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(54) **ELECTRICALLY CONDUCTIVE FABRIC**

ELEKTRISCH LEITFÄHIGER STOFF

ÉTOFFE ÉLECTROCONDUCTRICE

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Description

Technical field

[0001] The invention relates to a woven electrically conductive fabric that is electrically conductive in warp and in weft direction and in the directions that make an angle with the warp and weft directions. Such electrically conductive fabrics can e.g. be used in electrical heating elements, in textile electronics - which are electrical components consisting essentially out of textile structures (e.g. conductive textiles, e.g. in apparel) -, as sensor and for electromagnetic shielding.

Background art

[0002] Electrically conductive fabrics for use in electrical heating elements or for use in textile electronic components are known. US2004/173028 for instance, describes the combined use of an electrically conductive fabric in a car seat for car seat heating and as sensor.

[0003] US 3,472,289 describes a number of textile fabrics wherein metal filament yarns are used as electrical conductor. This publication describes the application of such fabrics as heating elements. However, these fabrics are not for all applications optimal, and show a number of drawbacks.

[0004] EP2206813A1 relates to a textile product that includes a leno woven fabric comprising electrically conductive yarns running in two directions. Electrically conductive connecting yarns - for connecting the conductive yarns of the fabric to a current source or an electric circuit; and to electrically contact the conductive yarns - are integrated in the fabric according to weaving technology over a portion of their length. The connecting yarns are formed by electrically conductive floating yarns that are sectionally integrated in the fabric.

[0005] EP2206813A1 discloses an electrically conductive fabric comprising a set of electrically conductive yarns in warp direction of the fabric; a set of electrically conductive yarns in the weft direction of the fabric; a set of electrically non-conductive yarns in the warp direction of the fabric; a set of electrically non-conductive yarns in the weft direction of the fabric; and a set of binding yarns in the warp direction of the fabric. The binding yarns are uniformly distributed over the width of the fabric. The set binding yarns provides by means of a leno weave with the set of electrically conductive yarns in warp direction the connection in the fabric between the set of electrically conductive yarns in warp direction and the set of electrically conductive yarns in weft direction.

Disclosure of the invention

[0006] It is an objective of the invention to provide an electrically conductive fabric that satisfies a combination of requirements:

- sufficiently isotropic electrical conductivity (also and especially in the conditions of use of the fabric) in warp and in weft direction, but also in the directions making an angle with the warp and weft direction. Preferably, the surface resistivity in the directions that make an angle of 45° with the warp and weft direction is at maximum 6 times higher than the average of the surface resistivity in warp and in weft direction. A sufficient isotropy is specifically of importance in conditions where the fabric is used where electrodes are connected in such a way to the fabric that the straight connection between the electrodes is not in warp or in weft direction.
- the fabric must have a textile character. With textile character is meant that the fabric must feel like a textile fabric, more specifically a textile fiber feel, as is obtained with fabrics with natural fibers (cotton, wool) or synthetic fibers or filaments (polyester, polyamide...).
- excellent durability in cyclic loading (e.g. cyclic bending loading) and with sufficient maintenance of the electrical conductivity after cyclic loading, and
- preferably be corrosion resistant.

[0007] Preferred fabrics have good air permeability and/or offer excellent electromagnetic shielding.

[0008] The objectives are reached with an electrically conductive fabric, comprising

- a set of electrically conductive yarns in the warp direction of the fabric, these yarns are uniformly distributed over the width of the fabric;
- a set of electrically conductive yarns in the weft direction of the fabric, preferably these yarns are uniformly distributed over the length of the fabric;
- a set of electrically non-conductive yarns in the warp direction of the fabric, preferably these yarns are uniformly distributed over the width of the fabric;
- a set of electrically non-conductive yarns in the weft direction of the fabric, preferably these yarns are uniformly distributed over the length of the fabric;
- a set of binding yarns in the warp direction of the fabric, these binding yarns are uniformly distributed over the width of the fabric; these yarns are preferably not electrically conductive,

and wherein

- the density of the set of electrically conductive yarns in the warp direction is substantially equal to the density of the electrically conductive set of yarns in the weft direction is;
- the electrically conductive yarns in the warp direction and the electrically conductive yarns in the weft direction have the same electrical conductivity, when considered per unit of length of the yarn;
- the set of binding yarns provides - via a leno weave

with the set of electrically conductive yarns in warp direction - the connection in the fabric between the set of electrically conductive yarns in warp direction and the set of electrically conductive yarns in weft direction.

