(No Model.)

F. J. NASH.

INSULATION OF ELECTRIC CONDUCTORS.

No. 447,896 Patented Mar. 10, 1891.

FIG. 1.

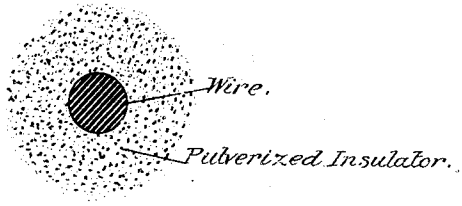


FIG. 2.



FIG. 3.

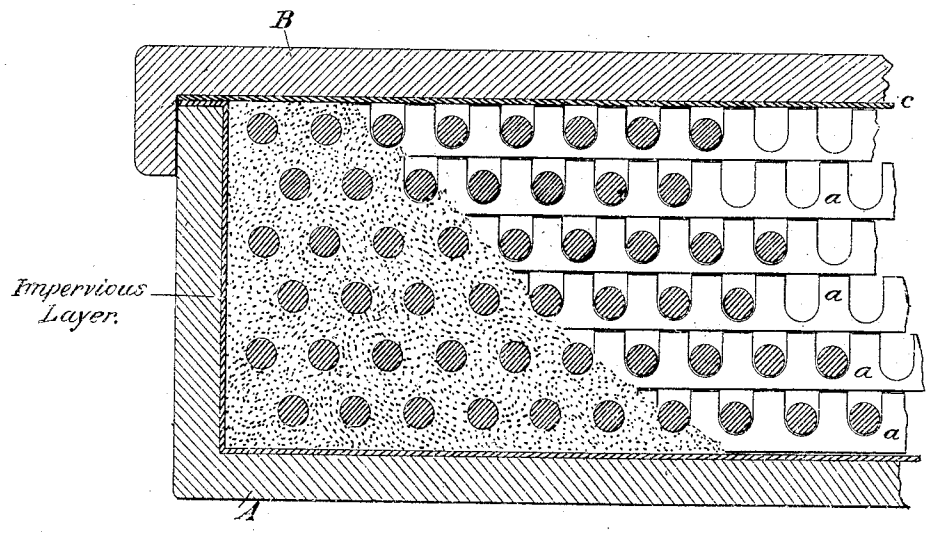


FIG. 4.

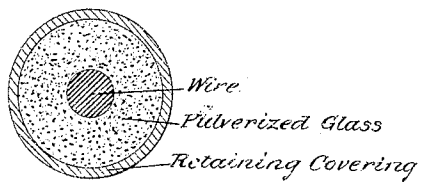
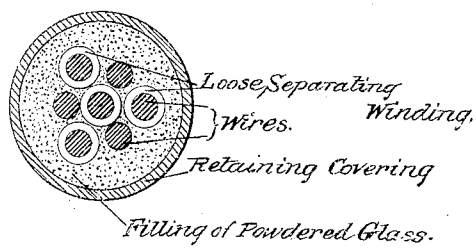


FIG. 5.



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INSULATION OF ELECTRIC CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 447,896, dated March 10, 1891.

Application filed May 12, 1890. Serial No. 351,460. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC J. NASH, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Insulation of Electric Conductors, of which the following is a specification.

This invention relates to means for insulating electric conducting wires or cables whether for aerial or underground use.

My invention is based upon the well-known fact of the superior insulating qualities of glass or other vitreous substances. If it were practicable to run molten glass around the entire length of an electric conductor, its insulation would be practically perfect so long as the glass envelope remained intact. Such a construction, however, even if possible, would be subject to the insuperable difficulty that the glass would crack or chip off upon very slight bending of the wire. If the glass could be so applied as to be as yielding or flexible as the rubber or gutta-percha insulations commonly used, it would be free from this objection.

