April 22, 1930. E. H. JACOBS 1,755,324

LIGHTNING ARRESTER

Filed March 31, 1924 3 Sheets-Sheet 1

Fig. 1

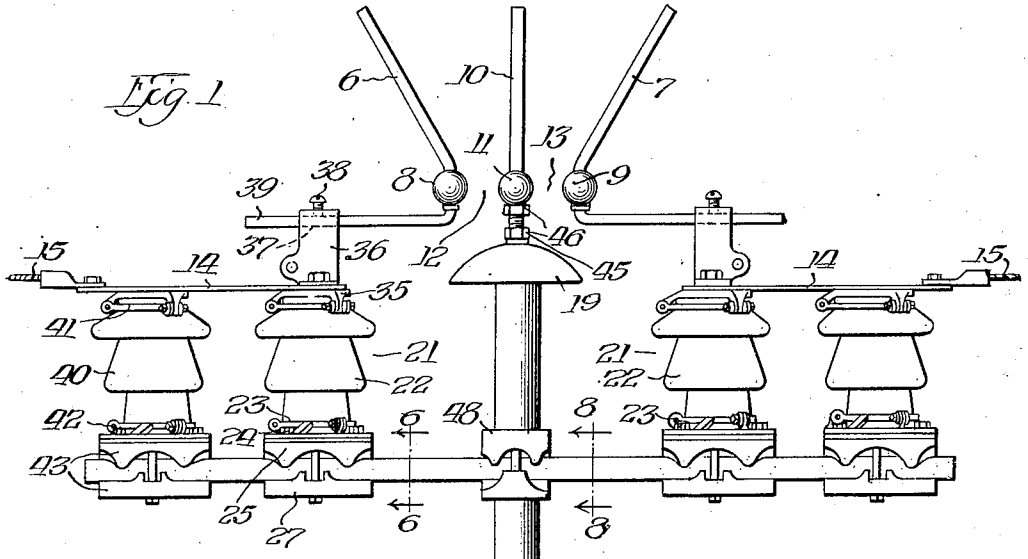


Fig. 2

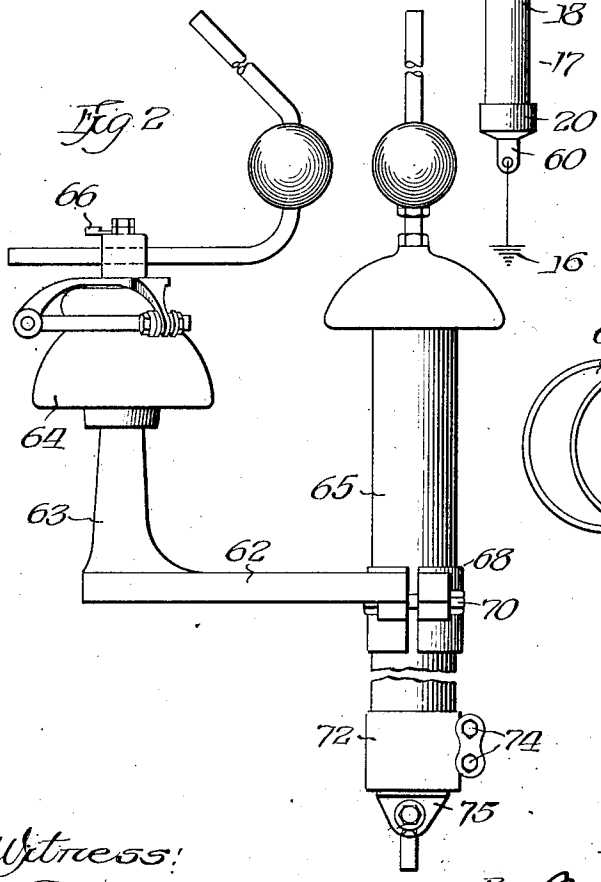
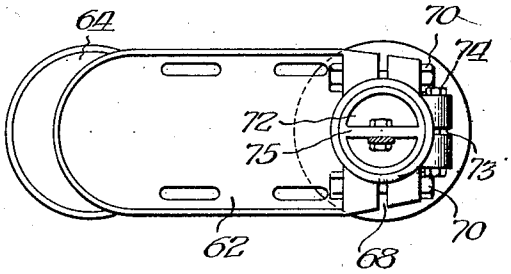


