(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 959 043 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
10.05.2017 Bulletin 2017/19

(21) Application number: **14714369.7**

(22) Date of filing: **25.02.2014**

(51) Int Cl.:
D03D 13/00 *(2006.01)* ***D03D 41/00*** *(2006.01)*
D03D 47/27 *(2006.01)* ***D03C 13/00*** *(2006.01)*

(86) International application number:
PCT/IB2014/059241

(87) International publication number:
WO 2014/128681 (28.08.2014 Gazette 2014/35)

(54) **LOOM FOR TRIAXIAL FABRICS WITH STATIC SHEDDING DEVICE**

WEBMASCHINE FÜR TRIAXIALE GEWEBE MIT STATISCHER FACHBILDEVORRICHTUNG

MACHINE A TISSER POUR TISSU TRIAXIAL AVEC DISPOSITIF STATIQUE POUR LA FORMATION DE LA FOULE

(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

(30) Priority: **25.02.2013 IT FI20130035**

(43) Date of publication of application:
30.12.2015 Bulletin 2015/53

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(56) References cited:
WO-A1-2010/004284
DE-A1-102010 007 048
DE-T2- 60 010 676
GB-A- 1 190 214

EP 2 959 043 B1

Description

Technical field

[0001] The present invention belongs to the sector of the automatic looms used to produce triaxial fabrics. Specifically, triaxial fabrics of the so-called bidimensional type.

State of the art

[0002] An automatic loom is a machine used to produce fabrics through an appropriate interlacing of yarns, called weft and warp respectively, usually perpendicular to each other. At the industrial level, such a machine usually operates in conjunction with other machines which perform auxiliary functions, for instance feeding the yarns necessary to form the fabric, or thin strips called tapes, used instead of the yarns. The interlacing of the weft and warp yarns results in a bidimensional fabric, featuring two axes substantially perpendicular to each other. Such an arrangement limits both the visual and tactile effects obtainable and the mechanical properties of the fabric, as touched on in US 6494235 that describes a weaving machine. Because of the reasons here highlighted, starting from the late seventies, the bidimensional triaxial fabric, composed of one series of warp yarns and two different series of weft yarns, has been the object of special attentions, basically because of its high structural and mechanical strength characteristics. US 3446251 (A) describes a number of variants of a triaxial fabric. A number of patent applications, including those which mention said application, highlight both the different characteristics and the variety of applications of this type of fabrics. Usually, in triaxial fabrics both series of weft yarns cross one series of warp yarns, so as to form with the latter an angle close to 60 sexagesimal degrees; the fabric thus obtained offers a high stability and a uniform resistance to shearing stress and to tearing. However, many other types of fabric can be obtained by varying the crossing modes, the angles, or other parameters.

[0003] An example of triaxial fabric (1) of the bidimensional type is shown in Fig. 1. This figure shows the directions of the warp yarns and of the weft yarns.

[0004] Machines for the production of triaxial fabrics that sew or glue fibers or superimposed yarns are known. For instance, a bidimensional fabric featuring a weft orthogonal to the warp can be transformed into a bidimensional fabric featuring an oblique weft and subsequently sewn with a third yarn, so as to produce a triaxial fabric. Similar systems are described in many patent applications, including, amongst others, patent application EP 0250044 (A1). Anyway, the principle of superimposing two layers of yarns, one of which oblique, is known for long time and is already described, for instance, in US 2985941 (A).

[0005] Such systems present a number of drawbacks, from the point of view of the process as well as of the characteristics of the finished product. For instance, the glues, the powders, or the films used require special attentions during their use, besides being subjected to phenomena featuring a high variability. Furthermore, the sewing process requires particularly complex and delicate machines and the interlacing obtained does not allow to block the yarns as it would be preferable.

[0006] It follows that a fabric thus obtained is not comparable to that produced by using machines that actually cross the yarns.

[0007] Patent application US 3799209 (A) describes a machine that is particularly suitable for the production of a triaxial fabric of the type described in patent application US 3446251 (A) mentioned above. In the weaving machine described in said patent application the warp yarns are guided by a series of heddles which handle them in such a way as to allow their mutual crossing. Gaps, also referred to as sheds, are formed during said handling and are used to insert the weft yarn. Said machine, developed starting from already known principles and mechanisms, is extremely complex and bulky. As a matter of fact, the movements of the elements of the machine shall be very accurate and the just described mechanism shall be repeated a high number of times in order to get a strip of fabric that extends for a reasonable width, consequently the repetition of many auxiliary handling elements shall be provided.

[0008] Said problems are so far inherent to the technology, in that they have not been solved by the subsequent patent applications. For instance, patent application US 3999578 (A) describes some improvements related to the insertion of the weft yarn which, on the other hand, don't solve the mentioned problems.

Purposes and summary of the invention

[0009] The present invention aims at solving the problems highlighted above by reducing both the complexity of the systems used and the overall dimensions of the loom with respect to the width of the fabric produced. Said characteristics are obtained thanks to the combined use of an innovative oblique weaving front and a combined warp yarn guide and oblique fixed weft feeding system.

[0010] In the present text, the weaving front F corresponds to the direction of the inserted oblique weft yarn.

[0011] In the loom according to the present invention, said weaving front F is oblique, i.e. the direction is incident, but not perpendicular to the X direction of the warp yarns (21). This detail is clearly shown in Fig. 2.

[0012] The loom for triaxial fabric (1) according to the present invention is capable of producing fabrics starting from different kinds of textile materials, including, but not limited to, yarns, tapes, multi-filament yarns. In order to adapt the operation to the various materials and to the various industrial automation requirements, the assembly (2) used to feed the series of warp yarns can assume different arrangements, for instance it can be formed of

one or two beams (22) or one or several creels.

[0013] The warp yarns are handled, via the traction exerted by the bolt, by a move-forward assembly (3). As a matter of fact, the warp is preferably driven by means of the traction exerted by the already formed bolt of fabric (1) that is rolled up around the motor-driven reel (31). Advantageously said move-forward assembly (3) can include one or several motor-driven cylinders whose side surfaces exert an auxiliary friction driving action onto the already formed bolt of fabric (1).

[0014] Alternatively, said one or several motor-driven cylinders can exert a traction sufficient for bolt traction and/or warp yarn driving. In addition, advantageously said one or several motor-driven cylinders can be installed even before the weaving front F, so as to make slip-off from the creel or unrolling from the beam(s) easier.

[0015] If one or several motor-driven cylinders are present both upstream and downstream the weaving front F, then the former perform a warp yarn (21) unrolling or slip-off function, the second perform a triaxial fabric (1) bolt traction function, and both also act onto the tension the yarns are subjected to. The amount of the latter tensions conforms to different requirements that take place in the individual areas of the loom. For instance, said tensions can make the passage of the cursor on the weaving front easier or prevent the bolt from being set to a status that might cause its breakage or folding.

[0016] As it will be better described later, also the assembly (4) in charge of inserting the oblique fixed weft yarn (41) contributes to control the tensions.

[0017] The assembly (2) in charge of feeding the warp yarns (21) operates in such a way as to place said yarns on two separate surfaces, by using appropriate transmission means or devices known in the sector.

[0018] In order to make the subsequent insertion of the oblique weft yarn (51) easier, the warp yarns (21) can be held spaced from the oblique fixed weft yarn (41) by a board (8) adjacent to each feeding surface.

[0019] Conveniently said boards (8a, 8b) can be properly shaped so as to modify the tensions that are generated in the warp yarns and/or the directions of said warp yarns.

[0020] The assembly (4) in charge of inserting the oblique fixed weft yarn (41) includes means to handle said just placed oblique fixed weft yarns. Said handling means transport the previously positioned oblique fixed weft yarn along the X direction, after being unrolled from a feeding reel.

