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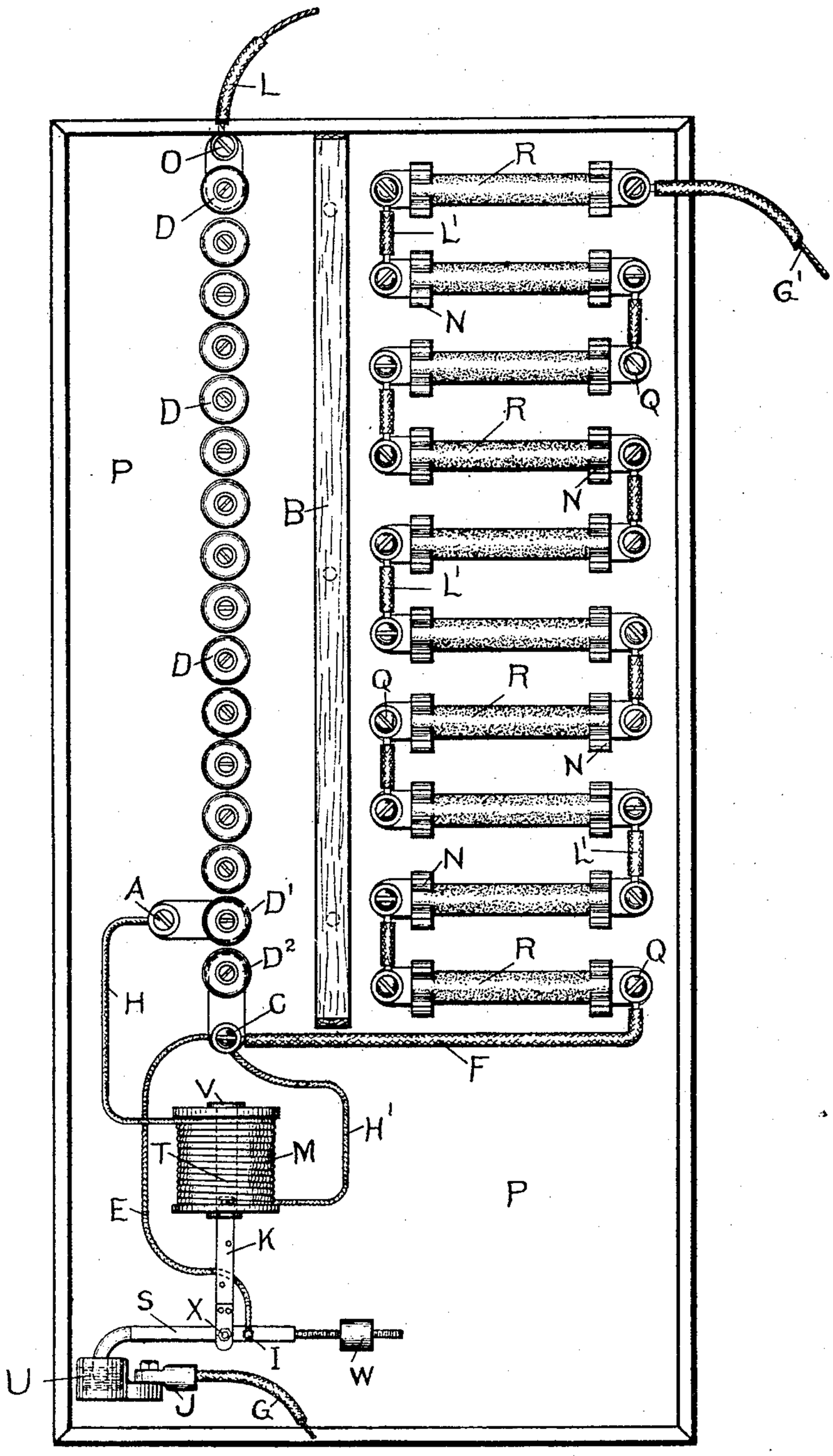
H. R. SARGENT.

LIGHTNING ARRESTER.

(Application filed Mar. 27, 1901.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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LIGHTNING-ARRESTER.

SPECIFICATION forming part of Letters Patent No. 717,285, dated December 30, 1902.

Application filed March 27, 1901. Serial No. 53,037. (No model.)

To all whom it may concern:

Be it known that I, HOWARD R. SARGENT, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Lightning-Arresters, (Case No. 1,741,) of which the following is a specification.

This invention is adapted to be applied to any desired electrical apparatus for the purpose of breaking arcs which may form between contacts.

The invention is particularly intended and designed for application to lightning-arresters, especially for those adapted to be employed in circuits of enormously high potential.

It is well known that lightning-arresters are intended to provide a path for a static discharge, such as lightning, in order to prevent injury by such discharge to machines or apparatus connected to the line. It is also well known that great difficulty is always found in lightning-arresters efficient for this purpose on account of the tendency of the line-current to follow the lightning discharge, continue to arc across the dischargers of the arrester, and thus maintain a short circuit to ground. This difficulty naturally increases in proportion to the potential of the line, and hence is very great on lines of, say, ten thousand volts or more, which lines arresters constructed in accordance with this invention are designed to protect. I have conceived the idea of automatically inserting resistance in series with the air-gaps as soon as a lightning discharge has passed, so that the line-current which tends to follow the discharge is blocked and cut down to such extent that the arcs between the dischargers are broken. Such an arrester has been found to work perfectly in practice and actually obviates the difficulties hitherto encountered. A path of low resistance is normally provided for a lightning discharge; but as soon as such discharge has passed to earth the automatically-inserted resistance prevents the line-current from following through to ground.

