(No Model.)

J. B. HENCK, Jr.

ELECTRIC CABLE.

No. 248,742. Patented Oct. 25, 1881.

Fig. 1.

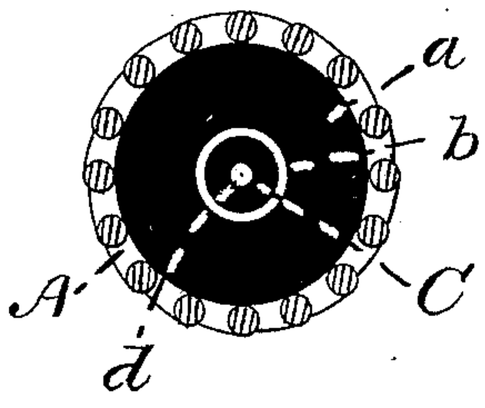


Fig. 2.

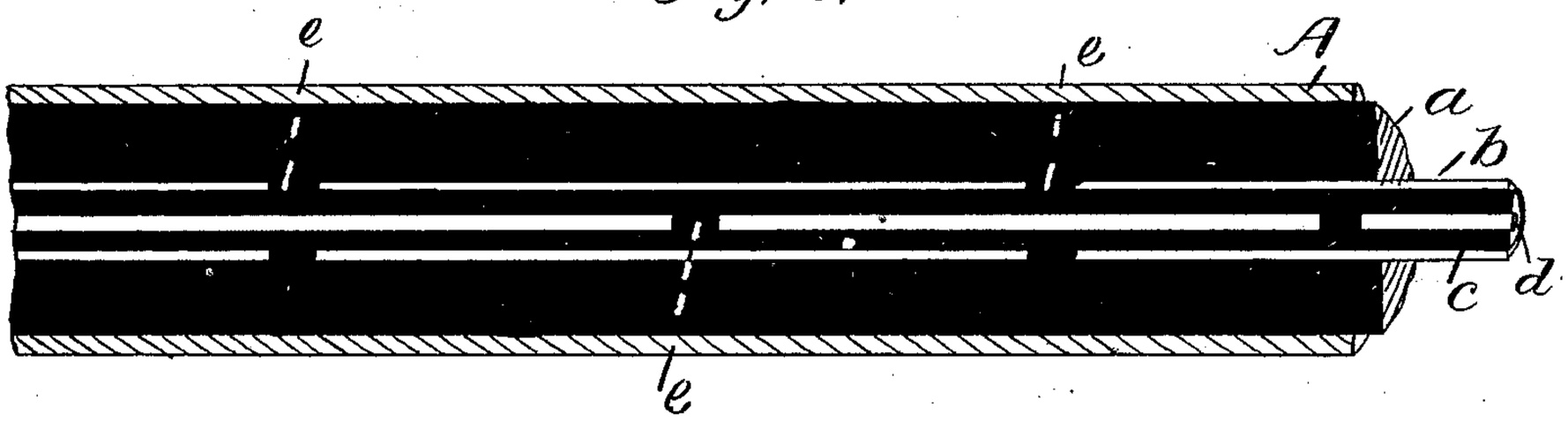
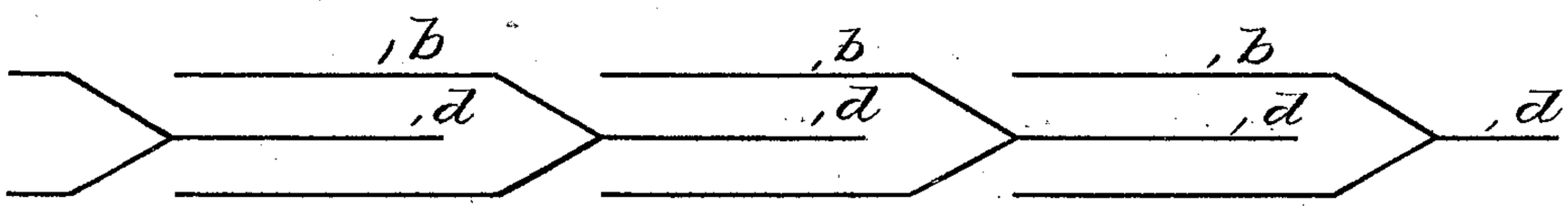


Fig. 3.

