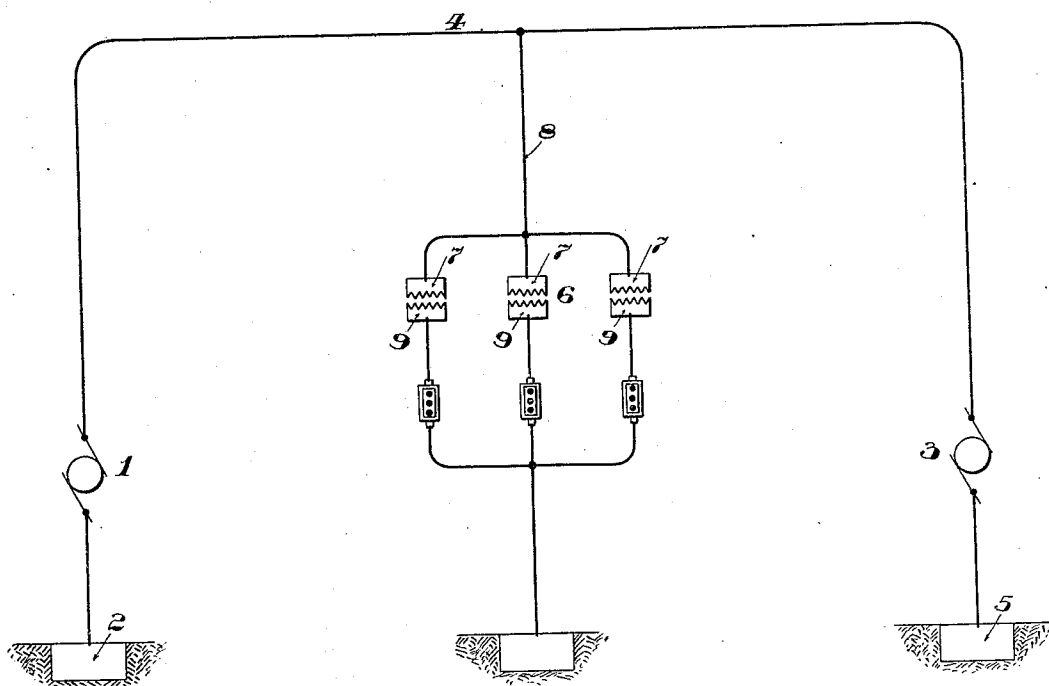


(No Model.)

A. WURTS.
LIGHTNING ARRESTER.

No. 509,783.

Patented Nov. 28, 1893.



WITNESSES:

H. L. Finner
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UNITED STATES PATENT OFFICE.

ALEXANDER WURTS, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, OF SAME PLACE.

LIGHTNING-ARRESTER.

SPECIFICATION forming part of Letters Patent No. 509,783, dated November 28, 1893.

Application filed May 16, 1893. Serial No. 474,461. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER WURTS, a citizen of the United States, residing in the city of Pittsburg, in the county of Allegheny, State of Pennsylvania, have invented a new and useful Improvement in Lightning-Arresters, (Case No. 552,) of which the following is a specification.

The object of my invention is the provision of a lightning arrester for the protection of electric wires and connected apparatus, whereby safe discharge of static electricity from the line may be rendered possible, and the dynamo current may be prevented from following discharges of such static electricity.

My invention is further designed to accomplish the above purpose without the use of moving parts, and may be said to differ essentially from the generally known forms of lightning arresters designed to accomplish the above named purpose, in that it absolutely prevents the dynamo arc from starting, whereas such other forms of arrester depend upon the starting and subsequent extinguishing of the dynamo arc. Where such dynamo arc is permitted to start, the most rapid means of extinguishing the same cannot act fast enough to prevent more or less damage being done. Great advantage will therefore follow from the use of an arrester whereby initial arcs are obviated.

My invention is illustrated in the accompanying drawing which is a diagrammatic representation of my invention as used in the protection of electric circuits.

At 1 is shown the generator which is grounded at 2 and which runs translating devices 3, through the wire 4, the return being through the ground device 5. I have shown here a grounded generator and translating device, as it is in this form of distribution system my invention will commonly be used, the dynamo current being most likely to follow the static discharge where said dynamo is grounded. It will be understood, however, that my invention is quite applicable to other forms of distribution system.

At 6 is shown one of my lightning arresters, consisting of a group of spark gaps, 7, connected by a common wire 8 to the line or lines

of the system, and grounded by means of a group of resistances, one resistance for each gap, said resistances being preferably provided with a common connection to ground as shown. I have shown only three spark gaps and resistances in the figure but it will be understood that any number may be used, according to circumstances. More than one will however be necessary in most commercial systems, and I have found that ten spark gaps and resistances are generally quite convenient in this connection.

