(No Model.)

H. METZGER.

UNDERGROUND ELECTRIC CONDUCTOR.

No. 372,078. Patented Oct. 25, 1887.

Fig. 2.

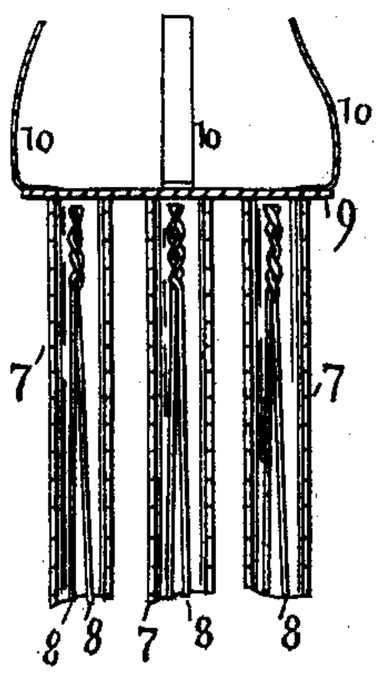


Fig. 1.

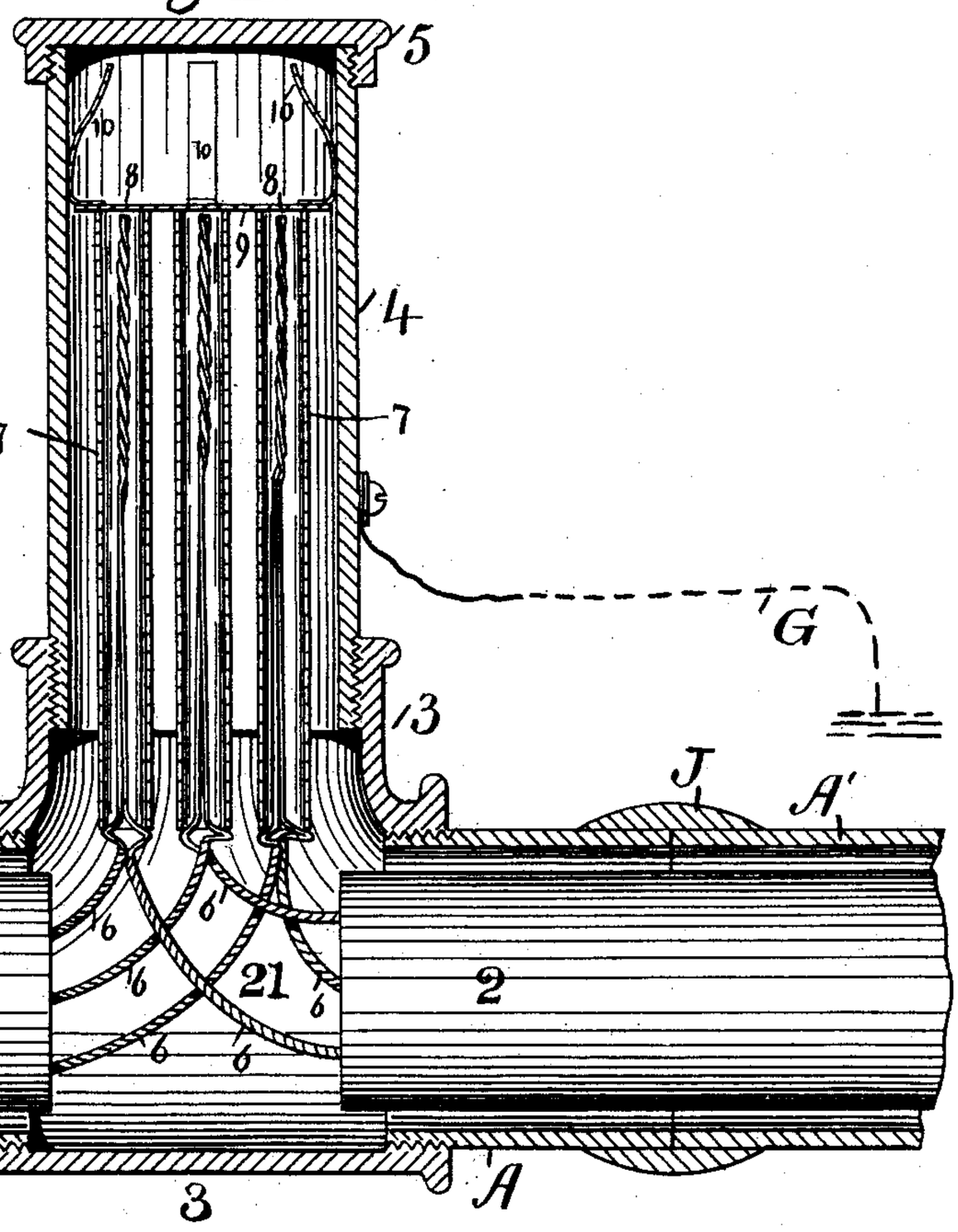
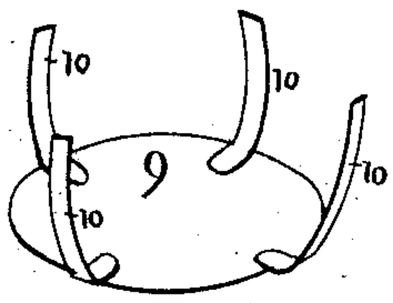
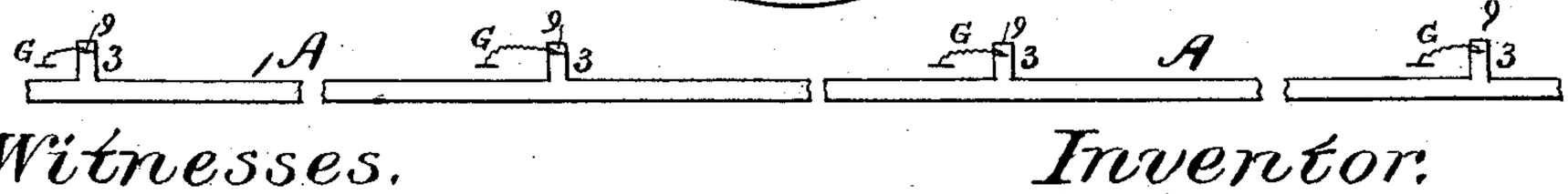


