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ANTISTATIC FABRICS

Douglas Bulgin, Erdington, Birmingham, England, assignor to Dunlop Rubber Company Limited, London, England, a British company

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This invention relates to the production of fabrics having antistatic electrical properties.

The conductivity that is desirable in an antistatic fabric depends on the application for which the fabric is intended. An antistatic fabric which is to be used in circumstances in which the risks arising from the generation of static electrical charges are not very serious may quite satisfactorily have a relatively high resistance, that is to say, a resistance up to about 100,000 megohms per unit square. A lower resistance of the order of magnitude of 10 to 100 megohms per unit square is desirable in a fabric which is intended for use in the presence of inflammable vapours, e. g. in operating theatres, where it is a matter of vital importance that no static electrical charges should be generated. Megohms per unit square is the resistance in megohms to the passage of electricity on or parallel to a surface between two electrodes placed to form opposite sides of a square and is independent of the dimensions of the square. Otherwise stated, if the length of two parallel electrodes is always equal to the distance between them it is immaterial what the length of these electrodes is as the resistance increases directly proportional to the distance between the electrodes and inversely proportional to the length of the electrodes, that is, to the width of the electrical path.

For this reason only cotton and viscose rayon are generally considered suitable for use in operating theatres, but even these materials are likely to be unsuitable in dry weather or conditions of low relative humidity. Experience has shown that the relative humidity of air should not be lower than 65% for safe use of cotton and viscose rayon fabrics. It is of course not always possible to keep the relative humidity of the atmosphere above 65%, and accordingly there is a need for a fabric in which there can be virtually no generation of static charges by movement at any atmospheric humidity. It is among the objects of the present invention to provide such a fabric.

According to the invention, an antistatic fabric is made up of fibrous material containing electrically conductive carbon black and fibrous material free from such black in such proportions that the electrical resistance of the fabric as a whole is less than 100,000 megohms per unit square at all humidities.

Carbon black is a product resulting from the incomplete combustion of hydrocarbon gas such as acetylene or natural gas and is generally deposited by actual contact of a flame upon a metallic surface. Normally carbon black is a non-conductor of electricity but is made conductive by treatment for that purpose and is known in the trade as electrically conductive carbon black.

Normal fibrous material free from carbon black, such as viscose rayon or cotton, has a high electrical resistance at low relative humidity and a lower resistance at high relative humidity. It has been found that, whereas fibrous material containing a relatively small proportion of carbon black has the same characteristic, fibrous material containing more than a certain critical proportion

of carbon black has a resistance which varies to a very much smaller extent with humidity and which in any case does not rise as its humidity falls. In the case of acetylene black this critical proportion is usually around 25%, but it varies somewhat with the particular fibres used.

The fabrics of the present invention, i. e. fabrics having a resistance less than 100,000 megohms per unit square at all humidities, may be satisfactorily produced using a fibrous material containing a proportion of carbon black that is not less than the critical proportion referred to above. Even if only a small proportion of the black-containing fibrous material is used, it is this material rather than the fibrous material free from black which makes the more important contribution to the conductivity of the fabric as a whole, and it is therefore possible to make the resistance of the present fabrics more or less independent of humidity by using a suitable proportion of the black-containing fibrous material. In general the use of about 10% of the black-containing fibrous material referred to gives the fabric a resistance which is substantially independent of humidity, that is to say, a resistance which does not, at any humidity, depart from its means value by any factor greater than about ten. Such a substantially constant resistance may be contrasted with the resistances of fabrics free from black, which at certain humidities may depart from their mean values by factors as great as ten thousand.

In general the proportion of black-containing fibrous material used in the present fabrics is not substantially less than 2%. Preferably the proportion used is from 5 to 20%. If the fabric has substantially less than 2% of the black-containing fibrous material, its resistance will be undesirably high; while if it has substantially more than 20% the resistance will (at some humidities at least) be undesirably low, and a fire risk and also an electric-shock risk may be introduced if the fabric is to be used in proximity to apparatus connected with the electric means for instance. With higher proportions of black-containing material, moreover, the mechanical strength of the fabric is impaired appreciably, a fibre containing carbon black being much weaker than a similar fibre free from black.

The proportion of black-containing fibrous material and the proportion of black in this material do not by themselves exclusively determine the resistance-humidity characteristics of the fabrics. Other factors which affect these characteristics are the denier of the fibres, their lengths (if they are used in staple form), and the nature of the weave.

The fabric may be woven from a mixed yarn spun from the two fibrous materials together, or it may be woven from two types of yarn, one of the two types being spun from the fibrous material free from black and the other being spun from the fibrous material containing electrically conductive carbon black. In the latter case the fabric may be so woven as to have a fine black-and-white chequered pattern, which by virtue of its distinctive appearance facilitates identification of the fabric.

It is not essential, where one yarn containing black and another yarn free from black are used, that the fabric should have both black-containing warp threads and black-containing weft threads. Even if the black-containing threads do not cross each other, the antistatic properties of the fabric may be entirely satisfactory, provided the black threads are reasonably close together.

