



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.07.2019 Bulletin 2019/30

(51) Int Cl.:
D05B 23/00 (2006.01) D05B 37/04 (2006.01)

(21) Application number: **19152694.6**

(22) Date of filing: **21.01.2019**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **18.01.2018 TR 201800741**

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Remarks:

A request for re-establishment of rights in respect of the twelve-month period from the date of filing of the first application is pending (Art.87(1) and Art.122 EPC).

(54) **SEWING MACHINE AND THE METHOD FOR CLOSING AN OPEN END OF A TUBULAR KNITTED ARTICLE**

(57) A sewing machine and the method for closing open end of tubular knitted articles. The sewing machine is configured to knit and close the open end of a tubular knitted article, comprising a frame (10), a knitting head (20) and a thread cutter. The knitting head (20) and the thread cutter are disposed rotatable on the frame (10),

the knitting head (10) has a needle (1), a needle-shaped hook (2) and a knot making peg (3) to form thread knots (44), and the thread cutter is configured to cut the knitting thread, wherein the thread cutter is configured in a fashion of making a relative movement to the knitting head (20).

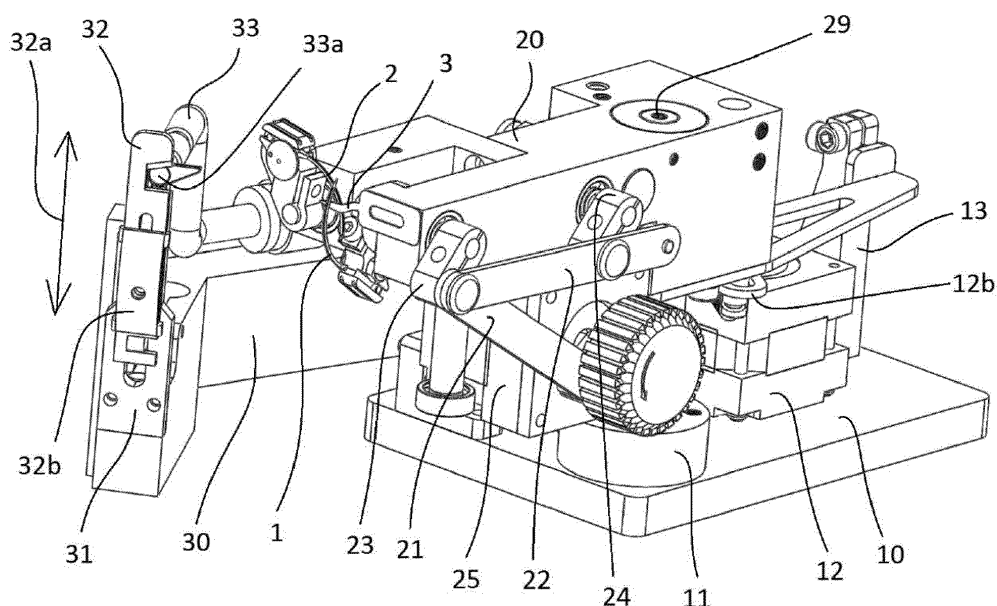


FIG. 1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention is concerned with a machine and the method thereof for joining open ends of knitted articles manufactured in cylindrical (or tubular) form such as stocking, specifically to a sewing machine and the method by using a pair of needles.

Description of the Related Art

[0002] Tubular knitted articles such as stocking are manufactured by using cylindrical sewing machines. The knitted article having two open ends on both sides, whereof one end (toe pocket) is then moved away from the needles of the sewing machine to another station for join by knitting. The transfer of the tubular knitted article from sewing machine to toe closing station can either be performed manually or by using an automatic mechanism as described under EP2377979.

[0003] As described under EP2377979, once the knitting cycle of the sock is completed at the sewing machine, the stitches in the last-to-knit rank are received individually from the knitting needles and are registered separately to a pair of semi-ranks, and then one of the semi-ranks is transferred relatively onto the corresponding stitches of another semi-rank. This operation is performed by a circumferential mechanism comprising a pair of semicircular members capable of rotating 180 degrees, whereof one of the semicircular members is swingable over another semicircular member and is capable of registering all of the loops to a plural pairs of stitches in a formation of semicircle. With this movement, the plural pairs of stitches are in position for join with stitches the open end (toe pocket) of the knitted tubular article.

[0004] Knitting mechanisms designed for toe closing may be equipped with one or two needles. Sewing machines with one needle used for registering a thread to a continuous loops of stitch, while another with two needles use for forming two thread to a knitting loop.

[0005] It is known for the state of the art that conventional machine with one needle have difficulty to close toe pocket such as the stockings are exposed to a risk of raveling.

[0006] Sewing machines with two needles essentially comprise one needle, one needle-shaped hook and a peg to tie knots.

[0007] The needle and hook of these machines bear a hole nearby the sharp edge. A thread is engaged through the hole of the needle, and another thread is engaged through the hole of the hook. The needle penetrates into the pair of stitches, moving in one side and out from the other side; meanwhile, pulling the thread through the pair of stitches. After penetration of the nee-

dle along with the thread thereon through the pair of stitches, the hook retains the thread on the needle. The needle retracts through the last stitch it penetrates into, meanwhile leaving the thread retained by the hook in the pair of stitches. Thereby, the pair of stitches are tied with double knots.

[0008] This operation is repeated for each pair of stitches to complete the toe closing process. Once toe closing is completed, there are not any pairs of stitches left for the needle to knit, therefore thread knots are disposed on the knot making peg. Knot making peg has a conical shape, where the thread knots disposed on the knot making peg move outwards from the sharp tip of the peg. Thereby, an extra thread knot is formed. In this position, one end of the extra thread knot remains on the sock while the other end is on the knot making peg, so it needs to be cut to be released. When the extra thread knot is cut and released, a portion of the thread knot is left on the sock whereas the other end is retained on the knot making peg. The portion retained on the knot making peg will be position at the knit starting point of the toe of the sock to be closed next. Therefore, thread knot portions of certain lengths remain at the starting and end points of the knitting course of the toes of stockings manufactured by using this method.

[0009] Ideally, thread knot portions remained at the starting and end points of the stocking toe should nearly be of similar length, typically between 8mm and 10 mm. On the other hand, besides the thread knots remained at the starting and ending points of the knitting course of the stocking toe, pieces of thread of various lengths may also be left on the stocking after the last rank of the stocking is knitted.

[0010] Various mechanisms to cut the extra thread knot and methods suitable for these mechanisms are known in the state of the art. For instance, EP 2300653 describes a cutter mounted on the knitting head to cut the thread knots at a predetermined distance as well as a distance between this cutter and the knot making peg. However, with the mechanism described in EP 2300653, it is not possible to cut the thread knots formed after knitting uniformly (at an almost standard length) at both ends of the stocking; nor is it possible to cut the pieces of thread remaining on the stocking (i.e. Pieces of thread that belong to the stocking) after the last rank of the stocking is knitted. As such, pieces of thread left on the stocking after the last rank is knitted may have loose ends randomly hanging in various directions.

SUMMARY OF THE INVENTION

[0011] The accomplish its above-mentioned object, the present invention discloses a sewing machine for knitting the open end of a tubular knitted article, comprises a frame, a knitting head and a thread cutter. The knitting head has a needle, a needle-shaped hook and a knot making peg to form a thread knot. The thread cutter use to cut the thread knots, wherein the thread cutter is con-

figured in a fashion that enables its movement relative to the knitting head.

[0012] According to a configuration of the said invention, the sewing machine is equipped with an air suction controllable by the cutter.

[0013] According to a configuration of the said invention, the driving force for the cutter making a relative moving to the knitting head may be provided either by means of the knitting head itself or by an independent actuator.

