(No Model.) 2 Sheets—Sheet 1

E. THOMSON.

LIGHTNING ARRESTER.

No. 444,678. Patented Jan. 13, 1891.

Fig 1

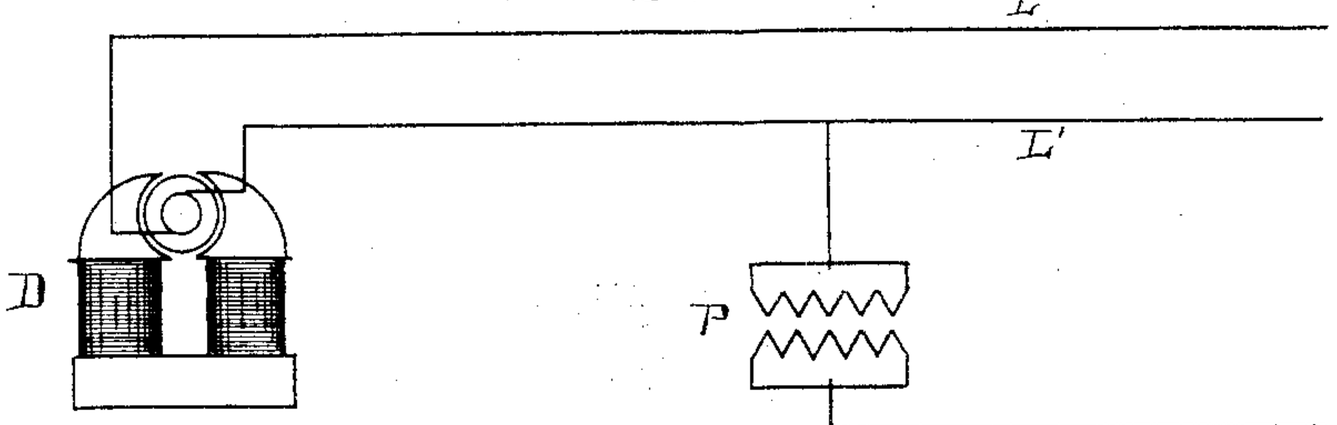


Fig 2

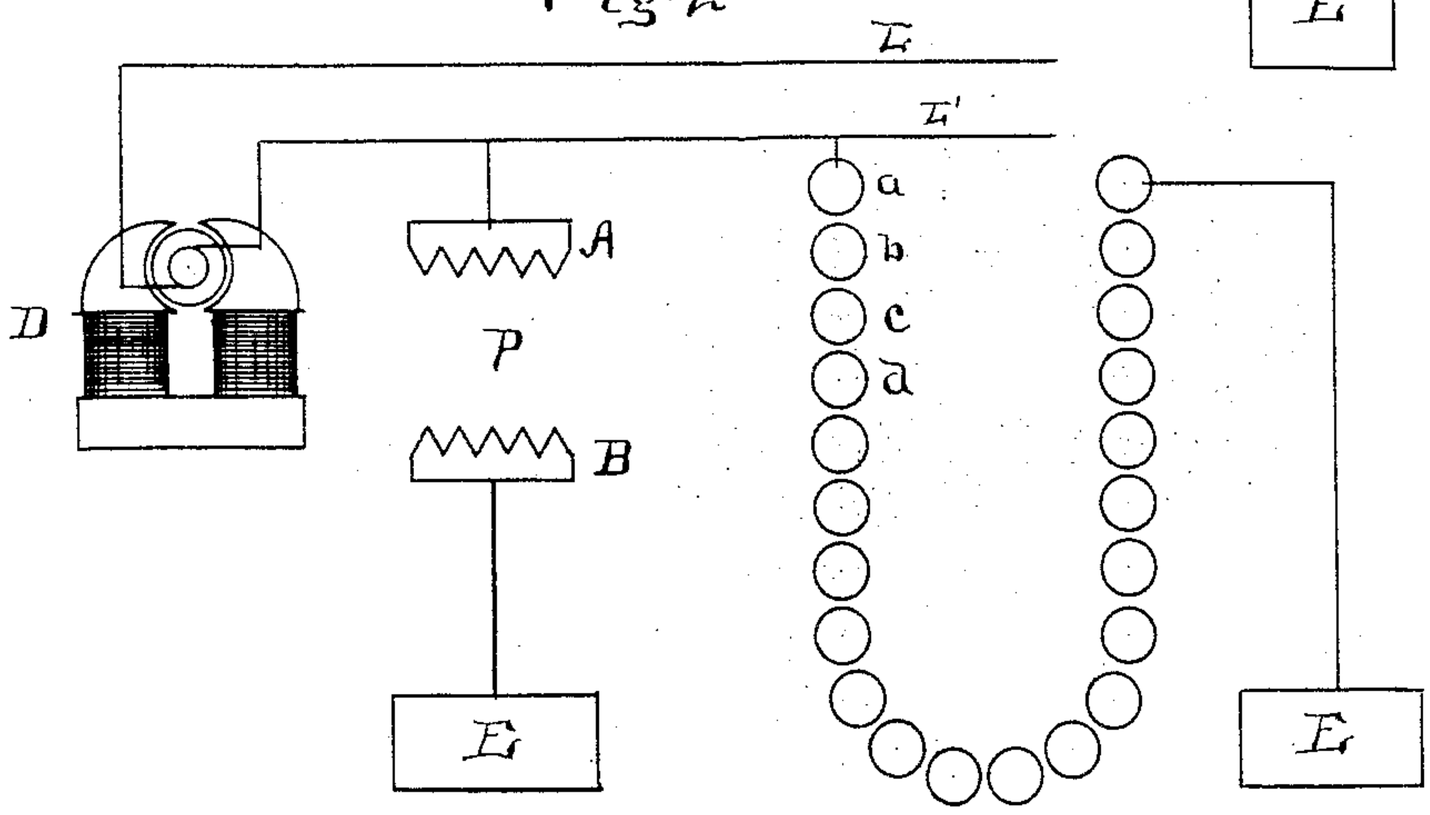
