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(54) **CONDUCTING FABRIC WITH HIGH VERSATILITY IN USE**

(57) A conducting fabric (1), comprising at least two yarns (3) adapted to carry an electric power supply, woven directly during weaving, the yarns (4; 10) of the fabric that intersect the at least two yarns (3) adapted to carry

an electric power supply being welded at intersections (5) with the at least two yarns (3) adapted to carry an electric power supply, in order to define areas of the fabric that are adapted to be supplied with power.

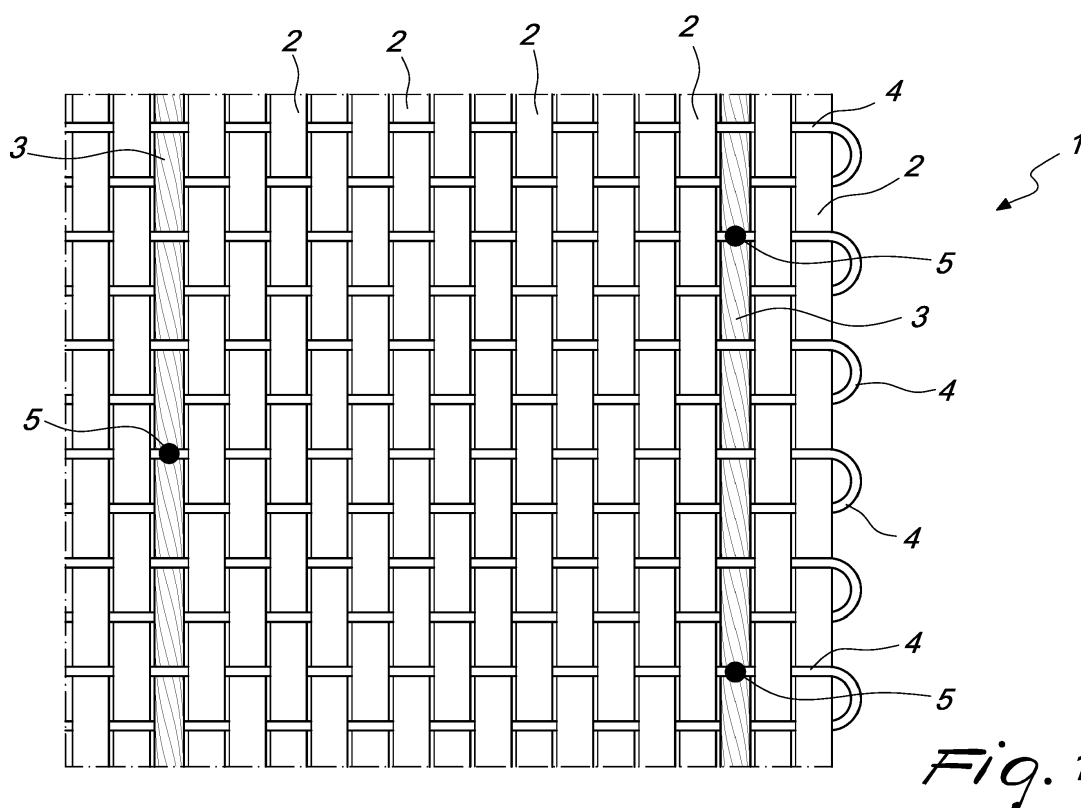


Fig. 1

Description

[0001] The present invention relates to a conducting fabric with high versatility in use. More particularly, the invention relates to a conducting fabric capable of carrying electric power inside it.

[0002] As is known, conducting fabrics, also known as "conduthermal" fabrics, are commercially widespread which are provided by means of continuous copper yarn (which acts as weft yarn) and glass fiber (which acts as warp), so as to provide equipotential multisector electrical resistors which are mutually connected in parallel by using a flat copper band coupled to the laminated fabric. This solution with copper flat band, however, has some disadvantages, which are first of all due to the fact that the applied copper band is extremely rigid, which entails a problem for particular applications in which the fabric fundamentally must be flexible.

[0003] Furthermore, the applied copper band can create problems if it is necessary to perform a coupling or adhesive bonding with resin or materials that must penetrate into the fabric uniformly, since the band would create a barrier to this penetration.

