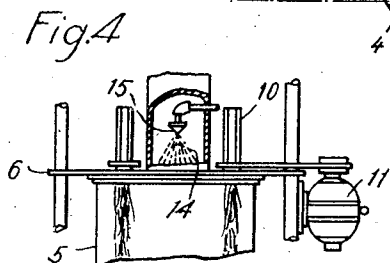
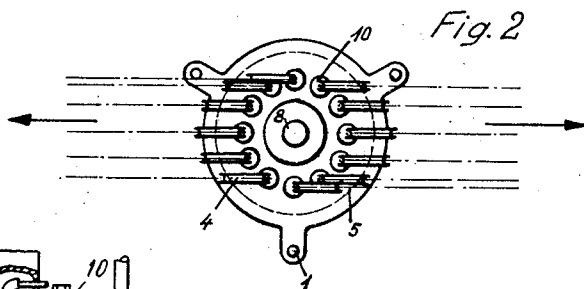
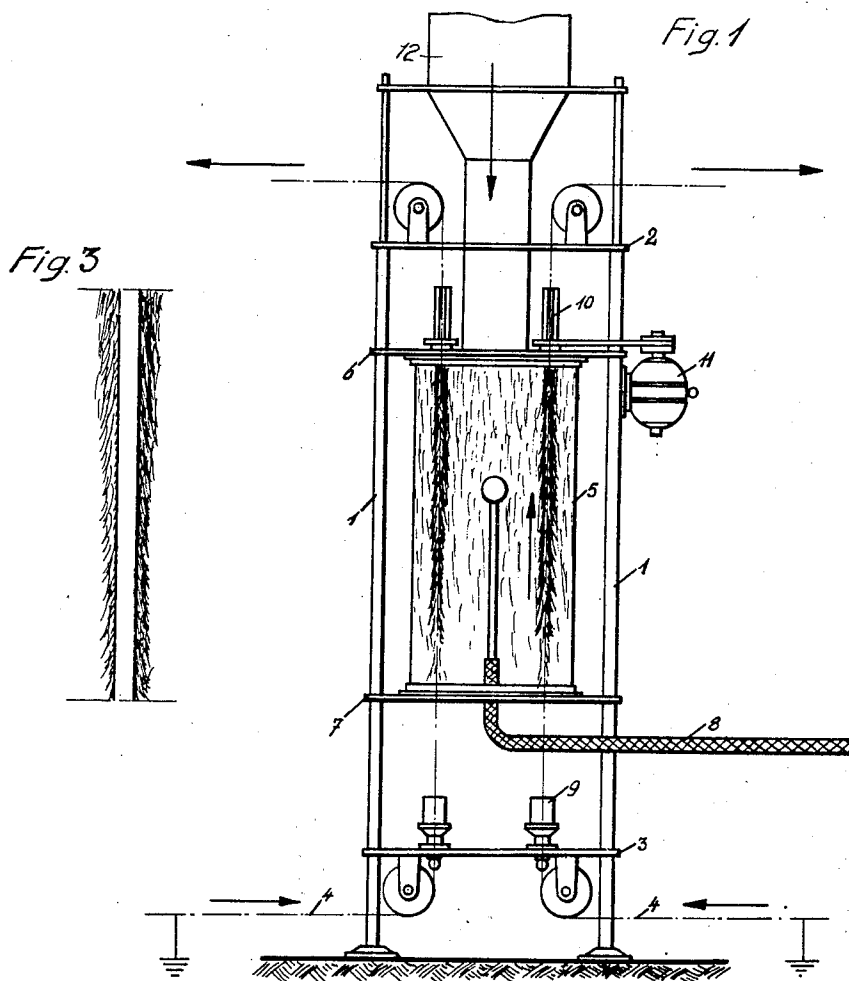


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INSULATING METHOD FOR ELECTRIC AND THERMO-TECHNICAL
PURPOSES, AND APPARATUS FOR ACCOMPLISHING THE SAME
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INSULATING METHOD FOR ELECTRIC AND
THERMO-TECHNICAL PURPOSES, AND
APPARATUS FOR ACCOMPLISHING THE
SAME

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For the insulation of electric conductors the whipping method has been hitherto applied, according to which the conductors are whipped with yarns, produced from textile materials, such as cotton, silk, asbestos and others. This method is very complicated and requires time, as from the textile material has first to be produced thread, or, if paper is to be used for insulation, a paper strip has first to be produced from the raw paper material.

