

No. 793,445.

PATENTED JUNE 27, 1905.

T. J. JOHNSTON.
LIGHTNING ARRESTER.
APPLICATION FILED NOV. 8, 1901.

Fig. 1.

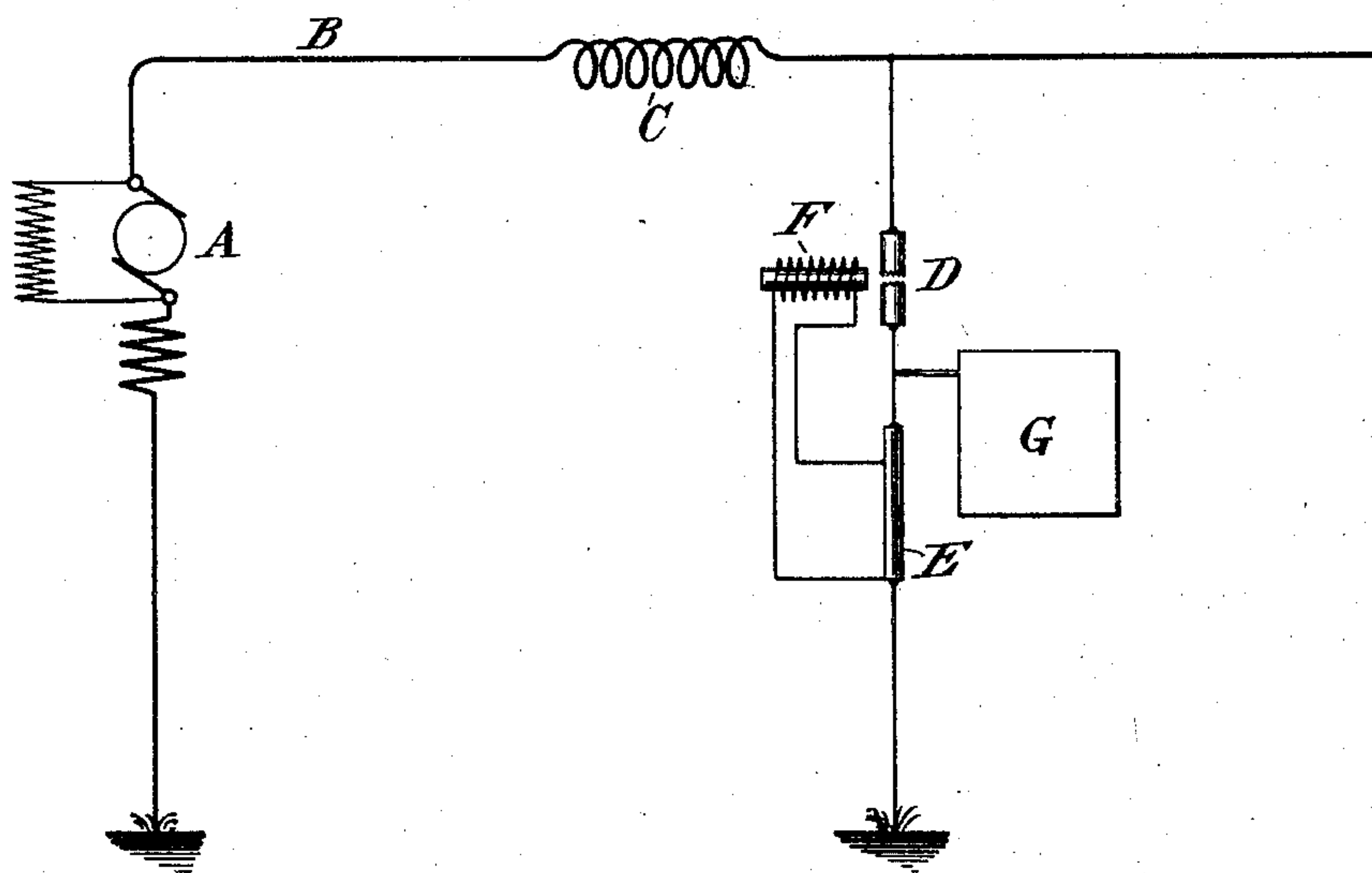
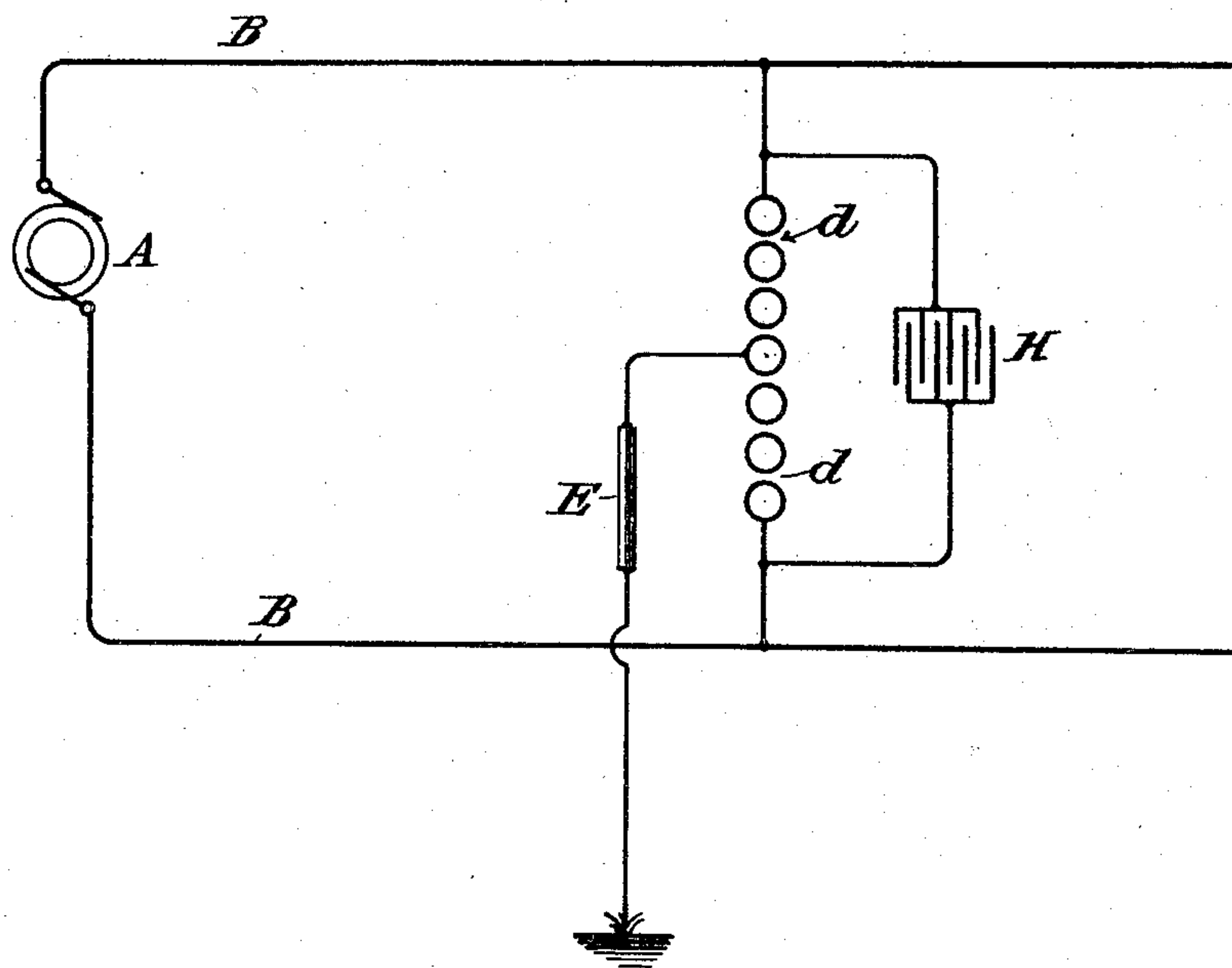


