Aug. 12, 1930. G. F. GRAY 1,772,664

LIGHTNING ARRESTER

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Fig. 1.

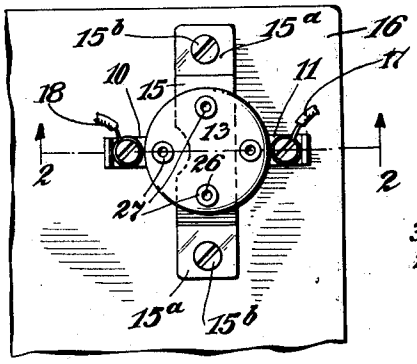


Fig. 2.

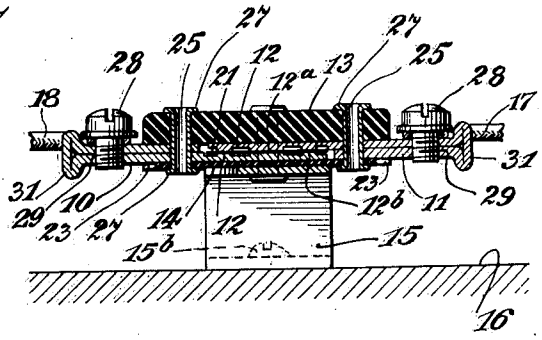


Fig. 3.

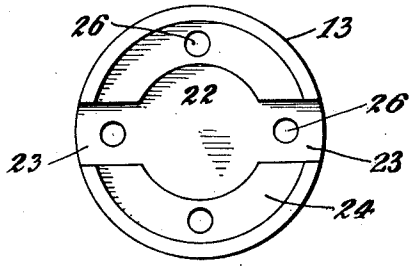


Fig. 6.

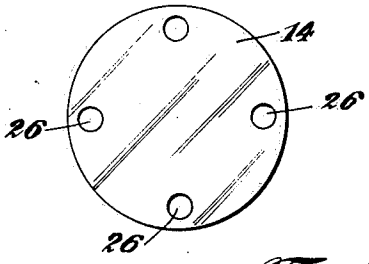


Fig. 4.

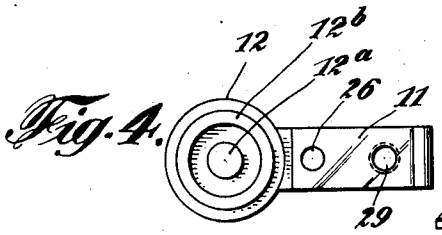


Fig. 7.

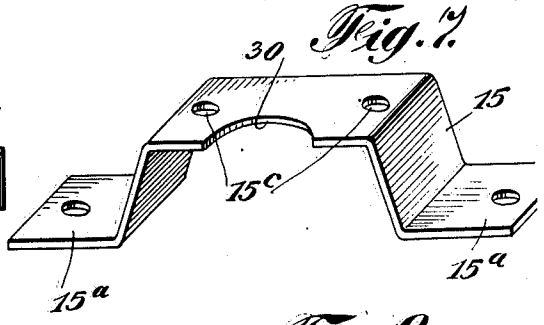


Fig. 5.

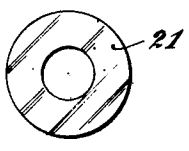
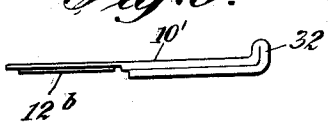


Fig. 8.



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Fig. 9.

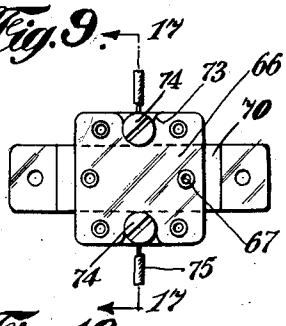


Fig. 10.



Fig. 11.

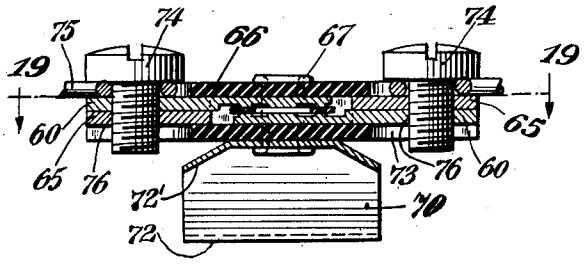


Fig. 12.

