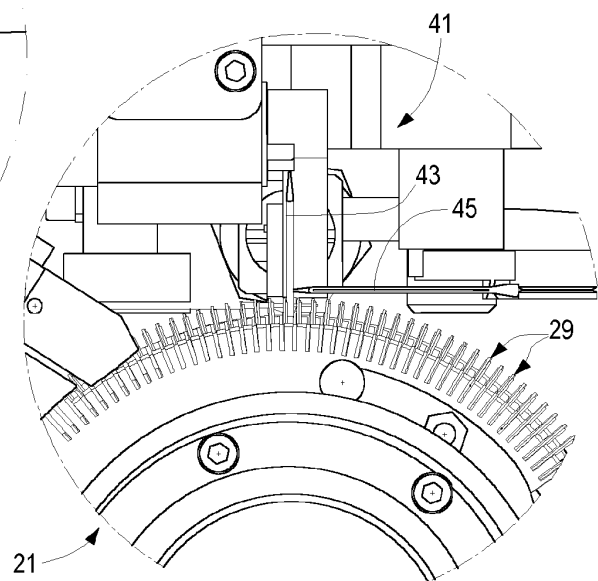


Fig.22

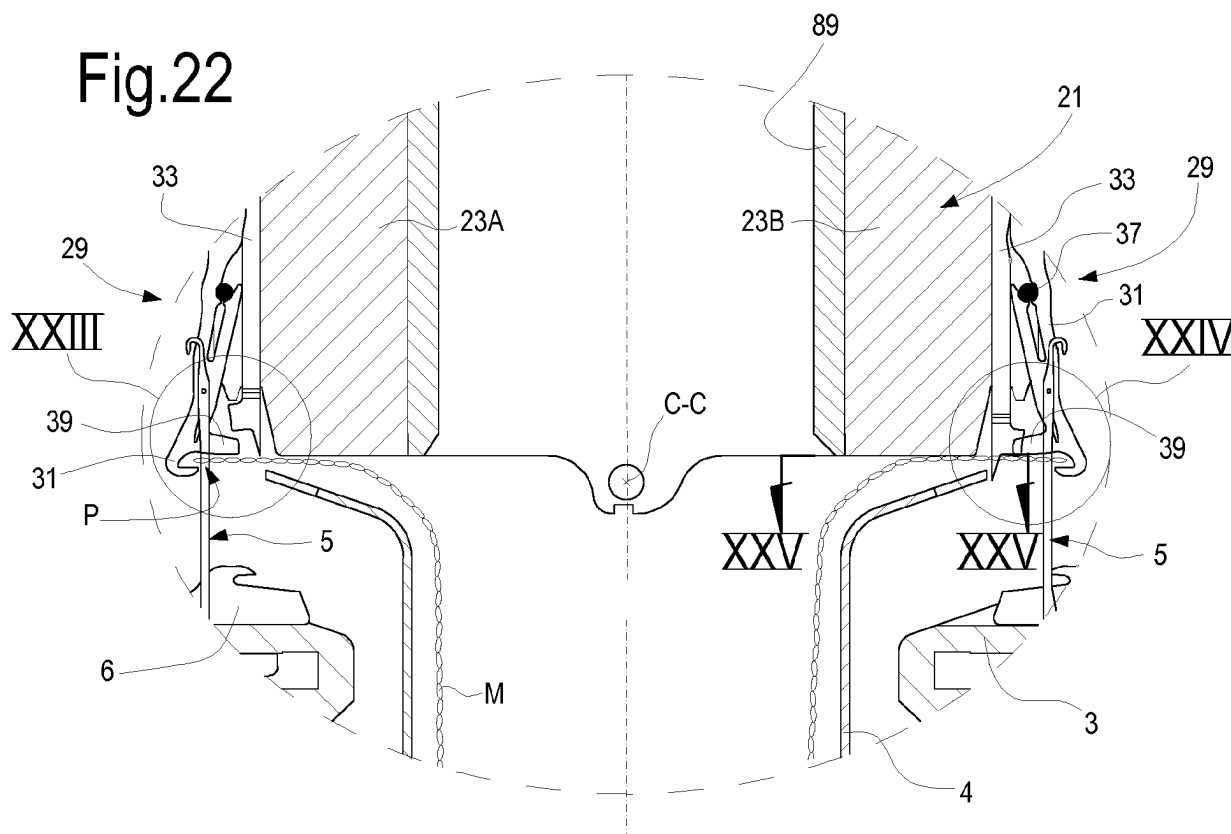


Fig.23

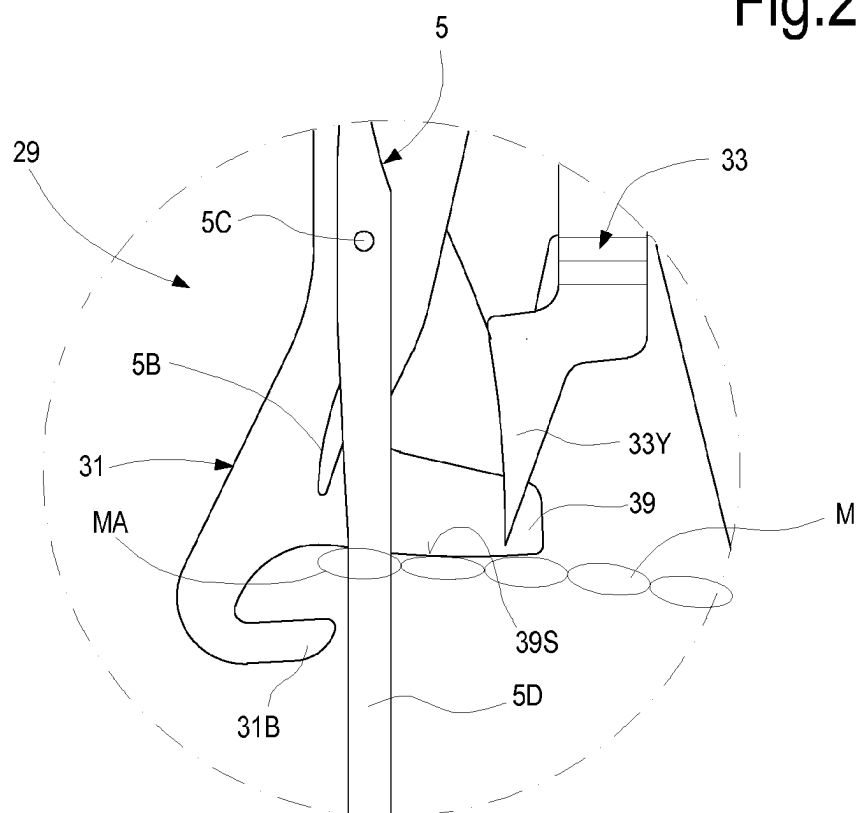


Fig.24

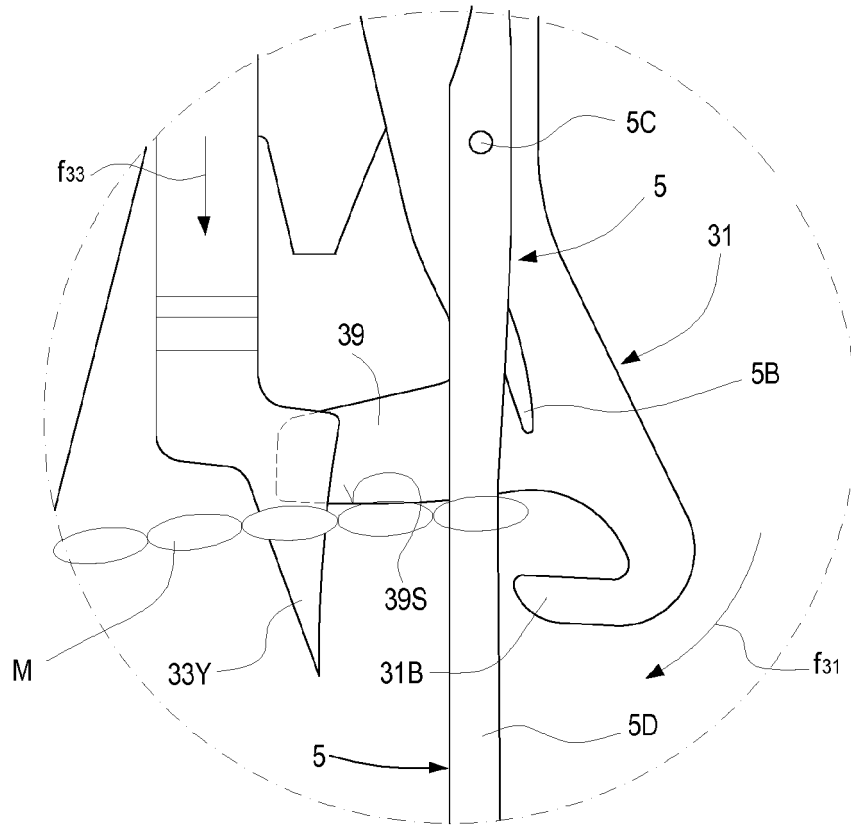
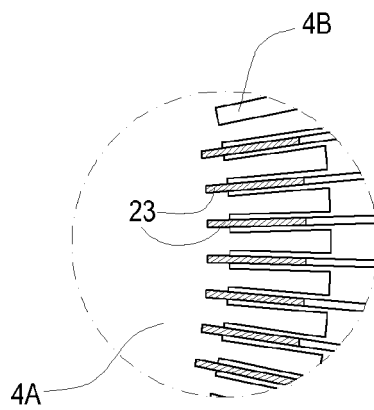


