(No Model.)

F. J. NASH.

ELECTRIC CONDUCTOR.

No. 447,897. Patented Mar. 10, 1891.

FIG. 1.

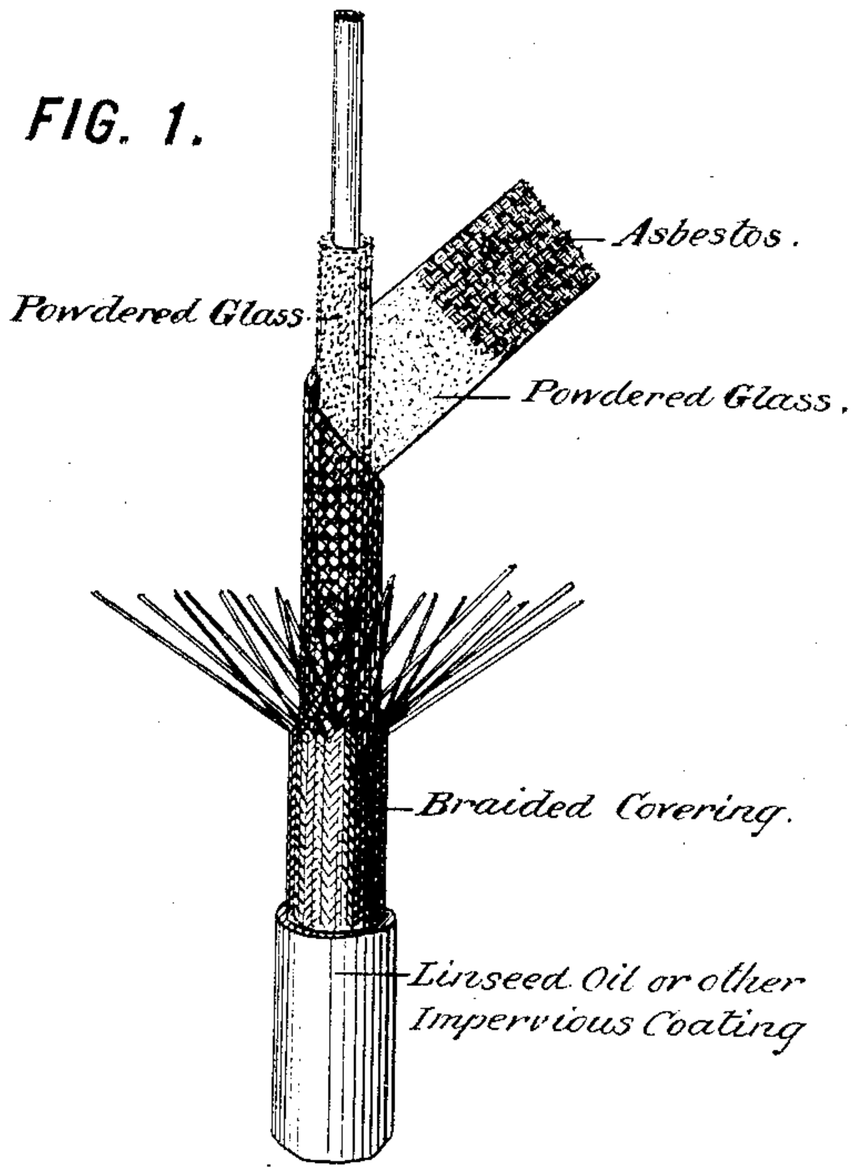


FIG. 2.

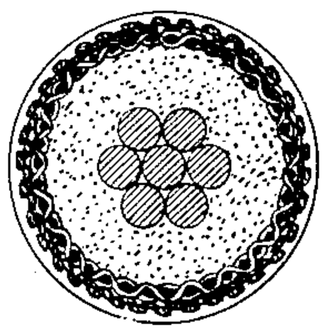


FIG. 3.

