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(54) **Jointing composite fabrics**

(57) Composite fabric comprising spaced apart linear yarns extending in the longitudinal plane of the fabric, wherein at least some of said yarns are turned back and extend at least partially back through the fabric in said spaced apart relationship, wherein the yarns are interconnected and encapsulated by a homogeneous matrix material leaving free loops extending from at least one end of the matrix material which are formed by the apexes of the turned back yarns.

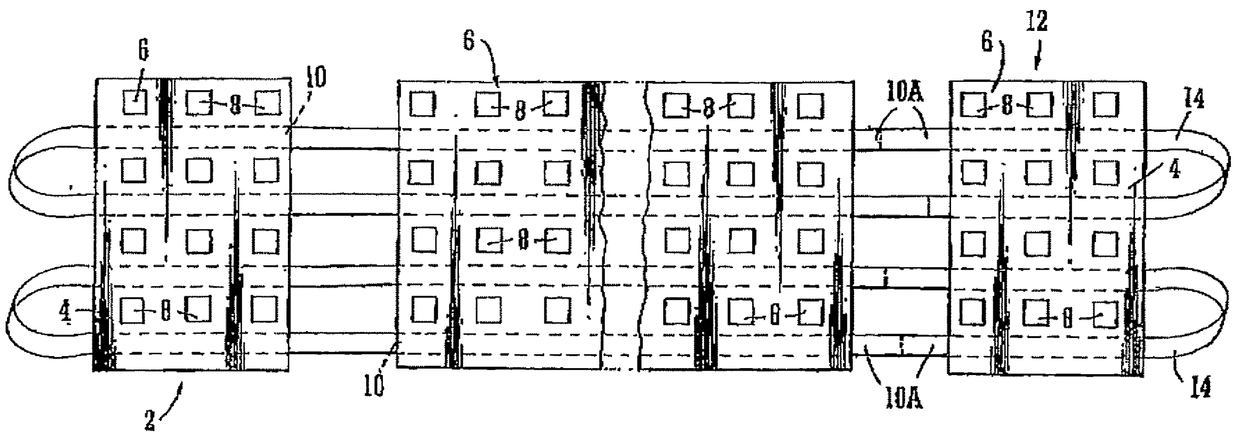

FIG. 4

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Description

[0001] The present invention relates to composite fabrics and the jointing of composite fabric ends, and has particular, though not exclusive, reference to the jointing together of the opposed ends of a papermakers dryer fabrics or like industrial fabric so as to bring the same into an endless band.

[0002] A non-woven membrane which is suitable for use in paper machine clothing and its method of manufacture is described in UK patents GB 2,202,873 (Lefkowitz) and GB 2,235,705 (Lefkowitz). This prior non-woven membrane has a knuckle free planar surface comprising a lattice structure of interconnecting machine and cross-machine direction polymeric structural members residing in a single plane which define a matrix of spaced apertures there between. A proportion of the machine direction lands contain an encapsulated machine direction yarn.

[0003] One process for the production of such a composite membrane is described in US patent 4,740,409. In this method, load bearing yarns are fed from a creel to lie within the zone of an extruder die. The extruder feeds a molten matrix, accompanied by the yarns, onto a pinned surface of a casting drum. This creates a perforated tape which is allowed to cool to the point where it can be removed from the casting drum.

[0004] To yield a fabric of useful size, the tape is then directed around a tail roller and returned to a position alongside the polymer melt, having first been re-located back on the pinned drum. The edge of the tape is softened, or more specifically, re-melted so that it can combine with the adjacent extrudate. An endless porous sheet results, consisting of continuously joined porous tapes whose boundaries are barely discernable. Given that the attendant machinery is large enough, there is no limit to the size of fabric which can be produced.

