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TEXTILE MATERIAL

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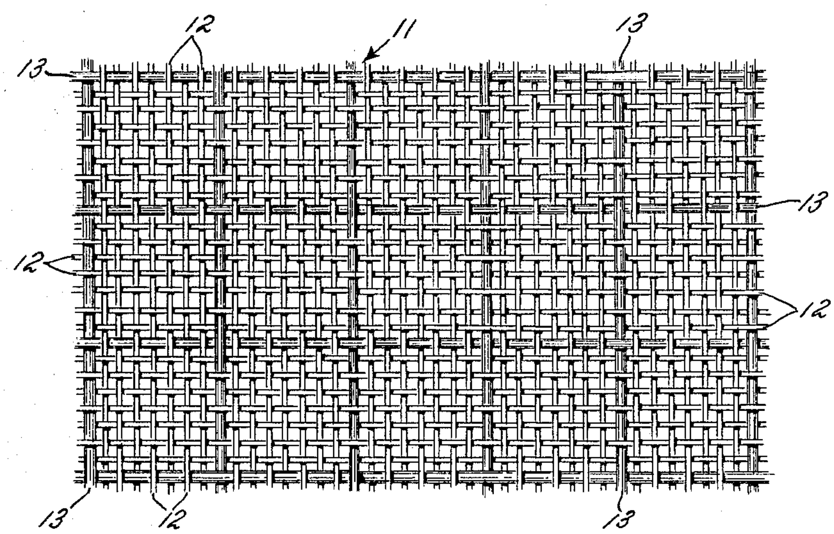
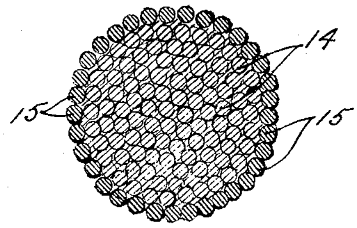


Fig. 1



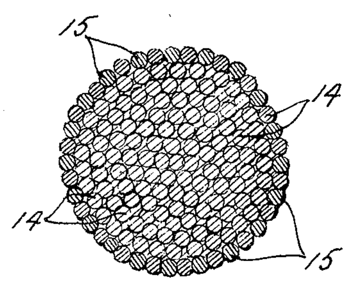


Fig. 2 Fig. 3

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TEXTILE MATERIAL

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This invention relates to textile material. More particularly, the invention relates to textiles and textile materials, such as fabrics, filaments, fibers, and the like which tend to build up and maintain undesirable static charges.

In general, hydrophobic fibers, such as nylon and the like, as well as hydrophilic fibers, such as wool and cotton, at low relative humidity, tend to generate an electrical charge, that is, to build up static electricity. As a result, such fibers and textile materials made therefrom attract dust and dirt. Build-up of static electricity also causes items of apparel to cling to the body or to be attracted to other garments. Statically charged textiles can cause sparks and become highly dangerous in, for example, a place like an operating room where ether or other explosive material is generally present.

In order to overcome these drawbacks, textile materials are often provided with non-metallic, antistatic surface finishes to prevent electrostatic build-up. However, such antistatic agents are frequently not permanent in their protective effect, tend to cause discoloration, and/or are relatively easily removed by washing, dry cleaning, rubbing, or chemical bleaches and the like. Furthermore, the non-metallic antistatic agents present a further disadvantage in that they require moisture and relatively warm temperatures in order to operate in preventing the build-up of static electricity. Consequently, since many of these materials only have a temporary usefulness in preventing electrostatic build-up and do not operate at low temperatures, or in relatively dry atmospheric conditions such as might be encountered in colder regions of the world, they are of limited use and even in temperate climates often do not solve problems in manufacturing operations and actual use involving textile materials treated therewith.

The above disadvantages are overcome by providing, in accordance with the present invention, a textile material containing a continuous system of fibers which possess metallic electrical conductivity.

The terms "metallic electrical conductivity" and "metallic conductance," as employed throughout this specification and in the appended claims, are to be understood to mean a conductivity on the order of at least 10^6 mhos per meter, that is, a resistance on the order of at most 10^{-6} ohm-meters.