Fig. 3



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LIGHTNING ARRESTER

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Fig. 4

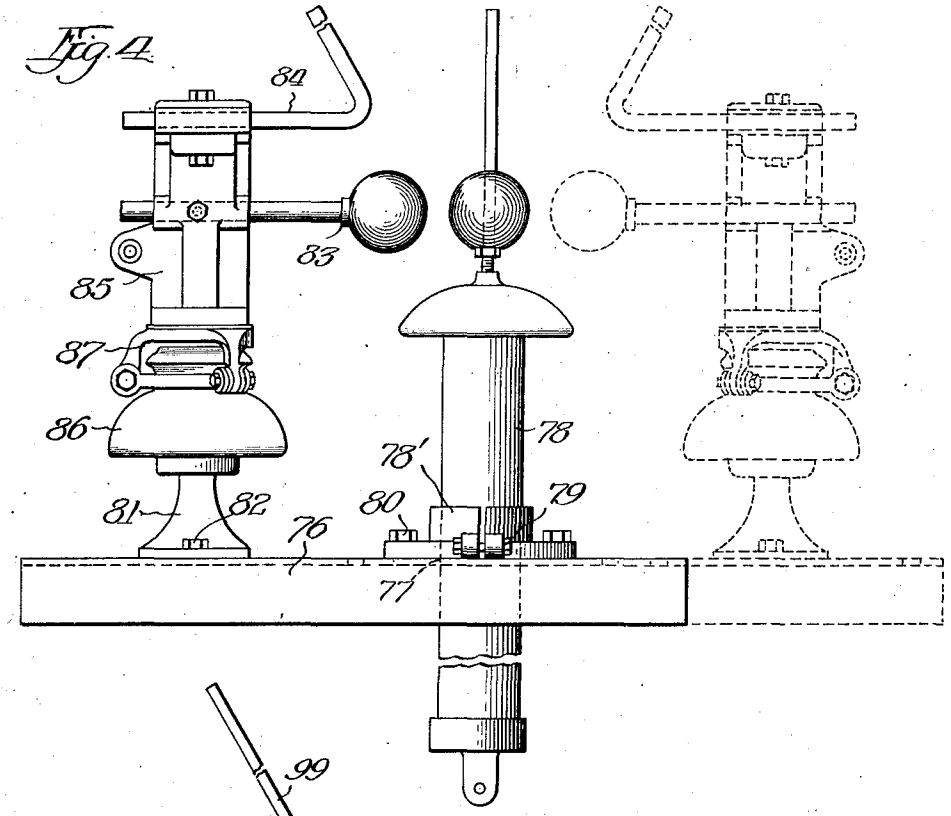
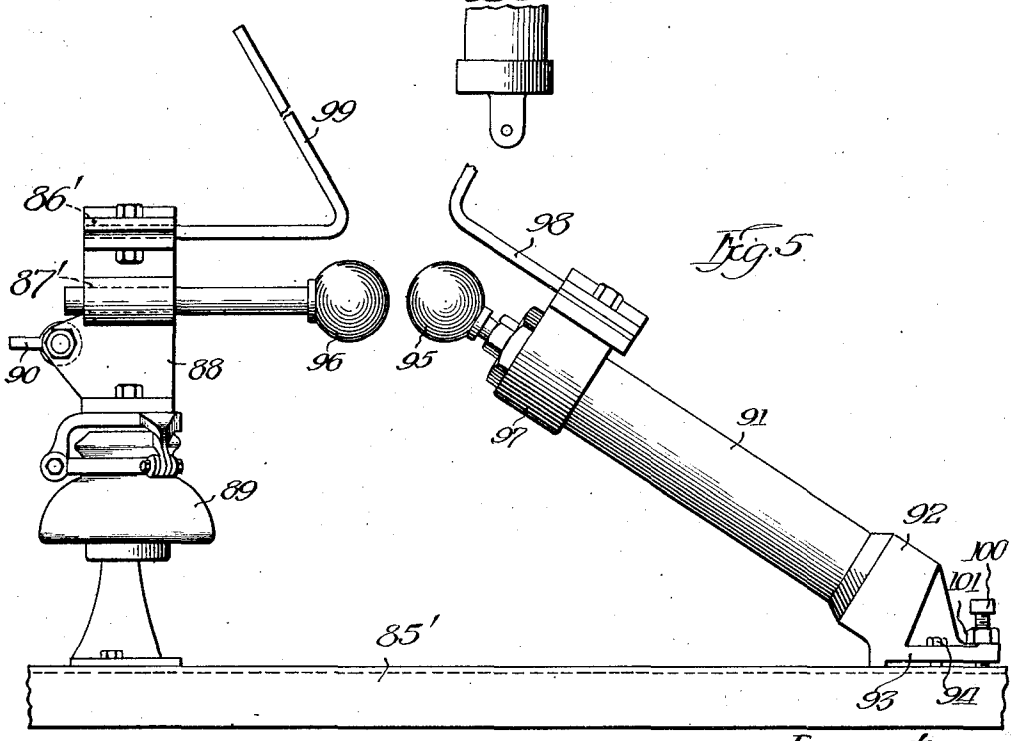