Fig.25



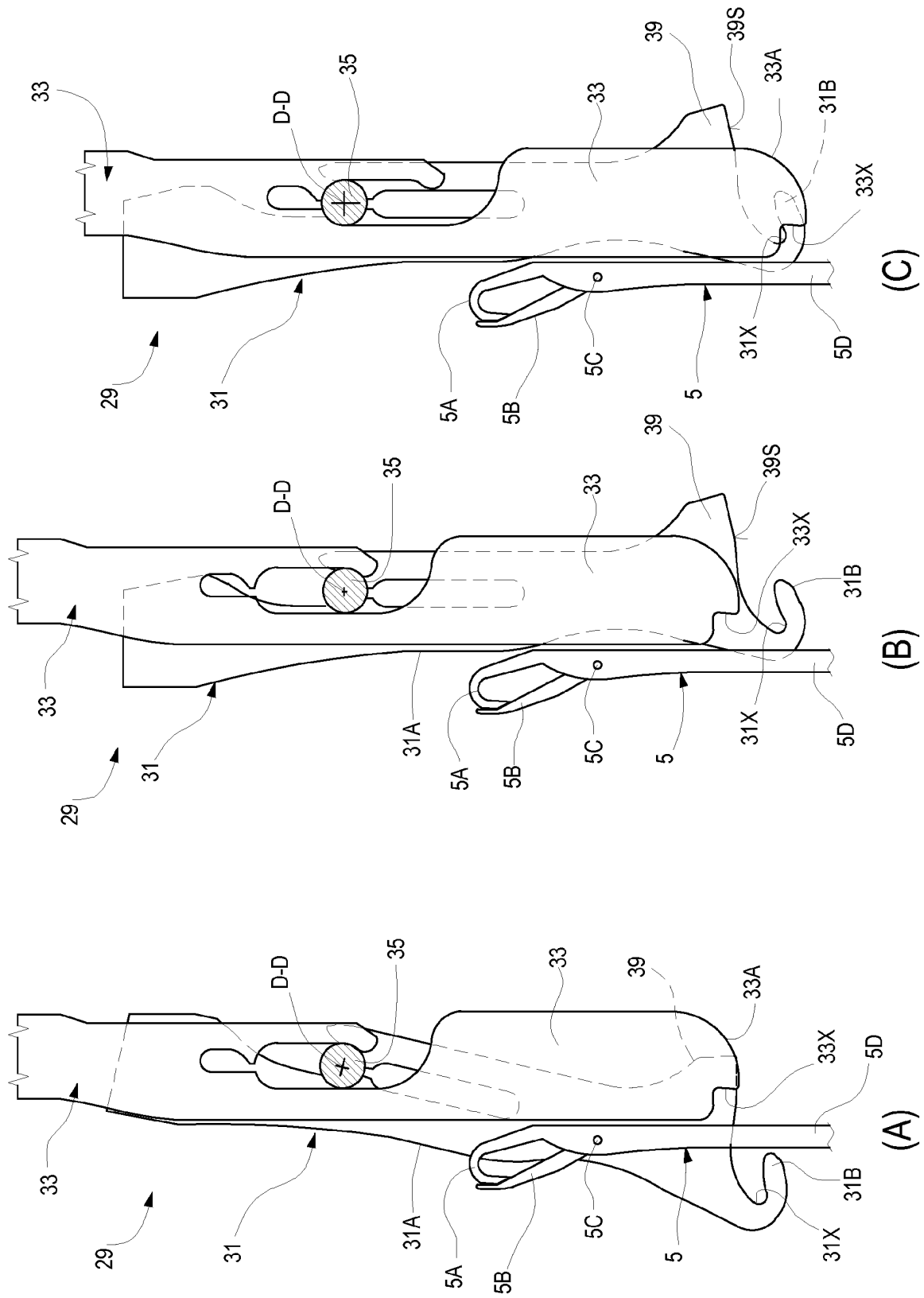


Fig.26

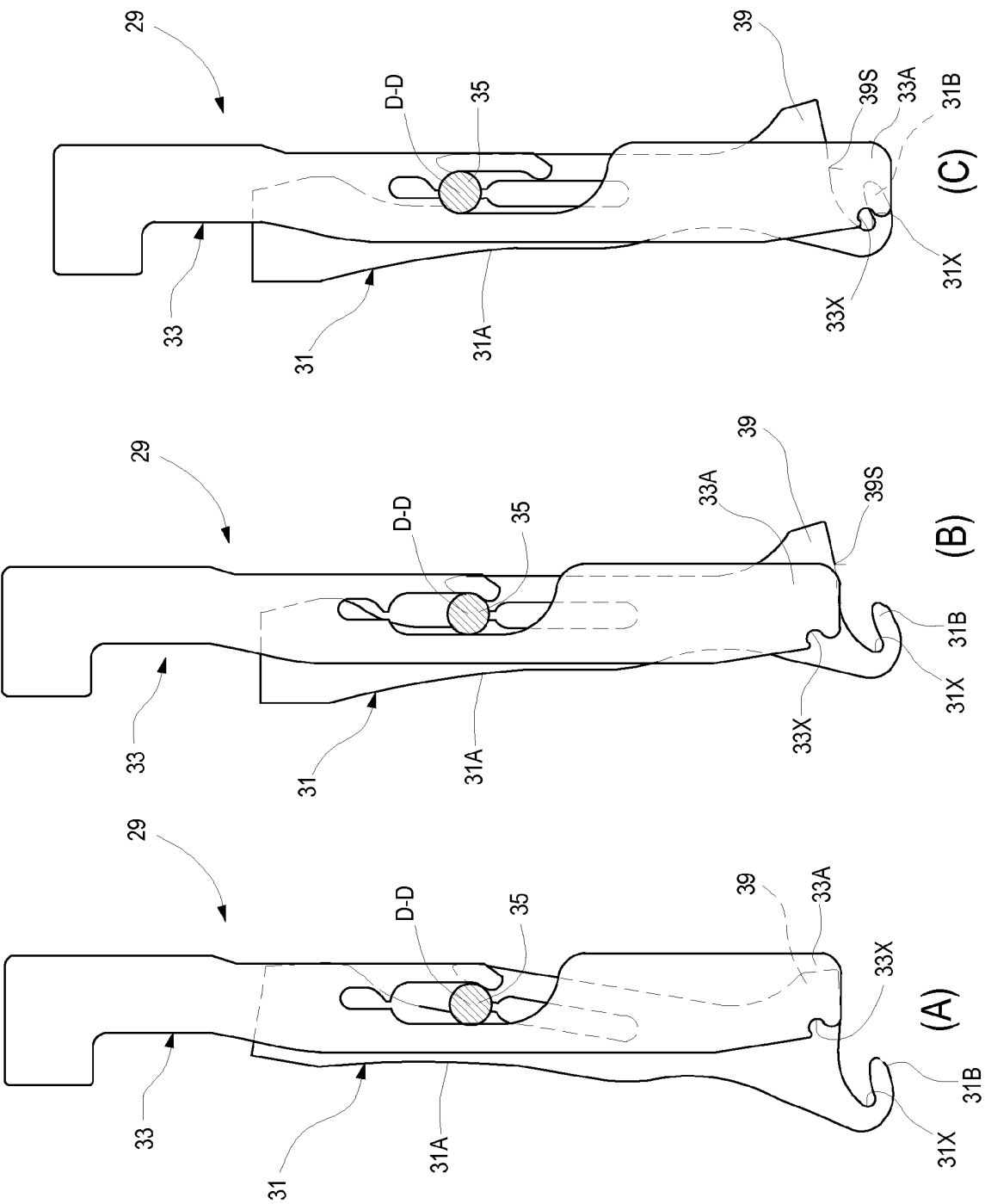


Fig.27

Fig.29