Reference is made to the attached drawing taken in conjunction with the following description in order to more completely and clearly understand the present invention.

In the drawing:

FIG. 1 shows schematically a textile material according to the invention containing an electrically conductive, continuous metallic grid system;

FIG. 2 shows schematically a composite yarn useful in the practice of the invention wherein the core yarns are non-metallic and the cover yarns are metal fibers; and

FIG. 3 shows schematically a construction similar to the composite yarn of FIG. 2 except that the cover yarns are alternately metallic and non-metallic, whereas all of the core yarns are non-metallic.

A textile material according to the invention contains a continuous system possessing the necessary metallic electrical conductivity. The continuous system can be represented by a grid. Regardless of the particular shape or form, continuity of the metal fiber system is necessary

in order to achieve the conductivity of the order desired. In FIG. 1, numeral **11** generally designates a fabric which comprises non-metallic threads **12** and a continuous metallic fiber grid **13**. On the other hand, as shown by FIG. 2, a continuous system of metallic fibers, in accordance with the invention, can be one which contains core yarn formed of continous non-metallic filaments **14** which are covered by metallic fibers **15** having the desired properties of conductivity or as shown in FIG. 3 by a blend of metallic and non-metallic fibers. When the cover of a composite yarn being utilized in carrying out the practice of this invention is a blend of metallic and non-metallic fibers, it is preferred that the cover be a blend of metallic and non-metallic components in which up to 50% by weight based on the total weight of the cover is a metallic component. It is to be noted that in this case, a constant and sufficient degree of conductivity is achieved since throughout such a blend there is a repetitive contact of metal-to-metal. It is this continuous metal-to-metal contact which provides the required degree of conductivity. Consequently, textile material according to the invention contains a continuous system of fibers possessing the necessary metallic electrical conductivity, since the fibers possessing the ability to conduct electricity are contiguous in relation to each other so that the electric current can pass from one fiber to another. It is not required that all of the metal fibers touch each other but only a sufficient portion of them to make that area of a textile material which they permeate electrically conductive or conducting. As mentioned hereinbefore, a simple continuous system of this type can be referred to as a grid, that is, a row of metallic fibers or yarns crossing at a right angle another row of metallic fibers or yarns in such a manner that they are in contact at the crossover points. It is to be understood, however, that the grid or continuous metallic fiber system can be very irregular and distorted without impairing it antistatic effectiveness. Generally, however, a regular grid has approximately a rectangular shape, the sides of which are formed by the metal fibers or yarns. In those cases where the system is more irregular, it may take the general shope of a net or the like formed by the metal fibers or yarns. In this instance, the area of non-metallic fibers bounded by the continuous system of metal fibers can vary greatly in the same textile material because of the irregularity of the structure. It is to be noted, however, that in order to make the antistatic protection more effective, the average area of the fabric covered by non-metallic fibers should be kept substantially below 1 square centimeter.

The electrically conductive metal fiber system, regardless of its particular shape, comprises by weight, based on the total weight of the fabric in which it is being utilized, only a minor part of the textile material, the bulk of which is composed of the non-metallic fibers which are necessary to maintain the usual functional and aesthetic properties of non-metallic textiles as they are used in garments, carpets, draperies, upholstery, and the like.

Textile material, according to the invention, can be made by the usual methods of textile manufacturing. For woven or knitted fabrics, the metallic electrical conducting yarn can be used as a portion of the wrap and filling yarns. In unwoven fabrics, the metallic fibers can be introduced into the feeders during web formation. In this connection, it is to be noted that the use of binders which interfere with metal-to-metal contact is to be avoided. Accordingly, such methods as needle-punching or the use of thermoplastic fibers for bonding are preferred. In the field of carpets and other tufted fabrics, it is desirable to use a woven or knitted backing containing a grid of metallic conducting yarn, and a tufting yarn containing a mixture of metallic conducting and non-conducting fibrous yarns.