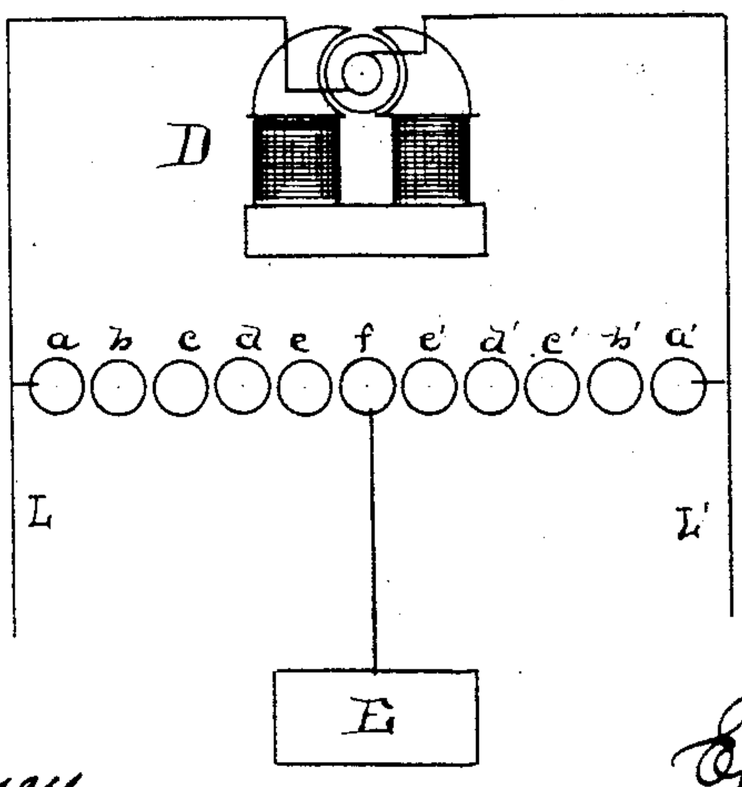


Fig 3.



WITNESSES:

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John C. Randall

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ATTORNEY.

(No Model.) 2 Sheets—Sheet 2.