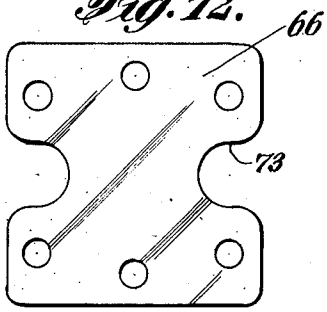


Fig. 13.

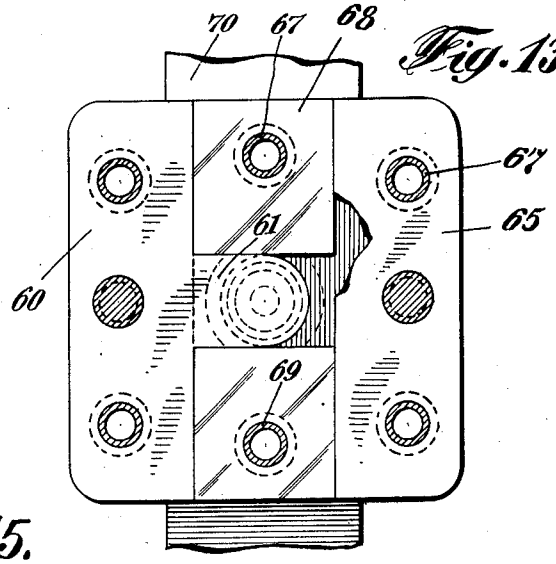


Fig. 14.

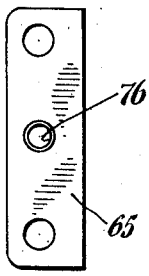


Fig. 15.

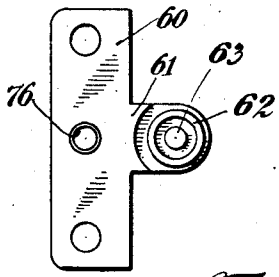


Fig. 16.

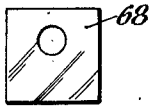
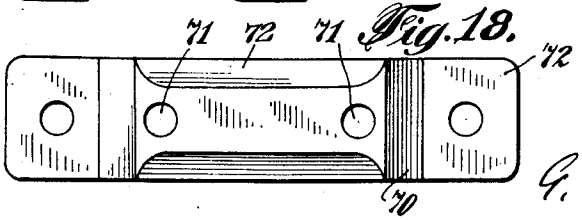


Fig. 17.



Fig. 18.



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UNITED STATES PATENT OFFICE

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LIGHTNING ARRESTER

Application filed June 4, 1924. Serial No. 717,691.

This invention relates more particularly to lightning arresters of the type presenting an air gap adapted to break down and pass current under relatively low voltages, as, for instance, charges induced by distant lightning. It is particularly adapted for use in connection with radio receiving systems between aerial and ground, in parallel with the radio translating apparatus.

One purpose of the invention is to produce a device of this type which is of extremely cheap, as well as simple, construction, yet answers all the requirements of the fire underwriters. The discharge gap, that is, the thickness of air dielectric between terminals, is very accurately predetermined. The device has discharge terminals or electrodes of ample area, separated by a mica washer against opposite faces of which the terminals are clamped. It is a simple matter to gauge the thickness of the mica washer and the accuracy of the terminal faces engaging the mica may be insured by embossing cooperating ring clamping surfaces for the washer, in combination with central bosses which form the discharge terminals or electrodes. The dies for stamping these may be made as accurately as desired, with the result that the electrode surfaces embossed thereby being perfectly accurate, all other dimensions of the electrodes and clamping elements become functionally unimportant and require only approximate accuracy.

Clamps for positioning and enclosing the electrodes are preferably of bakelite which may be molded to shape or may be built up as a laminated structure comprising sheet bakelite layers held together by eyelets, rivets or screws.

The device is a very small capacity condenser, making it well adapted for use in radio apparatus as above described.

