J. A. L. DEARLOVE.

ELECTRIC TELEGRAPHY.

APPLICATION FILED MAR. 1, 1909.

942,620.

Patented Dec. 7, 1909.

Fig. 1.

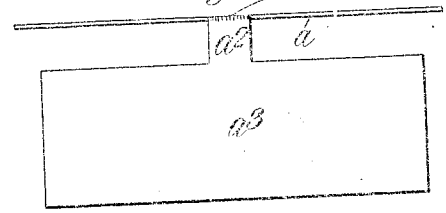


Fig. 3.

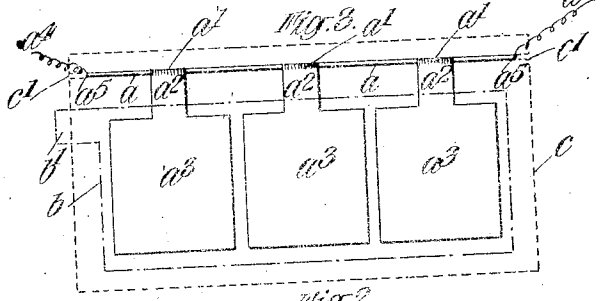


Fig. 2.

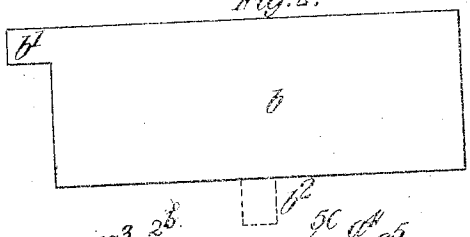


Fig. 4.

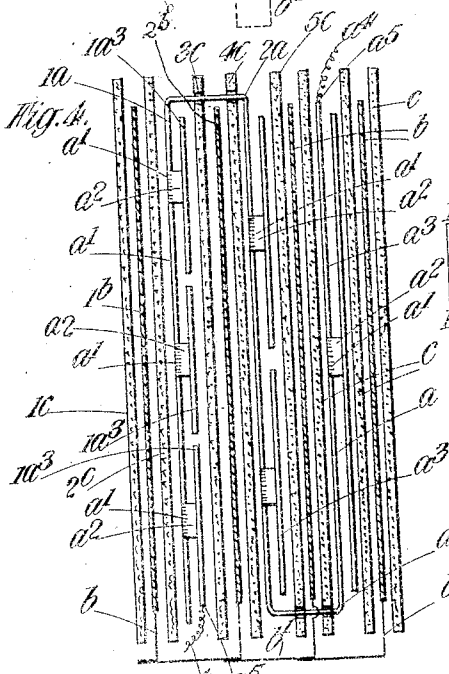
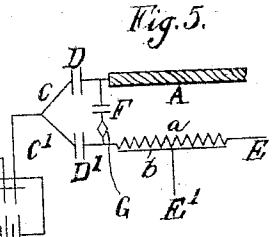


Fig. 5.



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UNITED STATES PATENT OFFICE.

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ELECTRIC TELEGRAPHY.

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To all whom it may concern:

Be it known that I, JOSEPH ARTHUR LOVEL DEARLOVE, a subject of the King of Great Britain, residing at 4 Great Winchester street, in the city of London, England, have invented certain new and useful Improvements in or Relating to Electric Telegraphy, of which the following is a specification.

This invention relates to improvements in electric telegraphy particularly applicable for use in duplexing submarine cables and other lines, an object being to render the artificial cable or line usually associated with duplex systems of telegraphy of such a character that the conductor resistance thereof is independent of variations in temperature.

In connection with systems such as herein referred to, it is well known that, in order to obtain a duplex balance, it is necessary to employ an artificial cable or line possessing in certain respects the same electrical properties as the cable to be duplexed. For instance, a certain electrostatic capacity is associated per unit length in the cable and the ratio in ohms and microfarads respectively is a constant quantity for any length of the cable having a uniform core. The artificial cable or line should therefore have the same values as regards capacity and resistance associated in corresponding ratios; the even distribution of the capacity and resistance in the artificial cable or line facilitates the obtaining and maintaining of the required balance for insuring the proper working of the system.

According to the known method of construction, the artificial cable or line has been constituted of a "grid" or zig-zag piece of tinfoil which represents the conductor of the cable this "grid" being arranged against one, two or more sheets of paraffined paper having upon the other side a uniform sheet of tinfoil to represent the "earth" or sea water as the case may be. The zig-zag strip is constructed of such a width that its resistance bears the same ratio to its capacity in relation to the uniform sheet of tinfoil as the resistance of the conductor of the true cable bears to its capacity in relation to the "earth" or sea water per unit length. It is found that the resistance of the tinfoil strip as heretofore employed fluctuates with the variations in temperature—rising with a rise in temperature and falling with a fall in temperature—the duplex balance being in consequence subjected to disturbance and necessitating re-adjustment in order to keep the system in satisfactory working condition. These variations are more apparent and appreciable in connection with the artificial line than with the cable as the latter, especially in the case of a submarine cable, being immersed in the sea, is subjected only to small variations in temperature, while the artificial cable or line may be subjected to comparatively wide ranges of variation which may necessitate frequent readjustment and consequent trouble and inconvenience.