Fig. 4.



Witnesses.
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by A. Pollok
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UNITED STATES PATENT OFFICE.

J. BENJAMIN HENCK, JR., OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF SAME PLACE.

ELECTRIC CABLE.

SPECIFICATION forming part of Letters Patent No. 248,742, dated October 25, 1881.

Application filed July 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, J. BENJAMIN HENCK, Jr., of Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Electric Cables, of which the following is a specification.

My invention relates to electric cables, and its object is to overcome the retardation of signals resulting in such cables from the statical induction caused by the near proximity of the earth's surface. It is well known that such induction tends, in ordinary cables, to accumulate upon the surface of the conducting-wire a large portion of any current sent through the cable, in the same manner that a charge is retained or accumulated upon the surface of a Leyden jar. The rate at which electrical signals can be transmitted through cables of any great length is, owing to this accumulation, very slow, even when the most delicate instruments are used as receivers, and telephonic communication is, in consequence of the extreme brevity of telephonic signals, almost an impossibility.

It is a well-known fact in electrical science that the retardation of signals dependent on the cause hereinbefore described is approximately proportional to the square of the length of the cable. It is evident, therefore, that it will only be one-tenth as great in a series of ten short cables as in a single cable composed of a continuous conductor equal to their combined length.

Experience has demonstrated, also, that a condenser, or even a series of condensers in circuit, will not interfere with or impede telephonic correspondence; also, that in the telegraphic operation of long submarine cables, from the above and other considerations, it has been found advantageous to employ condensers in connection with the Thompson galvanometer and recorder.

In view of the foregoing I have invented a new cable or medium for electrical correspondence and communication; and my invention consists, briefly, of an electric cable with its central conductor or core divided up into any suitable number of lengths, totally insulated one from another, each length being surrounded by a thin layer of gutta-percha or other dielectric, which is again surrounded by a tube or coating of metal, which is also divided into lengths, the number and length of which equal the number and length of the lengths into which the central core is divided; but the tube is so arranged relatively to the central core that the breaks in the continuity of the tube shall occur at the middle of each length of the central core, and vice versa. I thus practically attain the effects of a metallic line which is divided into a number of lengths, each length terminating in one plate of a condenser of which the next length is an extension of the other and opposite plate. In such a line, although there is no metallic connection between the several lengths, the static induction, instead of operating to delay and retard signals, is caused to transmit the signals sent from one length to another through the condensers until the distant end of the cable is reached. This effect may obviously be attained by inserting tin-foil condenser or condensers of any ordinary construction at intervals throughout the length of the cable; but I prefer to accomplish the same result by the peculiar method of construction which I shall describe, as by adopting such construction I do not impair or interrupt the external continuity or the strength of the cable.

In order that my invention may be clearly understood, I will describe the drawings hereunto annexed.

Figure 1 is an end view of an armored cable constructed and arranged in accordance with my improvement. Fig. 2 shows, in longitudinal section, part of an armored cable similarly constructed. Figs. 3 and 4 are modifications, Fig. 4 being adapted for use suspended on poles or other supports, or suitable for underground work, in which the armor is dispensed with as being in this case a non-essential.

In all the figures, *d* is the metallic core, which, as shown, is not continuous, but is divided by the breaks or spaces *e e* into as many lengths as may be desired. For example, a cable required to cross the Atlantic might be made in fifty-mile lengths, while in a cable twelve miles long the conducting-core might with propriety be divided into half-mile lengths. This central metallic core, *d*, is surrounded and covered with a thin layer or dielectric of gutta-percha or other insulator, *c*, this again to be surrounded by a tube or coating of metal, *b*, to be

applied in any preferred manner. This metal coating is divided in precisely the same manner as the central core, and the divisions must be equal in number and length to those of the said central core. The intervals or spaces *e'* between the different lengths of the tube or external conducting-surface must, however, be so arranged as to be placed at or about the middle of each length of central core, *d*. When so arranged each break in the central core, *d*, will be overlapped by the middle portion of the tube *b*, and each break in the tube *b* by the middle of the central core, *d*. The respective spaces or intervals *e e'* between the successive lengths of conducting material, both in the central core and inclosing-tube, may be of any desired length. It is obvious that the length of the break or interval may vary with the length of the condenser.