[0021] The oblique fixed weft yarn (41) is positioned by using devices known in the sector, for instance by means of a weft-placer cursor (46) which slides on a guide parallel to the already positioned weft and is fed by a reel located on cylinders (44, 45) on which it turns, thus unrolling without submitting the yarn to torsions.

[0022] Conveniently said oblique fixed weft handling means can include two driving side tracks (42, 43) which possibly include guide elements (7), also referred to as yarn-guides, for said yarn (41). Said two side tracks (42, 43) can be replaced by equivalent devices, for instance chains or belts. Advantageously the outer side surface of each of said side tracks (42, 43) can feature a plurality of reliefs (421, 431), around which said oblique fixed weft yarn (41) is transmitted. In a preferred embodiment, said reliefs (421, 431) feature a substantially cylindrical shape.

[0023] On the other hand, said side tracks (42, 43) can be driven independently of each other, in order to distribute the tensions differently or to make the insertion of the inserted oblique weft yarn (51) easier or to get compacting effects in the already formed fabric (1). As already mentioned before, the action of said tracks (42, 43) can be coordinated with that of one or several of the motor-driven cylinders, if any, of the move-forward assembly (3). Furthermore, said side tracks (42, 43) can be not parallel to each other in order to limit the tensions generated by the yarn-guide element (7) or by the stretchers (10) onto the yarns.

[0024] On the other hand, the tension of the oblique fixed weft yarn (41) located between the side tracks (42, 43) is also controlled by means of said weft-placer cursor (46).

[0025] Said feeding assembly (4) makes it possible to position on the weaving front F the oblique fixed weft yarn (41) oriented according to a direction that is incident with respect to the X direction of the warp yarns.

[0026] Unlike that which happens in those machines which just superimpose a fixed weft to the warp yarns, in the loom according to the present patent application the oblique fixed weft is woven between the warp yarns on one surface and the warp yarns on the other surface.

[0027] The subdivision of the warp yarns on two different surfaces can be obtained starting either from one or several beams (22), should said feeding system (2) use a plurality of beams.

[0028] The triaxial fabric (1) is formed whenever the insertion assembly (5) positions the inserted oblique weft yarn (51). Said inserted oblique weft yarn (51) is guided between the warp yarns by means of appropriate systems usually utilized in the sector, including, for instance, systems based on cursor (9) and spear, or shell systems or air systems or others.

[0029] So, the warp yarns, the oblique fixed weft yarn, and the inserted oblique weft yarn follow three different directions which, in a particularly convenient embodiment of this invention, can form angles of sixty degrees.

[0030] As highlighted in the description of the status of the art, in the absence of an interlacement, the presence of yarns directed along three directions is not sufficient to form a properly spoken triaxial fabric (1).

[0031] In the invention according to the present patent application, the elements in charge of guiding (7) the warp yarns (21) operate in such a way as to rise some of them and to lower the remaining ones, so as to form a space aligned according to the weaving front F. Simultaneously, the inserted oblique weft yarn is made run transversally

with respect to the bolt so as to form the interweaving.

[0032] In particular, this interweaving does not concern the inserted oblique weft yarn (51) and the warp yarns (21) only, but also the oblique fixed weft yarn (41). The latter yarn (41) moves in the move-forward direction coordinately with the transversal crossing of the bolt by the inserted oblique weft yarn (51).

[0033] Thanks to said guide elements (7) the inserted oblique weft yarn (51) goes through above and below every warp yarn, alternatively.

[0034] The structure of the triaxial fabric (1) can be modified by acting on a number of mechanisms, some of which are classic in the sector, whereas others are specific to this invention. A simple example of a classic way to perform such a change consists in using a variety of warp yarn (21).

[0035] According to the present invention, special triaxial fabrics can be obtained by acting both on the yarn-guide elements (7) and on the assembly (4) in charge of inserting the oblique fixed weft yarn (41).

[0036] In particular, many combinations of crossing, hence of fabrics, can be obtained by varying the location of the yarn-guide elements. For instance, instead of positioning the yarn-guide elements (7) alternatively downwards and upwards it is possible to place several elements upwards and one only downwards alternatively, or vice versa. What just described allows to obtain a variety of crossing combinations concerning the inserted weft yarn (51).

[0037] In addition, it is possible to reduce or to increase the number of the yarn-guide elements, as well as the spacing of the warp yarns (21).

[0038] Likewise, and possibly in coordination with the just described changes, it is possible to act on the positioning of the oblique fixed weft yarn (41), by increasing or reducing the spacing between two parallel elements of the oblique fixed weft.

[0039] So, it is possible to obtain different combinations of triaxial fabric (1) by coordinating the different assemblies of the invention according to the present application.

[0040] The interweaving can be further fostered by the presence of some stretchers (10), which stabilize the position of the oblique fixed weft yarn (41). Said stretchers (10) feature a substantially vertical alternating movement, coordinated with the crossing sequence of the weaving front by the inserted oblique weft yarn (51).

[0041] The structure of the fabric thus obtained doesn't only vary with reference to the interweavings and to the angles between the yarns, but also on the basis of classic parameters specific to the automatic looms, including, amongst others, the distance between the yarns or their tension.

[0042] Said different structures can be obtained by acting onto various mechanisms. For instance, it is possible to vary the shape of the yarn-guide elements, the speed of the belts of the oblique fixed weft yarn insertion assembly (4), and to also possibly provide an independent driving of the two sides. Also, it is possible to act on the distance between the two tracks, so as to also take account of the effects of the interweaving in tensioning the yarns.

Brief description of the drawings

[0043]

Fig. 1 shows an example of triaxial fabric. In the middle of the figure, it is possible to observe the effect obtained whereas, on the edges, a number of yarns have been removed to make it easier to identify the warp yarns and the fixed and inserted, oblique weft yarns.
The figure shows the X, Y, and F axes representing the three directions of the triaxial fabric (1).

Fig. 2 shows an axonometric view of an embodiment of the loom according to the present patent application.
In order to make the understanding of the figure easier, a number of elements have been removed. On the right side of the figure, there is the assembly (2) in charge of feeding the warp yarns (21); the figure also shows the assembly (3) in charge of the forward moving of the warp yarns (21), the assembly (4) in charge of inserting the oblique fixed weft yarn (41), and the assembly (5) in charge of inserting the inserted oblique weft yarn (51). The figure also shows the elements (7) in charge of guiding the warp yarns (21).
The figure also shows the X, Y, and F axes representing the directions of the warp yarns (21), the oblique fixed weft yarn (41), and the weaving front, respectively.

Fig. 3 shows an axonometric view of a different embodiment of the loom, in which the warp yarns are arranged on one surface.

Fig. 4 shows a detail of the loom, where the yarn-guide elements (7) of the warp yarn (21) are highlighted. The yarn guides (7) are aligned along the weaving front F and are installed on the boards (8a, 8b).

Fig. 5 shows a detail emphasizing the crossing of the cursor (9) that drives the inserted oblique weft yarn (51) along the weaving front F, from one side to the other of the bolt, so as to form the triaxial fabric (1).

Fig. 6 shows a detail formed of two yarn-guide elements (7a, 7b) of two of the warp yarns (21a and 21b) and of the inserted oblique weft yarn (51) positioned by the cursor (9).

Fig. 7 shows a single yarn-guide element (7) of the type used for tapes. The arrow inside the figure indicates the move-forward direction of the warp yarns (21).

Fig. 8 shows a detail highlighting the crossing of the cursor (9) that drives the inserted oblique weft yarn (51) along the weaving front F in such a way as to

form the triaxial fabric (1) according to a point of view different from that of Fig. 5 so as to highlight the function of the yarn-guide elements (7).

Fig. 9a shows a detail of the loom, where the stretchers (10) are represented in their rest position.

Fig. 9b shows a detail of the loom, where the stretchers (10) are represented in their working position.

