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(54) A METHOD OF PRODUCING A WOVEN ELONGATE FLEXIBLE TUBE

VERFAHREN ZUR HERSTELLUNG EINES GEWEBTEN LÄNGLICHEN FLEXIBLEN SCHLAUCHS
PROCÉDÉ DE PRODUCTION D'UN TUBE FLEXIBLE ALLONGÉ TISSÉ

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(56) References cited:
WO-A2-01/44547 WO-A2-02/079554
CN-B- 102 587 015 DE-A1- 19 938 194
US-A- 4 844 131

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Description

[0001] The present invention relates to a method of producing a woven elongate flexible tube. More particularly, the invention relates to a method of producing a woven elongate flexible tube suitable for use in producing an inflatable safety belt.

[0002] Conventional safety belts, such as those more commonly known as seat belts and which are provided in motor vehicles as occupant restraints, typically comprise lengths of webbing strap which are woven from warp and weft yarns. As will be appreciated, the tensile strength of such safety belts is of primary importance, and so such belts are conventionally woven using relative heavy warp yarns which have a sufficiently high linear mass density to ensure adequate tensile strength in the finished belt.

[0003] Airbags typically supplement simple seat belt restraint mechanisms in order to provide additional protection to vehicle occupants in the event of a crash occurring. Whilst airbags have proliferated over recent years, and can now be very sophisticated and adaptable in order to optimize the supplementary protection that they offer in addition to that provided by a conventional seat belt, there can be some situations in which the level of protection offered to a vehicle occupant can be improved even further. For example, it can be difficult to provide an airbag which is suitably or reliably positioned to provide adequate protection to a rear seat passenger of a motor vehicle, due to the fact that the front seats of most vehicles configured to carry rear seat passengers are moveable in a fore-and-aft manner and/or in a tilting manner. In some vehicles the rear seats may also be moveable, which can also contribute to difficulties in reliably positioning a front-seat-mounted airbag to provide adequate protection for a rear seat passenger. Were a conventional airbag to be installed in the rear of a front seat of a vehicle, so as to deploy in front of a rear seat passenger sitting behind it, then the actual position of the airbag in front of the rear seat passenger can vary considerably depending on where the front and rear seats are actually positioned in relation to one another. This makes it extremely difficult to design and construct a suitable airbag for deployment from the front seat to reliably protect a rear seat passenger regardless of where the front seat is actually positioned.

[0004] It has therefore been proposed to provide safety belts which have their own integral airbags formed therein, in order to provide improved protection to vehicle occupants. Whilst such inflatable safety belts are envisaged to be particularly suitable for protecting rear seat passengers, their use is not limited solely to rear seat passengers, and they can also be used in combination with other separate airbag arrangements, either for front or rear seat passengers. Indeed, inflatable safety belts can be used much more widely than solely in motor vehicles.

[0005] Previously proposed inflatable safety belts of the type noted above are typically provided in the form

of an elongate woven tube, comprising both relatively heavy and thick yarns in a central region to provide similar tensile strength characteristics to conventional safety belts, and also relatively light and thin yarns to define a lighter weight and more flexible inflatable region of the belt. The inflatable region is thus defined by relatively lightweight woven fabric, which is folded inwardly between a pair of opposed and relatively heavy woven plies during normal use of the safety belt, but which expands therefrom upon inflation. An inflatable safety belt of this type is disclosed in CA2319832A.

[0006] WO0144547 discloses a device for producing a tubular belt band that can be turned inside out. The tubular belt band is suitable for inflatable auto safety belts. In the device and weaving process discussed in this document, the warp yarns are shed using a Jacquard machine.

[0007] However, inflatable safety belts of the type described above have been found to be difficult to weave in a reliable or convenient manner, due to the different weight and thickness of yarns involved, and the need to weave different features into various regions across the belts.

[0008] It is therefore an object of the present invention to provide an improved method of producing a woven elongate flexible tube, and in particular for use in producing an inflatable safety belt.

[0009] According to the present invention, there is provided a method of producing a woven elongate flexible tube suitable for use in producing an inflatable safety belt, the method involving the steps of: providing a plurality of yarns including at least one weft yarn and a plurality of warp yarns, said plurality of warp yarns including at least a first set of warp yarns and a second set of warp yarns, wherein the warp yarns of said first set have a higher linear mass density than the warp yarns of said second set; simultaneously weaving a pair of plies from said warp yarns in superimposed relation to one another and such that the plies become interwoven and interconnected by a pair of transversely spaced-apart and substantially longitudinally-extending woven seams between which said tube is defined, each said ply being woven from at least one said weft yarn and a plurality of said warp yarns drawn from both said first set and said second set; wherein said weaving involves: i) using warp yarns drawn solely from said first set to weave a central tensile load-bearing region of each said ply, located between said seams; and ii) using warp yarns drawn solely from said second set to weave side regions of each said ply located on opposite sides of said tensile load-bearing region; and wherein said weaving further involves a shedding process in which said warp yarns of said first set are shed via a first shedding mechanism, and said warp yarns of said second set are shed via a second shedding mechanism, said second shedding mechanism being a Jacquard mechanism.

[0010] Advantageously, said first and second shedding mechanisms are of different types or configurations

to one another.

[0011] Optionally, said method involves the use of a plurality of said weft yarns.

[0012] Preferably, said woven seams are woven from warp yarns drawn solely from said second set.

[0013] Conveniently, said first shedding mechanism may be a Dobby mechanism. However, it is envisaged that in some embodiments the first shedding mechanism may be a cam motion mechanism.

[0014] Conveniently, said Dobby mechanism comprises a plurality of first healds through which warp yarns of said first set pass, and said Jacquard mechanism comprises a plurality of second healds through which warp yarns of said second set pass, said first healds being arranged for movement at a different longitudinal position to said second healds, relative to a weaving direction in which said warp yarns are fed during said weaving.

[0015] Advantageously, said Dobby mechanism comprises a plurality of heald frames, each heald frame being operable independently to move a respective group of said first healds in synchronism.

[0016] Optionally, said Dobby mechanism comprises twelve heald frames.

[0017] Preferably, said first healds are located upstream of said second healds, relative to said weaving direction.

[0018] Conveniently, said heald frames are arranged for independent movement adjacent one another, and are all located behind said second healds of the Jacquard mechanism, relative to said weaving direction.

[0019] Advantageously, said shedding process involves the creation of a first shed amongst said first set of warp yarns using said non-Dobby mechanism, and a second shed amongst said second set of warp yarns using said Jacquard mechanism, wherein said first shed is larger than said second shed.

[0020] Optionally, said weaving involves a beating process which uses a graduated reed through which said warp yarns pass, said graduated reed comprising a plurality of spaced-apart dent wires and being configured so as to comprise: i) at least one coarse region in which said dent wires are arranged to define relatively large dents therebetween and through which warp yarns of said first set extend; and ii) fine regions in which said dent wires are arranged to define relatively small dents therebetween and through which warp yarns of said second set extend.

[0021] Preferably, said warp yarns are drawn from a plurality of beams.

[0022] Conveniently, the warp yarns of said first set may be drawn from a plurality of beams, and the warp yarns of said second set are drawn from at least one beam.

[0023] Advantageously, the warp yarns of said first set have a substantially equal linear mass density to one another, and the warp yarns of said second set have a substantially equal linear mass density to one another.

[0024] Preferably, the warp yarns of said first set have

a linear mass density in the range of 900 to 1100 dtex.

[0025] Conveniently, the warp yarns of the second set have a linear mass density in the range of 90 to 550 dtex.

[0026] Advantageously, the warp yarns of said second set have a linear mass density in the range of 200 to 300 dtex.

[0027] Optionally, the warp yarns of said second set have a linear mass density of approximately 160 dtex.

[0028] The method may involve a picking process which uses a double-rapier mechanism.

[0029] Preferably, the method may be configured to weave a plurality of said elongate flexible tubes substantially simultaneously; wherein a web of fabric is woven from said yarns; the web incorporating said plurality of tubes in adjacent and substantially parallel relationship to one another, each said tube being formed from a respective pair of said superimposed plies and between a respective pair of said woven seams; and the web comprising a respective region, located between each pair of adjacent tubes, which is woven from warp yarns drawn solely from said second set.

[0030] Conveniently, the or each said tube is woven such that said central tensile load-bearing regions of its constituent plies are substantially straight and of constant width, and such that its said woven seams diverge and converge at positions along its length so as to define at least one widened region of said tube which is wider than other parts of said tube.

[0031] Advantageously, each said tube is woven so as to comprise a plurality of said widened regions in longitudinally spaced-apart relation to one another, the web being woven such that the widened regions of each said tube are at least partially transversely overlapping and are longitudinally interdigitated with those of the or each adjacent tube.

[0032] So that the invention may be more readily understood, and so that further features thereof may be appreciated, embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view showing a length of an elongate flexible tube which may be woven via the method of the present invention, and which may be turned inside out to produce an inflatable safety belt;

Figure 2 is a transverse cross-sectional view through the flexible tube, taken along line II-II in figure 1;

Figure 3 is a schematic representation depicting the arrangement of yarns within the cross-section of the woven tube illustrated in figure 2;

Figure 4 is a transverse cross-sectional view through the flexible tube, similar to that of figure 2, but which is taken along line IV-IV in figure 1;

Figure 5 is a transverse cross-sectional view depicting the region of the flexible tube illustrated in figure 2 after it has been turned inside out in order to form a safety belt;

Figure 6 is a transverse cross-sectional view similar to that of figure 5, but which depicts the region of the flexible tube illustrated in figure 3 after it has been turned inside out to form a safety belt;

Figure 7 is a schematic illustration depicting four adjacent flexible tubes, of longer lengths than that shown in figure 1, with the tubes arranged in a nested array in which they may be woven as part of a larger woven web;

Figure 8 is a schematic side view showing an example power loom which may be used to implement the method of the present invention;

Figure 9 is a perspective view of the power loom, viewed from the opposite side to figure 8;

Figure 10 is a perspective view of the power loom, showing its reed and a plurality of harness cords and harness eyes which form part of a Jacquard mechanism and which are used to shed some of the warp yarns;

Figure 11 is a perspective view showing the ends of a plurality of heald frames which form part of a Dobby mechanism and which are used to shed other warp yarns;

Figure 12 is a perspective view showing a plurality of heald eyes which also form part of the Dobby mechanism;

Figure 13 is a perspective view showing the reed in greater detail;

Figure 14 is a perspective view showing part of a double-rapier weft yarn insertion device, and its associated yarn feeding arrangement;

Figure 15 is a perspective view showing another part of the double-rapier weft yarn insertion device;

Figure 16 is a perspective view showing the fabric edge region of a web of fabric which is woven by the power loom and which comprises a plurality of elongate flexible tubes in side-by-side relation to one another; and

Figure 17 illustrates a region of the woven web of fabric, comprising four elongate flexible tubes.

[0033] Turning now to consider the drawings in more

detail, figure 1 illustrates a length of an elongate flexible tube 1 of a type which may be woven via the method of the present invention. It is to be appreciated at the outset that the method of the present invention may be used to weave a tube which is considerably longer than the length illustrated in figure 1, which is simply intended to illustrate key features of the flexible tube 1 in a clear manner. Figure 2 illustrates the flexible tube 1 in transverse cross-section along line II-II denoted in figure 1, and figure 4 illustrates the flexible tube 1 in transverse cross-section along line IV-IV denoted in figure 1.

[0034] The flexible tube comprises an upper woven fabric ply 2 and a lower woven fabric ply 3. The two plies 2, 3 are arranged in superimposed relation to one another and are interwoven in their edge regions by a pair of transversely spaced-apart and substantially longitudinally-extending woven seams 4 which serve to interconnect the two plies 2, 3 to form the tube 1 therebetween. The woven seams 4 thus serve to define opposite edges of the tube 1. Within the woven seams 4, yarns of the two plies 2, 3 are interwoven via a one-piece weaving technique which is known *per-se*.

[0035] It will be noted that in the arrangement illustrated in figure 1, the woven seams 4 diverge at a first longitudinal position along the tube 1, and converge at second longitudinal position, so as to thereby form a pair of opposed wings 5 which define a widened region of the tube 1. Each wing 5 is located on the opposite side of a generally straight central region 6 of the tube 1. As will be understood from figure 4 in particular, in the region of the tube 1 comprising the wings 5, the wings 5 actually form regions of the two plies 2, 3 between which the tube is defined.