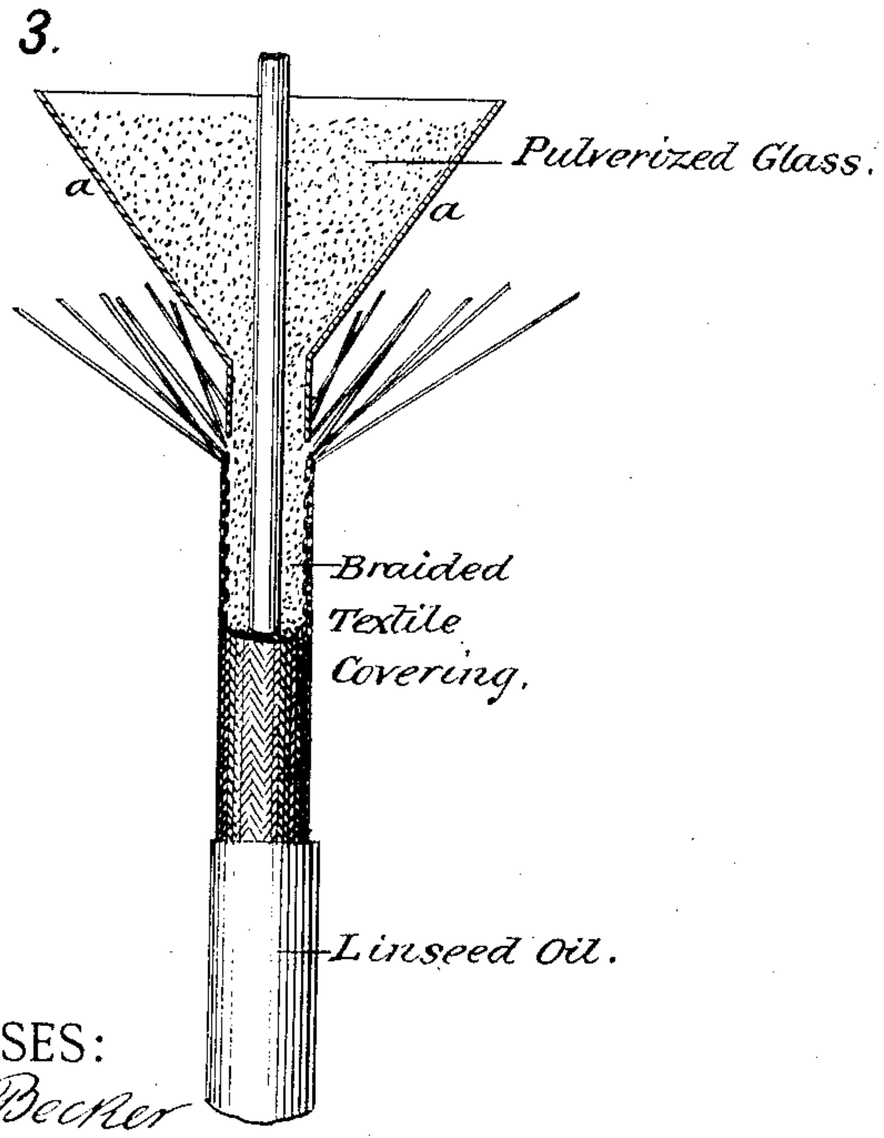
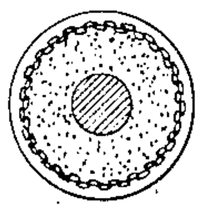


FIG. 4.



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UNITED STATES PATENT OFFICE.

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ELECTRIC CONDUCTOR.

SPECIFICATION forming part of Letters Patent No. 447,897, dated March 10, 1891.

Application filed May 13, 1890. Serial No. 351,637. (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 Insulated Electric Wires, of which the following is a specification.

This invention relates to means for insulating electric wires, and aims to provide a flexible covering of higher insulating value than any heretofore produced. It also aims to render the insulation flame-proof, uninflammable, and as nearly fire-proof as possible.