In the accompanying drawings,

Fig. 1 is a top plan view of one form of the device showing it attached to a suitable support;

Fig. 2 is an enlarged transverse sectional view on the line 2—2 of Fig. 1;

Fig. 3 is a rear face view of the casing member;

Fig. 4 is a face view of one of the electrodes;

Fig. 5 is a face view of the mica washer;

Fig. 6 is a face view of the closure or cover member;

Fig. 7 is a perspective view of the supporting bridge piece or bracket support for the device;

Fig. 8 is an edge view of a slightly modified form of electrode;

Fig. 9 is a plan view of further modified type of lightning arrester;

Fig. 10 is an edge view thereof;

Fig. 11 is an enlarged view in transverse section on the line 17—17 of Fig. 9;

Fig. 12 is a face view of one of the insulating clamping plates;

Fig. 13 is a view in longitudinal section on the line 19—19 of Fig. 11;

Figs. 14 to 17 are face views of a metallic spacer, electrode, insulating spacer, and mica washer respectively;

Fig. 18 is a top plan view of the bridge piece.

In the type of lightning arrester shown in Figs. 1 to 7 inclusive, a pair of electrodes, 10, 11 are provided with overlapped terminal end portions 12 spaced apart to provide a dielectric in the form of an air gap between them. Preferably the terminal ends of the electrodes are accommodated in a suitable casing or housing of insulating material which may comprise a body portion 13 and a bottom cover 14. The other ends of the electrodes extend beyond the casing and carry securing means such as binding screws 28 for electrical conductors. When the device is used in connection with a radio receiving apparatus, the housing may be supported upon a bridge piece or bracket 15 secured to the panel board 16 of the apparatus or in any other appropriate position adjacent the set which it is designed to protect. This bracket may be of general U shape, having apertured feet 15^a secured to the panel by screws 15^b. Lead wires 17, 18, connect the discharge device to the aerial and to the ground respectively.

Preferably each electrode (Figs. 2 and 4) is stamped from sheet metal and comprises a body portion folded or bent on itself to

provide two overlying thicknesses as indicated in Fig. 2. The end of one layer projects well beyond the other and is formed as an electrode terminal end 12 of ample area and substantially circular shape. The terminal end 12 has a central circular projection, 12^a, constituting a discharge terminal and surrounded by a spaced annular clamping rib 12^b (Fig. 4). The two electrodes are assembled with their flattened and rounded terminal ends in superposed relationship, a mica washer or similar dielectric spacer 21 being clamped between the ribs 12^b while the space between the two central projections 12^a serves as a spark gap or primary dielectric. The principal purpose of folding or bending the stock from which the electrodes are formed into two thicknesses is to eliminate the necessity for using supplementary spacer members for insuring proper initial or approximate adjustment of the gap between the discharge terminals. The spacer elements also serve as closures for what would otherwise be openings from the electrode discharge chamber.

If the terminal faces of the electrodes be embossed by suitable dies to form the ribs 12^b and discharge terminals 12^a, it is merely necessary to gauge the thickness of the mica washer 21 and the absolute accuracy of the spacing of the discharge terminals will be assured. If the dies themselves are accurately made, the embossed electrode terminal surfaces will be perfectly aligned and mated and all other dimensions of the electrodes and their associated parts become functionally unimportant and require only a rough approximation such as the approximately correct initial spacing afforded by the folded over electrode ends.

As seen most clearly in Figs. 2, 3, and 6, the body 13 of the insulating housing for the coacting electrodes is of approximately circular shape, having a central circular depression 22 to accommodate the two superposed terminal ends of the electrodes and formed also with a pair of diametrically opposed grooves or recesses 23 communicating with the central depression 22 and receiving intermediate portions of the doubled over bodies of the electrodes. The body of the casing member or housing is also dished or recessed at 24 to accommodate the flat and relatively thin circular cover plate 14.

The means which I have shown for clamping the housing and its cover plate and for clamping the electrodes in proper place within the housing comprises tubular connecting sleeves or eyelets 25 extending through aligned openings 26 in the housing, electrode shanks and housing cover. The ends of these tubular connecting devices are riveted as indicated at 27 to tightly clamp the housing and its cover and to maintain the electrodes firmly clamped in the grooves 23. Two of the connecting sleeves 25 that do not pass through the electrodes may pass through holes 15^c in the intermediate portion of the U shaped bracket 15, to properly secure the entire unit to said bracket.