Fig. 10 shows an axonometric view of an embodiment of the assembly (4) in charge of inserting the oblique fixed weft yarn (41).

Fig. 11 shows a detail of an embodiment of the assembly (2) in charge of feeding the warp yarns, should the latter include two beams (22a, 22b).

Detailed description of an embodiment of the invention

[0044] The loom according to the present patent application comprises:

- an assembly (2) in charge of feeding the warp yarns (21) ;
- an assembly (3) in charge of moving forward the warp yarns (21);
- an assembly (4) in charge of inserting the oblique fixed weft yarn (41);
- an assembly (5) in charge of inserting the inserted oblique weft yarn (51) along a weaving front F;
- a plurality of guide elements (7) for said warp yarns (21).

[0045] In a preferred embodiment, said feeding assembly (2) includes a beam from which two series of warp yarns (21) are generated, aligned in parallel to an X direction, arranged on two surfaces separated from each other which, in the embodiment shown here, are flat.

[0046] Between these surfaces, said assembly (4) makes the oblique weft advance in parallel to said X direction, after progressively forming it through an alternating insertion and retraction, i.e. by boustrophedonically arranging said yarn (41) along an Y direction that, at least in a position close to said weaving front F, is oblique with respect to said X direction.

[0047] Said warp yarns (21) are driven, along said X direction, by an assembly (3) in charge of making the warp yarns move forward thanks to the traction action exerted by a beam (31) on which the already formed bolt of fabric (1) is wound. The move forward assembly (3) advantageously comprises two motor-driven cylinders, which exert an auxiliary driving action onto the already formed bolt.

[0048] In the embodiment described here, said assembly (5) in charge of inserting the yarn (51) comprises a cursor (9) which moves along said weaving front F and crosses the bolt. The weaving front F is oblique with respect to the X direction according to which the warp yarns (21) are fed as well as to the Y direction according to which the oblique fixed weft (41) is inserted.

[0049] The passage of the cursor is coordinated both with the movement forced by the warp yarn move-forward assembly (3) and with the movement of the oblique fixed weft yarn (41) via the assembly (4) in charge of inserting said yarn.

[0050] In the embodiment described here there are two boards (8a, 8b) internally adjacent to each of said two surfaces containing the warp yarns (21) and external to the already arranged oblique fixed weft.

[0051] Advantageously these boards (8a, 8b) are initially parallel to the horizontal planes on which the warp yarns (21) arranged by the feeding assembly (2) are located, to subsequently taper in such a way as to foster the change of direction forced by the yarn-guide elements (7) of the warp yarns (21).

[0052] As a matter of fact, said loom comprises a plurality of guide elements (7) for the warp yarns (21), whose yarn input ends rest on next to the terminal edges of each of said two boards (8a, 8b), whereas the yarn output ends are located downstream the latter. The input and output ends of the different guide elements (7) are aligned parallel to said weaving front F and comprise appropriate check means for said warp yarn (21).

[0053] By virtue of what just described, the guide elements (7) keep the warp yarns spaced to make it possible to place the oblique fixed weft internally to the two warp yarn surfaces before said yarn (51) is laid down.

[0054] In a particularly convenient embodiment, said guide elements (7) are static and shaped so as to present a convex section on the side facing the weaving front F. Said convex profile determines a slightly arched shape of the yarn guide (7), which enables the latter to rise or lower the warp yarns (21) to facilitate the insertion of the inserted oblique weft yarn (51).

[0055] Surprisingly, the presence of said guide elements (7) in the loom according to the present patent application allows to also displace the oblique fixed weft already present between the two surfaces of the warp yarns.

[0056] This way, the yarn (51) can go through the gap determined by the guide elements (7) and cross both the warp yarns and those of the oblique fixed weft, thus originating a triaxial fabric.

[0057] In this embodiment, said guide elements (7) are arranged in such a way that said convex profile alternatively faces upwards or downwards, so that the yarn guide lowers or rises the warp yarn (21) sliding onto the outer section of said profile, respectively. Consequently, in the side views, every pair formed of successive elements forms an "X".

[0058] Advantageously, said guide elements (7) present an opening between a first section and a second section featuring a convex profile, so as to enable the warp yarn (21) to cross the yarn guide surface, consequently the warp yarn moves internally to the yarn guide along the first section and externally along said second convex section.

[0059] Note that the shape of boards (8a, 8b) makes

also it possible to vary the direction of the tensions in the warp yarns (21) next to the guide elements (7).

[0060] In a particularly complete embodiment, the loom comprises two parallel series of cuneiform stretchers (10), located before and after said weaving front F respectively, which develop an alternating movement in the vertical direction. The latter is temporally coordinated with the passage of the cursor (9) on the weaving front F. In a typical sequence, said stretchers (10) rise, said cursor (9) goes through and the stretchers consequently lower. This way, the stretchers come between the yarns and stabilize, in particular, the oblique fixed weft yarn (41) and consequently foster the interweaving.

[0061] In the present embodiment, the assembly (4) in charge of inserting the oblique fixed weft yarn (41) comprises a weft-placer cursor (46) which boustrophedonically places said yarn onto the side tracks (42, 43) of said assembly (4). Said weft-placer cursor (46) slides on a guide parallel to the already positioned weft and is fed by a reel located on cylinders (44, 45) onto which it rotates, thus unrolling without causing torsions onto the yarn.

[0062] The side tracks (42, 43) drive along the X direction the oblique weft yarn directed along the Y direction, which generates, together with the X direction, a non-right angle.

[0063] Said side tracks (42, 43), which can be advantageously driven independently by means of two separate driving assemblies, present, along the outer side surface, a plurality of reliefs (421, 431). Around said reliefs (421, 431), which feature a substantially cylindrical shape, the oblique fixed weft yarn (41) is transmitted.

Claims

1. A loom for triaxial fabric (1) comprising:

- an assembly (2) in charge of feeding warp yarns (21), aligned in parallel to an X direction, which arranges them on two surfaces separated from each other;
- an assembly (3) in charge of moving forward the warp yarns (21) according to said X direction;
- an assembly (4) in charge of inserting an oblique fixed weft yarn (41), which progressively forms the oblique fixed weft between said two surfaces of the warp yarns, by alternating insertion and retraction, i.e. by boustrophedonically arranging said yarn (41) along an Y direction that is oblique with respect to said X direction, while simultaneously making the just formed oblique weft move forward parallel to X direction;
- an assembly (5) in charge of inserting an inserted oblique weft yarn (51) along a weaving front F, the latter being oblique both with respect to the X direction and with respect to the Y direction according to which the oblique fixed weft (41) is inserted; said assembly (5) operating in coordination with said assembly (4) in charge of inserting the oblique fixed weft (41);

characterized in that it comprises a plurality of guide elements (7) for the warp yarns (21), whose yarn input ends are aligned along the terminal edges of each of said two surfaces of the warp yarns (21) whereas the yarn output ends are aligned parallel to said weaving front F and downstream of the latter, so as to contribute to keep the warp yarns(21) spaced from each other to make it possible to place the oblique fixedweft (41)internally to the two groups of warp yarns (21) before said inserted oblique weft yarn (51) is laid, and **in that** said guide elements (7) are shaped in such a way as to present a convex profile on the part facing the weaving front F, said guide elements (7) being mounted in such a way that said convex profile faces upwards or downwards, so that the guide elements (7) lower and rise the warp yarn (21) moving on the outer part of said profile respectively, by also displacing the oblique fixed weft (41) already located between the two surfaces of the warp yarns and forming a gap through which the inserted oblique weft yarn (51) is inserted, so that said inserted oblique weft yarn (51) crosses both the warp yarns (21) and those of the oblique fixedweft (41)alternatively, so as to form a triaxial fabric.