To accomplish a practically equivalent result to that here suggested is the purpose of my present invention. To this end my invention provides for insulating wires by surrounding them with a layer or bed of pulverized glass or other equivalent insulating material, the particles of which are not held to the wire by cement, but are free to move relatively to one another and are held in contact with the wires by suitable external means. In order to exclude air and moisture, the insulating particles are reduced to the condition of an impalpable powder; or, preferably, the insulating layer is composed of finely comminuted or granulated glass, the interstices between the angular particles thereof being filled by means of an impalpably-fine powder. The minute particles of this impalpable powder enter and so completely fill all the interstices between the coarser particles as to constitute an almost impervious layer when packed tightly around the wire. The insulating material, being of glass or other equivalent substance, is insoluble in an unabsorbent of water and is unaffected by the atmosphere or any other influences to which electric wires are liable to be exposed. By reason of the impermeability of the glass and the intimate union between the impalpable particles thereof the insulating layer or covering is practically impervious to air or moisture, it being only necessary in order to maintain it in this condition that it shall be held tightly packed, so as to keep its particles crowded closely together. By reason of the absence of cementing material the insulating particles are free to move relatively to one another in order to adapt the insulating layer or bed to movements of the wire, such as the bending thereof. The absence of cement is further advantageous in avoiding cracking or chipping of the insulating covering in consequence of bending or concussion. Cementing materials are usually inferior in their insulating properties, and if used would displace a portion of the powdered glass and reduce the efficiency of the insulating covering.

In applying my invention to the insulation of a single conductor the pulverized glass, preferably of two grades of fineness, as described, is packed tightly around the conductor and between the latter and a retaining-covering, which is applied by braiding or otherwise, the operations of applying this retaining-covering and packing the powdered glass thereinto around the wire being preferably performed simultaneously or in immediate succession and progressively. In the insulation of a cable or group of wires which are to be insulated from one another they are applied together with suitable means for keeping them mechanically separated, so that they extend parallel, but with intervening spaces. A retaining-covering is braided or otherwise formed tubularly around the group of wires at a little distance therefrom, and simultaneously therewith a filling of powdered glass is packed into the space within the covering between it and the wires and between the respective wires. In the laying of wires in an underground conduit they are stretched therein with suitable means at intervals for holding them out of contact with one another, and the pulverized glass is sifted in between the wires, so as to fill all the intervening spaces, and is tightly packed into the conduit.

Figure 1 of the accompanying drawings is

a transverse section of an electric wire, showing a portion of the pulverized insulating material around it. Fig. 2 shows on a magnified scale the coarsely-pulverized glass and the fine or impalpable powder which fills the interstices between the coarser particles. This view is necessarily somewhat diagrammatic, it being impossible to show the impalpable particles in actual contact, and the contact between the coarser particles being believed to be, in fact, much more intimate than it is possible to clearly indicate in a view of this character. Fig. 3 is a fragmentary cross-section of a suitable form of underground conduit the wires in which are insulated according to my invention. Fig. 4 is a transverse section of a single wire, showing its insulating-layer of pulverized glass and the outer retaining-covering of braided textile or other material. Fig. 5 shows my invention applied to the insulation of a cable, seven wires being shown, four of which are wound with a loose separating winding consisting of a spiral layer of twine, yarn, or similar material, in order to hold the wires apart and form suitable spaces between them, which may be entered by the filling of powdered glass by which the group of wires is inclosed, and which is held against them by the external retaining-covering.

The external covering in Figs. 4 and 5 may consist of hemp, cotton, or other textile fiber braided or woven around the wire or cable to form a tubular jacket therefor. Its pores or interstices may be advantageously filled by applying to it any suitable paint or varnish—such as linseed-oil, for example—which will serve both to prevent any particles of the insulating layer from escaping and to prevent moisture from entering into contact therewith. The exclusion of moisture in this manner is desirable, because if the insulating layer should chance to be somewhat loosely packed in some part the moisture might permeate it to some extent and thereby slightly impair its insulating value, even though the moisture might not pass entirely through to the wire. This is only to be apprehended when the retaining-covering may have been stretched or strained by too sharp bending of the wire or when the pulverized glass has not been packed with sufficient firmness into the space between the wire and the retaining-covering; but to provide against the possibility of these contingencies it is best to render the retaining covering or jacket impervious.

In the application of my invention shown in Fig. 3 a trough-shaped box A, of wood or metal, is provided, having a cover B and suitable means for fastening it tightly down. Within the box are placed at suitable intervals notched strips *a a* of wood or other insulating material, and the conducting-wires are laid parallel with one another, entering the notches and stretched to draw them straight and out of contact with one another. The pulverized glass is then sifted in around the wires, so as to pass beneath them, between them, and form a covering for them, whereupon the second layer of wires is laid in like manner, and so on, or all the wires may be laid and the pulverized glass poured in and jarred down so that it shall find its way into all the spaces between the wires. Enough pulverized glass is put in to fill the trough or box flush with its top, and it is crowded down tightly therein and held firmly in place by fastening on the cover B. The box A and cover B should be of impervious material, so as to exclude air and moisture, and their joints should be suitably packed, or if they are not sufficiently impervious a layer *c* of impervious material may be applied as a lining within the box and cover. In situations where the conduit is not subject to heat this layer is best applied as a coat of beeswax, which may be painted upon the inner sides of the box and cover, or paper saturated in beeswax may be laid around the inner sides of the box.

