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(54) **LOOM AND METHOD FOR WEAVING MULTILAYER FABRIC**

(57) The invention relates to a loom and a method for weaving multilayer or tubular fabrics. The loom is arranged such that a shuttle for inserting a weft thread in between warp threads can operate a right and a left translation along two distinct lines. The shuttle thereby describes a circular movement, the warp threads are spread

over three lines, thereby minimizing the friction between threads during the operations. The loom comprises means to displace the shuttle from one operating line to the other, by either rotating or translating the shuttle. To improve the production, two shuttles can operate at the same time.

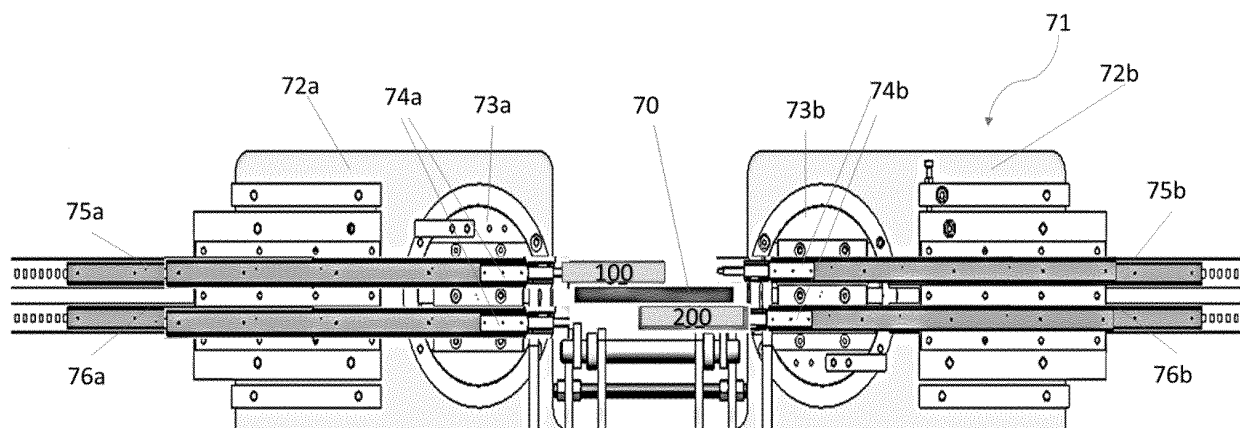


Figure 8

Description

[0001] The invention relates to the field of closed edge multilayer fabrics woven on a shuttle loom, especially seamless tubular fabrics in which a weft goes in an un-

[0002] Fabrics consist of a cross between warp threads and weft threads. In weaving machines or looms, the warp threads come from individual bobbins or from a weaving beam and are moved up and down to form a shed or sheds by a shedding mechanism. A weft thread is inserted between the warp threads in between each up and down movement of the warp threads and a reed is actioned to push the inserted weft thread against the weaving line or beating up point, before a new up-down movement of the warp threads to make a further shed.

[0003] There are several ways to insert a weft thread between the warp threads, such as with a gripper-, a rapier, a projectile, air- or water insertion means depending on the type of weaving machines. As illustrated in figure 1 showing a top view of a fabric 12 woven by a gripper weaving machine, the weft thread 10 on one side of the fabric is taken by a gripper and brought to the other side of the fabric. A reed pushes the threads up to the fabric line, the weft threads being interlaced with the warp threads 11 so that the weft is compacted. After that, the weft thread is cut, and a new weft thread is inserted. This principle is valid for gripper-, rapier, projectile, air- or water weaving machines.

[0004] The weft thread is interrupted (cut) each time.

[0005] An example of such gripper weaving machine is described in EP0109607A1. A projectile moves through the shed and inserts a weft thread. The projectile is then transported back without a weft thread on a different trajectory not extending through a shed. This involves that it is impossible to make seamless closed edge multilayer fabrics.

[0006] As illustrated on figure 2, with a shuttle weaving machine, a bobbin or spool 21 with weft thread 23 is installed in a shuttle 22 which goes through the shed of the warp threads 24 in alternating directions, further called shuttlespool. This method allows to avoid cutting the weft thread at every pick and the sides of the woven fabric are continuous when weaving with a shuttle.

[0007] When weaving, some of the warp threads in a shed are in an up position and some are in a down position when the shuttle crosses them. At the next weft insertion, the warp threads in the up position are moved to the down position and the ones in the down position are moved to the up position. When a Jacquard is used, more complex operations of the warp and weft threads are possible. In the description below, weaving works refer to simple weavings.

[0008] A modification of the basic technique described above allows to weave tubular or multilayer (for example

semi-tubular) seamless fabrics. To weave such tubular fabric, the tube is constructed from two superimposed layers of fabric, a top layer and a bottom layer. For implementing the tube with one layer of weft thread, in a first move, the shuttle passes through the shed of the warp threads of the top layer, the shed being formed by half the top warp thread being in an up-position, the other top warp threads in a bottom position, along with all the bottom warp threads of the bottom layer. After this first pick, all the warp thread of the top layer are moved to the up-position, along with half the bottom warp threads of the bottom layer i.e. half of all the bottom warp threads move upward to form a further shed, and the shuttle passes, in the other direction, through this warp thread shed of the bottom layer. The weft thread from the shuttle has then accomplished a rotation of the weft yarn.

[0009] This principle has mainly two disadvantages. Firstly, it is necessary to move the shuttle successively in both directions to weave a full revolution. Two weaving picks are necessary to complete one cycle or one full revolution.

[0010] Secondly, many threads are moved up and down at every passage of the shuttle, thereby possibly creating friction and deterioration of the threads. The detrimental effect of friction does not allow to weave with delicate yarns and/or high density of warp threads, as can be required for medical application. For example, tubular fabrics can be used for manufacturing stents for inserting into the lumen of an anatomic vessel. Knitted fabrics have been used but a further coating is needed on the fabric to compensate for the low density of fibers to reach the expected performance of blood impermeability. Compared to knitting, weaving allows to produce much denser fabrics. However, for such applications, the yarns must be made from small filaments, that tend to degrade easily and protrude from the yarn upon repeated frictional rubbing, making the tubular fabric not compliant for such medical applications. The applicant has therefore judged necessary to develop a new process for weaving tubular textiles to minimize the friction between yarn and optimize the weaving efficiency.