Any appropriate means might be utilized for connecting the aerial and ground leads 17, 18 to the respective electrodes. For purposes of illustration, I have shown the binding screws 28, threaded in suitable openings 29 near the outer ends of the body portion of the electrodes.

It will be noted that in this device as in those described below, the size of the mica washer and spacing of the parts is such that all other possible paths for the discharge are much longer than between electrodes 12^a.

The manner of operation of the device will be apparent. The superposed terminal faces of the electrodes act somewhat like a small capacity air condenser, the thin layer of air being between surfaces 12^a, 12^a being readily broken down and passing discharge currents under relatively low voltages. In order to insure against the discharge creeping from the rivets 25 to the bracket 15, I form this bracket with a cutout portion 30 at that edge which is adjacent the aerial electrode 10. Discharges from the electrodes 10 are thus compelled to jump the spark gap between the terminals 20 and pass through the electrodes 11. The connecting devices 25 which are in contact with the bracket are insulated from the cover by the housing 13, 14.

In Fig. 2 it will be noted that shanks of the electrodes are folded in a peculiar manner which provides T-shaped ends 31 integrally united to the electrodes. These flat ends may conveniently serve to confine the wire beneath the head of the binding screw. The T-shape affords an upwardly projecting end regardless of which side up the terminal is usd.

In Fig. 8 a slightly modified form of electrode 10′ is shown and in this instance the outer end 32 of the electrode is offset vertically in only one direction, and two sets of electrodes must be provided in order that their electrodes may face oppositely while their ends project in the same direction.

With the form of lightning arrester shown in Figs. 9 to 18 inclusive, I effect a considerable saving of the comparatively expensive insulating material by the use of metallic spacer members. The electrodes 60 are of general T shape. Overlapping legs 61 of the T's constitute the terminal ends of the electrodes, being shaped and flattened by suitable dies similarly to the electrodes disclosed in Figure 2 and Figure 4. Each terminal end includes an upstanding washer clamping rib 62, and concentric therewith a circular upstanding discharge terminal 63. Ribs 62 are adapted to clamp a mica washer 64 between them and approximate initial spacing of the

electrode discharge terminals is had by the interposition of metallic spacer members 65 between the cross bars of the T-shaped electrodes and the two relatively thin, flat clamping plates 66 of insulating material, which retain the electrodes in proper position. Rivets 67 or other suitable securing devices passed through the electrodes, spacers and plates 66 serve to securely clamp the electrodes between the plates with their terminal ends in properly spaced relationship, the exact width of the spark gap being predetermined by the gauge of the mica washer.

The present requirements of the fire underwriters is to the effect that the spark gap must be completely enclosed and to comply with these requirements, I employ additional spacer members 68 of insulating material at each side of the electrode terminals completely filling the spaces between the metallic spacers and the cross bars of the T shaped electrodes. In other words, the spacers 68 which are cut from sheets of insulating material are of a thickness equal to the combined thickness of the electrodes 60 and the spacers 65 and are firmly clamped between the plates 66 by rivets or other securing devices 67, 69. The securing devices 67, 69 may conveniently serve for the attachment of the lightning arrester unit to a U-shaped bracket or bridge piece 70 having apertures 71 in its intermediate portion for the reception of the securing devices and including apertured feet 72 to facilitate its attachment to a supporting panel board (not shown).

The intermediate portion of the bridge piece 70 is formed with angularly disposed edge portions 72′ so that the edges of the bridge piece are spaced well away from the other metallic parts of the lightning arrester and there is no likelihood of a spark jumping from an electrode or spacer to the bridge member. A wide enough margin is turned down at each side of the bridge piece so that the possibility of a discharge creeping along the surface of the plates 66 to the bridge is also obviated.

The manufacturing process is simplified to some extent by providing diametrically opposed recesses 73 in the edges of the clamping plates 66 to accommodate terminal binding screws 74 for the lead wires 75. The screws work in registering tapped holes 76 in the electrodes 60 and spacers 65 and are adapted to clamp an encircling end of wire in the grooves 73. By virtue of this construction it is unnecessary to tap holes in the insulating clamping plates 66.