[0036] Turning now to consider figure 2, the tube 1 is woven from a plurality of warp yarns 7 and a plurality of weft yarns 8. The warp yarns 7 comprise two distinct types, namely a first set of warp yarns 7a and a second set of warp yarns 7b. The warp yarns 7a of the first set have a higher linear mass density than the warp yarns 7b of the second set, and are thus thicker and heavier than the warp yarns 7b of the second set. As will be noted from figure 3, which denotes the different types of warp yarns 7 in the transverse cross-section II-II illustrated in figure 2 (i.e. through a relatively narrow region of the tube 1 not having wings 5), warp yarns 7a of the first set are used in transversely central regions of the two plies 2, 3, and warp yarns 7b of the second set are used in the woven edge seams 4.

[0037] In widened regions of the tube 1 having the wings 5 (such as at the transverse cross-section IV-IV), then it is to be appreciated that the wings 5 are woven from warp yarns 7b of the second set (i.e. those having a relatively low linear mass density), whilst the warp yarns 7a of the first set continue to run through central regions of the two plies 2, 3.

[0038] The above-mentioned distribution of warp yarns 7 from the first and second sets, across the width of the tube 1, results in the two plies 2, 3 each comprising a

relatively thick and heavy central region 6, and relatively thin and lightweight side regions comprising the interconnecting woven seams 4 and the wings 5. This allows the central regions 6 of the plies 2, 3 to serve a tensile load-bearing function in the finished safety belt, and allows the wings 5 to be more flexible and to define a lightweight inflatable region of the finished safety belt, as will become clear hereinafter.

[0039] It is envisaged that in embodiments of the present invention, the first set of warp yarns 7a will all be identical and will thus have a substantially equal linear mass density to one another, which may be in the range of 900 to 1100 dtex. The second set of warp yarns 7b may also all be identical to one another, so as to have a substantially equal linear mass density to one another, and which may be in the range of 90 to 550 dtex, optionally 200 to 300 dtex. In particular embodiments it is envisaged that the linear mass density of the warp yarns 7b of the second set may be approximately 160 dtex.

[0040] It is envisaged that the weft yarns 8 may have similar characteristics to the warp yarns 7b of the second set, and may thus have a linear mass density in the range of 90 to 550 dtex, optionally 200 to 300 dtex, and in some embodiments approximately 160 dtex. In this regard, it will of course be appreciated that the main tensile strength requirements of safety belts are longitudinal, with transverse tensile strength being of considerably less importance.

[0041] It is envisaged that all of the yarns 7, 8 may be formed from polyethylene terephthalate (PET).

[0042] The two plies 2, 3 may be interconnected by additional stitched tear-seams 9 along respective opposed edges of their central regions 6.

[0043] When the flexible tube 1 has been woven via the method of the present invention, so as to have the above-described construction, it may be turned inside out in order to form a finished safety belt 10. Figures 5 and 6 illustrated transverse cross-sections of the tube 1 after it has been turned inside out, with figure 5 illustrating the region of the tube 1 denoted at line II-II in figure 1, and figure 6 illustrating the widened region of the tube 1 denoted at line IV-IV in figure 1. As illustrated in figure 5, the process of turning the tube 1 inside out serves to pull the woven interconnecting side seams 4 of the tube inside the tube. This serves to provide a neat edge profile to the finished safety belt 10, whilst the use of the relatively lightweight and thin warp yarns 7b to form the edge seams 4 provides relatively soft edges 11 to the resulting safety belt 10. As will be noted from figure 5, the central regions 6 of the two plies 2, 3 extend substantially the width of the safety belt 10, with a cavity 12 being defined therebetween.

[0044] Having regard to figure 6, then it is to be appreciated that as the tube 1 is turned inside out, the outwardly extending wings 5 of the tube 1 are also pulled inside the tube 1. It is proposed that the wing regions 5 of the two plies 2, 3 will be folded as illustrated in figure 6, to ensure that the resulting safety belt 10 is as thin as practicable,

which is helpful in ensuring that the safety belt may be wound onto a retractor reel in a neat and space-efficient manner.

[0045] Upon injection of a large volume of inflating gas into the cavity 12 of the safety belt 10, for example from an inflator of type known *per se*, the cavity 12 will be caused to expand. In the region of the safety belt 10 comprising the folded wings 5, the flow of inflating gas will serve to expand the wings 5, breaking the tear seams 9, such that the wings 5 will inflate outwardly from opposite sides of the safety belt 10, thereby forming an inflated airbag at an appropriate position along the safety belt 10.

[0046] Turning now to consider figure 7, there is illustrated a length of an elongate web of fabric 13 which may be woven via the method of the present invention, and which incorporates a plurality of the above-described elongate flexible tubes 1 formed in adjacent and substantially parallel relationship to one another. The specific web 13 illustrated incorporates four tubes 1, although it is to be appreciated that more or fewer tubes 1 could be formed within the web 13 without departing from the scope of the present invention.

[0047] As will be noted, each of the flexible tubes 1 illustrated in figure 7 has more than one widened region 14 comprising the above-described wings 5. It is furthermore to be appreciated that figure 7 only illustrates a short length of the web 13, comprising two such widened regions 14 of each tube 1. In practice, it is envisaged that the web 13 will be woven in a continuous manner so as to be of very significant length, and will incorporate a plurality of flexible tubes 1 with each tube having a large number of widened regions 14 formed at longitudinally spaced-apart positions along its length. It is also to be appreciated, that in practice each tube 1 will have its widened regions 14 formed at a much greater longitudinal spacing from one another than illustrated in figure 7. Figure 7 is thus not to scale and is provided for illustrative purposes only.

[0048] Figure 7 furthermore illustrates how adjacent flexible tubes 1 may be nested against one another, so as to maximise the number of tubes 1 that may be formed across the width of the web 13. As will be noted, the widened regions 14 of each tube are formed so as to be at least partially transversely overlapping and are longitudinally interdigitated with those of the or each adjacent tube 1.

[0049] The web 13 may be woven on a special power loom which is configured to weave the adjacent flexible tubes 1 simultaneously, and also to weave the respective plies 2, 3 of each tube 1 simultaneously. Each of the tubes 1 is woven so as to have the characteristics described above, and so the web 13 will be woven using warp yarns drawn from both said first set of warp yarns 7a and said second set of warp yarns 7b. Side regions 15 of the web 13, and regions 16 of the web located between each pair of adjacent tubes 1 are woven from warp yarns drawn solely from the second set of warp yarns 7b, and may either be woven as two discrete and

superimposed layers, or may be woven via a similar one-piece weaving technique to that used to create the woven seams 4 of the tubes 1, in which case the regions 15, 16 will be formed as single layer of fabric. In the case that the regions 15, 16 are woven as discrete layers, then each layer will be substantially identical to the fabric of the wings 5 defining the widened regions 14 of each tube 1. On the other hand, if the regions 15, 16 are woven as single layer of fabric, then they will be substantially identical to the woven seams 14 defining the edges of the tubes 1.

[0050] It is proposed that after the web 13 has been woven via the method of the present invention, the individual tubes 1 will be cut from the web, by creating cuts through the fabric of the web along the woven edges 4 of the tubes. At that stage of the production process each tube 1 will thus comprise a plurality of widened regions 14 at spaced-apart positions along its length. Each tube 1 may thus be used to produce a plurality of inflatable safety belts, as it is envisaged that each safety belt will require only one widened region 14 to define a single inflatable region of the belt. The tubes 1 may thus each be cut into a plurality of smaller lengths, with the dashed lines 17 in figure 7 denoting appropriate cut lines. Each cut line 17 is located between successive widened regions 14 along the length of the tube 1. Thereafter, the resulting shorter lengths of tube may be turned inside out to form respective safety belts 10 as described above.

[0051] Figure 8 is a schematic illustration showing the primary features of a power loom 18 which is specifically configured to implement the method of the present invention. In overview, the warp yarns 7 are drawn into the mechanism of the loom 18 from a plurality of warp beams 19 at the rear of the loom on which the yarns are initially wound, and are then drawn through a shedding system 20, and subsequently through a beating mechanism 21. The weft yarns 8 are inserted via a weft insertion mechanism (not shown in figure 8), and the resulting woven web 13 is then taken up on a fabric beam 22 at the front of the loom 18.

[0052] Figure 9 is a perspective view from the rear of the loom 18, and from the opposite side to that illustrated in figure 8, and illustrates a possible arrangement of the warp beams 19. The plurality of warp beams 19 comprises a pair of primary first warp beams 19a, and a single second warp beam 19b which is located closer to the mechanism of the loom, and thus in front of the two first warp beams 19a. The two first warp beams 19a are wound with a plurality of the first (relatively high linear mass density) warp threads 7a, and the second warp beam 19b is wound with a plurality of the second (relatively low linear mass density) warp threads 7b.

[0053] The plurality of warp beams 19 may further comprise one or more smaller secondary warp beams 19c, each of which may be wound with warp yarns 7 of a slightly different characteristics to those wound on the primary beams 19a, 19b. For example, the or each secondary warp beams 19c may be wound with warp yarns of slightly

lower linear mass density than the aforementioned first warp yarns 7a, but somewhat higher than that of the aforementioned second warp yarns 7b, and may be used to form relatively soft edges to the central regions 6 of the two plies 2, 3 of each tube 1. As will therefore be appreciated, the provision of a plurality of beams 19 allows the convenient supply of various different types of warp yarns to the loom 18. Nevertheless, in some embodiments it is envisaged that one or more of the primary beams 19a, 19b, 19c may be wound with more than one different type of warp yarn 7, even if differing only in colour, in which case the relevant beam may be provided with one or more flanges along its length to separate the different types of warp yarn 7.

[0054] Returning now to consider figure 8, the shedding system 20 is configured and operable to create a shed 23 in the warp yarns 7, as will be understood by those of skill in the art. The shed 23 is created by selectively lifting the warp yarns 7 in a predetermined manner so as to create a desired pattern in the weave of the fabric of the web 13. As will also be appreciated, the desired pattern for the central tensile load-bearing regions 6 of the plies 2, 3 of each tube will be different to the desired pattern for the more flexible wings 5 of the plies, and also different to the desired pattern for the woven edge seams 4 and the web regions 15, 16 adjacent and between the tubes 1. To achieve these various different desired patterns, the shedding system 20 is computer-controlled via an electronic control unit 24. As will be explained in more detail below, the shedding system 20 furthermore comprises a first shedding mechanism 25 which is configured to lift the warp yarns 7a of the first set, and a second shedding mechanism 26 which is configured to lift the warp yarns 7b of the second set. The first and second shedding mechanisms 25, 26 are of different types/configurations to one another, and in the particular power loom 18 illustrated; the first shedding mechanism 25 is provided in the form of a Dobby mechanism, and the second shedding mechanism 26 is provided in the form of a Jacquard mechanism, both of which will be understood by those of skill in the art, and both of which are independently controlled by the electronic control unit 24. However, it is envisaged that in some embodiments the Dobby mechanism 25 could be substituted by another type of (non-Jacquard) shedding mechanism such as, for example, a cam motion mechanism of a type understood by those of skill in the art.

[0055] The Dobby mechanism 25 comprises a plurality of heald frames 27, of which only one is illustrated schematically in figure 8 for the sake of simplicity. Each heald frame 27 supports a plurality of first healds 28 which hang downwardly from the heald frame 27 and which each have an eye 29 at their lowermost end through which a respective warp yarn 7a of the first set passes, as shown most clearly in figure 12. The heald frames 27 are arranged adjacent one another in an array, and are independently vertically moveable in respective guides 30 at the sides of the loom 18, as shown most clearly in figure

11, under the control of the electronic control unit 24. The particular loom 18 illustrated is equipped with twelve heald frames 27, but as will be noted from figure 11, the loom 18 has some vacant guides 30 and so could be equipped with more heald frames 27 in other embodiments. Indeed, fewer than twelve heald frames 27 could also be used in some embodiments.

[0056] The Jacquard mechanism comprises a large number of harness chords 31, each of which is connected to a respective second heald 32 at its lowermost end. The second healds 32 each have an eye 33 formed at their lowermost ends, through which respective warp yarns 7b of the second set pass, as illustrated most clearly in figure 10.