Fig. 2.



Witnesses
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THOMAS J. JOHNSTON, OF BROOKLYN, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

LIGHTNING-ARRESTER.

SPECIFICATION forming part of Letters Patent No. 793,445, dated June 27, 1905.

Application filed November 8, 1901. Serial No 81,637.

To all whom it may concern:

Be it known that I, THOMAS J. JOHNSTON, of Brooklyn, in the county of Kings and State of New York, have made certain new and useful Improvements in Lightning-Arresters, of which the following is a specification.

My present invention relates to lightning-arresters, and has for its object to improve the protection which these devices afford to electrical machinery generating current at such potential as is liable to cause an arc to follow the action of the lightning-arrester when it relieves the line of static charge.

Under some conditions, as when the discharge is of a rapidly-oscillating character or when it consists of a single impulsive discharge practically instantaneous and often of high potential, I have found it of advantage to associate with the spark-gap a device having electrostatic capacity. In many instances it will be found sufficient to provide upon one side of the spark-gap a plate of some size connected with the ground-line or forming a part of it. The effect of this is to weaken the dielectric at the spark-gap, or rather to put it under strain, so that it tends to break down readily, or, in common parlance, "attracts" the discharge. This, however, is not the only function of electrostatic capacity when associated with the spark-gap of a lightning-arrester where the latter is used on a dynamic circuit. Under such conditions, as is well known, the machine-current follows the lightning discharge across the spark-gap, often giving rise to disastrous arcs which may, where considerable energy is involved, cause the destruction of the apparatus. In fact, this is the main reason for lightning protection, since under most conditions the mere diversion of the static discharge is effected with comparative ease, at least except where the direct stroke of lightning is concerned. Under these conditions it is of value to employ electrostatic capacity at the spark-gap, though usually in a different form from the simple one above outlined. Where reasonably high potentials are used, it is desirable to employ a condenser in shunt to the spark-

gap, since the machine-current following the discharge tends to vary in such way as to charge the condenser, and by thus deflecting current from the arc between the spark-gaps renders the arc unstable and to a certain extent self-interrupting. Thus the condenser permits the use of a smaller resistance in the ground-circuit, it being desirable, as is well understood, to keep this resistance as small as is consistent with a proper limiting of the afterflow of machine-current.

