

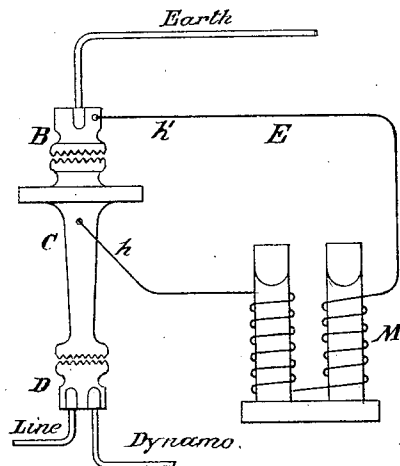
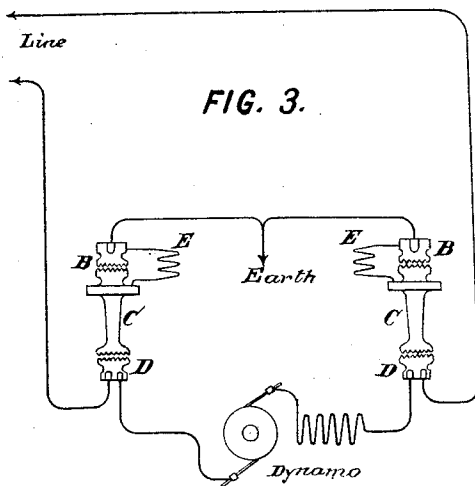
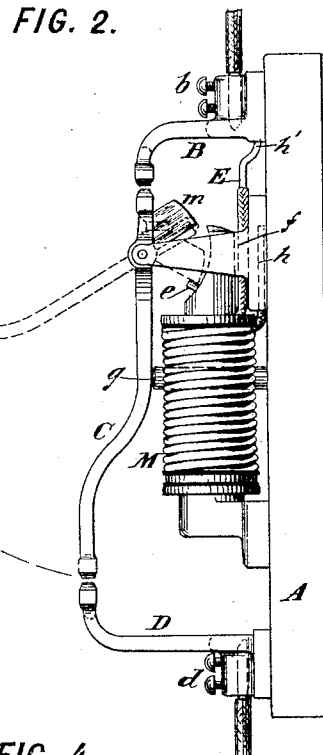
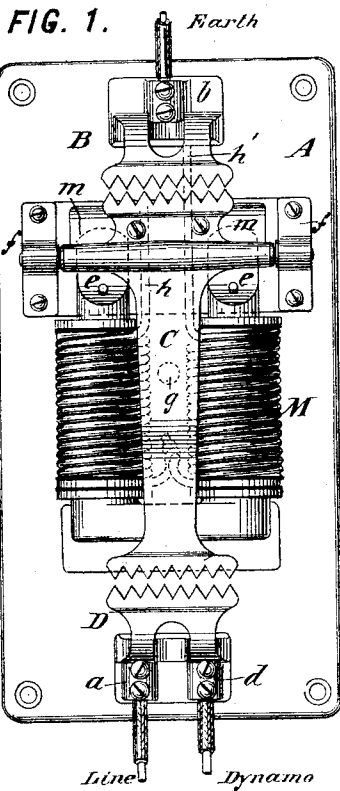
(No Model.)

3 Sheets—Sheet 1.

J. J. WOOD.
LIGHTNING ARRESTER.

No. 460,289.

Patented Sept. 29, 1891.



WITNESSES:

John Becker
Fred White

INVENTOR:

James J. Wood,

By his Attorneys,

Arthur G. Fraser & Co.

(No Model.)

3 Sheets—Sheet 2.

J. J. WOOD.
LIGHTNING ARRESTER.

No. 460,289.

Patented Sept. 29, 1891.

FIG. 5.

