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(54) **Fabric for the manufacturing of protective clothing against stun guns**

(57) The present invention relates to a fabric that is suitable for making protective clothes against electro-shock weapons, which comprises electrically conducting elements, the electrically conducting elements being formed either by stainless-steel fibres or by mutually perpendicular stainless-steel filaments, and the said fabric having an electrical resistance of at most 10^5 ohm/square. The presence of sufficient stainless-steel fibres or stainless-steel filaments in the fabric ensures a good conductivity for the fabric, so that the electrical charge issuing from the electroshock weapon is dissipated through the fabric, and the risk of injury is minimized for the person wearing protecting clothes made from this fabric.

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Description

[0001] The present invention relates to a fabric that is suitable for making protective clothes against electroshock weapons.

[0002] Police forces and other security personnel are making increasing use of electroshock weapons, also called shock impact weapons, stun guns or tasers, for immobilizing suspects or animals. These weapons deliver an electric shock in order to interrupt the function of the superficial muscles.

[0003] A well-known type of electroshock weapon is the Taser®, which causes paralysis by delivering an electric shock of 50,000 to 1,000,000 volt. Such a taser generally has two pins (electrodes), with a current passing through them. The pins can penetrate through clothes and may be fitted with barbs to prevent them from becoming detached easily. When the pins come sufficiently close to the human body, the person in question receives a number of electric shocks. These block the electric signals between the brain and the muscles, causing paralysis and collapsing of the person in question. In an alternative embodiment, the pins (electrodes) are connected to the device by electrically conducting wires, so they can be propelled from the weapon over a distance of 4-10 metres.

[0004] The police and other security personnel must be able to have suitable protective clothes that neutralize the effect of electric shock weapons in order to ensure adequate protection from such weapons and to prevent the use of their own weapons against them.

[0005] Fabrics for making such protective clothes are already known *per se.* It is for example known to weave into a fabric electrically conducting wires at a certain distance (1 cm) from one another. However, these fabrics have the disadvantage that sparks are generated when an electroshock weapon comes into contact with them but the electrodes of the weapon do not come into direct contact with the wires present. Furthermore, these fabrics cannot neutralize the whole current surge issuing from the electroshock weapon.

[0006] To solve the above problem, US patent specification 2006/0,175,581 discloses a fabric that is provided with an electrically conducting coating. However, this solution has the disadvantage that an additional processing step is required in order to apply the coating to the fabric. In addition, the effect of the coating is limited in time, because it disappears from the fabric after a number of washing operations. A coated fabric is also inevitably much less comfortable to wear, because it is much less permeable to air and water vapour.

[0007] The aim of the present invention is therefore to provide a fabric for making protective clothes against electroshock weapons that are comfortable to wear and offer permanent protection against electroshock weapons.

[0008] The aim of the invention is achieved by providing a fabric that is suitable for making protective clothes against electroshock weapons, which comprises electrically conducting elements, the electrically conducting elements being formed either by stainless-steel fibres or by mutually perpendicular stainless-steel filaments, and the said fabric having an electrical resistance of at most 10^5 ohm/square, measured according to European Standard EN 1149. The electrical resistance of the fabric is measured more specifically according to European Standard EN 1149-1. The fabric preferably has an electrical resistance that lies between 10^2 and 10^5 ohm/square (O/square), measured according to European Standard EN 1149-1, and more preferably one that lies between 10^3 and 10^4 ohm/square. More especially, the fabric according to the invention has an electrical resistance of at most 10^4 ohm/square, measured according to European Standard EN 1149-1. Most especially, the fabric according to the invention has an electrical resistance of at most 10^3 ohm/square, measured according to European Standard EN 1149-1.

[0009] This European Standard EN 1149-1 is used to determine in particular the surface resistance of a fabric with the aid of two metal rings of a different diameter and is carried out at a humidity of 25% and a temperature of 23°C (it should be mentioned here that this very low humidity should be regarded as a worst case scenario).

[0010] The presence of sufficient stainless-steel fibres or stainless-steel filaments in the fabric ensures that the fabric has a much higher conductivity than the human body, so the electric charge issuing from the electroshock weapon is dissipated through the fabric, and the risk of injury is minimized for the person wearing the protective clothes made from such a fabric. Furthermore, the use of stainless steel has the advantage that the fabric is washable and offers permanent protection from electric discharges issuing from electroshock weapons. Another advantage is that stainless steel does not corrode.

