Oct. 30, 1928.

E. H. JACOBS

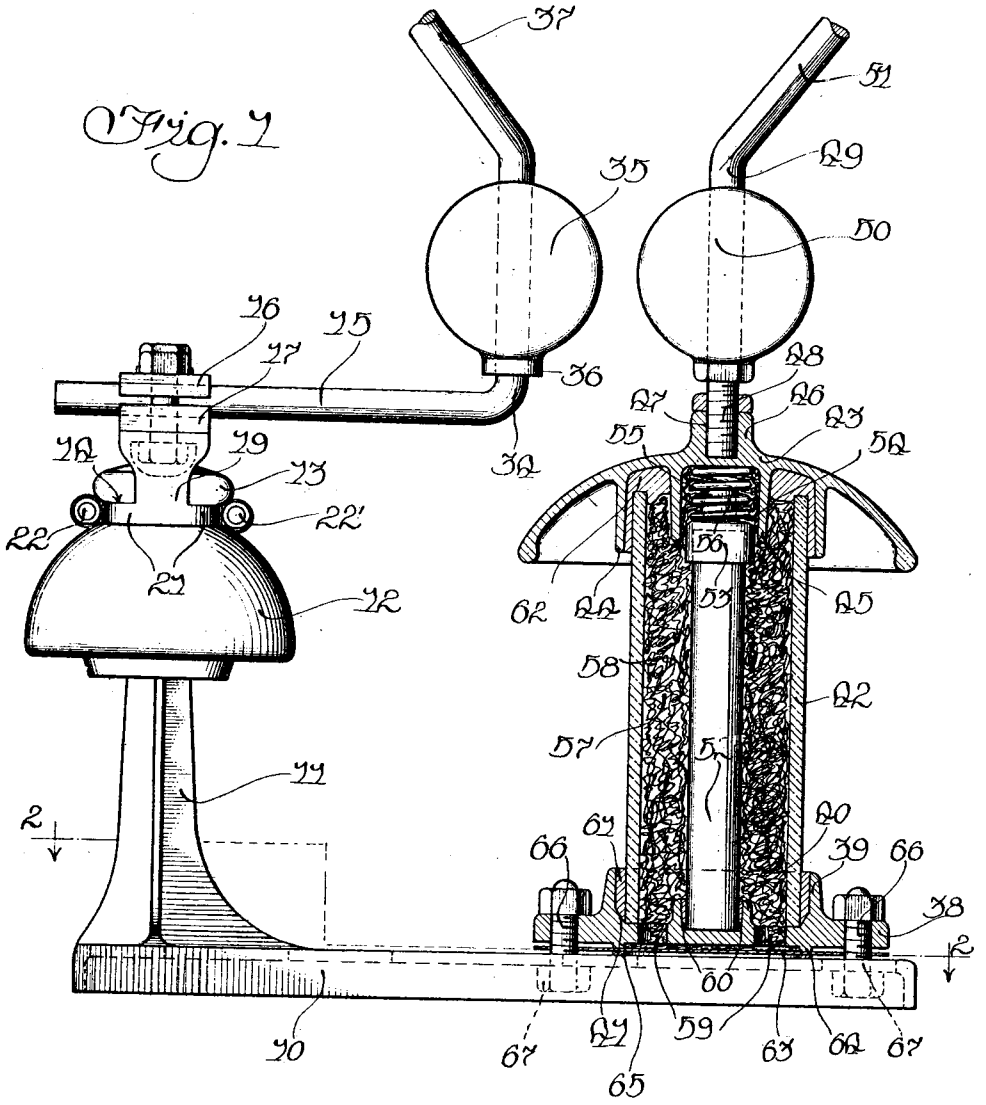
1,689,781

LIGHTNING ARRESTER

Filed Feb. 4, 1921

2 Sheets-Sheet 1

Fig. 1



Inventor
Ernest H. Jacobs
By Brown Borden, Dennis
Attorneys

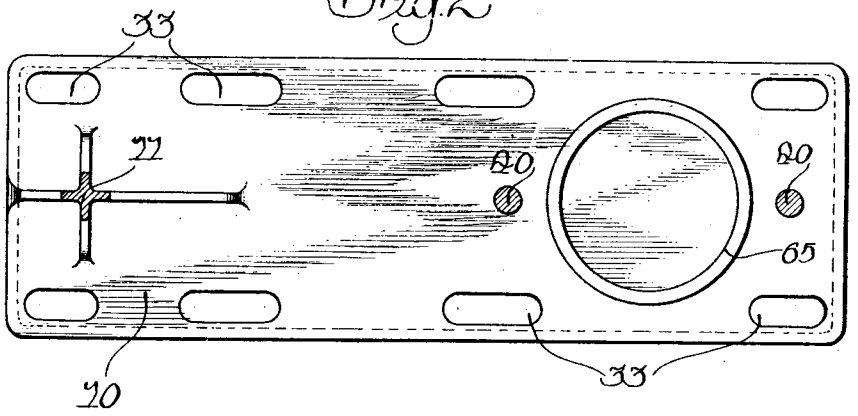
Oct. 30, 1928. 1,689,781

E. H. JACOBS

LIGHTNING ARRESTER

Filed Feb. 4, 1921 2 Sheets-Sheet 2

Fig. 2



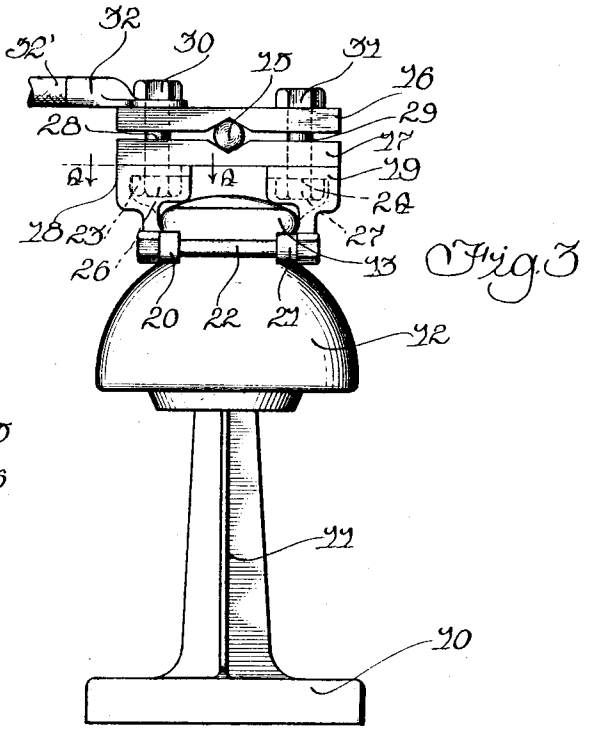


Fig. 3

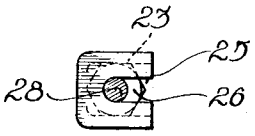


Fig. 4

Inventor
Ernest H. Jacobs
By Brown Borden & Quinn
Attorneys

Patented Oct. 30, 1928. 1,689,781

UNITED STATES PATENT OFFICE.

ERNEST H. JACOBS, OF CHICAGO, ILLINOIS, ASSIGNOR TO ELECTRICAL ENGINEERS EQUIPMENT COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

LIGHTNING ARRESTER.

Application filed February 4, 1921. Serial No. 442,341.

This invention relates to protective devices for electrical circuits, and more particularly to those devices known as lightning arresters of the air break or horn gap type.

In electrical distribution systems it is necessary to provide some means for protecting the lines and connected apparatus against potential disturbances generally termed lightning. As lightning is the most frequent cause of these disturbances, such devices are usually known as lightning arresters. The purpose is to discharge the excessive potential to ground with the least possible delay, with as little disturbance and damage to the apparatus and lines. Horn gap arresters of the type to which my invention relates consists generally of 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, but at the same time it should have sufficient resistance to exclude the flow of any appreciable amount of dynamic current which tends to follow the discharge to earth.