A number of suitable types of conductive carbon black are available including acetylene black, which is generally known as Shawinigan black; reinforcing furnace black, for example those commercially available under the names Philblack 0, Vulcan 3, and Vulcan XXX; channel black for example Spheron C; and channel black that has been submitted to heat treatment, e. g. at 1000° C.

The black which is preferred for the present purpose is Shawinigan black.

The fibrous material that contains the carbon black may be a regenerated cellulose, such as a viscose rayon obtained by extruding a solution of cellulose xanthate in aqueous sodium hydroxide containing dispersed carbon black into a coagulating bath of a suitable aqueous mineral acid, e. g. sulphuric acid.

Instead of a regenerated cellulose containing carbon black, there may be used such other fibrous materials as nylon or polyester fibres spun from a nylon or polyester melt in which carbon black has been incorporated.

The fibrous material free from black may be a cellulosic fibrous material such as cotton or viscose rayon. Other materials which may be used include nylon and polyester fibrous materials. A mixture of fibrous materials free from black may be used.

As an example of a particularly suitable fabric having the desired antistatic properties reference is made to a fabric containing 10% by weight of threads of viscose rayon containing 30% of Shawinigan black together with 90% of viscose rayon threads free from carbon black and having a resistance not less than 0.5 megohm per unit square not greater than 5 megohms per unit square at any humidity. This fabric may be contrasted with a similar fabric free from black, whose resistance varies with humidity between 0.5 and 10^6 megohms per unit square.

The fabrics of the present invention are valuable not only for use in goods intended to be employed in operating theatres and the like; examples of other applications are their use in the manufacture of transmission belting and conveyor belting, and, after proofing, in the production of garments of various kinds.

Having now described my invention, what I claim is:

1. An antistatic fabric made up of fibrous material having electrically conductive carbon black dispersed throughout the fibre and fibrous material free from such black in such proportions that the electrical resistance of the fabric as a whole is less than 100,000 megohms per unit square at all humidities.

2. A fabric according to claim 1, in which the fibrous material having electrically conductive carbon black dispersed throughout the fibre is fibrous regenerated cellulose.

3. A fabric according to claim 1, in which the fibrous material free from black is a cellulosic fibrous material.

4. A fabric according to claim 1 in which the weight of the fibrous material having electrically conductive carbon black dispersed throughout the fibre is at least 2% of the total weight of the fabric.

5. A fabric according to claim 4, in which the weight of the fibrous material containing electrically conductive carbon black is from 5% to 20% of the total weight of the fabric.

6. A fabric according to claim 1, in which the two fibrous materials are present in such proportions that the electrical resistance of the fabric as a whole is substantially independent of its humidity.

7. A fabric according to claim 1, in which the fibrous material containing electrically conductive carbon black

contains such a proportion of the black that its resistance does not rise as its humidity falls.

8. A fabric according to claim 1, in which the electrically conductive carbon black present is acetylene black.

9. A fabric according to claim 1, in which the weight of the electrically conductive carbon black is 25% or more of the total weight of the fibrous material in which it is present.

10. A fabric according to claim 1, which is woven from a mixed yarn spun from the two fibrous materials together.

11. A fabric according to claim 1, which is woven from two types of yarn, one of the two types being spun from the fibrous material free from black and the other being spun from the fibrous material containing electrically conductive carbon black.

12. A fabric according to claim 11, which is so woven as to have a fine black-and-white chequered pattern.

13. An antistatic fabric which contains about 90% by weight of viscose rayon free from carbon black and correspondingly about 10% by weight of viscose rayon containing about 30% by weight of electrically conductive acetylene black.

14. An antistatic fabric made of fibrous yarns, said yarns made up of from 2% to 20% of fibres having electrically conductive carbon black dispersed throughout the fibres, the balance of the fibres of the yarn being substantially without electrically conductive carbon black.

15. An antistatic fabric made of fibrous yarns, from 2% to 20% of said yarns having electrically conductive carbon black dispersed throughout the fibres, the balance of the yarns being substantially without electrically conductive carbon black.

16. An antistatic fabric made of woven yarns, the yarns woven in one direction containing from 2% to 20% of fibres having electrically conductive carbon black dispersed throughout the fibres, the balance of the fibres of said fabric being substantially without electrically conductive carbon black.

17. An antistatic fabric having an electric surface resistance not less than 0.5 megohm per unit square nor greater than 5 megohms per unit square at any humidity which contains about 90% by weight of viscose rayon free from carbon black and correspondingly about 10% by weight of viscose rayon containing about 30% by weight of electrically conductive acetylene black.

18. An antistatic fabric having an electrical resistance less than 100,000 megohms per unit square at any atmospheric humidity comprising from 5 to 20 percent by weight of artificial fibrous material containing not less than 25 percent by weight of electrically conductive carbon black dispersed throughout the fibres, said fibres being woven with a fibrous material free from carbon black.

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