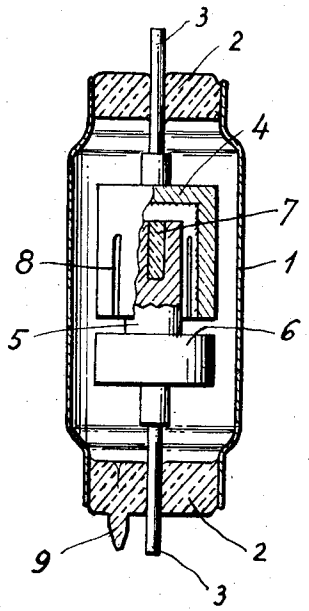
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LIGHTNING ARRESTER

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LIGHTNING ARRESTER

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This invention relates to lightning arresters and more particularly to lightning arresters adapted for use on telephone lines or in connection with telephone equipment. For this use, it is dsirable for the lightning arrester to be small in size, to sparkover as soon as possible after there is an increase in potential resulting from a lightning stroke, to prevent a large buildup of potential across the telephone equipment, and to have long life notwithstanding repeated sparkovers thereof. In the prior art there have been repeated efforts to achieve the aforesaid results, and one form of lightning arrester that has achieved substantial success is the gas filled type of device. However, the prior types of gas filled lightning arresters have not fully satisfied the hereinabove stated requirements.

It is a primary object of this invention to provide a gas filled lightning arrester, especially adapted for use in conjunction with telephone equipment, which more nearly satisfies the above-stated requirements than has heretofore been possible.

Another object of the invention is to provide a lightning arrester in which the initial sparkover occurs sooner than has heretofore been achieved.

Still another object of the invention is to provide a lightning arrester, especially adapted for use in conjunction with telephone equipment, which will stand repeated sparkovers without injury thereto.

An additional object of the invention is to provide a lightning arrester with improved thermal properties, whereby the heat generated in the lighting arrester is quickly dissipated without injuring any of the component parts of the arrester.

Another object of the invention is to provide a lightning arrester, especially adapted for use in conjunction with telephone equipment, with an improved mechanical arrangement of the parts.

Still another object of the invention is to provide a lightning arrester, especially adapted for use in conjunction with telephone equipment, with improved electrical characteristics.

It is an additional object of the invention to provide a method of making the aforesaid lightning arrester.

In carrying out the aforesaid objects, there is provided a gas filled glass envelope containing two electrodes. One of the electrodes is in the form of a hollow cylinder while the other electrode, also of cylindrical shape, is positioned inside of and concentric with the first-named cylinder. It is desirable that the spacing between the two cylinders be very small and also that it be uniform. In order to meet this requirement, a circular plate having the same outer dimensions as the outer diameter of the first named cylinder, is positioned on the second-named cylinder and spaced a short distance from the first-named cylinder. It is therefore possible to align the two cylinders very accurately by moving one of them while observing the relationship of the first-named cylinder to said circular plate. The second-named cylinder has a cup therein filled with metallic aluminum. After the

envelope has been evacuated but before being filled with gas, the metallic aluminum is vaporized by induction heating to deposit a thin film of aluminum upon the facing surfaces of the two cylindrical electrodes. This promotes rapid sparkover following each lightning stroke. Other metals or substances may be used in place of aluminum, for example, magnesium. Other features of the invention will appear in the following detailed description.

The drawing is a cross-sectional view of one form of the invention.

Referring to the drawing, a glass envelope **1** is closed at both ends **2** thereof with sintered hard glass parts. Located in these end parts **2** are two rigid conductors **3** which are firmly supported and held in place by the end parts **2**. The upper conductor **3** carries a cylindrical cup shaped electrode **4** and the lower conductor **3** carries a cylindrical electrode **5** in the form of a rod. The electrode **5** carries an enlarged circular part **6** of the same diameter as the diameter of the upper cylindrical member **4**, for reasons hereinafter stated in detail. The rod **5** has a cup shaped opening **7** filled with metallic aluminum for purposes elsewhere described in detail. The outer cylinder **4** has slits **8** for the purpose of improving the bipolar effects of the lightning arrester. The cylindrical elements **4**, **5** and **6** are composed of metals whose melting point is considerably higher than aluminum. For example, iron, nickel, etc. may be used for these members. The pump stem **9** projects from one end part **2**.