[0014] According to a configuration of the said invention, in any position of the knitting head and the cutter, the distance between the position where the knitting knots is formed and the cutter varies between 3 to 30 mm. Preferably the distance varies between 20 mm and 30 mm.

[0015] The invention also discloses a sewing method adopted aforementioned sewing machine for closing an open end of tubular knitted article, including the steps: a plural pairs of stitches at an open end of the tubular knitted article being arranged to along a semicircle, then a thread being feed into the knitting head to form a thread knots to connect the pairs of stitches. Once the connection process being completed, the knitting head forming an extra thread knots to be cut by a thread cutter of the sewing machine, wherein the cutter can make a relative moving to the knitting head of the sewing machine.

[0016] The invention also disclosure a stocking manufactured by using the sewing method described above, comprising two thread knots with 8 to 10 mm long remained at both ends for knitting purpose.

[0017] Therefore, besides providing cutting extra thread knots, the thread cutter can a relative moving toward the knitting head for further adjusting the lengths of thread knots remained on the tubular articles (stockings) and left on the knitting head as a start and end points when manufacturing stockings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Figure 1 is a perspective view of the sewing machine.

Figure 2 is another perspective view of the sewing machine.

Figure 3 is a plan view of the sewing machine.

Figure 4 is a perspective view of the sewing machine, shows the initial step for joining corresponding pairs of stitches.

Figure 5 is a perspective view of the sewing machine, shows the thread knots with undesirable length being sucked by the air suction hose.

Figure 6 is a perspective view of the sewing machine, shows thread knots with undesirable length being cut after taken in during the progress of the knitting operation.

Figure 7 is a perspective view of the sewing machine, shows formation of some additional amount of thread knots by the sewing machine.

Figure 8 is a perspective view of the sewing machine, shows the knitting head moving away from the knitting position.

Figure 9 is a perspective view of the sewing machine, illustrates the thread knots being cut by the movable blade.

Figure 10 is a perspective view of the sewing machine, shows the knitting head withdrawing from knitting position by rotating nearly 90 degrees after the knitting operation is completed.

Figure 11-A is a perspective view of the sewing machine, shows the knitting head in the knitting position.

Figure 11-B is a perspective view of the sewing machine, shows the knitting head making a partial retraction from the knitting position.

Figure 11-C is a perspective view of the sewing machine, shows the knitting head rotating for nearly 90 degrees.

Figure 12 is a perspective view of the sewing machine, shows a close-up view of the knitting head.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0019] The sewing machine disclosed in the invention comprises a frame (10), a knitting head (20) which is rotatably connected to the frame (10) by means of a knitting head cam (11). A primary motor (12), preferably being a stepper motor, is mounted on the frame (10). A bell crank (12a) and an arm (12b) are mounted on the outlet of the said primary motor (12). Wherein one end of the arm (12b) is connected with the knitting head cam (11). This allows rotation of the knitting head (20), driven by the primary motor (12), around a rotation axis (29). Besides, it should also be noted that movement of the knitting head (20) could also be provided by means of a linear mechanism known in the art.

[0020] A cutter arm (30) is connected with the frame (10) for making an axial rotation toward an axle (39). In addition, a primary stopper (13) projecting upward from the frame (10) for positioning the knitting head (20) being in knitting position as shown in FIG. 2.

[0021] On the other end (open end) of the cutter arm (30) is mounted a thread cutter, capable of moving around a circle trace, and the thread cutter comprising a fixed blade (31) and a movable blade (32) capable of moving towards and away the former. A dished plate (32b) is provided on the blades (31, 32) so that the movable blade (32) can exert some pressure on the fixed blade (31).

[0022] A secondary stopper (14) is mounted on one end of the knitting head (20) and positioned between the knitting head (20) and cutter arm (30). In addition, a spring (15) has two ends, one end connected to the frame (10) and the other end connected to the cutter arm (30) for pulling the cutter arm (30) towards the knitting head (20) when the cutter arm (30) is dismissed, as indicated in Figure 10. The knitting head (20) is capable of rotating

of its own to a certain extent but once the secondary stopper (14) contacts the cutter arm (30), the knitting head (20) and the cutter arm (30) rotate together. As an alternative, the secondary stopper (14) can also be mounting on the cutter arm (30).

[0023] Alternatively, the cutter arm (30) and the thread cutter may be actuated by means of a separate actuator independent from the drive of the knitting head (20). In view of this, an additional motor member may connect with the axle (39). However, it should also be noted that the movement of the thread cutter might be actuated by means of a linear mechanism for making a movement or by means of a mechanism making a general planar motion for moving along a linear trace or moving on a plane. When the cutter arm (30) is actuated independently, knitting head (20) may as well be fixed on the frame (10).

[0024] The knitting head (20) bears a needle (1) on one end, a needle-shape hook (2) and a knot making peg (3) neighbored by the needle-shape hook as a placement for disposing the thread knots.

[0025] The needle (1) and the hook (2) required for the knitting operation are actuated by a secondary motor (25), preferably being a stepper motor. A primary plate (21) and the secondary plate (22) are connected to the output end of the secondary motor (25). Wherein one end of the primary plate (21) is connected to the secondary motor (25), and the other end of the primary plate (21) is linked to the needle controlling arm (23) in an eccentrically rotating fashion. At the connection point of the needle controlling arm (23) and the primary plate (21), there is also a secondary plate (22) connected at one end. The secondary plate (22) is engaged to the hook controlling arm (24) at a position close the other end in an eccentrically rotation fashion.

[0026] One end of the needle controlling arm (23) is embedded by means of a swing bearing in the body of the knitting head (20), and the other end is engaged thereto so that it actuates the motion of the needle (1). One end of the needle controlling arm (24) is embedded by means of a swing bearing in the body of the knitting head (20), and the other end is engaged to the hook (2) so that it actuates the motion thereof. In this position, the motion is first transferred to a gear assembly (28) and then to the hook (2). Wherein the gear assembly comprising two gears are clutched against each other at a 90-degree angle against each other. Thus, when the secondary motor (25) completes one cycle, motion of the needle (1) and the hook (2) is synchronized.

[0027] The cutter arm (30) has a longitudinal form comprising two sections, ideally positioned in a wide angle against one another. As described above, this arm connects to the frame (10), by means of an axle (39), in a rotatable fashion.

[0028] On its end close to the blades (31, 32), the cutter arm (30) bears with a piston (35) for actuating the movable blade (32) by means of a piston rod (34). An air suction hose (33) provided on the upper section of the cutter arm (30). The suction head of the air suction hose

(33) extends to the immediate back of the movable blade (32). The air suction inlet (33a) is closed when the movement blade (32) is in lower position. Although the air suction hose (33) is always in air suction mode, it does not consume energy when the air suction inlet (33a) is closed.

[0029] When the knitting operation advances to the stage of closing the open toe of the tubular knitted article, as indicated in Figure 3, the pairs of stitches (42) to be linked are arranged along a semi-circle as described in EP2377979. Meanwhile, the needle (1) to perform the knitting operation and the hook (2) are essentially positioned vertically to the horizontal knitting axis (41) of the pairs of stitches, as indicated in Figure 3e. Meanwhile, the cutter arm (30) is also positioned to the trace of the pairs of stitches (42) which have been joined stitching. In this position, the distance between the position where the thread knots will be formed and the point where they will be cut by the blades (31, 32) is about 30 mm.

[0030] As illustrated in Figure 4, when the needle (1) mounted on the knitting head (20) and the first pair of stitches (42) to be knitted are arranged alignment, the sharp tip of the needle (1) and the thread in the hole (1a) nearby the sharp tip passes across the pair of stitches (42). Before the needle (1) moves out of the first pair of stitches (42), the hook (2) grips the thread lying in the needle (1) and the needle (1) moves out of the pair of stitches (42) leaving a thread, previously pulled from the hole (2a) at the tip of the hook (2), inside the pair of stitches. Thus, the first pair of stitches (42) are knotted and knitted together. While knitting the first pair of stitches (42), thread knots (44b) already remained on the knot making peg (3) are also disposed onto the first pair of stitches (42).