It will be noted that with the form of electrodes shown in Figs. 2 and 11, I employ a washer which overlaps the edges of the clamping ribs of the electrodes at each side. The purpose of this enlarged washer is to effectively guard against a discharge following the surface of the washer from one clamping rib to another and incidentally to guard against electrical leakage from one electrode to another exteriorly of the clamping rib. It furthermore renders the presence of rough or burred washer edges quite immaterial.

It will be noted that the previously described modified forms of the invention all embody certain common features of great practical importance. In almost every instance the use of molded insulating material is dispensed with and sheet stock is used. In every instance, also, a laminated construction is employed consisting of plurality of laminations of conducting and non-conducting members. Certain of the conducting members constitute electrodes in each case and are properly spaced apart to provide an air gap between them by one or more of the non-conducting members. In addition to the saving effected by using insulators and spacers cut from sheet stock, I employ numerous expedients described in detail above to further reduce the cost of materials and labor. It should be borne in mind that with any form of a device, mica could be substituted for bakelite and bakelite substituted for the mica spacers or numerous other classes of sheet insulating material substituted for both.

As suggested in the preliminary discussion of the invention, the units herein shown may conveniently be used as static discharge devices with radio receiving apparatus and are adapted to be positioned between the aerial and ground in parallel with the apparatus. As described, it is designed to pass all static charges of sufficient potential to interfere with the proper functioning of the radio receiving apparatus.

I claim:

1. An electrical discharge device, including a pair of electrodes each consisting of a length of metal folded upon itself to provide a body portion of double thickness and each including an extended discharge terminal end, formed by a single thickness of metal, means for supporting the electrodes with their terminal ends in overlying relationship each in the plane of the folded back portion of the double thickness body portion of the other, parallel faced housing plates of non-conducting material engaging a portion of each of said body portions and beyond which the outer ends of which said double thickness body portions project for attachment of line terminals and a sealing washer clamped between annular, parallel surfaces of said overlapped portions whereby a sealed-in air gap is provided between said terminal ends.

2. An electrical discharge device, including a pair of electrodes each consisting of a length of metal folded upon itself to provide a body portion of double thickness and each

including an extended slightly flattened discharge terminal end, formed from a single thickness of metal, means for supporting the electrodes with their terminal ends in overlying relationship each in the plane of the folded back portion of the double thickness body portion of the other, parallel faced housing plates of non-conducting material engaging a portion of each of said body portions and beyond which the outer ends of which said double thickness body portions project for attachment of line terminals and a sealing washer clamped between annular, parallel surfaces of said overlapped portions whereby a sealed-in air gap is provided between terminal ends; said terminal ends each including accurately formed discharged terminals surrounded by an annular groove which is completely surrounded by an annular rib having a continuous clamping surface for sealing engagement with the washer.

3. An electrical discharge device, including a pair of electrodes each consisting of a length of metal folded upon itself to provide a body portion of double thickness and each including an extended discharge terminal end of less than half the thickness of said body portion, means for supporting the electrodes with their terminal ends in overlying relationship each in the plane of the folded back portion of the double thickness body portion of the other, parallel faced housing plates of non-conducting material engaging a portion of each of said body portions and beyond which the outer ends of which said double thickness body portions project for attachment of line terminals and a sealing washer clamped between annular, parallel surfaces of said overlapped portions whereby a sealed-in air gap is provided between said terminal ends; and securing means for electrical conductors associated with the opposite ends of the electrodes exteriorly of the housing.

4. An electrical discharge device, including a pair of electrodes each consisting of a length of metal folded upon itself to provide a body portion of double thickness and each including an extended slightly flattened discharge terminal end, means for supporting the electrodes with their terminal ends in overlying relationship each in the plane of the folded back portion of the double thickness body portion of the other, parallel faced housing plates of non-conducting material engaging a portion of each of said body portions and beyond which the outer ends of which said double thickness body portions project for attachment of line terminals and a sealing washer clamped between annular, parallel surfaces of said overlapped portions whereby a sealed-in air gap is provided between said terminal ends; and securing means for electrical conductors associated with the opposite ends of the electrodes exteriorly of the housing, securing devices passing through the housing sections and electrodes and clamping the electrodes between the housing sections.