[0057] As illustrated most clearly in figure 8, but which will also be noted from figures 10 and 12 which are views from the front of the loom 18, the heald frames 27 of the Dobby mechanism 25 are located upstream of the harness cords 31 of the Jacquard mechanism 26, relative to the weaving direction of the loom indicated by arrow D in figure 8. This means that the first healds 28 are all located upstream of the second healds 32. Accordingly, the Dobby mechanism 25 is operable to lift warp yarns 7a of the first set to a greater height than to which the Jacquard mechanism 26 lifts the warp yarns 7b of the second set, such that a first shed is created amongst said first set of yarns 7a which is larger than a second shed which is created amongst said second set of yarns 7b. This is to ensure that the sheds are both sufficiently large in their forwardmost regions to permit the weft yarns 8 to be inserted cleanly by the weft insertion mechanism.

[0058] Having particular regard to figure 10, it will be noted that the harness cords 31, and their associated second healds 32, of the Jacquard mechanism are arranged in groups which are spaced apart across the width of the loom 18. Similarly, the first healds 28 of the Dobby mechanism 25 are arranged in groups, the groups of first healds 28 being located between the groups of second healds 32. As will also be appreciated, the yarns 7a of the first set are arranged in groups corresponding to the positions of the first healds 28 of the Dobby mechanism 25, whilst the yarns 7b of the second set are arranged therebetween in groups corresponding to the positions of the second healds 32 of the Jacquard mechanism 26.

[0059] By virtue of the above-described relative configurations of the Dobby and Jacquard mechanisms, the Dobby mechanism 25 may be used to create the shed 23 amongst the relatively thick and heavy warp yarns 7a of the first set, whilst the Jacquard mechanism 26 may be used to create the shed 23 amongst the relatively thin and lightweight warp yarns 7b of the second set. This relative operation of the two mechanisms provides significant benefits to the weaving process for forming the tubes 1 in the web 13 of fabric. The Dobby mechanism 25 is well suited to shedding the relatively heavy yarns 7a of the first set, in regions of the web 13 defining the central tensile load-bearing regions 6 of the plies 2, 3, for which relatively simple and regular weave patterns

are considered preferable in terms of the desired properties of a finished safety belt 10. However, the Dobby mechanism 25 is not suited to shedding the relatively light yarns 7b of the second set in regions of the web where the more flexible wings 5 of the plies and the interconnecting woven seams 4 are formed. This is because more complicated weave patterns are required in order reliably to form the interconnected woven seams 4 (which of course serve to interconnect the plies 2, 3 of each tube); not only due to the requirement to implicate warps yarns from both plies 2, 3 into the woven seams 4, but also do the need to weave the seams 4 so that they have regions which extend diagonally across the web 13 to define the diverging and converging edges of the wings 5.

[0060] As illustrated in figure 8, the beating mechanism 21 comprises a reed 34 which extends across the width of the loom 18 and which moved by the mechanism between a rearward position (illustrated) to facilitate insertion of the weft yarn 8 through the shed 23, and a forward position in which it urges the last inserted length of weft yarn 8 against the fell 35 of the web 13. As illustrated most clearly in figure 13, the reed 34 comprises a plurality of spaced-apart dent wires 36 between which there are defined dents 37 through which the warp yarns 7 pass. It is to be noted, however, that the reed 34 is actually graduated in the sense that it comprises coarse regions 38 (only one illustrated in figure 13) in which the dent wires 36 are relatively widely spaced-apart so as to define relatively large dents 37 therebetween, and fine regions 39 in which the dent wires 36 are relatively closely spaced-apart so as to define relatively small dents 37 therebetween. The coarse regions 38 of the reed 34 are transversely aligned with the groups of first healds 28 of the Dobby mechanism 25, whilst the fine regions are transversely aligned with the groups of second healds 32 of the Jacquard mechanism. The coarse regions 38 of the reed 34 are thus arranged to receive yarns 7a of the first set through their dents 37, and the fine regions 39 are arranged to receive yarns 7b of the second set through their dents 37. As will thus be appreciated, the graduated reed 34 is thereby specifically configured to move reliably through the warp yarns of both sets, and to neatly beat the weft yarns 8 against the fell 35.

[0061] Figure 14 illustrates part of a weft insertion mechanism 40 which is suitable for use in the present invention. It is to be appreciated, however, that alternative types of weft insertion mechanism could be used instead. The specific weft insertion mechanism 40 illustrated is configured to insert two identical weft yarns 8 simultaneously, and thus comprises a pair of weft yarn packages 41 (only one being shown) in the form of reels of identical yarn. The two weft yarns 8 extend from their respective yarn packages 41 and into respective weft accumulators 42, each of which has a weft feeder 43 which presents the respective weft yarn 8 to a first rapier (not shown in figure 14). The rapier is configured and operable, under the control of the electronic control unit

24, to collect the two weft yarns 8 from one side of the loom 18 and then move rapidly across the loom, through the shed 23 created amongst the warp yarns 7 by the Dobby and Jacquard mechanisms, and between the reed 34 and the fabric edge 35.

[0062] Figure 15 shows a rapier 44, which also forms part of the weft insertion mechanism 40 but which is initially located on the opposite side of the loom. As will be appreciated by those of skill in the art, when the reed 34 is located in its rearmost position as shown in figure 8, the two rapiers simultaneously move through the shed 23 towards one another. The first rapier which is initially located adjacent the weft feeders 43 carries the two weft yarns 8 towards the second rapier 44, and when the two rapiers meet in a transversely central region of the loom, the second rapier collects the two weft yarns 8 from the first rapier. Thereafter the two rapiers return to their outward positions by moving rapidly apart from one another, and in so doing the second rapier carries the two weft yarns 8 the rest of the way through the shed 23, thereby completing a pick. The beating mechanism 21 then operates to move the reed 34 forwards so that it beats the just inserted length of the two weft yarns 8 against the fell 35, and then backwards so that it returns to its rearmost position illustrated in figure 8 to permit the two rapiers then to move towards one another; this time the second rapier carrying the two weft yarns 8 through the first part of the shed 23 before passing them on to the first rapier which then carries the weft yarns 8 through the rest of the shed 23 as the rapiers then move apart again, thereby completing another pick.

[0063] It is preferred to weave the web 13 comprising the tubes 1 in the manner described above, by inserting two identical weft yarns 8 because this has been found to create safety belts 10 having a flat appearance and very good haptic properties, as well as being very flexible and thus susceptible to convenient winding on a seatbelt reel. Another advantage which the inventors have found from using two weft yarns 8 is that a weave resulting from inserting two relatively thin weft yarns 8 (for example 160 dtex) is more susceptible to the creation of tight folds in the wings 5 of the plies 2, 3, than if a single weft yarn 8 (for example 340 dtex) were to be used. This is significant, because of course the wings 8 will define the widened inflatable regions of the finished safety belts 10 and must be capable of being tightly folded between the central regions 6 of the two plies 2, 3 when the flexible tube 1 is turned inside out to form the safety belt 10. It is to be appreciated, however, the insertion process of the present invention could nevertheless involve the insertion of just a single weft yarn 8, or indeed in other embodiments could involve the insertion of more than two weft yarns 8.

[0064] Figure 16 illustrates the fell region of a web 13 being woven via the method of the present invention, and which comprises a large number of flexible tubes 1. The central regions 6 of the uppermost plies 2 of each tube are clearly visible, as indeed are the woven edge seams

4. Figure 17 illustrates a region of a web 13 after it has been removed from the loom 18, and which incorporates two pairs of flexible tubes 1 ready to be cut from the web in the manner described above.

5 **[0065]** When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or integers.

10 **[0066]** The features disclosed in the foregoing description, or in the following claims, or in the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for obtaining the disclosed results, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof within the scope of independent claim 1. While the invention has been described in conjunction with the exemplary embodiments described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure. Accordingly, the exemplary embodiments of the invention set forth above are considered to be illustrative and not limiting.

Claims

1. A method of producing a woven elongate flexible tube (1) suitable for use in producing an inflatable safety belt (1), the method involving the steps of: providing a plurality of yarns including at least one weft yarn (8) and a plurality of warp yarns (7), said plurality of warp yarns (7) including at least a first set of warp yarns (7a) and a second set of warp yarns (7b), wherein the warp yarns (7a) of said first set have a higher linear mass density than the warp yarns (7b) of said second set; simultaneously weaving a pair of plies (2,3) from said yarns (7, 8) in superimposed relation to one another and such that the plies (2,3) become interwoven and interconnected by a pair of transversely spaced-apart and substantially longitudinally-extending woven seams (4) between which said tube (1) is defined, each said ply (2,3) being woven from at least one said weft yarn (8) and a plurality of said warp yarns (7) drawn from both said first set (7a) and said second set (7b); wherein said weaving involves: i) using warp yarns drawn solely from said first set (7a) to weave a central tensile load-bearing region (6) of each said ply (2,3), located between said seams (4); and ii) using warp yarns drawn solely from said second set (7b) to weave side regions (5) of each said ply (2,3) located on opposite sides of said tensile load-bearing region (6); and **characterised in that:** said weaving further involves a shedding process in which said warp yarns of said first set (7a) are shed via a first shedding mechanism (25), and said warp

yarns of said second set (7b) are shed via a second shedding mechanism (26), said second shedding mechanism (26) being a Jacquard mechanism

2. A method according to claim 1, wherein said woven seams (4) are woven from warp yarns drawn solely from said second set (7b). 5
3. A method according to claim 1 or claim 2, wherein said first mechanism (25) is a Dobby mechanism. 10
4. A method according to claim 3, in which said Dobby mechanism (25) comprises a plurality of first healds (28) through which warp yarns of said first set (7a) pass, and said Jacquard mechanism (26) comprises a plurality of second healds (32) through which warp yarns of said second set (7b) pass, said first healds (28) being arranged for movement at a different longitudinal position to said second healds (32), relative to a weaving direction (D) in which said warp yarns (7) are fed during said weaving. 15 20
5. A method according to claim 4, wherein said Dobby mechanism (25) comprises a plurality of heald frames (27), each heald frame (27) being operable independently to move a respective group of said first healds (28) in synchronism. 25
6. A method according to claim 5, wherein said Dobby mechanism (25) comprises twelve heald frames (27). 30
7. A method according to any one of claims 4 to 6, wherein said first healds (28) are located upstream of said second healds (32), relative to said weaving direction (D). 35
8. A method according to any one of claims 5 to 7, wherein said heald frames (27) are arranged for independent movement adjacent one another, and are all located behind said second healds (32) of the Jacquard mechanism (26), relative to said weaving direction (D). 40
9. A method according to any preceding claim, in which said shedding process involves the creation of a first shed (23) amongst said first set of warp yarns (7a) using said non-Jacquard mechanism (25), and a second shed (23) amongst said second set of warp yarns (7b) using said Jacquard mechanism (26), wherein said first shed is larger than said second shed. 45 50
10. A method according to any preceding claim, in which said weaving involves a beating process which uses a graduated reed (34) through which said warp yarns (7) pass, said graduated reed (34) comprising a plurality of spaced-apart dent wires (36) and being con-

figured so as to comprise: i) at least one coarse region (38) in which said dent wires (36) are arranged to define relatively large dents (37) therebetween and through which warp yarns of said first set (7a) extend; and ii) fine regions (39) in which said dent wires (36) are arranged to define relatively small dents (37) therebetween and through which warp yarns of said second set (7b) extend.