Summary of the invention

[0011] To this purpose, in one aspect, the present invention relates to a loom for weaving multilayer fabrics, wherein a shuttle carrying a shuttlespool with weft thread for inserting a weft thread in between warp threads is arranged to operate a right and a left translation along a first operating trajectory or line extending between the warp threads through a first shed and a second operating trajectory or line, distinct from the first operating trajectory, extending between the warp threads through a second shed. The shuttle thereby describes a circular movement. The two operating trajectories or lines are preferably parallel.

[0012] A multilayer fabric designs a weaving work where at least two layers are manufactured simultane-

ously, possibly linked to each other while weaving. Preferably, the multilayer is a bi-layer fabric. In particular, a multilayer fabric can be a tubular weaving work, i.e., two superimposed layers connected along each side of the weaving work. The invention does not relate to double cloth construction where two separate fabrics, are woven in the loom at the same time, one on top of each other, one on each operating line, but to the weaving of a single fabric that can have a specific arrangement with several layers in the weaving construction in order to confer the fabric a three-dimensional structure once finished.

[0013] Weaving fabric or weaving work will be used interchangeably below and have the same signification for the purpose of the invention.

[0014] The right and left translations designate the translations of the shuttle from one side of the weaving fabric to the other side of the weaving work, in one direction and in the other direction. They refer to relative movements, seen from a weaver side.

[0015] Contrary to classical looms where the warp threads are either in an up- or in a down-position, the loom of the invention allows to position the warp threads of a shed either in an up-position, a down-position or a median position, one of the operating trajectories or lines of the shuttle extending through a shed, i.e. between the threads in the up-position and the threads in the median position, the other operating trajectory or line of the shuttle extending through another shed, i.e. between the warp threads in the median position and the threads in the down-position.

[0016] The operating lines or translations designate the lines or trajectories along which the shuttle is displaced between warp threads for weaving.

[0017] Typically, the multilayer fabric is still decomposed in a top layer and in a bottom layer as a result of the weaving steps. The warp thread of the half of the tubular fabric (the top layer) can alternatively be positioned in an up- or in a median-position, while the warp thread of the other half (bottom layer) can alternatively be positioned in a median- or in a down-position. This arrangement involves much less thread crossing and limits the deterioration due to the friction caused by these thread crossings.

[0018] The median position designates a substantially horizontal plane wherein the warp threads of a shed are arranged relative to the weaving work. However, the median position can comprise two distinct horizontal planes, at a short distance from each other, for example a few millimeters or centimeters. Warp threads for the top layer of the fabric being in a median position slightly higher than the warp threads for the bottom layer of the fabric in their median position. This allows to further minimize the frictions between threads and optimize space. An up-, down- or median positions are to be understood as relative positions, not necessarily being in a vertical plane, this terminology intends to illustrate a distance between the threads, as will be understood by a person skilled in the art.

[0019] As the shuttle traverses between warp thread sheds, depending on the direction of its movement, on two distant parallel lines, the loom is arranged with means to displace the shuttle between these two operating lines after each travers.

[0020] To further increase the efficiency of the weaving process, advantageously, the loom comprises two shuttles, arranged for operating a right and a left translation along the two distinct parallel lines. This is allowed by the fact that each of the right and the left movements are not happening on the same line, but rather each shuttles follows a circular path. One of the parallel lines is for a right translation while the other parallel line is for the left translation.

[0021] In a second aspect, as an independent means of the loom of the invention, the invention also relates to a shuttle suitable for use with the loom of the first aspect.

[0022] In another aspect, the present invention relates to an automated method for weaving a tubular fabric on a loom, wherein,

- Warp threads for half of the tubular fabric (the upper part) are distributed between an up- and a median-position to form a shed, and warp threads for the other half of the tubular fabric (the lower part) are distributed between a median- and a down-position to form another shed,
- A shuttle carrying a shuttlespool with weft threads moves in a first direction along a line through the shed, extending between the warp threads in the up- and median-position and
- The shuttle moves in a second direction, along a line through another shed, the line extending between the warp threads in the median- and down-position.

[0023] Preferably, the two lines are parallel.

[0024] After a translation along one direction is operated, the distribution of the warp thread can be modified for the next passage of the shuttle. For example, in the case of a tubular fabric, after the shuttle has moved along the line extending between the warp threads in the up- and median-position, the distribution of these warp threads of this half of the tubular fabric can be modified, but remain distributed either in the up- or median-position.

[0025] To increase the efficiency of the method, a second shuttle translates along the second direction while the first shuttle translates in the first direction, and the second shuttle translates along the first direction while the first shuttle translates in the second direction.

[0026] Using the loom or the method of the invention, the weft thread is implemented in a spiral manner. When two shuttles are used, two weft threads are implemented in a double spiral or double helix manner.

[0027] The invention will be better understood with reference to the drawings, on which:

- Figure 1 illustrates a rapier weaving pattern of the

- prior art for a flat fabric;
- Figure 2 illustrates a shuttle weaving pattern of the prior art for a flat fabric;
- Figure 3 is a perspective view of an ongoing tubular weaving work;
- Figure 4 is a side view of the ongoing tubular weaving work of figure 3;
- Figure 5 illustrates the method of the invention for weaving a tubular fabric with one shuttle;
- Figure 6 illustrates the method of the invention for weaving a tubular fabric with two shuttles;
- Figures 7 to 13 illustrates a particular embodiment of the different steps of the weaving process with two shuttles, and
- Figure 14 is a perspective view of a shuttle suitable for the loom and the method of the invention.

[0028] With reference to figures 3 and 4, a tubular weaving work is ongoing, with a tubular part 30 already formed, which is flattened with a top part T, substantially flat, and a bottom part B, also substantially flat and parallel to the top part T. Warp threads extend from the top of the tubular weaving work, along two directions: Some warp threads 2T extend substantially horizontally, i.e. in the plane of the weaving work, while some of the warp threads 1T extend in a plane at an angle above the horizontal plane, thereby forming a first shed. A shuttle with weft thread can travel through the first shed, along a line S1 (dotted line). Similarly, warp threads extend from the bottom B of the tubular weaving work, along two directions: some warp threads 1B extend substantially horizontally, i.e. in the plane of the weaving work (substantially in the same plane as warp threads 2T or slightly below), while some of the warp threads 2B extend in a plane at an angle below the horizontal plane, thereby forming a second shed. The shuttle with weft thread can travel through the second shed, along a line S2 (dotted line).