5. An electrical discharge device, including a pair of electrodes each consisting of a length of metal folded upon itself to provide a body portion of double thickness and each including an extended slightly flattened discharge terminal end, means for supporting the electrodes with their terminal ends in overlying relationship each in the plane of the folded back portion of the double thickness body portion of the other, parallel faced housing plates of non-conducting material engaging a portion of each of said body portions and beyond which the outer ends of which said double thickness body portions project for attachment of line terminals and a sealing washer clamped between annular, parallel surfaces of said overlapped portions whereby a sealed-in air gap is provided between said terminal ends; and securing means for electrical conductors associated with the opposite ends of the electrodes exteriorly of the housing; securing devices passing through the housing sections and electrodes and clamping the electrodes between the housing sections, said securing devices being of conducting material, a bracket of conducting material for supporting the housing, said bracket having a cut-away portion having a recess therein to prevent a spark from jumping between the bracket and one of said securing devices.

6. An electrical discharge device, including a pair of electrodes each consisting of a length of metal folded upon itself to provide a body portion of double thickness and each including an extended slightly flattened discharge terminal end, means for supporting the electrodes with their terminal ends in overlying relationship each in the plane of the folded back portion of the double thickness body portion of the other, parallel faced housing plates of non-conducting material engaging a portion of each of said body portions, and beyond which the outer ends of which said double thickness body portions project for attachment of line terminals and a sealing washer clamped between annular, parallel surfaces of said overlapped portions whereby a sealed-in air gap is provided between said terminal ends; said housing including a body portion having a central recess therein accommodating the overlying terminal ends, having opposed grooves therein receiving the intermediate portions of the bodies of the electrodes and including a cover plate co-acting with the body to clamp said electrodes in place.

7. A device of the character described, including a pair of electrodes having their discharge terminal ends arranged in opposed

substantially parallel relationship; an annular washer of dielectric material clamped between continuous annular surfaces formed on adjacent faces of said terminal ends and spacing them apart, providing, surrounding and laterally closing in an air gap between them; and a housing of insulating material enclosing said gap and clamping the terminal ends of the electrodes.

8. A device of the character described, including a pair of electrodes having their discharge terminal ends arranged in opposed substantially parallel relationship; an annular washer of dielectric material clamped between continuous annular surfaces formed on adjacent faces of said terminal ends and spacing them apart, providing, surrounding and laterally closing in an air gap between them; a housing of insulating material enclosing said gap and clamping the terminal ends of the electrodes and means securing the electrodes in proper position within the housing and preventing relative separation of the electrodes.

9. A device of the character described, including a pair of electrodes having their discharge terminal ends arranged in opposed substantially parallel relationship; an annular washer of dielectric material clamped between continuous annular surfaces formed on adjacent faces of said terminal ends and spacing them apart, providing, surrounding and laterally closing in an air gap between them; and a housing of insulating material accommodating the terminal ends of the electrodes, said housing including a body and a cover enclosing said gap and clamping the electrodes between them.

10. A device of the character described, including a pair of electrodes having their terminal ends arranged in opposed substantially parallel relationship; an annular washer of dielectric material clamped between continuous annular surfaces formed on adjacent faces of said terminal ends and spacing them apart, providing, surrounding and laterally closing in an air gap between them; a housing of insulating material receiving the terminal ends of the electrodes said housing including a body and a cover enclosing said gap and means clamping the body and cover together and securing the electrodes in place between them.

11. An electrical discharge device, including a pair of electrodes each consisting of a length of metal folded upon itself, to provide a body portion of double thickness and each including an extended slightly flattened discharge terminal of less than half the thickness of the body, means for supporting the electrodes with their terminal ends in overlying relationship, each in the plane of the folded back portion of the double thickness body portion of the other, parallel faced housing plates of non-conducting material engaging a portion of each of said body portions and beyond which the outer ends of said double thickness body portions project for attachment of line terminals and a sealing washer clamped between annular parallel surfaces of said overlapped portions whereby a sealed-in air gap is provided between said terminal ends.

Signed at New York city, in the county of New York, and State of New York, this third day of June, A. D. 1924.

GEORGE FRANCIS GRAY.