2. A loom according to the previous claim, **characterized in that** said guide elements (7) are static.

3. A loom according to one or several of the previous claims, **characterized in that** said yarn guide elements (7) present:

- a warp yarn (21) input and output ends, both including appropriate check means for said yarn;
- a first section;
- a second convex section;
- an opening between said first planar section and said second convex section, so as to enable the warp yarn (21) to cross the surface of the yarn guide, so that the warp yarn runs internally to the yarn guide along the first section and externally along said second convex section.

4. A loom according to one or several of the previous claims, **characterized in that** it comprises two boards (8a, 8b), each of which is interposed between one of said surfaces of the warp yarns (21) and the oblique fixed weft, and is properly shaped so as to reduce the distance between said surface and the weaving front F in the move forward direction.

5. A loom according to one or several of the previous

claims, **characterized in that** it comprises two parallel series of cuneiform stretchers (10), located before and after said weaving front F respectively, which develop an alternating movement in a vertical direction, temporally coordinated with the passage along the weaving front F of the inserted oblique weft yarn (51); each of said stretchers coming between the yarns so as to temporally stabilize the position of said oblique fixed weft yarn (41).

6. A loom according to one or several of the previous claims, **characterized in that** said assembly (4) in charge of inserting the oblique fixed weft yarn (41) comprises two side tracks (42, 43) in charge of driving said oblique fixed weft yarn (41) boustrophedonically arranged according to said move forward direction parallel to said X direction.

7. A loom according to the previous claim, **characterized in that** each of said side tracks (42, 43) can be operated independently of each other, in order to get compacting effects onto the fabric (1).

8. A loom according to one or several of the previous claims, **characterized in that** said move forward assembly (3) takes advantage of the traction action exerted by the winding of the already formed bolt of fabric (1).

9. A loom according to one or several of the previous claims, **characterized in that** said move forward assembly (3) comprises one or several motor-driven cylinders which foster the slip-off or the unrolling of said warp yarns (21).

10. A loom according to one or several of the previous claims, **characterized in that** said move forward assembly (3) comprises one or several motor-driven cylinders that drive the already formed bolt of fabric (1).

Patentansprüche

1. Webmaschine für triaxiale Gewebe (1), umfassend:

- eine Gruppe (2) für die Zufuhr der Kettfäden (21), parallel zu einer Richtung X ausgerichtet, die sie auf zwei voneinander getrennten Oberflächen anordnet;
- eine Gruppe (3) für den Vortrieb der Kettfäden (21) entsprechend dieser Richtung X;
- eine Gruppe (4) für das Einlegen eines festen schrägen Schussfadens (41), der progressiv den festen schrägen Schuss zwischen den beiden Oberflächen der Kettfäden bildet, wobei Einlegen und Rückzug abgewechselt werden, das heißt, dass dieser Faden (41) bustrophedon entlang einer Richtung Y angeordnet wird, die schräg zur Richtung X ist, wobei gleichzeitig der eben gebildete schräge Schuss parallel zu Richtung X vorgetrieben wird;
- eine Gruppe (5) für das Einlegen eines schrägen Schussfadens (51), der entlang einer Webfront F eingelegt wird, wobei die Letztere schräg sowohl zur Richtung X als auch zur Richtung Y ist, entsprechend welcher der feste schräge Schussfaden (41) eingelegt wird; wobei diese Gruppe (5) koordiniert mit der Gruppe (4) für das Einlegen des festen schrägen Schussfadens (41) zusammenwirkt;

dadurch gekennzeichnet, dass sie eine Vielzahl von Führungselementen (7) für die Kettfäden (21) umfasst, deren Enden für den Fadeneinlauf an den Abschlussrändern von jeder dieser beiden Oberflächen der Kettfäden (21) ausgerichtet sind, während die Enden für den Fadenauslauf parallel zur Webfront F und hinter dieser Letzteren ausgerichtet sind, so dass sie dazu beitragen, die Kettfäden (21) voneinander entfernt zu halten, um zu ermöglichen, den festen schrägen Schussfaden (41) innerhalb der beiden Gruppen von Kettfäden (21) anzuordnen, bevor dieser eingelegte schräge Schussfaden (51) abgelegt wird, und dadurch, dass diese Führungselemente (7) so geformt sind, dass sie ein konvexes Profil auf der zur Webfront F hin gerichteten Seite aufweisen, wobei diese Führungselemente (7) so eingebaut sind, dass dieses konvexe Profil nach oben oder nach unten gerichtet ist, so dass die Führungselemente (7) jeweils den Kettfaden (21) absenken und anheben, der auf der Außenseite dieses Profils verläuft, wobei ebenso der feste schräge Schussfaden (41) verschoben wird, der bereits zwischen den beiden Oberflächen der Kettfäden angeordnet ist, und ein Spalt gebildet wird, durch den der eingelegte schräge Schussfaden (51) eingelegt wird, so dass der eingelegte schräge Schussfaden (51) sich abwechselnd sowohl mit den Kettfäden (21) als auch mit den festen schrägen Schussfäden (41) überkreuzt, so dass er ein triaxiales Gewebe bildet.

2. Webmaschine nach dem vorangehenden Anspruch, **dadurch gekennzeichnet, dass** diese Führungselemente (7) statisch sind.

3. Webmaschine nach einem oder mehreren der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** diese Fadenführungselemente (7) aufweisen:

- ein Ende für den Einlauf und ein Ende für den Auslauf des Kettfadens (21), beide entsprechende Haltemittel für den Faden umfassend;
- einen ersten Abschnitt;
- einen zweiten konvexen Abschnitt;

- eine Öffnung zwischen diesem ersten flachen Abschnitt und diesem zweiten konvexen Abschnitt, so dass es dem Kettfaden (21) möglich ist, die Oberfläche der Fadenführung zu durchqueren, so dass der Kettfaden im ersten Abschnitt innerhalb der Fadenführung und im zweiten konvexen Abschnitt außerhalb verläuft.

4. Webmaschine nach einem oder mehreren der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** sie zwei Tafeln (8a, 8b) umfasst, von denen jede zwischen eine dieser Oberflächen der Kettfäden (21) und den festen schrägen Schussfaden kommt und zweckmäßig geformt ist, um in der Vortriebrichtung den Abstand zwischen der Oberfläche und der Webfront F zu verringern.

5. Webmaschine nach einem oder mehreren der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** sie zwei parallele Reihen von kegelförmigen Ausbreitern (10) umfasst, die vor und nach der Webfront F angeordnet sind und eine wechselnde Bewegung in eine vertikale Richtung entwickeln, die zeitlich koordiniert ist mit dem Durchlauf des eingelegten schrägen Schussfadens (51) entlang der Webfront F; wobei jeder dieser Ausbreiter so zwischen die Fäden kommt, dass die Position dieses festen schrägen Schussfadens (41) vorübergehend stabilisiert wird.

6. Webmaschine nach einem oder mehreren der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** diese Gruppe (4) für das Einlegen des festen schrägen Schussfadens (41) zwei seitliche Riemen (42, 43) für das Mitnehmen des festen schrägen Schussfadens (41) umfasst, der bustrophedon entsprechend der Vortriebrichtung parallel zur Richtung X angeordnet ist.

7. Webmaschine nach dem vorangehenden Anspruch, **dadurch gekennzeichnet, dass** jeder dieser seitlichen Riemen (42, 43) unabhängig voneinander betätigt werden kann, um eine verdichtende Wirkung auf das Gewebe (1) zu erreichen.

8. Webmaschine nach einem oder mehreren der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** diese Vortriebgruppe (3) die Zugwirkung ausnutzt, die durch das Aufwickeln der schon gebildeten Gewebebahn (1) ausgeübt wird.

9. Webmaschine nach einem oder mehreren der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** diese Vortriebgruppe (3) eine oder mehrere motorisierte Walzen umfasst, die das Abspulen oder das Abwickeln dieser Kettfäden (21) begünstigen.