An additional advantage of the arrangement proposed is that lightning protection is usually comparative—that is to say, it being generally impossible to obtain an electric circuit with no inductance the endeavor has been to increase the inductance of the machinery-circuit or that part which requires protection and to diminish as far as possible the inductance of the path which it is desired that a static discharge shall take. This has in many cases been accomplished by interpolating in the protected circuit an artificial inductance, generally in the form of an open coil especially designed for this class of reactance. This has become a recognized and valuable adjunct to a lightning-arrester. Its use in alternating-current circuits, however, is objectionable in many cases, since it constantly consumes energy on all circuits of commercial frequency. Nevertheless, it has been often applied even on alternating-current circuits.

By my invention it is manifest that the amount of artificial inductance needed to protect any circuit may be reduced to the same extent that the invention reduces the inductance of the ground-circuit, by which I am able to obtain both the advantages pointed out—namely, the reduction of the ohmic and inductive resistance of the ground-circuit and the reduction of the artificial inductance necessary in the protected circuit.

The accompanying drawings show in conventional diagram the two applications of the invention to which I have referred.

Figure 1 is a diagram of the grounded circuit having the first form of the invention ap-

plied thereto. Fig. 2 is a diagram representing a metallic alternating circuit with the second form of the invention.

In Fig. 1, A is a generator of the compound or railway type having one terminal grounded and the other connected to the line B. C is an artificial inductance or "kicking" coil, as it is commonly called, in series in the line B. D is the spark-gap of the lightning-arrester, one side of which is grounded, and in the ground-circuit is a non-inductive resistance E. This resistance is of any form which will not increase the inductance of the grounded circuit, a common type being a carbon rod the resistance of which is proportioned to the line-voltage in well-known ways. F is a blow-out magnet which is connected in shunt to a part of the resistance and acts upon the arc, following the lightning discharge across the terminals D, the coil of the magnet being energized by the drop in that part of the resistance spanned by its terminals. Electrically connected to a terminal of the spark-gap is a device having electrostatic capacity, such, for example, as a plate of good conducting metal, (indicated diagrammatically at G.) This may be of any convenient form or size, but should preferably have considerable surface. It is well understood that it is not necessary that it should be a single flat plate, but may be folded or rolled, provided the surfaces of the plate do not come into electrical contact.

In Fig. 2 the same letters refer in general to the same parts, but here a different form of lightning-arrester is employed. The system being alternating is not grounded, and lightning-arresters now in common use, consisting of a number of substantial cylinders, of a good conducting metal, insulated from each other and having their surfaces brought into proximity without contact, so as to form a series of spark-gaps extending from one line to the other, are employed. The number of the gaps will depend upon the voltage of the line, as is well understood, and commonly the

central one of the cylinders is grounded. In the ground-circuit a resistance E is included, and resistances are frequently also inserted between the line on each side and the lightning-arrester, although I have not illustrated them. The spark-gaps are formed at *d d* between the cylinders, and in shunt to the series of gaps is placed a condenser H of such electric capacity as is suitable to the character of the circuit, depending upon the frequency and potential, as is well understood. The calculation of the electrical constants being within the knowledge of every engineer it is unnecessary to further refer to them.

Having thus described my invention, what I claim, and desire to protect by Letters Patent of the United States, is—

1. The combination of a circuit to be protected, a series of spark-gap terminals connected directly to said circuit, a grounded connection to said spark-gap terminals containing a non-inductive resistance, and a device possessing capacity connected to said spark-gap terminals.

2. In a lightning-arrester, the combination of a plurality of spark-gap terminals, a direct connection between one of said terminals and the circuit to be protected, a ground connection from another of said terminals, a non-inductive resistance in said ground connection, and a device possessing electrostatic capacity associated with the spark-gap terminals.

3. In a lightning-arrester, the combination with a protected circuit containing inductance, of a grounded circuit having a spark gap or gaps and a non-inductive resistance in series, and a device having electrostatic capacity associated with said grounded circuit.

In witness whereof I have hereunto signed my name, in the presence of two witnesses, this 6th day of November, 1901.

THOMAS J. JOHNSTON.

Witnesses:

ERMINA E. WALKER,
DANIEL J. McNAMARA.