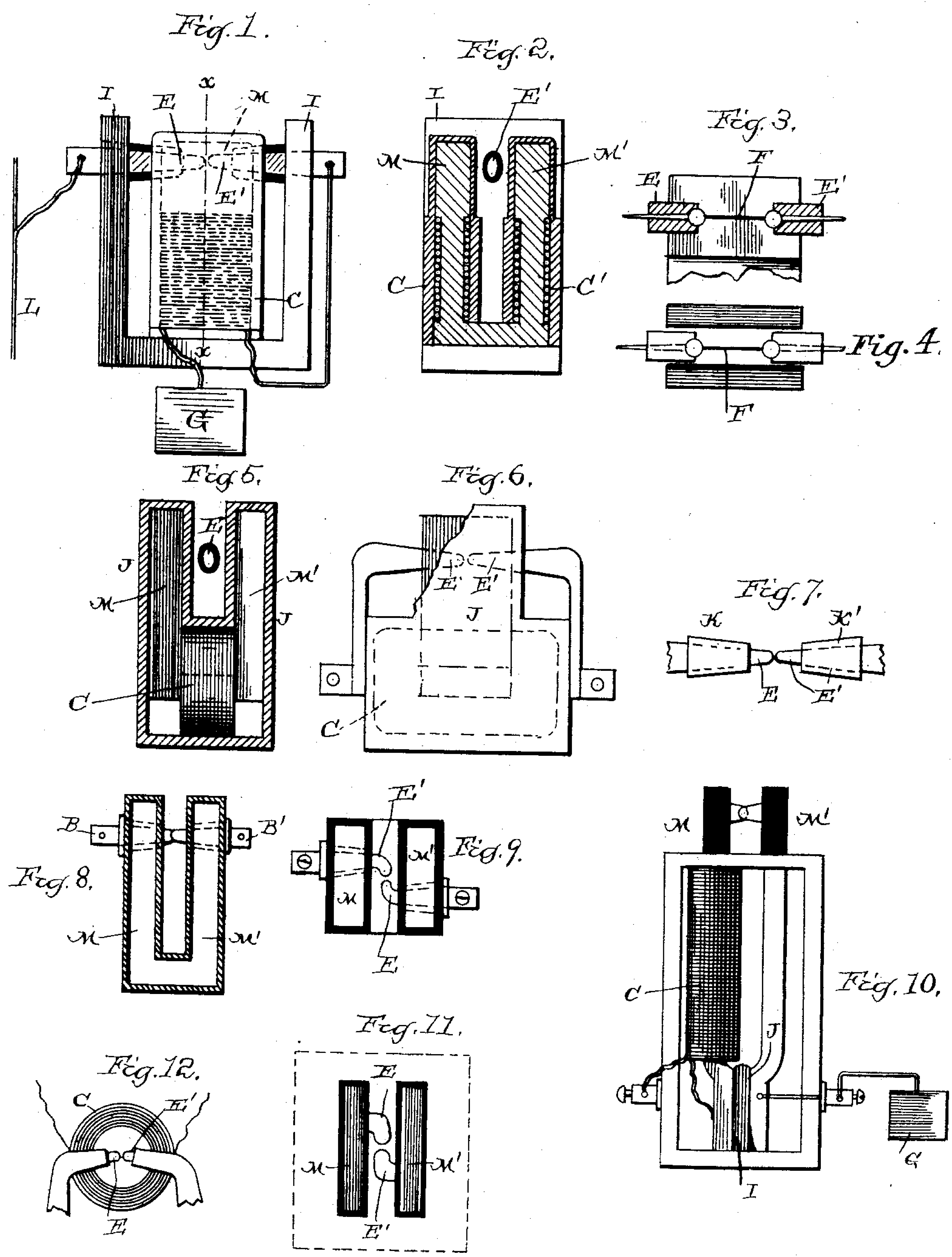
(No Model.)

# E. THOMSON.

## LIGHTNING ARRESTER.

No. 401,085. Patented Apr. 9, 1889.