[0031] Once the first pair of stitches (42) are knitted completely, the semicircular member carrying the pair of stitches (42) turns axially (41) according to the direction (43) by the means already known in the art. By doing so, the second pair of stitches (42) is aligned to the needle (1). The knitting operation repeats all of the pairs of stitches according to a knitting direction (5) as shown in Figure 12, until all of the pair of stitches are registered to the knitting thread knots (42a). Meanwhile, the thread knot (44b) engaged to the first pair of stitches (42) advances towards the blades (31, 32) of the cutter.

[0032] As shown in Figure 5, the movable blade (32) partially moves away from the fixed blade (31) with an upward motion (32a), and thereby opens the air suction inlet (33a) mounting on the air suction hose (33). The thread knots (44b) engaged to the first pair of stitches (42) is sucked into the air inlet (33a) of the air suction hose (33). Meanwhile, the thread knots (44b) engaged to the first pair of stitches is positioned between the two blades (31, 32).

[0033] As shown in Figure 6, with a downward motion (32a) of the movable blade (32), the thread knots (44b) is cut with a remaining nearly 8 to 10 mm long left on the stocking and suck out the leftover thread knots (44b) for

disposal by the air suction hose (33).

[0034] Once knitting operation of all pairs of stitches (42) is completed, an extra thread knots (44) is to be ready for stitching hang on the knot making peg (3). The knot making peg (3) has a conical shape tip (3a) for moving outwards and a conical sharp for disposing the thread knots (44) on the knot making peg (3). Thereby, once an extra thread knot (44) in nearly 30 to 40 mm length is formed, the knitting head (20) partial turns around a direction (29a) of its axis (29), and moves away from the pairs of stitches (42). With this motion, the last-formed thread knots (44) is positioned between the two blades (31, 32), as the movable blade (32) opens up. In this position, the distance is nearly 20 mm to 30 mm between the two blades (31, 32) and the tip (3a) of the knot making peg (3) mounted on the knitting head (20)).

[0035] As shown in Figure 9, with a downward motion of the movable blade (32), the thread knots is cut into two pieces. Where one piece (44a) with a nearly 8 to 10 mm long left on the stocking, and the other piece (44b) with a remaining nearly 20 to 30 mm long hang on the knot making peg (3).

[0036] As shown in Figure 10, once the toe pocket is knitted and the thread knots (44a, 44b) is cut, the knitting head (20) turns 90 degrees around a direction (29a) of its axis (29). Meanwhile, the cutter arm (30) also partially rotates around a direction (39a) of its axis (39) and then drifts away from the semicircular member in an eccentric fashion because of the blocking of the secondary stopper (14).

[0037] The sewing machine provided in aforementioned embodiment can be adopted to a method for closing the open end of tubular knitted article as narrated hereinafter. Firstly, the sewing machine is in a knitting position, the open end of tubular knitted article is registered to a plural pairs of stitches (42) around a semicircle, a thread (4) feed into the knitting head (20) to link the remaining portion of the thread knots (44b) and to start knitting of thread knot (42a). Then the air inlet (33a) of the air suction hose (33) is opened for taking in the thread knots (44b) which is ready-for-cutting, and then thread knot (44b) is cut into two pieces by two blades (31, 32) and resume knitting the remaining thread knot (42a) until the knitting operation of pair of stitches (42) is finished. Hereafter the knitting head (20) is utilized to form an extra thread knots (44) and the knitting head (20) is partially actuated for deviating from the knitting position, coming toward the cutter arm (30), and for disposing the extra thread knots (44) on the blades (31, 32) as shown in FIG. 11B. The blades (31, 32) are adopted in separate the extra thread knots (44) from the starting and the ending thread knots (44a, 44b). Finally, the knitting head (20) is on a full run for the cutter arm (30) to move away.

[0038] Repeats aforementioned steps when making a join stitching to another tubular knitting article. Therefore, owing to the independent deployment of the thread cutter, the cutting may be processed on both ends of the tubular knitting article with an adjustable length to the

remaining thread knots (which is the distance between the thread cutter and the knot making peg).

5 Claims

1. A sewing machine for knitting an open end of a tubular knitted article, comprises a frame (10), a knitting head (20) mounted on the frame (10), and a thread cutter movably mounted on the frame (10), wherein the knitting head (20) has a needle (1), a needle-shaped hook (2) and a knot making peg (3) for forming thread knots (44), the thread cutter use to cut the thread knots (44); and the sewing machine being **characterized in that**: the thread cutter is configured in a fashion that enables its movement relative to the knitting head (20).
2. The sewing machine as claimed in claim 1, wherein the knitting head (20) is movably deployed on the frame (10), and the thread cutter is actuated by means of the knitting head (20) or an independent actuator.
3. The sewing machine as claimed in claim 1, wherein the thread cutter is equipped to move along a circular trace, a linear trace, or a trace on a general plane.
4. The sewing machine as claimed in claim 1, wherein the thread cutter having a cutter arm (30) rotatable connected to the frame (10).
5. The sewing machine as claimed in claim 4, wherein a stopper (13) is mounting between the thread cutter and the knitting head (20).
6. The sewing machine as claimed in claim 1, wherein an air suction inlet (33a) connected with the thread cutter in an operational manner.
7. The sewing machine as claimed in claim 6, wherein the thread cutter has a fixed blade (31) and a movable blade (32), and the air suction inlet (33a) is disposed behind the movable blade (32).
8. The sewing machine as claimed in claim 1, wherein the knitting head (20) is pivoted onto the frame (10) and driven by a knitting head cam (11).
9. The sewing machine as claimed in claim 1, wherein a distance between a position where the knitting knot (44) is formed and the thread cutter is varies between 3 to 30 mm.
10. The sewing machine as claimed in claim 9, wherein the distance is varied between 20 to 30 mm.
11. A sewing method for closing an open end of tubular

knitted article compatible with a sewing machine as claimed in claim 1, and its steps comprises:

a plural pairs of stitches at an open end of the tubular knitted article being arranged along a semicircle, a thread (4) being feed in a knitting head (20) of said sewing machine to form thread knots (44) to connect the pairs of stitches, and once the process of the pairs of stitches being all completed, the knitting head (20) of the sewing machine forming an extra thread knots (44) to be cut by a thread cutter of the sewing machine; wherein the thread cutter being relatively movable to the knitting head (20).

12. A sewing method as claimed in claim 11, when the knitting head (20) leaves another extra thread knot (44b) as a starting point for connecting a plural pairs of stitches of another tubular knitted article, the thread cutter being adopted to process cutting the another extra thread knot (44a).
13. A sewing method as claimed in claim 11, wherein the tubular knitting article has one extra thread knots (44b) with preferable length between 8 to 10 mm after being cut, and another extra thread knots (44a) on the knitting head (20) with preferable length between 20 to 30 mm after being cut.
14. A stocking manufactured by using a sewing method as claimed in claim 11, comprises two thread knots (44a, 44b) of 8 mm to 10 mm long at both ends.