[0011] In a preferred embodiment of the fabric according to the invention, the said stainless-steel fibres are (intimately) mixed with the fibres from which the yarns of the fabric are made. This means that all the yarns from which the fabric is made contain both a certain amount of stainless steel fibres, and a certain amount of non-metal fibres. In particular, each yarn contains at least 0.5 wt-% of stainless-steel fibres, for example at least 1 wt-% fibres, such as at least 5 wt-% or at least 8 wt-% fibres. The higher the percentage of stainless-steel fibres by weight, the lower the electrical resistance, and the better the protection against the effect of electroshock weapons. When the fabric contains around 1 wt-% of stainless-steel fibres, a tingling is still experienced by the wearer when the fabric is brought into contact with an electroshock weapon. However, as the percentage of stainless-steel fibres by weight is increased, the tingling will be reduced.

[0012] The fabrics made from the yarns described above preferably comprise at least 1 g/m^2 of stainless-steel fibres, for example at least 2 g/m^2 of stainless-steel fibres, preferably at least 10 g/m^2 of stainless-steel fibres

and more especially at least 16 g/m^2 of stainless-steel fibres.

[0013] In a more preferred embodiment, the other, non-metallic fibres for which the yarns of the fabric are made are chosen from a group comprising natural, artificial or synthetic fibres. In particular, the fibres from which the yarns of the fabric are made are chosen according to the other properties the fabric in question is required to have, and are for example aramids, modacrylic and FR viscose for making a fireproof fabric, or they are cotton, PES, PA, wool, etc. for purposes of comfort and appearance.

[0014] In another preferred embodiment of the fabric according to the invention, the said fabric comprises a first group of stainless-steel filaments and a second group of stainless-steel filaments, which extend respectively in the longitudinal and transverse direction of the fabric. This produces a lattice structure of stainless-steel filaments in the fabric. It is important for the different filaments to lie sufficiently close to one another, so that a fine lattice structure is obtained. In particular, the maximum distance at which two stainless-steel filaments can lie from each other is the same as the diameter of the electrodes in the electroshock weapon. This prevents the electrodes from coming into contact with a non-conducting yarn, and it prevents undesirable sparking.

[0015] According to a special embodiment of the fabric according to the invention, the stainless-steel filaments of the same group are laid at a distance of at most 1.5 mm from one another.

[0016] Another aim of the present patent application relates to the use of stainless-steel fibres or mutually perpendicular stainless-steel filaments in fabrics that are suitable for making protective clothes against electroshock weapons.

[0017] The fabric according to the present invention is described below in more detail in order to further explain the characteristics of the present invention and present its additional advantages and features. It will be obvious that nothing mentioned in the following description can be taken as a limitation of the scope of protection sought for the invention in the claims.

[0018] The present invention relates to a fabric that is suitable for making protective clothes against electroshock weapons, so that police and other security personnel can adequately protect themselves from the effect of these weapons.

[0019] For this purpose, the present invention provides a fabric, which can be of the woven, knitted or non-woven type, is suitable for making protective clothes against electroshock weapons, and comprises electrically conducting elements, the electrically conducting elements being formed either by stainless-steel fibres or by mutually perpendicular stainless-steel filaments, and the said fabric having an electrical resistance of at most 10^5 ohm, measured according to European Standard EN 1149-1. The presence of sufficient stainless-steel fibres or stainless-steel filaments in the fabric ensures a higher conductivity for the fabric than the conductivity of the human body, so that the electrical charge issuing from the electroshock weapon is dissipated through the fabric, and no harm comes to the person wearing the protective clothes made from this fabric.

[0020] The stainless-steel fibres are made of stainless steel having a certain composition, such as for example type 304 or type 316. Stainless steel 304 has for example the following composition: <0.08% of C, 17.5-20% of Cr, 8-11% of Ni, <2.0% of Mn, <1% of Si, <0.045% of P and <0.03% of S, the rest being Fe. Stainless steel 316 has for example the following composition: <0.03% of C, 16-18.5% of Cr, 10-14% of Ni, 2-3% of Mo, <2% of Mn, <1% of Si, <0.04% of P and <0.03% of S. All these quantities are expressed in percentages by weight.

[0021] The stainless-steel fibres are made by the bundled drawing process. This method is described e.g. in the following patent documents: US-A-2,050,298, US-A-3,277,564 and US-A-3,394,213. The process starts with stainless-steel wires that are covered with a coating of iron or copper. A bundle of these coated wires is then enclosed in a metal pipe. The resulting pipe is reduced in diameter by successive drawing operations. This gives a composite bundle with a smaller diameter. The successive drawing stages can alternate with a suitable heat treatment in order to make further drawing possible or easier. This converts the wires in the composite bundle into thin fibres, which are individually embedded in a matrix of the coating material - copper or iron. Such a bundle normally contains 500-1500 fibres. Once the required final diameter of the fibres has been reached, the coating material is removed by etching it out with an acid. The final result is an uncoated fibre bundle.