To overcome this inconvenience, it has been proposed to use flaky, fibrous material which, with the aid of special devices, is applied on to the conductors as a di-electric or insulative coating. According to a proposed method the flaky material is moved in a continuous, uniform eddy by a circulating air current. The air current conveys the flaky material to cylinders which supply it to the wire to be insulated and which has been previously coated with gum. Owing to the gum, the flocks stick on the wire, distributed as uniformly as possible over the entire length and circumference of the same. The difficulty connected with this insulating method is that the flocks cannot be brought on to the conductors so uniformly that the diameter of the insulation is the same at all points of the wire surface. The speed at which the blowing on of the sticky conductor by an air current saturated with textile fibres takes place can be only limited as, if the speed of the gas or air is increased, the fibres which have already stuck on the wire might be torn away. This happens especially with fibres designed not to stick directly on the conductor but on fibres already covering the conductor, for instance if the thickness of the insulation has to be increased. The method according to the present invention avoids all the inconveniences of the commonly applied methods. It is based on the fact that bodies with similar electric charge (+ or -) repel one another, whereas bodies with opposite charge attract one another. The method is characterized chiefly by the use of high-voltage electric currents for opening and distributing insulating material of any kind.

These currents are further used for applying the insulating material on to the electric conductors. The individual fibres and particles of the material are electrically charged through the pole of a high voltage source so that they deposit on bodies, which are connected to the opposite pole of the high voltage source. The arrangement may be made so that the bodies to

be insulated are grounded and that the other pole of the high voltage source is grounded also.

The insulating of the conductor according to this method is carried out much more rapidly (about 25 times as rapid) than the hitherto employed method, and it permits of the simultaneous insulating any desired number of conductors in one operation, which may all be of the same diameter or of different diameters. The insulating layer obtained in this manner is of uniform thickness on all points of the conductors, and it is possible to regulate the thickness of the insulating layer as desired, as the method is carried out in an undisturbed atmosphere, as will be hereinafter explained.

An apparatus employed for carrying out the new method is diagrammatically illustrated by way of example in the accompanying drawing, in which:-

Fig. 1 is a side elevation and

Fig. 2 a top plan view.

Fig. 3 shows a section of a conductor covered, fox-tail like, with insulating material, the covering being not yet smoothed.

Fig. 4 shows a fragmental vertical section of an upper portion of a modified form of the apparatus.

The apparatus consists of uprights 1 connected at the top end and near the lower end by transverse bars or plates 2 and 3, on which pulleys for changing the direction of the conductors 4 are mounted. The uprights 1 carry a cylindrical container 5, made of transparent, insulating material, preferably glass. This container 5 is closed at the top and bottom by cover plates 6 and 7. A sputtering electrode 8 projects from below into the container 5 and represents one pole of the high voltage source. The conductors 4 to be insulated pass through the container 5, and any number of conductors are grouped around the sputtering electrode 8 at a suitable distance from the same. On the lower transverse plate 3 containers 9, filled with adhesive are mounted, through which the conductors to be insulated are passed prior to passing through the container 5. Insulation smoothing devices 10 are mounted on the cover plate 6, one for each conductor 4, these being designed to smooth the insulating material adhering to the conductor as the conductor passes through the center bore thereof. The smoothing devices are rotatively driven from a motor 11. The loose fibrous material is fed to the container 5 through a charging funnel 12 mounted on the cover plate 6.