It is desirable, for reasons hereinafter mentioned, for the space between the outer surface of electrode **5** and the inner surface of the cylindrical portion of electrode **4** to be substantially uniform as well as of a very small dimension. For example, the sparkover space is preferably about 0.2 to 0.4 millimeter. In assembling the device it would be difficult to achieve this small spacing, especially achieving uniformity of the spacing at the same time, unless special arrangements were made. Consequently, a large circular base **6** is located on the rod **5**. Circular member **6** has precisely the same outer dimensions as the outer dimensions of cylindrical member **4**. Therefore the spacing between the outer cylindrical surface of rod **5** and the inner cylindrical surface of electrode **4** may be adjusted by heating one of the end parts **2** to a molten state and moving one of the conductors **3** until the circular member **6** appears to be precisely in alignment with the cylindrical member **4**. When the outer surfaces of members **4** and **6** appear to be in perfect alignment it is known that the rod **5** is perfectly centered within the cylindrical member **4**. After this centering operation, the envelope may be evactuated through the pump stem **9**. While the envelope is evacuated, the coil of a high frequency induction heating apparatus may be placed around the envelope **1** so as to induce strong eddy currents in the metallic aluminum **7**, thereby vaporizing the same. It is also possible to vaporize the aluminum after the tube has been filled with gas. The vaporized aluminum condenses on the inner surface of cyclindrical member **4** as well as on the outer surface of rod **5**. The aluminum coating thus produced may be either continuous or somewhat discontinuous. In the latter event it would mean that there would be exposed portions of the base metal forming the electrodes **4** and **5**. Since the melting points of electrodes **4** and **5** are considerably higher than that of the metallic aluminum **7**, the induction heating does not melt the electrodes **4** and **5**. Following vaporizing of the aluminum, the induction heating coil is removed, and a suitable gas is allowed to enter through the pump stem **9**. This gas may be of any well known type which causes the sparkover between electrodes **4** and **5** to occur more rapidly than would otherwise be possible. Neon and argon have

long been known to be suitable gases for this purpose and may be used separately or a mixture of them can be used. In the case of argon the pressure of the gas in the envelope 1 should be higher than is customary in gas filled lightning arresters. The customary pressure is 60 millimeters of mercury, whereas with the present arrangement it is posible to greatly increase the pressure to values between 100 and 300 millimeters of mercury. The preferred dimensions for the device as a whole are as follows. The axial length of the glass cylinder 1 may be 25 millimeters. The diameter of rod 5 may be 8 millimeters. If argon is used, the gas pressure may be 200 millimeters of mercury and the distance between the electrodes 4 and 5 may be 0.25 millimeter. A lightning arrester built according to these specifications will withstand several hundred discharges, each of which has 200 watt seconds of energy, without showing any substantial damage.

It has been found that the thin aluminum coating on the electrodes greatly reduces the delay period between the actual surge (due to the lightning stroke) and the initial sparkover. Moreover, the aforesaid coating promotes the transition to an arc discharge. As a result, the potential built up across the telephone equipment, due to a given lightning surge, is less than in the case of prior lightning arresters.

The lead-in conductors 3 should preferably be made of non-magnetostriction material. Examples of such materials are tungsten and molybdenum. The hard glass end parts 2 rigidly support the conductors 3 and hold them in accurate alignment. Moreover, the end parts 2 absorb heat generated by the lightning arrester. The enlarged part 6 also functions to absorb heat.

It is also possible to place a radioactive substance in the discharge space in order to promote discharge, all as is well known in the art.