The drawing is a face view of a lightning-arrester which has been constructed and found to operate satisfactorily in practice.

The parts are mounted upon an insulating-panel P, which may be secured to a suitable support in any desired manner. A number of solid metallic cylinders D are mounted on the panel by means of screws, as shown, and the line connection is made at L with the binding-post O, which is connected with the topmost discharger D. An insulating-barrier B, suitably mounted on the panel P, separates the dischargers from a number of graphite resistance-rods R, which are mounted in suitable spring-clips N. These clips are secured to the panel by screws Q, which also serve as binding-posts for the connecting-wires L'. From the topmost resistance-rod extends a grounded connection G'. These resistance-rods are preferably of graphite, as stated, but may be of any suitable material and of any desired shape. To the lowest metallic discharger D^2 is connected a binding-post C, and from this extends a connection F to the binding-post Q of the lowest resistance-rod R. At the bottom of the panel is pivoted at I a switch-piece S, provided with an adjustable balance-weight W. The left-hand end of the switch S is adapted to normally dip into a mercury-cup U, provided with a connection-piece J, in which is secured a ground-lead G. A connection E extends from the binding-post C of the lowest discharger D^2 to the pivot-piece I of the switch S, which pivot serves as a binding-post for the connection. By means of this connection a path of low resistance is provided for lightning through the dischargers and across the short air-gaps between them by way of the switch and the mercury-cup to ground. A binding-post A is connected to the discharger D', and between this binding-post A and the binding-post C or the discharger D^2 is connected the magnet-coil M by means of the leads H and H'. After a lightning discharge has passed to ground, as described, the air-gap between the dischargers D' and D^2 is sufficient to shunt a portion of the line-current which may be arcing across the gaps through the coil M, and in such case the magnet will draw up its core K, which is attached to the switch S at X, so that the ground-circuit will be broken at the mercury-cup. The core K is carried by a non-magnetic portion T, provided

with a keeper V, and the core has a comparatively short movement, so that the switch will not be opened more than about a couple of inches. It is only necessary that the switch open sufficiently far so that the resistance of the gap between the end of the switch and the mercury-cup will be greater than that through the resistance-rods R. As soon as the circuit at the switch is completely broken the line-current tending to flow through the dischargers across the air-gaps is obliged to pass through the resistance R to ground. This resistance blocks the line-current and so cuts it down that the arcs across the air-gaps are extinguished, the magnet M is de-energized, and the switch drops to its normal engagement in contact with the mercury in the cup U.

It has long been known in this art that a resistance could be advantageously employed in series with the air-gaps for the purpose of cutting down the line-current tending to follow a lightning discharge. It has also been suggested to employ an electromagnet for automatically breaking the ground-circuit or increasing the distance between the dischargers. In the case of the resistance the latter was permanently in series with the air-gaps and formed a serious barrier to the passage of the lightning discharge. In the case of the switch in the ground connection there was great difficulty with arcing at the switch-contacts, and it was necessary to provide a switch having a very great range of movement for the purpose of completely breaking the circuit. Furthermore, when the ground-circuit has such a long break in it a secondary discharge of lightning was liable to take place, which would destroy the insulation of apparatus on the line in preference to jumping such a wide gap.

As described above, I have conceived the idea of inserting a finite resistance in shunt to the switch and have found that this resistance may be so small that the line-current tending to follow the lightning discharge will pass through it to ground in preference to the short air-gap at the switch, and at the same time the resistance may be sufficiently large to block the line-current and break the arcs between the dischargers. Furthermore, as this resistance is not normally in series with the air-gaps, it forms no obstruction to a lightning discharge. I have found, further, that this resistance may be large enough to block the line-current and at the same time be substantially small enough to permit a secondary lightning discharge to pass through it to ground at a time when the switch S is opened. There is this important advantage over the arrester wherein the ground-circuit was entirely broken by an electromagnet, that in this case means is always provided for the safe conduction of a lightning discharge to ground. As the break at the switch is not great, there may be occasions where the lightning will prefer to jump this break; but in any case the switch and the resistance can be so designed that the better path of the two for a lightning discharge is a better path than any other on the line.