10. Webmaschine nach einem oder mehreren der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** diese Vortriebgruppe (3) eine oder mehrere motorisierte Walzen umfasst, die die schon gebildete Gewebebahn (1) führen.

Revendications

1. Machine à tisser pour tissu triaxial (1) comprenant :

- un ensemble (2) d'alimentation de fils de chaîne (21), alignés en parallèle à une direction X, qui les dispose sur deux surfaces séparées l'une par rapport à l'autre ;
- un ensemble (3) d'avancement de fils de chaîne (21) suivant la direction X ;
- un ensemble (4) d'insertion du fil de trame fixe oblique (41), qui forme progressivement la trame fixe oblique entre lesdites deux surfaces des fils de chaîne, l'insertion et la rétraction étant alternées, c'est-à-dire en disposant boustrophedoniquement ledit fil (41) le long d'une direction Y qui est oblique par rapport à ladite direction X, tout en faisant avancer en même temps la trame oblique à peine formée parallèlement à la direction X ;
- un ensemble (5) d'insertion du fil (51) de la trame oblique le long d'un front de tissage F, celui-ci étant oblique par rapport à la direction X ainsi qu'à la direction Y d'insertion de la trame fixe oblique (41) ; ledit ensemble (5) opérant d'une manière coordonnée avec ledit ensemble (4) d'insertion de la trame fixe oblique (41) ;

caractérisée en ce qu'elle comprend une pluralité d'éléments de guide (7) des fils de chaîne (21), dont les extrémités d'entrée du fil sont alignées le long des bords extrêmes de chacun desdites deux surfaces des fils de chaîne (21) tandis que les extrémités de sortie des fils sont alignées parallèlement audit front de tissage F et en aval de celui-ci, de telle sorte à contribuer à garder les fils de chaîne (21) espacés l'un par rapport à l'autre pour permettre de disposer le fil de trame fixe oblique (41) à l'intérieur des deux groupes de fils de chaîne (21) avant que ledit fil de trame oblique (51) inséré soit posé, et **en ce que** lesdits éléments de guide (7) sont façonnés de telle sorte à présenter un profil convexe du côté regardant le front de tissage (F), lesdits éléments de guide (7) étant montés de telle sorte que ledit profil convexe regarde le haut ou le bas, de telle sorte que les éléments de guide (7) baissent ou lèvent le fil de chaîne (21), se déplaçant du côté extérieur dudit profil respectivement, tout en déplaçant également le fil de trame fixe oblique (41) déjà positionné entre les deux surfaces des fils de trame (41) déjà positionnés entre les deux surfaces des fils de chaîne et formant un

passage à travers lequel le fil de trame oblique (51) est inséré, de telle sorte que ledit fil de trame oblique (51) inséré se croise alternativement avec les fils de chaîne (21) et ceux de la trame fixe oblique (41), de telle sorte à former un tissu triaxial.

2. Machine à tisser selon la revendication précédente, **caractérisée en ce que** lesdits éléments de guide de fils (7) sont statiques.

3. Machine à tisser selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** lesdits éléments de guide présentent :

- une extrémité d'entrée et une extrémité de sortie du fil de chaîne (21), toutes les deux comprenant des moyens appropriés de rétention dudit fil ;
- une première section ;
- une deuxième section convexe ;
- une ouverture entre ladite première section planaire et ladite deuxième section convexe, de telle sorte à permettre au fil de chaîne (21) de traverser la surface du guide-fil de telle sorte que le fil de chaîne glisse à l'intérieur du guide-fil le long de la première section et à l'extérieur le long de ladite deuxième section convexe.

4. Machine à tisser selon une ou plusieurs des revendications précédentes, **caractérisée en ce qu'**elle comprend deux tables (8a, 8b) chacune desquelles est interposée entre une desdites surfaces des fils de chaîne (21) et le fil fixe oblique et est adéquatement façonnée de telle sorte à réduire la distance entre ladite surface et le front de tissage F dans la direction d'avancement.

5. Machine à tisser selon une ou plusieurs des revendications précédentes, **caractérisée en ce qu'**elle comprend deux séries parallèles d'élargisseurs cunéiformes (10), placés respectivement avant et après ledit front de tissage F, qui développent un mouvement alternatif en direction vertical, temporairement coordonné avec le passage le long du front de tissage F du fil de trame oblique (51) inséré ; chacun desdits élargisseurs s'interposant entre les fils de telle sorte à stabiliser temporairement la position dudit fil de trame fixe oblique (41) .

6. Machine à tisser selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** ledit ensemble (4) d'insertion du fil de trame fixe oblique (41) comprend deux chenilles latérales (42, 43) d'entraînement dudit fil de trame fixe oblique (41) disposé boustrophedoniquement suivant ladite direction d'avancement parallèle à ladite direction X.

7. Machine à tisser selon la revendication précédente, **caractérisée en ce que** chacune desdites chenilles latérales (42, 43) peut être actionnée indépendamment l'une par rapport à l'autre, dans le but d'obtenir des effets de compactage du tissu (1).

8. Machine à tisser selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** ledit ensemble (3) d'avancement exploite l'action de traction exercée par l'enroulement de la pièce de tissu (1) déjà formée.

9. Machine à tisser selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** ledit ensemble (3) d'avancement comprend un ou plusieurs cylindres motorisés qui facilitent le défilement et le déroulement desdits fils de chaîne (21).

10. Machine à tisser selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** ledit ensemble (3) d'avancement comprend un ou plusieurs cylindres motorisés qui entraînent la pièce de tissu (1) déjà formée.