[0005] Alternatively, the membrane can be formed by feeding a respective one of an array of bi-component yarns, the core of which has a higher melting point than that of the sheath, into every second or third peripheral groove of a pinned roller which is arranged in nip forming relationship with a press roll. The material of the sheath is first melted and then the yarns move into and through the roller nip whereupon the melted sheath material is forced into lateral grooves and the vacant longitudinal grooves in the roller. Upon cooling, the melted material sets to provide the machine and cross-machine structural members to the finished membrane.

[0006] A further method to produce a composite membrane suitable for use as a dryer fabric is described in WO 91/02642 (Huyck Corporation). This prior method uses two pre-cast rolls of thermoplastic film with machine direction reinforcing yarns being introduced as the middle of the sandwich. With films of polymers with high melt temperatures, pre-heating of these films may be required before they advance towards the forming zone, where they are merged into a single entity by means of pressure and heat.

[0007] For many years considerable attention has been directed to the provision of seam forming elements at the respective ends of woven dryer fabrics, whereby said ends might be securely and uniformly joined in such a manner that the permeability in the seam region is not materially different from that of the body of the fabric.

[0008] Originally dryer fabric seaming was effected either by sewing, or otherwise securing, a substrate carrying laterally extending loops to each of respective fabric ends or by folding back and sewing the fabric edges to create a seam and inserting a spiral, the loops at the respective ends being interdigitated and a pintle wire introduced into the tunnel formed by the interdigitated loops to hold the ends together.

[0009] Another well practised procedure is to "weave-back" free warp ends into the body of the fabric and in so doing form loops from the individual warp yarns at the ends of the fabric, which can then be interdigitated and a pintle wire introduced as described above. Alternatively, a preformed spiral yarn can be inserted into the aforementioned said loops and used to seam the fabric.

[0010] EP 0,399,674 discloses a method of seaming a composite dryer fabric which is an adaptation of the technique of weaving back the free warp yarns of a woven fabric. In this prior technique naked machine direction yarns extend from either end of the composite fabric, these free yarn ends are folded back upon themselves and encapsulated on a moulding plate, to provide free loops at either end of the fabric which can be interdigitated and a pintle inserted therein to render the fabric endless.

[0011] However, the above described method is not ideal for joining composite fabric ends, in that the seam region is provided with a double layer of monofilament yarn, which can make the fabric stiff in the seam area and therefore more difficult to install on a machine.

[0012] It is an object of the present invention to provide a composite fabric, a method of jointing a composite fabric, and a composite fabric seam which overcomes or alleviates the above described drawback.

[0013] In accordance with a first aspect of the present invention there is provided a composite fabric comprising spaced apart linear yarns extending in the longitudinal plane of the fabric, wherein at least some of said yarns are turned back and extend at least partially back through the fabric in said spaced apart relationship, wherein the yarns are interconnected and encapsulated by a homogeneous matrix material leaving free loops extending from at least one end of the matrix material which are formed by the apexes of the turned back yarns. This structure has the advantage that it negates the disadvantages associated with folding back the yarns on themselves to provide the loops, in that the double thickness of the yarns in the region of the seam is not present, which double thickness can render the fabric stiff making it difficult to install on a machine.

[0014] The turned back portion of the yarn within the matrix material may be connected to a separate yarn running along the same line and at a position remote from the fabric end.

[0015] The open part of the loop may extend in a substantially transverse plane to the longitudinal extent of the fabric. This enables easy interdigitation of opposed fabric ends and insertion of a pintle wire to make a longer and/or endless fabric. By controlling the sizes of fabric lengths added on, an endless fabric of the desired length can be readily constructed.

[0016] The matrix material may have apertures therein in lateral offset disposition relative to the yarns and extending throughout the fabric.

[0017] In accordance with a second aspect of the present invention there is provided a method of manufacture of a jointed or seamed composite fabric comprising the steps of making a first strip of fabric by providing an array of spaced apart yarns extending in a first plane, turning back at least some of the yarns in order that they extend at least partially back in said spaced apart relationship in said plane, and encapsulating said yarns in a homogeneous matrix material to leave free loops extending from one end of the matrix material formed by the apex of the turned back yarns.