[0004] Furthermore, another drawback is due to the linear expansions that each material can have if it is heated and which, in the case of two different materials (fabric and solid conducting band), in case of encapsulation, might cause breakages or separations.

[0005] The aim of the present invention is to provide a conducting fabric with high versatility in use that allows to provide within a same fabric areas that have specific characteristics that are identical or different depending on the quantity of conducting material that is present in each area and the purpose of which is to generate heat.

[0006] Within this aim, an object of the present invention is to provide a conducting fabric with high versatility in use which can be flexible.

[0007] Another object of the present invention is to provide a conducting fabric that allows to carry both power and electrical signals.

[0008] A further object of the present invention is to provide a conducting fabric that can be provided directly with a weaving loom of the perpendicular or circular type.

[0009] Another object of the present invention is to provide a conducting fabric that can be provided as a function of the power to be carried.

[0010] Another object of the present invention is to provide a conducting fabric that is highly reliable, relatively simple to provide and at competitive costs.

[0011] This aim, as well as these and other objects which will become more apparent hereinafter, are achieved by a conducting fabric, characterized in that it comprises at least two yarns adapted to carry an electric power supply, woven directly during weaving, the yarns of the fabric that intersect said at least two yarns adapted to carry an electric power supply being welded at intersections with said at least two yarns adapted to carry an electric power supply, in order to define areas of said

fabric that are adapted to be supplied with power.

[0012] Further characteristics and advantages of the invention will become more apparent from the description of preferred but non-limiting embodiments of the conducting fabric according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a view of a first embodiment of the fabric according to the present invention;

Figure 2 is a view of a second embodiment of the fabric according to the present invention;

Figure 3 is a view of a third embodiment of the fabric according to the present invention.

[0013] With reference to the figures, in which identical reference numerals correspond to identical elements, the conducting fabric according to the invention, designated generally by the reference numeral 1, comprises a plurality of warp yarns 2, the warp yarns comprising at least two insulated conducting warp yarns 3 which are adapted to carry the electric power supply within the fabric 1 itself, as if they were a line cable that carries power and/or signals.

[0014] In this case the weft yarn 4 is a conducting and insulated continuous yarn, for example made of copper, which intersects the power supply yarns 3, indeed drawing power from them.

[0015] More particularly, the weft yarn 4 is a copper yarn which runs back and forth, weaving in with the warp yarns which are conveniently made for example of glass fiber. The continuous yarn allows to provide a resistive fabric with practically nil electromagnetic emissions. This is due to the fact that the continuous yarn that is woven in at each return runs practically in contact with the forward one; then the loom performs the desired beat and then another forward and return run in contact. With this fabric architecture, the electromagnetic field generated by an electrical cable crossed by a current which moves in one direction is canceled out by the opposite electromagnetic field generated by the subsequent cable (in contact) which is crossed by the same current but in the opposite direction. The weft yarn 4 "connects" to the conducting warp yarn 3 by means of welds 5 which can be provided by spot welding, tin welding, welding paste, ultrasound or any other known method in order to provide electrical sectors that are powered by the conducting warp yarns 3.

[0016] Conveniently, in order to avoid the deformation of the fabric during any co-lamination and calendaring process, it is possible to provide for the insertion, during weaving, of a microfilament 8 made of glass in the weft, warp, or in both directions, which is hot welded onto the insulated conducting yarn, or on the yarn 2 made of insulating material, generating a mesh which makes it possible to increase the tensile strength of the fabric in the various directions, including the oblique one.

[0017] The fabric described above is provided by con-

tinuous weaving on a weaving loom, and it is also possible to decide on the dimensions in relation to the power to be carried.

[0018] The fabric described above allows to provide inside it areas that have mutually identical or different specific characteristics depending on the quantity of conducting material that is present in each sector (length and cross-section of the yarn, specific resistance).

[0019] Therefore, considering that the fabric is used as an electrical resistor to produce heat, it is possible to obtain articles with areas having a variable resistance which are therefore capable of delivering different power levels and/or of being powered with different power supply voltages.

[0020] The fabric can be calendered or coupled with insulating materials such as silicones, EPDM, resins of another kind and rubbers in general.