The difficulty hereinbefore encountered in the employment of a resistance between the grounded electrodes and ground is the inability to maintain the capacity of the resistance approximately constant and secure satisfactory operation thereof. Because of the well known surface flow or skin effect of conductors, there is a tendency for the excessive potential to flow to ground by way of the surface of the resistance. If the potential or inertia of the discharge varies, the efficiency or effectiveness of the resistance varies. Other causes, such as rain and sleet tend to decrease the resistance, besides atmospheric electricity manifests a predominant influence upon varying the capacity.

It is one of the important features of the invention to provide means whereby the resistance is maintained substantially constant in capacity. To this end an insulating chamber surrounds the resistance within which fluid or semi-fluid is kept for the purpose of sealing the resistance from the atmosphere. Since the tendency of the discharge is to flow along the outer surfaces of the resistance, and since the insulating mass is in contact therewith, there is a tendency for the insulating material to carry a part of the discharge. The insulating mass is preferably a compound of bituminous character, which is only slightly conductive, but which, in reality, forms a conductor of large capacity and high resistance for high potential discharges. This mass has the further desirable characteristic that it is self-healing because of the fluid or semi-fluid character of the same.

The present invention as represented in the embodiment hereinafter described in detail is designed to meet the demand for a simple and inexpensive, yet compact and durable lightning arrester capable of quick and facile assembly and installation. The embodiment described is particularly well suited for use in installations involving comparatively low voltages where it is desired to provide ample protection for the line, but where the use of the more elaborate devices of this character would entail an initial outlay or expense which would be prohibitive.

The invention provides an insulated electrode connected to line and mounted on a suitable base, the electrodes carrying an arcing horn on which a discharge ball is adjustably mounted. A second grounded electrode carrying a similar discharge ball is also mounted on said base, and includes an arcing member and grounded conductor of relatively large area and high resistance of the character above described. This insures a large capacity with sufficient resistance to prevent continuous arcing of the dynamo potential after a surge has passed through the arrester.

The discharge balls or spheres are mounted on parallel axes, namely the horns, and they are rotatable to present fresh discharge surfaces to maintain the sphere gap at proper efficiency.

The device is characterized by simplicity and compactness, and also the changeability of the parts thereof, which latter features make for cheapness of manufacture, consequent low original cost and moderate expenses for upkeep.

While I shall describe in detail a preferred structural arrangement, it is to be understood that I reserve the right to modify the structure in providing refinement of the same when reducing to practice.

A more concrete understanding of my invention may be obtained from the follow-

ing detailed description and the appended claims, taken in connection with the accompanying drawings, in which:

Figure 1 is a side elevation of my invention, a portion thereof being shown in section;

Figure 2 is a horizontal section taken on the line 2—2 of Figure 1;

Figure 3 is an end elevational view of the invention; and,

Figure 4 is a detail section taken on the line 4—4 of Figure 3.

Referring now to the structural arrangement of my invention, I provide a metallic base 10 having a standard 11 preferably integrally cast therewith, and extending upright therefrom at one end of the base. The standard 11 carries an insulator 12, having a head 13, below which is formed a peripheral groove 14. The line electrode is mounted on the insulator 12, said electrode comprising a rod 15 receivable between the two jaws 16 and 17 of a suitable clamp, lugs 18 and 19 supporting said jaws 16 and 17, said lugs having oppositely extending arms 20 and 21 respectively, said arms being curved to conform to the shape of the neck or groove 14 of the insulator and adapted to seat in said groove, suitable bolts 22 and 22′ extending through the free ends of the arms 20 and 21 to clamp the lugs 19 on the insulator. The lugs are each provided with recesses 23 and 24 respectively, and slots 25 (as shown in detail in Figure 4). The recesses are adapted to receive the heads 26 and 27 of bolts 28 and 29, said bolts extending through the slot 25 and through the jaws 16 and 17, suitable nuts 30 and 31 being carried by the upper ends of the bolts. A connecting lug 32 is disposed on one or the other of the bolts, in the present instance, on the bolt 28 under the nut 30 thereof, said lug 32 having connection with the line by a suitable conductor 32′. The standard 11 is made cross shaped in cross section, which makes for strength and yet lightness in construction. The base 10 may be constructed of brass if desired, and is provided with a plurality of elongated openings 33—33 for securing the same to a suitable grounded support.