[0018] Preferably, the step of encapsulation involves leaving free yarns protruding from the other end of the matrix material.

[0019] In one embodiment the method further includes the steps of providing a second strip of fabric by providing a corresponding second array of spaced apart yarns extending in a first plane and encapsulating said yarns in said matrix material to leave free yarns protruding from at least one end of the matrix material.

[0020] The method may further involve the step of joining opposed ends of the first and second fabric portions of the fabric to make a longer fabric by placing in contact a respective free yarn of one portion with a respective corresponding free yarn of the other portion and interconnecting and encapsulating said contacting yarns in said matrix material to form a homogeneous length of fabric. The step of interconnecting said contacting free yarns also includes the step of joining said free yarns before encapsulation in said matrix material. In one embodiment respective joints of the yarns are not substantially aligned. This has the advantage of reducing areas of localised weakness. The method may include the step of joining the opposed loop bearing ends of two first sections of fabric by interdigitating the loops of the opposed ends and then interconnecting the two portions with a pintle. This has the advantage that a particular length of fabric can be constructed from the interconnection of a plurality of first and/or second fabric portions and the fabric can be rendered endless by providing two first, loop bearing portions at opposite ends of a fabric length thus constructed and interconnecting with a pintle. This has the additional advantage that main body sections can be made in advance, and when constructing the fabric appropriately sized jointing strips can be added to make the fabric up to the desired size.

[0021] The method further includes the step of providing a plurality of apertures in the matrix material in lateral offset disposition relative to the yarns and extending throughout the material. The apertures may be formed during the encapsulation of the yarns by placing each of the array of yarns and/or turned back yarns and/or joined yarns into a respective groove of a mould comprising upstanding pins serving to form said apertures in said material and then encapsulating the yarns, within the matrix material of the mould.

[0022] The invention will now be described further, by way of example only, with reference to the accompanying drawings, in which:-

> Fig. 1 through 5 are schematic views showing the steps in the construction of a composite fabric in accordance with one embodiment of the present invention.

[0023] A composite fabric is constructed in accordance with one of the methods disclosed in GB 2,202,873 or GB 2,235,705, as described earlier. The fabric comprises a knuckle free non-woven membrane 2 as best illustrated in Fig. 1, having a planar surface comprising a lattice structure of interconnecting machine and cross-machine direction polymeric structural members 4, 6 residing in a single plane which define a matrix of spaced apertures 8 therebetween. Each of the machine direction (md) lands 4 contains an encapsulated md yarn 10. The membrane 2 forms the main body of the fabric.

[0024] However, in an adaptation to this prior method a length 10A of each yarn 10 is left free at each end of the membrane, the length of the free portion of the yarns 10A being in the range of 1 to 500mm, typically 50mm.

[0025] A jointing strip 12, as best illustrated in Fig. 2, of a similar construction to main body 2 is also formed such that it has the same width, as measured in the intended cross-machine direction, and the same thickness as that of membrane 2. The jointing strip 12 however is likely to be of a much shorter length, that is typically 5 to 500 cm, when measured in the intended machine direction. Similar to the main body 2 the jointing strip 12 has free yarns 10A extending from one end thereof, but has loops 14 formed from the yarns 10 extending from the opposite edge thereof.

[0026] The jointing strip 12 is formed on a pinned mould plate 11 having a plurality of upstanding pins 13 having the same configuration as that of the pinned drum used to construct the main body of the fabric. In this instance, the yarns would initially be placed through alternative grooves 15 of the mould plate (Fig. 3) and then looped back and passed through the respective adjacent empty groove 17 prior to being encapsulated in the polymeric material to provide lattice membrane structure with embedded md yarns. This fixes the loops in place such that they protrude from one edge of the membrane structure, substantially in a transverse plane to the longitudinal extent thereof as illustrated in Fig. 2. It also leaves free yarns 10A extending from, the opposite edge of the membrane structure.