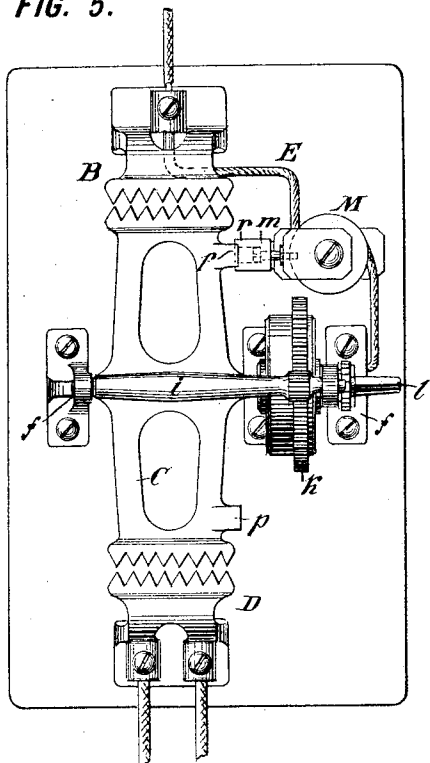


FIG. 6.

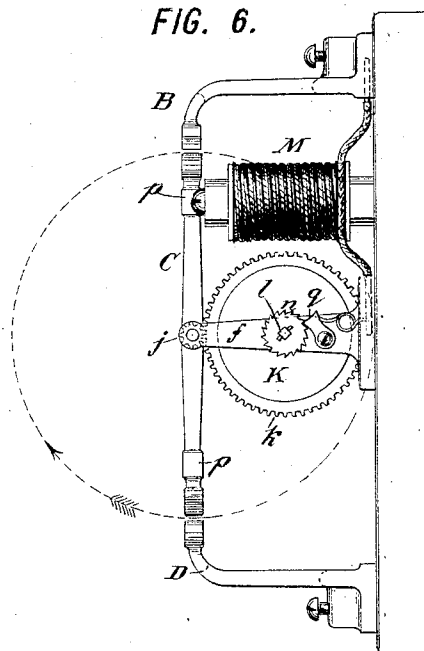


FIG. 7.

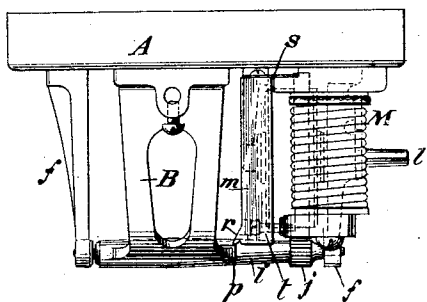
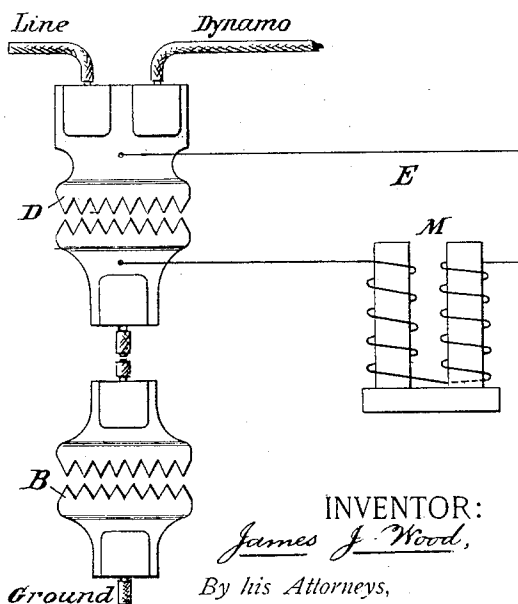


FIG. 11.



WITNESSES:

John Becker
Fred White

INVENTOR:

James J. Wood,

By his Attorneys,

Arthur C. Fraser & Co.

(No Model.)

3 Sheets—Sheet 3.

J. J. WOOD.
LIGHTNING ARRESTER.

No. 460,289.

Patented Sept. 29, 1891.

FIG. 8.