According to my invention I apply around the wire a layer of pulverized glass or other equivalent pulverized insulating material, this layer being held against the wire by means of a retaining envelope or jacket. The pulverized particles are uncemented, being consequently free to move relatively to one another when the wire is bent, and the retaining-jacket is made of flexible material to permit of the flexure of the wire. The pulverized glass is packed tightly around the wire, so that its particles wedge closely together and constitute so far as insulating qualities are concerned practically a solid glass tube around the wire, while possessing nevertheless the advantage of being free to move in case of flexure, so that the insulating-tube cannot be cracked or chipped off by the bending of the wire. In order that no interstices shall be left between the pulverized particles sufficiently large to permit access of moisture to the wire, the glass is pulverized to a sufficient fineness to enable the particles to be packed together with practical solidity. Preferably the glass is ground of two grades of fineness, the coarser grade of crushed or granulated glass about as fine as fine sea-sand, and a finer grade ground to an impalpably fine powder. The two grades being thoroughly mingled the impalpable particles fill the interstices between the coarser granules and exclude air and moisture therefrom. In order to render the insulating-covering as nearly fire-proof as possible, so that it will not be inflammable and will resist any degree of heat short of that which would fuse the glass, the retaining-envelope, or an inner layer thereof, is made of asbestus applied preferably in the form of tape wound spirally around the wire. When thus applied an external envelope of textile material is applied preferably by braiding or weaving it tightly around the asbestus layer. This outer envelope may, however, be omitted and the asbestus constitute the sole retaining-envelope for holding the pulverized glass or insulating material against the wire; but in such case the asbestus is preferably applied by braiding it or weaving it around the wire. In order to fill the pores in the retaining-envelope and effectually exclude the penetration of moisture thereinto, the envelope is saturated with an impervious coating of some suitable material, preferably linseed-oil, which, on becoming oxidized, forms a tough and durable skin well adapted to resist the atmospheric influence. A coating of rubber or gutta-percha may be used instead.

Figure 1 of the accompanying drawings is a dissected view showing a wire insulated according to the preferred embodiment of my invention. Fig. 2 is a transverse section on a larger scale showing the same construction except instead of a single wire a group of smaller wires is provided for greater flexibility. Fig. 3 is a side elevation illustrating a modified construction of the insulation and showing also one method of applying it. Fig. 4 is a transverse section on a larger scale of the insulated wire shown in Fig. 3.

The wire shown in Fig. 1 is insulated first by a layer of powdered glass immediately surrounding it, and secondly by a layer of asbestus applied in the form of a tape wound spirally around the wire and serving to hold the powdered glass against it. Around the asbestus is braided a covering of hemp, cotton, or other textile fiber, and the wire is subsequently passed through a bath of linseed-oil by which it is given an impervious coating for excluding air or moisture. In applying the insulation in this manner, the preferred method is to sift or sprinkle the powdered glass on one side of the asbestus tape and roll or press it thereagainst, so as to cause it to work into the interstices thereof and adhere thereto. The asbestus tape is wound upon the wire with the glass against the wire. The powdered glass thus applied may be of equal thickness for many uses; but where a thicker insulation is desired the powdered

glass should be applied in a dense tubular bed or layer around the wire and between it and the asbestus. This can best be done by passing the wire downwardly through a hopper *a*, (shown in Fig. 3,) containing the powdered glass, any suitable means being provided for forcing the glass down through the mouth of the hopper as the wire is drawn through and compacting it around the wire with the desired firmness. In order to hold the layer of glass thus applied, the asbestus or other retaining envelope must be wound, braided, or otherwise formed around the wire at the instant of the emergence of the tubular column of glass from the mouth of the hopper, as shown in Fig. 3, where the retaining-envelope is shown as in the process of being braided on, which may be done in any ordinary braiding-machine. The braided covering in Fig. 3 may be of asbestus or any other fibrous material. Its surface is to be covered or saturated with any impervious or moisture-excluding coating, such as linseed-oil.