[0009] Such a fabric provides a sufficient isotropy of the surface resistivity when the surface resistivity is measured in different directions.

[0010] With surface resistivity of fabrics is meant the electrical resistance that is measured by placing two electrodes on the fabric. The two electrodes are positioned parallel to each other at a distance D. The width of the electrodes is also equal to D, such that a fabric of square shape with sides equal to D is enclosed by the electrodes. The length D for the determination of the surface resistivity is 10 cm.

[0011] Traditional textile fabrics such as woven fabrics or knitted fabrics have a high inherent anisotropy of the surface resistivity caused by the structure and the positioning of the electrically conductive yarns: the surface resistivity strongly depends from the direction in which it is measured. When the electrodes are positioned such that the shortest distance between the electrodes is in the direction of the warp yarns or of the weft yarns (when these yarns are conductive) then the surface resistivity is much lower than when the shortest distance between the electrodes is making an angle with the warp and weft yarns (e.g. an angle of 45°). However, the fabrics of the invention have a sufficient degree of isotropy when the surface resistivity is measured in different directions. The objective is a ratio of the surface resistivity in 45° direction with the average of the surface resistivity in warp and weft direction of at maximum 6.

[0012] The conductive fabric of the invention has by the synergistic combination of its features a number of specific properties:

- the surface resistivity of the fabric is isotropic in warp and in weft direction. Preferably, the surface resistivity in warp direction is at maximum 10% higher or 10% lower than the surface resistivity in weft direction.
- the anisotropy of the surface resistivity in the other directions is limited (e.g. when the surface resistivity is measured in other directions, e.g. in 45° direction and compared with the surface resistivity in warp and/or weft direction), such that the surface resistivity is sufficiently isotropic.
- the electrical conductivity and the isotropy of the electrical conductivity are maintained at and after mechanical loading (including at cyclic dynamic loading) of the fabric e.g. in tensile load in one or more directions, in shearing, and in bending.
- the fabric is durable in cyclic bending, maintaining its electrical properties, including isotropy of the electrical conductivity (as expressed by the surface resistivity).
- the fabric is well drapable, such that other than flat shapes can be covered by the fabric.
- the fabric has a textile character.

[0013] Preferably, the same yarns are used in the set of electrically conductive yarns in warp direction as in the set of electrically conductive yarns in weft direction. Better isotropy is obtained, especially in mechanical load of the fabric.

[0014] Preferably the set of electrically non-conductive yarns in the warp direction has a density (number of yarns per cm) that is at least five times, and preferably at least 10 times, higher than the density (number of yarns per cm) of the set electrically conductive yarns in warp direction.

[0015] Preferably, the set of electrically non-conductive yarns in the weft direction has a density (number of yarns per cm) that is at least five times, and preferably at least 10 times, higher than the density (number of yarns per cm) of the set electrically conductive yarns in weft direction.

[0016] Preferably, the electrical conductive yarns in warp direction have in the fabric a crimp of less than 5%, more preferably less than 2%.

[0017] Preferably, the binding yarns in the warp direction have a crimp in the fabric which is at least 5% (absolute percentage) higher than the crimp in the fabric of the electrically conductive yarns in warp direction.

[0018] Preferably, the binding yarns in the warp direction have a crimp in the fabric between 2 and 20 %; more preferably between 7 and 20%.

[0019] Preferably, the electrically non-conductive yarns in the warp direction have a crimp between 2 and 10 %.

[0020] Preferably, the electrically non-conductive yarns in the weft direction have a crimp between 2 and 10 %.

[0021] More preferably, the electrically conductive yarns in weft direction have a crimp in the fabric less than 10 %, more preferably less than 5 %, even more preferably less than 2%.

[0022] Fabrics with high air permeability can be obtained. Preferably, the fabric has an air permeability of more than 1000 liter/ (dm^2.min), wherein the measurement is performed at an under pressure of 100 Pa and according to BS5636:1990. More preferably, the air permeability is more than 2000 liter/ (dm^2.min) and e.g. less than 3000 liter/ (dm^2.min).

