J. T. GREENE.

LIGHTNING ARRESTER.

APPLICATION FILED AUG. 5, 1913.

1,155,415.

Patented Oct. 5, 1915.

2 SHEETS—SHEET 1.

Fig. 1.

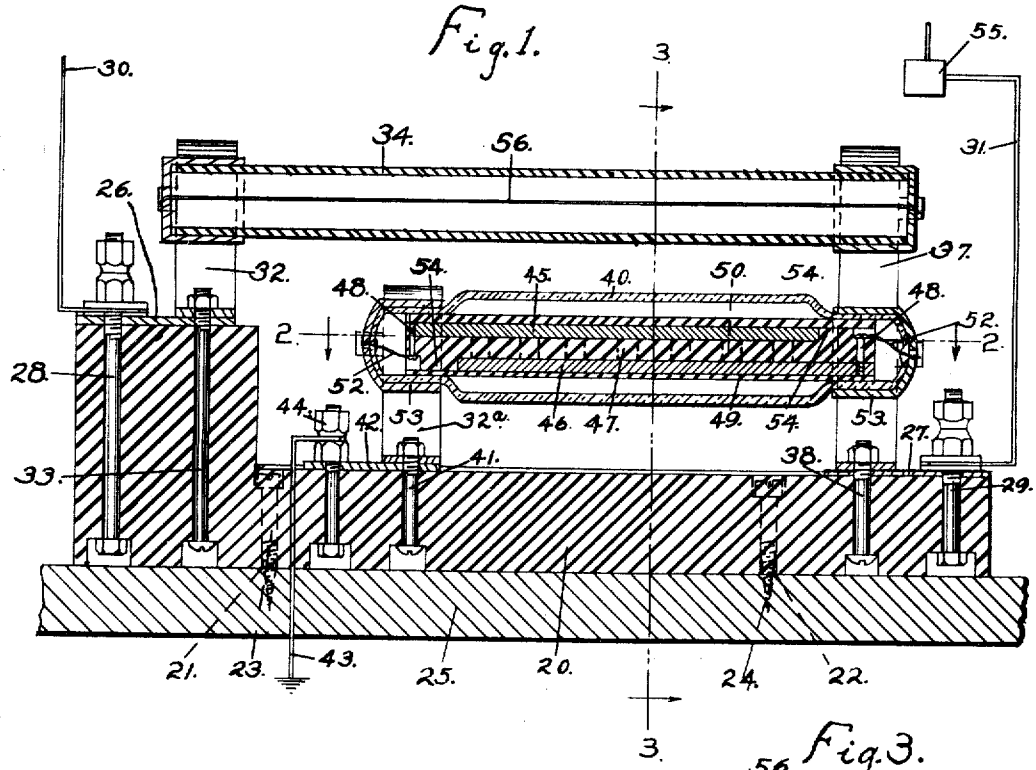


Fig. 2.

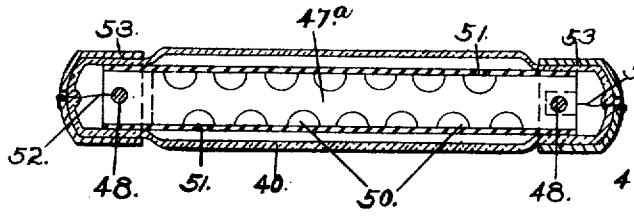
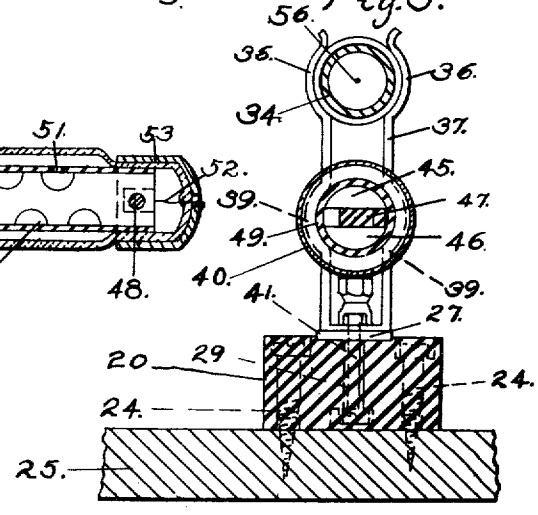


Fig. 3.



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2 SHEETS—SHEET 2.