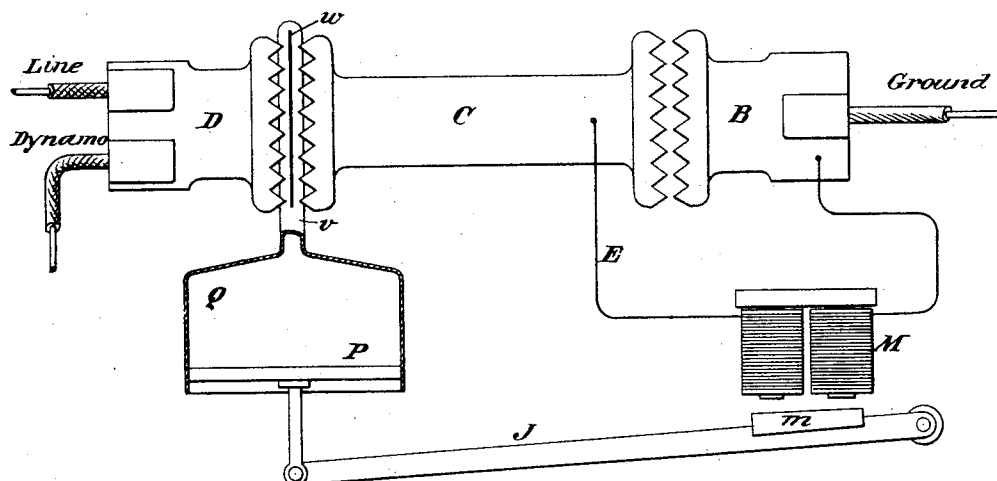
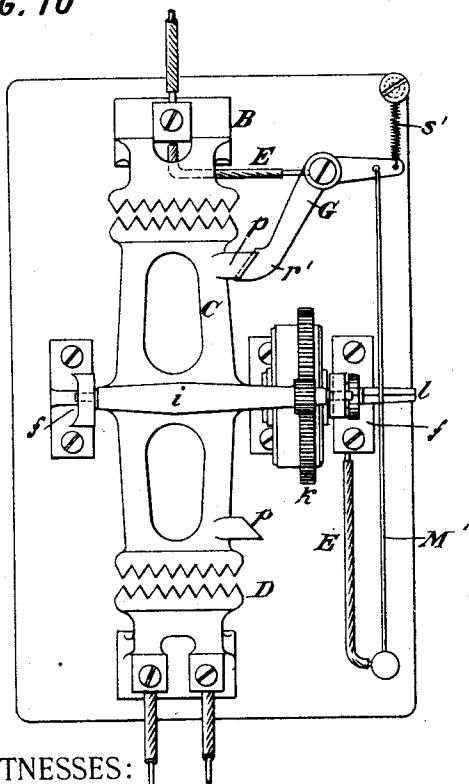


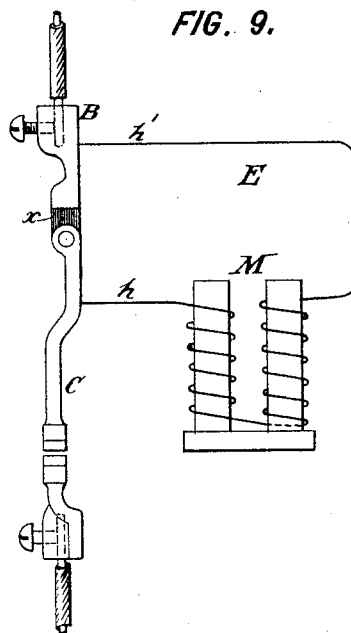
FIG. 10



WITNESSES:

John Becker
Fred White

FIG. 9.



INVENTOR:

James J. Wood,

By his Attorneys,

Arthur C. Brasen & Co.

UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF BROOKLYN, NEW YORK.

LIGHTNING-ARRESTER.

SPECIFICATION forming part of Letters Patent No. 460,289, dated September 29, 1891.

Application filed September 25, 1890; Serial No. 366,072. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Lightning-Arresters, of which the following is a specification.