11. A method according to any preceding claim, wherein said warp yarns (7) are drawn from a plurality of beams (19). 10
12. A method according to claim 11, wherein the warp yarns of said first set (7a) are drawn from a plurality of beams (19a), and the warp yarns (7b) of said second set are drawn from at least one beam (19b). 15
13. A method according to any preceding claim, wherein the warp yarns of said first set (7a) have a substantially equal linear mass density to one another, and the warp yarns of said second set (7b) have a substantially equal linear mass density to one another. 20
14. A method according to any preceding claim, the method being configured to weave a plurality of said elongate flexible tubes (1) substantially simultaneously; wherein a web (13) of fabric is woven from said yarns (7,8); the web (13) incorporating said plurality of tubes (1) in adjacent and substantially parallel relationship to one another, each said tube (1) being formed from a respective pair of said superimposed plies (2,3) and between a respective pair of said woven seams (4); and the web (13) comprising a respective region (16), located between each pair of adjacent tubes (1), which is woven from warp yarns drawn solely from said second set (7b). 25 30 35
15. A method according to any preceding claim, wherein the or each said tube (1) is woven such that said central tensile load-bearing regions (6) of its constituent plies (2,3) are substantially straight and of constant width, and such that its said woven seams (4) diverge and converge at positions along its length so as to define at least one widened region (14) of said tube (1) which is wider than other parts of said tube (1). 40 45
16. A method according to claim 15, as dependent upon claim 14, wherein each said tube (1) is woven so as to comprise a plurality of said widened regions (14) in longitudinally spaced-apart relation to one another, the web (13) being woven such that the widened regions (14) of each said tube (1) are at least partially transversely overlapping and are longitudinally interdigitated with those of the or each adjacent tube (1). 50 55

Patentansprüche

1. Verfahren zum Herstellen eines gewebten länglichen flexiblen Schlauchs (1), der zur Verwendung beim Herstellen eines aufblasbaren Sicherheitsgurts (1) geeignet ist, wobei das Verfahren die folgenden Schritte beinhaltet: Bereitstellen mehrerer Fäden, die wenigstens einen Schussfaden (8) und mehrere Kettfäden (7) beinhalten, wobei die mehreren Kettfäden (7) wenigstens einen ersten Satz von Kettfäden (7a) und einen zweiten Satz von Kettfäden (7b) beinhalten, wobei die Kettfäden (7a) des ersten Satzes eine höhere lineare Massendichte als die Kettfäden (7b) des zweiten Satzes aufweisen; gleichzeitiges Weben eines Paares von Lagen (2,3) aus den Fäden (7, 8) in übereinanderliegender Beziehung zueinander und derart, dass die Lagen (2,3) durch ein Paar von quer beabstandeten und im Wesentlichen in Längsrichtung erstreckten gewobenen Nähten (4), zwischen denen der Schlauch (1) definiert ist, miteinander verwoben und verbunden werden, wobei jede Lage (2,3) aus wenigstens einem der Schussfäden (8) und mehreren der Kettfäden (7), die sowohl aus dem ersten Satz (7a) und dem zweiten Satz (7b) gezogen werden, gewebt ist; wobei das Weben Folgendes einschließt: i) Verwenden von Kettfäden, die ausschließlich aus dem ersten Satz (7a) gezogen werden, um einen zentralen zugbelastbaren lasttragenden Bereich (6) jeder Lage (2,3), der sich zwischen den Nähten (4) befindet, zu weben; und ii) Verwenden von Kettfäden, die ausschließlich aus dem zweiten Satz (7b) gezogen wurden, um Seitenbereiche (5) jeder Lage (2,3), die sich auf gegenüberliegenden Seiten des ausziehbaren tragenden Bereichs (6) befinden, zu weben; und **dadurch gekennzeichnet, dass:** das Weben ferner einen Fachbildungsvorgang, in dem die Kettfäden des ersten Satzes (7a) über einen ersten Fachbildungsmechanismus (25) fachbildend behandelt werden, und die Kettfäden des zweiten Satzes (7b) über einen zweiten Fachbildungsmechanismus (26) fachbildend behandelt werden, einschließt, wobei der zweite Fachbildungsmechanismus (26) ein Jacquardmechanismus ist
2. Verfahren nach Anspruch 1, wobei die gewebten Nähte (4) aus Kettfäden gewebt sind, die ausschließlich aus dem zweiten Satz (7b) gezogen wurden.
3. Verfahren nach Anspruch 1 oder 2, wobei der erste Mechanismus (25) ein Schaftmechanismus ist.
4. Verfahren nach Anspruch 3, in dem der Schaftmechanismus (25) mehrere erste Litzen (28), durch die Kettfäden des ersten Satzes (7a) laufen, umfasst und der Jacquardmechanismus (26) mehrere zweite Litzen (32), durch die Kettfäden des zweiten Satzes (7b) laufen, umfasst, wobei die ersten Litzen (28) für eine Bewegung in einer anderen Längsposition als die zweiten Litzen (32), relativ zu einer Webrichtung (D), in der die Kettfäden (7) während des Webens zugeführt werden, angeordnet sind.
5. Verfahren nach Anspruch 4, wobei der Schaftmechanismus (25) mehrere Litzrahmen (27) umfasst, wobei jeder Litzrahmen (27) unabhängig voneinander betriebsfähig ist, um eine jeweilige Gruppe der ersten Litzen (28) synchron zu bewegen.
6. Verfahren nach Anspruch 5, wobei der Schaftmechanismus (25) zwölf Litzrahmen (27) umfasst.
7. Verfahren nach einem der Ansprüche 4 bis 6, wobei sich die ersten Litzen (28), relativ zu der Webrichtung (D), stromaufwärts von den zweiten Litzen (32) befinden.
8. Verfahren nach einem der Ansprüche 5 bis 7, wobei die Litzrahmen (27) für die unabhängige Bewegung angrenzend angeordnet sind, und sich alle hinter den zweiten Litzen (32) des Jacquardmechanismus (26), relativ zu der Webrichtung (D), befinden.
9. Verfahren nach einem der vorhergehenden Ansprüche, in dem der Fachbildungsvorgang die Erzeugung eines ersten Fachs (23) unter dem ersten Satz von Kettfäden (7a) unter Verwendung des Nicht-Jacquardmechanismus (25), und eines zweiten Fachs (23) unter dem zweiten Satz von Kettfäden (7b) unter Verwendung der Jacquardmechanismus (26) beinhaltet, wobei das erste Fach größer als das zweite Fach ist.
10. Verfahren nach einem der vorhergehenden Ansprüche, in dem das Weben einen Schlagvorgang, der ein abgestuftes Riet (34) verwendet, durch das die Kettfäden (7) laufen, beinhaltet, wobei das abgestufte Riet (34) mehrere voneinander beabstandete Kerbendrähthe umfasst (36) und konfiguriert ist, um Folgendes zu umfassen: i) wenigstens einen groben Bereich (38), in dem die Kerbendrähthe (36) angeordnet sind, um relativ große Kerben (37) dazwischen zu definieren, und durch den sich Kettfäden des ersten Satzes (7a) erstrecken; und ii) feine Bereiche (39), in denen die Kerbendrähthe (36) angeordnet sind, um relativ kleine Kerben (37) dazwischen zu definieren, und durch die sich Kettfäden des zweiten Satzes (7b) erstrecken.
11. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Kettfäden (7) aus mehreren Webbäumen (19) gezogen werden.
12. Verfahren nach Anspruch 11, wobei die Kettfäden des ersten Satzes (7a) aus mehreren Webbäumen

(19a) gezogen werden, und die Kettfäden (7b) des zweiten Satzes aus wenigstens einem Webbaum (19b) gezogen werden.

13. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Kettfäden des ersten Satzes (7a) eine im Wesentlichen gleiche lineare Massendichte zueinander aufweisen, und die Kettfäden des zweiten Satzes (7b) eine im Wesentlichen gleiche lineare Massendichte zueinander aufweisen. 5 10
14. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Verfahren konfiguriert ist, um mehrere der länglichen flexiblen Schläuche (1) im Wesentlichen gleichzeitig zu weben; wobei eine Stoffbahn (13) aus den Fäden (7,8) gewebt ist; wobei die Bahn (13) die mehreren Schläuche (1) in angrenzender und im Wesentlichen paralleler Beziehung zueinander enthält, wobei jeder Schlauch (1) aus einem jeweiligen Paar der überlagerten Lagen (2,3) und zwischen einem jeweiligen Paar der gewebten Nähten (4) ausgebildet ist; und wobei die Bahn (13) einen jeweiligen Bereich (16), der sich zwischen jedem Paar angrenzender Schläuche (1) befindet, der aus Kettfäden gewebt ist, die ausschließlich aus dem zweiten Satz (7b) gezogen werden, umfasst. 15 20 25
15. Verfahren nach einem der vorhergehenden Ansprüche, wobei der oder jeder der Schläuche (1) derart gewebt ist, dass die zentralen zugbelastbaren lasttragenden Bereiche (6) seiner einzelnen Lagen (2,3) im Wesentlichen gerade und von konstanter Breite sind, und derart, dass seine gewebten Nähte (4) an Positionen entlang seiner Länge divergieren und konvergieren, um wenigstens einen verbreiterten Bereich (14) des Schlauchs (1), der breiter als andere Teile des Schlauchs (1) ist, zu definieren. 30 35
16. Verfahren nach Anspruch 15, abhängig von Anspruch 14, wobei jeder Schlauch (1) gewebt ist, um mehrere der verbreiterten Bereiche (14) in einem in Längsrichtung voneinander beabstandeten Verhältnis zueinander umfasst, wobei die Bahn (13) derart gewebt wird, dass die verbreiterten Bereiche (14) jedes Schlauchs (1) wenigstens teilweise quer überlappen und mit denen des oder jedes benachbarten Schlauchs (1) in Längsrichtung miteinander verflochten sind. 40 45 50

Revendications

1. Procédé de production d'un tube (1) flexible allongé tissé adapté pour être utilisé dans la production d'une ceinture de sécurité gonflable (1), le procédé impliquant les étapes de : 55
fourniture d'une pluralité de fils comportant au moins un fil de trame (8) et une pluralité de fils de chaîne

(7), ladite pluralité de fils de chaîne (7) comportant au moins un premier ensemble de fils de chaîne (7a) et un second ensemble de fils de chaîne (7b), les fils de chaîne (7a) dudit premier ensemble ayant une densité de masse linéaire plus élevée que les fils de chaîne (7b) dudit second ensemble ; tissage simultané d'une paire de brins (2, 3) à partir desdits fils (7, 8) en relation superposée les uns aux autres et de telle sorte que les brins (2, 3) deviennent entrelacés et reliés entre eux par une paire de coutures (4) tissées transversalement espacées et sensiblement étendues longitudinalement entre lesquelles ledit tube (1) est défini, chaque dit brin (2, 3) étant tissé à partir d'au moins un dit fil de trame (8) et d'une pluralité desdits fils de chaîne (7) tirés des deux dit premier ensemble (7a) et dit second ensemble (7b) ; ledit tissage impliquant : i) l'utilisation des fils de chaîne tirés uniquement dudit premier ensemble (7a) pour tisser une région porteuse (6) de traction centrale de chacun desdits brins (2, 3), située entre lesdites coutures (4) ; et ii) l'utilisation des fils de chaîne tirés uniquement dudit second ensemble (7b) pour tisser des régions latérales (5) de chaque dit brin (2, 3) situées sur des côtés opposés de ladite région porteuse (6) de traction ; et **caractérisé en ce que** :

ledit tissage implique en outre un processus de levée des fils de chaîne dans lequel lesdits fils de chaîne dudit premier ensemble (7a) sont levés par l'intermédiaire d'un premier mécanisme de levée des fils de chaîne (25), et lesdits fils de chaîne dudit second ensemble (7b) sont levés par l'intermédiaire d'un second mécanisme de levée des fils de chaîne (26), ledit second mécanisme de levée des fils de chaîne (26) étant une mécanique Jacquard.

2. Procédé selon la revendication 1, lesdites coutures (4) tissées étant tissées à partir de fils de chaîne tirés uniquement dudit second ensemble (7b).
3. Procédé selon la revendication 1 ou la revendication 2, ledit premier mécanisme (25) étant une ratière.
4. Procédé selon la revendication 3, dans lequel ladite ratière (25) comprend une pluralité de premières lisses (28) à travers lesquelles passent les fils de chaîne dudit premier ensemble (7a), et ladite mécanique Jacquard (26) comprend une pluralité de secondes lisses (32) à travers lesquelles passent les fils de chaîne dudit second ensemble (7b), lesdites premières lisses (28) étant agencées pour se déplacer dans une position longitudinale différente desdites secondes lisses (32), par rapport à une direction (D) de tissage dans laquelle lesdits fils de chaîne (7) sont alimentés pendant ledit tissage.
5. Procédé selon la revendication 4, ladite ratière (25) comprenant une pluralité de cadres (27) de lisses,

chaque cadre (27) de lisses pouvant fonctionner indépendamment pour déplacer un groupe respectif desdites premières lisses (28) en synchronisme.