[0027] As best illustrated in Fig. 4, the jointing strip 12 is then joined to the main body 2, by overlapping their respective protruding yarns 10A and interlocking these yarns together. Each pair of joined yarns is placed in a respective groove of a pinned mould plate, whose upstanding pins have the same effective configuration as that of the pinned roller. These yarns are then embedded in the molten matrix material using whichever method has been chosen. Upon cooling, the resultant machine and cross-machine direction lands formed are consistent with those the main body 2 and the jointing strip 12. This provides a like permeability characteristic to this region, when compared to that of the remainder of the fabric, and with the machine-direction yarns encapsulated within the md lands provides an invisible joint between the main body 2 and the jointing strip 12.

[0028] A similar jointing strip 12 is joined to the opposite end of the main body 2 in the same manner to form the completed composite fabric.

[0029] The composite fabric can be formed into an endless loop by interdigitating the loops 14 at the opposing ends and interconnecting such with a pintle in a known manner. For this purpose the loops 14 at one end tilt to one side, whilst the loops of the opposite end have a complementary tilt such that they evenly overlap when interdigitated.

[0030] Methods of joining the free yarns 10A of the main body 2 and jointing strip 12, could include techniques such as ultrasonic welding chemical bonding adhesive means, crimping and other mechanical means. The jointing of the yarns may also be staggered with respect to the width of the fabric, to avoid a line of localised weakness. The individual joints have been illustrated in Fig. 4 in such a staggered manner. Although the free yarns have been described as being overlapped before interconnection, they may alternatively be laser welded. In this instance, for example, near infrared (NIR) e.g. CO_2 laser could be used, aided by a thin layer of material which concentrates the laser energy at the interface. Further it is possible to use diode lasers or ionic diode lasers.

[0031] Although the jointing strip has been described as being formed on a pinned mould plate, it could alternatively be produced on the other means such as on a pinned roller.

[0032] Although a yarn has been described as being present in every machine-direction land of the composite fabric, some such machine direction lands may not contain yarn. Also, cross-machine direction yarns may additionally be provided in some or all of the cross-machine direction lands. Alternatively, other cross-machine direction support could be included.

[0033] Although the method of production has been described with reference to those described in GB 2,202,873 and GB 2,235,705, other methods of production of the main composite fabric bodies could be used provided that free yarns protrude from each edge of the main body. The matrix material of the fabric may be formed from polymeric materials such as polyesters, polyamides, polyimides polyolefines, PPS, PCTA, polyurethane and rubber based materials. These would typically be processed by some sort of melt processing, as would in general be applied to thermoplastic systems. In some cases it may be desirable to secondary cure the finished product to give a thermoset, e.g. through the use of electromagnetic irradiation.

[0034] If the matrix material is being added into the mould plate or pinned roller such could be provided in a particulate, or liquid form or indeed a sheet of such material which is then brought into liquid form by application of heat.

[0035] It should be understood that the foregoing description and drawings are not intended to be limiting, but are only exemplary of the inventive features which are defined in the claims.

Claims

1. Composite fabric comprising spaced apart linear yarns extending in the longitudinal plane of the fabric, wherein at least some of said yarns are turned back and extend at least partially back through the fabric in said spaced apart relationship, wherein the yarns are interconnected and encapsulated by a homogeneous matrix material leaving free loops extending from at least one end of the matrix material which are formed by the apexes of the turned back yarns.

2. Composite fabric according to claim 1, wherein the turned back portion of the yarn within the matrix material may be connected to a separate yarn running along the same line and at a position remote from the fabric end.

3. Composite fabric according to claim 1 or 2, wherein the open part of the loop extend in a substantially transverse plane to the longitudinal extent of the fabric.

4. Composite fabric according to one of the preceding claims, wherein the matrix material have apertures therein in lateral offset disposition relative to the yarns and extending throughout the fabric.