This invention relates to lightning-arresters applicable to the ground connections of electric circuits generally for conducting lightning charges to earth. In the use of such lightning-arresters on circuits carrying currents of high voltage, such as those for arc lighting, it frequently occurs that the static discharge between the points or serrations of the discharge-plates of the lightning-arrester will cause the starting of an arc from one plate to the other, which will continue as long as the current on the circuit continues to be generated, unless it be in some way ruptured or extinguished. Several attempts have been made to provide automatic means for extinguishing such arcs and restoring the lightning-arrester to operative condition ready to conduct away the next static discharge. My invention provides an improved device for this purpose.

The preferred form of my invention is shown in Figures 1 to 4 of the accompanying drawings, the remaining figures of which show modifications.

Fig. 1 is a front elevation of my improved lightning-arrester. Fig. 2 is a side elevation thereof. Fig. 3 is a diagram showing the circuit connections of two lightning-arresters on opposite sides of the dynamo which they are placed to protect. Fig. 4 is a diagram showing the circuit connections pertaining to one lightning-arrester. Fig. 5 is a front elevation of a modified construction embodying my invention. Fig. 6 is a side elevation thereof. Fig. 7 is a plan thereof. Fig. 8 is an elevation of a further modified construction, partly in section. Fig. 9 is a front elevation of another modification. Fig. 10 is a diagrammatic side elevation of another modification, partly in section. Fig. 11 is a diagrammatic elevation illustrating a further modification.

I will first describe the construction shown in Figs. 1 to 4.

On an insulating base-plate A, preferably of slate, are fixed two discharge-plates B and

D, of metal, between which extends a plate C. This intermediate discharge-plate closely approaches the plates B and D at its ends, but does not touch them. The approaching portions of the respective plates are preferably serrated in order that the points may provide means for the continual discharge of static electricity between them. The plate B is formed at its base with a binding-post or socket *b*, to which is connected the ground-wire leading to an earth connection. The plate D is formed with two binding-posts *a* and *d*, one of which receives the line-wire and the other the wire leading to one of the terminals of the dynamo. In case the line is struck by lightning the static discharge jumps from the plate D to C and again across the gap between C and B and passes to earth.

In order to protect a dynamo from lightning discharges coming in over either terminal portion of the line-wire, it is customary to provide it with a lightning-arrester adjacent to each of its terminals and between it and the exterior line, as shown in Fig. 3. In case the circuit should chance to be grounded at any point, or in case lightning discharges should pass simultaneously by both lightning-arresters to earth, there is liability that the current from the dynamo will follow the static discharge by forming arcs across the gaps or breaks between the plates of the arresters, thereby establishing a short circuit of much less resistance than the line-circuit, so that the greater portion of the current from the dynamo flows by this short circuit. There is great danger in such a case that the dynamo will be burned out or seriously injured by the large current generated by its high electro-motive force against the comparatively trifling resistance of the short circuit. Injury to the dynamo may be prevented by providing it with an instantaneously-acting automatic regulator, by which its electro-motive force can be quickly enough reduced; but in any event it is desirable that a short circuit so formed shall be instantaneously broken in order not to interrupt the working of the line.

To this end my invention provides a shunt-circuit E, connecting either two of the discharge-plates—for example, the plates B and C, as shown in Fig. 4—in which shunt is installed an electro-magnet M. Upon the for-

mation of an arc between the plates C and D the current passing through the shunt E excites the magnet M. This magnet is caused to actuate any suitable arc-rupturing device, which instantly extinguishes the arc and breaks the short circuit, whereupon the magnet is demagnetized.