Fig. 3.

Fig. 4.





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UNDERGROUND ELECTRIC CONDUCTOR.

SPECIFICATION forming part of Letters Patent No. 372,078, dated October 25, 1887.

Application filed June 4, 1887. Serial No. 240,207. (No model.)

To all whom it may concern:

Be it known that I, HENRY METZGER, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain Improvements in Underground Electric Conductors, of which the following is a specification.

My invention relates to appliances for reducing the well-known interference which arises between parallel telephone-wires when laid or supported in close proximity to one another, and while it may be applied to other systems of electrical communication, it is to be understood that I aim especially in preventing or remedying the troubles affecting telephone-lines. These disturbances have always, even under the most favorable circumstances, been among the most serious obstacles to successful telephony; but when telephone-lines are constructed underground, and especially when cable conductors are used, such disturbances are greatly intensified, as will be obvious upon a careful consideration of the conditions. The interfering phenomena are electro-magnetic or electro-dynamic induction between wire and wire and absolute leakage from each wire to the others. In both cases the ultimate result is the same—namely, that messages passing over any of the wires are reproduced upon the receiving-telephones of the other lines, thus exciting considerable confusion, and being, moreover, decidedly adverse to efficiency and order, besides being inimical to secrecy in transmission. These injurious influences are common in some degree to all telephone-lines, although, as hereinbefore indicated, they are emphasized in underground construction by reason of the close proximity in which the several lines are necessarily laid. Experience has, however, demonstrated that leakage at junction or splice boxes is, in underground lines, the worst evil of the two.

There is still another adverse influence that is especially an accompaniment of underground lines. This is the electrostatic induction between the mass of the earth and the several line-wires, and is experienced to an intensity many times greater than if the lines were strung on poles of ordinary height, in which case it may usually be ignored. This phenomenon results in a retardation of signals, caused by the retention of the telephonic currents in a state of charge upon the surface of the conducting-wires, this charge being induced by the electricity of the earth, which is attracted to the outside of the insulating medium, and the retardation is made apparent by a certain sluggishness in the reproduction of articulate speech, which increases with the square of the length of the conductor, and which, if unchecked, rapidly reaches a point when the articulated words cease altogether to appear.

The object of my invention is to remedy altogether the adverse effect of leakage and to mitigate the effects of electro-magnetic induction between wire and wire, and to counteract and in a great measure to eliminate the retarding effects of the electrostatic induction between the wires and the earth in underground cable systems.

