No. 840,036. PATENTED JAN. 1, 1907.

E. A. BALDWIN.

LIGHTNING ARRESTER CONNECTION.

APPLICATION FILED AUG. 8, 1904.

Fig. 1

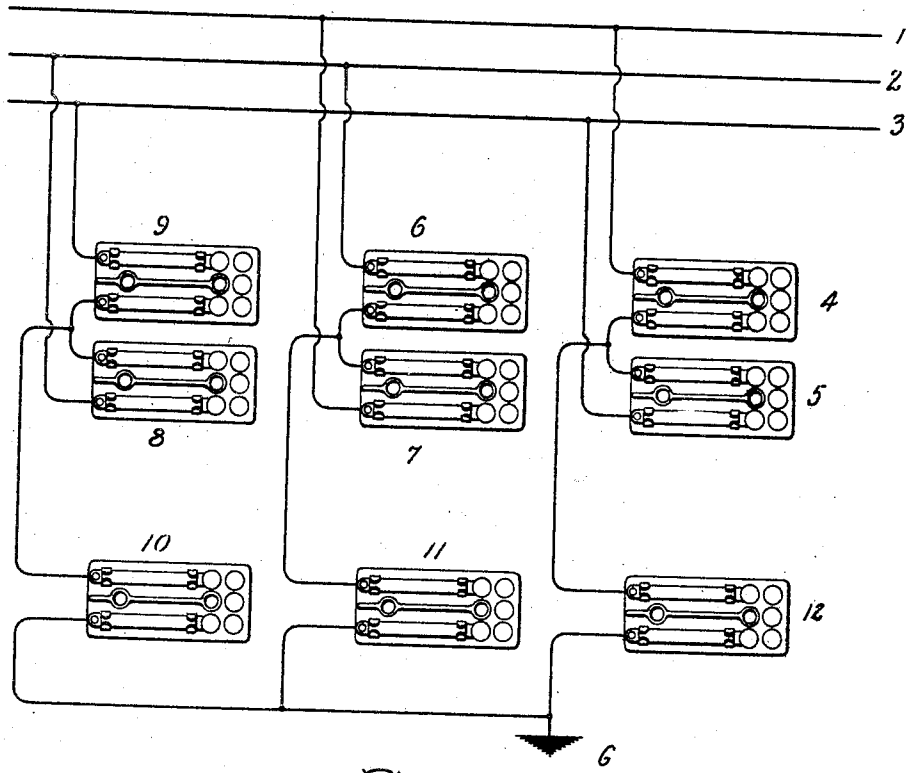
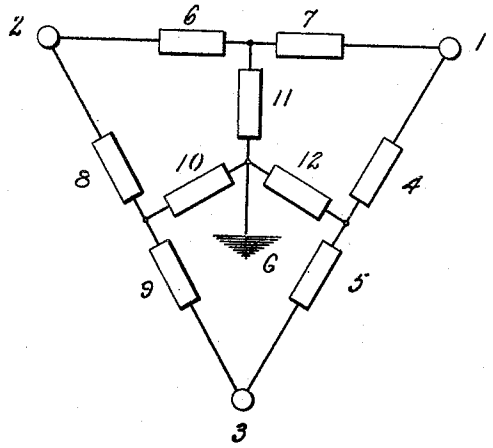


Fig. 2.



WITNESSES:

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UNITED STATES PATENT OFFICE.

EDWARD A. BALDWIN, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

LIGHTNING-ARRESTER CONNECTION.

No. 840,036. Specification of Letters Patent. Patented Jan. 1, 1907.

Application filed August 8, 1904. Serial No. 219,858.

To all whom it may concern:

Be it known that I, EDWARD A. BALDWIN, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Lightning-Arrester Connections, of which the following is a specification.

Static charges on alternating-current-transmission lines arise from two distinct causes—first, from lightning discharges and inductive effects due to atmospheric conditions, and, second, from resonance effects arising in the line conductors themselves. It is customary to protect against atmospheric discharges by connecting lightning-arresters between each line conductor and ground. This arrangement, however, does not fully protect the system from abnormal voltages existing between line conductors as the result of resonance. Abnormal voltages due to resonance appear to be most common in circuits made up partly of capacities and partly of reactances and in long-distance transmission-lines. In extreme cases the abnormal voltage may be several times the normal working voltage of the system; but as the frequency is many times the normal frequency the central-station instruments will not indicate in any way this abnormal voltage. In general, no indication of its presence is given until the insulation fails and a short circuit between line conductors is formed. In underground-cable work and in systems made up partly of underground cables and partly of overhead wires this static discharge between conductors is particularly troublesome, because of the relatively small distance between the underground cables and the consequent liability of a destructive arc.