5. Composite fabric according to one of the preceding claims, wherein joints of the yarns are not substantially aligned.

6. Method of manufacture of a jointed or seamed composite fabric comprising the steps of making a first strip of fabric by providing an array of spaced apart yarns extending in a first plane, turning back at least some of the yarns in order that they extend at least

partially back in said spaced apart relationship in said plane, and encapsulating said yarns in a homogeneous matrix material to leave free loops extending from one end of the matrix material formed by the apex of the turned back yarns.

7. Method according to claim 6, wherein the step of encapsulation involves leaving free yarns protruding from the other end of the matrix material.

8. Method according to claim 6 or 7, wherein the method further includes the steps of providing a second strip of fabric by providing a corresponding second array of spaced apart yarns extending in a first plane and encapsulating said yarns in said matrix material to leave free yarns protruding from at least one end of the matrix material.

9. Method according to one of the claims 6 to 8, wherein the method involve the step of joining opposed ends of the first and second fabric portions of the fabric to make a longer fabric by placing in contact a respective free yarn of one portion with a respective corresponding free yarn of the other portion and interconnecting and encapsulating said contacting yarns in said matrix material to form a homogeneous length of fabric.

10. Method according to one of the claims 6 to 9, wherein the step of interconnecting said contacting free yarns includes the step of joining said free yarns before encapsulation in said matrix material.

11. Method according to one of the claims 6 to 10, wherein the method include the step of joining the opposed loop bearing ends of two first sections of fabric by interdigitating the loops of the opposed ends and then interconnecting the two portions with a pintle.

12. Method according to one of the claims 6 to 11, wherein the method includes the step of providing a plurality of apertures in the matrix material in lateral offset disposition relative to the yarns and extending throughout the material.

13. Method according to one of the claims 6 to 12, wherein the apertures are formed during the encapsulation of the yarns by placing each of the array of yarns and/or turned back yarns and/or joined yarns into a respective groove of a mould comprising upstanding pins serving to form said apertures in said material and then encapsulating the yarns, within the matrix material of the mould.

