

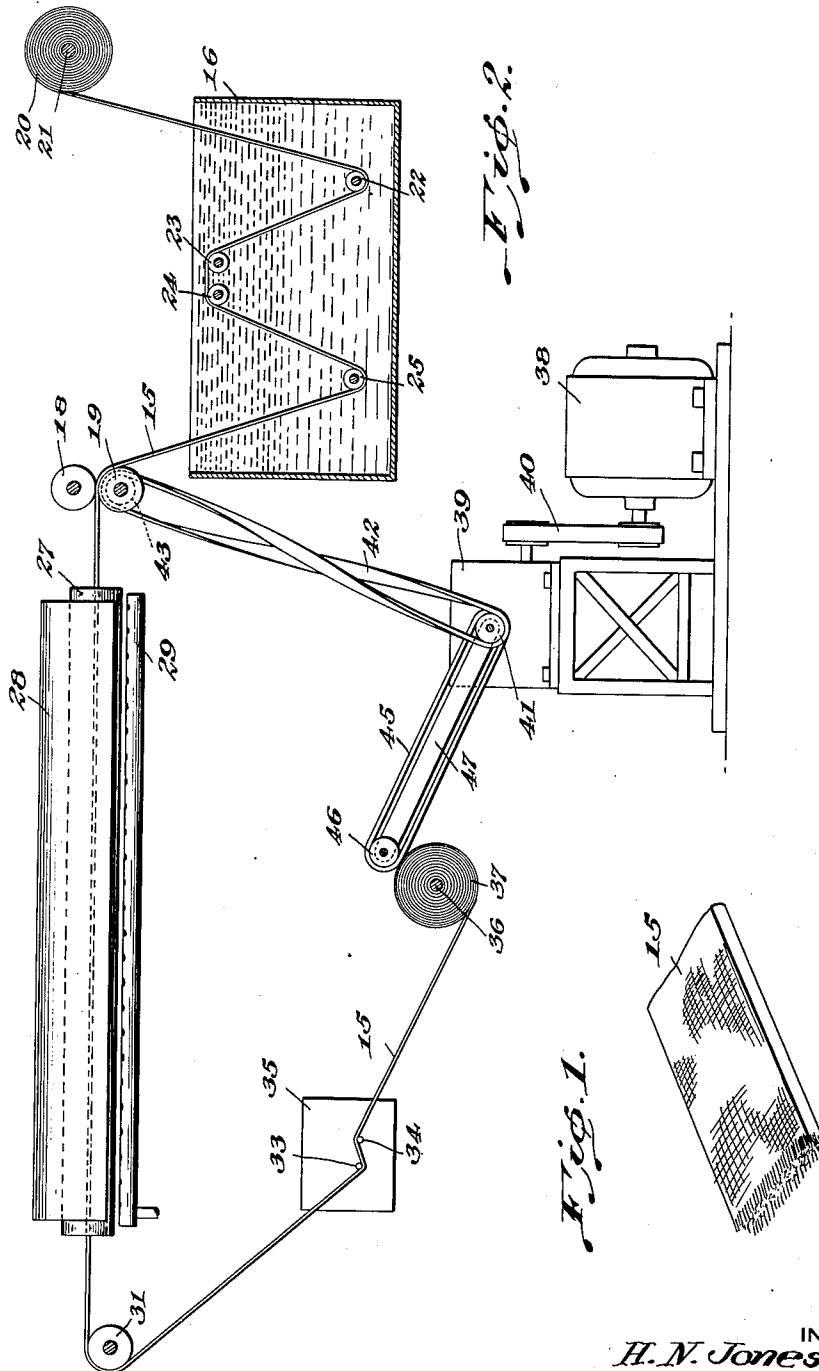
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CARBONACEOUS COATING FOR GLASS FIBERS

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CARBONACEOUS COATING FOR GLASS FIBERS

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This invention relates to mineral fibers coated with carbonaceous material and to a method and apparatus for producing the same. The invention is particularly applicable to impart electrical semi-conductive properties to fibrous mineral insulating fabrics but may be used wherever it is desired to provide mineral fibers with a coating of carbonaceous material.