[0029] With reference to figure 5, in a first step A, a shuttle 50 with weft thread 51 translates along the top line S1, for example from the front to the back (relative to the cut view). The front position of shuttle 50 is illustrated by a large size than when it is in the back.

[0030] At the end of the translation, in a step B, the shuttle 50 is displaced vertically to the line S2. Meantime the reed can be actioned to bring the weft to the weaving line.

[0031] In a step C, the shuttle 50 translates along the bottom line S2, for example from the back to the front (relative to the cut view).

[0032] After the translation, in a step D, the shuttle is displaced vertically up to line S1, to accomplish the rotation and be ready for the next weaving cycle.

[0033] At this stage, a reed can be operated to push the weft up to the beat-up line.

[0034] Before a new passage of the shuttle along line S1, the position of threads 1T and 2T are inverted by actioning the appropriate heddles for examples. This can

be done after the full rotation of the shuttle or while the shuttle translates along line S2. Similarly, after the passage of the shuttle along line S2, the position of threads 1B and 2B are inverted, either after the full rotation of the shuttle or while the shuttle operates along S1.

[0035] The method being automated, a person skilled in art will understand that some operations can be done simultaneously to gain time and improve the efficiency and the productivity.

[0036] Generally speaking, the position of the warp thread of a shed is usually controlled by conventional heddles through which the warps passes. In a conventional loom, the heddles can move between two positions, while in the loom of the invention, the heddles can be mobile between substantially three positions.

[0037] With reference to figure 6, the same method as disclosed in relation with figure 5 can be implementing, using a second shuttle 60, to weave thread 61.

[0038] In step A', while shuttle 50 is translated to the back along line S1, the shuttle 60 is translated to the front along S2.

[0039] In a step B', while the shuttle 50 is displaced vertically down to the line S2., the shuttle 60 is displaced vertically up to line S1 while a reed motion can be actioned.

[0040] In a step C', while the shuttle 50 translates along the bottom line S2, for example from the back to the front (relative to the cut view).

in a step D', while the shuttle 50 is displaced vertically up to line S1, to accomplish the rotation and be ready for the next rotation, shuttle 60 is displaced vertically down while a reed motion can be actioned. The weft thread 51 and 61 coming out of the shuttles 50 and 60 form a loop which, after striking the reed, implement the tubular or multilayer fabric.

[0041] It becomes obvious that, by spreading the warp threads on three levels to form two sheds instead of a single shed with warp threads on two levels as is usually done in the field, much less friction is generated when inverting the positions of the warp thread between each passage of the shuttle.

[0042] The general aspect of the method having been described, the specificities of the loom to operate the method will now be detailed, in particular the means to operate the translation of the shuttle(s) and the means to displace the shuttle between the two operating lines after each translation.

[0043] Referring to figure 7, a tubular fabric 70 is being weaved in a loom 71, comprising, symmetrically positioned shuttle handling units 72a and 72b. Each shuttle handling unit comprises a turntable 73 (73a and 73b). Each turntable 73 has two cavities 74 symmetrically arranged parallel to and on each side of the longitudinal axis, of a size suitable to accommodate both shuttles 100 and 200. Each cavity 74 is open to both sides of the turntable. Each shuttle handling unit 72 also comprises two parallel rods 75 (75a and 75b) and 76 (76a and 76c). The turntables 73 can rotate by 180 ° around its longitudinal

axis between two positions in which one cavity 74a is aligned with a cavity 74b at the other side of the weaving work and also aligned with rods 75a and 75b, such that the rods 75a and 75b can pass through the cavities to handle a shuttle. The other cavities 74a and 74b are also aligned with rods 76a and 76b such that the rods 76a and 76b can pass through these cavities to handle a shuttle.

[0044] On figure 7, a shuttle 100 is in the top cavity 74a of the turntable 73a while a shuttle 200 is in the bottom cavity 74b of turntable 73b. The treads are not represented for clarity reasons, however, each shuttle contains a weft thread and warp threads extend from the weaving fabric 70, on three levels: some threads extend towards above the plane of the tubular weaving work (up-position, threads of the upper part of the tubular fabric), in the same plane (median position, threads from the upper and the lower part of the tubular fabric) and towards below the plane of the tubular weaving work (down-position, threads of the lower part of the tubular fabric).

[0045] In figure 8, the shuttles 100 and 200 are pushed in the opposite directions respectively by the push rods 75a and 76b. Shuttle 100 follows a line slightly above the plane of the weaving work 70 and passes between the warp threads in the up-position and the warp threads in the median position, while shuttle 200 follows a line slightly below the plane of the weaving work 70 and passes between the warp threads in the down-position and the warp threads in the median position. The opposite rod, though not handling a shuttle, also moves symmetrically toward the opposite shuttle.

[0046] In figure 9, the shuttles have reached the middle position, 100 is above 200. At this stage, each shuttle is in contact with both rods of its line and a takeover is performed, i.e. 100 is in contact with rod 75a and rod 75b, a disconnection between rod 75a and 100 and a connection between shuttle 100 and rod 75b are made, while 200 is in contact with rod 76a and rod 76b and a disconnection between rod 76a and 200 and a connection between shuttle 200 and rod 76b are made.

[0047] Connection and disconnection between the rods and the shuttles can for example be made through activation and deactivation of electromagnets, each of the shuttle and the extremities of the rods being equipped with suitable complementary (electro)magnets. Alternatively, clipping means or any other releasable fastening means can be envisaged.

[0048] In figure 10, rod 75b pull the shuttle 100 into cavity 74b while rod 76a pull shuttle 200 into cavity 76a, position reached on figure 11.

[0049] The shuttles now need to be placed on the other translation line. To this purpose, the turntables 73a and 73b are actioned: a 180° rotation is started. Figure 12 illustrates an intermediate step after a 90° rotation, figure 13 illustrates the loom after the full 180° rotation of the turntables. The loom is in the same configuration as on figure 7, to the exception that 200 replaces 100 and will be handled by the top rods 75a and 75b, and 100 replaces

200 and will be handled by the lower rods 76a and 76b.

[0050] 200 and 100 are then translated as previously described and illustrated on figures 8 to 10, and further rotated as illustrated on figures 11 to 13, to achieve a full rotation.

[0051] After this stage, a reed can be applied to bring the two weft threads along the fabric line. A reed deposit can be performed after each translation, for example during the rotation of the turntables in order to improve efficiency.