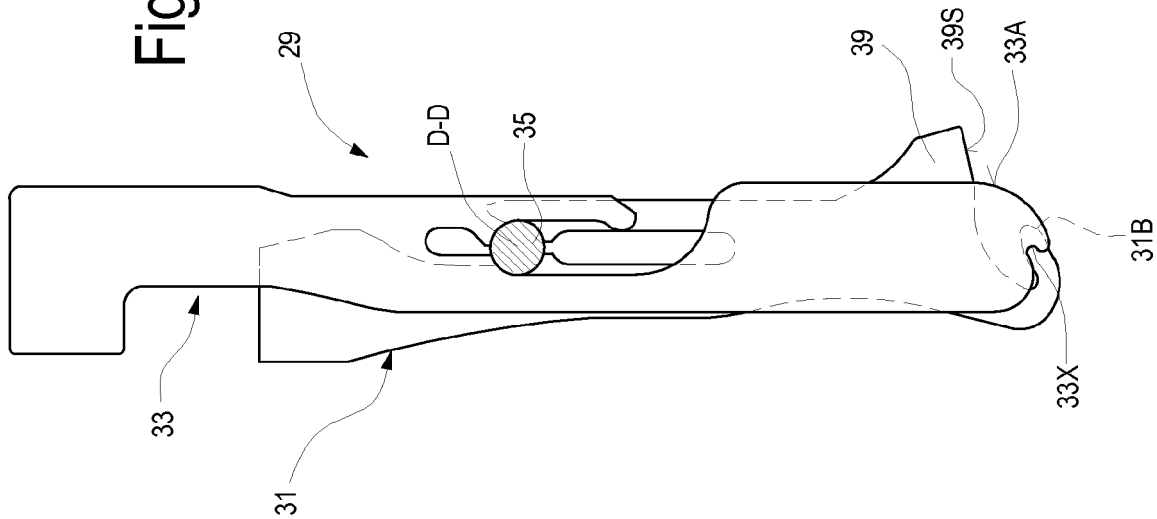
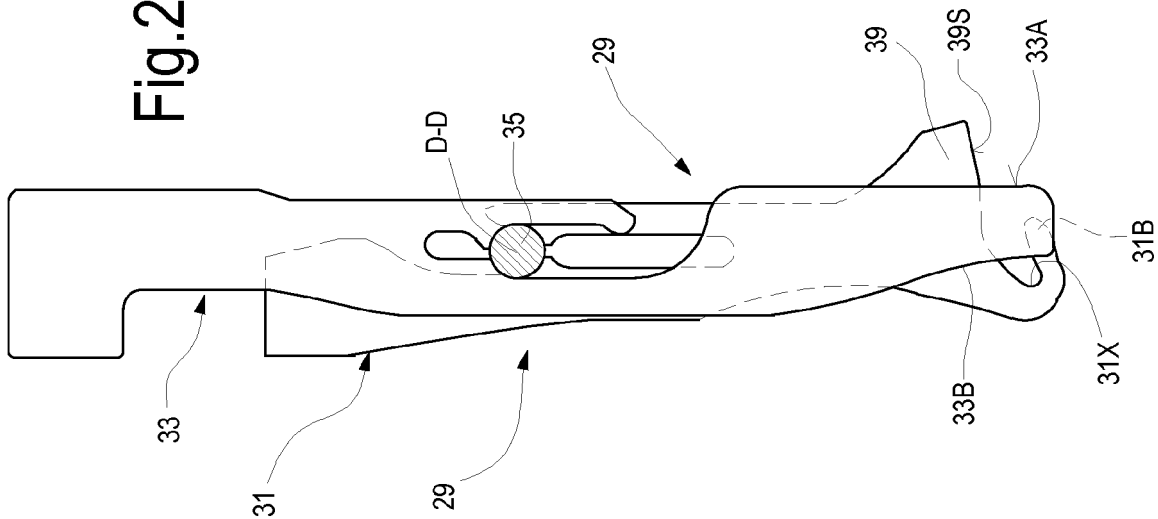
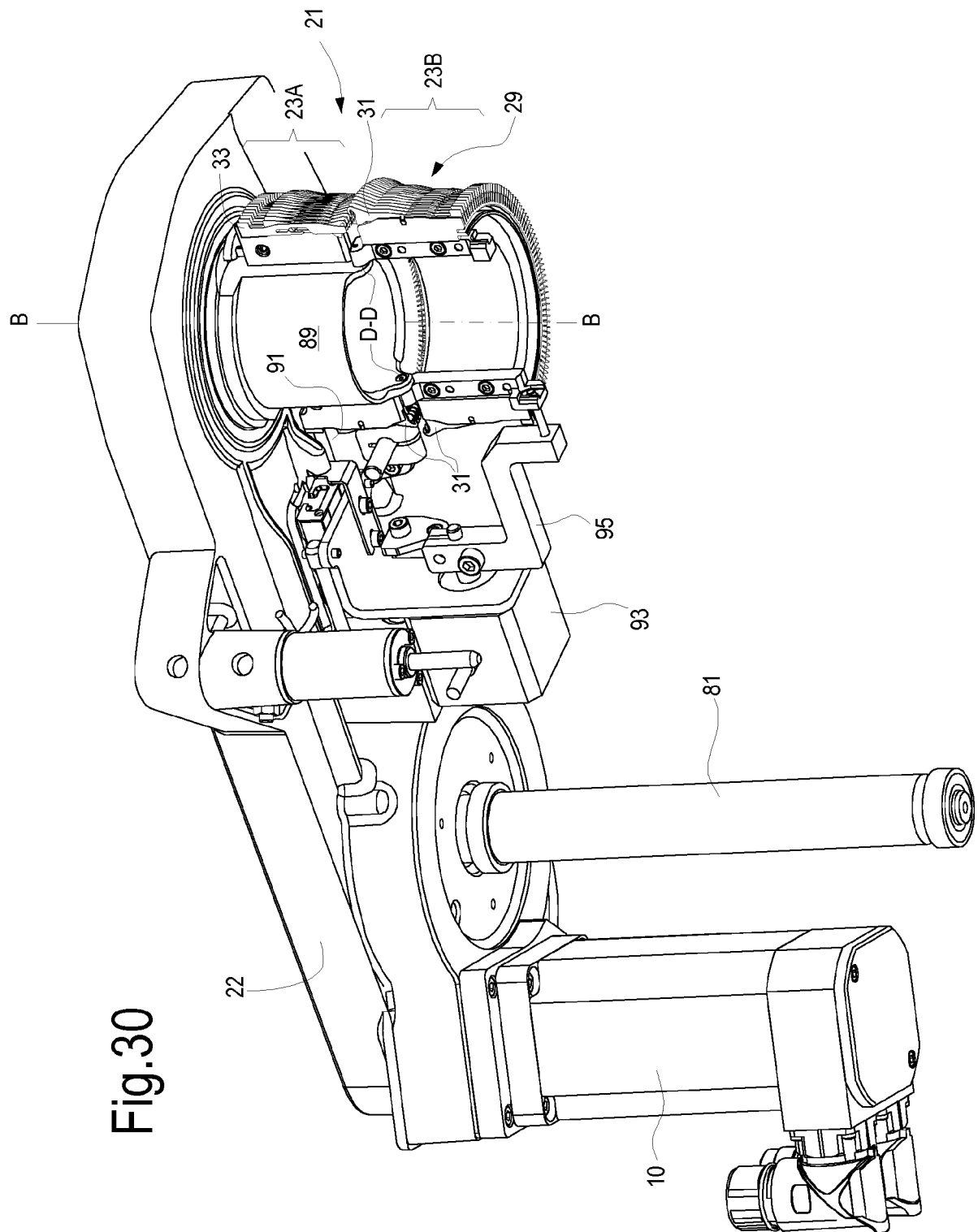