Fig 5.

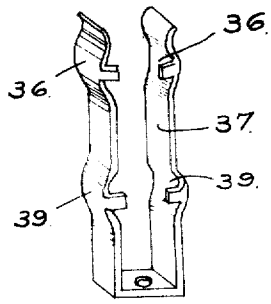


Fig 4.

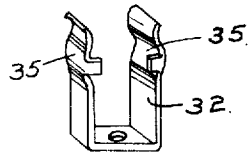


Fig 6

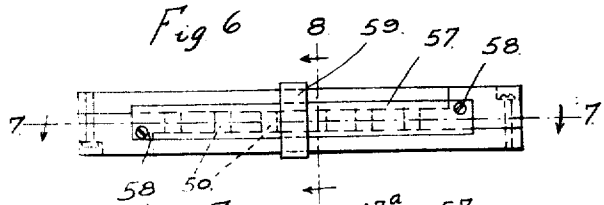


Fig 8.

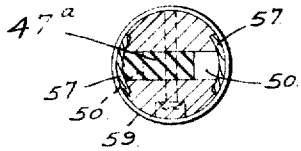


Fig 7.

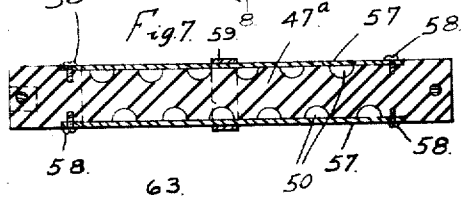


Fig 9

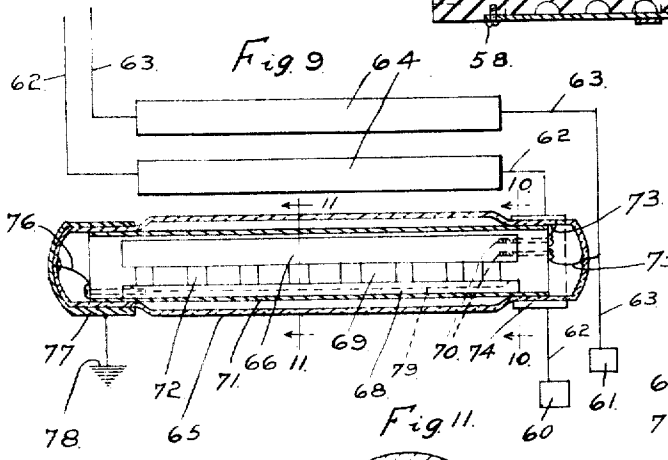


Fig 10.

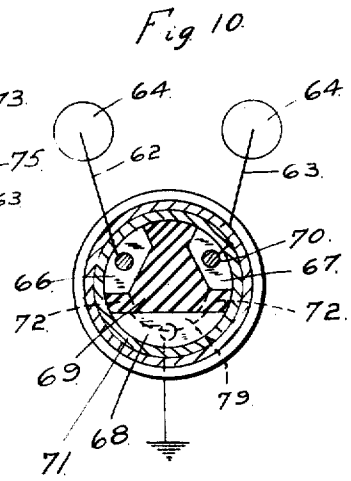
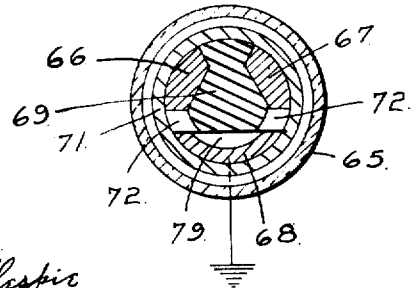


Fig 11.



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LIGHTNING-ARRESTER.

1,155,415. Specification of Letters Patent. Patented Oct. 5, 1915.

Application filed August 5, 1913. Serial No. 783,009.

To all whom it may concern:

Be it known that I, JOHN T. GREENE, a citizen of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Lightning-Arresters, of which the following is a specification.

My invention relates to apparatus for protecting electrically operated instruments or devices from the destructive effects of abnormal currents or impulses due to lightning discharges, crosses with lines carrying higher potential, and other like causes.

The primary object of the invention is to provide an apparatus of this sort which will be relatively inexpensive to manufacture, reliable and certain in its operation, compact in structure and of a size and character to fit into existing installations, and which will be of a rugged construction so that it may be shipped to distant points without danger of disturbing or breaking the parts and so that it will be capable of withstanding the high temperatures and stresses resulting from the electric discharges across the spark gaps.