Referring to Figs. 1 and 2, the magnet M is in the form of a horseshoe-magnet with its poles turned upwardly and cut away to form concave or arc-shaped faces on their front sides. The armature *m* is a bar extending across in front of the poles and fastened to the upper end of the discharge-plate C. This plate is pivoted on a transverse axis between two uprights *ff*, fastened to the base-plate, this axis being much closer to its upper end than to its lower end. Upon the excitation of the magnet its armature is attracted downwardly, and thereby causes the plate C to be tilted or swung from the position shown in full lines in Fig. 2 to that shown in dotted lines. This movement swings its lower end outwardly to a considerable distance from the plate D, and thereby draws out and ruptures the arc passing between them. The upper end is also swung inwardly away from the end of the plate B, but to a less distance. As soon as the arc is broken the current ceases to flow over the short circuit and the magnet is instantly demagnetized, releasing its armature, whereupon the plate C, the center of gravity of which is below its pivotal axis, falls back to the position shown in full lines, where its serrated ends are brought into close juxtaposition with those of the plates B and D, thereby restoring the instrument ready for the next discharge. The swinging plate C is arrested in its normal position by a stop *g*, and its outward motion is limited by the striking of the armature against stop-pins *ee*, set in the magnet-poles. The shunt-circuit E is completed by connecting one terminal wire *h* of the magnet to the metallic base of the bearing-standards *f* and by connecting the other terminal *h'* to the plate B. It will be observed that the shunt E and magnet M are so disposed as not to be traversed by the static discharge, which jumps directly between the plates D C B. Aside from the fact that the path through the shunt is too circuitous to be followed by the static discharge as compared with the direct path through the air between the serrated ends of the plates, the self-induction of the shunt-wire, by reason of its being coiled upon itself in numerous convolutions, is so great that it affords a practically insuperable barrier to the passage of a discharge of static electricity. This self-induction is intensified by the magnetic resistance of the iron core of the magnet. There is consequently no liability of injury to the electro-magnet by the passage of a lightning discharge through it.

My improved arrester acts instantly and with certainty in extinguishing an arc, and is not liable to be injured either by a lightning

discharge or by a prolonged arc. Its success is due in part, as I believe, to the arrangement of the magnet out of the path of the lightning discharge, and where it is certain to receive all or a large proportion of the current from the dynamo in case an arc is formed, and in part to the fact that the attraction of the magnet sets in motion a movable armature and its attached plate C, which (by their momentum or otherwise) continue to move even after the cessation of the magnetic attraction, so that the discharge-plates are moved farther apart than barely sufficient to disrupt the arc, whereby the certainty of action of the device is increased. In practice the device works instantly upon the formation of an arc and extinguishes it so quickly that it can barely be seen, and instantly the parts return to rest, ready for the next discharge.

Figs. 5, 6, and 7 illustrate a modification wherein the arc-disrupter is operated by the energy of a compressed or coiled spring or a clock-work or other motor, instead of by the energy of the electro-magnet. The intermediate discharge-plate C is here pivoted at its middle, so that its arms are of equal length. Its spindle *i* is formed with a pinion *j* at one end, meshing with a gear-wheel *k*, formed on the spring-barrel of a clock-work K. A spiral clock-spring is inclosed in this barrel, its outer end being fastened to the barrel and its inner end to a spindle *l*, carrying a ratchet-wheel *n*, engaged by a pawl *q*. The clock-work imparts to the pivoted plate C a normal tendency to revolve in the direction of the arrow in Fig. 6. The plate is, however, held stationary and in line between the plates D and B by an electro-magnetic detent. The plate C has two projections *pp*, one of which encounters and normally rests against the inclined end *r* of the armature *m* of the electro-magnet M. The armature is pivoted on a flexible spring *s*, and is stopped in its outward movement by a screw *t*, both of which are shown in Fig. 7. The electro-magnet M is connected in a shunt E, extending from the plate B to one of the frames *f*, between which the plate C is pivoted. Whenever a discharge of electricity passes between the plates D C B and is followed by an arc, the current deflected through the shunt excites the magnet, which attracts its armature *m* toward it, thereby withdrawing its end *r* from the path of the projections *p*, thus releasing the plate C, which immediately proceeds to revolve under the tension of the clock-work. Its revolution carries its serrated ends away from the ends of the plates B and D, thereby drawing out and rupturing the arcs. By the rupturing of the arcs the current is broken and the magnet M is demagnetized, so that its armature *m* is retracted, thereby bringing its stop *r* into position to intercept and stop the other projection *p* on the plate C, so that the plate is arrested upon the completion of a half-revolution and remains in position to receive the next discharge of lightning. The instru-

ment requires winding up at occasional intervals—say every few weeks or months, according to the length of the spring actuating the clock-work.