6. Procédé selon la revendication 5, ladite ratière (25) comprenant douze cadres (27) de lisses. 5
7. Procédé selon l'une quelconque des revendications 4 à 6, lesdites premières lisses (28) étant situées en amont desdites secondes lisses (32), par rapport à ladite direction (D) de tissage. 10
8. Procédé selon l'une quelconque des revendications 5 à 7, lesdits cadres (27) de lisses étant agencés pour un mouvement indépendant les uns à côté des autres, et sont tous situés derrière lesdites secondes lisses (32) de la mécanique Jacquard (26), par rapport audit sens du tissage (D). 15
9. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit processus de levée des fils de chaîne implique la création d'un premier pas (23) parmi ledit premier ensemble de fils de chaîne (7a) en utilisant ladite mécanique non Jacquard (25), et un second pas (23) parmi ledit second ensemble de fils de chaîne (7b) utilisant ladite mécanique Jacquard (26), ledit premier pas étant plus grand que ledit second pas. 20 25
10. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit tassement implique un processus de tassement qui utilise un peigne (34) gradué à travers lequel passent lesdits fils de chaîne (7), ledit peigne (34) gradué comprenant une pluralité de fils dentés espacés (36) et étant conçu pour comprendre : i) au moins une région grossière (38) dans laquelle lesdits fils dentés (36) sont agencés pour définir des dents (37) relativement grandes entre elles et à travers lesquelles s'étendent les fils de chaîne dudit premier ensemble (7a) ; et ii) de fines régions (39) dans lesquelles lesdits fils dentés (36) sont agencés pour définir des dents (37) relativement petites entre elles et à travers lesquelles s'étendent des fils de chaîne dudit second ensemble (7b). 30 35 40 45
11. Procédé selon l'une quelconque des revendications précédentes, lesdits fils de chaîne (7) étant tirés d'une pluralité d'ensouples (19).
12. Procédé selon la revendication 11, les fils de chaîne dudit premier ensemble (7a) étant tirés à partir d'une pluralité d'ensouples (19a), et les fils de chaîne (7b) dudit second ensemble étant tirés à partir d'au moins une ensouple (19b). 50
13. Procédé selon l'une quelconque des revendications précédentes, les fils de chaîne dudit premier ensemble (7a) ayant une densité de masse linéaire sensi-

blement égale les uns aux autres, et les fils de chaîne dudit second ensemble (7b) ayant une densité de masse linéaire sensiblement égale les uns aux autres.

14. Procédé selon l'une quelconque des revendications précédentes, le procédé étant conçu pour tisser une pluralité desdits tubes flexibles allongés (1) sensiblement simultanément ; une sangle (13) de tissu étant tissée à partir desdits fils (7,8) ; la sangle (13) incorporant ladite pluralité de tubes (1) en relation adjacente et sensiblement parallèle les uns aux autres, chacun desdits tubes (1) étant formé à partir d'une paire respective desdits brins superposés (2,3) et entre une paire respective desdites coutures (4) tissées ; et la sangle (13) comprenant une région respective (16), située entre chaque paire de tubes adjacents (1), qui est tissée à partir de fils de chaîne tirés uniquement dudit second ensemble (7b).
15. Procédé selon l'une quelconque des revendications précédentes, le ou chacun desdits tubes (1) étant tissé de telle sorte que lesdites régions porteuses (6) de traction centrales de ses brins (2,3) constitutifs sont sensiblement droits et de largeur constante, et telles que sesdites coutures (4) tissées divergent et convergent en des positions sur sa longueur de manière à définir au moins une région élargie (14) dudit tube (1) qui est plus large que les autres parties dudit tube (1).
16. Procédé selon la revendication 15, comme dépendante de la revendication 14, chaque dit tube (1) étant tissé de manière à comprendre une pluralité desdites régions élargies (14) en relation longitudinalement espacées les unes des autres, la sangle (13) étant tissée de telle sorte que les régions élargies (14) de chacun desdits tubes (1) se chevauchent au moins partiellement transversalement et sont longitudinalement interdigitées avec celles du ou de chaque tube (1) adjacent.

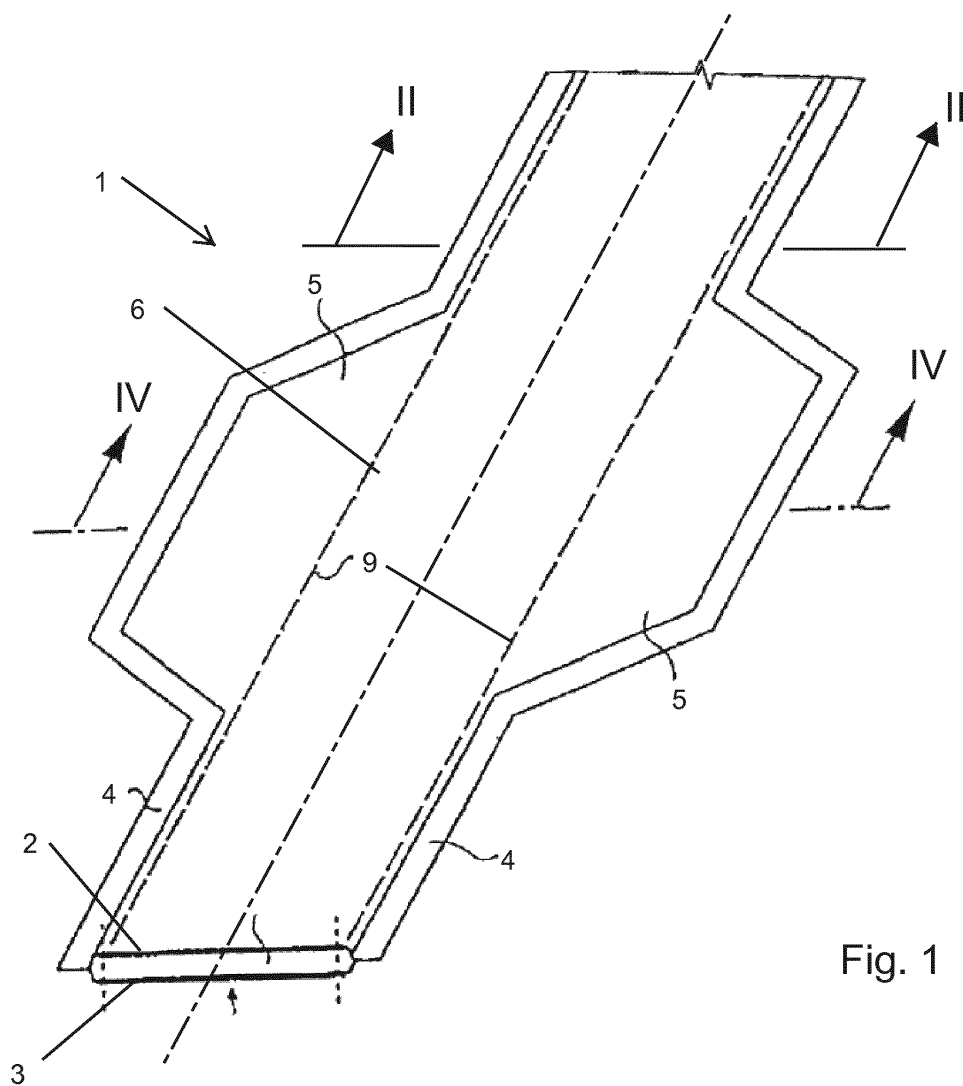


Fig. 1

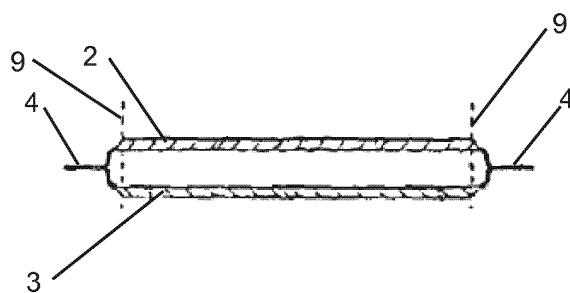


Fig. 2

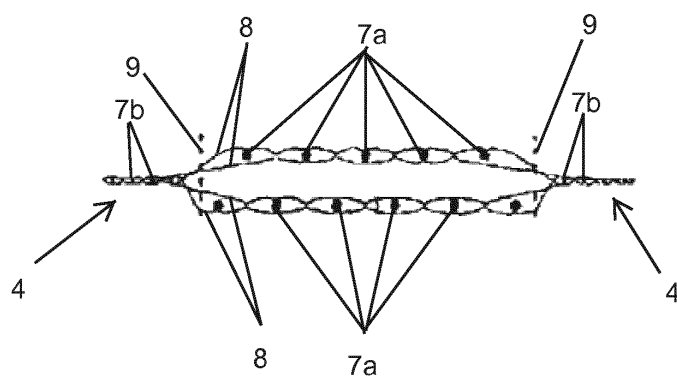
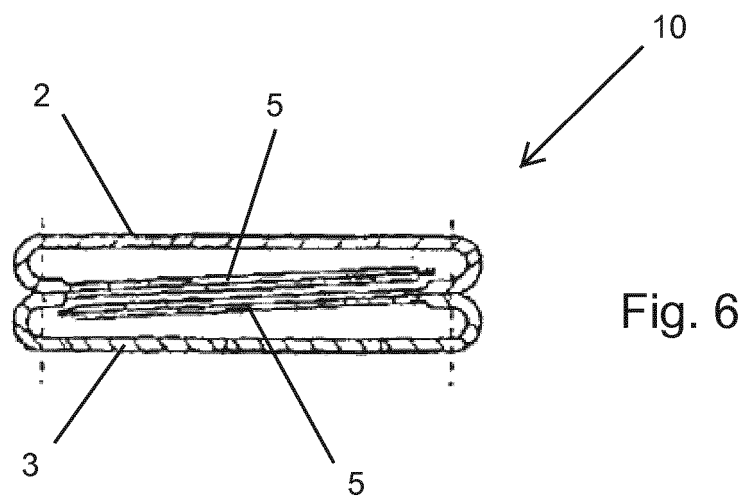
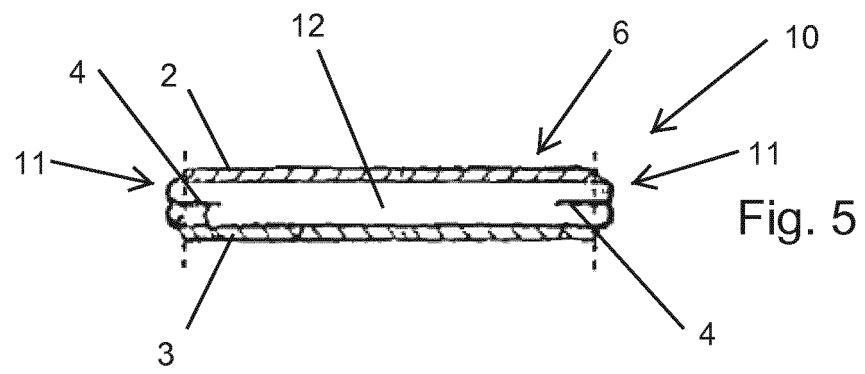
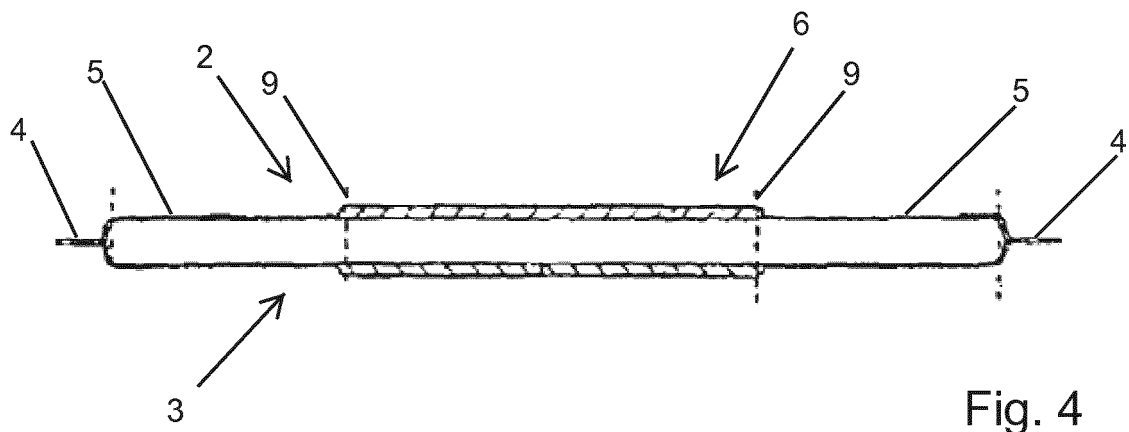