Fig. 5



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LIGHTNING ARRESTER

Filed March 31, 1924 3 Sheets-Sheet 3

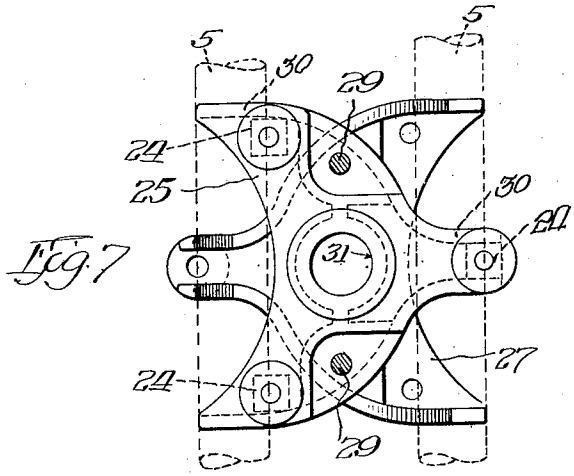

Fig. 7

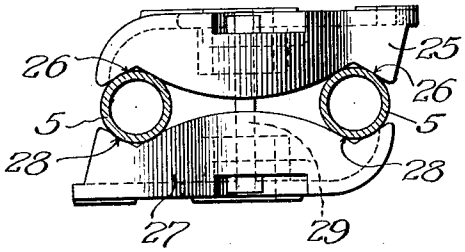

Fig. 6

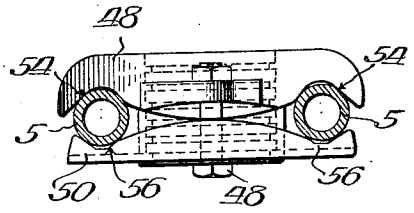

Fig. 8

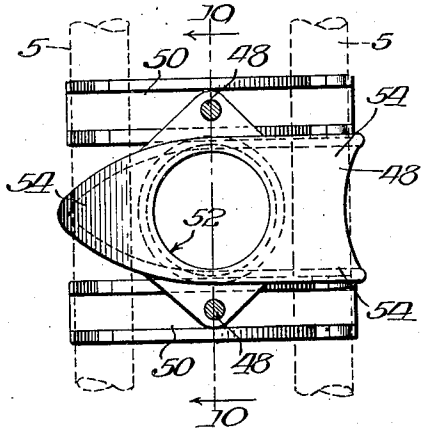

Fig. 9

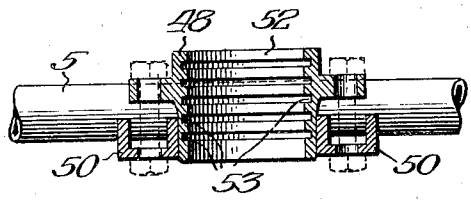

Fig. 10

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Patented Apr. 22, 1930 1,755,324

UNITED STATES PATENT OFFICE

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LIGHTNING ARRESTER

Application filed March 31, 1924. Serial No. 703,025.