The invention has for a further object an apparatus comprising a device which provides a discharge gap or gaps serving to free the line, with which it is employed, of abnormally high potential currents or impulses of short duration, such, for example, as those due to lightning discharges, combined with means whereby, in the case of a continued current of a pressure greater than that which the line is intended to carry (resulting, for example, from a cross with some high potential circuits) the aforementioned device, or lightning arrester proper, is protected from injury or destruction and a permanent grounding of the current therethrough prevented.

A further object is to provide a lightning arrester of the vacuum type in which the discharge is distributed over a considerable portion of the space within the evacuated tube or vessel that contains the electrodes so as to avoid the injurious and destructive effects of a discharge concentrated at one point.

A further object is to provide in a vacuum lightning arrester means whereby a casual inspection when the device is subjected to a testing discharge will reveal the state of the vacuum and will therefore show whether or not the device is in working condition.

While the arrangements herein shown and described might be used in any situation whether an electrically operated instrument is to be protected from abnormal currents, the apparatus is particularly applicable, in design and construction, for use in connection with railway signaling apparatus, one of the objects of the invention being to provide a vacuum lightning arrester which will meet the conditions of this service, and which will, in particular, withstand the constant vibration to which a lightning arrester used in this connection is subjected.

The invention has for further objects such other new and improved constructions, arrangements and devices in lightning arresters, and particularly in vacuum lightning arresters, as will be hereinafter described and claimed.

The invention is illustrated, in certain preferred embodiments, in the accompanying drawings wherein—

Figure 1 is a longitudinal sectional view of the apparatus. Fig. 2, a sectional plan taken on line 2—2 of Fig. 1; Fig. 3, a vertical sectional view on line 3—3 of Fig. 1; Figs. 4 and 5, views, in perspective, of the spring terminal clips used to support the arrester and fuse; Fig. 6, a detail view illustrating a modified arrangement of the electrodes; Fig. 7, a section taken on line 7—7 of Fig. 6; Fig. 8, a sectional view on line 8—8 of Fig. 6; Fig. 9, a view partly diagrammatic and partly in section illustrating a modified construction whereby a single device can be used for protecting two lines, and Figs. 10 and 11 are sectional views taken on lines 10—10 and 11—11, respectively, of Fig. 9.

Like characters of reference designate like parts in the several figures of the drawings.

Referring first to Figs. 1 to 5 inclusive, 20 designates a base, preferably of porcelain, on which the apparatus is mounted. The base is formed with perforations 21, 22 for the screws 23, 24 by means of which it may be secured to the switch board signal box or other support, designated 25. On opposite ends of the base 20 are metal plates 26, 27, with which the binding posts 28, 29 are respectively in contact. The line running to the instrument to be protected is interrupted

and the ends thereof 30, 31, connected with the binding posts 28, 29, respectively. 32 designates a spring terminal clip (Fig. 4) which is secured by means of screw 33 to the base 20 in contact with the plate 26. One end of a fuse 34 of any ordinary and suitable construction is supported between the curved portions 35 of the clip 32. The other end of the fuse is supported between the curved portions 36 of a terminal clip 37 (Fig. 5) secured to the plate 27 and base 20 by the screw 38. The clip 37 is formed below the curved portions 36 with similar bends 39 designed to receive one end of a tubular evacuated glass container 40, the other end of which is supported by a clip 32^a similar to the clip 32 previously mentioned. This clip is secured by a screw 41 to the base 20 in contact with a plate 42. A grounded line 43 is connected with the binding post 44 on the plate 42. The clip 32^a is electrically connected with the ground by a line designated 43.