[0021] As an alternative to the first embodiment described previously, the fabric can be made, instead of with a continuous weft, with a weft made of yarn, for example copper yarn, which is single, in this case designated by the reference numeral 10.

[0022] The two power supply warp yarns 3 cross the single weft yarn 10 and the weft yarn 10 is welded at the intersection of the power supply warp yarn 3 with welds 5 and with a connecting wire 9 which has the purpose of closing the circuit.

[0023] More generally, the invention provides for replacing yarns made of insulating material, both in the weft and in the warp, with at least one yarn made of conducting material so as to form areas of fabric that can be supplied with electric power.

[0024] The yarn that carries the power supply can therefore also be provided in the weft instead of in the warp as described previously.

[0025] Likewise, in a third embodiment, even in a "mesh" fabric that is usually provided by means of a circular loom it is possible to make use of the principle on which the present invention is based. In this case, Figure 3, the fabric 1 comprises a plurality of weft or warp yarns which can alternately be of the insulating or of the insulated conducting type 3. At least two of the latter will be used to supply power to the circuit composed of other insulated conducting yarns 4 which will act as resistors (for example copper yarn) and other non-conducting yarns 2 (for example glass or polyester yarn).

[0026] Advantageously, the warp yarns of the conducting type can be provided by means of a flat ribbon made of metal, for example made of copper, which is very thin, such as not to compromise the flexibility of the fabric, and which can be used easily instead of a warp yarn.

[0027] In practice it has been found that the fabric according to the invention fully achieves the intended aim and objects, being able to provide a fabric that can be supplied with electric power, with areas having a different resistances depending on the requirements.

[0028] The fabric thus conceived is susceptible of numerous modifications and variations, all of which are

within the scope of the accompanying claims.

[0029] All the details may furthermore be replaced with technically equivalent elements.

[0030] In practice, the materials used, as well as the contingent shapes, may be any according to the requirements and the state of the art.

[0031] The disclosures in Italian Patent Application no. 102019000013944, from which this application claims priority, are incorporated herein by reference.

[0032] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A conducting fabric (1), **characterized in that** it comprises at least two yarns (3) adapted to carry an electric power supply, woven directly during weaving, the yarns (4; 10) of the fabric that intersect said at least two yarns (3) adapted to carry an electric power supply being welded at intersections (5) with said at least two yarns (3) adapted to carry an electric power supply, in order to define areas of said fabric that are adapted to be supplied with power.
2. The conducting fabric according to claim 1, **characterized in that** said at least two yarns (3) adapted to carry an electric power supply are warp yarns.
3. The conducting fabric according to claim 1, **characterized in that** said at least two yarns (3) adapted to carry an electric power supply are weft yarns.
4. The conducting fabric according to one or more of the preceding claims, **characterized in that** said at least two yarns (3) adapted to carry an electric power supply are made of copper or other conducting material.
5. The conducting fabric according to one or more of the preceding claims, **characterized in that** said warp yarns (2) or weft yarns (4; 10) which intersect and are welded to said at least two yarns (3) adapted to carry an electric power supply are made of copper or other conducting material.
6. The conducting fabric according to one or more of the preceding claims, **characterized in that** the weft yarns (4; 10) and/or the warp yarns (2) that are different from said at least two yarns (3) adapted to carry an electric power supply and from said warp or weft yarns that intersect said at least two yarns (3) adapted to carry an electric power supply are

made of insulating material.

7. The conducting fabric according to one or more of the preceding claims, **characterized in that** said warp yarns are provided by means of a flat metal ribbon. 5
8. The conducting fabric according to one or more of the preceding claims, **characterized in that** said yarns (4, 10) of the fabric are a continuous single yarn. 10
9. A method for providing a conducting fabric, **characterized in that** it comprises the steps of: 15
- weaving, directly on a weaving loom, a fabric (1) by replacing at least two weft yarns (4; 10) or warp yarns (2) with yarns (3) adapted to carry an electric power supply; 20
 - welding warp or weft yarns at crossing points (5) with said at least two yarns (3) adapted to carry an electric power supply; 25
- said weft yarns (4; 10) or warp yarns (2) that intersect said at least two yarns (3) adapted to carry an electric power supply being made of conducting material. 30