5 Fig. 8 shows a further modification of the arc-disrupter. The three plates B, C, and D are fixed, and the magnet M is connected in a shunt E between the plates C and B. Its armature *m* is mounted on a lever J, coupled
10 to a piston P, working in a cylinder Q, from which leads a pipe *v*, terminating in a discharge opening or slit *w*, which constitutes a nozzle arranged to direct a jet or sheet of air between the serrated ends of the plates C and
15 D. Upon the formation of an arc the current diverted through the shunt excites the magnet, which attracts its armature and moves the piston P forcibly into the cylinder Q, thereby compressing the air therein and blowing a puff of air out through the nozzle or slit
20 against the arc, whereby the latter is blown out. The sole function of the break between the plates B and C is to establish a resistance sufficient to divert the requisite current
25 through the shunt of the electro-magnet. Any other suitable resistance than this break might be provided. For example, referring to Fig. 9, a carbon block *x* might be interposed between the ground terminal plate B and the
30 movable intermediate plate C, the function of this block being to develop sufficient resistance to the passage of a dynamic current to divert sufficient current through the shunt to vitalize the electro-magnet. In this construction
35 the magnet may act, as in Figs. 1 and 2, to vibrate the movable plate C.

Instead of an electro-magnet, any other electro-motive device known to electricians may be employed. As an example of such
40 device I may mention a thermo-expansive spring or wire adapted to be heated by the passage of a current and by its expansion to actuate the arc-rupturing device. Fig. 10 shows such a construction, the thermo-expansion wire M' forming part of a shunt-circuit
45 E between the plates B and C. This wire is normally stretched taut by a spring *s'*, which tends to tilt a detent elbow-lever G, so as to release its stop-arm *r'* from the projection *p*
50 on the plate C. Upon the formation of an arc a current passes through the shunt, which

heats and expands the wire M' and enables the spring *s'* to withdraw the detent, whereupon the plate C executes half a revolution under the impulse of a clock-work or other
55 motor, which may be of the same construction as shown in Figs. 5 and 6.

Fig. 11 shows a construction wherein two pairs of plates are used between which to form the two breaks.

I claim as my invention the following-defined novel features or improvements, substantially as hereinbefore specified, namely:

1. The combination, with a lightning-arrester having three discharge-plates with two
65 intervening breaks, one of the terminal plates connected to the dynamo and line and the other to earth, of a shunt-circuit connecting one of the terminal plates to the intermediate
70 plate, and an arc-rupturing device adapted to act upon the passage of a current through said shunt and to extinguish the arc between the other terminal plate and the intermediate
plate.

2. The combination, in a lightning-arrester, 75 of two fixed terminal discharge-plates and an intermediate plate, a shunt between one of the terminals and the intermediate plate, an electro-magnet in said shunt, and means adapted upon the excitation of said magnet
80 to impart motion to said intermediate plate to rupture the arc between it and the other terminal plate.

3. The combination of fixed terminal discharge-plates D and B, a pivoted intermediate
85 plate C, an armature *m* carried thereby, a shunt-circuit E, connecting one of the terminal plates with said intermediate plate, and an electro-magnet M, connected in said
shunt.

4. The combination of fixed plates D and B, pivoted plate C, shunt E, magnet M, armature *m*, and oppositely-acting stops *e* and *g*
90 for limiting the opposite movements of the plate C.

In witness whereof I have hereunto signed my name in the presence of two subscribing
95 witnesses.

JAMES J. WOOD.

Witnesses:

ARTHUR C. FRASER,
GEORGE H. FRASER.