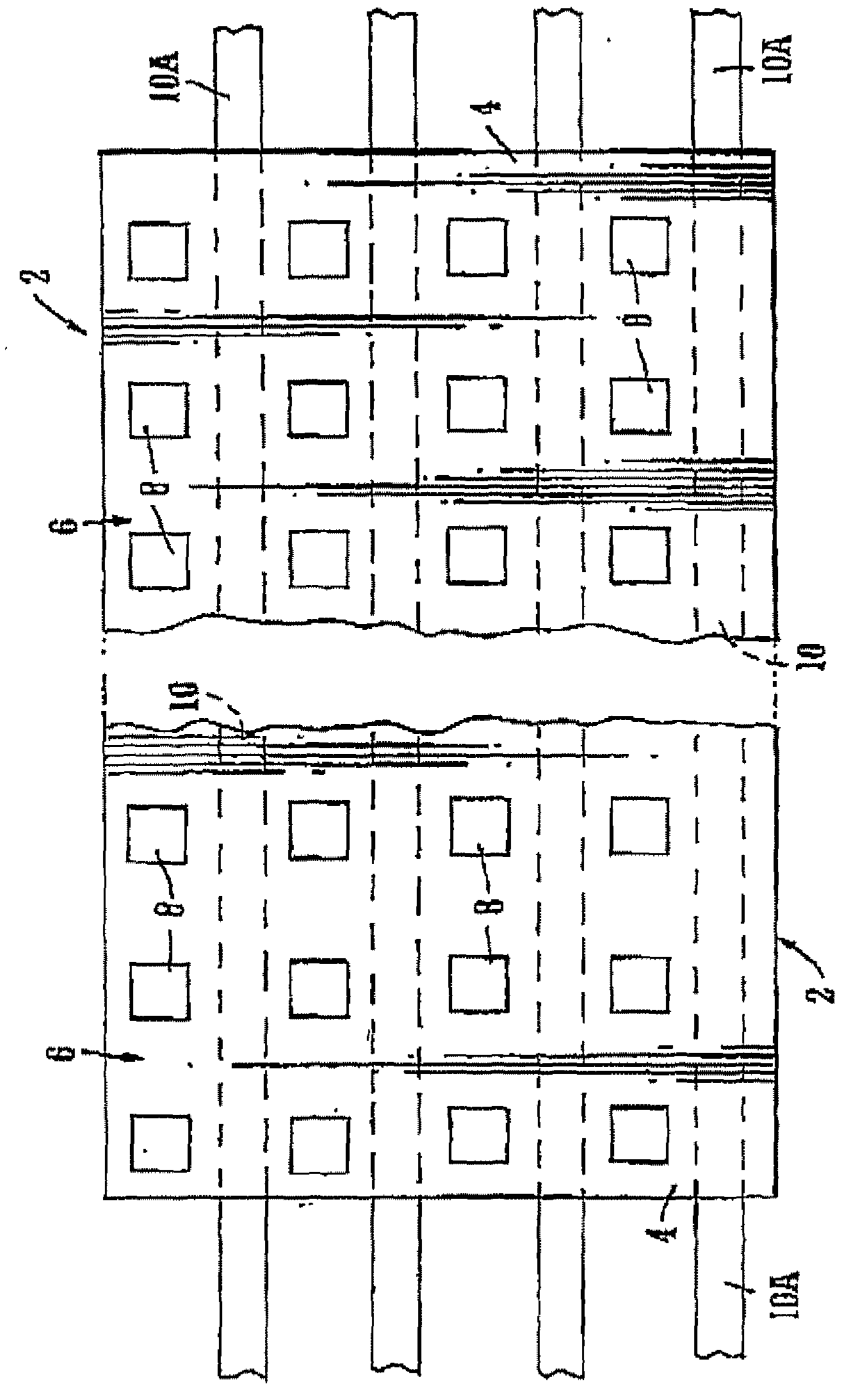

FIG. 1

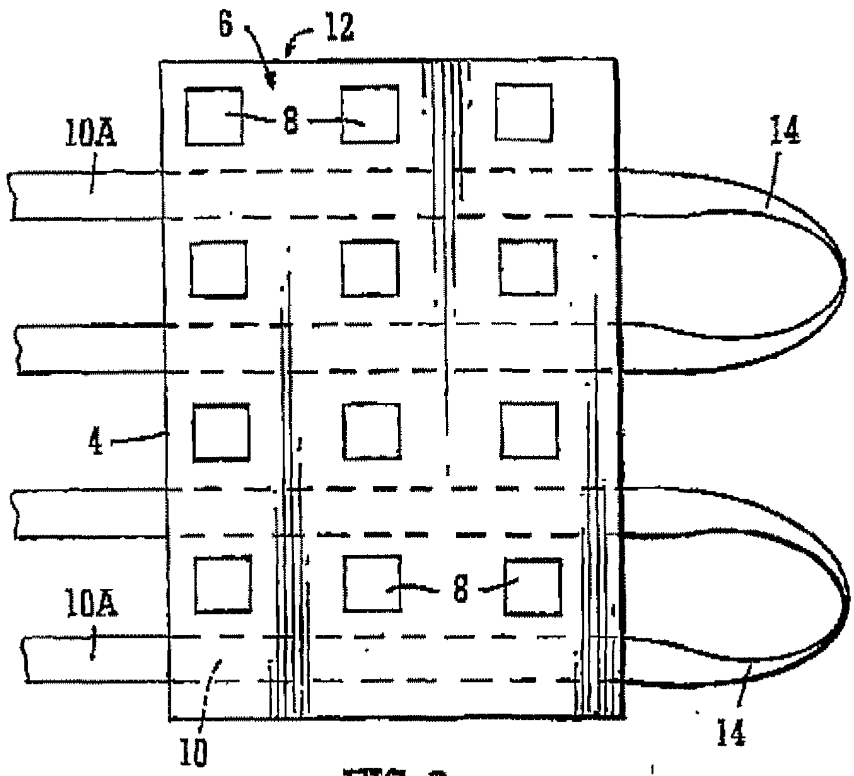