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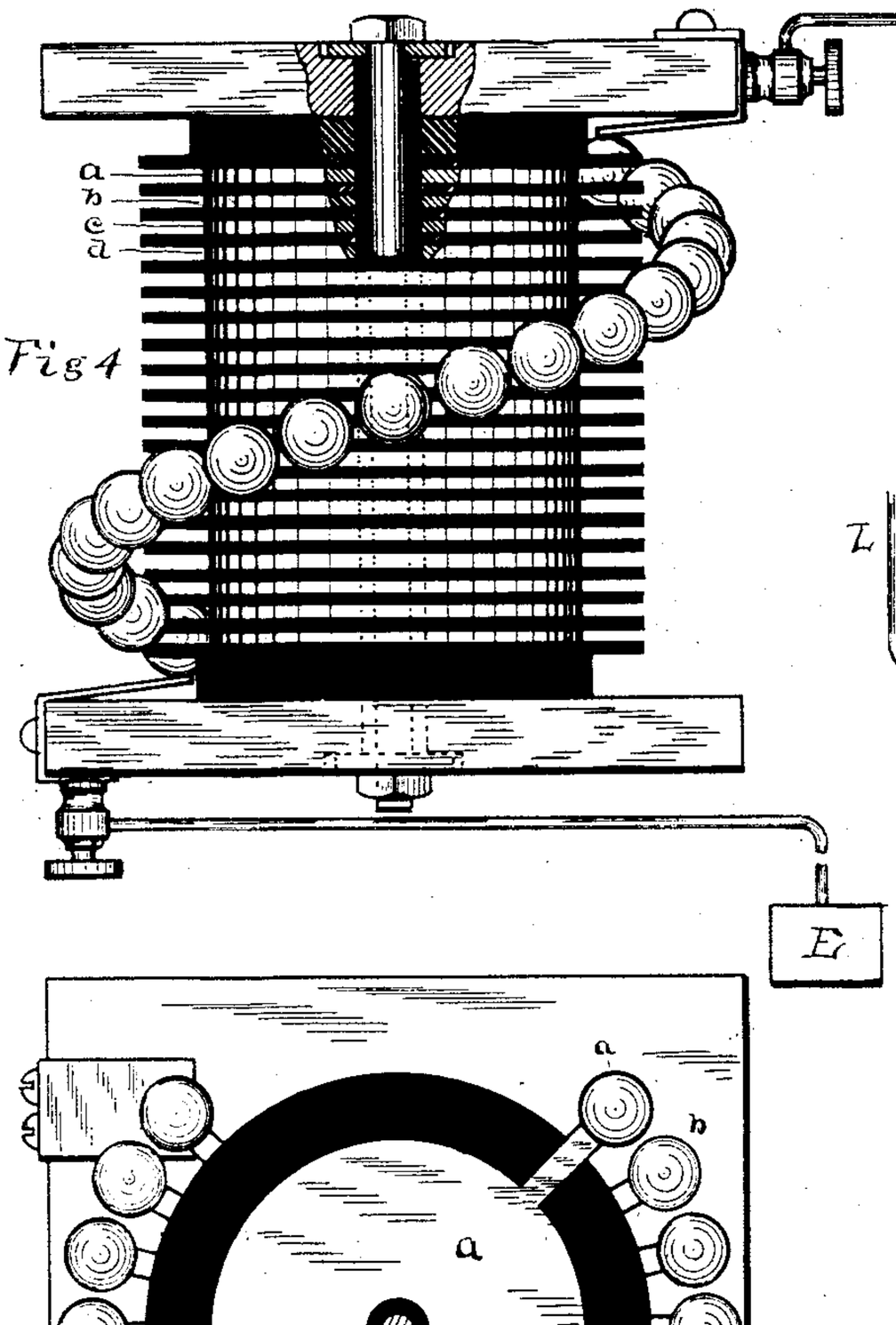