This invention relates to protective devices for electrical circuits and is a continuation in part of my co-pending application, Serial No. 336,954 filed Nov. 10, 1919, which has resulted in Patent No. 1,497,978 granted June 17, 1924.

In electrical distribution systems it is necessary to provide some means for protecting the lines and connected apparatus against potential disturbances such as "lightning". As lightning is probably the most common of these disturbances, devices of this sort are usually known as lightning arresters. The purpose is to discharge the excessive potential to ground with the least possible delay and with as little disturbance and damage to the apparatus and line, as possible. Air break arresters of the type to which my present invention relates, usually comprise a pair of proximate electrodes, one connected to the line and the other connected to ground through a high resistance. The resistance unit should be of a capacity large enough to relieve the disturbance on the line, and it should have sufficient resistance to exclude the flow of any appreciable amount of dynamic current which tends to follow the discharge to ground.

In meeting these requirements I have found that the desired length of the resistance unit is frequently considerably greater than the distance which is necessary between the mounting frame or other support and the electrodes, to secure the desired insulating strength. Where the resistance unit is arranged perpendicular to the frame with its lower end mounted thereon, the supporting insulator and other fittings for supporting the other electrode or electrodes, in close proximity to the electrode or electrodes on the resistance unit, have had to be of substantially the same length as the resistance unit irrespective of whether or not the length of the resistance unit is greater than is necessary to provide the desired spacing from the frame or support. The electrode supports and insulators are therefore frequently much larger than necessary, the distance between the electrodes and the supporting frame is frequently much greater than necessary, and the over-all dimensions of the entire installation are commonly materially greater than they need be. This defeats compactness and where other apparatus is positioned near the support frequently results in positioning the electrodes so that the break occurs closer to the other apparatus than desirable. Furthermore the mechanical stresses which a resistance unit of this type will withstand are directly proportional to the distance between the point of support and the free end of the unit, so that the greater the distance from the attachment to the frame to the free end of the resistance unit the less able is the resistance unit to withstand such mechanical stresses as are imposed upon the free end thereof. Inclined disposition of the resistance unit has been provided for but additional supporting insulators for the electrode or electrodes connected to the resistance unit have been necessary, the resistance unit being connected obliquely between the resistance electrode and the supporting base without being adapted to perform any electrode supporting function at all.

The primary object of my present invention is to overcome the foregoing difficulties and more particularly to provide for supporting the ground or resistance electrode upon the resistance unit a distance from the supporting frame less than the length of the resistance unit so that said distance need be no greater than necessary to provide the required insulation and the line electrode supports will not have to be unduly long. The ability to withstand mechanical stresses at the free end of the resistance unit is increased and the ground connection may be straight and substantially normal to the spark gap at a distance greater than that between said gap and the frame.

Another object is to provide a simple and compact device that may be economically produced and in which assembly is facilitated and excessive dimensions and all unnecessary material are eliminated.

To acquaint those skilled in the art with the nature and scope of my invention I shall now describe certain specific embodiments

of the same in connection with the accompanying drawings in which:

Fig. 1 is a side elevational view of one embodiment of my invention;

Fig. 2 is a similar view of another embodiment;

Fig. 3 is a bottom plan view of the embodiment shown in Fig. 2;

Figures 4 and 5 are side elevational views of further embodiments of the invention;

Fig. 6 is a detail section on line 6—6 of Fig. 1 showing the line electrode support mounting crabs;

Fig. 7 is a top plan view of the same;

Fig. 8 is a detail section on line 8—8 of Fig. 1 showing the resistance unit mounting crabs;

Fig. 9 is a top plan view of the same; and

Fig. 10 is a vertical section on line 10—10 of Fig. 9.

