(No Model.)

# W. & T. G. McMAHON.

## UNDERGROUND CABLE.

No. 273,869. Patented Mar. 13, 1883.

*Fig. 1.*

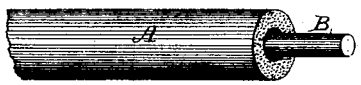



*Fig. 2.*

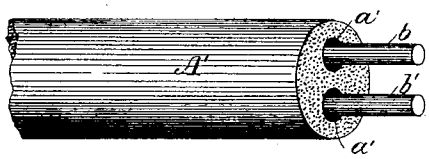



*Fig. 3.*

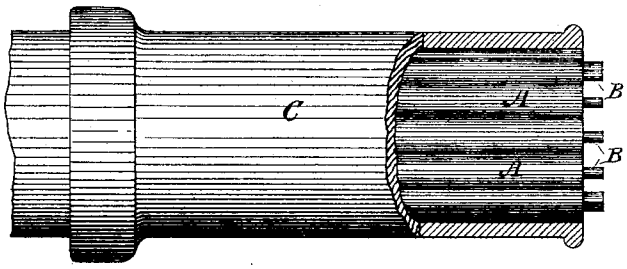



*Fig. 4.*

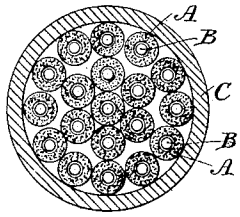



*Fig. 5.*

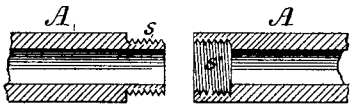
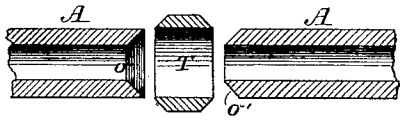



*Fig. 6.*




WITNESSES

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# UNITED STATES PATENT OFFICE.

WILLIAM McMAHON AND TIMOTHY G. McMAHON, OF CHARLESTOWN, NEW HAMPSHIRE, ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE UNDERGROUND ELECTRIC CABLE COMPANY, OF NEW HAMPSHIRE.

## UNDERGROUND CABLE.

SPECIFICATION forming part of Letters Patent No. 273,869, dated March 13, 1883.

Application filed September 22, 1882. (No model.)

*To all whom it may concern:*

Be it known that we, WILLIAM McMAHON and TIMOTHY G. McMAHON, both of Charlestown, in the county of Sullivan and State of New Hampshire, have invented certain new and useful Improvements in Underground Cables; and we do hereby declare that the following is a full, clear, and exact description of the same.

Our invention relates to insulated conductors for conveying electrical currents for any of the purposes for which such currents are ordinarily used, and more especially to insulated underground conductors, although the improvements are of utility in and applicable to any relations or positions in which insulated conductors of electricity are desirable.

In order to be commercially practicable, underground insulated conductors must be furnished with an insulating and protecting medium economical in first cost, of high insulation, durable, and easy of application, to which ends many materials, combinations, and forms have been devised, the most common of which have been compositions, solid or presumably solid at ordinary temperatures, but plastic at high temperatures, so that they could be applied to the conductors in a plastic condition. Some of these possessed the merit of economy in first cost, but were found to lack durability, being affected by thermal and hygrometric changes, and hence proved in the end to be lacking in actual economy. Others proved comparatively durable, and not subject to any great change under such influences; but their prime cost, due to expensiveness of the materials used, especially where rubber and such materials entered into the composition, rendered them economically undesirable. In other instances the conductors are placed and kept separated from each other in tubes which are filled with an insulating-liquid; but in such cases constant attention was required in order that the tubes be kept constantly full of the liquid under pressure, and leakage and evaporation prevented; hence such systems, so far as we know, have failed of general adoption. Moreover, where in compositions hydrocarbons—such as paraffine, asphalt, &c.—were used, the insulation itself was highly combustible and proved in some instances a source of great danger.

In view of these things the object of our invention is to produce an insulated conductor wherein the insulating material shall be cheap in prime cost, durable, of high insulative capacity, easy of application, and, under ordinary circumstances, practically incombustible. To accomplish this we make the insulation of the conductors as an already-formed tube of paper completely encircling, protecting, and insulating the conductor.

The insulating properties of paper were of course known before our invention. For instance, in some positions, for small spaces or for temporary uses, sheet-paper has been wrapped around the conductor, and it has been suggested that paper-pulp be coated upon the conductor; but so far as we know no means were suggested or shown of carrying this mere suggestion into practice. Paper has also been used incidentally alternative with cloth or any other fabric as a base, upon which an asphalt composition was applied, and a tube then formed thereof, which served as a mandrel, upon which a cement pipe was cast. Beyond this, so far as we have been able to ascertain, no way has been devised or disclosed for utilizing the insulating properties of paper.

In our invention tubes are formed preferably from the pulp, and, when they are to be used in any peculiar situations, with any desired exterior configuration best fitting them for use in the peculiar situation. They are formed under great pressure, so as to render them hard in substance, firm, and homogeneous, and so formed they are practically incombustible, or at least not liable to combustion from any influence of the current. We prefer that the insulating-tube should be loose upon or around the inclosed conductor, so that both may be free to expand or contract, each independently of and without danger of injury to the other; but this feature of mere loose insulation forms no part of the invention intended to be secured herein, and hence no claim thereto is herein made.

In the drawings, Figure 1 is a view of a single insulated conductor embodying our invention, and Fig. 2 a view showing the inven-

tion applied to two conductors, while Figs. 3 and 4 are views showing how a number of conductors may be grouped for an underground system. Figs. 5 and 6 show how the adjacent ends of sections may be coupled together.

A is a paper tube, formed preferably from pulp, and whose internal diameter is slightly larger than the diameter of the wire or conductor B. The tube is formed in lengths, and in the process of manufacture is subjected to such pressure as will thoroughly consolidate it, rendering it hard, firm, and homogeneous. The wire B is then passed therethrough or the tube slipped over the conductor. The tube A is made in lengths or sections, and the various lengths or sections may be united by a male and female screw, *s s'*, (see Fig. 5,) formed thereon; or the adjacent ends of sections may be beveled, (see *o o'*, Fig. 6,) and the joint protected by a thimble, T. Two or more apertures, *a a'*, may be made in the same tube, (see Fig. 2,) in each of which apertures is a wire, *b b'*, which may form a complete metallic circuit or be members of independent electric circuits. For underground use a number of the insulating-tubes A or A' may be placed in one protecting-envelope, C, Figs. 3 and 4, which envelope C may be a wooden, iron, paper, or composition pipe, or which may be merely a box or trench.

By these means we are enabled to utilize the high insulating properties of paper, and to furnish an insulated conductor, cheap, durable, easy of manipulation and use, and of high insulative capacity.

What we claim is—

An insulated conductor for conveying electric currents, consisting of the combination of a metallic conductor and a formed pipe of paper only, substantially as set forth.

WILLIAM McMAHON.
TIMOTHY G. McMAHON.

Witnesses:
H. W. PARKER,
JOHN W. COLLINS.