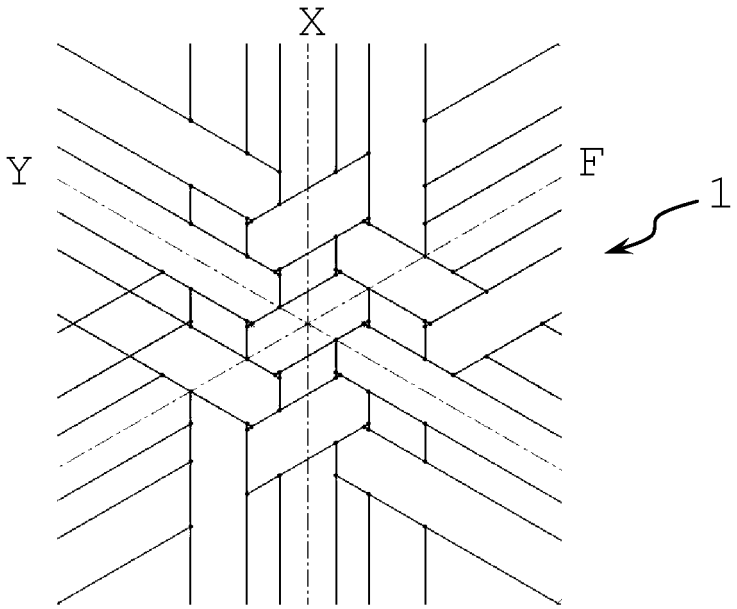

FIG. 1

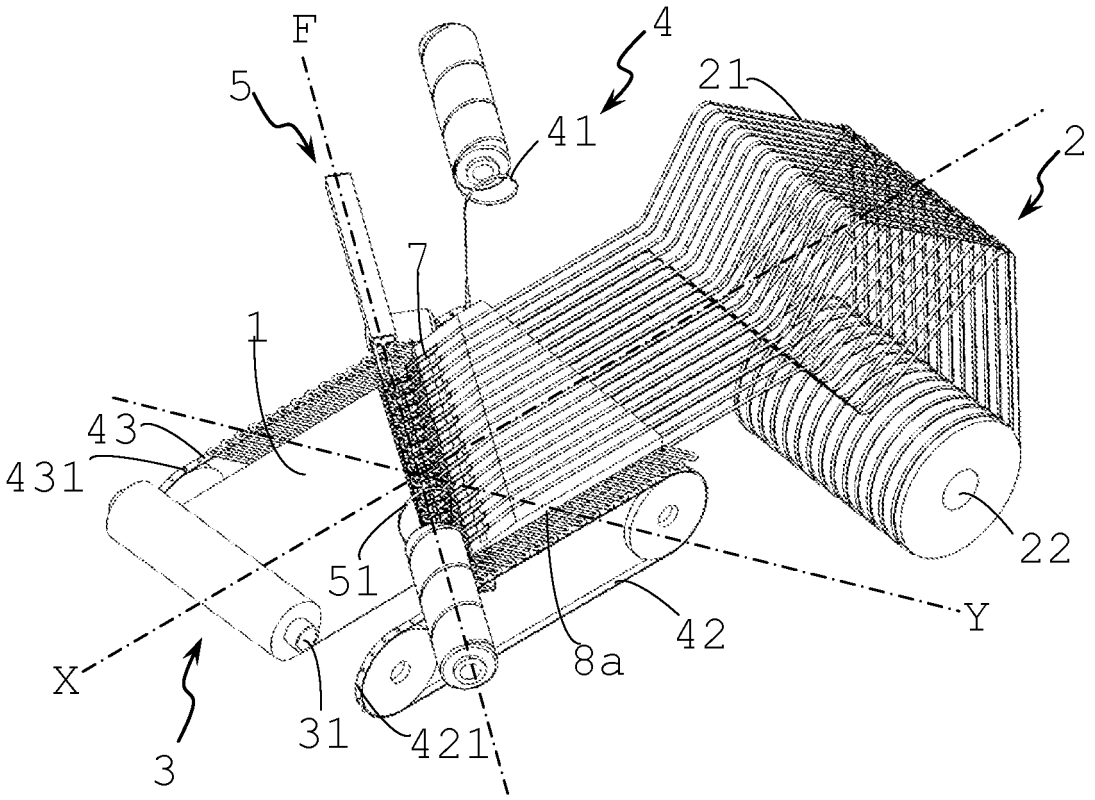

FIG. 2

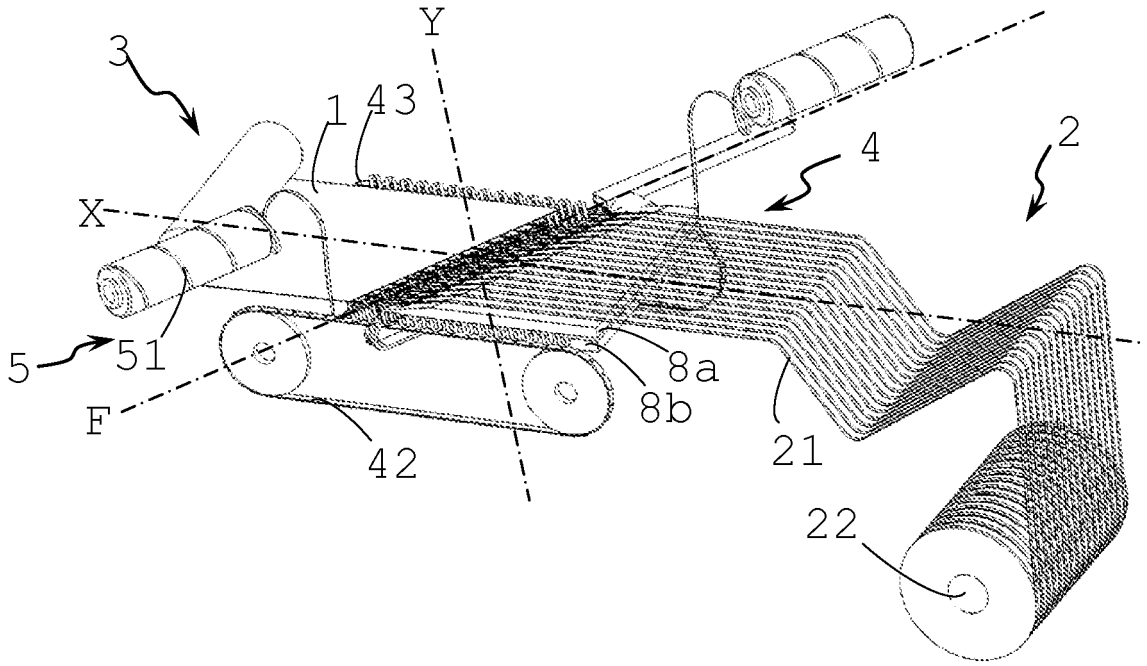

FIG. 3

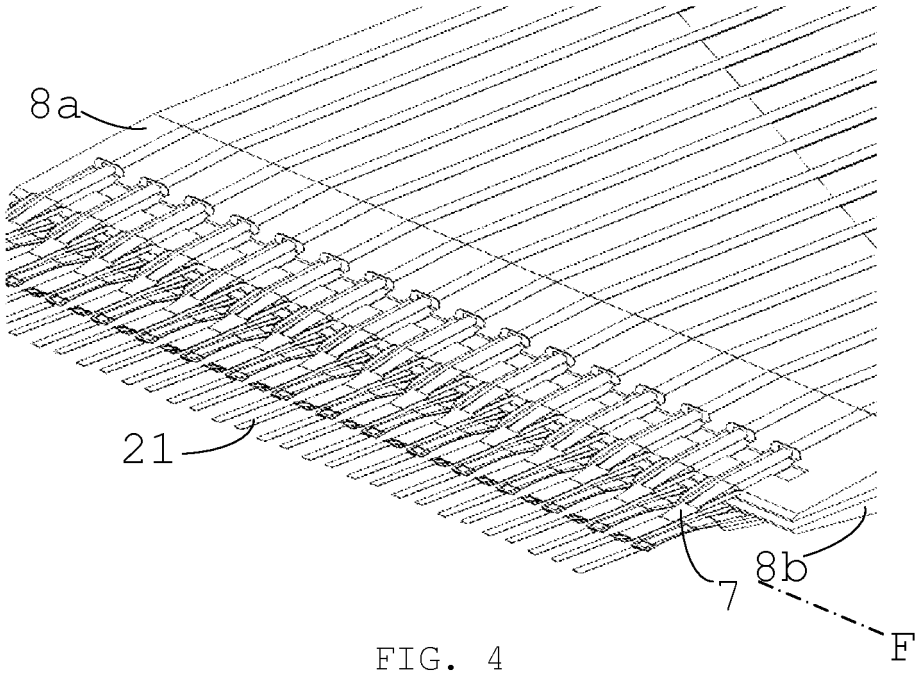

FIG. 4

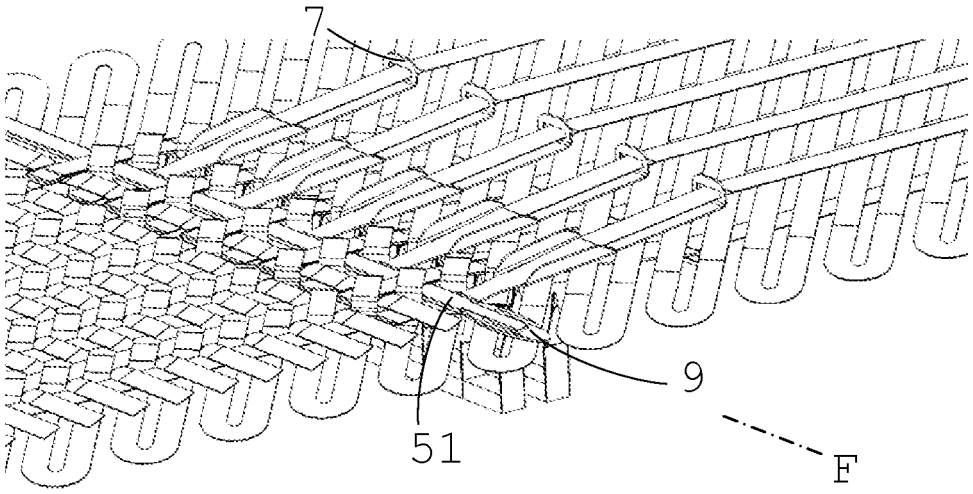

FIG. 5