Fig 4

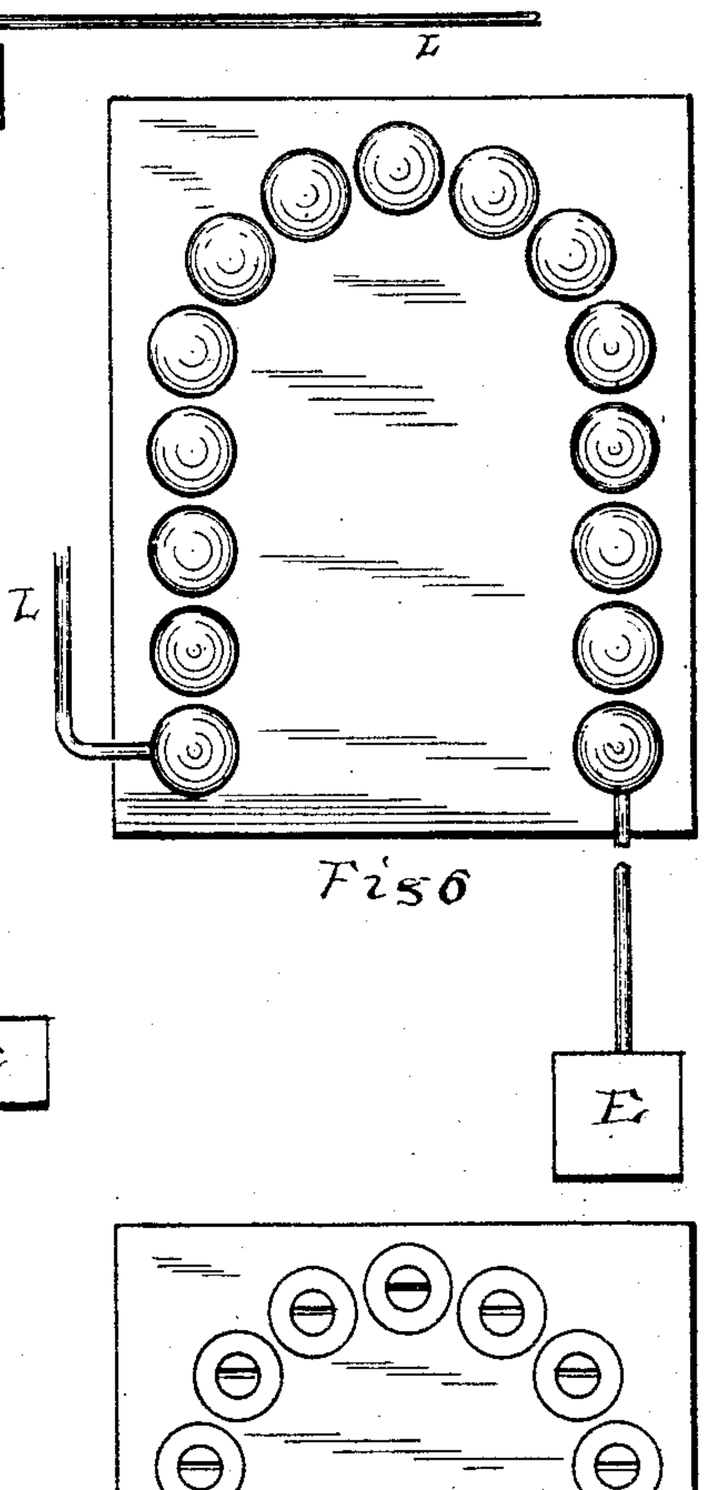

Fig 6

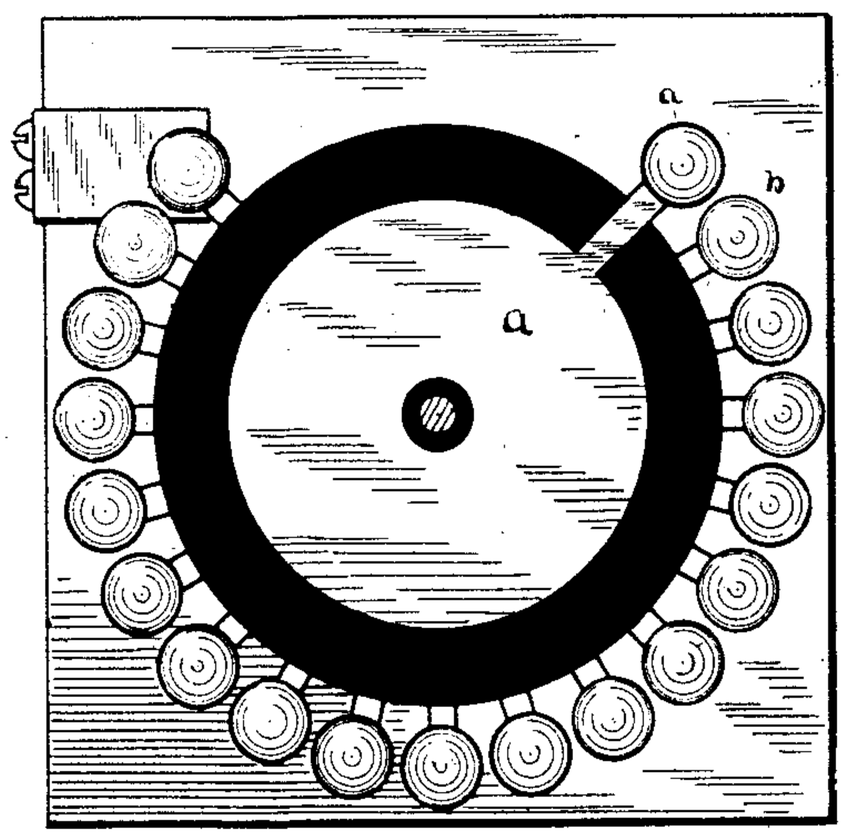

Fig 5

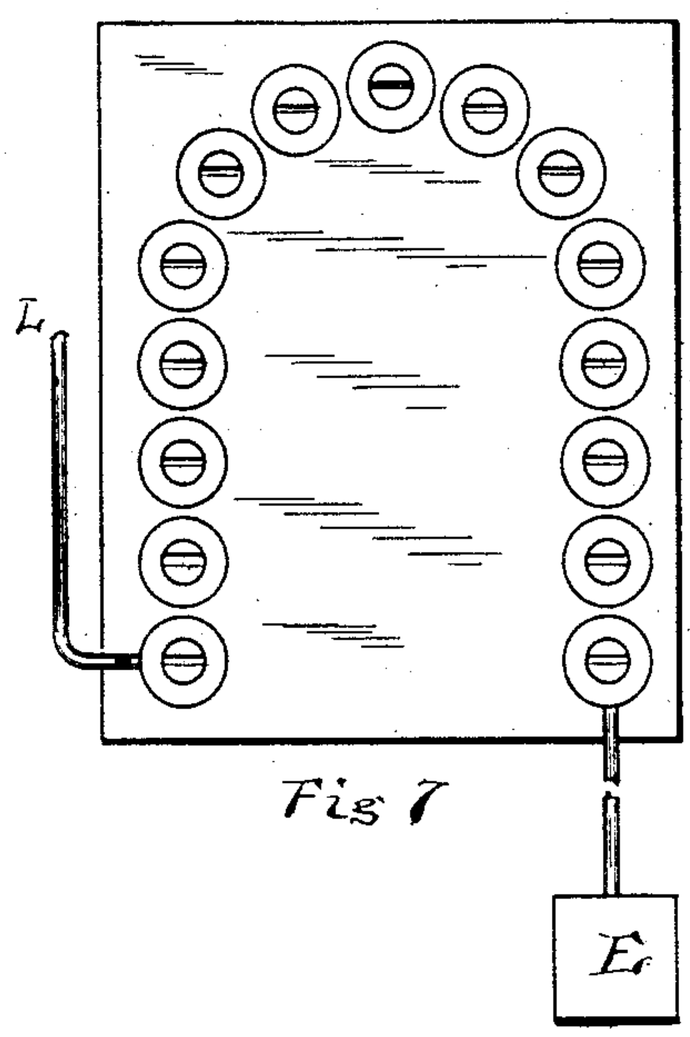

Fig 7

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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF CONNECTICUT.

LIGHTNING-ARRESTER.

SPECIFICATION forming part of Letters Patent No. 444,678, dated January 13, 1891.

Application filed March 17, 1890. Serial No. 344,116. (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 Lightning-Arresters, of which the following is a specification.

My present improvement relates to lightning-arresters for application to circuits which would form arcs, or which are of sufficient potential to cause a continuance of a discharge of current when the spaces of the lightning arrester have been bridged by a discharge inductively produced by the clouds.