The present invention is designed to obviate or minimize the objections above referred to and to this end it is proposed to employ a conductor composed of metal or alloy having a negligible or nearly negligible co-eficient of temperature, that is to say a metal or alloy which is not appreciably affected by variations in temperature. The metal or alloy may be used in the form of wire, strip, ribbon or other suitable form and for convenience of manufacture may be rolled or otherwise rendered as thin as possible, the desired resistance per unit length being obtained by varying the width of the strip or ribbon or, in the case of the wire form being adopted, the diametrical measurement thereof. For the purpose of the present invention such metals or alloys as the known platinum-silver "eureka" or "manganin" or German silver may be employed.

In constructing the improved artificial cable or line, the earth or the water as the case may be is represented by a sheet of tinfoil of the usual formation and commonly termed "earth plate", the sheets pertaining to a section or plate being connected together by lugs arranged at the ends thereof. The conductor or resistance side of the plate may be formed as to the greater part thereof of tinfoil in one or more sections having a lug or lugs for the connection thereto of a strip or ribbon of the aforesaid metal or alloy. The total area of the tinfoil is adjusted so that its capacity bears the desired ratio to the resistance of the conducting strip or ribbon to which it may be attached by soldering or otherwise. It is obvious that the connection of the tinfoil sections to the conducting strip do not appreciably affect the resistance of the strip, but the extension of the conductor acts as one coating of a Leyden jar, the other coating being the "earth plate".

Thus by varying the area of the tinfoil sections and the sectional area of the strip or ribbon of the aforesaid metal or alloy to which they are connected both the resistance and capacity may be adjusted to correspond with the resistance and capacity of any actual cable the artificial line is intended to imitate or represent.

The strip and sheet above referred to are separated from the earth plate by a dielectric, preferably paraffined paper, and the line is built up by joining together, with the aid of solder, successive strips the strip thus constituting the conductor. The strip is therefore for the purpose of obtaining the best results made as long as possible without joint. The strip conductor may be doubled back upon itself with the dielectric between the layers, and the earth plates, which, in practice need not be placed behind the metal strip conductor itself, are all joined together by their lugs to form a complete plate representing the "earth" or sea water. The strip conductor may be in a continuous length, the extremities being brought out to connect to the next or another plate or element similarly constructed, and so on, until the required number is provided. By constructing the artificial cable or line according to the improved method, the distribution of the capacity and resistance is enabled to be accomplished in a very satisfactory manner, the sub-division of the capacity being insensibly small; the strip conductor is moreover embedded in the mass of the plate and forms an integral part thereof, the ends only of the strip or connecting wires being not so embedded.

In order that the said invention may be clearly understood and readily carried into effect, I will proceed to describe the same more fully with reference to the accompanying drawings, in which:—

Figure 1 represents a form of conductor whereof the strip of metal of negligible or nearly negligible coefficient is attached to a lug formed or provided on a tin-foil sheet. Fig. 2 represents a form of capacity or earth plate showing a lug at one end and, in dotted lines an alternative arrangement by which the lug may be disposed at the bottom of the plate or sheet of tin-foil. Fig. 3 is a view illustrating a modified form of conductor; the figure also illustrating, in dot-and-dash lines, a capacity or "earth" plate having a lug at one end for effecting the connection with a similar adjacent plate by means of the lug and in simple dotted lines the outline of the dielectric. Fig. 4 illustrates the improved method of assembling the aforesaid sheets and conducting strip in forming a complete element of the artificial line. Fig. 5 is a diagrammatic view illustrating the mode of applying the improved artificial line in practice.

Referring to Figs. 1, 2 and 3, the conductor a, formed as a wire, strip or ribbon composed of the metal or alloy having negligible temperature co-efficient, such as manganin, for example, is attached at a' by soldering or the like to the lug a^2 pertaining to the sheet or plate a^3 of tinfoil. In order to secure better and more uniform distribution of the capacity, the aforesaid plate or sheet a^3 may be subdivided, as shown by way of example in Fig. 3, in which figure three sections a^3 are depicted, each section a^3 being formed with a lug a^2 for the attachment of the strip or wire a, by soldering or other means, as shown at a'. b, shown in dot-and-dash lines in Fig. 3, is a tinfoil plate which is formed or provided with a lug b' for enabling successive plates to be connected together so as to form the complete "earth" plate for a section of say one microfarad or more than one microfarad as may be required. The lug b' is shown projecting from one of the shorter sides or ends of the plate, but the lug may be arranged to project from one of the longer sides or the bottom of the plate as indicated in dotted lines at b^{11}. Or the lug may be otherwise arranged as may be found convenient or desirable. The dielectric c which may be composed of sheets of paraffined paper is indicated in dotted lines in Fig. 3. a^4 is the conducting wire which is connected with the strip a by soldering at points, such as a^5, so that the junction is effected well within the area of the sheets of dielectric. By subdividing the capacity in the manner shown in Fig. 3 the distribution of the charge is rendered more uniform. For example assuming the conductor a to equal a unit length of strip having one ohm resistance, a current traversing the aforesaid conductor, successively charges the divisions a^3 (Fig. 3) at the several points a' in that figure, whereas in an arrangement of single section sheet, such as shown in Fig. 1, the single integral sheet a^3 is charged only at one point a'. The dielectric is of such dimensions as to comprehend or contain within its area or mass the capacity or earth plate and the conductor or resistance, only the conducting wires a^4 and the lug b' of the earth plate b protruding from or extending beyond the boundary of the said dielectric.