The method is carried out in that the covering material, for instance textile fibres or paper dust, loosened, for instance, by rapidly rotating brushes, flows through the funnel 12 into the transparent container 5. The insulating material in the container is electrically charged by the influence effect of sputtering electrode 8 connected to the high voltage source. This charging with electrons of similar polarity effects a further loosening of the insulating material as the individual particles repel one another, according to the law that bodies of similar electric charge repel one another. The electrically charged particles possess the tendency to move away from the sputtering electrode, the point of high potential, in outward direction towards the zone of low potential (phenomenon of the electric wind). This tendency is especially favorable for this method. The particles are thereby thrown against the adhesively coated conductors 4 to be insulated which are conducted through the container at a suitable distance from the sputtering electrode 8. These conductors, being grounded, or connected to the other pole of the high voltage source, attract with high velocity the ionized particles of insulating material. These particles, shot against the bare conductors, cover the same in foxtail-like formation. The foxtail-like coverings are then smoothed as they are drawn through the smoothers 10. The conductors are then perfectly insulated.

The conductors 4, before they enter into the container 5, are passed through the containers 9, so that they are coated with a suitable adhesive, whereby the adhesion of the particles of insulating material to the conductor is facilitated.

The coating of the conductors with adhesive may however be effected in that the adhesive is introduced in the form of mist 14 (Fig. 4) from a nozzle 15 into the container 5. The mist particles are then submitted to the same law as the fibre particles, that is, they are electrically charged and fly on to the conductors to be insulated. As the adhesive mist is also distributed between the particles of insulating material, the cover on the conductors consists of a mixture of adhesive and fibre particles. It is not absolutely necessary to coat the conductors with adhesive, as the particles of insulating material adhere well to the conductors when the current has been cut off, as, owing to the high speed at which they flow towards the conductors, they intermix and become matted so that they form a dense cover. The thickness of the insulating layer can be regulated very accurately and in a simple manner by varying the strength of the electrical potential, as with increasing potential also the force which separates the particles of the insulating material increases, and also the speed with which the particles flow towards the conductors. If the electrical potential decreases, the reverse condition occurs. A further possibility of regulation consists in altering the speed with which the conductors pass through the container 5 filled with electrically loaded fibres and along the sputtering electrode 8. At higher speed the layer of insulating material becomes thinner and it becomes thicker at lower speed. Another possibility of regulation is to regulate or alter the quantity of fibres fed into the container in a unit of time. Conductors of different thickness can be insulated at the same time, if for every conductor a drive is provided which can be regulated, as the speed with which the conductors are moved through the container 5 is different according to

the thickness of the conductor and of the insulation to be produced. In order to attain a uniform distribution of the insulation over the entire circumference of conductors, that is also on the side of the same turned away from the sputtering electrode 8, driving gears of known type, not shown on the drawing, are provided, which effect the speed of rotation of the conductors. An advantage of the method not to be underestimated is, that the insulating material is completely used up, as the particles are whirled up continually as long as they remain ionized and as they give up their charge only when they come in contact with the conductor. Another chief advantage of the method is that the covering of the conductors with fibrous material is carried out in the closed container 5, in an undisturbed atmosphere.

The insulating speed can be increased as desired by increasing of the voltage.

According to this method not only wires or strands, but also shaped elements of any form can be insulated.

High voltage direct current as well as alternating current can be used.

I claim:—

1. A method of electrically depositing particles of insulating material on an electrical conductor; consisting in disposing the conductor in the particles, charging the conductor at a certain potential, charging the particles at a different potential, and moving the charged particles to the conductor.

2. A method of coating an electrical conductor with particles of insulating material; consisting in disposing the conductor in the particles, applying a thin liquid, settable adhesive coat to the conductor, charging said conductor electrically at a certain potential, charging the particles at a different potential, and moving the charged particles on to the settable coat, so that the latter may dry to hold the particles in position.