[0052] The circular operation of the shuttle has here been described using two rods on each line, meeting the shuttle halfway through the translation. Any other suitable arrangement can be imagined by a person skilled in the art. In particular, the takeover does not necessarily happen in the middle of the fabric, there could be only one rod per translation line, each rod being arranged for pushing the shuttle all the way through to the opposite cavity, or alternatively to pull the shuttle all the way through from its starting cavity.

[0053] A turntable has here been used to illustrate the means to move the shuttle from one translating line to the other. This particular rotating arrangement allows to keep the shuttle moving forward with the same head on front. However, any other means to move the shuttles upwards or downwards after a translation can be envisaged by a person skilled in the art. For example, the shuttle could be translated up or down, like with an elevator.

[0054] In general, to operate the translation of the shuttle along the weaving line, the push rod(s) need to cooperate with the shuttle. Any suitable cooperation means can be applied, whether there is one push rod per line or two collaborating push rods per line or any other system to move a shuttle from one side to the other side.

[0055] In one specific embodiment, a push rod can comprise at least an electromagnetic surface, and the part of the shuttle which comes into contact with the push rod can comprise a ferromagnetic element, for example in iron.

[0056] To enhance stability of the connection between the rod and the shuttle, one or more pins or plugins can protrude from the rod or from the shuttle, and the shuttle or the rod can comprise corresponding orifices to let the plugins penetrate. This works as a male-female collaboration, like an electrical plug and socket.

[0057] The plugins can further serve to make an electric connection with the shuttle to provide electric energy to some elements in the shuttle, for example for a small motor allowing to regulate the tension in the weft thread by rotating the spool.

[0058] For example, with reference to figure 14, a shuttle 140 is aligned with a rod 150 at the extremity of which two metal plugins 151 protrude parallelly. Between the pin 151, a flat surface comprises an electromagnet 152.

[0059] The shuttle 140 is globally symmetrical in shape. It has a rectangular frame within which a spool or shuttlespool 142 is arranged. At each extremity of the frame 145, a flat surface 143 comprises two pinholes

141, separated by the same distance as the plugins 151 of the rod 150 and deep enough to receive these plugins. The flat surface 143 comprises a piece in iron 144, to adhere by magnetism to the electromagnet 152 of the rod when it is activated. The spool 142 extends longitudinally within the frame and mainly consists of an axis around which the weft thread is wound (not shown) an unroll radially. A guiding hole within the long side of the frame can be foreseen to guide the thread. One extremity of the shuttlespool is coupled with a motor 146 enclosed within the frame.

[0060] During weaving, the tension of the weft thread can be adjusted by actioning the motor (146) to slightly rewind the thread if necessary. The two plugins can provide the electrical power supply for the motor (146) located in the shuttle to adjust the tension of the weft thread. Alternatively, the tension can be adjusted using conventional springs.

[0061] The loom and the weaving method of the invention are automatically managed, using a software which may be run on a processor such as a microprocessor, an FPGA, a microcontroller or similar. The software is in the form of a computer program, e.g., when compiled for a target application. When executed on a processor the computer program controls the displacement of the warp threads between their up-median- and down positions, as well as the translation of the shuttle(s) between the warp threads and the displacement of the shuttle(s) between the two parallel translation lines. The executed computer program can also control, if it's present, the activation and deactivation of electromagnets and any motor that can be present on a shuttle. The executed computer program can control motorized means to thereby rotate a yarn carrier fastened onto the shuttle.

[0062] The computer program can be stored on a machine-readable memory such as a CD-ROM, a DVD, a magnetic tape, a harddisc, a flash drive or equivalent.

[0063] The loom and method of the invention allow to weave very fine and fragile yarns or fibers, according to a very dense array of fibers, while minimizing the frictions. This allows to manufacture tubular fabrics of very high quality, which can, in particular, be used for medical applications, like stents for example. Such tubular fabrics can have section as small as of a few millimeters, for example 25 to 50 mm.

Claims

1. Loom (71) for weaving seamless closed edge multilayer fabrics (30; 70), wherein a shuttle (50; 60; 100, 200) carrying a shuttlespool (142) with weft thread (51; 61) for inserting the weft thread in between warp threads is arranged to operate a right and left translation along a first operating trajectory extending between the warp threads through a first shed (1T, 2T) and a second operating trajectory, distinct from the first operating trajectory, extending between the

warp threads through a second shed (1B, 2B).

2. Loom (71) according to claim 1, wherein the first and the second operating trajectories are parallel.
3. Loom according to one of claims 1 and 2, arranged to allow the warp threads to be either in an up-position, a down-position, or a median position, such that one of the first and second sheds is between the warp threads in the up-position and the warp threads in the median position, and the other one of the first and second sheds is between the warp threads in the median position and the warp threads in the down-position.
4. Loom according to one of claims 1 to 3, comprising two shuttles (50, 60; 100, 200), each arranged for operating a right and a left translation along the first and second operating trajectories.
5. Loom according to one of claims 1 to 4, wherein one of the first and second operating trajectories is for a right translation while the other one of the first and second operating trajectories for the left translation.
6. Loom according to one of claims 1 to 5, comprising rods (75, 76; 150) to handle the shuttle, the rods being arranged with an electromagnet (152) for fastening the shuttle along a paramagnetic section of the shuttle (143) when the electromagnet is activated.
7. Loom according to one of claims 1 to 6, comprising rods to handle the shuttle, the rods and the shuttle being arranged with cooperating plugins (151, 141) and pinholes.
8. Loom according to one of claims 1 to 7, wherein the shuttle comprises a motor (146) for rewinding weft thread.
9. Loom according to one of claims 1 to 8, comprising means (73, 74) to displace the shuttle between the two operating trajectories after each translation.
10. Loom according to one of claims 1 to 9, wherein the means to displace the shuttle between the two operating trajectories comprise a turntable to rotate the shuttle by 180°.
11. Method for weaving a closed edge multilayer textile on a loom, wherein,
 - Warp threads for half of the textile are distributed between an up- and a median-position to form a shed, and warp threads for the other half of the textile are distributed between a median- and a down-position to form another shed,

- A shuttle carrying a shuttlespool (142) with weft thread (51; 61) moves in a first direction along a first operating trajectory through the shed extending between the warp threads in the up- and median-position and

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- The shuttle moves in a second direction, along a second operating trajectory through the other shed extending between the warp threads in the median- and down-position.

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- 12.** Method according to claim 11, wherein after a translation in one direction is operated, the distribution of the warp threads of a shed is modified for the next passage of a shuttle.