The inner end of the electrode 15 is bent upwardly at 34, and then a freely rotatable ball 35 is mounted thereon, a collar 36 anchored on the electrode serving as a bearing for the ball. The free end of the electrode is bent outwardly as at 37 after the ball has been placed in position and serves to prevent the same from becoming displaced from the electrode.

The purpose of permitting free rotation of the ball is so that a renewable arcing surface is provided which will prolong the life of the device.

The grounded electrode is supported in a foot piece 38, the same being mounted on the base 10 in a manner which will be described presently. The foot piece 38 is provided with an exterior annular flange 39 and an interior flange 40, the inner peripheral surface of the flange 39 and its juncture with the foot-piece 38 preferably being beveled as at 41. A sleeve or shell 42 of insulating material, such as heavy fiber or the like, is seated and cemented in the recess provided by the flange 39, said shell being slightly less in diameter than the flange. The shell 42 bears at its upper end a water-shed or protector 43, and serves to support the same, said water-shed 43 having an external annular depending flange 44, and an internal similar flange 45, on the under surface thereof. The water-shed 43 has been shown as concavo-convex in cross-section, but this shape need not be adhered to. A stud 46 is cast on the top of the water-shed 43, and is provided with a threaded opening 47, to receive the threaded end 48 of a rod 49. An arcing ball 50 is carried by the rod 49 and is rotatable thereon, for presenting a fresh surface. The upper end of the rod 49 may be straight or bent away from the insulated electrode as shown at 51, to form the horn gap with the electrode 37.

A conductor 52 of relatively high resistance is arranged concentrically and vertically in the shell 42, the lower end of the conductor 52 seating in the recess formed by the flange 40, said conductor being slightly less in diameter than the flange. The reason for forming of the shell and the conductor of less diameter than those of the flanges 39 and 40 will appear later. The substance from which the conductor 52 is made up is not of the essence of this invention, but the same may be of a mixture of clay and graphite, carborundum, or any other suitable material of relatively high resistance and good mechanical strength.

The conductor 52 carries a metallic cap member 53 on the upper end thereof, said cap member being partly receivable within the pocket 54 formed by the flange 45. The cap 53 is preferably provided with an axial lug 55, and a coil spring 56 seats on said lug, and is interposed between the socket formed in the bottom of the water-shed and the metallic cap 53. The spring permits ready assembly and maintains contact even with considerable variation in the parts which make up the assembled device.

It can be readily seen that the shell 42 forms a chamber, which, for convenience, is designated 57, said chamber receiving a filler 58, which is of low conductivity, in fact, an insulator for normal voltages. The foot-piece 38 is provided with a plurality of openings 59—59, which serve for the purpose of introducing the filler, as will be explained presently. The mobility of the filler 58

causes the same to contact closely with the surface of the resistance rod 52. The effective resistance due to skin effect or surface flow is thereby appreciably reduced. The filler 58 is not a pure insulator, and possesses some conductivity, but only to the degree that it serves as an exceedingly high resistance. Being so disposed, it is in parallel to the resistance rod 52 and begins to act when the flow through the rod is excessive.