The arrester shown in Figure 1 is of the double or multiple gap type, having a pair of horn electrodes 6 and 7 and a pair of sphere electrodes 8 and 9 with intermediate horn and sphere electrodes 10 and 11 arranged with sphere and horn gaps 12 and 13 between them and said first electrodes. Either electrodes 6—8 or 7—9 may obviously be omitted or a greater number may be suitably arranged about electrodes 6 and 7. The electrodes 6—8 and 7—9 are connected to the line by means of metal terminal pieces 14 to which the line conductors 15 are electrically and mechanically connected. The electrodes 10 and 11 constitute the ground electrodes and are connected to ground 16 through the resistance unit 17 which may be of the type disclosed in my above referred to co-pending application or of any other suitable or preferred type. Where one side of the device is omitted or where additional electrodes are employed the supporting frame may be varied accordingly.

Suffice it to say that the resistance unit 17 comprises a tubular casing member 18 of insulation having terminal caps 19 and 20 mounted on its upper and lower ends respectively and connected through the interior of the tubular casing by resistance means which will not offer serious hindrance to the passage of lightning or the surge or potential wave to ground, but will at the same time check or limit to a safe value the flow of dynamic current tending to follow same. The terminal cap 19 is preferably petticoated as shown, to form a water shed.

The mounting of electrodes 6—8 and 7—9 is the same so that a description of one will suffice for both. They are mounted upon the upper ends or heads of electrode supports 21 and said supports are mounted at their lower ends upon frame members 5 and extend perpendicular upwardly therefrom.

Each support 21 comprises an insulator 22 beaded annularly at its base and secured in a sectionalized insulator clamp 23 of the universal type. Formed integral with one of the sectionalized bands of the clamp, for example, is a mounting plate which is mounted by bolts 24 upon the upper surface of a mounting plate or crab 25. Crab 25 has integral claws 26 which engage over the pipes 5 as shown in Fig. 6. A similar crab 27 having claws 28 similarly engaging the pipes 5 is slung beneath the pipes and the two crabs 25 and 27 are clamped in place upon the pipes by bolts 29. The engagement of the claws prevents turning of the crabs on the supporting pipes, yet by loosening bolts 29 the crabs may be shifted along the pipe frame to secure approximately the desired spacing of the electrodes, tightening of bolts 29 again locking the crabs firmly in place. The heads of bolts 24 cooperate with the depending flanges 30 of the upper crab 25 as shown in dotted lines in Fig. 7 and this prevents turning of the bolts and facilitates threading the nuts upon and unthreading them from the upper ends of said bolts. The crabs 25 and 27 are universal. Either may be used above or below and each has a central opening 31. Where an axial pin or stud support for the insulator 22 is provided these studs or pins may project down through openings 31 and be threaded at their lower ends to receive a nut for clamping the crabs upon the frame.

The upper end of insulator 22 is similarly grooved and beaded and clamped upon said beaded upper end is a sectionalized clamp 35 of the universal type. Clamped upon clamps 35 with the inner ends of terminal members 14 clamped between them and the brackets are upwardly extending metal brackets 36 having transverse openings 37 in which are clamped by screws 38 the rods 39 which are formed into the horn electrodes 6 and 7. The rods 39 are slidably mounted in openings 37 to permit adjustment of the gaps and are clamped in any adjusted position by screws 38. The sphere or ball electrodes 8 and 9 are freely rotatable on the parallel upright portions of electrodes 6 and 7 to permit renewing the arcing surfaces, the horn electrodes 6 and 7 diverging from sphere electrodes 8 and 9 upwardly as shown, the horn gap being slightly greater than the sphere gap as shown.

The outer ends of terminal pieces 14 are supported by line insulators 40 being secured upon the upper ends thereof by sectionalized clamps 41. The insulators 40 are in turn clamped in perpendicular position upon pipes 5 by sectionalized clamps 42 and crabs 43.

The metallic cap 19 is threaded or otherwise suitably secured upon the upper end of the insulating tube of the resistance unit 17 and the vertical rod constituting the intermediate horn electrode 10 is threaded at its lower end into firm mechanical and electrical engagement therewith. The vertical position

of the horn electrode 10 may obviously be adjusted by threading it into or out of cap 19 a suitable lock nut 45 being provided for locking it in adjusted position. The sphere electrode 11 is preferably threaded upon electrode 10 and is adjustable up and down into proper relation with electrodes 8 and 9 and its rotation about electrode 10 permits renewing the arcing surfaces. A lock nut 46 locks electrode 11 in any desired adjusted position.