Fig.28





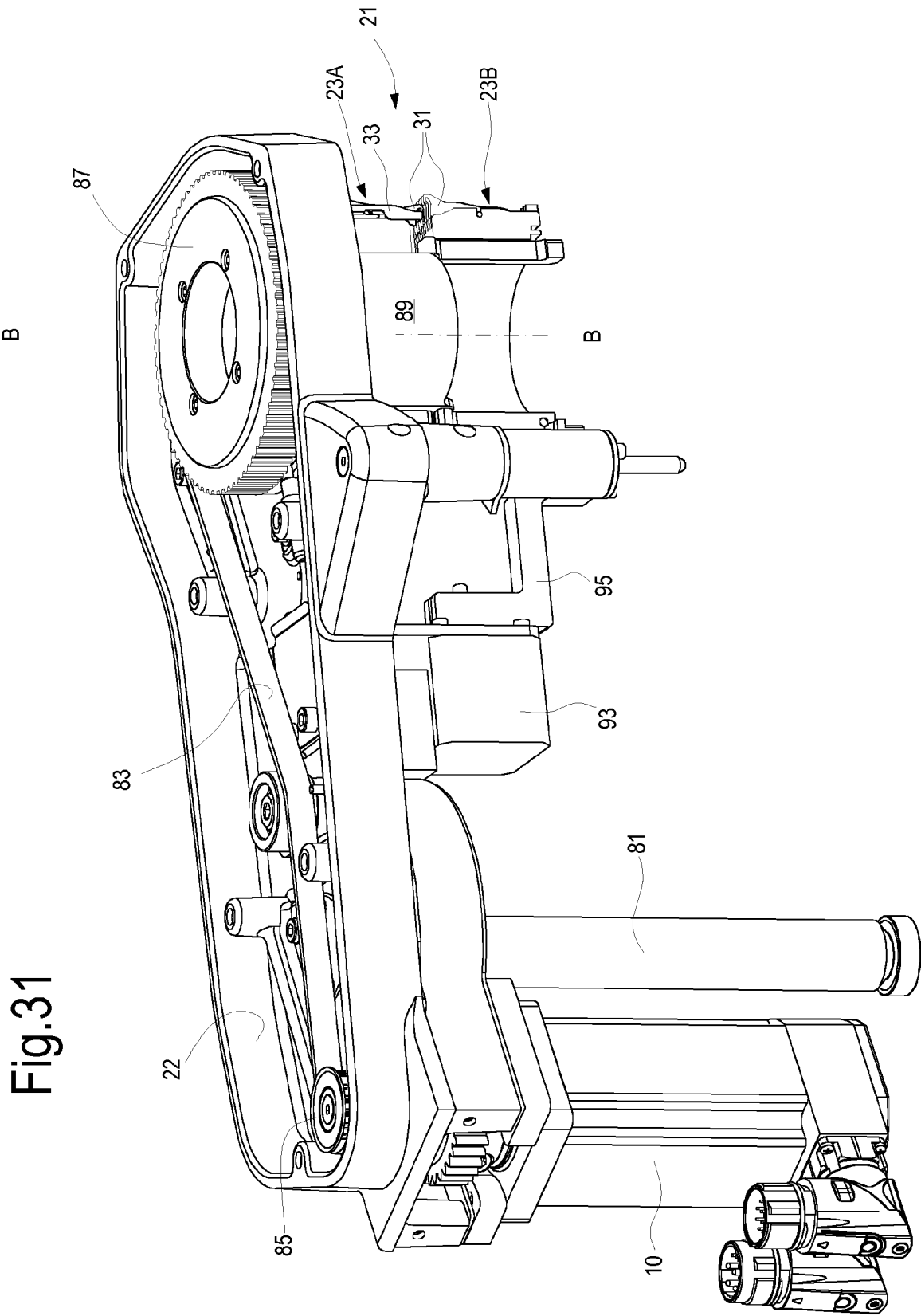


Fig.33

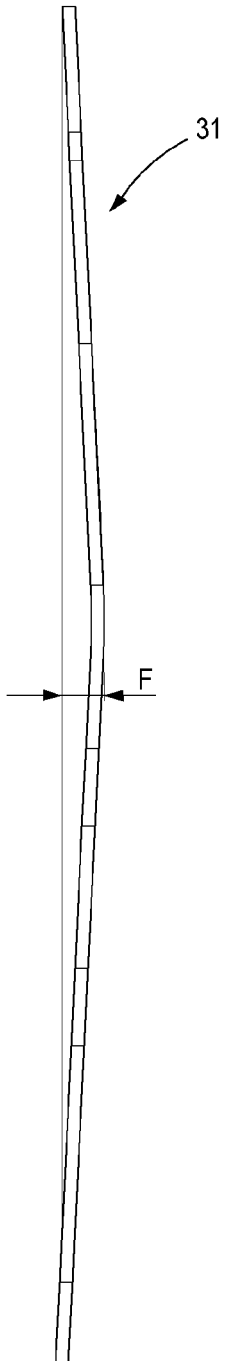


Fig.32

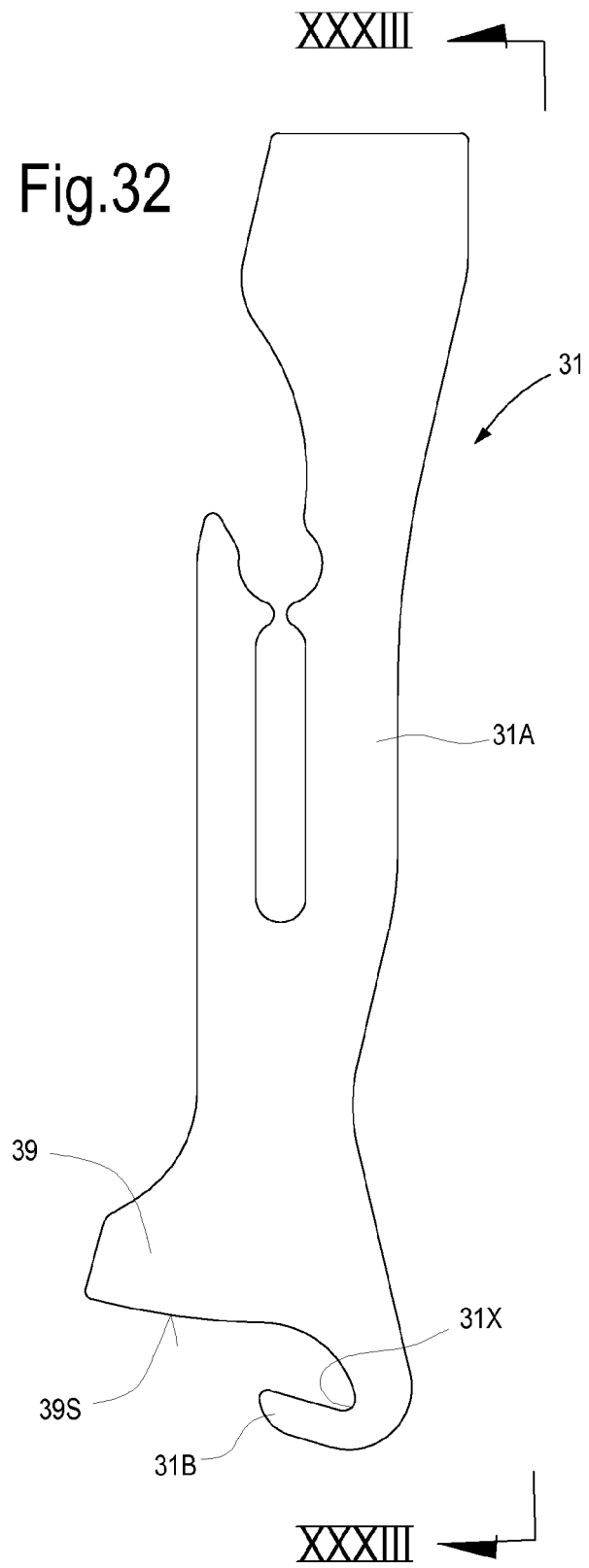


Fig.34