It is well known that subterranean or submarine wires are especially subject to electrostatic ratardation, not only because they are so much nearer to the earth than in the case of overhead wires, but because, also, they are necessarily insulated throughout their length, and there can be, therefore, no lateral dissipation of the currents traversing the lines at points of support, as in the overhead lines. It is also well known that such points of leakage, if of uniform and high resistance, oppose retardation of signals simply because they facilitate discharge and enable the line to be promptly cleared, and that is one of the principal reasons why overhead lines can be operated quicker than underground or submarine lines, in which every particle of the electricity sent into a line has to be discharged at the ends. Yet, while it has been known that if a system of uniform leakage of high resistance for underground lines could be established and maintained the results would be beneficial, heretofore and prior to my invention means whereby such a system of leakage could be applied have not, so far as I am aware, been devised. It is also desirable that such currents as escape from the several wires, instead of being permitted to flow to the remaining conductors, shall in all cases be directed to the earth, and that the escape to earth shall be facilitated.

The difficulty has been to provide such a uniform leakage and to maintain the same constant and without increase, the tendency in all underground lines being to a depreciation of insulation.

My invention accomplishes the desired ends, and with means and appliances of the most simple character.

It consists, generally stated, in providing means for collecting the leakage or escape from the various telephone-wires of a cable at the various splice or junction points thereof, (at which points it has been found that leakage from wire to wire is most likely to occur,) and also in combining, in the manner hereinafter stated, with a series of glass tubes, each inclosing a conductor-splice, a permanent conducting-plate common to the series and in contact with a ground-connection, but not in contact with any of the conductors, whereby the hygroscopic properties of glass are utilized and a permanent and constant escape of high resistance maintained for the purpose of rapidly clearing the lines of static charge, and of thereby greatly reducing the adverse effects of static induction.

In the drawings which illustrate this specification, Figure 1 is a sectional elevation of a construction of underground telephone-cable embodying my invention. Fig. 2 is a detail of construction, showing the combination of the glass inclosing-tubes with the conducting collecting-plate. Fig. 3 is a perspective view of the collecting-plate itself, and Fig. 4 is a diagram indicating an underground line provided with a series of splicing or jointing points each constructed in accordance with my invention.

In the drawings the body of the cable is represented by 2, and is furnished by the manufacturer in suitable lengths, although, if desired, it may be cut by the user into any shorter lengths, as may be found convenient. The cables usually contain a considerable number of conductors; but for clearness of illustration I have shown but three. At each cable-junction the two ends of the cable, which is usually lead-covered, are introduced in any preferred way into the splice-containing box 3.

In the drawings I have indicated at A the cable entering through an auxiliary or extension pipe, A′, which connects with the main side pipe A, the latter being screwed in one of the side orifices of the junction-box 3, the two pipes being united by a joint, J. At the other side the cable 2 is indicated as being led directly into the side pipe B, which in this case closes down on the cable, the joint covering J being closed down on the covering. The entire junction or splice box is T-shaped, and comprises the body 3, the lateral wings A and B, and the vertical extension 4, the wings and the vertical extension being screwed into apertures in the three sides of the chamber 3, which apertures are tapped for the purpose.

In uniting the conductors of two lengths of cable to form a continuous cable the several insulated conductors 6 have their covering stripped for a convenient distance from their ends, and each end 8 is then spliced by a twist-splice to its corresponding conductor in the next cable length.

Inasmuch as it is necessary for testing purposes that the several cabled conductors shall be easily accessible for testing purposes at suitable points, this is provided for by turning the spliced ends 8 into an upright position, as shown, after which a glass tube, 7, is slipped over each splice. The several tubes in practice fill or nearly fill the vertical extension-pipe 4, and are kept in an upright position by supporting them upon the bend in the wire below. The space 21 in the chamber 3 around the conductors may be filled with hot paraffine.

The splices of each pair of conductors are fitted with the glass tubes, for the purpose not only of insulating the splices from one another and from the pipe, but also to accomplish this by using a transparent material, whereby the splices can readily be at any time examined. Glass, being, moreover, one of the most hygroscopic materials known, I have ascertained is particularly adapted for my purpose of establishing a uniform but slight escape. I find that it speedily acquires, when so placed, a thin but continuous film of moisture, which I utilize, as hereinafter described, as an aid in conducting direct to earth electricity leaking from the several wires. The glass tubes 7 may be placed in position either before or after the attachment of the vertical pipe 4; but whenever inspection is desired it is only necessary to unscrew the said pipe and to slide it off, when the mass of glass tubes will be seen all standing together, and the splices can be examined at leisure. The several glass tubes are adjusted until the upper ends are flush with one another, so as to present collectively a substantially flat surface.