The height of supports 21 is such that the electrodes 6—8 and 7—9 will be positioned from frame 5 sufficiently to secure the desired insulating strength, the distances or air gaps between said electrodes and the frame being obviously considerably less than the length of the resistance unit 17. Proper operation of the resistance unit 17 frequently requires that it be of a length considerably greater than the necessary gap between the frame and the electrodes and to avoid making the lengths of supports 21 and 40 greater than necessary to secure the desired spacing of the electrodes from the frame, I make such supports only large enough to secure the desired spacing and I then extend the resistance unit 17 downwardly between pipes 5 through the plane thereof. This permits spacing the electrodes 10 and 11 substantially the same distance from the frame 5 as the line electrodes with a resistance unit much longer than said distance.

The resistance unit extends perpendicular to frame 5 and is mounted substantially intermediate its ends upon frame 5 by an upper mounting member 48 and cooperating lower mounting plates 50. Member 48 has a central hub through which there is an opening 52 and the insulating sleeve 18 of the resistance unit extends through said opening, the sleeve being cemented or otherwise suitably secured in the opening 52 which preferably has annular grooves or corrugations 53 and the surface of the tube lying within the opening may be roughened or corrugated to permit the cementitious or binding material to secure a firm grip on the sleeve and member 48. Member 48 has three claws 54 engaging over pipes 5 and the plates 50 extend transversely beneath the pipes and have claws 56 engaging same, plates 50 and member 48 being clamped firmly upon the pipes by suitable bolts 48′. By loosening the bolts 48′ the resistance unit may obviously be shifted along the pipes 5 and locked in any desired position by again tightening said bolts.

In addition to positioning electrodes 10 and 11 proximate the line electrodes and substantially the same distance from frame 5 as said electrodes with a resistance unit of a length greater than the necessary length of the supports 21, the extension of the resistance unit through the plane of frame 5 provides a ground connection substantially normal the gaps between the electrodes, which is straight and greater than the distance between said gaps and the supporting frame. This provides a highly effective blowing-out action for any arc that may tend to establish between the electrodes. In addition the distance between the support and the free end of the resistance unit being considerably less than the length of said unit, the strength of the unit and ability to withstand the mechanical stresses to which the free end is subjected is increased. The ground electrodes are obviously supported solely by resistance unit 17 and they are mounted on one side of the supporting frame with the ground connection from the terminal lug 60 below or on the other side of the frame.

In the embodiment shown in Fig. 2 the supporting frame 62 has an integral perpendicular post 63 upon which the insulator 64 is cemented or otherwise suitably secured. As before, the line electrodes are mounted upon the upper end of the supporting insulator approximate the ground electrodes which are mounted upon the upper end of resistance unit 65. The line is connected to the line electrodes through a terminal 66 and the resistance unit is mounted within its length on the frame 62 by a sectionalized clamp 68, one half of which is formed integral with frame 62 while the other half is in the form of a cap clamped about unit 65 and bolted to the other half by bolts 70.

As before resistance unit 65 extends through the plane of frame 62 and on its lower end below the frame has a terminal cap 72 split at 73 and clamped upon the insulator sleeve by bolts 74, and provided with a depending terminal lug 75 to which the ground connection is adapted to be made.

In the embodiment shown in Fig. 4 the supporting frame is in the form of an inverted channel 76 having an opening 77 in its upper wall through which the resistance unit 78 extends. The resistance unit 78 is mounted within its length upon frame 76 by a two-piece or sectionalized clamp 78′ which embraces and is clamped upon the resistance unit intermediate its ends by bolts 79 and is in turn secured upon frame 76 over opening 77 by bolts 80. In this case stud or post insulated supports 81 are shown mounted upon frame 76 by bolts 82 and the sphere and horn electrodes 83 and 84 are separately mounted in transverse openings extending through the metal bracket 85 one above the other. The bracket 85 is mounted on the outer end of insulator 86 by a universal clamp 87 and the line connection may be made directly to bracket 85.

