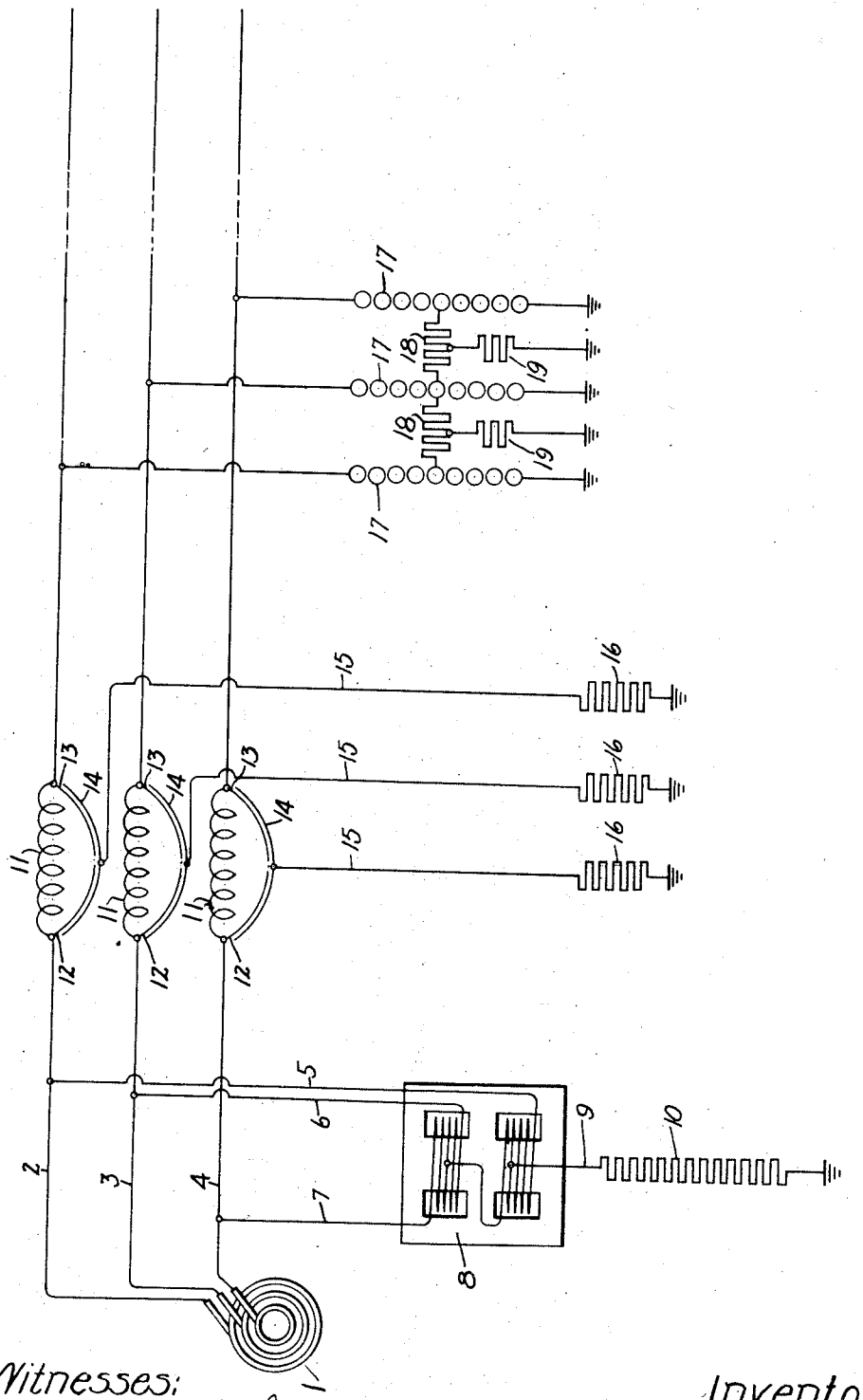
E. J. BERG.

LIGHTNING ARRESTER.

APPLICATION FILED JUNE 1, 1907.

981,742.

Patented Jan. 17, 1911.



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UNITED STATES PATENT OFFICE.

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LIGHTNING-ARRESTER.

981,742. Specification of Letters Patent. Patented Jan. 17, 1911.

Application filed June 1, 1907. Serial No. 376,751.

To all whom it may concern:

Be it known that I, ERNST J. BERG, 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-Arresters, of which the following is a specification.

My invention relates to devices for protecting electric circuits and apparatus against lightning and similar phenomena of abnormal voltage and abnormal frequency, and more particularly to devices for protecting either single phase or polyphase alternating-current systems of distribution.

In many alternating-current systems of distribution and particularly in polyphase systems, one of the conductors of the system is grounded through the generator and also through a transformer or other translating device, and it is found that lightning discharges and other abnormal and destructive disturbances tend to pass to ground through the generator or transformer rather than through the protective devices provided for that purpose. All the circuits of the system may be insulated from ground, in which case the only path to ground is over the usual lightning arresters or through the insulation of the system, and in an ungrounded system; even when the lightning arresters are in good condition, the lightning discharges tend to break down the insulation of either the generators or the transformers before the insulation on the other parts of the system is affected. It is desirable, therefore, that the system be grounded, but in some other manner than through the generator or transformer and preferably in such a manner that one line of polyphase system may be grounded without short-circuiting the system. It is also found that if each conductor has a discharge path to ground consisting of a series of metallic cylinders separated in series with resistance and by air gaps made so as to prevent the dynamic current following the very high voltages caused by lightning, the low frequency oscillation cannot pass across all of the spark gaps of the discharge path to ground, while if the discharge path is of a length to relieve the greater part of the abnormal conditions on the circuit numerous discharges tend to carry metal from each cylinder and deposit it on the next, thereby gradually building up metallic bridges across the gaps and tending to close up the air gaps until eventually there is no spark gap path to ground for the high frequency oscillations.