My invention is based upon the principle that where a number of breaks are made in an electric circuit, or when a number of discharge-spaces are successively placed to be traversed by a discharge, the total distance traversed by the discharge as given by the sum of the spaces or breaks may be made much greater than the striking distance of a discharge between only two plates where a single break exists only in circuit; or, in other words, that an induced discharge of lightning or a sudden high-potential impulsive discharge will leap a number of striking-spaces in succession, and such a number of them as would be several times the length of a single space which would be leaped by the same discharge. I have found, on the other hand, that when such discharge has taken place and the potential of the line is such as would tend to maintain an arc at the breaks or striking-spaces such potential can readily be made insufficient to do so by multiplying the number of striking-spaces, and that an arc is much more readily maintained between two plates with a single wide space than between a succession of discharge points or over a succession of spaces placed in series and which the arcing tendency has to bridge, particularly if the discharging surfaces or metallic parts are of good conductibility for heat, the difference being the formation of a number of arcs between cold metal in succession as compared with the formation of a single longer arc over two metallic points.

My invention consists, broadly, then, in constructing a lightning arrester or discharger with a succession of striking-spaces in series and in making the sum of the striking-spaces several times greater than the space which would be given to an ordinary lightning-arrester, or between the plates of a single break lightning-arrester. It is preferable that the metal pieces interposed between each successive break should have some capacity for static charge, as this facilitates the successive breaking down of the disruptive spaces by a lightning discharge or sudden static effect.

In Fig. 1 I have shown a dynamo-generator D, whose terminals are connected to a line L L′, such as may feed any set of devices. Each of these terminals (one only being shown) is connected to the lightning-arrester. Now in the figure the lightning-arrester shown is simply an exaggeration of the ordinary form of arrester, in which serrated plates are opposed one to the other, with a space between at P, one of such plates being connected to the line L and the other to an earth or ground at E. This would constitute a lightning-arrester for a circuit in which the potential was not sufficient to continue an arc across the disruptive space at P. In Fig. 2 is shown, however, an outline view of my present arrangement as compared with the arrangement Fig. 1 if extended to give the same disruptive space which I obtain in my improvement. In this case I connect to each line, where both are subject to static discharge, an arrester composed substantially of a number of bodies of conducting material having some surface, as *a b c d*, &c., the first one *a* being connected to the line L, and the last one to the earth-plate E or ground. This gives a succession of striking-spaces or breaks in the connection from the line L to the ground E, and the total length of the striking-spaces may be very considerable, the number of breaks provided being not less than one break for each thirty to forty volts potential of the dynamo in its normal working. For comparison there is also shown in Fig. 2 the plates A B, separated by a space at P, as in Fig. 1; but the space is made wide enough to equal the combined length of the breaks between the pieces *a b c d*, &c., in my improved form. Manifestly the

space at P would serve as a very slight protection if used as shown, the distance to be traversed by the static discharge being so great that the machine D and the other apparatus would not be safe from injury, as the potential in the line would have to rise to a point enabling it to bridge over the gap thus made.

Notwithstanding the fact that in my improved arrangement the pieces *a b c d*, &c., are in succession, and the combined or added space of all the breaks is several times more than the space between the plates of an ordinary lightning-arrester, as at P, Fig. 1, a sudden discharge coming over the line, even of moderate power as to striking distance, has no difficulty in getting to earth, as it breaks down disruptively each one of the spaces, as between *a b*, *b c*, *c d*, &c., successively, but at very small intervals of time, the spark jumping from *a* to *b* destroying the electrostatic resistance of the space between *a* and *b*, sending the discharge in full force from *b* to *c*, and so on until the spaces are broken down.

In Fig. 3 there is shown a combination in one arrangement of a lightning-arrester for the two lines L L′, leading from the dynamo D. Here a single range of conductors of some capacity separated by air-spaces or striking distances exist, the central one *f* having a connection to ground, while the line L L′ is connected to the extremes of the whole range, leaving a set of disruptive spaces on each side of the earth connection and between it and the terminal wires of the dynamo.