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# UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS.

## LIGHTNING-ARRESTER.

**SPECIFICATION** forming part of Letters Patent No. 401,085, dated April 9, 1889.

Application filed October 8, 1888. Serial No. 287,565. (No model.)

*To all whom it may concern:*

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented a certain new and useful Improvement in Electric-Arc Rupturing Devices and Lightning-Arresters for Electric Power, Lighting Circuits, &c., of which the following is a specification.

My invention relates to that class of electric devices designed to effect the rupture of an electric arc formed between two electrodes or conducting-bodies by the direct application of some arc-disrupting force—such, for instance, as a magnetic field, a blast of gas or liquid, or any other directly-applied device adapted to displace or sever and put out the arc. Such devices have been applied in connection with the plates or electrodes of a lightning-arrester where there is liability to the formation and continuance of an objectionable electric arc following upon the passage of an electric discharge across the lightning-arrester electrodes. They are likewise applicable to the electrodes or abutments holding between them the fusible strip or wire of an electric safety-fuse when the fuse is used upon a high potential circuit or under conditions where the electro-motive force is sufficient to maintain an electric arc between the electrodes or abutments after the fuse is melted. My invention is, however, applicable, not only to an arc-rupturing device in connection with electrodes such as mentioned, but also to an arc-rupturing device applied to the arc field between any two electrodes or conducting-bodies where it is desirable to effect or assist in effecting the rupture of the arc by a device acting upon the arc itself.

The object of my present invention is, generally speaking, to increase the efficiency and certainty of operation of arc-rupturing devices such as I have described; and to this end my invention consists in the application of a shield or septum of insulating material between the opposed surfaces of the arc-rupturing device and the electrodes or conducting-bodies between which the arc to be ruptured is formed, thereby preventing an arc from forming at any other portion of the electrodes or conductors than those directly subject to the arc-rupturing force, and permitting the arc-rupturing device, when of conducting material, to be applied without danger of defective action very closely to the electrodes.

The protecting shield or septum may be of any desired material and applied in a variety of ways, either to the electrodes or to the arc-rupturing devices, or to both, as may be desired. The arc-rupturing devices I have herein described for the purpose of illustrating my invention consist of a magnet applied to the arcing-electrodes after the manner described in my prior patent, No. 321,464, of July 7, 1885.

When my invention is applied to an arc-rupturing device consisting of a magnet properly arranged with reference to the electrodes across which the arc to be ruptured is formed, the interposed insulating septum or shield may be formed by coating or covering the poles or metallic portions of the magnet with enamel, rubber, or other insulating material, enamel being preferable on account of its incombustible nature. By this means discharges or arcs which might otherwise pass from the poles or electrodes placed in the magnetic field to the magnet-pole, thereby escaping the action of the magnet in rupturing the same, are prevented. I find it in fact desirable to apply the insulation-shield to all metal portions which are in proximity to the arc to be ruptured, and also to coat or cover the electrodes themselves with insulating material at parts outside of the magnetic field, so that any possibility of a discharge or arc forming at any other portion of the conductors than those directly included in the magnetic field may be avoided.

In the accompanying drawings, Figure 1 is a side elevation, and Fig. 2 is a vertical cross-section, on the line X X, Fig. 1, of a device embodying my invention. Fig. 3 shows in side elevation, and Fig. 4 in plan, the application of my invention to an arc-rupturing device used with electrodes designed for another purpose. Fig. 5 is a section, and Fig. 6 a side elevation with a part broken away, of another form of my invention. Fig. 7 shows the application of the insulation to electrodes liable or subject to arcing. Fig. 8 is a vertical section, and Fig. 9 a horizontal section, of a device constructed in accordance with my invention. Figs. 10 and 11 are a side elevation and plan of a modified manner of mounting and constructing the arc-rupturing magnet and the arcing-electrodes. Fig. 12 illustrates another form of magnet applied as an arc-rupturing device.