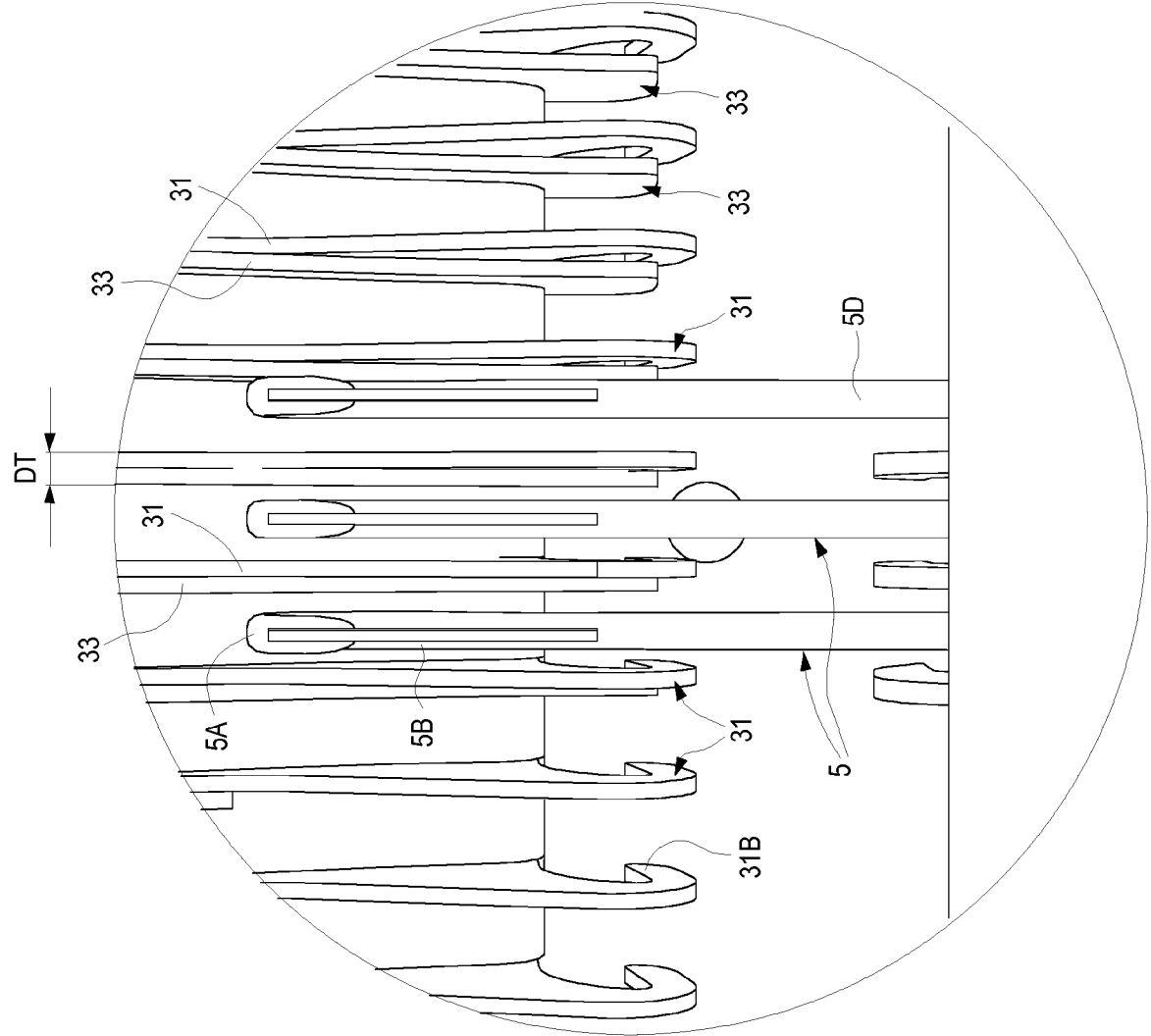


Fig.35

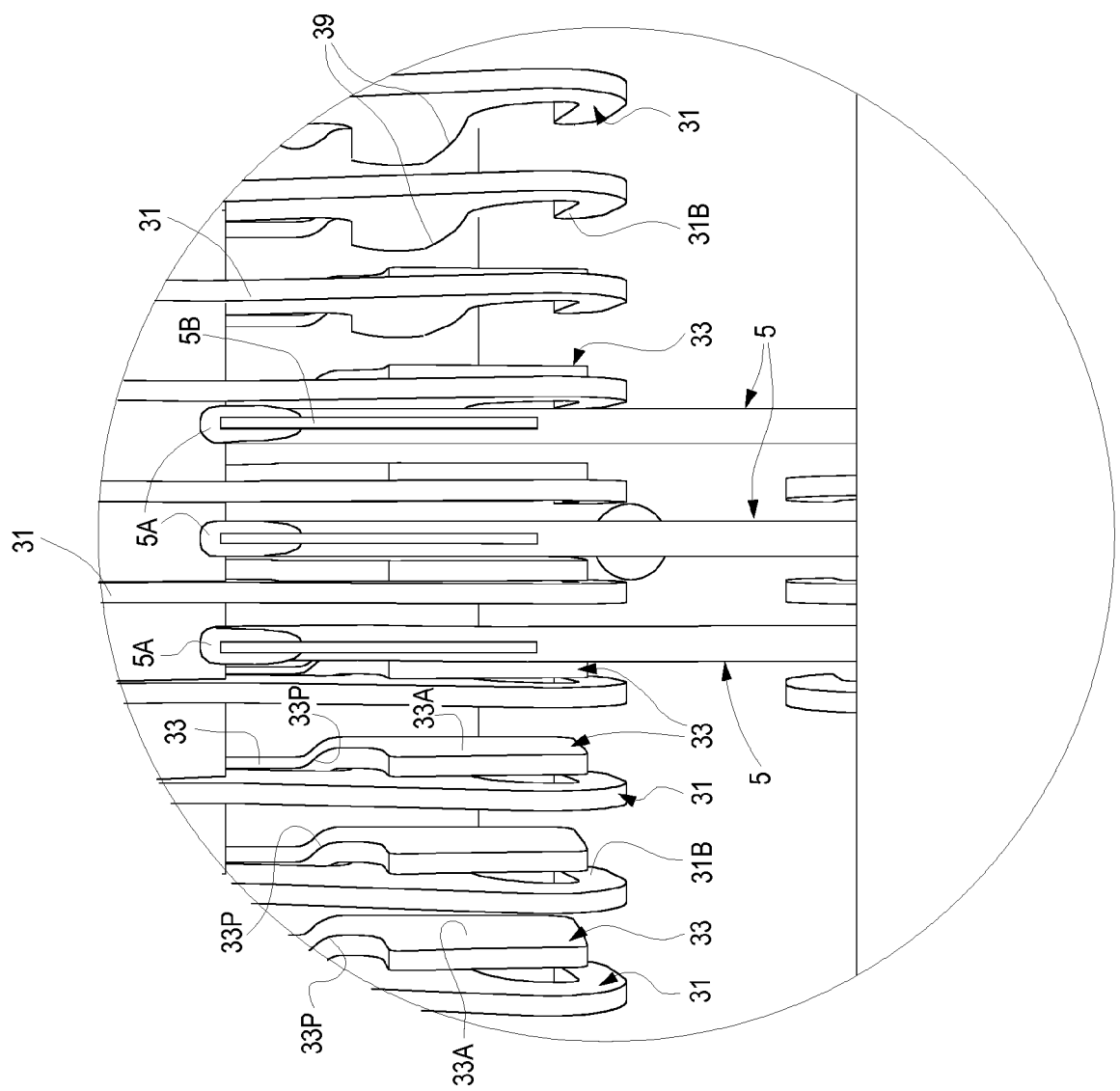


Fig.36B

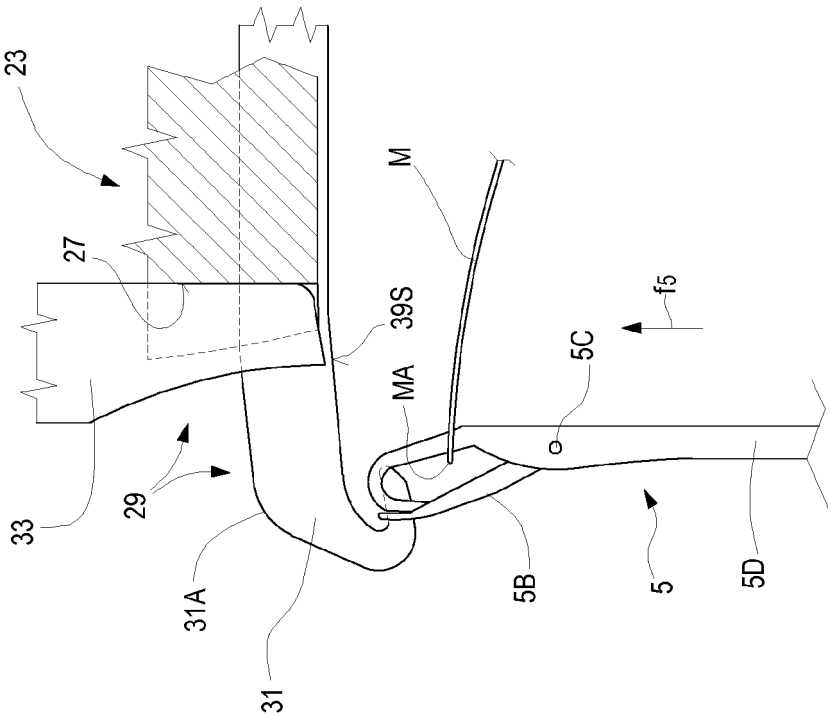


Fig.36A

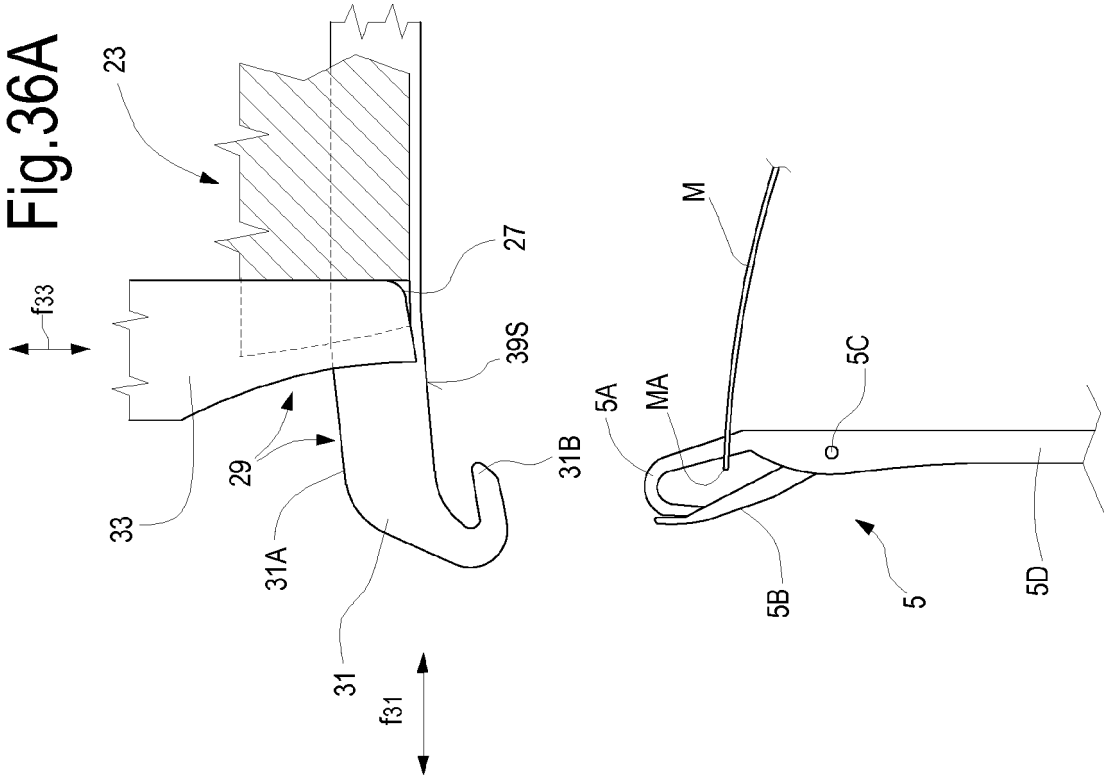


Fig.36C