In order to enable the assembling of the parts of an artificial line according to the improved method to be clearly understood, reference will now be made to Fig. 4. Protecting sheets of dielectric 1^c are first laid, and on these sheets an earth plate 1^b is placed which is covered by one or more sheets of dielectric 2^c; on the latter is arranged the conductor strip 1^a connected with the tinfoil plate or subdivided plates 1^{a3} as described; a sheet or sheets of dielectric 3^c is or are then added, followed by a second earth

plate 2^b and then a further sheet or sheets of dielectric 4^c; then another conductor strip 2^a and a sheet of dielectric 5^c. The arrangement is repeated, as will be seen from the figure under description, until the required "plate" or "section" of artificial cable or line is obtained, a sufficient number of the plates or sections being associated in the required manner to constitute the artificial line. It will be seen that the conductor strip is continuous and that the same is passed from one resistance plate to another preferably in a continuous manner so that, when the element is completed, only the conducting wires (a^4) extend from the element; the lugs pertaining to the earth plates being immediately superimposed are connected together by solder and taken to earth as will be readily understood.

The dielectric may be notched as shown at c' (Fig. 3) so as to permit of the strip being continuous and still be embedded therein. The improved form of the artificial cable or line having the aforesaid metal or alloy of strip, wire or ribbon form constituting part of the conductor and having negligible temperature coefficient together with the tinfoil extension sheet or sheets all embedded in the dielectric is essential to the accomplishment of the objects aimed at and offers additional facilities for the even distribution of the capacity and resistance so that the electrical properties of the actual cable to be duplexed may be accurately represented in the artificial line.

The strip of alloy before being used may be annealed and protected by a varnish such as shellac varnish or other suitable preparation; or the strip may be tinned before the laying or assembling of the plates is commenced. The conductor strip may be shunted by a suitable plain wire resistance for adjustment purposes; such resistance may or may not be embedded in the plate as found desirable.

Referring to Fig. 5, *a* is the wire, strip or ribbon hereinbefore described and *b* the earth plate, both if desired being earthed as indicated at E E′ respectively. A is the cable and B the sending or transmitting instrument. C C′ are the arms of the bridge, D D′ being the condensers in the respective arms. Across the said arms the receiving condenser F is arranged in series with the receiving instrument G. The arrangement is that ordinarily adopted and will therefore be readily understood without further description.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In a duplex system of telegraphy, an artificial line consisting of earth plates, inducing elements, a resistant element directly connected with said inducing elements, and dielectric arranged in operative relation to the aforesaid resistant and inducing elements and to the earth plates.

2. In a duplex system of telegraphy, an artificial line consisting of earth plates, inducing elements, a conducting element of resistant material having negligible temperature coefficient which is directly connected with said inducing elements and dielectric interposed between the successive lengths of said resistant element.

3. In a duplex system of telegraphy, an artificial line comprising earth plates, inducing sheets, dielectric arranged in operative relation to said earth plates and inducing sheets, a conducting strip of negligible temperature coefficient directly connected to said inducing sheets and having the successive lengths arranged on opposite sides of the dielectric.

4. In a duplex system of telegraphy, an artificial line comprising earth plates, a conductor formed as a strip composed of metal having negligible or nearly negligible temperature coefficient, an extension or extensions of tinfoil or similar metal attached to the said strip, and dielectric interposed between successive lengths of said strip.

5. In a duplex system of telegraphy, an artificial line comprising earth plates, a conductor formed as a wire composed of metal having negligible temperature coefficient, an extension or extensions of tinfoil attached to the said wire, and dielectric interposed between successive lengths of said wire.

6. In a duplex system of telegraphy, an artificial line, comprising earth plates, a conductor formed as a ribon composed of metal having negligible temperature coefficient and an extension or extensions of tinfoil attached to the said ribbon, and dielectric interposed between successive lengths of said ribon.

7. In an artificial cable or line, the combination of a conductor in strip form having negligible temperature coefficient a series of inducing sheets attached thereto, earth plates and dielectric arranged between said conducting and inducing sheets and the earth plates.

8. In an artificial line, the combination of a conducting strip, a series of adjustable extensions thereon, earth plates, and dielectric arranged in operative relation to said parts.

In testimony whereof I affix my signature in presence of two witnesses.

JOSEPH ARTHUR LOVEL DEARLOVE.

Witnesses:
T. SELLY WARDLE,
WALTER J. SKERTEN.