[0023] Furthermore, fabrics can be made with a rather low conductivity (e.g. fabrics with a surface resistivity in the range of 0.1 to 10 Ohm, when measured in warp direction, preferably between 1 and 10 Ohm, more preferably between 5 and 10 Ohm) and that still have the mentioned favorable properties.

[0024] Preferably the leno weave is formed by twisting each yarn of the set of binding yarns with respect to one yarn of the set of electrically conductive yarns in the warp direction, with each time in between one yarn of the set of electrically conductive yarns in weft direction.

[0025] It is a specific objective of the invention to provide such fabrics in the range of surface resistivity between 0.1 and 10 Ohm (and preferably between 1 and 10 Ohm, more preferably between 5 and 10 Ohm), when measured in warp direction of the fabric, because such fabrics are interesting for application as heating element, e.g. for heating of car seats.

[0026] In a preferred embodiment, the set of electrically non-conductive yarns in warp direction and the set of electrically non-conductive yarns in the weft direction are connected to each other by means of a classical weave (with classical weave is meant that the weave is not a leno weave; examples of weaves that can be used are plain weaves, twill weaves and satin weaves or weaves derived from those weaves). Preferably, there are no floating yarns over more than two yarns.

[0027] In a specific embodiment, the connection between the set of electrically conductive yarns in warp direction and the set of electrically non-conductive yarns in weft direction is obtained by means of a classical weave (with classical weave is meant that the weave is not a leno weave; examples of weaves that can be used are plain weaves, twill weaves and satin weaves or weaves derived from those weaves). Preferably, there are no floating yarns over more than two yarns.

[0028] In an embodiment of het invention, the connection between the set of electrically non-conductive yarns in warp direction and the set of electrically conductive yarns in the weft direction is obtained by means of a classical weave (e.g. a plain weave, a twill weave or a satin weave or derived weaves). Preferably, there are no floating yarns over more than two yarns.

[0029] In an embodiment, the connection between the set of electrically non-conductive yarns in the weft direction and the set of binding yarns in the warp direction is obtained by means of a classical weave (e.g. a plain weave, a twill weave or a satin weave or derived weaves), preferably there are no floating yarns over more than two yarns.

[0030] These embodiments, in themselves and in combination, offer the benefit that the fabric properties are even better maintained - including the electrical properties and the isotropy of the electrical conductivity and their durability in dynamic loading, also in bending load - when the fabric is mechanically loaded.

[0031] In a preferred embodiment, the set of electrically non-conductive yarns in warp direction and the set of electrically non-conductive yarns in the weft direction are connected to each other by means of a leno weave. To this end, an additional set of binding yarns in warp direction can be available; this additional set can make a leno weave in combination with the electrically non-conductive yarns in warp direction with in between the non-conductive yarns in weft direction. Preferably, the electrically conductive yarns in weft direction are also connected to the electrically non-conductive yarns in warp direction via the leno weave made by the electrically non-conductive yarns in warp direction in combination with the additional set of binding yarns in warp direction. Preferably, the yarns of the additional set of binding yarns are the same in structure and composition as the set of binding yarns making the leno weave with the set of electrically conductive yarns in warp direction.

[0032] These embodiments, in themselves and in combination, offer the benefit that the fabric properties are even better maintained - including the electrical properties and the isotropy of the electrical conductivity and their durability in dynamic loading, also in bending load - when the fabric is mechanically loaded.

[0033] Preferably, the set of electrically non-conductive yarns in warp direction and/or the set of electrically non-conductive yarns in weft direction comprise monofilament yarns or multifilament yarns or yarns spun from fibers, preferably out of polymeric material.

[0034] More preferred are multifilament yarns out of polyester or polyamide, e.g. finer than 600 dtex, e.g. finer than 200 dtex. Such yarns are beneficial for the durability of the fabric.

[0035] The use of textured multifilament yarns in the set of electrically non-conductive yarns in weft direction and/or the use of textured multifilament yarns in the set of electrically non-conductive yarns in warp direction is preferred for obtaining a good air permeability of the electrically conductive fabric.

[0036] Preferably, thermally stabilized (heat set) multifilament yarns are used in one or both of the sets of sets of electrically non-conductive yarns.