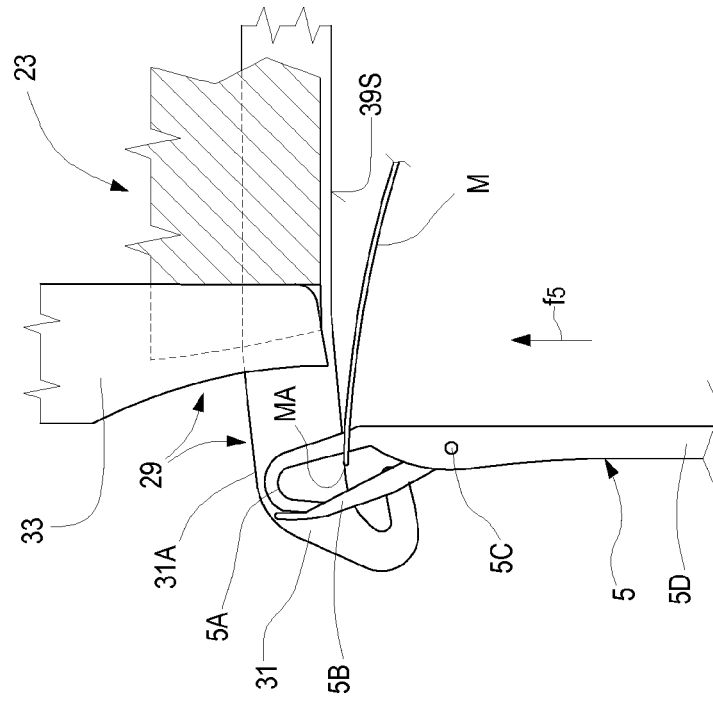


Fig.36D

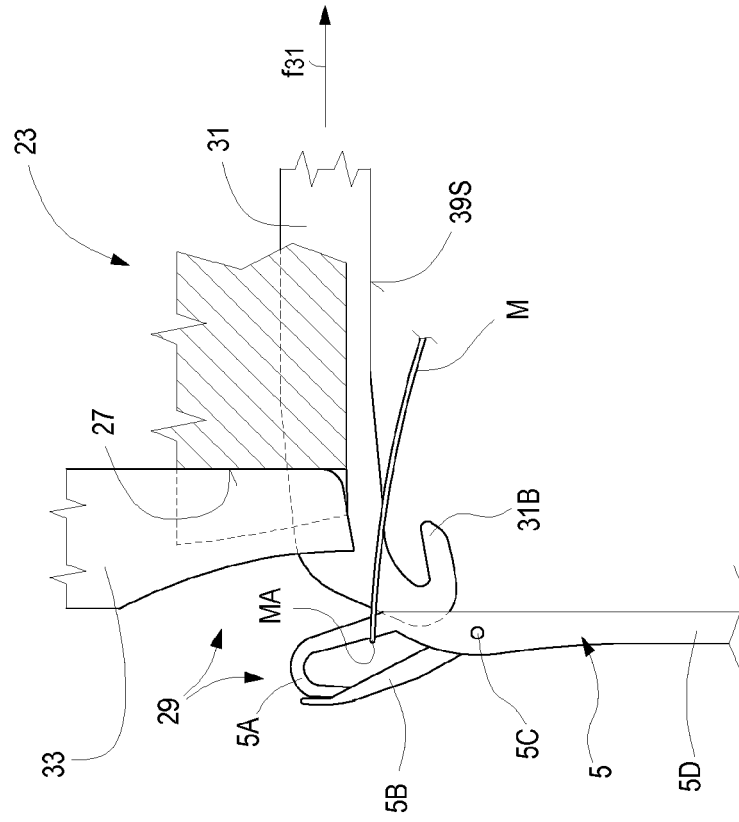


Fig.36F

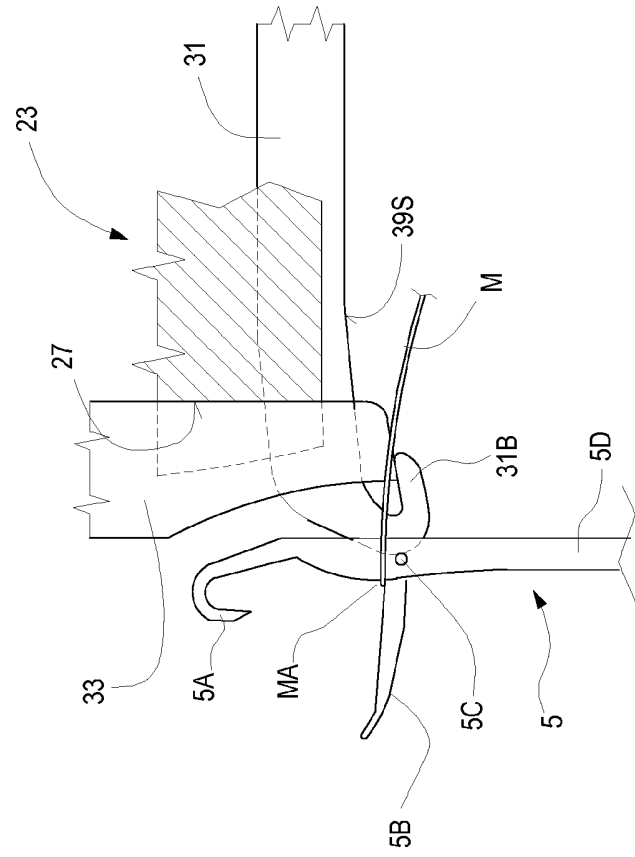


Fig.36E

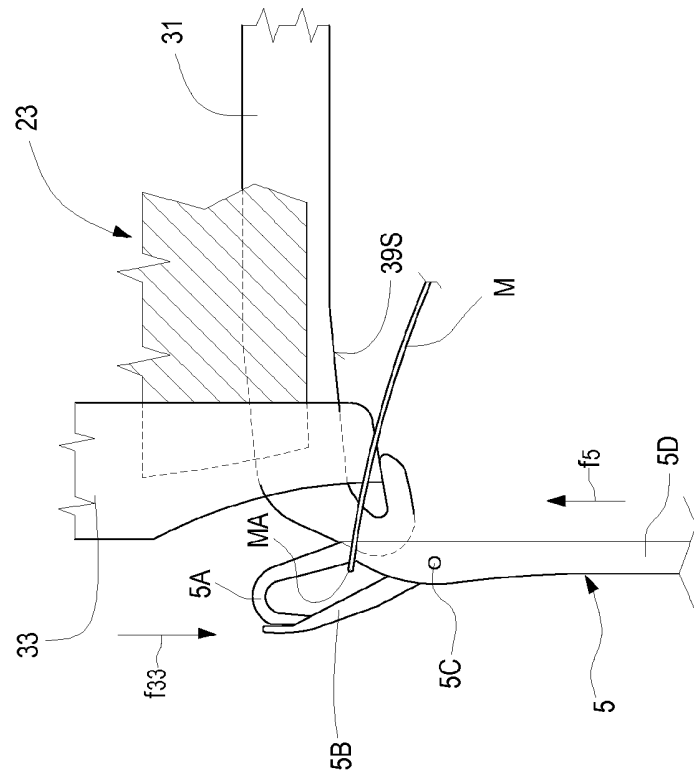