Fig. 3



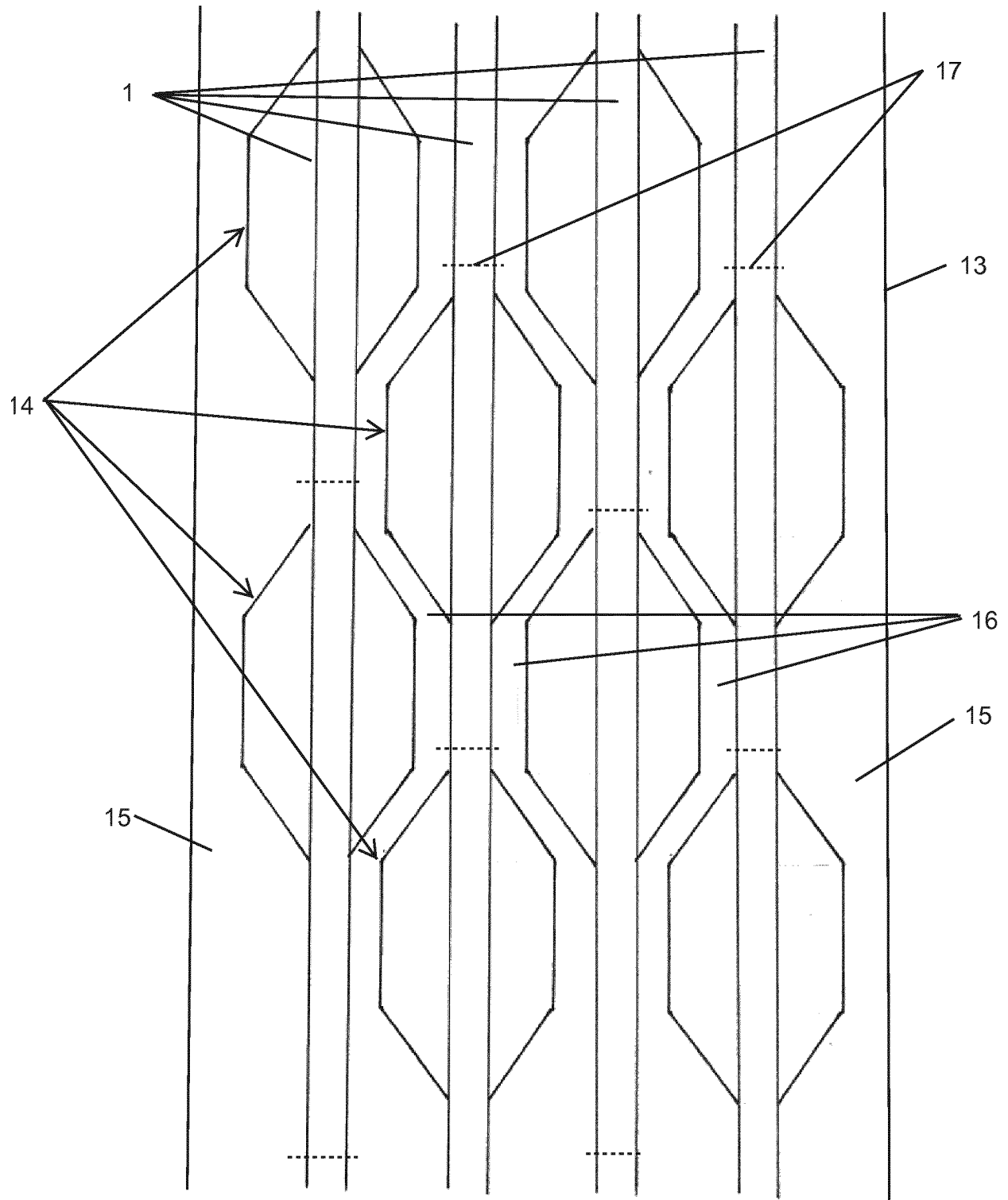


Fig. 7

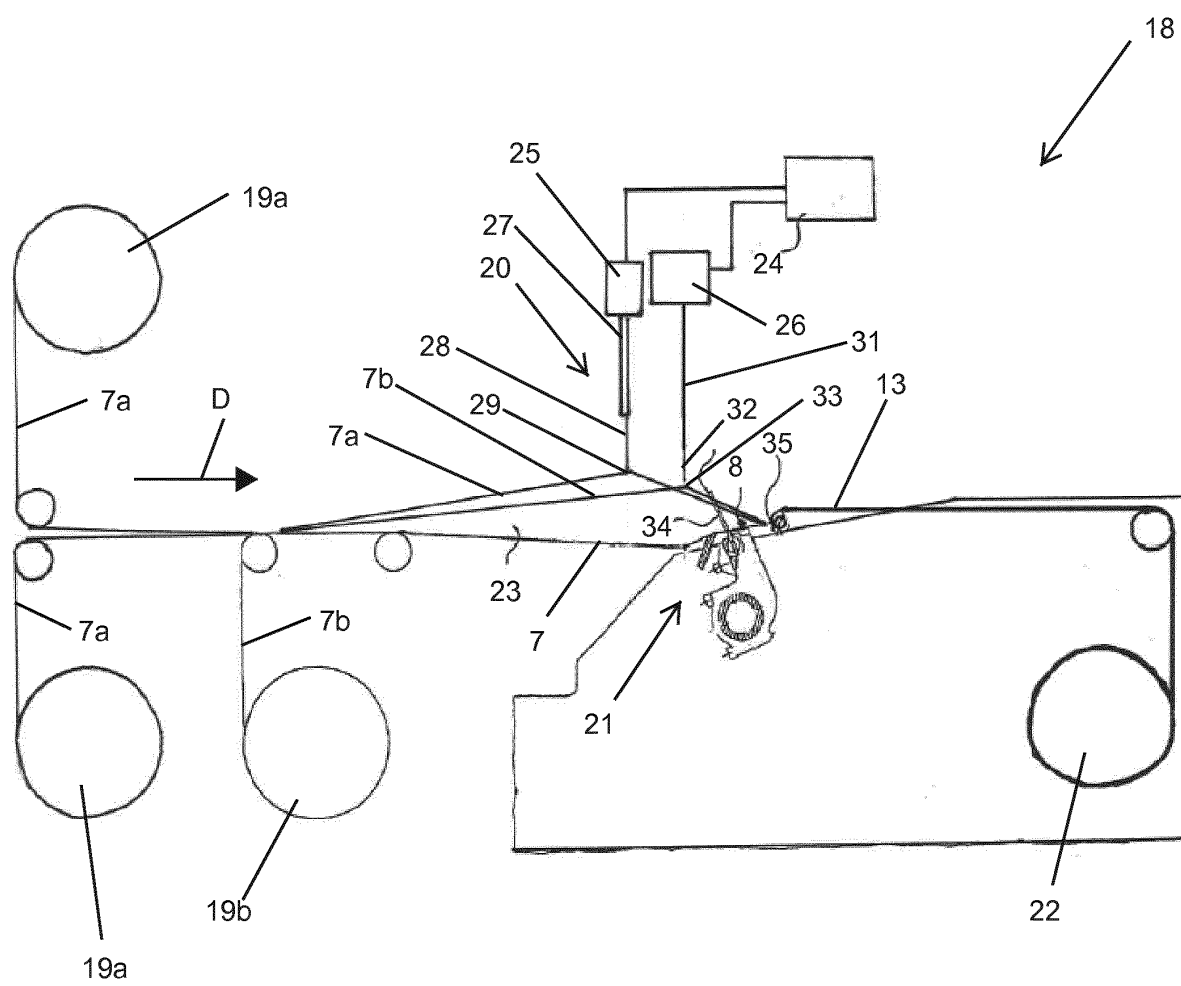


Fig. 8

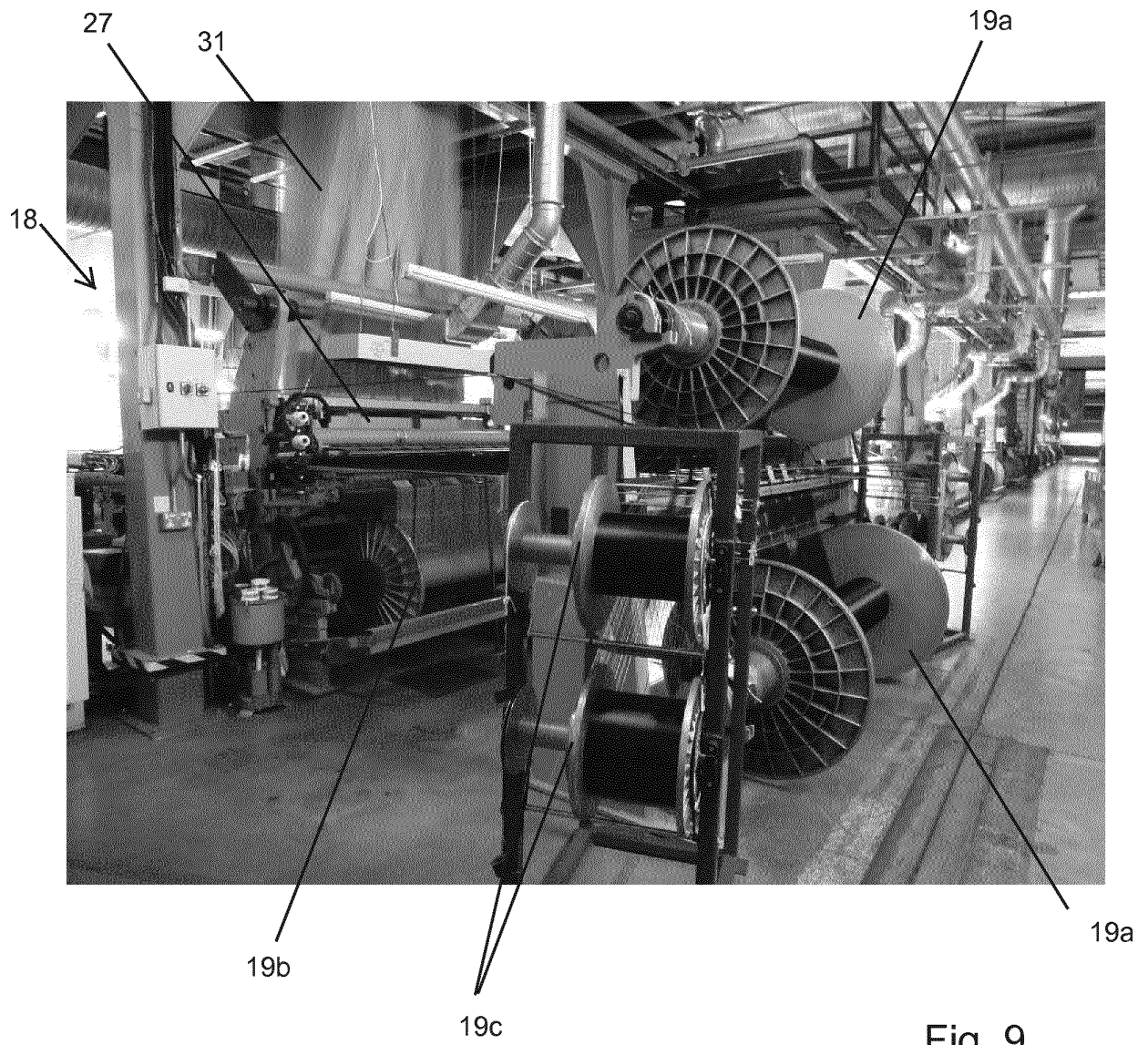


Fig. 9

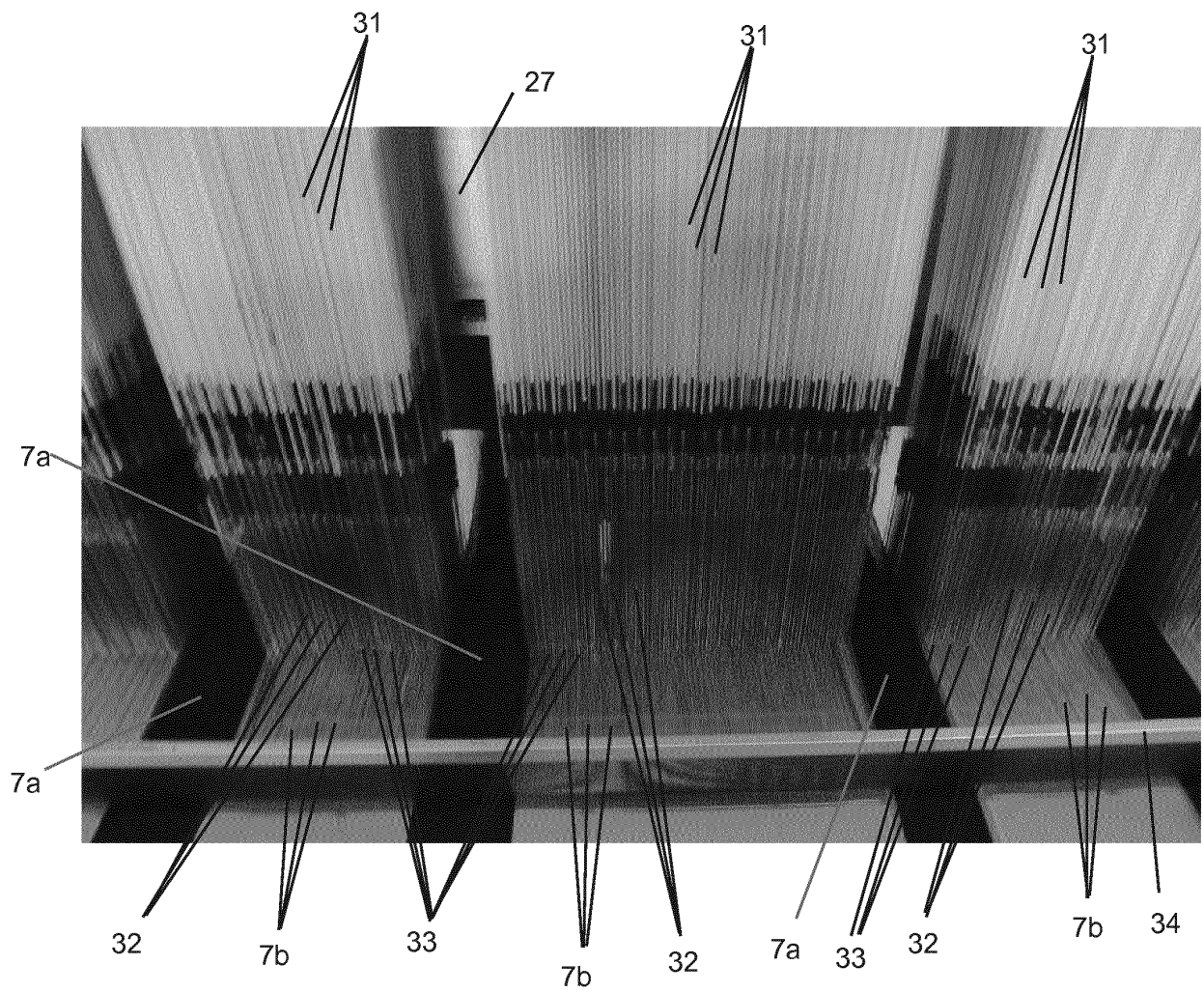


Fig. 10

