(No Model.)

W. R. PATTERSON.

Manufacture of Underground Telegraph Lines.

No. 239,539. **Patented March 29, 1881.**

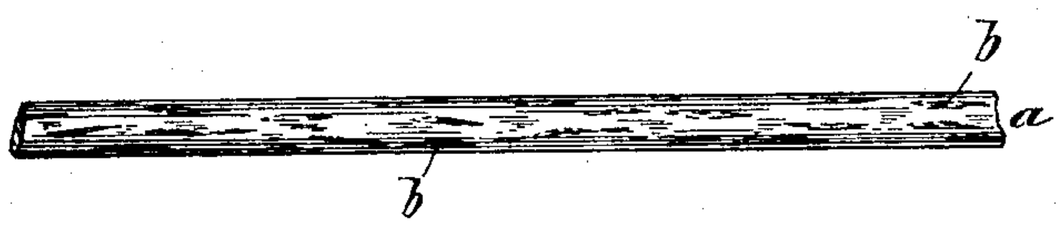

Fig 1

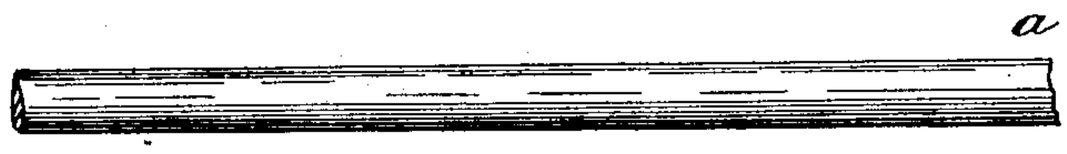

Fig 2

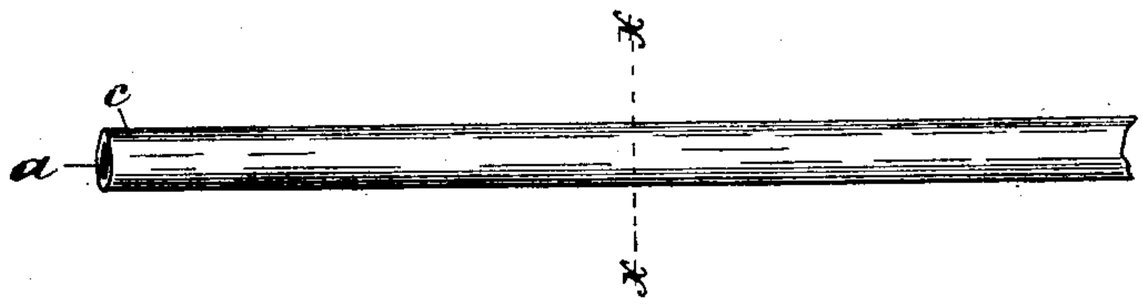

Fig 3

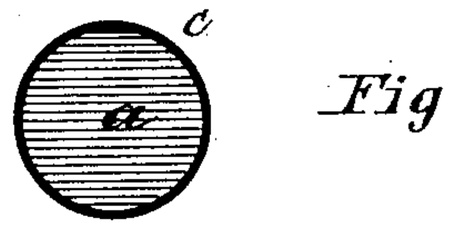

Fig 4

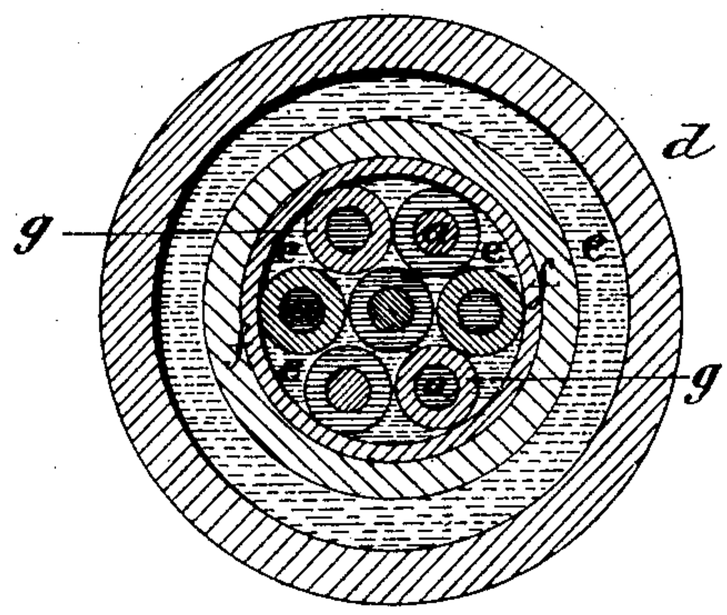

Fig 5

Witnesses

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WILLIAM R. PATTERSON, OF EVANSTON, ASSIGNOR TO WESTERN ELECTRIC MANUFACTURING COMPANY, OF CHICAGO, ILLINOIS.

MANUFACTURE OF UNDERGROUND-TELEGRAPH LINES.

SPECIFICATION forming part of Letters Patent No. 239,539, dated March 29, 1881.

Application filed December 13, 1880. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM R. PATTERSON, of Evanston, in the county of Cook and State of Illinois, have invented a new and useful Improvement in the Manufacture of Underground-Telegraph Lines, of which the following is a specification.

My invention relates to the preparation of the copper conducting-wires and the fibrous material with which they are covered; and it consists in removing therefrom all substances which would be detrimental to the maintenance of the integrity and insulation of the conductors of oil-cables.

I have found that there are on the surface of copper wire of commerce many kinds of substances the presence of which in a cable of this character has always proved injurious. Among the injurious substances I have found sulphide of copper, chloride of copper, sodium, and other metals, and oxide of copper, iron, and other metals. Oxide of copper is always present, being formed by the process of annealing, and by the necessary or accidental exposure in transshipment or storage to air containing oxidizing agents. The sulphide is also sometimes present, being formed by similar exposure. The sulphate may be formed by the action of a minute quantity of sulphuric acid in the oil, aided by the heat necessary to expel the moisture at one stage of the manufacture, or by other accidental means. Chloride of copper may be formed resulting from the presence of chlorine in some combination, remaining after the bleaching process to which the cotton must be subjected. Salts of other metals, when found, are usually in the fibrous covering, and iron oxide may be present in fine particles coming from the iron pipe generally used. The oxides and other unavoidable compounds are generally uniformly distributed, while the accidental compounds—such, for example, as may be formed from a drop of acid—only occur here and there. Any given piece of commercial