Fig.36G

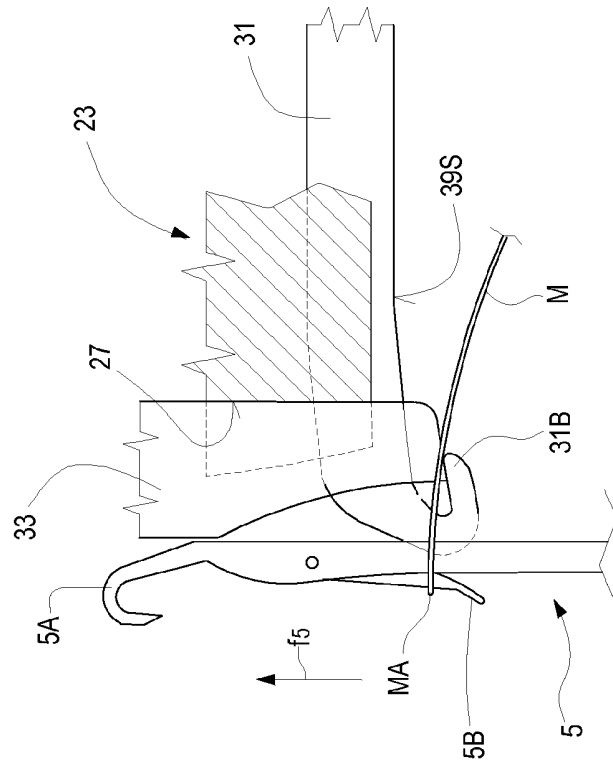


Fig.36H

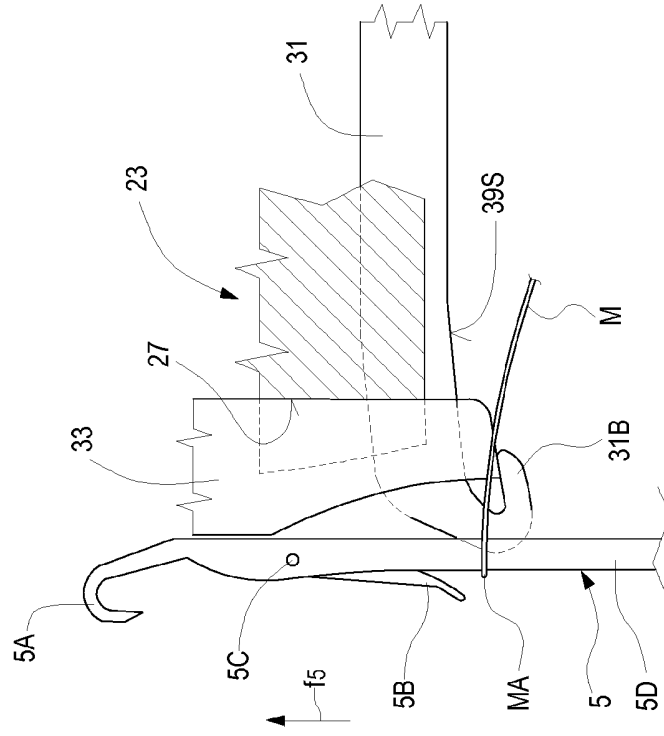


Fig.36I

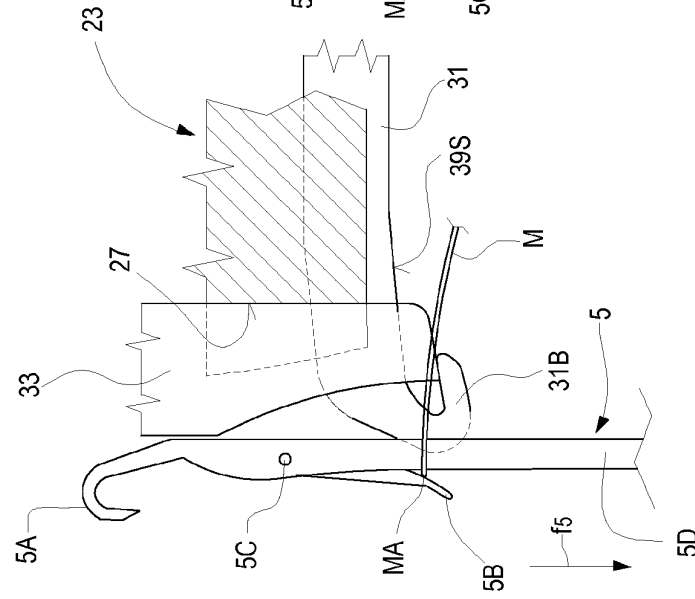


Fig.36J