Semi-conductive electrical insulation is preferred in some instances, and is especially desirable for insulating high voltage coils in motors, generators, and other electrical equipment. In this type of apparatus, where a relatively high potential exists between the rotor or stator of the machine and the conductors in the coil a corona effect between the conductor and the iron or other grounded parts of the machine occurs particularly at the edges of the coil slots. This condition causes rapid breakdown of the insulation and damage to the apparatus. To correct this, a semi-conductive insulation is employed between the conductor and the iron to lower the potential gradient to a value where corona is retarded or substantially prevented and breakdown in the insulation avoided. The semi-conductive insulation is usually applied as an outer layer of insulation to the coil or to the individual conductors.

Various insulating materials have been employed in an attempt to obtain semi-conductive properties, such as fibrous mineral material having incorporated therein conducting substances such as graphite, metallic paint, comminuted metal, metallic wires or strands, or the like. Amorphous carbon, comminuted metal and similar loose divided material was held to the fibers by adhesives or binders such as varnishes. These expedients, however, have been generally unsuccessful because of the difficulty encountered in applying the conducting material evenly to the insulating material and because of the failure of the conducting material to form the proper bond with the fibers.

For example, in the case of employing conducting materials such as graphite applied to the fibrous material by working it into the interstices between the fibers the resulting conducting characteristics of the insulation were erratic and not reproducible because of the uneven deposit of the conducting material and the relatively large particles of coating material. The arrangement of the particles of conducting material was more or less haphazard and without uniformity in the degree of contact between adjacent particles. All of this caused a variation in

conductivity through the coating which adversely affected the results obtained.

The conducting material also lacked the required amount of adhesion to the insulating material and was easily displaced by handling and flexing of the finished product incident to its use. Attempts to bond the conducting material to the fibrous material by means of varnishes, lacquers, and the like, tended to defeat the purpose of the conductive coating because the bonding material coated each particle of the conducting material and separated the particles one from the other. This resulted in a poor path for current.

It is an object of the present invention to provide a carbonaceous coating for mineral fibers that is pliable and adheres tightly to the fibers. When fibrous materials are coated and employed as electrical insulation they may be handled and flexed without substantial displacement of the carbonaceous material.

It is another object of the invention to provide a carbonaceous coating for fibrous mineral material that is of uniform thickness over the entire surface of the fibers with the carbonaceous material uniformly distributed throughout the fabric or other fibrous article.

It is another object to produce a fabric of mineral fibers in which the fibers are coated with electrical conducting material of uniform conductivity throughout the coating to impart predetermined semi-conducting properties to the insulation.

A further object of the invention is to produce a semi-conducting fabric of mineral fibers that may have imparted thereto, electrical conductivity of predetermined value within narrow limits.

It is a still further object of the invention to provide a method of applying carbonaceous coating to mineral fibers that may be readily varied to produce semi-conducting insulation of any desired degree of conductivity.

Other objects and advantages will be apparent from the following description.

In the drawing:

Figure 1 is an elevational perspective view of a semi-conducting fabric of mineral fibers in the form of woven tape made in accordance with the present invention.

Figure 2 is a diagrammatic elevational view of a form of apparatus adapted to carry out the method of the present invention.

The present invention provides an insulating fabric formed of mineral fibers such as glass fibers in braided, woven, yarn, or strand form.

In the preferred embodiment of the invention, the fabric is in the form of woven tape illustrated at 15 which has electrical conducting material dispersed throughout the body of the tape and coating the individual fibers thereof.