FIG. 2

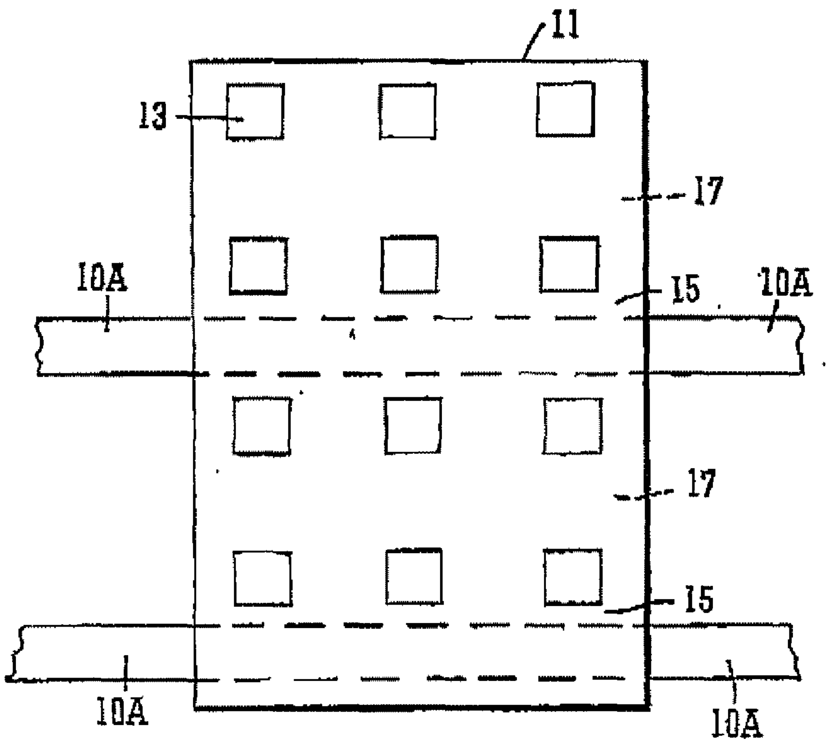

FIG. 3