The axial slits 8 in the hollow cylinder 4 improve the bipolar ignition properties of the device, that is it makes the device act in substantially the same way irrespective of which electrode is positive with respect to the other. It is also possible to place axial slits in the rod 5 for the purpose of improving the bipolar properties of the device.

I claim to have invented:

1. A lightning arrester comprising a transparent envelope, a hollow cylindrical electrode in the envelope, a rigid inlet wire supporting said electrode, a second cylindrical electrode located within and coaxial with the first one, a second rigid inlet wire supporting the second cylindrical electrode, both of said wires being held in fixed positions by the wall of the envelope, the envelope being composed of material which may be placed in a moulten state and when in that state will allow the two rigid wires to be moved with respect to each other whereby the cylindrical electrodes may be adjusted to be coaxial, and a circular element mounted on the second rigid wire in a position spaced from the first cylindrical electrode and having the same diameter as the first cylindrical electrode so that the two cylindrical electrodes may be adjusted until they are concentric by moving at least one of the rigid wires until the circular element appears to be coaxial with the first cylindrical electrode.

2. A lightning arrester comprising first and second adjacent electrodes, the facing surfaces of the electrodes having a thin coating thereon of a metal which improves the breakdown characteristics of the arrester, an inert gas filled envelope surrounding the foregoing parts, and leads from the electrodes extending through the envelope, said envelope being substantially entirely transparent.

3. A lightning arrester comprising an envelope containing primarily an inert gas, a hollow electrode, a first rigid conductor rigidly supported by the envelope and carrying said electrode, a second electrode extending inside the first one, a second rigid conductor rigidly supported by the envelope and carrying the second electrode, and means located on the second rigid conductor for indicating the relative positions of the facing surfaces of the two electrodes.

4. A lightning arrester comprising a cup-shaped hollow cylindrical electrode, a second cylindrical electrode inside the first one and spaced therefrom, conductors extending from said electrodes respectively for supporting them, the second electrode defining a cup that is positioned near the closed end of the hollow cylindrical electrode, metallic aluminum in said cup, the electrodes being composed of metal having a higher melting point than aluminum whereby the aluminum may be vaporized by an induction heating coil without melting the electrodes, and an envelope surrounding the foregoing parts.

5. A lightning arrester as defined by claim 4 in which the envelope is primarily filled with an inert gas which lowers the sparkover potential of the lightning arrester.

6. A lightning arrester comprising a hollow metallic electrode, a second metallic electrode located inside of the first one and spaced therefrom, the inside surface of the first electrode and the outside surface of the second one having a thin coating of a metal of a lower melting point than the metal of either of said electrodes, the metal of said coating being one that improves the sparkover characteristics of the arrester, and a transparent envelope surrounding all of the foregoing parts.

7. A lightning arrester as defined in claim 6 in which the coating on both electrodes is aluminum.

8. A lightning arrester comprising an envelope, a hollow cylindrical electrode in the envelope, a rigid inlet wire supporting said electrode, a second cylindrical electrode located within and spaced from the inside of the first electrode, a second rigid inlet wire carrying the second cylindrical element, the envelope holding both of said wires in fixed relationship, and a metallic element of sufficient size to absorb substantial heat mounted on the second rigid wire adjacent said electrodes to thereby reduce the heat rise of the second rigid element at its junction with the envelope.

9. A lightning arrester as defined in claim 8 in which said metallic element is circular and of substantially the same diameter as the diameter of the hollow cylindrical electrode and having greater spacing from that electrode than does the second electrode whereby the initial sparkover takes place between the hollow and the second electrodes.

10. A lightning arrester as defined in claim 8 having gas in the envelope and in which the metallic element is spaced farther from the hollow electrode than is the second electrode whereby initial spark-over occurs between the hollow and second electrodes, the metallic element being close enough to the hollow electrode that after the initial spark-over has so heated the gas in the space between said electrodes as to render the discharge more difficult it may then discharge from the hollow electrode to the metallic element, said envelope comprising transparent glass whereby heat radiated from any discharge between the hollow electrode and the metallic element may be dissipated by radiation through the glass.

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