I have found that where the resistance in a ground connection is sufficiently large, the dynamo current which would pass through such resistance would be too small to maintain itself. In other words, a certain ampere is necessary in a dynamo current before it can be made to follow a disruptive discharge over a practical spark gap and form an arc. At first sight, therefore, it would appear that all that would be necessary to prevent the dynamo current from following the discharge would be to introduce in the ground connection a resistance sufficiently large to reduce the dynamo current at the given voltage to such a quantity as is incapable of forming an arc. In practice, however, it will be found that the introduction of such a resistance would oppose the static discharge to such an extent as to force it to choose a path through the insulation of the generator sooner than leap the spark gap. This is, of course, the very thing that must be avoided. I have found that this difficulty may be overcome by using such a number of resistances as to reduce the opposition to discharge to a point considerably lower than that offered by the armature insulation. In so increasing the number of resistances, two plans offer themselves. Either one spark gap may be used in series with a number of resistances in parallel with each other, or a group of parallel spark gaps may be used, each having a proper resistance in series with it.

Upon consideration of the first of the above plans, it is immediately evident that the group of resistances in parallel with each other is the equivalent of one resistance opposing a correspondingly less number of ohms to the flow

of current. Putting such a group in series with one spark gap would therefore, while lowering the resistance to disruptive discharge, correspondingly lower the resistance to the passage of dynamo current, and the whole purpose of using such resistance would be nullified. The second plan, however, offers a solution of the problem. I have found that where a number of spark gaps are employed in multiple arc with each other, a disruptive discharge, in striking from the wire 8 to the ground will form a spark at all the gaps of the group simultaneously, but that this is only true where the resistance of each path is high. Slight differences in the width of the spark gaps will not disturb this law. This being the case, it is evident that this arrangement of the spark gaps and resistances will lower the resistance to disruptive discharge in proportion to the number of gaps in the group, and thus the potential at which such discharge will take place may be lowered as much as desired and the desired protection may be afforded to the dynamo or translating devices. Prevention of the formation of a dynamo arc, however, depends upon the reduction of the strength of the dynamo current which is able to follow the arc temporarily as above explained, and consequently, the use of the gaps and their resistances in the multiple arc arrangement shown will not in the least increase the tendency to form a dynamo arc across such gaps. This is due to the fact that, although upon occurrence of the multiple sparks, the parallel paths offered to the dynamo current will afford a path of greatly increased total conductivity. This conductivity is due to the division of the current, and the amount of current which will be able to follow each spark will be too small, owing to the great resistance of each path, to maintain an arc which will hold even momentarily.

The resistance which must be put in series with each spark gap will vary with the voltage of the circuit to be protected as well as with the width of the spark gap, this latter factor being in turn dependent upon the striking potential assumed. Supposing for instance that the breaking down of the armature insulation will take place under a strain of six thousand volts, and assuming a factor of safety of two, the spark gap must be made narrow enough to permit the formation of a

spark at a potential of three thousand volts. This I have found by experiment to be about three sixty-fourths of an inch. Now to hold an arc across a spark gap of this width will require a current of about a quarter of an ampère. The strength of current necessary to so hold an arc of course varies with the width of the gap. It will therefore be necessary to put a sufficient resistance in series with the spark gap so that, at the potential normally on the line, due to the generator, the current which can flow on the occurrence of a spark shall not be as much as a quarter of an ampère. Supposing that the dynamo potential is five hundred volts, it will require a total resistance on each branch to earth of two thousand ohms, to bring this current down to a quarter of an ampère. A part of this total resistance is that afforded by the spark gap itself, and therefore in the case supposed, if a resistance of two thousand ohms be put in series with the spark gap, the arc will be prevented. Of course for greater safety a greater resistance than this may be employed. The above figures are of course to be taken as extremely approximate. The circumstances of each case must govern the amount of resistance to be put in circuit with each spark gap.

I claim—

1. A lightning arrester for electric circuits consisting of a group of spark gaps, each having a resistance in series therewith sufficient when added to the resistance of the spark gap on discharge, to cut down the dynamo current below the ampère necessary to maintain an arc across said spark gap, substantially as described.

2. A lightning arrester for electric circuits consisting of a group of spark gaps, connected in multiple arc between one point of the line and the ground, and each having a resistance in series therewith sufficient when added to the resistance of the spark gap on discharge, to cut down the dynamo current below the ampère necessary to maintain an arc across said spark gap, substantially as described.

In testimony whereof I have hereunto subscribed my name this 11th day of May, A. D. 1893.

ALEXANDER WURTS.

Witnesses:

JAMES WM. SMITH,
HAROLD S. MACKAY.