[0022] The fabric according to the invention can be obtained in one of two ways. In one case, the stainless-steel fibres (e.g. stainless-steel fibres sold under the commercial name of Bekinox®) are combined with the fibres used for making the fabric preferably by intimate mixing. For example, 10 wt-% of stainless-steel fibres can be mixed with 90 wt-% of other fibres, which can be natural, artificial or synthetic in origin. These "other fibres" are principally chosen according to the other characteristics required for the fabric in question, and can be for example aramids, modacrylic or FR viscose in order to obtain a fireproof fabric, or they can be cotton, PES, PA, wool, etc. for purposes of comfort and appearance.

[0023] In the case of intimate mixing, preferably stainless-steel fibres are used whose length and fineness are as close to the characteristics of the "other fibres" as possible. For example, when stainless-steel fibres and aramid fibres are intimately mixed together, stainless-steel fibres of 6.5-22 microns and a fibre length of about 3-10 cm can be chosen, depending on the spinning method used.

[0024] In addition to "intimate mixing", it is possible to obtain fabrics with the required characteristics, especially a high conductivity and an associated limited resistance, by providing the fabric with mutually perpendicular stain-

less-steel filaments. In the case of these fabrics, the basic yarns used for making the fabric do not themselves contain stainless steel, but instead, as it were, a lattice structure of stainless-steel filaments is formed in the fabric. For this purpose, the fabric in question contains mutually perpendicular stainless-steel filaments extending both in the longitudinal and in the transverse direction of the fabric.

[0025] It is important for the different filaments to lie sufficiently close to one another, so that a fine lattice structure is obtained. In particular, the maximum distance at which two stainless-steel filaments can lie from each other is the same as the diameter of the electrodes in the electroshock weapon. This prevents the electrodes from coming into contact with a non-conducting yarn, and prevents undesirable sparking.

[0026] The present invention also relates to the use of stainless-steel fibres or mutually perpendicular stainless-steel filaments in fabrics that are suitable for making protective clothes against electroshock weapons.

[0027] The use of stainless-steel fibres, which are mixed with the fibres from which the yarns of the fabric are made, or the use of mutually perpendicular stainless-steel filaments, which are incorporated in the fabric, gives comfortable fabrics for making protective clothes against electroshock weapons, which retain their protective action permanently even after being washed many times (at least 50 times). In addition, these fabrics are also to be antistatic in accordance with European Standard EN 1149/5.

[0028] The patent proprietor prepared a number of fabrics according to the invention, which were then subjected to the following test: the fabric was pressed against the arm of a volunteer, and a hand-held electroshock weapon was then brought into contact with the fabric. The volunteer described the resulting sensation in the case of each fabric. The electrical resistance of the corresponding fabric was also measured according to European Standard EN 1149-1, using an annular electrode with a distance of 10 mm between the two rings. The resulting value of O was multiplied by a factor of 19.8 in order to obtain the value in units of ohm/square. This factor is specific for the annular electrode used.

Fabric 1:

[0029] Fabric 1 was made of a modacrylic-cotton blend and contained a lattice of mutually perpendicular stainless-steel filaments laid at a distance of 1 cm from one another. The fabric had the following characteristics:

- Warp: 32 threads per cm of a 55/45% modacrylic-cotton blend (count: Nm 40/2) + 1 thread of a twisted yarn per cm, consisting of 2 sides of a 55/45% modacrylic-cotton blend (count: Nm 40/1) and one side of a fine stainless-steel filament (77 dtex)
- Weft: 24 picks per cm of a 55/45% modacrylic-cotton blend (count: Nm 40/2) + 1 thread of a twisted yarn per cm, consisting of 2 sides of a 55/45% modacrylic-cotton blend (Nm 40/1) and one side of a fine stainless-steel filament (77 dtex)
- Weave structure: 3/1 twill
- Weight: 320 g/m^2
- Overall composition:

  54.7% of modacrylic

  44.7% of cotton

  0.6% of stainless steel.

[0030] Fabric 1 contained 1.8 g of stainless steel per square metre. This fabric did not ensure complete protection against hand-held electroshock weapons, for the volunteer felt a certain tingling. The electrical resistance obtained for this fabric was 16 GO/square (=16x10^9 O/square).