Within the tubular container 40 are arranged two electrodes 45, 46, preferably made of carbon, extending lengthwise of the tube and spaced apart by a spacing element 47 made of some non-conducting refractory material such, for example, as porcelain. The electrodes are secured to the spacer by any suitable means, for example, by the screws 48 and, in the construction shown in Figs. 1, 2 and 3, the electrodes and spacer are contained in a tubular member 49 preferably made of fiber or other tough material, although this element might be made of mica or any other convenient and suitable material. The tube 49 serves to hold the carbons and spacer together, these parts forming a unitary structure which can be fitted closely into the inclosing tube 40. The spacer is formed with openings therethrough at intervals so as to provide a number of discharge gaps between the electrodes. For example, grooves or notches 50 may be formed in opposite sides of the spacer. The purpose of multiplying the discharge gaps is to produce a division and distribution of the discharge from end to end of the tube so that its effects will not be concentrated at one point. The discharge taking place in a vacuum lightning arrester produces a considerable amount of heat and also gives rise to stresses, the exact character of and cause of which I have not been able to ascertain with accuracy, but which, it is certain, tend to break the glass container particularly if softened by heat. These effects are obviously enhanced if concentrated at one point and particularly, in the case of an arrester supported at opposite ends, if the discharge takes place at the middle of the tube. As a matter of fact, lightning arresters of the cartridge type in which there are two oppositely disposed electrodes, one at each end of the tube, are very likely to fail, as experience has amply demonstrated, by breaking in the middle. The arrangement herein shown and described obviates this danger. The tubular member 49 also serves to protect the container 40 from the effect of the discharges through the gaps 50. If the tubular member 49 is made of opaque material it may be pierced opposite certain of the openings 50 with peek holes 51 in order that the operation of the device may be observed and the condition of the vacuum determined. Anyone familiar with apparatus of this sort can readily tell by the appearance of the medium during a discharge whether the vacuum is as high as it should be. Leading-in wires 52 are sealed through opposite ends of the container 40 and connected with the exterior metal caps 53 and with the screws 48. Preferably the spacer 47 is formed at opposite ends with projections 54 which intervene, in each case, between the end of one of the electrodes and the connections of the other electrodes; this arrangement serving to protect these connections against the effects of the discharges from one electrode to the other and also obviating the danger of the discharge jumping from one electrode to the connections of the other, short circuiting the discharge gaps.

Assuming that the line 31 is connected with the instrument to be protected, shown diagrammatically in Fig. 1 and designated 55, any discharge to ground through the arrester will first pass through the fusible element 56 of the fuse 34. Therefore should the line 30 be crossed with some high potential line such as a transmission line or trolley wire, or if the amperage of the current should be increased by, for example, a decrease of the resistance in the circuit, or for any other cause, the consequent blowing out of the fuse will cut out the arrester so that it will not be injured or a permanent ground established therethrough as would be likely to happen if the device were subjected for any considerable length of time to a current of large amperage and of sufficient voltage to discharge across the gaps.

A modification of the interior arrangements of the lightning arrester is shown in Figs. 6 to 8 inclusive. The electrodes and spacer are substantially the same as in the other figures but instead of being inclosed in a tubular member such as the member 49, the openings 50 in the spacer providing the discharge gaps are covered with strips 57 of mica or other translucent material which are preferably set into recesses in the side faces of the spacer, designated 47^a in these figures, and are secured thereto by the screws 58. One or more bands 59 may be employed for binding the mica strips against the spacer and to assist in holding the electrodes in position.

In Figs. 9 to 11 inclusive, I have shown an apparatus in which the arrester is provided with two electrodes, each connected with a line wire, and a third electrode which is grounded. Referring to these figures, 60, 61 designate two instruments to be protected by the apparatus, and 62, 63, the aerials leading to these instruments respectively. Fuses 64 are interposed in these lines. The lightning arrester consists of an evacuated tube 65 containing two electrodes 66, 67 connected respectively with the lines 62, 63, and a third electrode 68 which is grounded, the electrodes being spaced apart by a porcelain spacer 69 to which the electrodes are secured by screws 70 and by the non-conducting, refractory cylindrical member 71. The edges of the spacer 69 intervening between electrodes 66, 67 and the electrode 68, are formed with notches 72 to provide discharge gaps. In the drawings the electrode 66 has a leading-in wire 73 connected to a ring 74 on the outside of the tube 65 which is connected with the line 62 between its fuse and the instrument 60. The electrode 67 has a leading-in wire 75 connected to the line 63 between its fuse and the instrument 61. The electrode 68 has a wire 76 sealed through the other end of the tube and connected with a cap piece 77 with which the grounded wire 78 is in contact. The electrode 68 is preferably formed with grooves 79 in alinement with the oppositely arranged spark gaps 72 so that the discharge from one of the line electrodes to the grounded electrode tends to produce the ionization of the gaps between the other line electrode and the grounded electrode which will assist in discharging any excessive potential on the line connected with the second mentioned line electrode. This may be of some importance as it is always possible that where one of the adjacent lines receives a heavy static charge the other line will receive a lesser charge which, while insufficient to find a ground through the lightning arrester will be strong enough to injure the apparatus with which the line in question is connected.