[0037] Preferably, thermally stabilized (heat set) yarns are used in the set of binding yarns, for instance texturized polyester multifilament in the range of 50 - 2000 dtex, e.g. in the range of 100 - 600 dtex, e.g. in the range of 100 - 500 dtex, e.g. 165 dtex or e.g. 550 dtex. In an embodiment of the invention, the electrically conductive fabric has a surface resistivity between 1 en 10 Ohm when measured in the warp direction of the fabric.

[0038] In an embodiment of the invention, part of the binding yarns of the set of binding yarns have a leno weave in S-direction, whereas another part of the binding yarns of the set of binding have a leno weave in Z-direction when binding with the same weft yarn. Preferably -when considered over a unit of width of the fabric (and considered for a conductive weft yarn) - the number of binding yarns that make a leno weave in S-direction is substantially equal with the number of binding yarns that make a leno weave in Z-direction. The characterizing feature of this embodiment synergistically maintains further the isotropy of the electrical conductivity (of the surface resistivity) of the fabric (in weft and warp direction, but also in other directions) at mechanical load of the fabric, as the fabric remains more stable in mechanical loading, as the fabric deforms more uniformly.

[0039] In an embodiment of the invention, the electrically conductive yarns of the set of electrically conductive yarns in warp direction and the electrically conductive yarns in the set of electrically conductive yarns in the weft direction comprise metal fibers and/or metal filaments; preferably stainless steel fibers and/or stainless steel filaments. Preferably metal monofilaments or metal multifilaments are used as they have a low change in electrical conductivity at mechanical load (e.g. in tensile load of the fabric). However, it is also possible to use spun yarns, e.g. blended yarns out of non-conductive fibers (e.g. comprising cotton and/or polyester) and metal fibers (e.g. out of stainless steel).

[0040] The use of metal filaments (meaning with virtually unlimited length) is preferred over the use of metal fibers (which has a specific length). Fibers are spun into yarns. Filaments - on their own (monofilament) or combined (twisted, plied, cabled) into a yarn (of into a multiple yarn) provide fabrics with improved isotropy of the surface resistivity.

[0041] Preferably filaments out of stainless steel are used. The use of stainless steel multifilament yarns provides a synergistic improvement of the durability in cyclic loading of the fabric. Multifilaments out of stainless steel can e.g. be produced using the technology of bundled drawing. Such multifilaments have a characterizing hexagonal cross section.

[0042] Metal multifilament yarns as conductive yarns in warp and weft directions preferably have a twist of at least 40 turns per meter, and preferably less than 200 turns per meter. Such twist improves the isotropy of the electrical conductivity of the fabric.

[0043] In a preferred embodiment, the electrically conductive yarns in warp and in weft direction are multifilament yarns out of stainless steel, e.g. bundle drawn stainless steel filaments. Preferably such yarns have a twist of at least 40 turns per meter, and preferably less than 200 turns per meter. Such twist improves the isotropy of the electrical conductivity of the fabric.

[0044] The use of metal fibers or metal filaments as or in the electrically conductive yarns provides the additional benefit that the electrically conductive fabric provides good shielding properties against electromagnetic radiation.

[0045] In an embodiment, the cover factor of the fabric is higher than 0.5, preferably higher than 0.7. With cover factor is meant the ratio of the surface that is covered by the yarns of the fabric over the surface of the fabric. A cover factor equal to 1 means that the full surface of the fabric is covered and that no space is present between the yarns in the fabric. At a cover factor equal to 0.5, half of the surface is covered by the yarns of the fabric and half of the surface is not covered because there is space between the yarns in the fabric. This additional feature of this embodiment contributes to and increases the maintenance of the isotropic electrical conductivity of the fabric at mechanical loading.

[0046] In a specific embodiment of the invention, the surface resistivity of the fabric in warp direction is at maximum 10% higher or 10% lower than the surface resistivity in weft direction.

[0047] In a preferred embodiment, the surface resistivity in the direction under an angle of 45° with the set of electrically conductive yarns warp direction is at maximum six times the average of the surface resistivity in warp and in weft direction. And preferably at maximum five times, more preferably at maximum three times, and even more preferably at maximum two times the average of the surface resistivity in warp and in weft direction.

[0048] In a specific embodiment of any of the described embodiments of the invention, the fabric comprises electrical connectors via which an electrical current and/or a voltage can be applied to the fabric.