copper wire, such as is used for other telegraphic purposes and such as heretofore has been used in cables, is liable to be tarnished by one or more of the substances mentioned. Although the wires all test well at first, there will in all probability be some point where the insulation will be imperfect, and where there will be comparatively much more escape than elsewhere, owing perhaps to an impurity in the fiber, to the presence of a drop of water, or to the distance between the wires being reduced by twisting or bending. The current thus escaping from a conductor to the ground or neighboring conductors will decompose the film of sulphide of copper. This is most noticeable where the insulation is poorest. The sulphur will immediately take hydrogen from the oil, forming hydrogen sulphide. The tendency is to deposit the metallic copper produced by the decomposition at the negative electrode, but it is retained by the fibers of the covering. The hydrogen sulphide, held from escaping in bubbles by the same cause, is left to combine again with the copper of the wire, forming again sulphide of copper. This will again be decomposed by the action of the current, and more copper will be deposited in the fiber. By a continuation of this action copper will be gradually deposited in the fiber, until ultimately—the time depending on the original degree of insulation, the amount of available sulphide, and the strength of the current—a fault will be developed which will interrupt the working of the line. If sulphate of copper is present in a cable of this kind, it will in like manner be decomposed by the current escaping, and the metallic copper will be deposited upon the fibrous covering. The oil and oxide present furnish the elements necessary to unite with the other products resulting from the decomposition of the sulphate of copper, and form sulphuric acid, which, if in sufficient quantity, will attack the wire, and the process of decomposition and combination will be repeated until the insulation is destroyed. When chloride of copper is present it will in a similar manner be decomposed, and result in the deposition of metallic copper upon the fibrous covering and the formation of hydrochloric acid, which attacks the wire and forms a chloride which is again decomposed. In a like manner any metallic salt decomposed by a current of electricity seems to result in the formation of the corresponding acid by aid of hydrogen from the oil. When an oxide of copper or other metal is subjected to the action of the current in presence of oil, the insulation of the wires rap-