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- 13.** Method according to claim 11 or claim 12, wherein a second shuttle translates along the second operating trajectory while the first shuttle translates along the first operating trajectory, and the second shuttle translates along the first operating trajectory while the first shuttle translates along the second operating trajectory.

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- 14.** Method according to one of claims 11 to 13, wherein, between two translations, the shuttle is rotated between the two operating trajectories.

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- 15.** Method according to one of claims 11 to 13, wherein, between two translations, the shuttle is translated between the two operating trajectories.

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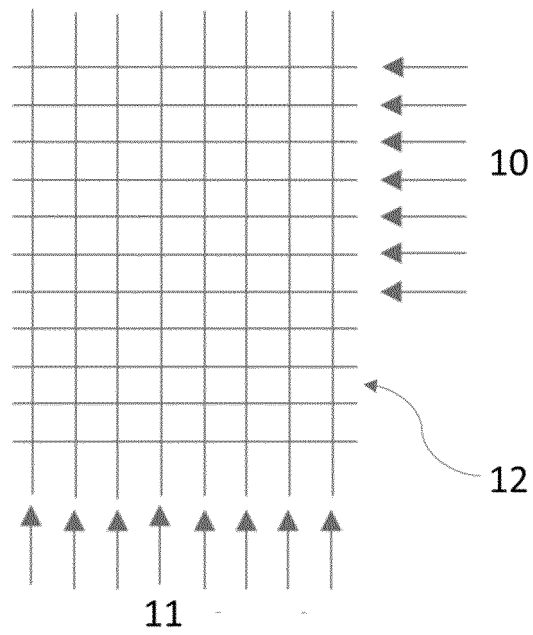