[0049] The electrical conductive fabric offers effective shielding against electromagnetic radiation of a wave length larger than ten times the dimension of the distance between the electrically conductive yarns in the fabric. Therefore, the distance between consecutive electrically conductive yarns is preferably at maximum 3 cm, more preferably at maximum 1 cm, even more preferably at maximum 6 mm, for a suitable shielding against electromagnetic radiation. Such fabrics (with a limited distance between consecutive conductive yarns) have - thanks to the synergistic effect of this feature - an improved isotropy of the surface resistivity of the fabric.

[0050] The second aspect of the invention is the use of the electrically conductive fabric of the first aspect of the invention as sensor, as capacitor, as part in electronic components (e.g. textile electronic components) or as electrical heating element.

[0051] Fabrics according to the invention can e.g. be used in heating elements, e.g. in apparel (coats, underwear, scarfs or shawls), in car seat heating or for heating of domestic seats, or in or as textile electronic components (e.g. in process control in apparel - electrical or electronic textiles, e.g. as sensor).

Mode(s) for Carrying Out the Invention

[0052] An exemplary fabric of the invention comprises the following sets of yarns:

- in warp direction a set of twisted stainless steel multifilament yarns (e.g. multifilament yarns which are 200 bundle drawn stainless steel filaments each of diameter 40 μm, twisted together with 200 turns per meter in Z - direction), with a density of two yarns per centimeter. These yarns have a crimp in the fabric of 1%.
- in warp direction a set of binding yarns out of polyester, e.g. a monofilament 480/1 dtex, with a density of two yarns per centimeter. These yarns have a crimp in the fabric of 7 %.
- in warp direction a set of polyester multifilament yarns (e.g. 167/1 dtex or 550/1 dtex), with a density of 14 yarns per centimeter. These yarns have a crimp in the fabric of 5 %.
- in weft direction a set of twisted stainless steel multifilament yarns (e.g. multifilament yarns comprising 200 bundle drawn stainless steel filaments each of

diameter 14 micrometer, twisted together with 200 turns per meter in Z direction), with a density of 2 yarns per centimeter. These yarns have a crimp in the fabric of 2%.

- in weft direction a set of polyester multifilament yarns (e.g. 167/1 dtex, or e.g. 550/1 dtex), with a density of 14 yarns per centimeter. These yarns have a crimp of 5% in the fabric.

[0053] The sets polyester multifilament yarns in the warp and weft direction are connected by means of a plain weave.

[0054] The set electrically conductive yarns in weft direction can be connected with the set of polyester multifilament yarns in warp direction by means of a plain weave.

[0055] The set electrically conductive yarns in warp direction and the set binding yarns in warp direction are not interwoven with the set polyester yarns in weft direction, but one set runs over and the other set below the set polyester multifilament yarns is weft direction.

[0056] Each binding yarn makes a leno weave with a yarn from the set of twisted stainless steel multifilament yarns in warp direction, with in between each time one yarn of the set of twisted stainless steel multifilament yarns in weft direction.

[0057] The surface resistivity of the fabric is in warp direction 0.2 Ohm, in weft direction 0.2 Ohm and 1 Ohm in the direction making an angle of 45° with warp and weft direction.

[0058] The air permeability is 1370 l/(dm^2.min), wherein the measurement is performed at an under pressure of 100 Pa and according to BS5636:1990. This fabric can be bent easily (e.g. up to a small bending radius) and has excellent durability in mechanical loading, inlcuding in cyclic bending loading over 180°. When the fabric is mechanically loaded, the change of the surface resistivity of the fabric is limited.

[0059] After bending with a bending radius of 1 mm the surface resistivity of the tested fabric samples increased with at maximum 10%.

[0060] As an alternative, it is also possible to connect the sets polyester multifilament yarn in the warp and in the weft direction by means of a leno weave. To this end, an additional set of binding yarns in warp direction can be available, e.g. the additional binding yarns can be the same in terms of structure and composition as the set of binding yarns making the leno weave with the set of electrically conductive yarns in warp direction. This additional set can make a leno weave in combination with the electrically non-conductive yarns in warp direction with in between the non-conductive yarns in weft direction. Preferably, the electrically conductive yarns in weft direction are also connected to the electrically non-conductive yarns in warp direction via the leno weave made by the electrically non-conductive yarns in warp direction in combination with the additional set of binding yarns in warp direction. Such fabric also provided excellent performance results.