Fabric 2:

[0031] Fabric 2 was made of aramid fibres, mixed with stainless-steel fibres, and had the following characteristics:

- Both the warp and the weft consisted of successive sets of 2 threads of a 87/13% blend of meta-aramid and stainless-steel fibre (count: Nm 60/2) and 1 thread of a 70/30% blend of meta-aramid and para-aramid (count: Nm 50/2), the mixing being intimate in every case.
- Densities: warp: 25 threads per cm, and weft: 21 picks per cm
- Weave structure: herringbone on the basis of a 2/1 twill
- Weight: 170 g/m^2
- Overall composition:

  81 % of meta-aramid

  11 % of para-aramid

  8% of stainless steel.

[0032] Fabric 2 contained 13.6 g of stainless steel per square metre. This fabric offered a good protection against hand-held electroshock weapons, for the volunteer did not feel anything. The electrical resistance obtained for this fabric was 4.4 x 10^3 O/square.

[0033] In addition, similar fabric was prepared that only contained 5 g/m^2 of stainless-steel fibres. With this amount of stainless-steel fibres, the volunteer still felt a mild tingling.

Fabric 3:

[0034] Fabric 3 was made of polyamide fibres, mixed with stainless-steel fibres, and had the following charac-

teristics:

- Only one yarn was used in both the warp and the weft, namely an 87/13% blend of
  PA-6,6 and stainless-steel fibres with a count ofNm 54/2
- Densities: warp: 25 threads per cm, and weft: 21 picks per cm
- Weave structure: plain weave
- Weight: 190 g/m^2
- Overall composition:

  87% of PA-6,6

  13% of stainless steel.

[0035] Fabric 3 therefore contained 24.7 g of stainless steel per square metre. In the case of this fabric, the volunteer again naturally did not feel anything when touched with a hand-held electroshock weapon. The electrical resistance obtained for this fabric was 2.6 x 10^3 O/square.

[0036] In some other tests, the stainless-steel fibres in Fabric 1 were replaced by carbon fibres. In the case of this fabric, the volunteer experienced a severe shock.

[0037] The examples described above clearly show that the amount of stainless steel (expressed in g/m^2) that must be present in the fabric in order to ensure a good protection against electroshock weapons is at least 1.5 g/m^2 when the fabric is provided with mutually perpendicular stainless-steel filaments, and at least 5 g/m^2 for a minimum protection, but preferably at least 10 g/m^2, when the fabric is provided with stainless-steel fibres.

Claims

1. Fabric that is suitable for making protective clothes against electroshock weapons, which comprises electrically conducting elements, **characterized in that** the electrically conducting elements are formed either by stainless-steel fibres or by mutually perpendicular stainless-steel filaments, the said fabric having an electrical resistance of at most 10^5 ohm/square, measured according to European Standard EN 1149.

2. Fabric according to Claim 1, **characterized in that** the said stainless-steel fibres are mixed with the fibres from which the yarns of the fabric are made.

3. Fabric according to Claim 2, **characterized in that** the said fabric contains at least 10 g/m^2 of stainless-steel fibres.

4. Fabric according to Claim 2 or 3, **characterized in that** the other fibres from which the yarns of the fabric are made are chosen from a group comprising natural, artificial or synthetic fibres.

5. Fabric according to Claim 1, **characterized in that** the said fabric comprises a first group of stainless-steel filaments and a second group of stainless-steel filaments, which extend respectively in the longitudinal and transverse direction of the fabric.

6. Fabric according to Claim 6, **characterized in that** adjacent stainless-steel filaments of the same group are laid at a distance of at most 1.5 mm from one another.

7. Use of stainless-steel fibres or mutually perpendicular stainless-steel filaments in fabrics that are suitable for making protective clothes against electroshock weapons.

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EUROPEAN SEARCH REPORT

Application Number
EP 10 17 0626

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	US 2010/058507 A1 (SCHULTZ GREGORY RUSSELL [US]) 11 March 2010 (2010-03-11) * abstract; figures 1-4,8-10,13 * * paragraph [0009] * * paragraph [0027] - paragraph [0032] * * paragraph [0035] * * paragraph [0042] - paragraph [0044] *	1-7	INV. F41H1/02
X	DE 10 2006 007518 A1 (HAVER & BOECKER OHG [DE]) 23 August 2007 (2007-08-23) * abstract; figure 1 * * paragraph [0052] - paragraph [0056] *	1,5,6	
A	US 3 851 456 A (HAMADA K ET AL) 3 December 1974 (1974-12-03) * abstract; figures * * column 2, line 24 - line 34 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F41H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 January 2011	Schwingel, Dirk

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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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 17 0626

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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07-01-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010058507 A1	11-03-2010	NONE	
DE 102006007518 A1	23-08-2007	EP 1985166 A1	29-10-2008
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 2050298 A **[0021]**
- US 3277564 A **[0021]**
- US 3394213 A **[0021]**