Figure 1

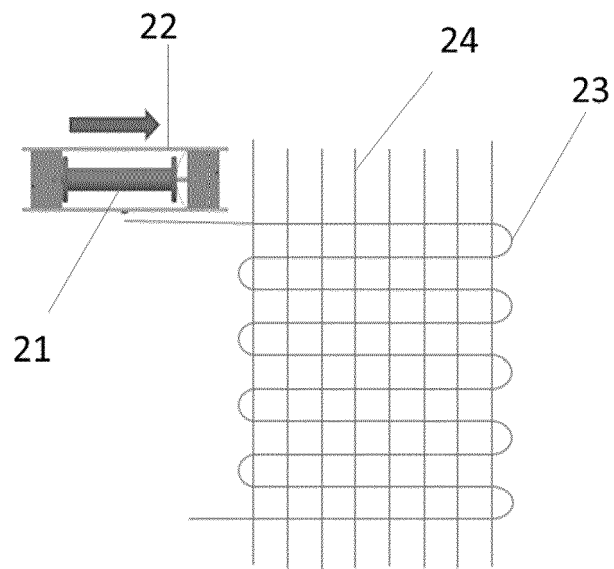


Figure 2

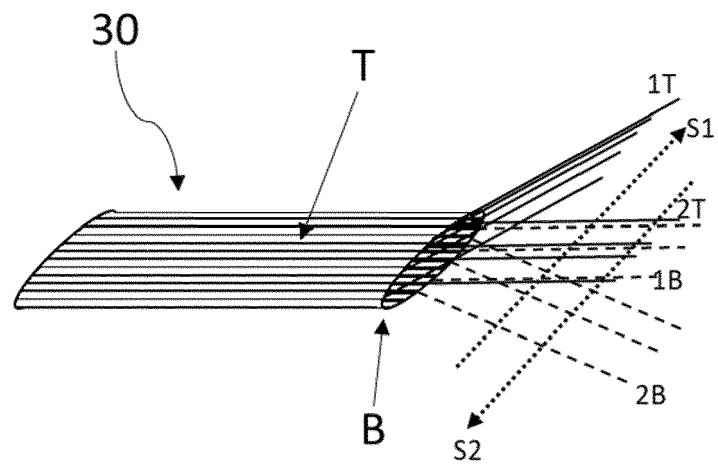


Figure 3

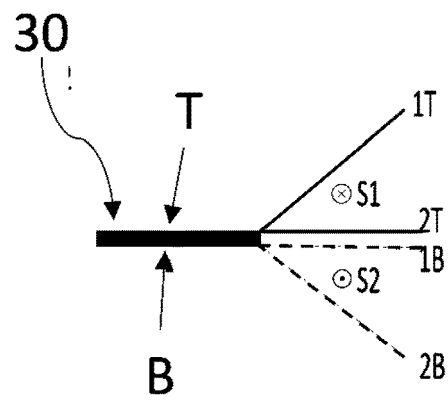


Figure 4

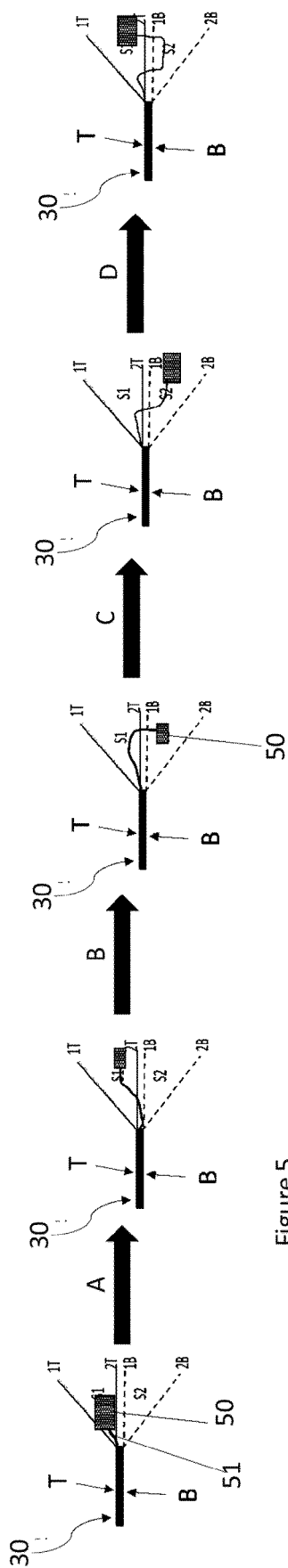


Figure 5

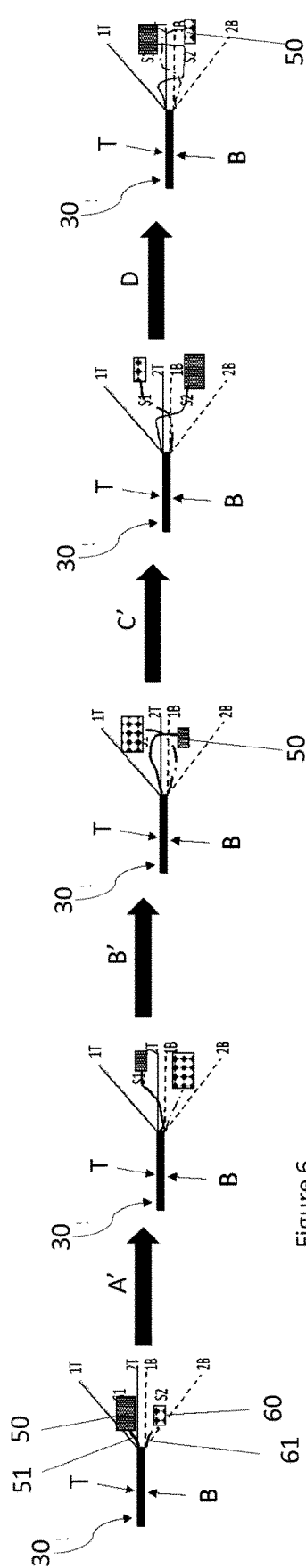


Figure 6

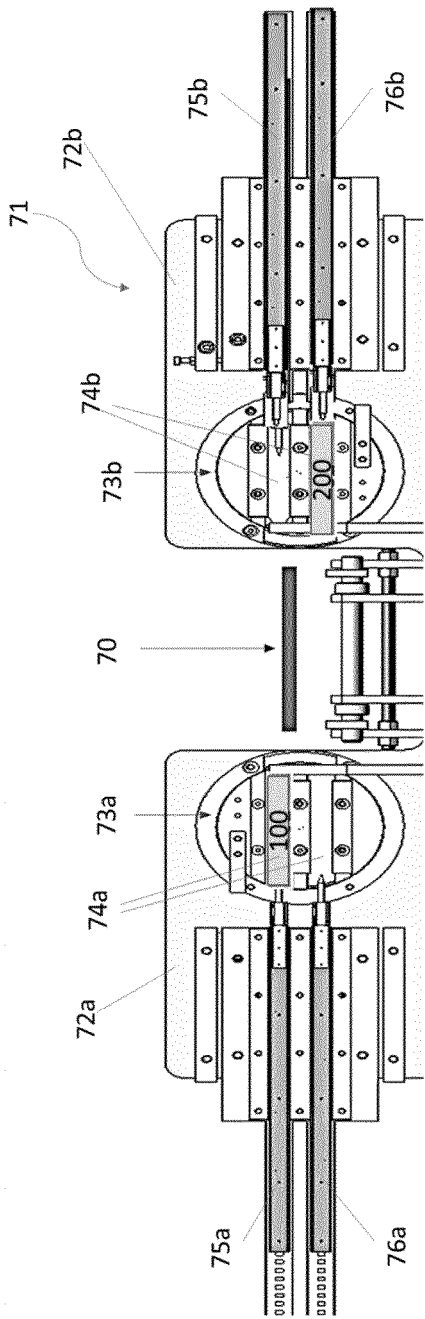


Figure 7

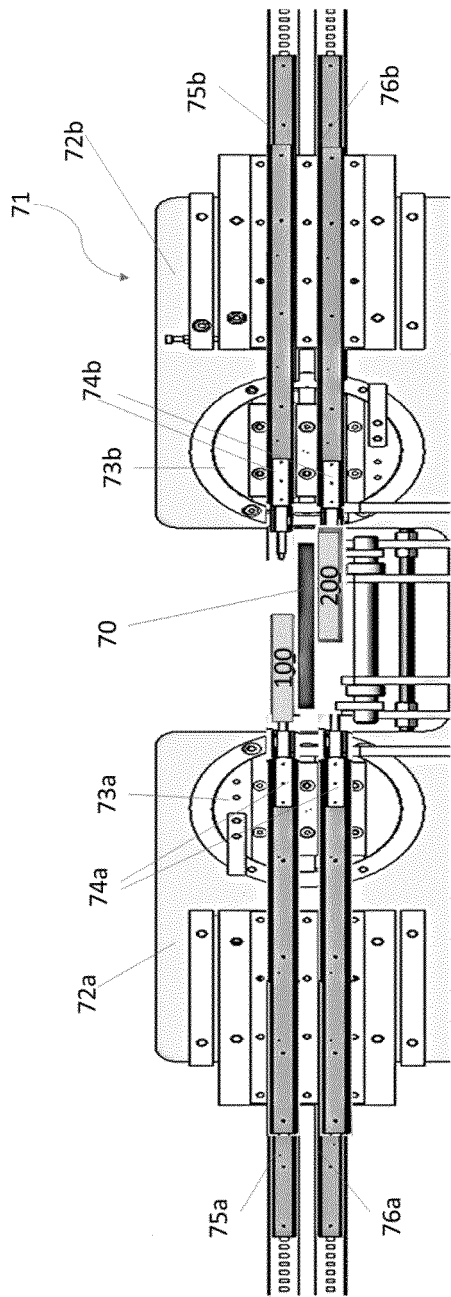