In accordance with the invention, the conducting material is applied in the form of a liquid carbon-containing material or a solution of carbon-containing material by dipping the fibrous product into a bath of the liquid or solution or by spraying the same onto the fibrous article in amounts sufficient to obtain substantially complete impregnation of the fibrous material. The impregnated tape is then heated to an extent sufficient to partially pyrolyze the carbonaceous material. This partial pyrolyzation is carried, preferably, to an extent where substantially all of the carbonaceous material is reduced to carbon but is not carried to completion so that the carbonaceous material remaining on the fibers is in a coherent pliable condition.

Preferably, the carbonaceous material is applied to the tape by submerging the tape in a bath of the material in liquid form or in solution. The liquid flows into contact with substantially all the fibers throughout the body of the tape and forms a uniform coating on the fiber surfaces. When the tape is subsequently heat-treated to reduce the liquid to a partially carbonized condition the resulting coating on the fibers uniformly covers the individual fibers and is evenly dispersed throughout the body of the tape.

The carbonaceous material may be a solution of sugar, starch, glucose, sorbitol, glycerol, and the like in water, or other carbonaceous materials such as mineral wax in suitable solvents. It may also be in the form of a liquid carbonaceous material, for example, hydrocarbon oil or castor oil or heat liquefied mineral wax. With all of these materials the application of heat to the impregnated tape causes pyrolysis of the impregnating material and deposits a coating of partially carbonized material on the fibers of the insulating material. The coating forms without any perceptible division of the material into particles to provide, in effect, a carbonaceous coating as a substantially continuous phase.

The degree of conductivity of the finished product may be varied to suit the conditions under which the product is to be used. This may be accomplished by controlling the amount of liquid or solution in the tape prior to partial pyrolyzation. The amount of material applied to the tape may be varied, if desired, or a portion of the liquid or solution may be expressed from the tape after application thereto, leaving a controlled amount of carbonaceous material remaining to provide the desired amount of coating on the finished product.

The amount of carbonaceous material in the finished product may also be varied by adjusting the concentration of the carbonaceous material applied to the tape. Liquid carbonaceous materials may be diluted with suitable solvents, and the concentration of solutions of sugar, starch or glucose can be varied as found suitable.

For greater ease of operation and to obtain more accurate results, it has been found preferable to vary the electrical conductivity of the fibrous product by controlling the degree of pyrolyzation as by adjusting the temperature to which the impregnated tape is subjected or the length of time it is heated.

The carbonaceous coating produced by par-

tially pyrolyzing the liquid or solution on the fiber surfaces is in the form of a resinous film on the fibers. It is conducting to a degree dependent upon the extent of carbonization with complete carbonization as the theoretical maximum. In the practice of the invention complete pyrolyzation is not attained so that to obtain the higher degrees of conductivity pyrolyzation is carried to an extent closely approaching but just short of complete carbonization. The coating then approaches pure carbon in properties with just sufficient resinous characteristics to be pliable and adherent to the fiber surfaces.

As an additional feature of the present invention, I have discovered that employment of carbonaceous materials such as carbohydrates, for instance, sugar and starch, in water solution result in more nearly perfect coatings on the fibers apparently for the reason that the presence of water retards combustion of the material to provide a more adherent pliable coating.

In Figure 2 of the drawing an apparatus is illustrated that may be employed to perform the method of the present invention as a continuous process. The apparatus includes a tank 16 to contain a bath of liquid carbonaceous material and that may be heated to maintain the bath fluid if necessary. A pair of coating pressure rolls 18, 19 are provided above the tank. Mineral fibrous material in the form of woven glass tape is taken from a usual roll 20 mounted on a spindle 21 and passed over rolls 22, 23, 24, 25 beneath the surface of the liquid in the tank. After leaving the liquid the tape is passed between the pressure rolls which are adjusted to exert the required amount of pressure upon the tape to squeeze out excess liquid and return it to the tank. The amount of liquid remaining in the tape may be thus controlled to obtain the quantity of carbonaceous material in the finished product imparting the desired amount of conductivity thereto.