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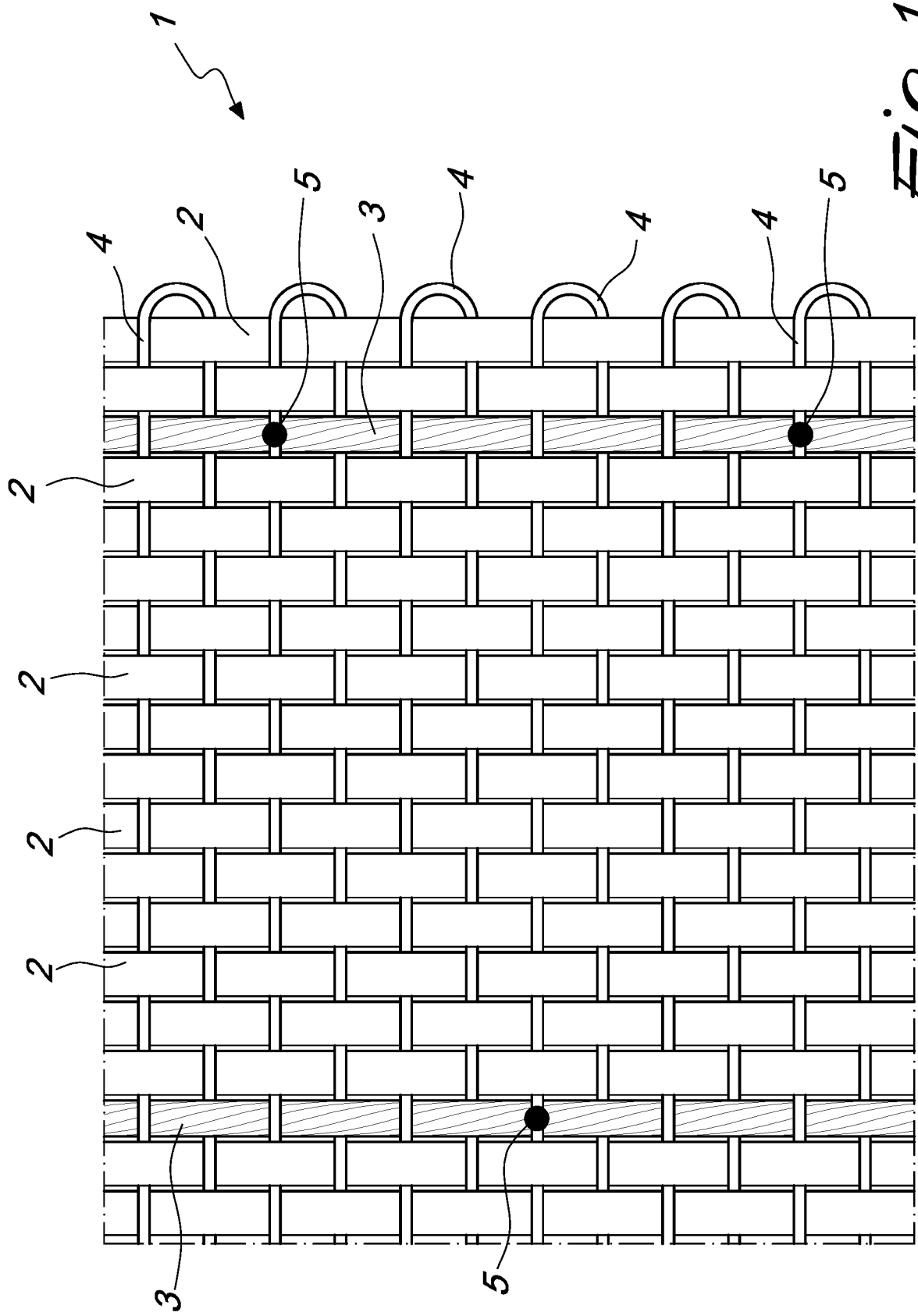