Figure 8

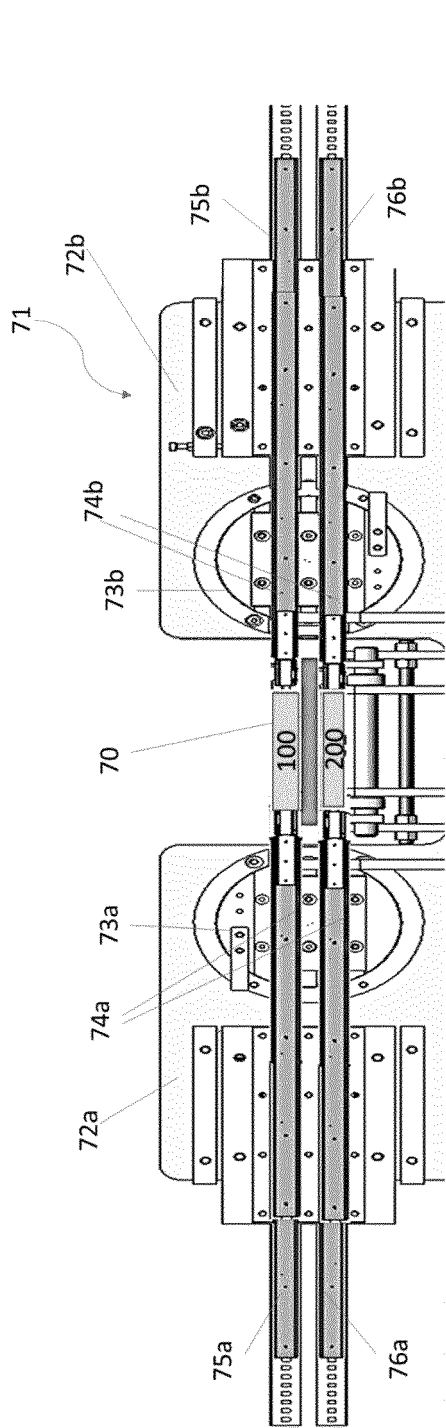


Figure 9

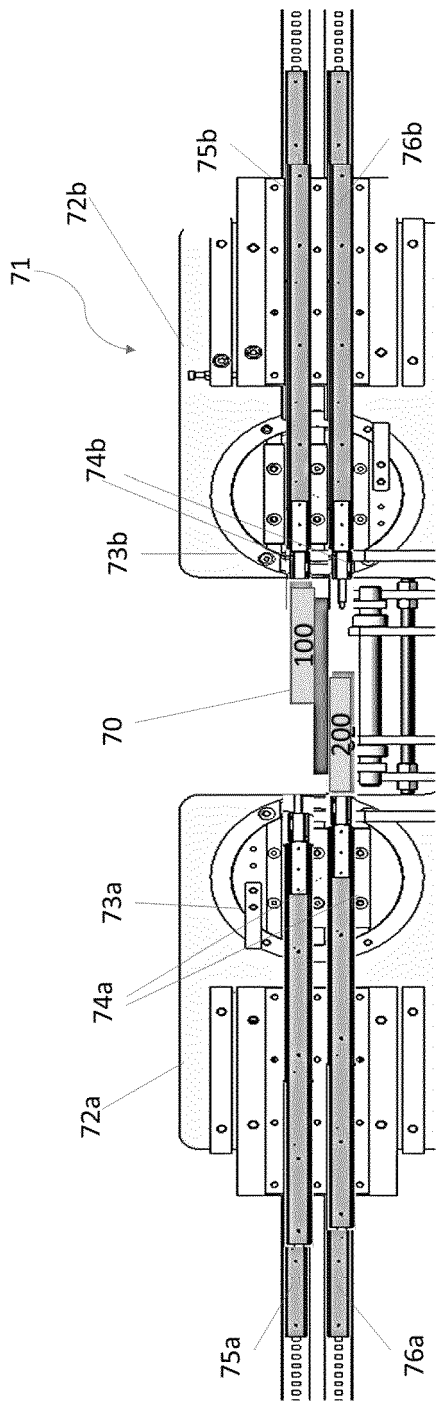


Figure 10

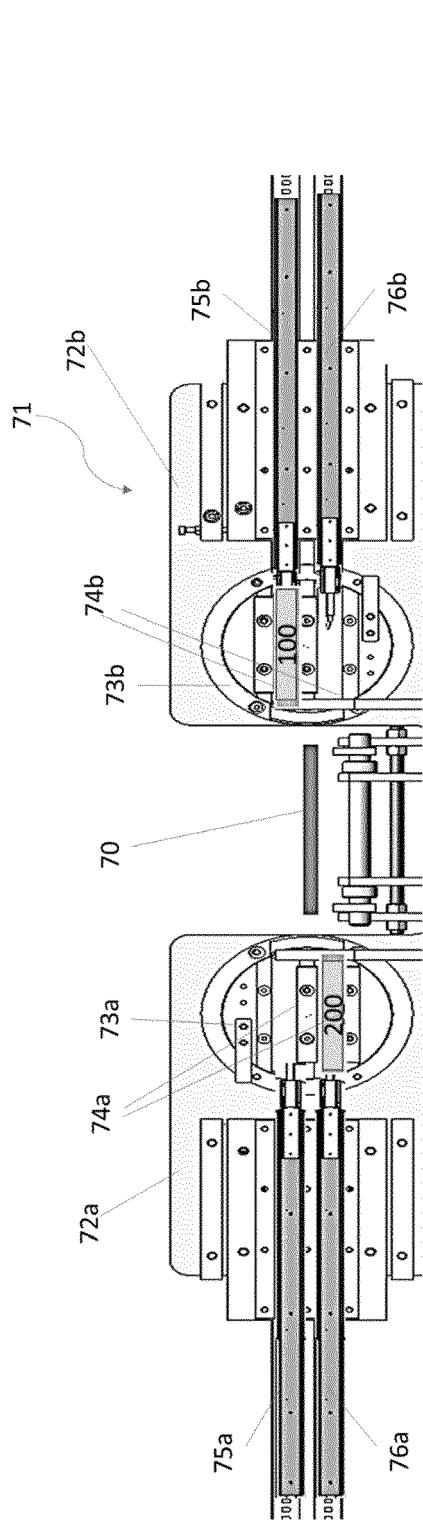


Figure 11

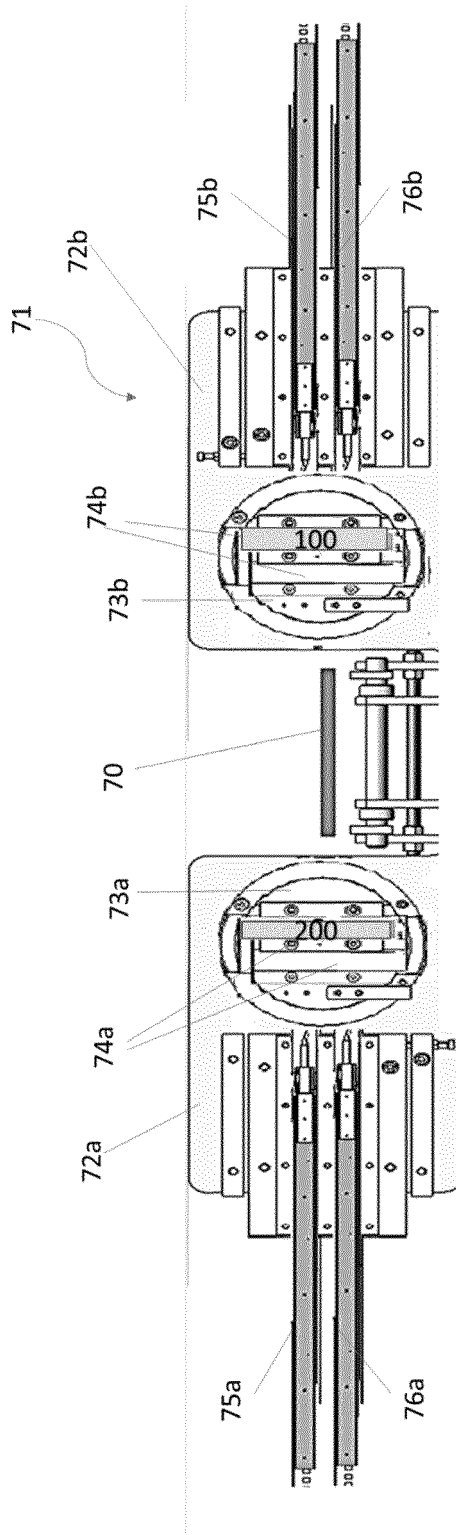


Figure 12

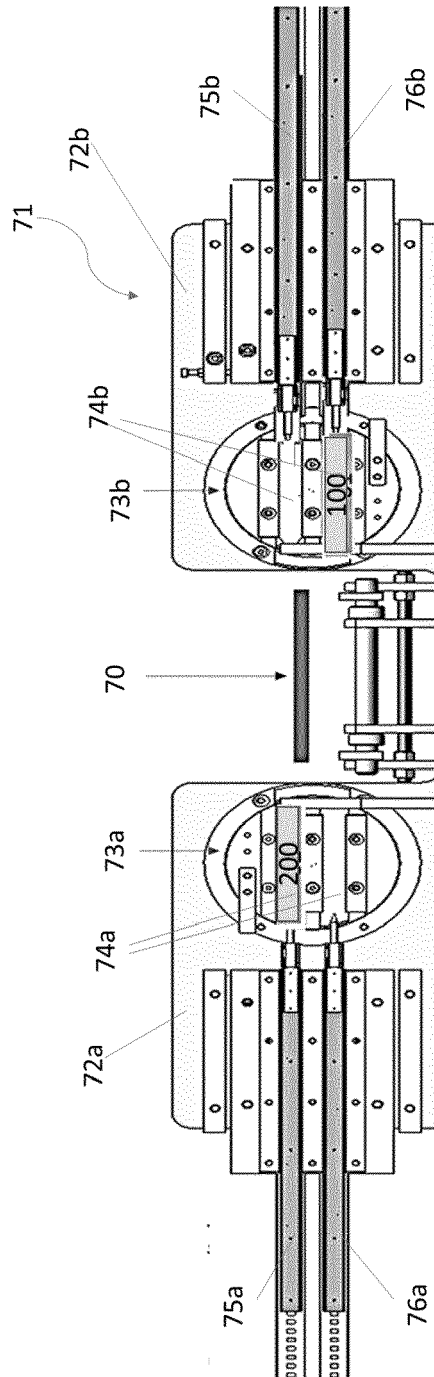


Figure 13

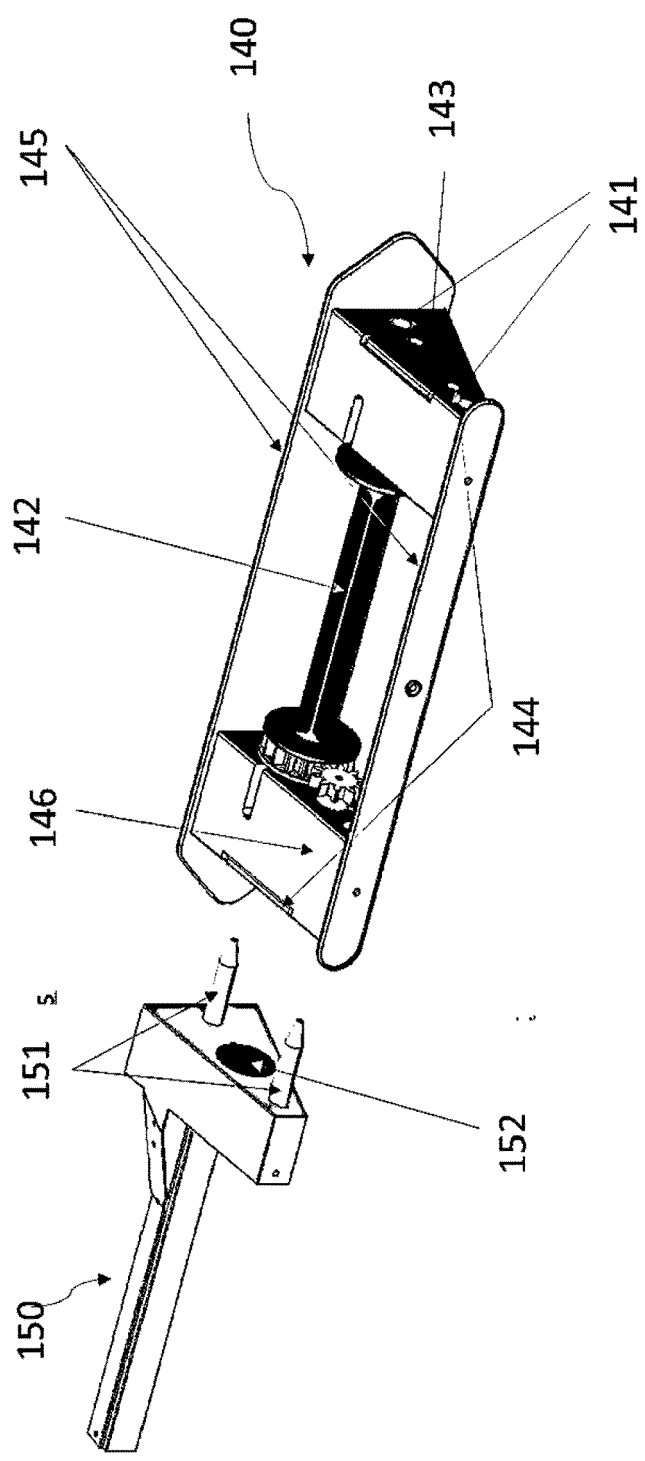


Figure 14



EUROPEAN SEARCH REPORT

Application Number

EP 22 18 0648

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			TECHNICAL FIELDS SEARCHED (IPC)
			D03D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 November 2022	Examiner Hausding, Jan
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
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