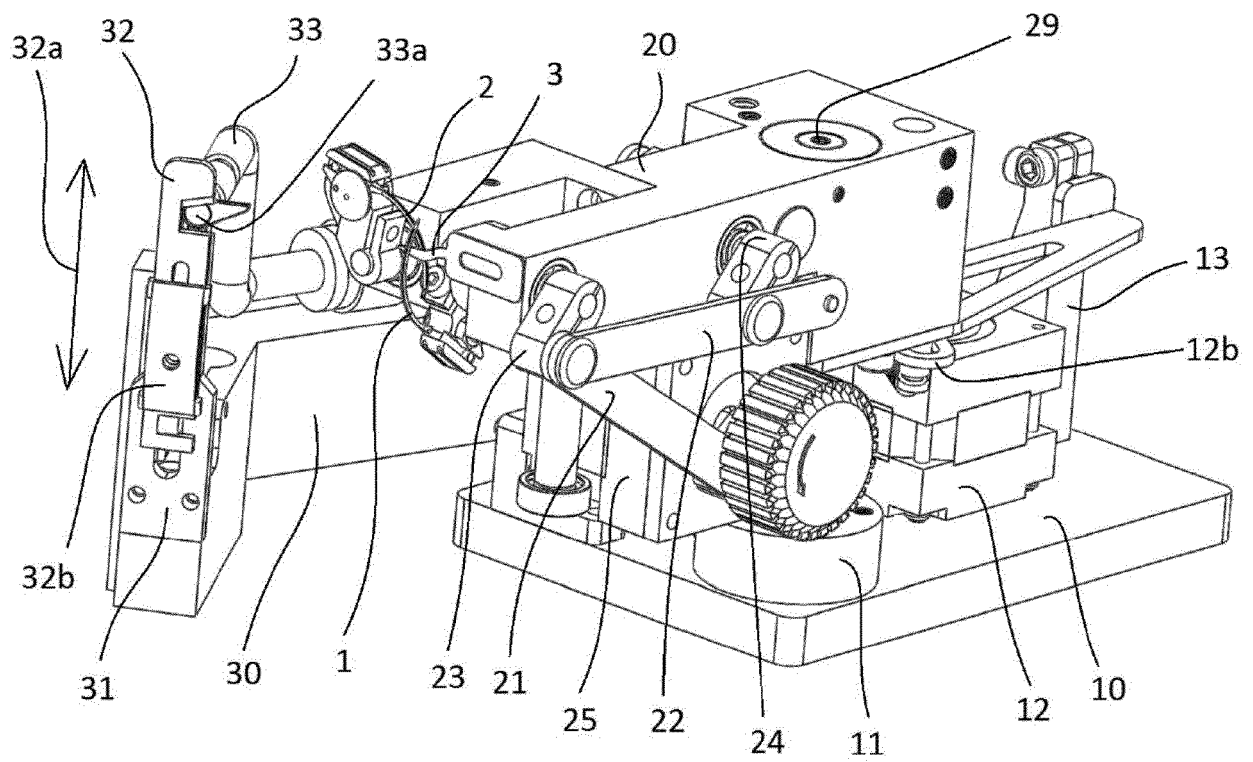


FIG. 1

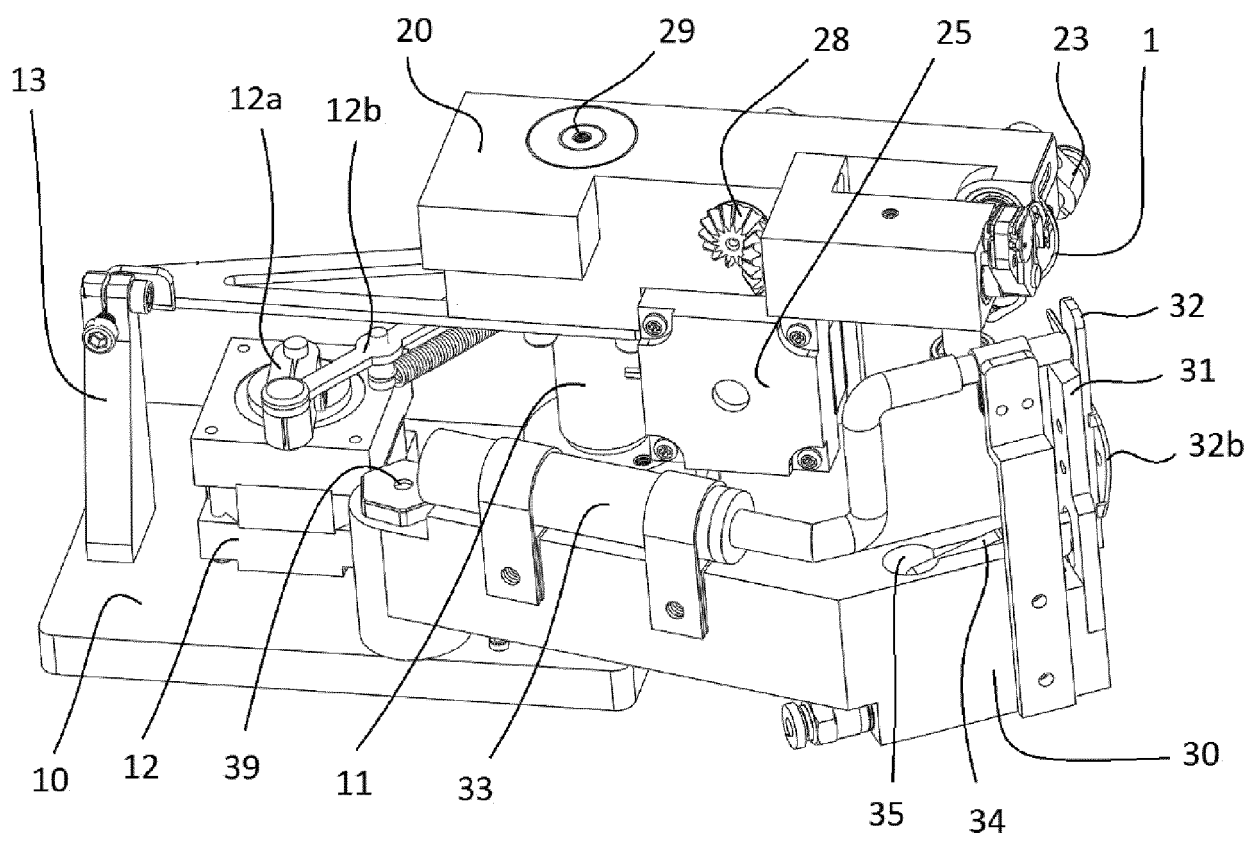


FIG. 2

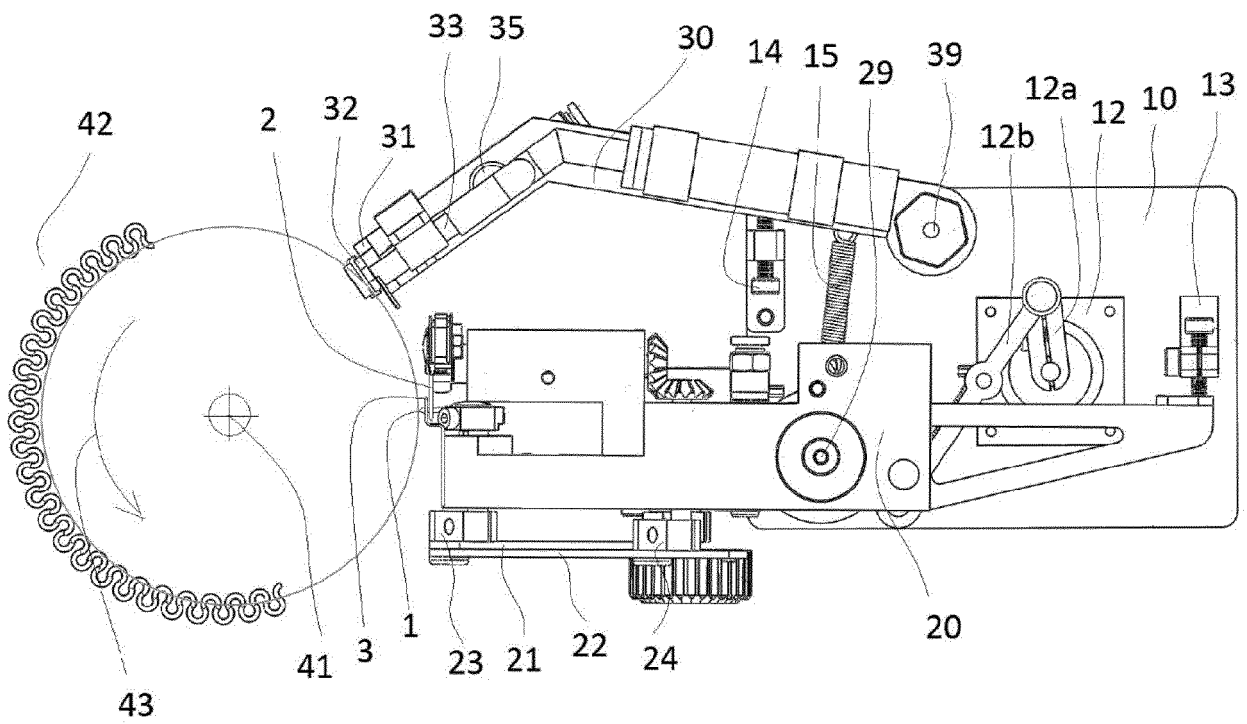


FIG. 3