While my invention has been described in certain preferred embodiments, it will be understood that modifications might be made without departure from the invention.

I claim:

1. In a vacuum lightning arrester, the combination with an evacuated transparent container, of electrodes arranged therein, and a spacer of refractory, non-conducting material between said electrodes formed with grooves which provide discharge gaps between the electrodes visible through said container.

2. In a vacuum lightning arrester, the combination with an evacuated container, of electrodes arranged in parallel relation in said container, a spacer between said electrodes, and leading-in wires sealed through opposite ends of said container and connected with said electrodes respectively, said spacer provided at opposite ends with projections which intervene, in each case, between the end of one of the electrodes and the connection between the leading-in wire and the other electrode.

3. In a vacuum lightning arrester, the combination with an evacuated tubular glass container, of electrodes arranged longitudinally within said container, a spacer between said electrodes, and a tubular member surrounding said spacer and electrodes so as to hold them together, which is fitted into the ends of said container.

4. In a vacuum lightning arrester, the combination with an evacuated tubular glass container, of a pair of parallel electrodes therein, a porcelain spacer between said electrodes formed with grooves on opposite edges, screws for securing the electrodes to opposite ends of said spacer, the spacer being formed at opposite ends with projections intervening, in each case, between the screw securing one electrode to the spacer and the end of the other electrode, leading-in wires sealed through opposite ends of the container and connected with said screws respectively, and a tubular element surrounding said electrodes and spacers.

5. In a vacuum lightning arrester, the combination with an evacuated tubular glass container, of electrodes arranged longitudinally within said container, a spacer between said electrodes to which the electrodes are secured; the structure comprising said electrodes and spacer being supported at opposite ends in said container with the intermediate portion out of contact with the wall of said container, said spacer formed with grooves which provide gaps between said electrodes and protecting means intervening between said grooving and the wall of the container.

6. In a vacuum lightning arrester, the combination with an evacuated glass tube the ends of which are of smaller diameter than the middle portion, of a pair of electrodes arranged longitudinally in said tube, and a spacer to which the electrodes are secured and providing discharge gaps between the same; the structure comprising the electrodes and spacer being fitted into the ends of the tubular container.

7. In a vacuum lightning arrester, the combination with an evacuated tubular glass container, the ends of which are of smaller diameter than the middle portion, of electrodes longitudinally arranged in said container, a spacer between said electrodes formed with grooves on its edges and a tubular element into which said electrodes and

spacer are fitted; the structure comprising said tubular element, electrodes and spacer being fitted at opposite ends into the ends of said glass container.

8. In a lightning arrester, the combination with an evacuated tubular glass container and a pair of spaced supports adapted to engage the ends thereof, of electrodes arranged longitudinally within said container, and a rigid apertured spacer extending from end to end of said container and between said electrodes so as to provide a transverse support for said container, the intermediate portion of said container structure being out of contact with the walls of said container to provide a diffusion chamber.

9. A lightning arrester comprising the combination with an evacuated tubular container, of a plurality of electrodes therein arranged longitudinally thereof and in parallel relation to each other, and a spacer of non-conducting refractory material arranged between said electrodes, and to which the electrodes are secured, said spacer being provided with a plurality of discharge openings which distribute the discharge lengthwise of the container, the opposite ends of said contained structure being fitted within and supported by the tubular wall by said container, said contained structure being out of contact with the portion of said tube intermediate its ends and opposite the discharge openings in the spacer.

JOHN T. GREENE.

Witnesses:
FLORENCE M. SHEEHAN,
P. A. CHAPMAN.

Corrections in Letters Patent No. 1,155,415.

It is hereby certified that in Letters Patent No. 1,155,415, granted October 5, 1915, upon the application of John T. Greene, of Toledo, Ohio, for an improvement in "Lightning-Arresters," errors appear in the printed specification requiring correction as follows: Page 4, line 14, claim 8, for the word "container" read *contained;* same page, line 30, claim 9, for the word "by," second occurrence, read *of;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of November, A. D., 1915.

[SEAL.]

R. F. WHITEHEAD,

Acting Commissioner of Patents.