[0061] Features of the different embodiments and of the examples can be combined wherein such combinations are covered by the scope of the invention.

Claims

1. Electrically conductive fabric, comprising

   - a set of electrically conductive yarns in warp direction of the fabric;
   - a set of electrically conductive yarns in the weft direction of the fabric;
   - a set of electrically non-conductive yarns in the warp direction of the fabric;
   - a set of electrically non-conductive yarns in the weft direction of the fabric;
   - a set of binding yarns in the warp direction of the fabric, the binding yarns are uniformly distributed over the width of the fabric,

   and wherein the set binding yarns provides by means of a leno weave with the set of electrically conductive yarns in warp direction the connection in the fabric between the set of electrically conductive yarns in warp direction and the set of electrically conductive yarns in weft direction;
   characterized in that the yarns of the set of electrically conductive yarns in warp direction of the fabric are uniformly distributed over the width of the fabric; the density of the set of electrically conductive yarns in the warp direction and the density of the set of electrically conductive yarns in weft direction are substantially equal;
   and the electrically conductive yarns in the warp direction and in the weft direction have the same electrical conductivity.

2. The electrically conductive fabric of claim 1, wherein the set of electrically non-conductive yarns in the warp direction and the set of electrically non-conductive yarns in the weft direction are connected to each other by means of a leno weave.

3. The electrically conductive fabric of claim 1, wherein the set of electrically non-conductive yarns in the warp direction and the set of electrically non-conductive yarns in the weft direction are connected to each other by means of a classical weave.

4. The electrically conductive fabric as in any of the preceding claims, wherein the fabric has a surface resistivity between 0.1 en 10 Ohm when measured in the warp direction of the fabric.

5. The electrically conductive fabric as in any of the preceding claims, wherein a part of the binding yarns

of the set of binding yarns makes a leno weave in S-direction, whereas another part of the binding yarns of the set of binding yarns makes a leno weave in Z-direction.

6. The electrically conductive fabric as in any of the preceding claims, wherein the electrically conductive yarns in the set of electrically conductive yarns in the warp direction and the electrically conductive yarns in the set of electrically conductive yarns in the weft direction comprise metal fibers and/or metal filaments.

7. The electrically conductive fabric of claim 6, wherein the electrical conductivity of the electrically conductive yarns in the set of electrically conductive yarns in the warp direction; and the electrical conductivity of the electrically conductive yarns in the set of electrically conductive yarns in the weft direction is obtained by means of metal filaments in these yarns.

8. The electrically conductive fabric as in any of the preceding claims, wherein the cover factor of the fabric is more than 0.5.

9. The electrically conductive fabric as in any of the preceding claims, wherein the surface resistivity of the fabric in warp direction is at maximum 10% higher or 10% lower than the surface resistivity in weft direction.

10. The electrically conductive fabric as in any of the preceding claims, wherein the surface resistivity in the direction that makes an angle of 45° with the set of electrically conductive yarns in warp direction is at maximum 6 times the average of the surface resistivity in warp and in weft direction.

11. The electrically conductive fabric as in any of the preceding claims, wherein the fabric comprises electrical connectors via which an electrical current and/or a voltage can be applied to the fabric.

12. Use of the electrically conductive fabric as in any of the preceding claims, in an electrical heating element, and/or as part of electronic components - e.g. textile electronic components, and/or as sensor.

Patentansprüche

1. Elektrisch leitfähiger Stoff, umfassend

- einen Satz elektrisch leitfähiger Fäden in Kettfadenrichtung des Stoffes;
- einen Satz elektrisch leitfähiger Fäden in der Querfadenrichtung des Stoffes;
- einen Satz elektrisch nichtleitender Fäden in der Kettfadenrichtung des Stoffes;
- einen Satz elektrisch nichtleitender Fäden in der Querfadenrichtung des Stoffes;
- einen Satz Bindefäden in der Kettfadenrichtung des Stoffes, wobei die Bindefäden gleichmäßig über die Breite des Stoffes verteilt sind,