In the embodiment shown in Fig. 5 the supporting frame 85′ is again in the form of an inverted channel with electrodes separately mounted and separately adjustable in parallel transverse openings 86′ and 87′ in

a bracket 88 on the outer end of insulator 89 and the line connection 90 is directly to said bracket 88. In this case the resistance unit 91 is supported obliquely or inclined to frame 85', the terminal cap 92 at the lower end or base of the resistance unit having an oblique mounting flange 93 secured directly to the upper surface of the frame 85 by bolts 94. Projecting axially from the upper end of resistance unit 91 is the sphere electrode 95 for disposition proximate electrode 96 and mounted in a clamp projecting laterally from the terminal cap 97 for adjustment parallel the adjustment of electrode 95 is a horn electrode 98 for disposition proximate line electrode 99. The electrodes 95 and 98 are mounted directly on and supported solely by resistance unit 91 and the inclined or oblique disposition of said unit permits disposing said electrodes proximate the line electrodes without employing an unduly or unnecessary long support 89 and without extending the resistance unit through the plane of the supporting frame. This type is especially suitable where there is not sufficient space or clearance below the supporting frame or where said space or clearance is limited. The inclined disposition of the resistance provides a relatively straight and direct connection to grounding on frame 85.

As an additional adjustment for the electrodes supported on the outer end of the resistance unit, screws 100 are threaded through ears on flange 93 and cooperate with the upper wall of frame 85 so that by loosening bolts 94 and threading screws 100 in or out the resistance unit may be tilted as a unit and locked in any desired position by again tightening up bolts 94 and lock nuts 101 on screws 100.

I claim:

1. In combination, a supporting frame, an insulator projecting endwise from and disposed wholly upon one side of said frame, means at one end of said insulator for attaching same to said frame, a line electrode mounted upon the opposite end of said insulator, a resistance unit of such character that its length must exceed the distance from said line electrode to the frame in order to provide a resistance sufficient to exclude the flow of appreciable dynamic current following a discharge to ground, means attached to said resistance unit intermediate its ends and to said frame for supporting said resistance unit upon said frame with one end projecting from one side of said frame and freely positioned in proximity to said line electrode and the opposite end passing through the plane of said frame and projecting from the opposite side of the frame with said opposite end freely positioned at a distance from the opposite side of the frame, a ground electrode mounted directly upon the end of said unit in proximity to said line electrode, and a ground connection on the opposite end of said resistance unit.

2. In combination, a support, a resistance unit carrying and spacing a ground electrode from said support and of such character that its length exceeds the distance from the ground electrode to the support in order to provide resistance sufficient to exclude the flow of appreciable dynamic current following a discharge to ground, means attached to said resistance unit intermediate its ends and to said support for supporting said resistance unit upon said support with one end projecting from and freely positioned on one side of said support, said resistance unit passing through the plane of said support with its opposite end projecting from and freely positioned upon the opposite side of the support, the ground electrode being mounted upon one end of said resistance unit and a ground connection mounted upon the opposite end of said unit.

3. In combination, a support, an insulator mounted on and projecting from said support, a line electrode on the outer end of said insulator, a resistance unit of such character that its length exceeds the distance from the line electrode to said support in order to provide resistance sufficient to exclude the flow of appreciable dynamic current following a discharge to ground, means attached to said resistance unit intermediate its ends and to said support for supporting said resistance unit upon said support with one end projecting from and freely positioned on one side of said support, said resistance unit passing through the plane of said support with its opposite end projecting from and freely positioned upon the opposite side of the support, a ground electrode mounted on the resistance unit in proximity to said line electrode and a ground connection on the opposite end of said resistance unit.

4. In combination, a support, an insulator mounted on and projecting from said support, a line electrode on the outer end of said insulator, a resistance unit of a length exceeding the distance from the line electrode to said support, means attached to said resistance unit intermediate its ends and to said support for supporting said resistance unit upon said support with one end projecting from and freely positioned on one side of said support, said resistance unit passing through the plane of said support with its opposite end projecting from and freely positioned upon the opposite side of the support, a ground electrode mounted on the resistance unit on one side of said support and in proximity to said line electrode and ground connection on the opposite end of said resistance unit.

In witness whereof, I hereunto subscribe my name this 28th day of March, 1924.

ERNEST H. JACOBS.