In Figs. 1 and 2, M M′ are poles of a magnet, either a permanent or an electro-magnet, between which are mounted the electrodes E E′, separated, as in the case of a lightning-arrester, by a small interval or space over which a current of sufficiently high tension may force its way. As shown, the electrode E is connected with a line, L, while the electrode E′ is either directly connected to earth or is carried to earth through the coils C C′ of the magnet, of which M M′ are the poles. The electrodes E E′ are preferably supported by insulating material, I I, and are also preferably coated with enamel or other insulating material, except at their ends, where they approach between the magnet-poles. The magnet-poles M M′ are, in addition, coated all over with insulating material or surrounded by caps of insulating material lying either close to the pole itself or separated therefrom by a small interval—it matters not which. Where the coils C C′ are exposed to the action of an arc which might form between the electrodes E E′, the coils themselves are coated all over with a layer of insulating material to a thickness, say, of one-sixteenth of an inch or less, protecting them from arcing or short-circuiting. It will thus be seen that no metallic surfaces are exposed at or near the magnetic field except the electrodes E E′ of the lightning-arrester, similar to those described in my former patent referred to.

The connections of the device are unchanged in principle; but for relatively very high potentials the action is made very certain and is to be depended upon. Should a discharge occur to earth from the line L across the space between the electrodes E E′, due to induction or static charge produced by lightning, an immediate formation of an arc may result, especially if the line L is grounded in like manner at some other point, and the difference of potential of the grounded parts is high. Where the line L is one of heavy current and high potential, it is important to extinguish such an arc almost instantly, as it will create such a voluminous gas-stream as to do damage to the apparatus and be more difficult of extinction. The powerful magnetic field, however, in which the arc is formed when such magnet is properly magnetized results in a sudden break of such grounded current or arc. My present invention, on account of the layer of insulating material covering the poles of the magnet, allows such poles to be approached quite closely to the disrupting electrodes, thereby enhancing very much the intensity of the field. This, in fact, is one of the important results obtained in my present invention.

My invention may with equal effectiveness be applied to the case of electrodes normally having a fuse extending between them, as in Figs. 3 and 4, and placed in a circuit not grounded—that is, the magnet for disrupting the arc may, as I have indicated in other and former applications, be employed to surround a high-potential fuse, or a fuse in a high-potential circuit, or a circuit in which, after the fuse is melted by excess of current, the electro-motive force is still sufficient to maintain an arc in place of the fuse. As stated, the fuse is mounted between two supports, E E′, as in Figs. 3 and 4, and, in addition, included between magnet-poles M M′, which for continuous currents may be a permanent magnet or an electro-magnet traversed by a portion of the current, or an electro-magnet in any circuit capable of magnetizing it; or, in the case of alternating currents, it may be magnetized alternately by a portion of the alternating current traversing the coils of the magnet. The magnet-poles M M′ are in my invention coated, as in Figs. 1 and 2, with an insulating covering or shield placed close to the fuse F, and the supports themselves which uphold the fuse are, particularly where they pass outward or outside of the magnetic field between the poles M M′, also protected or coated or covered with insulating material, so that an arc cannot pass from a point on one of the supports E outside of the magnetic field, and whatever arc forms or can form exists in the magnetic field between the poles M M′ and is disrupted vigorously by the action of the magnet. In fact, the moment the fuse softens the tendency of the magnet is to rupture it by the magnetization of the current tending to produce motion in the magnetic field, which in turn is enormously intensified the moment the arc is formed in place of the fuse.

In Figs. 5 and 6 the magnet-coil is a single coil, C, surrounding the bent portion of the horseshoe M M′, and the whole structure, coil and magnet, is then inclosed in a complete covering of insulating material, which is shown at J surrounding the magnet on all sides and also the coil. The electrodes, one of which, E, is shown in Fig. 5, and both of which, E E′, are shown in Fig. 6, are presented at a small distance apart between the magnet limbs or poles, and are preferably coated, as in Fig. 7, by an insulating covering, K K′, in all positions or portions, except where they are presented to one another. This makes a simple device, and is applicable either to the electrodes, as shown, or to the electrodes or abutments holding a fuse.