und wobei der Satz Bindefäden mittels einer Linonbindung mit dem Satz elektrisch leitfähiger Fäden in Kettfadenrichtung die Verbindung in dem Stoff zwischen dem Satz elektrisch leitfähiger Fäden in Kettfadenrichtung und dem Satz elektrisch leitfähiger Fäden in Querfadenrichtung bereitstellt;
dadurch gekennzeichnet, dass die Fäden des Satzes elektrisch leitfähiger Fäden in Kettfadenrichtung des Stoffes gleichmäßig über die Breite des Stoffes verteilt sind;
die Dichte des Satzes elektrisch leitfähiger Fäden in der Kettfadenrichtung und die Dichte des Satzes elektrisch leitfähiger Fäden in Querfadenrichtung im Wesentlichen gleich sind;
und die elektrisch leitfähigen Fäden in der Kettfadenrichtung und in der Querfadenrichtung die gleiche elektrische Leitfähigkeit aufweisen.

2. Elektrisch leitfähiger Stoff nach Anspruch 1, wobei der Satz elektrisch nichtleitender Fäden in der Kettfadenrichtung und der Satz elektrisch nichtleitender Fäden in der Querfadenrichtung mittels einer Linonbindung miteinander verbunden sind.

3. Elektrisch leitfähiger Stoff nach Anspruch 1, wobei der Satz elektrisch nichtleitender Fäden in der Kettfadenrichtung und der Satz elektrisch nichtleitender Fäden in der Querfadenrichtung mittels einer klassischen Bindung miteinander verbunden sind.

4. Elektrisch leitfähiger Stoff nach einem der vorhergehenden Ansprüche, wobei der Stoff einen spezifischen Oberflächenwiderstand zwischen 0,1 und 10 Ohm aufweist, wenn er in der Kettfadenrichtung des Stoffes gemessen wird.

5. Elektrisch leitfähiger Stoff nach einem der vorhergehenden Ansprüche, wobei ein Teil der Bindefäden des Satzes Bindefäden eine Linonbindung in S-Richtung macht, wohingegen ein anderer Teil der Bindefäden des Satzes Bindefäden eine Linonbindung in Z-Richtung macht.

6. Elektrisch leitfähiger Stoff nach einem der vorhergehenden Ansprüche, wobei die elektrisch leitfähigen Fäden in dem Satz elektrisch leitfähiger Fäden in der Kettfadenrichtung und die elektrisch leitfähigen Fäden in dem Satz elektrisch leitfähiger Fäden in der Querfadenrichtung Metallfasern und/oder Metallfilamente umfassen.

7. Elektrisch leitfähiger Stoff nach Anspruch 6, wobei die elektrische Leitfähigkeit der elektrisch leitfähigen Fäden in dem Satz elektrisch leitfähiger Fäden in der Kettfadenrichtung und die elektrische Leitfähigkeit der elektrisch leitfähigen Fäden in dem Satz elektrisch leitfähiger Fäden in der Querfadenrichtung mittels Metallfilamenten in diesen Fäden erhalten wird.

8. Elektrisch leitfähiger Stoff nach einem der vorhergehenden Ansprüche, wobei der Deckfaktor des Stoffes größer ist als 0,5.

9. Elektrisch leitfähiger Stoff nach einem der vorhergehenden Ansprüche, wobei der spezifische Oberflächenwiderstand des Stoffes in Kettfadenrichtung maximal 10 % größer oder 10 % kleiner ist als der spezifische Oberflächenwiderstand in Querfadenrichtung.

10. Elektrisch leitfähiger Stoff nach einem der vorhergehenden Ansprüche, wobei der spezifische Oberflächenwiderstand in der Richtung, die in einem Winkel von 45° zu dem Satz elektrisch leitfähiger Fäden in Kettfadenrichtung verläuft, maximal das 6-fache des durchschnittlichen spezifischen Oberflächenwiderstands in Kettfaden- und in Querfadenrichtung beträgt.

11. Elektrisch leitfähiger Stoff nach einem der vorhergehenden Ansprüche, wobei der Stoff elektrische Verbinder umfasst, über die ein elektrischer Strom und/oder eine Spannung an den Stoff angelegt werden können.

12. Verwendung des elektrisch leitfähigen Stoffes nach einem der vorhergehenden Ansprüche in einem elektrischen Heizelement und/oder als Teil elektronischer Komponenten - z. B. elektronischer Textilkomponenten - und/oder als Sensor.