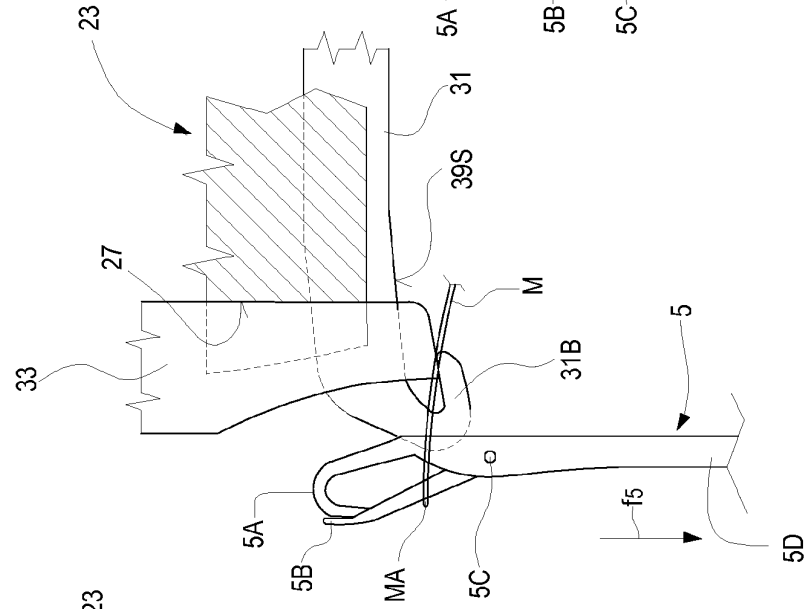
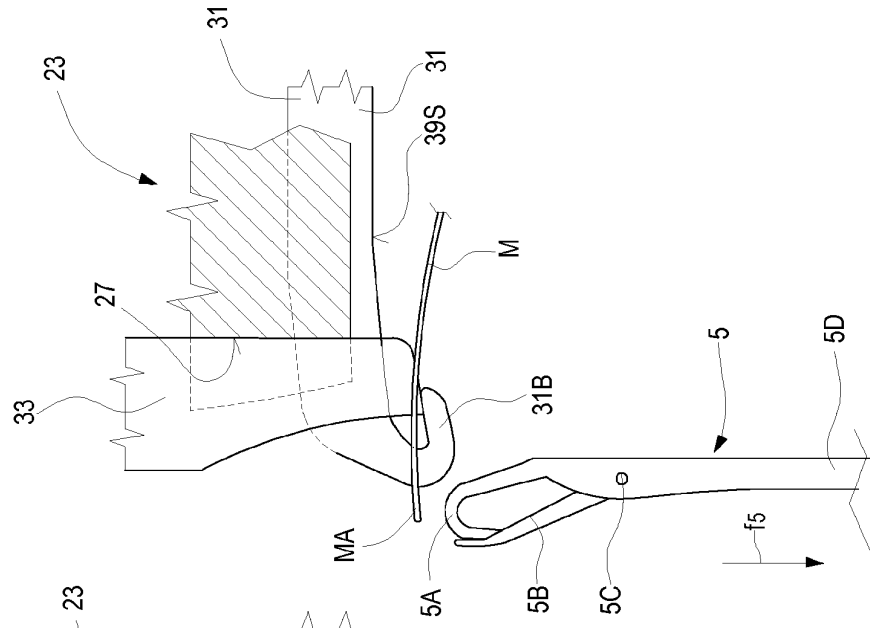


Fig.36K



REFERENCES CITED IN THE DESCRIPTION

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