Regardless of whether the textile materials are knitted, woven or non-woven, the electrical conductance properties are usually measured in terms of surface are resistivity and are expressed in ohms per square as outlined in the 1963 Technical Manual of the American Association of Textile Chemists and Colorists, Part II, BIII, where a standard test method for the electrical resistivity of fabrics is set forth. The resistivity of textile materials manufactured in accordance with the invention have values of not more than 10^9 ohms per square measured at 25% relative humidity at room temperature (approximately 25° C.). The volume resistivity of the metals used for the metallic electrically conductive fibers and yarns utilized to form the continuous system or grid is on the order of 10^{-8} through 10^{-6} ohm-meters.

In general, the textile material in accordance with the invention consists primarily of non-metallic fibers such as cotton, wool, nylon, Dacron, acrylic fibers, polyolefin fibers, any any of the other known natural or synthetic fibrous materials with up to about 10% by weight, based on the total weight of the material, of fibers which possess metallic electrical conductivity.

Metals which are useful in the textile materials of this invention include steel, iron, nickel, cobalt, chromium, molybdenum, tungsten, tellurium, tin, zinc, manganese, thallium, scandium, aluminum, magnesium, and the like or mixtures thereof.

In order to illustrate the invention more fully the following illustrative examples are set forth. In the examples, all parts and percents are by weight, unless otherwise stated.

Example I

A yarn is prepared from a blend consisting of 50% by weight of stainless steel fibers having an average diameter of 10 microns and 50% by weight of nylon fibers of a fineness of 6 denier. Both kinds of fibers have a length of approximately 1 inch. The yarn was made so that it contained about 40 fibers in cross-section. A plain fabric woven from this yarn was made on a conventional weaving apparatus and every tenth filling yarn and every tenth warp yarn was made with the described blended yarn. The remaining warp and filling yarns were continuous filament nylon yarns containing 34 filaments in cross-section and a fineness of about 6 denier.

Example II

A yarn is produced by twisting together three continuous chromium filaments of a diameter of 20 microns. A plain fabric was woven in which every 20th filling yarn and every 20th warp yarn is composed of the chromium yarn, the remaining warp and filling yarns being continuous polethyleneglycol terephthalate yarn.

The fabrics described in the above examples are antistatic and exhibit no tendency to accumulate electrostatic charges when tested by rubbing them against a worsted fabric. The fabrics were tested with the aid of a static volt detector or by the attraction of ash. Similar fabrics,

woven in like manner but without the metallic fibers, exhibit a strong tendency to build up static electricity and to attract ash.

The term "fibers" and "yarns" as employed throughout this specification and claims is intended to include and encompass a single filament, the plurality of filaments which may be drawn or twisted together to form a thread which may be made either of single or multiple threads, as well as the staple fibers and threads produced from them.

It is to be understood that although the instant invention has been described as set forth herein in a preferred form thereof, numerous modifications obviously can be made without departing from the spirit and scope thereof, and such modifications are to be understood as coming within the scope of the appended claims.

What is claimed is:

1. A textile material consisting essentially of non-metallic fibers and up to about 10% by weight of a continuous system of metallic fibers in continuous metal-to-metal contact and having an average diameter of about 20 microns and less, said textile material having the functional and aesthetic properties of non-metallic textiles and possessing metallic electrical conductivity.

2. A textile material consisting essentially of non-metallic fibers and containing a minor amount of a system of metal fibers having an average diameter of about 20 microns and less, said metal fibers being in continuous metal-to-metal contact, said textile material possessing a specific surface area resistivity of not more than 10^9 ohms, having the functional and aesthetic properties of non-metallic textiles and possessing metallic electrical conductivity.

3. A textile material consisting essentially of non-metallic fibers and containing a minor amount of metal containing yarns in the form of a grid, said yarns consisting of a blend of metal and non-metallic fibers, said metal fibers being in continuous metal-to-metal contact and having an average diameter of about 20 microns and less, said textile material having the functional and aesthetic properties of non-metallic textiles and possessing metallic electrical conductivity.

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