Revendications

1. Tissu électriquement conducteur, comprenant :

- un ensemble de fils électriquement conducteurs dans la direction de chaîne du tissu ;
- un ensemble de fils électriquement conducteurs dans la direction de trame du tissu ;
- un ensemble de fils non électriquement conducteurs dans la direction de chaîne du tissu ;
- un ensemble de fils non électriquement conducteurs dans la direction de trame du tissu ;
- un ensemble de fils de liaison dans la direction de chaîne du tissu, les fils de liaison étant répartis uniformément sur la largeur du tissu, et dans lequel l'ensemble de fils de liaison assure, au moyen d'une armure gaze avec l'ensemble de fils électriquement conducteurs dans la direction de chaîne, la liaison dans le tissu entre l'ensemble de fils électriquement conducteurs dans la direction de chaîne et l'ensemble de fils électriquement conducteurs dans la direction de trame ;

caractérisé en ce que les fils de l'ensemble de fils électriquement conducteurs dans la direction de chaîne du tissu sont répartis uniformément sur la largeur du tissu ;
la densité de l'ensemble de fils électriquement conducteurs dans la direction de chaîne et la densité de l'ensemble de fils électriquement conducteurs dans la direction de trame sont sensiblement égales ;
et les fils électriquement conducteurs dans la direction de chaîne et dans la direction de trame ont la même conductivité électrique.

2. Tissu électriquement conducteur selon la revendication 1, dans lequel l'ensemble de fils non électriquement conducteurs dans la direction de chaîne et l'ensemble de fils non électriquement conducteurs dans la direction de trame sont liés les uns aux autres au moyen d'une armure gaze.

3. Tissu électriquement conducteur selon la revendication 1, dans lequel l'ensemble de fils non électriquement conducteurs dans la direction de chaîne et l'ensemble de fils non électriquement conducteurs dans la direction de trame sont liés les uns aux autres au moyen d'une armure classique.

4. Tissu électriquement conducteur selon l'une quelconque des revendications précédentes, le tissu ayant une résistivité de surface de 0,1 à 10 ohms, mesurée dans la direction de chaîne du tissu.

5. Tissu électriquement conducteur selon l'une quelconque des revendications précédentes, dans lequel une partie des fils de liaison de l'ensemble de fils de liaison forme une armure gaze dans la direction S, tandis qu'une autre partie des fils de liaison de l'ensemble de fils de liaison forme une armure gaze dans la direction Z.

6. Tissu électriquement conducteur selon l'une quelconque des revendications précédentes, dans lequel les fils électriquement conducteurs dans l'ensemble de fils électriquement conducteurs dans la direction de chaîne et les fils électriquement conducteurs dans l'ensemble de fils électriquement conducteurs dans la direction de trame comprennent des fibres métalliques et/ou des filaments métalliques.

7. Tissu électriquement conducteur selon la revendication 6, dans lequel la conductivité électrique des fils électriquement conducteurs dans l'ensemble de fils électriquement conducteurs dans la direction de chaîne et la conductivité électrique des fils électriquement conducteurs dans l'ensemble de fils électriquement conducteurs dans la direction de trame sont obtenues au moyen de filaments métalliques présents dans ces fils.

8. Tissu électriquement conducteur selon l'une quelconque des revendications précédentes, dans lequel le facteur de couverture du tissu est supérieur à 0,5.

9. Tissu électriquement conducteur selon l'une quelconque des revendications précédentes, dans lequel la résistivité de surface du tissu dans la direction de chaîne est au maximum 10 % plus élevée ou 10 % plus basse que la résistivité de surface dans la direction de trame.

10. Tissu électriquement conducteur selon l'une quelconque des revendications précédentes, dans lequel la résistivité de surface dans la direction qui forme un angle de 45 ° avec l'ensemble de fils électriquement conducteurs dans la direction de chaîne est d'au maximum 6 fois la moyenne de la résistivité de surface dans la direction de chaîne et dans la direction de trame.

11. Tissu électriquement conducteur selon l'une quelconque des revendications précédentes, le tissu comprenant des connecteurs électriques par l'intermédiaire desquels un courant électrique et/ou une tension peuvent être appliqués au tissu.

12. Utilisation du tissu électriquement conducteur selon l'une quelconque des revendications précédentes, dans un élément chauffant électrique, et/ou en tant qu'élément de composants électroniques, par exemple des composants électroniques textiles, et/ou comme capteur.

REFERENCES CITED IN THE DESCRIPTION

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