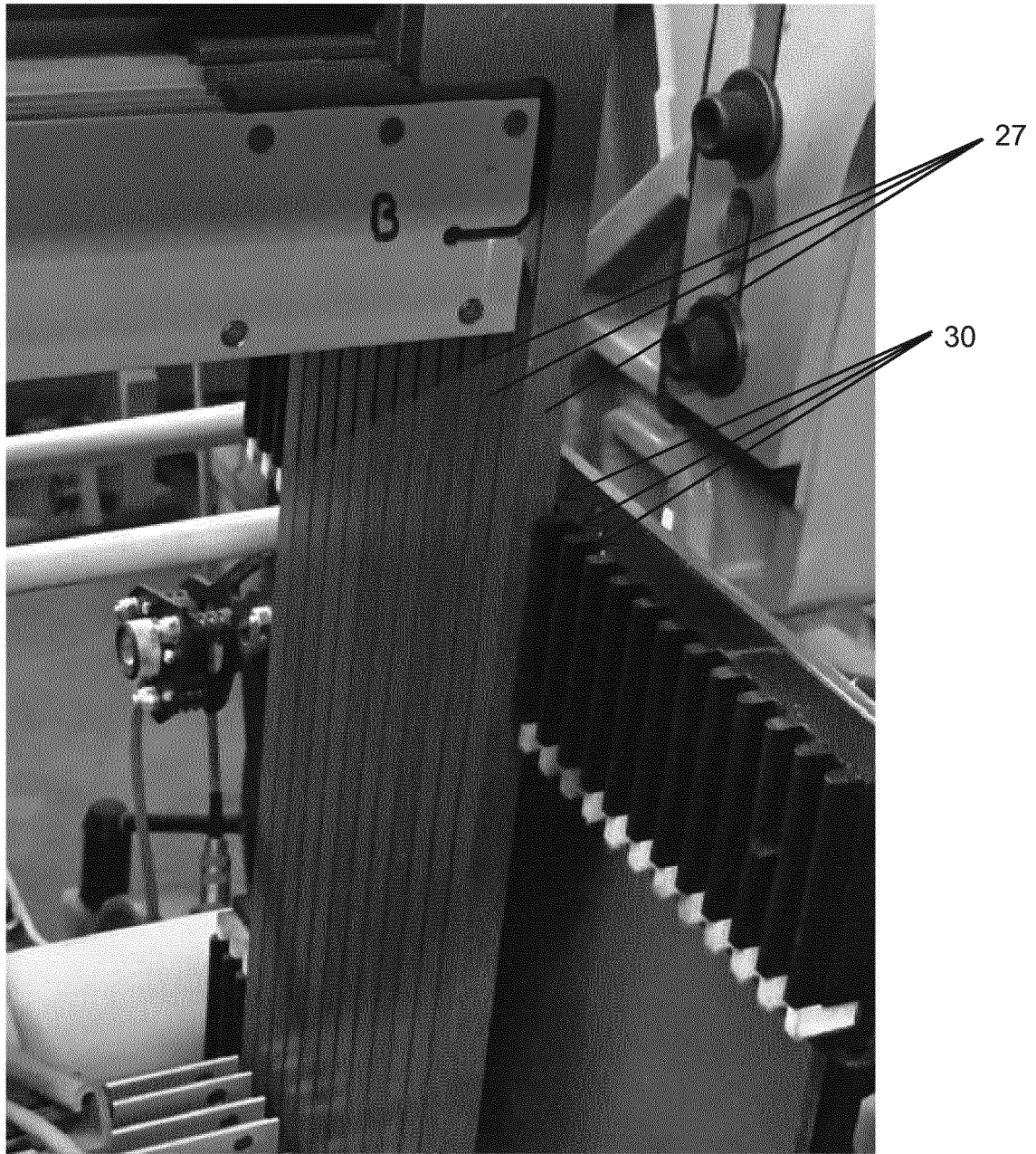


Fig. 11

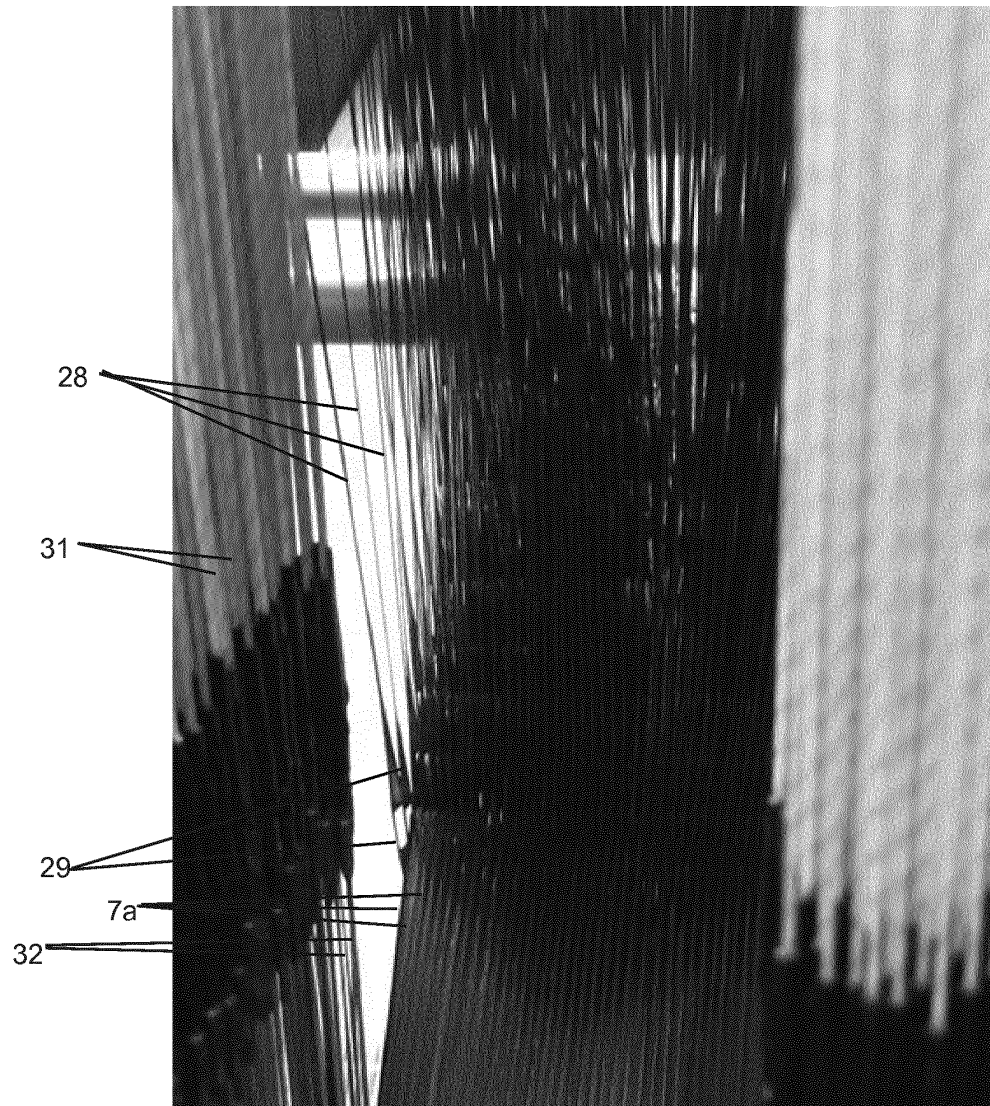


Fig. 12

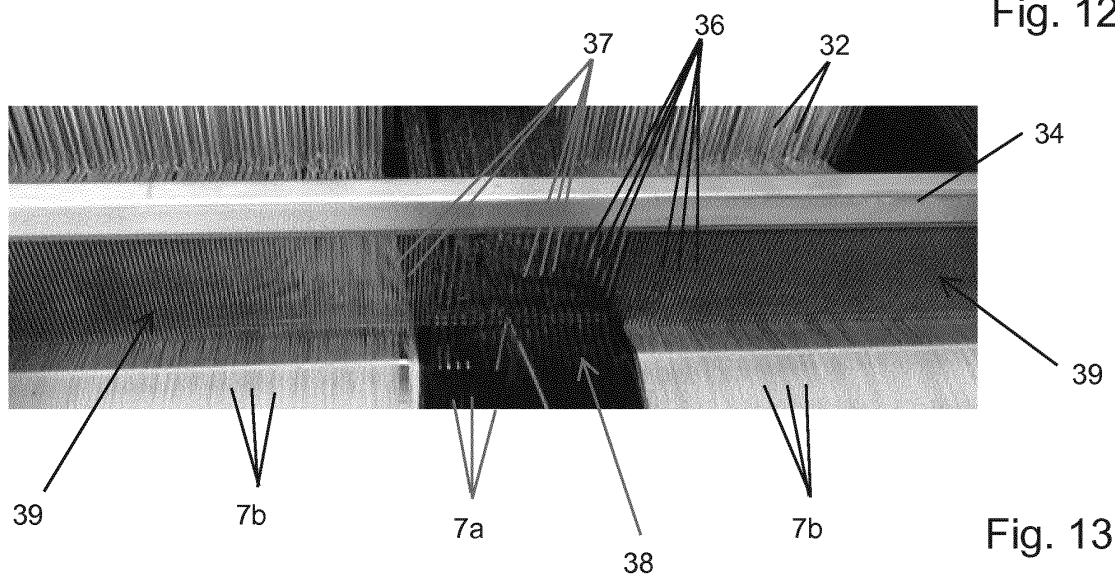


Fig. 13

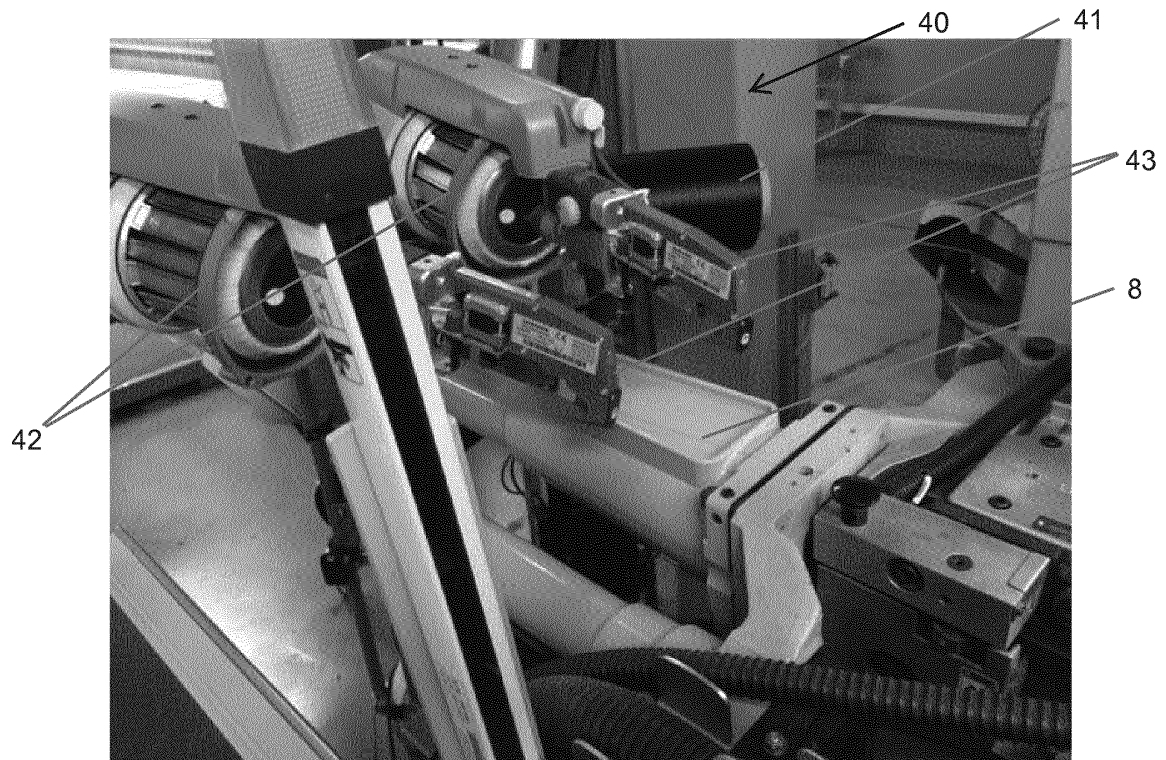


Fig. 14

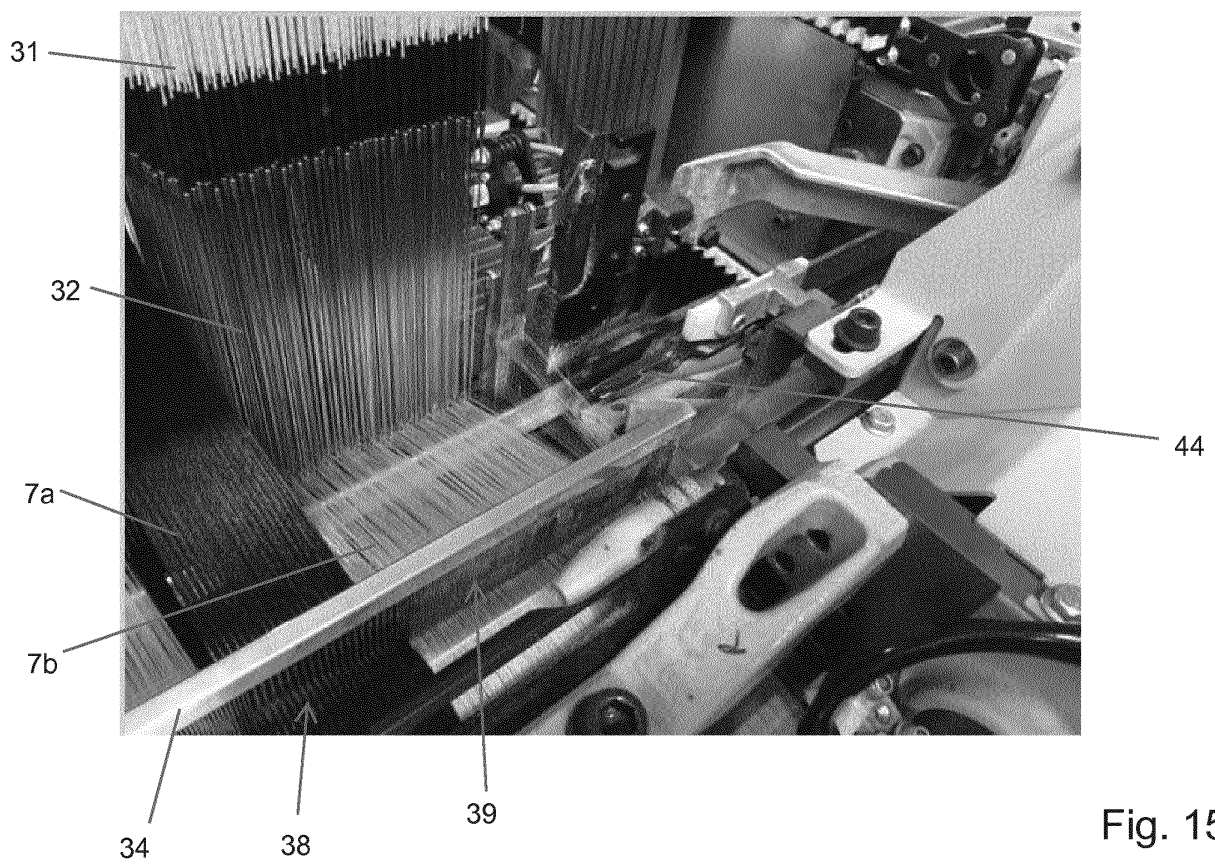