In Figs. 8 and 9 is shown a slight modification, in which the electrodes pass through openings in magnet-poles, and therefore have no inside portions or extensions leading outward from between the poles, each electrode

E E′ forming, as in the plan, Fig. 9, a sort of bent piece inserted through the edge from the outside and separated between the poles from its opposite electrode by a small space. In this case the electrode-pieces E E′ are of course carefully insulated from the magnet-poles where they pass through the same. This form is particularly suitable where the magnet is a permanent magnet coated all over with insulating material and carries the binding-posts B B′ or connections to the parts of the circuit, as in Fig. 1, or otherwise.

In Figs. 10 and 11, Fig. 10 being an elevation and Fig. 11 a plan view of the electrodes, copper pieces are set in or carried by the magnet-poles themselves, as shown, the poles being coated all over with insulating material, as before; but the magnet-poles M M′ are not one piece of metal, but are two separate pieces kept apart by an insulating layer or septum at I, so as to virtually form an insulated horseshoe. They may be either permanent magnets or they may be provided with magnetizing-coils C wound thereon. In this case one connection is made to M, and the other from M′ is carried to ground, the coil C being conveniently included in either circuit or anywhere in the circuit where it is convenient to place it, and being covered up from any possibility of contact with heated gases or arcs formed between the electrodes by a box or covering, as indicated in the figure. The insulating-layer I, which may be a slip of mica or slate, or even wood, is sufficient to insulate the magnetic poles M M′, which carry the electrodes E E′ and are in connection therewith; but the magnetism is not so prevented from passing, and can readily permeate the insulation I, and thus the structure becomes in essence a horseshoe-magnet as before, whose north and south poles have between them electrodes E E′, but in this case solidly attached to them and carried by the set of poles on their inner opposed faces. As before, the space between the pieces E E′ might be replaced by a fuse in cases where a fuse is required.

Fig. 12 shows the manner in which a simple coil, C, might be used as a magnet to produce the magnetic field. In this case the coil is placed so that the plane of its winding follows the position of the magnet-pole and generates a field in which the electrodes E E′ are mounted. To apply my present invention to this structure, the electrodes E E′ would be coated except at their ends with insulating material, and the coil C also be coated all over with a good heavy layer of insulator, or an insulating septum or shield of solid insulating material would be interposed between the coil itself and the discharging-electrodes E E′. The device, Fig. 12, while useful, is not by any means as powerful in its actions of breaking an arc between the electrodes E E′ as the electro-magnet devices which have been described. It is, in fact, an electro-magnet whose core is simply an air-core without iron, and partakes, therefore, of the properties of air-magnets in general.

What I claim as my invention is—

1. In an arc-rupturing device, a shield of insulating material located between the surfaces of the electrodes and adjacent conducting-surfaces of the device by which the arc is disrupted, as and for the purpose described.

2. An arc-rupturing device having its exposed surfaces adjacent to surfaces of the arcing electrodes or bodies shielded with insulating material.

3. The combination, with electrodes liable to abnormal arcing, of an arc-dispelling magnet and a shield of insulating material between opposed surfaces of the magnet and electrodes, as and for the purpose described.

4. In an arc-rupturing device, a magnet whose poles are covered with insulating-shields.

5. In an arc-rupturing device, an intercepting-shield of solid insulator between the poles of an arc-rupturing magnet and the arcing-electrodes.

6. In an arc-rupturing device, magnet portions shielded by an insulating-covering, in combination with shielded electrodes having an exposed metal portion wholly within the space between the magnet-poles.

7. In an arc-rupturing device, a divided magnet whose portions are electrically insulated, but free for the passage of magnetism from one to the other, the poles of which magnet each bear one of a pair of electrodes connected, respectively, to the parts of an electric circuit, substantially as described.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 26th day of September, A. D. 1888.

ELIHU THOMSON.

Witnesses:
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