Fig. 1

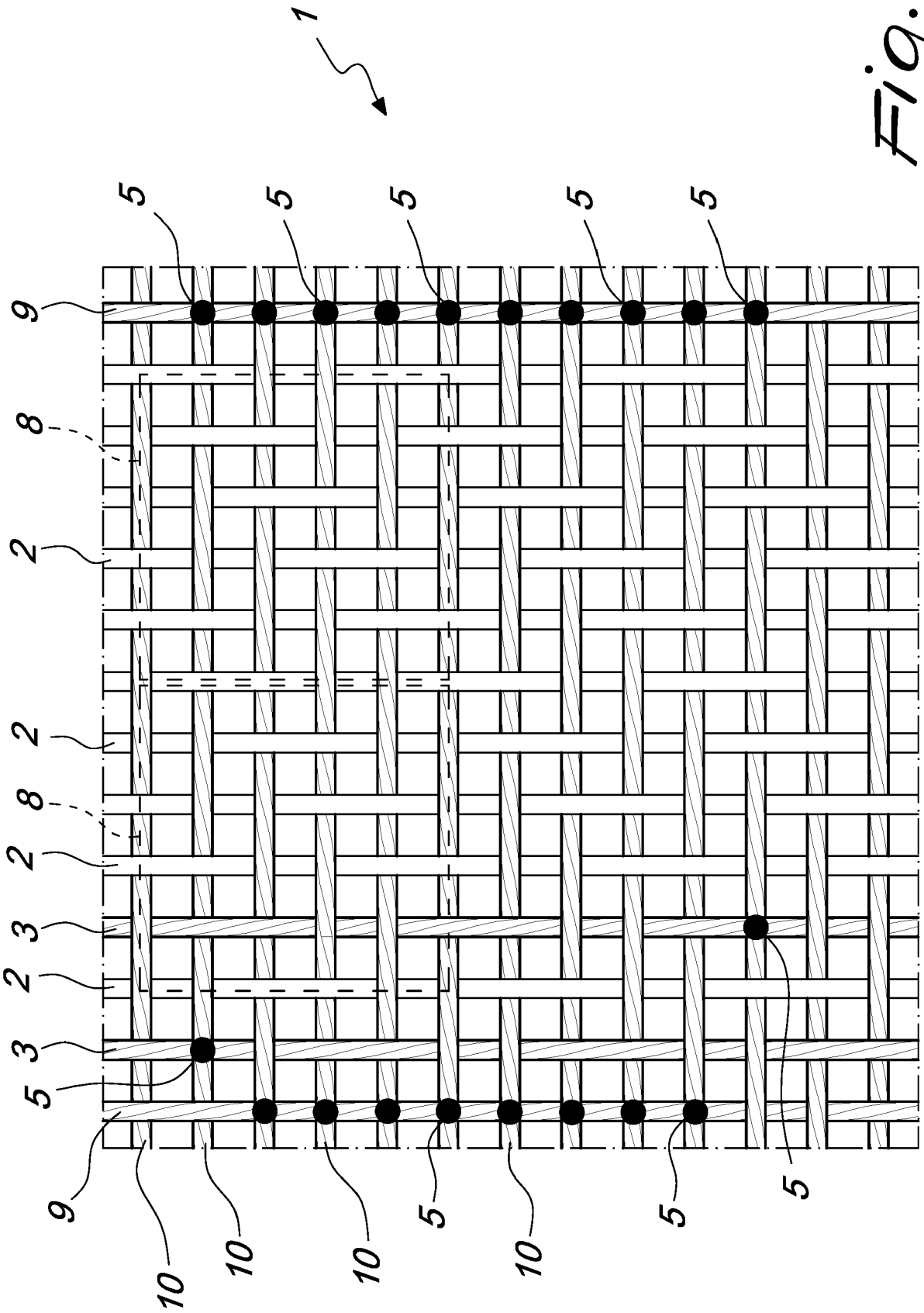


Fig. 2

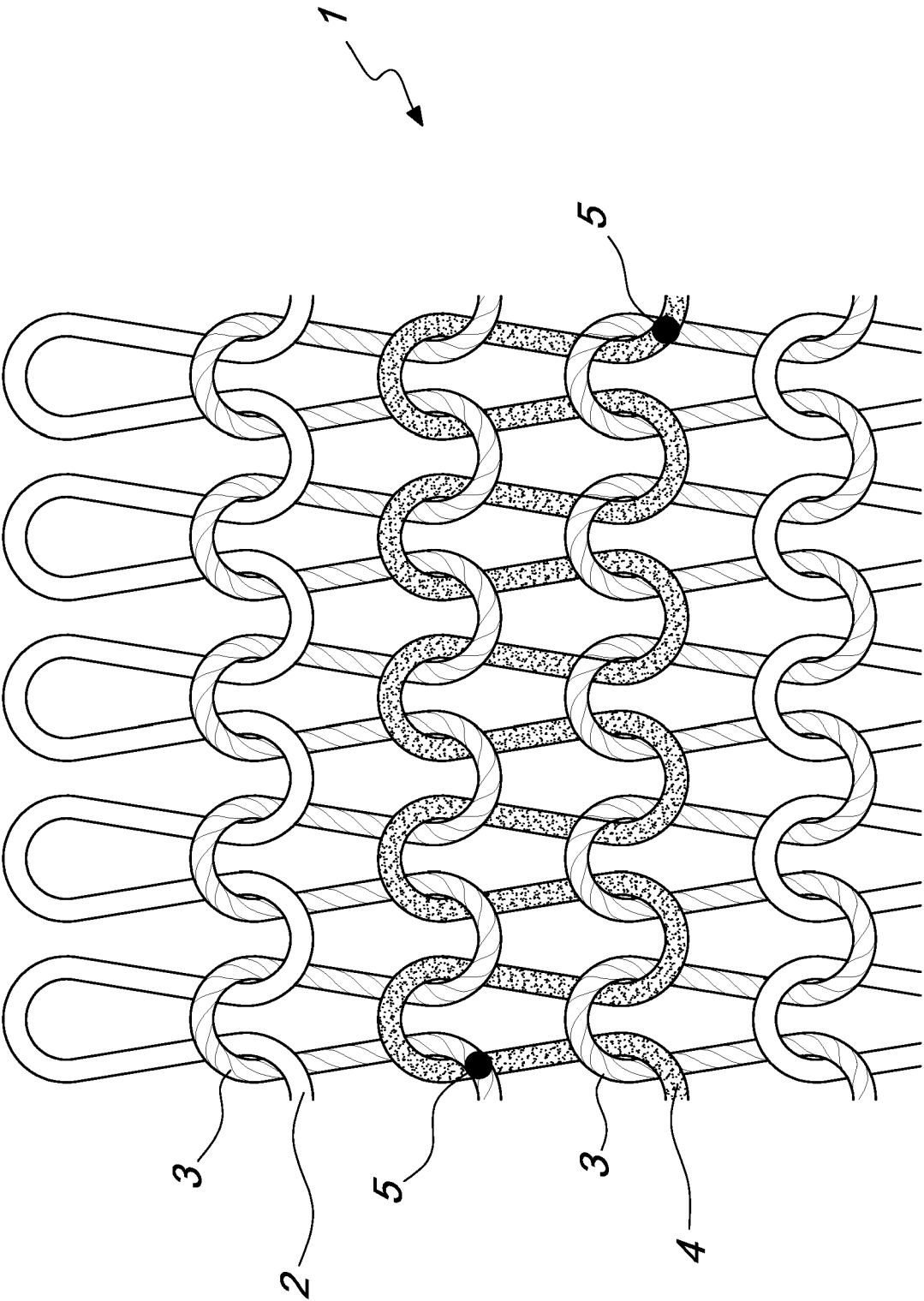


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 20 18 9254

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 722 614 A1 (SEFAR AG [CH]) 15 November 2006 (2006-11-15) * paragraph [0001] * * paragraph [0015] * * paragraph [0025] - paragraph [0027] * * paragraph [0029] - paragraph [0032] * * figures 1-4 *	1-9	INV. D03D1/00 D03D15/00 D04B1/14
X	FR 2 920 442 A1 (COMMISSARIAT ENERGIE ATOMIQUE [FR]) 6 March 2009 (2009-03-06) * page 4, line 7 - page 6, line 14 * * figure 3 *	1-9	
			TECHNICAL FIELDS SEARCHED (IPC)
			D03D D04B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 November 2020	Examiner Hausding, Jan
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 18 9254

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- IT 102019000013944 [0031]