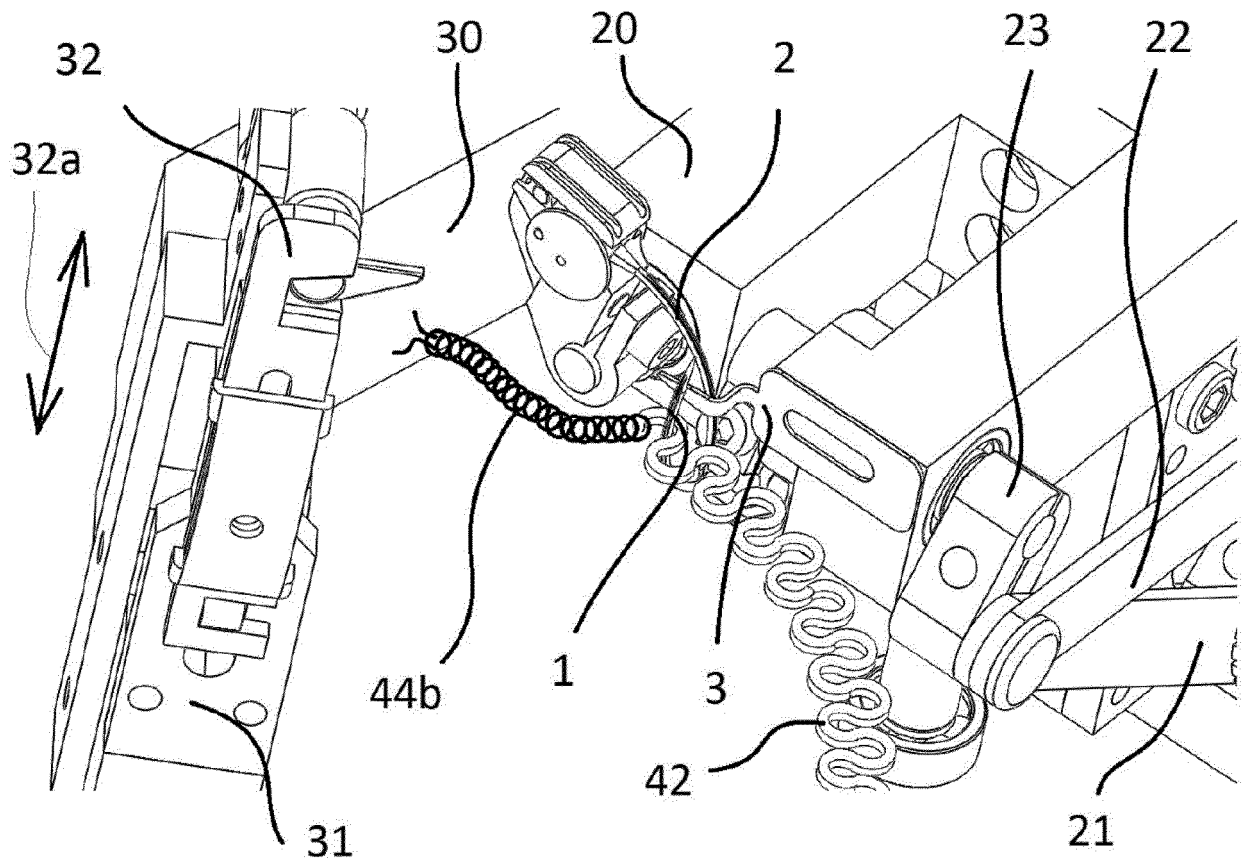


FIG. 4

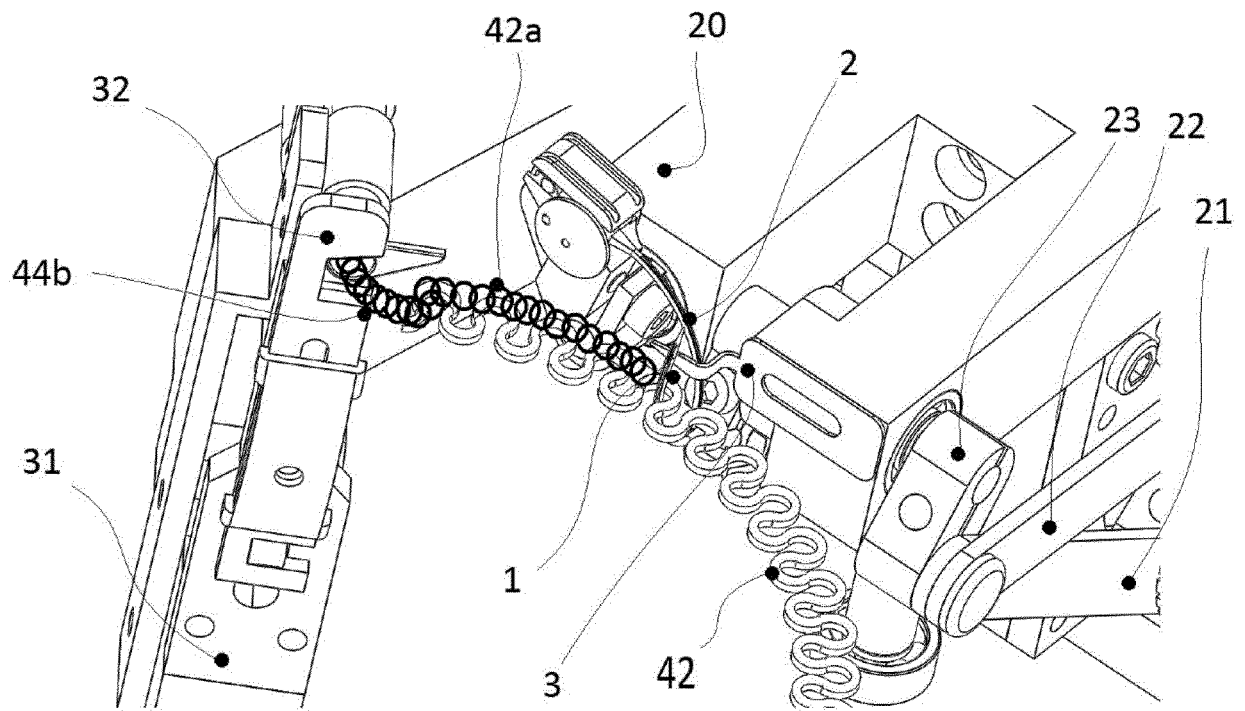


FIG. 5

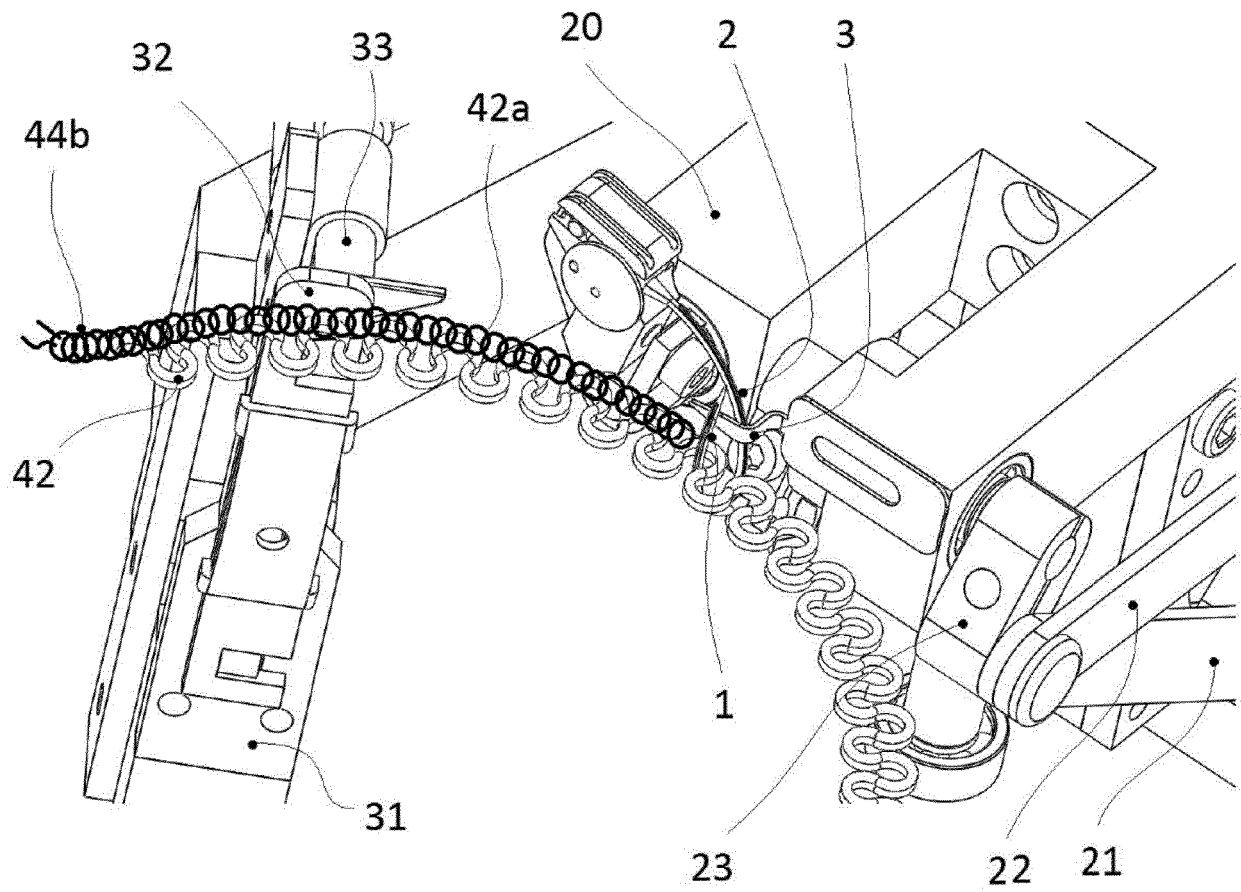


FIG. 6