Over the conducting-tube *b* is laid the usual thick coating of insulating material, *a*, and over all, for subaqueous purposes, the armor A.

When the cable is to be laid in a trough for underground work, or to be employed on aerial lines of telegraphic or telephonic communication, I prefer to construct my cable without a protecting-armor, as shown in Fig. 3. The insulating-covering may then be finished with rubber tape or any suitable water-proof substance.

In the operation of this cable a charge of positive electricity sent into one end will induce on the surrounding tube of that length which is separated from it only by a very thin dielectric a corresponding charge of negative electricity. This, again, in its turn, will induce a positive charge on the surface of the next length of the core, and so on until the end of the cable is reached. The core and tube thus form a series of condensers of peculiar form, through which the electrical impulses travel by induction.

In the construction of my cable it is desirable that the insulating medium employed to separate the central core from its overlapping tube should be of high specific inductive capacity, and that the insulating material surrounding the whole should be of low specific inductive capacity.

A modification of the above is shown in Fig. 4, in which the tube *b*, surrounding the core *d* of the first section, is connected to the core of the second section, and the tube of the second section to the core of the third, and so on to the end. This arrangement will be found advantageous when electric impulses are to be transmitted only in one direction through the cable, as any electrical excitation communicated to the core *d* will, in its transmission to the other end of the cable, always act by induction from within outward, and will therefore lose less of its energy by the accumulation of a charge upon the external covering of the cable or upon surrounding objects. When the cable is used in this form it will generally be necessary to use a double line of communication between any two points, the condensers being turned in opposite directions in the two lines, so that messages in one direction may be sent by one line and those in the opposite direction by the other.

Although I have shown but one line of communication in the drawings, I do not confine myself to that construction, as it is obvious that a number of such lines can readily be incorporated in one cable.

Having now described my invention, I claim—

1. An electric cable consisting of a central conducting-core divided into as many separate lengths as desired, and a conductor of tubular form surrounding the said core, but insulated therefrom, and divided into a corresponding number of lengths, both conductors being so arranged that each one shall overlap the breaks or intervals in the continuity of the other, substantially as described.

2. The combination, in an electrical cable, of a central conducting-core divided as described, a tubular conducting-surface similarly divided and overlapping the central conductor, but insulated therefrom and so disposed that the breaks or intervals in each conductor will be lapped by the substance of the other, and a water-proof and protective insulating-covering, as shown and described.

3. In an electric cable, the combination, substantially as described, of a central conducting-core divided into any required number of lengths, a tubular conducting-envelope for the same divided into a corresponding number of lengths, and both conductors being so arranged that their intervals or breaks of continuity in each shall be at the middle of the overlapping length of the other, a water-proof insulating-covering, and a metallic armor surrounding the whole, substantially as described.

4. A line of electrical communication composed of two parallel conducting-surfaces insulated one from the other and equally divided into any required number of lengths, but so arranged that the breaks or intervals of continuity in one shall be at the middle of the length of the other, in combination with an insulating material of high specific inductive capacity placed between the two parallel conductors, and an insulating-covering of comparatively low inductive capacity surrounding the whole, substantially as described.

5. The combination, in an electric cable, of a conductor formed of a series of overlapping sections, insulating material of high inductive capacity between said sections, and insulating material of less inductive capacity surrounding the conductor, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 30th day of June, 1881.

J. B. HENCK, JR.

Witnesses:

CHARLES T. LORING,

JOSEPH N. CONOLLY.