3. A method of applying a coat of insulating particles to an electrical conductor; consisting in disposing the conductor in a mass of particles of insulating material and wet adhesive material, charging the conductor electrically at a low potential, charging the particles at a high potential, moving some of the insulating and adhesive charged particles into attached relation on the conductor, and removing the latter from the mass.

4. A method of applying a coat of insulating particles to an electrical conductor; consisting in disposing the conductor in a mass of the particles of insulating material and liquid adhesive material charging the conductor electrically at a low potential, charging the particles at a high potential, whereby sufficient of said particles may be attracted to the conductor to form a relatively large coat thereon, removing the coated conductor from the mass, so that the adhesive material may dry, and smoothing the attracted particles on the conductor as it leaves the mass whereby to provide a smooth surface on the coat.

5. A method of applying insulating particles to the surface of an electrical conductor; consisting in rendering the surface adhesive, disposing the conductor in a mass of the particles, charging the conductor electrically at a certain potential, charging the particles at a different potential whereby some of the particles may fly to the conductor and form a coat on said surface, removing the conductor from the mass, and smoothing the surface of the coat.

6. An apparatus for coating movable electrical conductors comprising in combination a container of insulating material, the conductors being movable through the container in an annular series; means for delivering particles of fibrous coating material into the container around the conductors; said container having therein a central electrode which is adapted to deliver therefrom a high potential charge; means for delivering a thin adhesive covering to the conductors as they move into the container, said conductors adapted to be charged electrically at a low potential; so that as the charge is delivered from said electrode the particles may also be charged, whereby said particles may be attracted to the conductors to coat the latter, and means for smoothing the coated conductors as they leave the container.

7. An apparatus comprising means for charging, with high potential, small particles of insulating material; and means for charging an adhesive-coated wire conductor, near said particles, with lower potential.

8. An apparatus comprising means for providing a closed insulated space; means for supporting a conductor in said space; means for feeding, into said space, separated small particles of insulating material and a plurality of adhesive particles; means establishing a charge of high potential in the space; and means for charging said conductors with a lower potential.

9. An apparatus comprising means providing a laterally closed insulated space; means for holding a conductor in said space; means for simultaneously feeding into space a plurality of separated small particles of insulating material and adhesive particles separated in the form of a mist; means for establishing a charge of high potential in said space; means for charging said conductor with potential opposite in sign to that of said charge.

10. An apparatus comprising means for providing a laterally closed and insulated space; means for continually feeding a plurality of spaced conductors upwardly through said space; means for applying a settable adhesive to and around each conductor before it enters said space; means for feeding into said space a plurality of small particles of insulating material; means for establishing a charge of high potential in the midst of said space, whereby said particles are charged with charges of like sign, and are therefore further separated from each other and driven from said charge; means for charging said conductors with potential lower than that of said charge; whereby the particles are drawn at high speed strongly to said conductor and adhesive and permanently adhered to the adhesive and to each other, thereby distributing the particles around the conductors within a fox-tail-like formation; and means smoothing said formation around the conductor as latter passes from said space, thereby forming an effective insulating coating.

11. An apparatus comprising means for providing a laterally closed and insulated space; means for continually feeding a plurality of spaced wire conductors upwardly through said space; means for feeding into the top of said space a plurality of separated small particles of insulating material; means for introducing into said space, simultaneously with the particles, a plurality of adhesive particles separated in the form of a mist; means for establishing a charge of high potential in the midst of said space sub-

stantially equidistant from said conductors, whereby said particles are charged with charges of like sign, and are therefore further separated from each other and driven from said charge; means for charging said conductors with potential opposite in sign to that of said charge, whereby the particles are drawn at high speed strongly to said conductor and are permanently and evenly adhered to the adhesive and to each other, thereby distributing the particles evenly around the conductors within a fox-tail-like formation; and means for smoothing said formation tangentially around each conductor as latter passes from said space, thereby forming an effective insulating coating.