idly deteriorates, and the oil is found to contain traces of water.

When any of the substances I have mentioned as being injurious when on the surface of the copper wire are present in the fiber with which the wire is wound, chemical reactions similar to those I have described above are liable to occur to the injury of the cable. Unbleached cotton yarn—the only material that has been heretofore used to insulate the wires in this class of cables—I find always contains, in addition to other impurities, lumps of natural gums, which lower the insulation where they occur, and thereby occasion greater escape at certain points, resulting in more energetic chemical action when certain other impurities are present either in the cotton or oil or upon the wire. I have known cables in actual use to gradually deteriorate and fail from several of the causes I have mentioned, and have demonstrated by chemical experiment and analysis the possibility of such failure from any of them.

I prevent the destruction of the cable from any of the causes which I have mentioned in the following manner: By means of stiff wire scratch-brushes revolving against the wire, or by a dipping process of potash, dilute acid, and water-baths, I thoroughly remove all foreign substances from the surface of the copper wire. Then, immediately after the wire has been thus thoroughly cleaned, and in order to prevent a new coating of injurious substances from forming on the wire, I cover it with a coating of shellac, lacquer, paraffine, or other suitable material.

In the drawings, Figure 1 represents a piece of copper wire of commerce with its coating, *b*, of impurities.

a, Fig. 2, shows the wire with the impurities removed.

c, Figs. 3 and 4, shows the coating of shellac or other chemically inert substance.

Fig. 5 is a transverse section of an oil-cable containing wires, *a*, thoroughly cleaned and formed into a cable of insulated conductors. The wires are covered with fibrous coverings *g* and bound together by covering *f*, said coverings of fibrous material being thoroughly washed, as before described.

The iron pipe *d* and oil *e* are used in the ordinary way.

In place of unbleached cotton yarn I use that which is bleached and thoroughly washed, so as to remove all traces of any chloride which may be present from bleaching processes.

After the copper wire and fibrous covering are thus prepared I wind the wires and construct and lay the cable in the usual manner.

Prior to my invention it was customary to use shellac applied directly to the impure surface of copper wire of commerce. The yarn was wound upon this coating of shellac and embedded therein by heating the wire thus covered. The shellac thus used served to improve the insulation of the wire and prevent the cotton from unwinding or slipping; but all the original impurities were left upon the wire.

I use shellac or other chemically inert substance upon the clean surface of copper wire to keep it clean during the subsequent steps of the process of its manufacture and until it is all ready to be drawn within the pipe.

Cables are always heated or baked to expel all moisture before they are drawn within the iron pipe. This necessary heat effectually dissipates the very thin coating of shellac that I use to keep the surface of the wire clean during the process of its manufacture. The shellac has thus done its work when the cable is ready to go into the drying-oven.

I have pointed out one way of cleaning the wire. There are other ways of cleaning wire well known to those skilled in the art.

I claim—

The process consisting of cleaning the wire, applying a coating of shellac to keep it clean, covering the wire with clean fibrous material, and then forming the wire thus insulated into a cable and drying the cable, whereby the shellac is dissipated, substantially as described.

WILLIAM R. PATTERSON.

Witnesses:

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