Fig. 3 represents a metallic plate or disk, 9, provided with metallic wings or arms 10, having some degree of inherent elasticity or resiliency. The disk or plate (for the circular form, though preferable, is not essential) is of metal, preferably copper or brass, and is of a size just sufficient to slip within the vertical pipe 4. It is dropped into the end of the said pipe and caused to rest upon the flat surface formed by the glass-tube ends, as shown in Fig. 2. The spring-arms 10 are then bent and caused to press with considerable force against the interior surface of the tube 4, which is in permanent connection with the ground, either directly or by the interposition of a specially-arranged ground-wire, G. The plate 9 thus constitutes virtually a ground-plate in close proximity to but absolutely insulated from the conductor-splices. The whole is then surmounted by the screw-cap 5.

In Fig. 4 is shown in diagram a continuous cable, A, provided at splicing-points with

junction or test boxes 3, each of these being furnished, as hereinbefore described, with glass tubes surrounding the splices and surmounted by the plates or disks 9, connected to earth.

In practice the bared wire splices are of course in contact with their surrounding tubes at several points, the said tubes being much smaller with reference to the wire than is shown in the drawings. It is found to be absolutely impossible to exclude moist air from such cavities, and the surface of the glass, being, as hereinbefore stated, hygroscopic, condenses the said moisture, and is, in fact, generally covered with a light film of moisture. This film is, however, of high resistance by reason of the high specific resistance of pure water and of its extreme thinness, and the required conditions for an escape of high but constant resistance are thereby provided for each line through the intermediation of the moist glass surface surrounding the bared portion of the wire of each line, the metal plate in contact with the collective surface of the glass-tube ends, and the external pipe. A constant leak of proper resistance being thus provided at each splice-box for all the lines, it is found that the line both charges and discharges quickly, that the state of charge due to static induction is greatly diminished, and that retardation is much less perceptible. Consequently the voice-currents are transmitted much more clearly and the reproduced speech is clearer and more articulate than would otherwise be the case. In addition to this, the presence of the plate 9, connected to the earth, serves to conduct to earth and to promptly dissipate any currents leaking unduly from any of the wires, and thus to prevent the current of the several wires from leaking to the others, whereby interference between wires due to absolute leakage is prevented.

Having now described my invention, I claim—

1. The combination, with a subterranean electric cable or a bunched series of conductors, of junction-boxes therefor, within which the successive sections of conductors may be united, non-conducting tubes protecting the conductor ends or splices and separating them from one another, and an induction and leakage counteracting device, as indicated, located in close proximity to but not in contact with the said conductor ends, substantially as described.

2. In a subterranean cable, the combination, with the conductor splices or joints and a glass tube surrounding each joint, of a ground-plate resting on the collection of tubes in close proximity to but out of contact with the bare wire ends of all of the said splices, substantially as set forth.

3. The combination of the chamber 3, having lateral orifices for the introduction of the cable ends, and the vertical pipe 4, for the reception of the spliced ends, with the glass tubes 7, surrounding each of the said spliced ends, the conducting-plate 9, resting on the end of the group of tubes and provided with spring-arms 10, to make contact with the walls of the vertical pipe 4, a surmounting cap, 5, for the said vertical pipe, and a ground-connection, G, substantially as and for the purposes specified.

4. The combination, with the two ends of a multiple conductor-cable and with the metallic sleeves united thereto, of a T-shaped chamber joining the said sleeves and adapted to receive the bared splices of the several conductors, a series of glass tubes inclosed in the said chamber, each inclosing one of the said splices and arranged with their upper ends flush, so as to present a substantially flat surface, and a metal plate or disk lying upon the said surface and making contact by means of springs or their equivalents with the substance of the said chamber and with the earth, substantially as and for the purposes specified.

5. The combination, at a junction-box of an underground cable, of a series of bare wire splices, one for each pair of conductors, a glass tube, open at the top, surrounding each splice, an inclosing-pipe for the whole screwed vertically into the junction-box and in connection with the earth, and a metal disk or plate placed upon the flat surface formed by the glass-tube ends and making contact by means of springs with the inner surface of the said pipe for the purpose of carrying off leakage and reducing retardation.

6. The combination of the glass tubes, each inclosing a conductor-splice, and an earth-plate surmounting the whole and resting upon the flat surface formed by their upper ends, as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 26th day of May, 1887.

HENRY METZGER.

Witnesses:
H. S. A. STEWART,
GEO. I. WHITNEY.