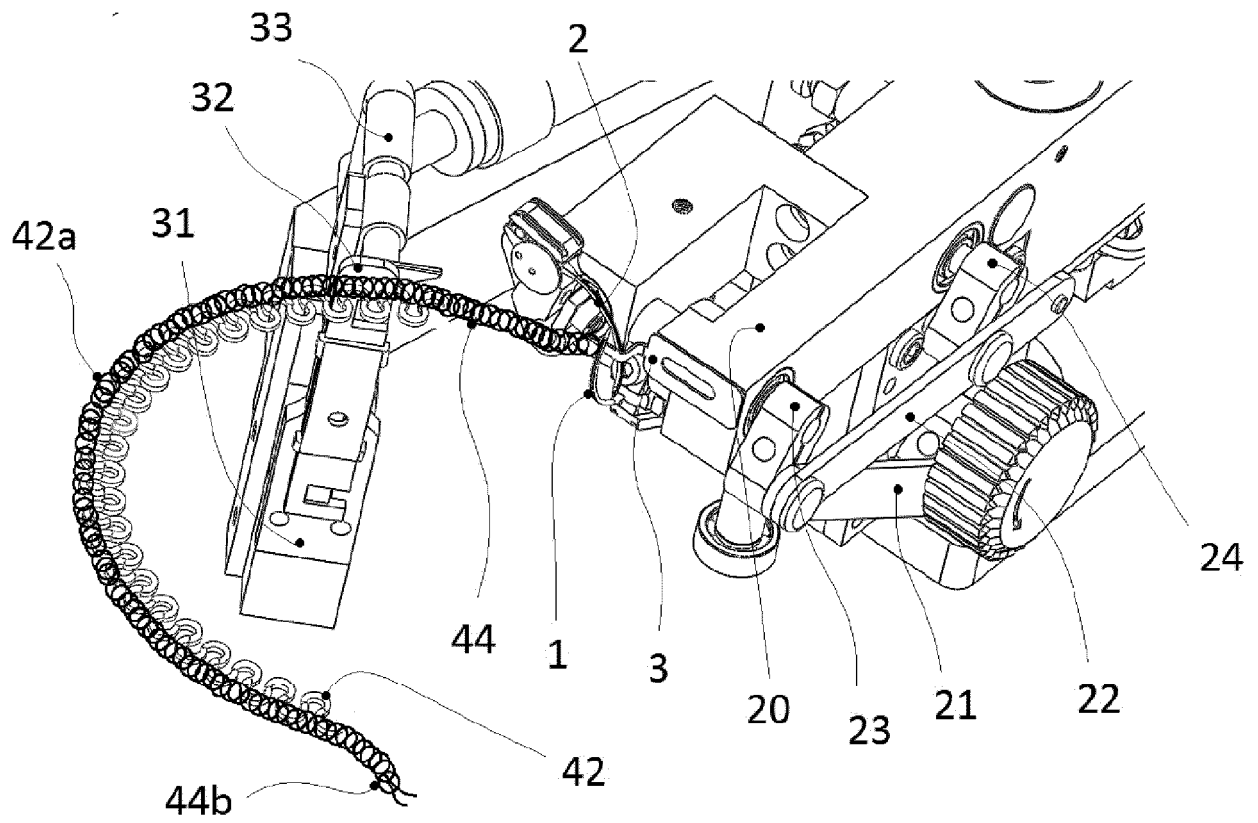


FIG. 7

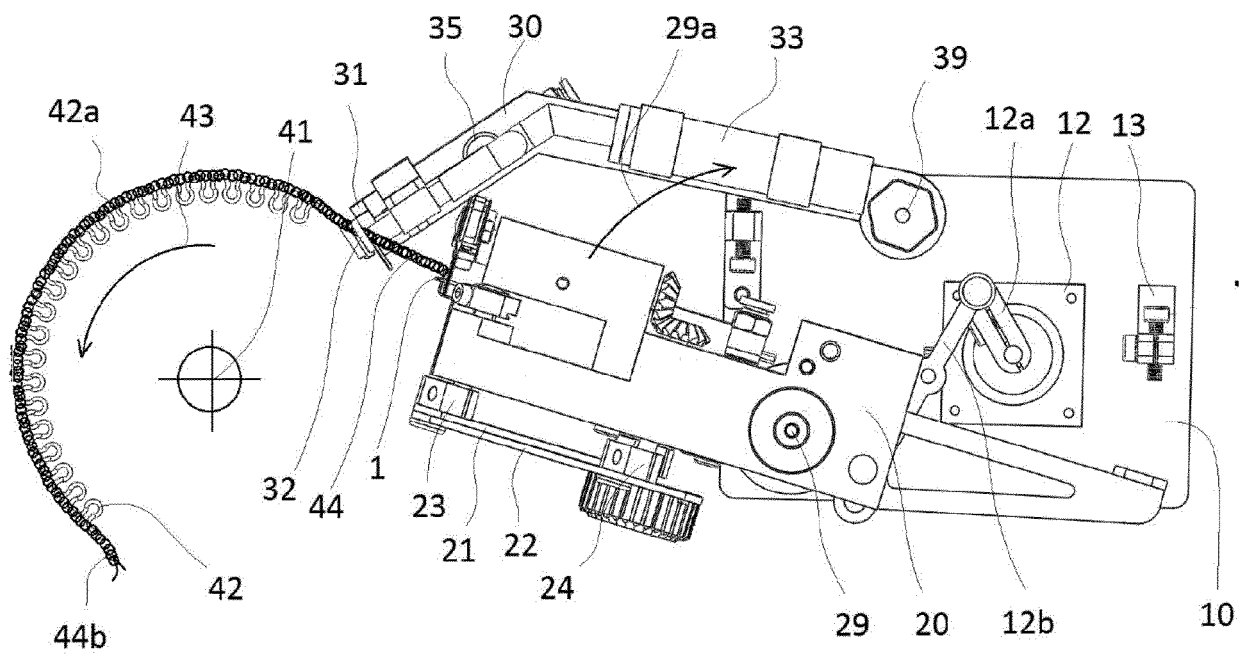


FIG. 8

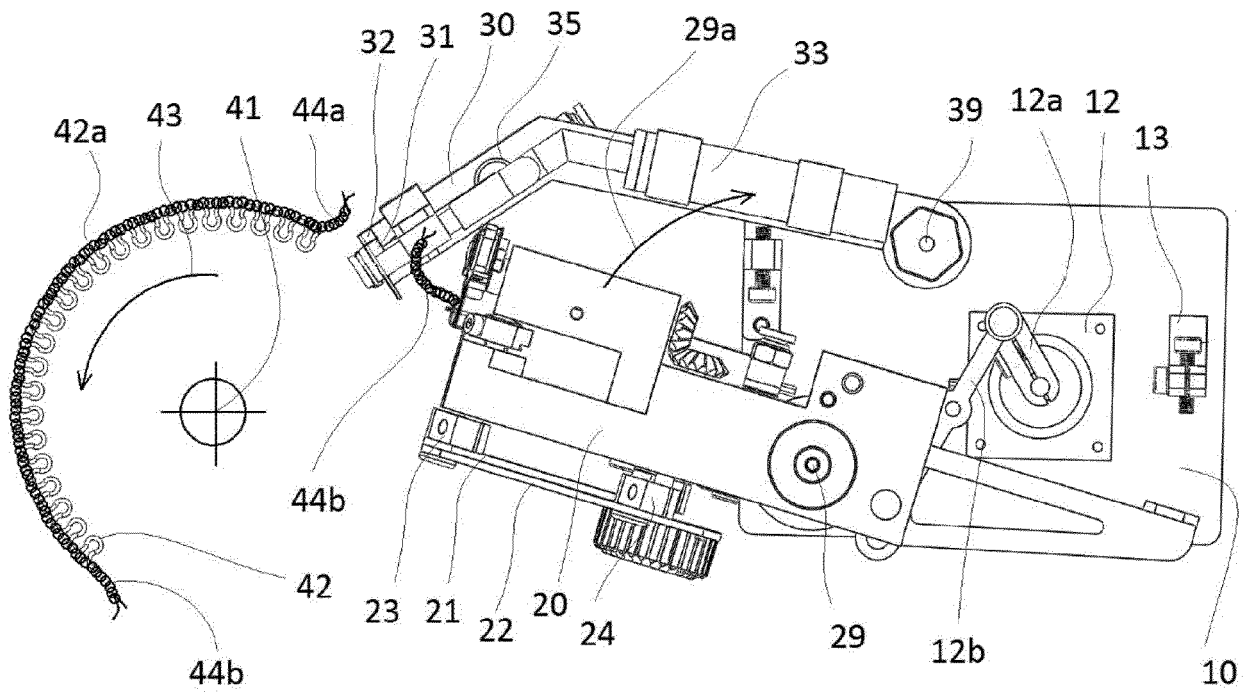


FIG. 9