From the pressure rolls the tape is passed through an oven 27 covered by a hood 28 and heated by a gas burner 29 therebeneath. The temperature of the oven is controlled to heat the tape to the degree necessary to partially carbonize the particular material employed. If desired, the tape may be preliminarily heated before it passes into the oven to dry or partially dry the fluid thereon and to aid pyrolyzation.

The temperature of the oven may be varied within reasonable limits depending upon the degree of carbonization that it is desired to obtain in the finished product and dependent upon the speed of movement of the tape therethrough. When employing the substances herein mentioned and similar carbonaceous materials it is desirable to heat the oven to 900° F. to 1100° F. and travel the tape through the oven at a rate permitting the tape to remain in the oven for approximately 10 to 30 seconds, depending upon the degree of pyrolyzation necessary to obtain the desired conductivity.

After leaving the oven, the tape is passed over a roll 31 and then over spaced electrodes 33, 34 which are connected to a megohmmeter or other suitable electrical indicating apparatus exemplified at 35 and arranged to continuously indicate the resistance of the finished tape. In this manner, a continuous check is obtained upon the operation. The finished tape is wound on a spindle 36 in the form of a roll 37.

The tape is fed continuously through the bath 75 and the oven by power derived from an electric

motor 38. The motor drives a speed reducing unit 39 through a belt 40. The driven shaft of the speed reducing element is provided at the outside of the unit with a pulley 41 which has driving connection by means of a belt 42 with a pulley 43 fixed to the shaft of the pressure roll 19 to drive said roll in a direction to draw the tape from the bath and feed it toward the oven. A second belt 45 passes around the pulley 41 and around an idler pulley 46 rotatably supported in the outer ends of arms 47 pivotally mounted on the driven shaft of the speed reducing unit. The belt 45 is held by gravity in tractive engagement with the roll 37 and is arranged to drive it at the same surface speed as the pressure roll 19. The speed reducing unit, the electric motor, or both may be adjusted to vary the rate of movement of the tape through the bath or oven to thereby control the extent of pyrolyzation of the carbonaceous material on the tape.

If desired, the coated tape may have additional material applied thereto either before or after it is applied to the conductor or other member to be insulated. Materials such as varnishes and lacquers may be employed to treat the tape and to bind it in place on coils and similar insulated apparatus. Varnishes and lacquers may also be applied to the tape to protect the coating of carbonaceous material on the fibers in the outer portions of the tape although this is not usually necessary.

I claim:

1. As a product of manufacture, an electrical insulating fabric of mineral fibers, an homogeneous electrical conducting material distributed throughout said fabric and coating the surfaces

of the fibers thereof, said material comprising an organic substance partially carbonized to the form of a pliable, flexible resinoid and being present in amount sufficient to impart semi-conducting electrical properties to the fabric.

2. As a product of manufacture, electrical insulation in the form of a fabric of glass fibers of uniform electrical conductivity, the fibers throughout the insulation having on their surfaces a film of homogeneous electrical conducting material which comprises a flexible and pliable, resin-like, partially carbonized carbohydrate substance, said conducting material being present in amount sufficient to impart semi-conducting electrical properties to the fabric as a whole.

3. As a product of manufacture, electrical insulation comprising a fabric of glass fibers, and a resin-like, electrical conducting, pliable, homogeneous coating material distributed throughout the fabric and covering the surfaces of the fibers, said coating material being in the form of partially carbonized sugar and being present in amount sufficient to impart semi-conducting electrical properties to the fabric.

4. As a product of manufacture, electrical insulation comprising a fabricated mass of fibrous glass having dispersed throughout a residue of a hydrocarbon oil partially pyrolyzed to an extent providing an adhering, pliable and flexible coating of homogeneous material on the surfaces of the fibers having electrical conducting properties, said residue being present in amount sufficient to impart semi-conducting properties to the fabricated mass.

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