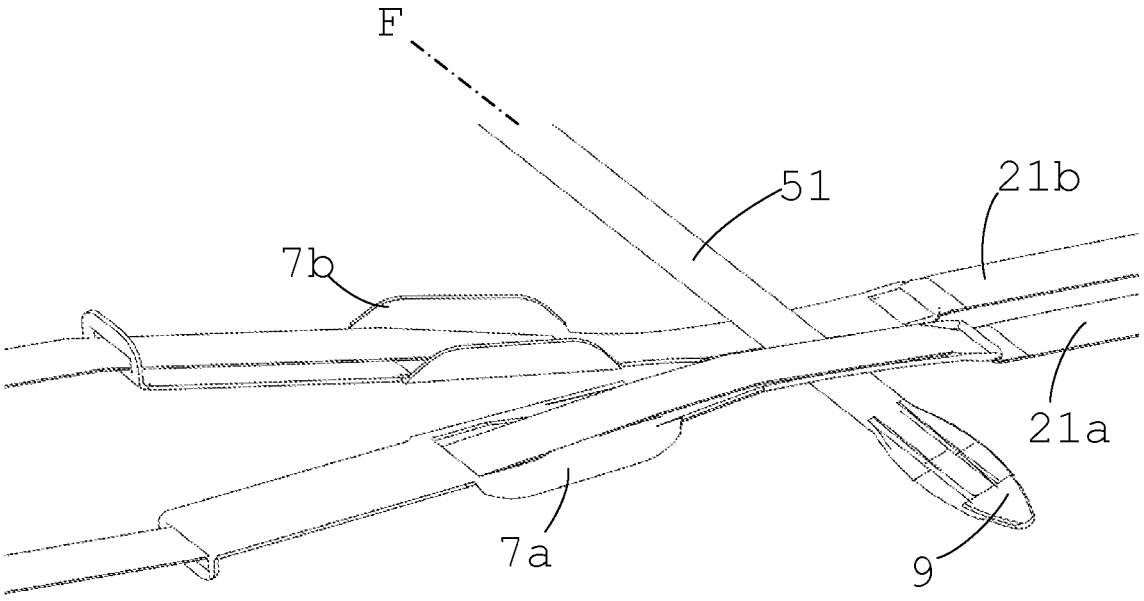

FIG. 6

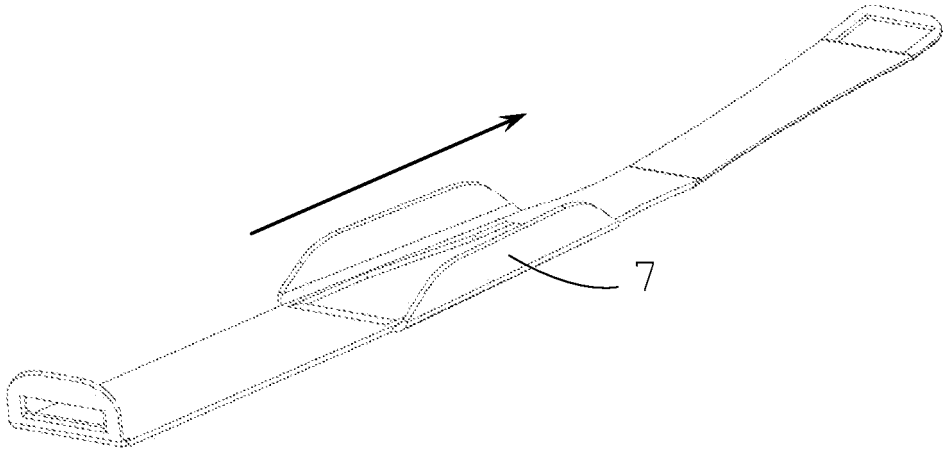

FIG. 7

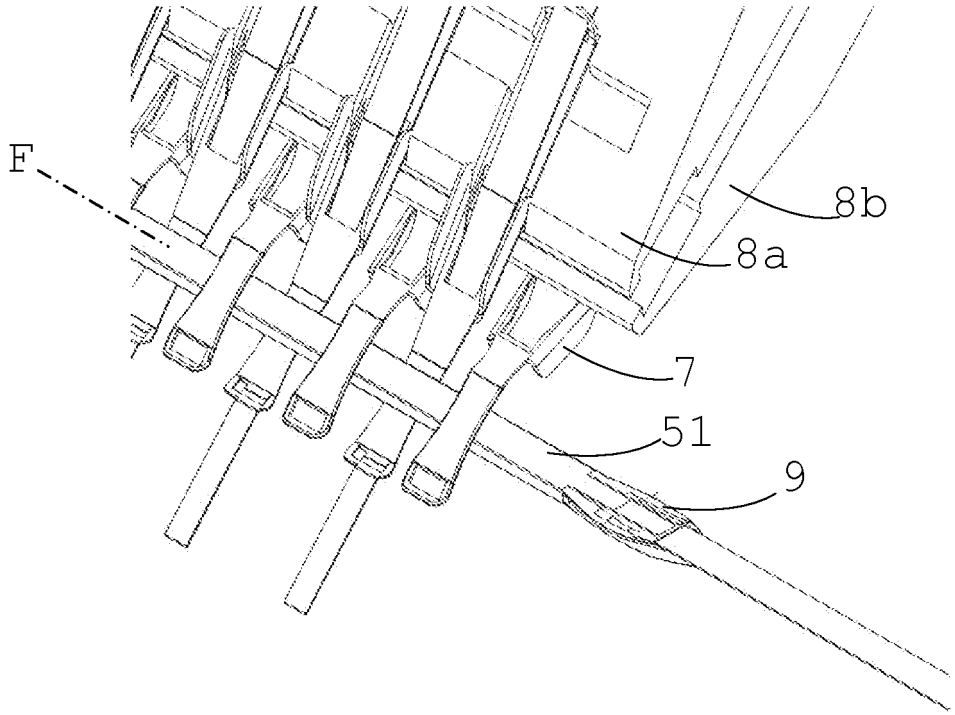

FIG. 8

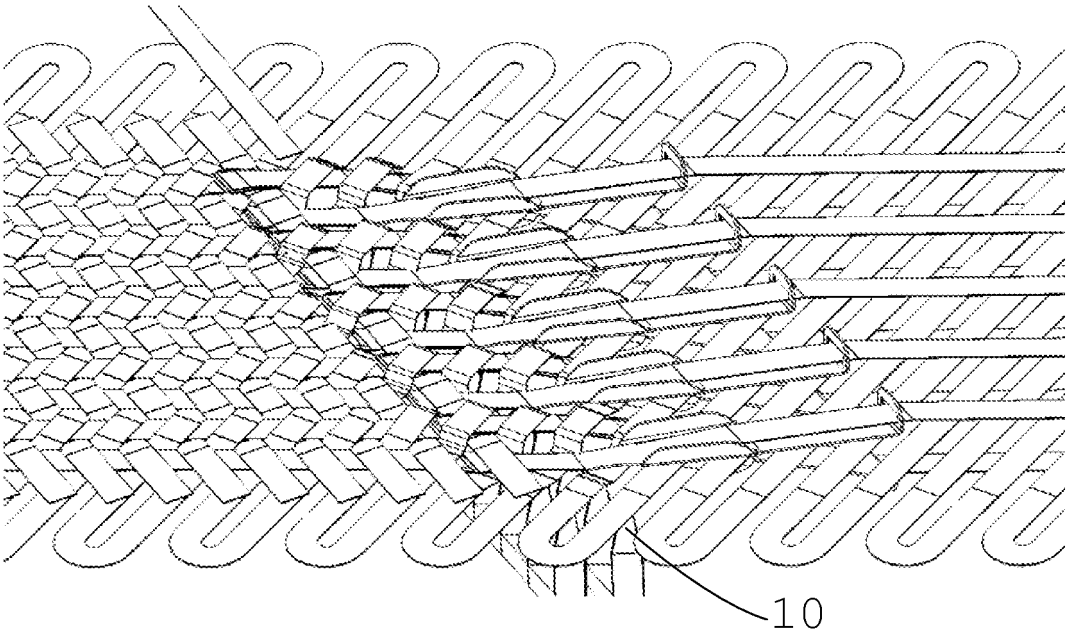

FIG. 9a

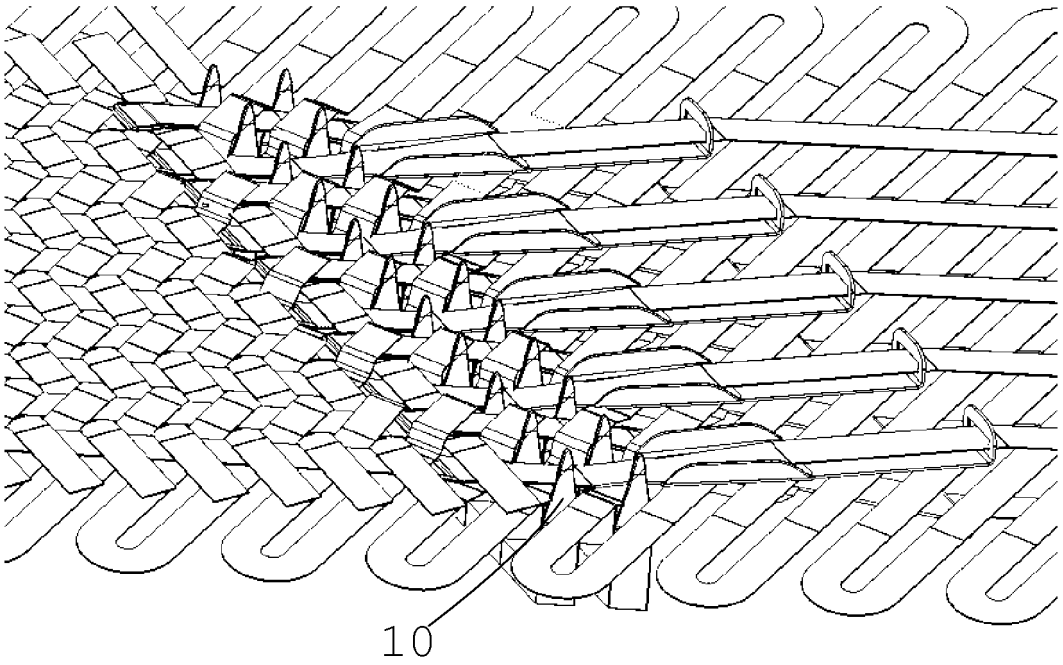

FIG. 9b

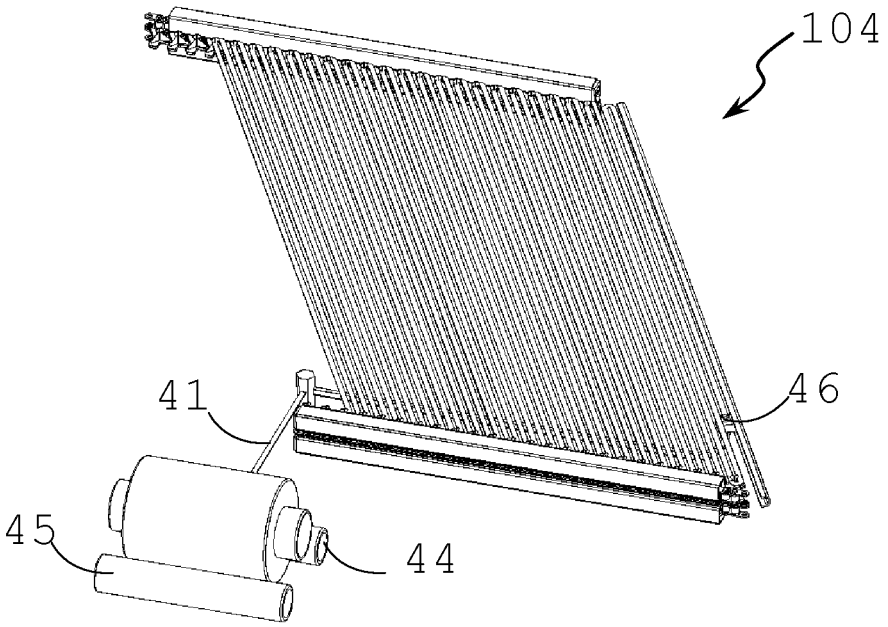