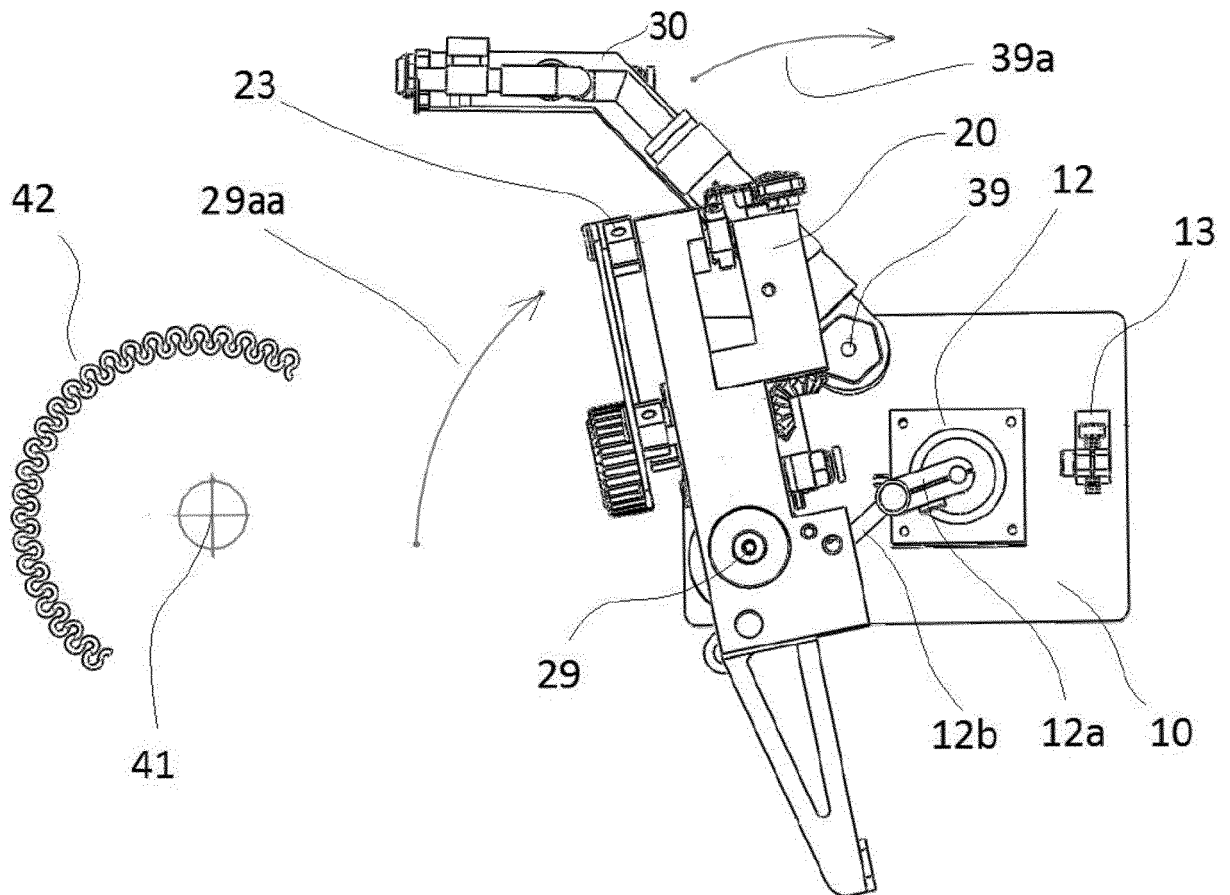


FIG. 10

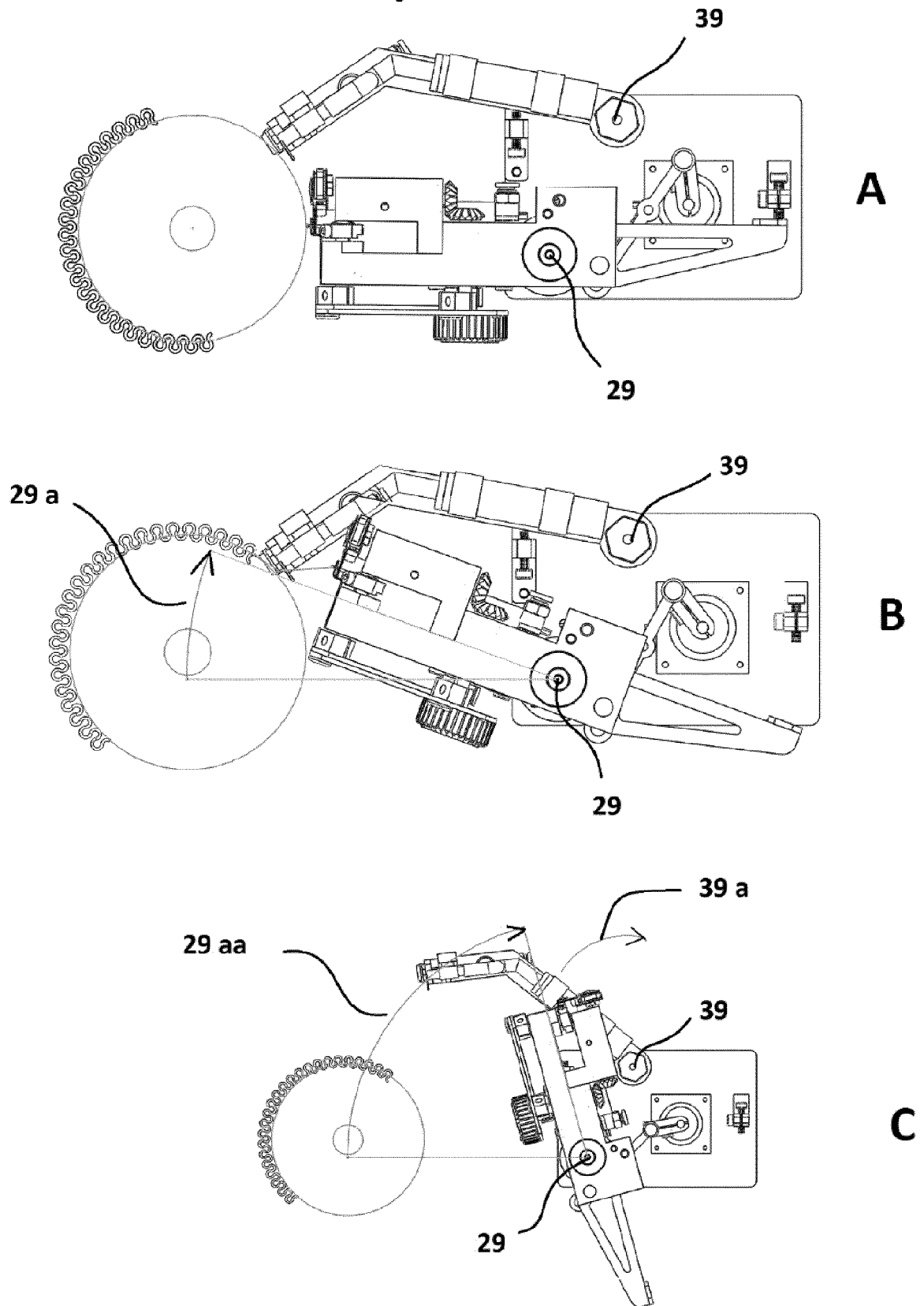


FIG. 11

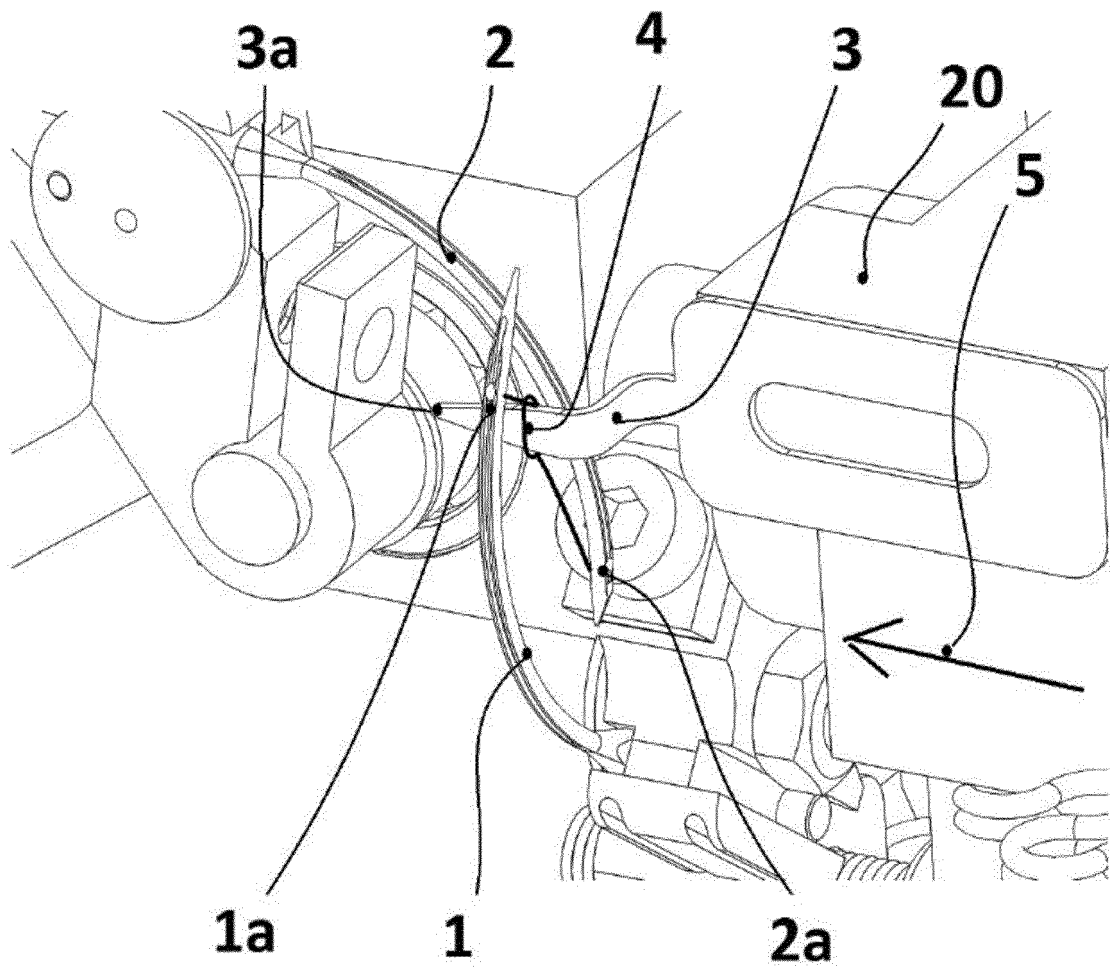


FIG. 12



EUROPEAN SEARCH REPORT

Application Number
EP 19 15 2694

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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