Fig. 15

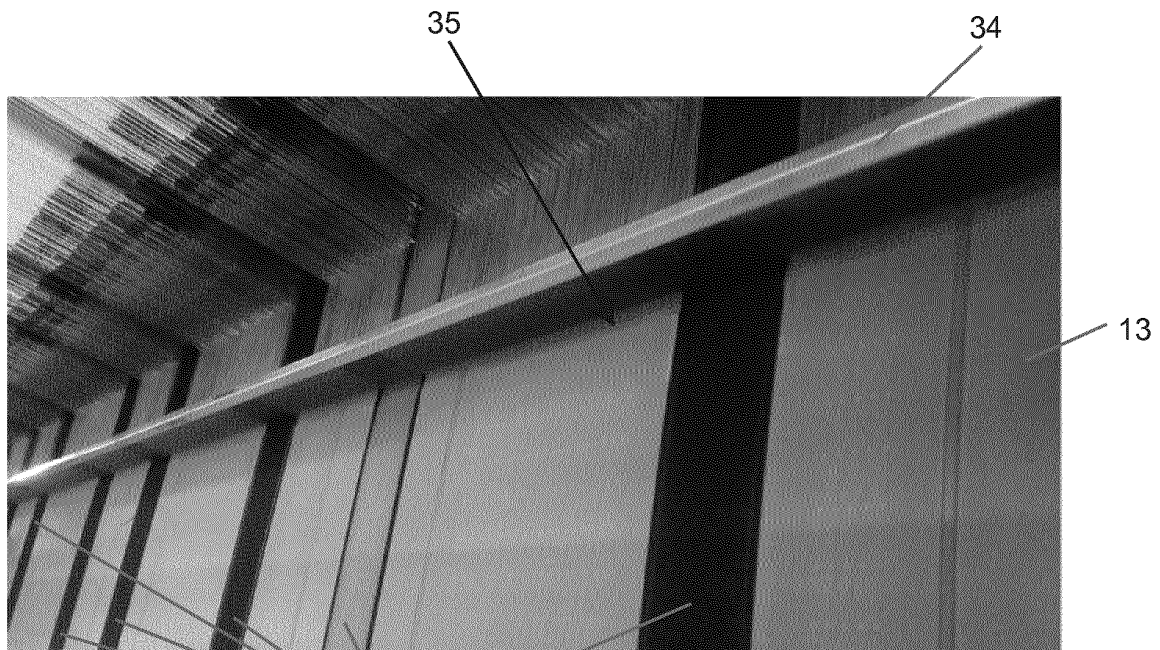


Fig. 16

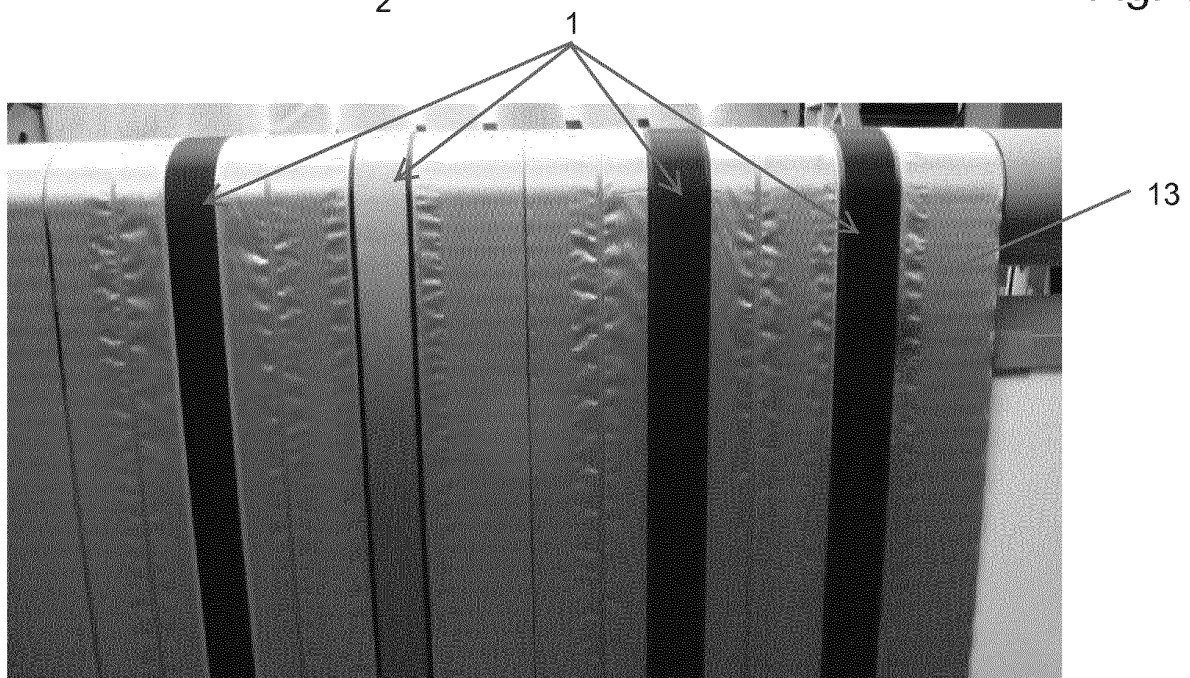


Fig. 17

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CA 2319832 A [0005]
- WO 0144547 A [0006]