FIG. 10

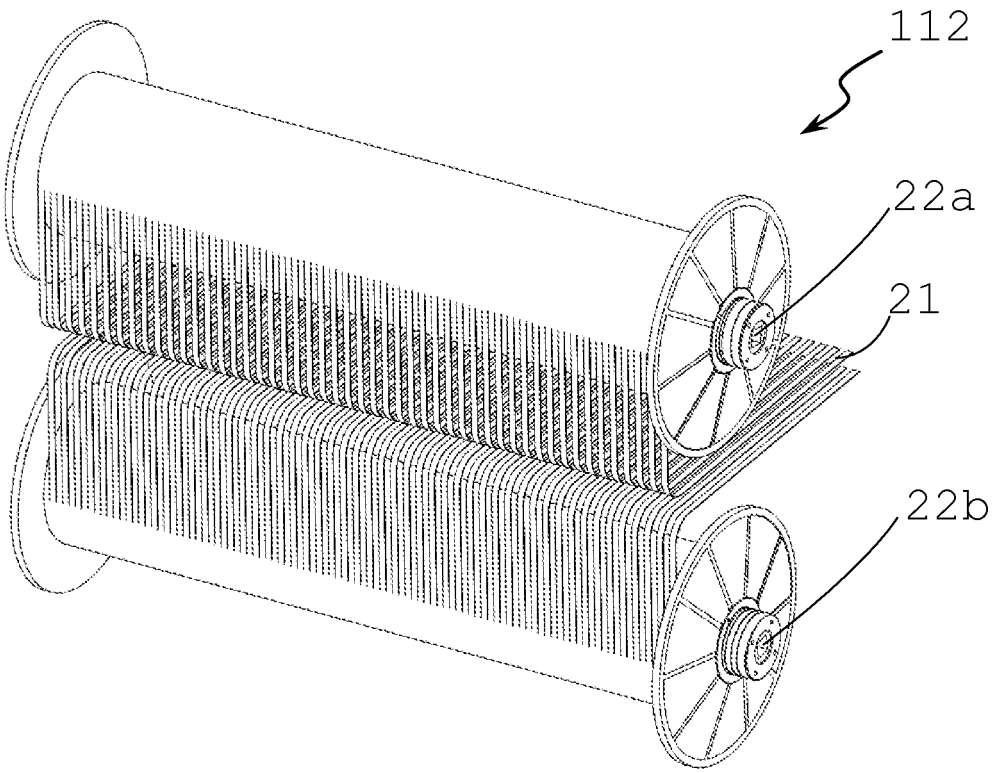

FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6494235 B **[0002]**
- US 3446251 A **[0002] [0007]**
- EP 0250044 A **[0004]**
- US 2985941 A **[0004]**
- US 3799209 A **[0007]**
- US 3999578 A **[0008]**