12. A method comprising charging, with high potential, small particles of insulating material; and charging an adhesive-coated wire conductor near said particles with a lower potential.

13. A method comprising charging with high potential separated small particles of insulating and adhesive material; and charging a wire conductor, near said particles, with a lower potential.

14. A method comprising, providing a closed insulated space; supporting a conductor in said space; feeding, into said space, separated small particles of insulating material and a plurality of adhesive particles; establishing a charge of high potential in the space; and charging said conductors with a lower potential, thereby adhering the particles around the conductor without the necessity of first coating the conductor.

15. A method comprising continually feeding a plurality of spaced conductors of different diameters upwardly through a laterally insulated and closed space of quiet air; charging insulating particles in said space with high potential and the conductors with lower potential.

16. A method comprising; providing a laterally closed and insulated space; continually feeding a plurality of spaced wire conductors upwardly through said space; feeding into the top of said space a plurality of separated small particles of insulating material; introducing into said space, simultaneously with the particles, a plurality of adhesive particles separated in the form of a mist; establishing a charge of high potential in the midst of said space substantially equidistant from said conductors, whereby said particles are charged with charges of like sign, and are therefore further separated from each other and driven from said charge; charging said conductors with potential opposite in sign to that of said charge, whereby the particles are drawn at high speed strongly to said conductor and adhesive and are permanently and evenly adhered to the adhesive and to each other, thereby distributing the particles evenly around the conductors within a fox-tail-like formation; and smoothing said formation tangentially around each conductor as latter passes from said space, thereby forming an effective insulating coating.

17. A method comprising continually feeding a plurality of conductors upwardly through a laterally insulated and closed space of quiet air; applying a settable adhesive to the conductors before they leave said space; loosening, separating and feeding into the top of said space a plurality of small particles of fibrous insulating material, whereby said particles will sink into the space; establishing a charge of high potential in the midst of said space substantially equidistant from said conductors, whereby said particles are charged with charges of like sign and therefore further separate from each other and

driven by the charge from said charge; simultaneously, with the establishment of said charge, charging said conductors with a potential opposite in sign to that of said charge; whereby the particles are drawn at high speed strongly to said conductors entirely by the force of the charges and adhere to the adhesive.

18. A method as in claim 17 including the step of applying the settable adhesive to and uniformly all around the conductor before it enters said space.

19. A method as in claim 17 including the step of smoothing said formation tangentially around the conductor as latter passes from said space, thereby forming an effective insulating coating.

20. A method as in claim 17 including the steps of regulating the thickness of said formation by regulating the voltage of the charge, the speed of feed of the conductors, and the rate of supply of the insulating particles; and continuing said method until all of the fed particles are adhered.

21. In the art of covering wire conductors with insulation, a method which comprises supporting a wire conductor; simultaneously applying adhesive and small particles of fibrous insulating material around the conductor; and matting and adhering together the fibrous particles around the conductor as they are applied.

22. In the art of covering wire conductors with insulation, a method which comprises support-

ing a wire conductor; simultaneously applying adhesive and a plurality of separated small particles of insulating material around the conductor; adhering together the particles around the conductor in a foxtail like formation without first coating the conductor; and smoothing said material, thereby compacting said formation.

23. In the art of covering wire conductors with insulation, a method which comprises supporting a wire conductor; simultaneously feeding, into space near said conductor, separated small particles of fibrous insulating material and a plurality of adhesive particles; establishing a charge of high potential in the space; and charging said conductors with a lower potential; thereby causing matting and adhering together the fibrous particles around the conductor without the necessity of coating the conductor.

24. In the art of covering wire conductors with insulation, a method which comprises providing a closed space; supporting a wire conductor in said space; feeding, into said space, separated small particles of insulating material and a plurality of adhesive particles; establishing a charge of high potential in the space; and charging said conductors with a lower potential; thereby causing the adhering of the fibrous particles around the conductor in a foxtail like formation; and smoothing said material, thereby compacting said formation.

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