Very many variations can be made in the construction and electrical connections of lightning-arresters or other apparatus embodying my invention without going beyond the limits of the invention, which comprehends, broadly, the idea of automatically inserting a definite resistance in series between contacts at which an arc may be formed in order to break the arc. As, for example, in the case of the lightning-arrester itself the coil of the magnet M may be connected in series with the air-gaps, and it has been found that an arrester so constructed operates satisfactorily. However, a series coil serves as a reactance in the lightning-circuit and as such is objectionable, and therefore the coil is preferably connected in shunt to a resistance in the circuit of the dischargers or contacts. This resistance in the case shown in the drawing is the air-gap between the dischargers D' and D^2, and it may be that this single gap may not be found sufficient, and in such case the number of air-gaps shunted by the coil would of course be increased. It should be noted that the coil M is connected around the lower dischargers and is separated from the line by a large number of air-gaps. This is in order that considerable resistance may be inserted between the line and the magnet, so that the latter will not normally be energized to raise the switch S out of the mercury-cup. There are many other ways well known to those skilled in the art by which the resistance may be cut in series with the contacts.

Enough has been said to indicate that I consider myself the first to conceive the idea of automatically inserting a definite resistance in series with contacts between which an arc may be formed in order to break the arc and that I am the first to conceive the idea of applying this conception to a lightning-arrester for high-potential circuits. It has also been shown how the invention may be applied in practice and that the invention has been already demonstrated to have great practical value.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A device for breaking electric arcs, which comprises contacts between which an arc may be formed, in combination with a definite resistance, and means which automatically cuts the resistance in series with the arc.

2. A device for breaking electric arcs, which comprises contacts between which an arc may be formed, in combination with a definite resistance, and an electromagnet energized by the current of the circuit closed by the arc, which magnet cuts the resistance in series with the arc.

3. A device for breaking electric arcs, which

comprises contacts between which an arc may be formed, in combination with a definite resistance, and an electromagnet connected in shunt to the circuit closed by the arc, which magnet cuts the resistance in series with the arc.

4. A device for breaking electric arcs, which comprises contacts between which an arc may be formed, in combination with a definite resistance, and an electromagnet in shunt to the circuit closed by the arc, which magnet is adapted to receive sufficient current to cut the resistance in series with the contacts when an arc is formed between them.

5. A device for breaking electric arcs, which comprises contacts between which an arc may be formed, in combination with a definite normally inoperative resistance, and an electromagnet which places said resistance operatively in series with the arc.

6. A device for breaking electric arcs, comprising contacts between which an arc may be formed, in combination with a normally short-circuited resistance in series with said contacts, and an electromagnet which opens the short circuit to such extent that the resistance in the air-gap therein is greater than in said resistance.

7. In a lightning-arrester, the combination with dischargers connected between line and ground and including an air-gap between them, of a definite resistance, and means which automatically cuts the resistance in series with the air-gap.

8. In a lightning-arrester, the combination with dischargers connected between line and ground and including air-gaps between them, of a definite resistance, and an electromagnet energized by the current which flows across the gaps, which magnet cuts the resistance in series with said gaps.

9. In a lightning-arrester, the combination with dischargers connected between line and ground and including air-gaps between them, of an ohmic resistance of non-gaseous material, and an electromagnet in shunt to a portion of the grounded discharge-circuit, which magnet is energized by current flowing from said circuit to cut the resistance in series with the air-gaps.

10. In a lightning-arrester, the combination with dischargers connected between line and ground and including air-gaps between them, of a definite resistance, and an electromagnet in shunt to a sufficient number of the air-gaps to receive sufficient current to enable it to cut said resistance in series with said gaps.

11. In a lightning-arrester, the combination with dischargers connected between line and ground and including air-gaps between them, of a normally short-circuited resistance in series with the air-gaps, and an electromagnet which opens the short circuit around said resistance.

12. In a lightning-arrester, the combination with dischargers connected between line and ground and including air-gaps between them, of a normally short-circuited resistance in series with said air-gaps, and an electromagnet which opens the short circuit to such extent that the resistance of the air-gap therein is greater than said resistance.

13. In a lightning-arrester, the combination with dischargers connected between line and ground and including air-gaps between them, of a switch in the ground connection, a resistance in shunt to the switch, and an electromagnet which is energized by current flowing through the dischargers to open the switch.

14. In a lightning-arrester, the combination with dischargers connected between line and ground and including air-gaps between them, and a switch having a short range of movement in the ground connection, a definite resistance in shunt to the switch, and an electromagnet energized by current flowing through the dischargers to open the switch, said resistance being small enough to form a path for the current so that the circuit at the switch will be broken by the short movement of the switch, and said resistance being large enough to reduce the current flowing through the dischargers to stop the arcing between the latter.

15. In a lightning-arrester, the combination with dischargers connected between line and ground and including air-gaps between them, of a switch in the ground connection, a resistance in shunt to the switch, and an electromagnet for the switch having a sufficient number of said air-gaps in series between itself and the line to prevent its being normally energized by the line-current, and connected in shunt to a sufficient number of said air-gaps to take current when the line-current follows a lightning discharge.

16. In a lightning-arrester, the combination with dischargers connected between line and ground and including air-gaps between them, of a resistance in the ground connection, a switch in shunt to the resistance, and an electromagnet for opening the switch; the break at the switch, and the resistance, each being of such nature that a secondary lightning discharge will pass across one or through the other in preference to the line insulation.

In witness whereof I have hereunto set my hand this 25th day of March, 1901.

HOWARD R. SARGENT.

Witnesses:
BENJAMIN B. HULL,
FRED RUSS.