In the preparation of the insulating filling material I may take any ordinary cheap glass, preferably the broken fragments or refuse from glass-mills, and after breaking it up by means of a stamp-mill or crusher into small pieces it is ground to any suitable fineness—say, for example, to about the same fineness as the sand used in hour-glasses, or perhaps a little coarser than that. The exact grade of coarseness desired may be attained by the use of sieves, as is well understood in the art. The grade of pulverized glass thus prepared will constitute the coarser grade. The finer grade or impalpable powder is prepared by continuing the grinding until the glass is reduced to fine dust. Its impalpability may be determined by subjecting it to the process called "floating"—that is, by mixing it with water and flowing off the water containing the particles which are fine enough to be held in suspension in it into a vat, where it is left undisturbed until these particles are precipitated, after which the water is drawn off and the precipitate is dried.

In lieu of using impalpably-pulverized glass as the finer powder, impalpably-pulverized quartz or silex may be used instead. In fact, both grades of the pulverized insulating material may be of silex or of any other insoluble and non-absorbent vitreous or silicious material; but pulverized glass is considered preferable to any other material. Ground porcelain might be used in place of glass.

The coarser and finer grades of glass or other material should be thoroughly mixed together in any suitable proportions—say, for example, in equal bulks—their complete intermingling being preferably effected by passing them through some good mixing-machine; or they may be separately applied to the wire, preferably in the case of single wires, in which it would be advantageous to have the finer powder applied directly against the wire and between it and the coarser pow-

der, although the difficulty of applying the powders in this way might be greater than would justify the slight advantage thereby obtainable.

The coarser grade of powder might be wholly omitted, only the impalpable powder being used; but this, while producing in some cases equally good effects, would in no case have any advantage over the combination of the two grades, and it would be less cheap, since the grinding of the impalpable powder costs somewhat more than the coarser grinding or crushing of the coarser grade of powder.

I disclaim the insulation of wires by cementing pulverized glass or silex to them; also, the use of soluble silicates of the nature of what is known as "water-glass," both of which have been heretofore proposed for insulating purposes, but both of which I consider practically worthless because of the inflexibility and brittleness of the insulating-covering.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. An electric conductor insulated by a surrounding bed or layer of insulating material in the condition of an impalpable powder, whereby the particles thereof pack together so closely as to exclude air and moisture.

2. An electric conductor insulated by a surrounding bed or layer of glass in the condition of an impalpable powder, whereby the particles thereof pack together so closely as to exclude air and moisture.

3. An electric conductor insulated by a surrounding bed or layer of insulating material in the condition of an impalpable powder, whereby the particles thereof pack together so closely as to exclude air and moisture, with a retaining-covering inclosing the insulating material.

4. An electric conductor insulated by a surrounding bed or layer of insulating material in the condition of an impalpable powder, whereby the particles thereof pack together so closely as to exclude air and moisture, with an impervious retaining-covering inclosing the insulating material to prevent access of air and moisture thereto.

5. An electric conductor insulated by a surrounding bed or layer of pulverized or granulated insulating material, the particles of which are free to move relatively, and an impalpable powder of insulating material filling the interstices between the coarser particles, whereby air and moisture are excluded.

6. An electric conductor insulated by a surrouding bed or layer of pulverized or granulated vitreous or silicious materials, the particles of which are free to move relatively, and an impalpable powder of insulating material filling the interstices between the coarser particles.

7. An electric conductor insulated by a surrounding bed or layer of pulverized or granulated glass, the particles of which are free to move relatively, and an impalpable powder of insulating material filling the interstices between the coarser particles.

8. An electric conductor insulated by a surrounding bed or layer of pulverized or granulated glass, the particles of which are free to move relatively, and impalpably-powdered glass filling the interstices between the coarser particles.

9. An electric conductor insulated by a surrounding bed or layer of pulverized or granulated glass, with an impalpable powder filling the interstices between the coarser particles, and an impervious retaining-covering to prevent access of air and moisture thereto.

10. A series or group of parallel wires laid in a retaining-conduit and insulated by a filling in said conduit of pulverized insulating material, forming a bed between and around the wires, and an impalpable powder filling the interstices between the coarser particles for excluding air and moisture from the wires.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

FREDERIC J. NASH.

Witnesses:
ARTHUR C. FRASER,
JNO. E. GAVIN.