It is the object of the present invention to provide means for protecting the transmission-line from abnormal voltages arising from any source, whether from atmospheric conditions or from resonance.

My invention will be readily understood by reference to the following description, taken in connection with the drawings forming a part of this specification.

Figure 1 shows the general arrangement of the lightning-arresters or resistance devices. Fig. 2 shows the same arrangement diagrammatically for convenience of reference.

The lightning-arresters shown are of the general type described in the patent to Wirt, No. 669,155, March 5, 1901. This invention, however, is not limited to the particular form of arrester including a non-inductive resistance and spark-gaps, as shown in the above-named patent, but may be any form which offers a suitable impedance to the flow of current, whether the arrester itself is made up of spark-gaps, resistances, reactances, or any combination of all or part of these. Throughout the claims I have referred to resistance devices connected between the transmission-wires, and by this I mean one or more of the lightning-arrester units mentioned above. Similarly I have referred in the claims to a resistance-path to ground, and by this I mean a path including ohmic resistance, spark-gaps, reactances, or other suitable means for causing a voltage drop in the ground connection when current flows therethrough.

The arresters shown in Fig. 1 consist, essentially, of an insulating base, on which are arranged two carbon resistance-rods and a plurality of metallic cylinders, between which sparks-gap are formed. The number of carbon rods and the number of spark-gaps for each unit may be increased to suit the particular voltage used for the line, and the invention is not limited to the particular number shown. Likewise the number of units may be increased at will. The conductors 1, 2, and 3 represent the three line-wires of the polyphase transmission-line. Between the conductors 1 and 3 is connected the resistance device composed or arresters 4 and 5.

The arresters 6 and 7 are connected between conductors 1 and 2, and the arresters 8 and 9 between the conductors 2 and 3. Between the arresters 4 and 5 a connection leads to a similar arrester 12, the other end of which is connected to ground. Similarly a connection from between the arresters 6 and 7 leads to the arrester 11, the other end of which is grounded. An arrester 10 is connected at one end to the connection between 8 and 9 and at the other end to the ground-wire. With this arrangement two paths are provided between each conductor and ground, thus furnishing ample discharge capacity in case of emergency. There is also provided a plurality of paths between each pair of conductors, these paths serving for the equalization of static charges between

conductors. Thus between conductor 1 and ground there is a path through arresters 7 and 11 and a parallel path through arresters 4 and 12, while between conductors 1 and 2 there is one path through arresters 7 and 6 and another path through arresters 4, 12, 11, and 6, as well as others, which are apparent from the diagram. The arrangement described provides the same number of arresters or resistance units between each conductor and ground as between one conductor and another, and as part of the arresters are used both in the ground connection and in the connection between conductors the arrangement described furnishes an efficient protection with a relatively small number of resistance units.

By the provision of a plurality of paths from each conductor to ground the injury or complete destruction of one path would not leave the conductor unprotected, as the remaining paths would still afford ample discharge capacity for ordinary conditions.

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

1. The combination with a polyphase transmission-line of means for protecting the line conductors consisting of resistance devices connected across each phase, and means connected with each of said devices for providing a resistance-path to ground.

2. Means for protecting line conductors of electric circuits, consisting of a resistance device connected between each two conductors of said line, said device including a spark-gap, and means connected with the center of each resistance device for providing a resistance-path to ground.

3. The combination with a transmission-line comprising three conductors, of three resistance devices arranged in delta between the three conductors, connections from the center of each side of the delta to other resistance devices, and means for connecting said last-named resistance devices to ground.

4. The combination with a polyphase transmission-line of means for protecting the line conductors, consisting of resistance devices connected across each phase, and means connected with the center of each resistance device for providing a resistance-path to ground, said means having substantially one-half the resistance of one of said resistance devices.

5. The combination with the conductors of an alternating-current-transmission line, of means for providing two permanent resistance-paths between each conductor and ground, said means providing a plurality of resistance-paths between conductors.

In witness whereof I have hereunto set my hand this 6th day of August, 1904.

EDWARD A. BALDWIN.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.