The insulated wire prepared according to my invention will be found to be as perfectly insulated as though it were inclosed in an unbroken tube of glass fused around it, while at the same time it will have all flexibility necessary for line-wires or aerial, underground, or submarine cables. It is not affected by moisture, which, even if it should penetrate the retaining-envelope, or two or more such envelopes in case two or more are applied, cannot reach the wire by reason of the impervious character of the layer of pulverized glass due to the particles thereof being so minute and so firmly packed together. The insulating covering is uninflammable and flame-proof when the outer wrapping is of asbestus, so that the wire is uninjured by any fire the heat of which is insufficient to fuse the glass. In the case of the construction shown in Fig. 1 the outer braided covering, if of cotton, jute, &c., may be burned off, but the spiral layer of asbestus tape will resist the flame and hold the glass in proper position around the wire.

In the preparation of the glass, broken or refuse glass is crushed or ground until it is reduced to the fineness of fine sand or thereabout. This will constitute the coarser grade of glass. To produce the finer grade, the grinding is continued until the glass is reduced to dust. To insure its impalpability it may be subjected to the process known as "floating"—that is, it is stirred into water, and the particles which are fine enough to remain in suspension therein are carried off by the flowing out of the water into a settling-tank where in course of time they are precipitated and the water decanted, the precipitate being then thoroughly dried.

Instead of using two grades of glass the glass may be reduced wholly to an impalpable powder; but the two grades are preferred by reason of the greater cheapness of the coarser glass, and because it is believed that a union of the two produces a more perfect fitting together of the particles and a more complete exclusion of air and moisture.

In place of glass, other vitreous materials may be used, such as ground porcelain, or such materials may be mixed with the glass. In place of the impalpable glass powder, quartz or silex may be ground to impalpability, or quartz may be used to replace both the coarser and finer grades of pulverized glass. Any vitreous or silicious substance which is insoluble in water and not affected by any substances that may permeate the outer envelope which may be used may be substituted for the glass as equivalents thereof.

I disclaim the use of powdered glass cemented around the wire so as to form a rigid coating; and I also disclaim the insulation of wires by applying around them a coating of a soluble silicate, such as water-glass. Both methods are considered impracticable, because of the inflexibility of the insulating coating and its liability to chip off or crack and thereby admit moisture. The cementing of glass around a wire would also be disadvantageous because the cement being an inferior insulating material would adulterate the glass and reduce its insulating value.

A layer of rubber or gutta-percha may be applied around the retaining-envelope if desired. In some cases it may be advantageous to coat the retaining-envelope with beeswax or other waxy material. For submarine cables the usual protecting armor may be applied.

My invention is applicable to the insulation of cables or combined strands of wire, as well as single wires. Where several wires are to be inclosed in one insulating covering and insulated from each other, the individual wires will be mechanically separated in any suitable way as by winding around them loose spirals of yarn or twine to keep them out of contact and form spaces between them, and the powdered glass insulation will be applied in such manner as to cause it to fill the spaces between the individual wires.

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

1. A wire inclosed in a layer of pulverized insulating material the particles of which are free to move relatively, and a retaining-envelope for holding the insulating material against the wire.

2. A wire inclosed in a layer of pulverized insulating material the particles of which are free to move relatively, and an impervious retaining-envelope for holding the insulating material against the wire and excluding moisture therefrom.

3. A wire inclosed in a layer of pulverized glass the particles of which are free to move relatively, and a retaining flexible envelope for holding the powdered glass against the wire.

4. A wire insulated by a layer of unce-

mented pulverized insulating material with a surrounding layer of asbestus.

5. A wire insulated by a layer of uncemented pulverized insulating material with a surrounding layer of asbestus and an outer envelope of textile material.

6. A wire insulated by a layer of uncemented pulverized insulating material with a surrounding layer of asbestus and an impervious coating for excluding moisture.

7. A wire inclosed in a layer of asbestus having a layer of uncemented pulverized insulating material applied to it on the side next the wire.

8. A wire insulated by a spirally-wound tape of asbestus having uncemented pulverized glass applied to its surface and filled into its interstices on the side next the wire, and an external binding envelope of textile material to hold the glass and asbestus closely against the wire.

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

FREDERIC J. NASH.

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