The object of my invention is to provide alternating-current systems having all the circuits insulated from ground with the same protection they would have if grounded through the generators and transformers, although the generators and transformers are completely insulated from ground; to provide a protective device which will relieve the distribution system of oscillations of any frequency; and which will be more reliable and effective than the protective devices heretofore in use.

In carrying out my invention I insulate all circuits and connect the system to an inductive device arranged to produce an artificial neutral, which is connected to ground through a current-limiting connection, such as a resistance, to prevent a short-circuit in case one of the conductors comes in contact with the earth.

I provide an improved arrangement of reactances and condensers to relieve the system of high frequency oscillations, and to relieve the line of either low frequency or high frequency oscillations I provide discharge paths which will always be in condition to relieve the system of high frequency oscillations regardless of the number of discharges which may have passed over them.

My invention will best be understood in connection with the accompanying drawing which is merely an illustration of one embodiment of my invention and in which the figure shows my invention applied to a three-phase system, although the invention is equally applicable to single phase systems or any other polyphase system.

In the embodiment of the invention shown in the drawings a three-phase generator 1 is connected to the conductors 2, 3 and 4 of the distribution system which delivers the energy of the generator to any suitable translating device. The generator 1, the conductors 2, 3 and 4 and the translating devices are all insulated from the ground and the only connection of the system to ground is through leads 5, 6 and 7 connecting the conductors of the system to an in-

ductive device 8 having windings arranged to produce a neutral which is connected through a lead 9 with a current limiting connecting or high resistance 10 connected to ground. If one of the conductors should break and come into contact with the earth the resulting flow of current would be limited by the current-limiting connection or resistance 10; while as regards lightning or similar disturbances, the system is as effectually grounded through the inductive device 8 as is a system in which one of the conductors is grounded through the generator and also through the transformers or other translating devices.

The high frequency oscillations or surges upon the line are intercepted by a a reactance coil 11 in series with each conductor and directed to ground through condensers consisting of a condenser plate 12 connected to one end of each reactance coil and a condenser plate 13 connected to the other end, both of said plates being in inductive relation to a condenser plate 14 connected through a lead 15 and resistance 16 to ground. High frequency oscillations coming from either side of reactance 11 pass from either plate 12 or plate 13 to the plate 14 and thence to ground. Each conductor is also connected to ground through a multigap arrester having a discharge path consisting of metallic parts 17 in series and separated by air gaps. The arresters are connected by means of metallic connections 18 of high resistance so that there is a discharge path from one to another through part of the gaps of one arrester, through the connection 18, and back through part of the gaps of the other arrester. There is also a discharge path to ground through part of the air gaps of the arrester and thence through a portion of the connection 18 and the resistance 19 to ground. The connection 18 and resistance 19 shunt a portion of the gaps of each discharge path, and a low frequency oscillation will pass over the air gaps to the connection 18, to ground through the resistance 19; while a high frequency oscillation will pass directly over the air gaps to ground even though the spark gaps between the conductor and the connection 18 become more or less ineffective owing to repeated discharges the spark gaps between the connection 18 and ground remain in good condition and ready to relieve the line of any oscillations which will not readily pass over the resistance 19.

The operation of this device is as follows: All the circuits of the system are completely insulated from the ground, but the system as a whole is grounded through the neutral of the inductive device 8 and the current limiting connection 10. If a high frequency surge or oscillation is set up anywhere in the system it will not pass through the reactance 11, but will be discharged to ground through the condenser plate 14 and directly over the air gaps of the discharge paths, the shunt connection through resistance 19 having very little effect. The system is relieved of other abnormal conditions by discharge over the air gaps to the connections 18 and thence through the resistance 19 to ground and also by discharge to ground through the neutral of the inductive device 8 and the high resistance 10. Excessive potential between phases is relieved by discharge over part of one multigap arrester, through connection 18 and are part of another arrester. The gaps shunted by the resistance 19 are always in operative condition and ready to assist the condensers in relieving the system of high frequency oscillations. By my invention, therefore, the system is well protected against disturbances of any frequency or voltage and the tendency for discharges to pass to ground through the generators or through any of the translating devices is reduced to a minimum.

My invention may be embodied in many different forms than those shown in the drawings, and I therefore do not wish to be restricted to the form shown and described but intend to cover by the appended claims all changes and modifications which come within the spirit and scope of my invention.

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

In a protective device for electric systems, the combination with a reactance adapted to be connected in series with the conductor to be protected, of condenser plates connected on each side of said reactance, and a condenser plate connected to ground and in inductive relation to said first-mentioned plates.

In witness whereof, I have hereunto set my hand this 31st day of May, 1907.

ERNST J. BERG.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.