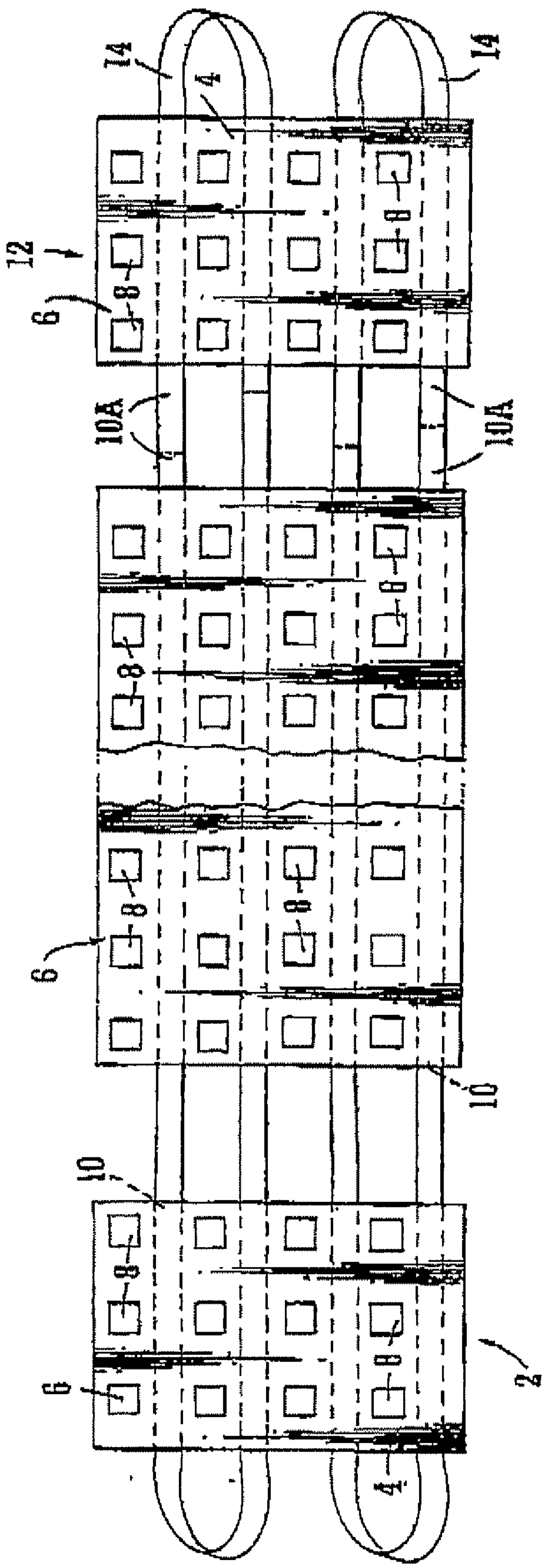

FIG. 4

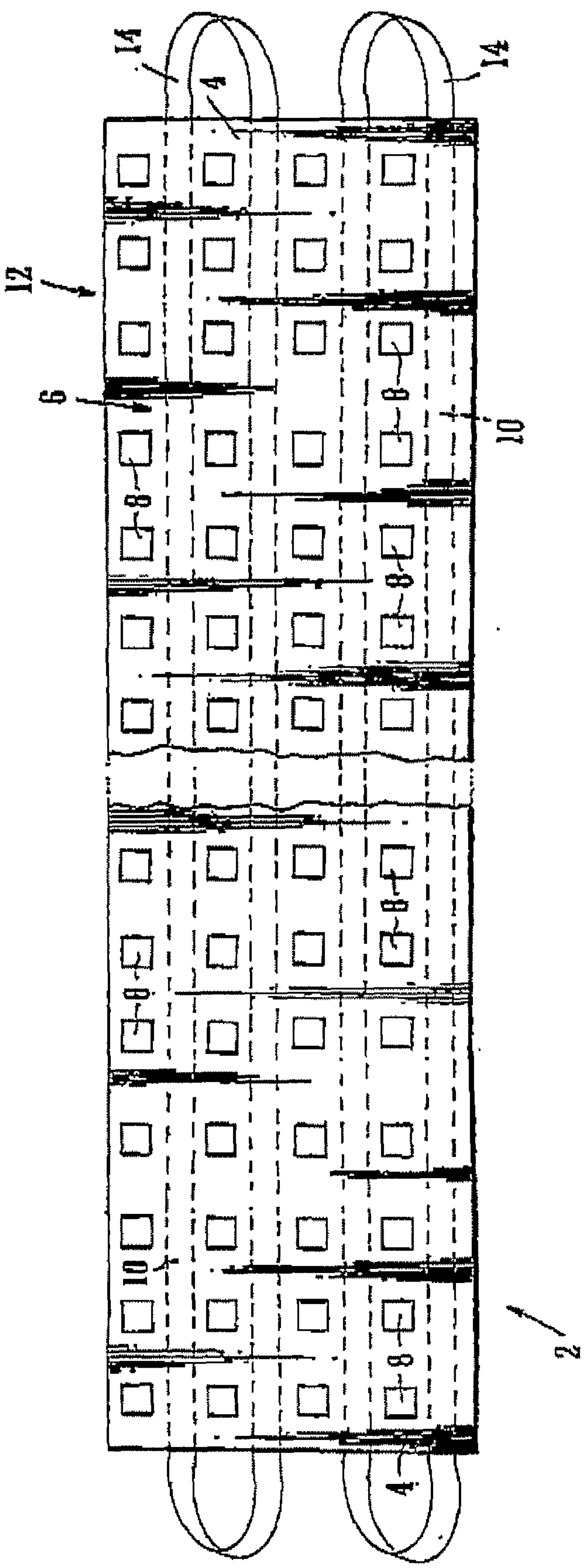

FIG. 5