In constructing my improved apparatus, I prefer to employ such an arrangement as is seen in Figs. 4 and 5, Fig. 4 being an outside elevation and Fig. 5 a plan of the lower part of the structure. A series of metallic plates *a b c d*, &c., separated by insulating-washers, such as hard rubber, each washer projecting a little distance, preferably, outside of the metallic plates, are held together in a suitable frame-work, connecting them and supporting them. Each plate, as *a*, Fig. 5, is provided with a lateral projection and carries a discharge-terminal, such as a ball, which lies within a small space of the succeeding terminal plate, as *b*, of the series. At one end of the series is a connection to the line, as at L, and at the other end is a connection to earth E. The effect of arranging the plates, as shown, is to give each one a certain static capacity, while the discharge-points or balls can be adjusted as to distance apart by simply swinging the plates around circularly, so as to arrange the balls or discharging-points in a spiral fashion or a zigzag fashion around the column of plates. At the same time additional plates might easily be built up on top of the column by unbolting the center bolt and stringing new plates and insulating-washers thereon, so as to increase the number of discharge-points and adapt the apparatus to working with higher potentials on the line L. Here again the sum or total of the discharge-spaces jumped is largely in excess or several times that of the striking distance in an ordinary lightning-arrester, or several times that space, which would be the largest space possible to be used with safety as a single space in protecting a dynamo against injury from induction-discharges, and the number of discharging-spaces is to be increased nearly in accordance with the increased potential of the line itself, using, say, for each thirty to forty volts of potential on the line a discharge-space, although there is no harm in increasing the number of discharge-spaces beyond the proportion which this would give.

Fig. 6 simply shows a series of insulated metallic plates or spheres of some static capacity mounted in the form of a U upon a stand, it being a convenient simple disposition where an apparatus as elaborate as Fig. 4 or 5 is not needed; and in Fig. 7 is shown a number of plates screwed down to a board, with a series of discharge-spaces existing between them. These and other modifications, of course, are easily arranged, it being only necessary that the capacities of the discharging-spaces shall be such as to give rise to the successive disruption of each space in such a way that the discharge may leap a number of spaces equaling a total single space when added, which the discharge would by no means be able to pass.

The gist of my invention in fact consists in providing a lightning-arrester in which the discharge-spaces are in series and of a total length when added together several times that which the discharge could pass if caused to leap a single discharge-space, or that which would be provided in an ordinary lightning-arrester with a single pair of discharge-plates, whereby I secure not only freedom of discharge of current but at the same time freedom from the formation of and continuance of arcs between the discharge-surfaces or over the discharge-spaces, it being necessary in order to sustain an arc between each space that a potential of about thirty to forty volts should exist thereat, and the number of discharge-spaces being made in excess of the potential divided by, say, thirty or forty volts, there is obtained security from continuous arcing.

My invention also provides that the successive discharge-spaces shall be formed between metallic or conducting bodies of some considerable static capacity, insuring the successive breaking down of the spaces, which is accomplished in an exceedingly short space of time, but nevertheless in a successive manner.

I do not herein claim a succession of plates separated from one another by insulating-spaces in a lightning-arrester in which the sum total of the insulating-spaces is the same as the striking space or break in an ordinary lightning-arrester.

I claim—

1. A lightning-arrester having two conducting parts between which a difference of po-

tential may exist, separated by a series of conducting-pieces, forming spaces the total length of which is too great to permit of an arc being maintained, but small enough to permit of a disruptive discharge.

2. A lightning-arrester having two conducting-pieces between which a difference of potential may exist, separated by a series of insulated conducting-pieces of suitable static capacity, between which is a series of spaces the total length of which is greatly in excess of the space ordinarily provided between the opposite parts of a lightning-arrester, whereby a disruptive discharge is permitted, but the formation of an arc prevented.

3. In a lightning-arrester having a series of disruptive spaces which the discharge must pass in reaching earth, a set of plates or surfaces whereby static capacity is secured, and separate connections from such plates or surfaces to dischargers, which form between them discharging-spaces in series, said dischargers being made of balls or other massive form as compared with the plates or extended surfaces, so as not to be readily heated by the spark of the discharge.

4. In a lightning-arrester, a column or compound condenser built up of conducting bodies, such as metal disks, and interposed insulating material, in combination with discharging-surfaces set spirally or angularly with relation to the axis of the column.

5. In a lightning-arrester, a series of plates separated by insulating material or spaces and having a determinate static capacity, a set of dischargers connected individually to the plates, with intervening disruptive spaces of limited extent between such dischargers, such dischargers and disruptive spaces between them being mounted or arranged so as to have an extended free air-space around them, substantially as described.

Signed at Lynn, Massachusetts, this 15th day of March, 1890.

ELIHU THOMSON.

Witnesses:
JOHN W. GIBBONEY,
JOHN E. RANDALL.