In assembly of the shell, water-shed and foot piece, the conductor 52 is seated in the recess formed by the flange 40, and cement such as Babbitt metal indicated at 60 is poured around the space between the conductor 52 and the flange 40. The shell 42 is now placed in position, and cement indicated at 61 is poured around the space provided between said shell and said flange 39. When this has set, the foot piece and shell and conductor are inverted, and the spring, cap 53 and shell are all seated in the recess in the water-shed 43; cement, such as babbitt in molten form, is now poured around the space between the shell 42 and the flange 44, and permitted to set, this cement being indicated at 62. After the cement has set, the filler 58 is introduced hot into the shell 42 through the openings 59. The filler is of a cementitious and somewhat plastic nature, and does not set firmly, and therefore, when the foot piece and shell and associated parts are returned to normal position, and the device assembled, it is necessary that some means be provided to prevent the escape of the filler 58, as it would do more or less rapidly under different conditions of temperature. I have therefore arranged a disk 63 of sheet metal, paper fiber, or other material, between an annular shoulder 64 formed on the under face of the foot piece 38, and a ring 65 conforming to the shoulder 64 formed on the base 10, said shoulder and ring gripping the disk when the foot piece is clamped on to the base by means of the bolts 66—66. The heads 67—67 of the bolts are arranged within the base 10, the base 10 being made of a semi-hollow construction for lightness. The bolts extend through the disk.

From the foregoing, it will be apparent that I have provided an improved protective device of the character referred to, which, while simple in construction and inexpensive to manufacture, is highly effective to safeguard an electrical distribution system against damage due to electrical surges set up, either by lightning or other causes. The setting of the discharge gap may be very readily regulated by the adjustable electrode 15. Due to the general arrangement and construction of the various parts, the device is rugged and durable. Those parts which might become affected by water, sleet or atmospherical conditions are enclosed within the shell 42, and sealed therein.

In the arrangement of the device as shown, two electrodes have been employed and a single gap provided, but it will be readily apparent that a plurality of gaps might be obtained by mounting an additional one or more electrodes on the base 10, where such arrangement is desired. While I have shown the insulated electrode as the adjustable one, it will be obvious that the other electrode may be made adjustable by modifying the arrangement of the structure without departing from the spirit of the invention.

The entire supporting column for the electrode 49 comprises a conductor of high resistance. This column includes three paths, namely, the rod 52, the compound 57, and the sleeve 42, all of progressively greater degrees of resistance respectively.

The device may be shipped for use assembled, or with the electrodes and the balls demounted, and, in fact, in some instances it is possible to ship the device completely disassembled, and assemble the same in the field. I have stated that the above described device is designed for low voltage systems, but it is apparent to those skilled in the art that such a limitation is not inherent. It may also be desirable, in some instances, to have the standard 11 detachable from the base 10, and therefore I do not limit the invention to the exact mounting of the standard as shown.

I contemplate changes in the device which are warranted by the scope of the claims.

I claim:

1. An electrode for lightning arresters comprising, in combination with a base, a foot piece removably secured to said base, a shell of insulating material carried on said base, a water shed on the other end of said shell, means for sealing said shell in said foot piece and shed, a solid resistance element in said shell, a filler surrounding said solid resistance element, means for introducting this filler into the shell after the same has been secured to said foot piece and water-shed, and a plate interposed between said foot piece and base for preventing said filler from working out of the shell, and an arcing terminal carried by the water-shed.

2. In a lightning arrester, a sleeve of insulating material, a metallic closure for one end of said sleeve, said closure having an opening for filling of the sleeve, a cap for the other end of the sleeve, said cap having a petticoat, said cap and closure being secured to the ends of the sleeve, a high resistance conductor connecting the cap and closure and lying within the sleeve, a filling of bituminous compound in the sleeve surrounding the high resistance conductor, means se-

cured by the closure for closing said filling openings, and an electrode mounted directly on the top of the cap.

3. In an electrode, the combination of a base, a shell of insulating material, a resistance element in said shell, a filler disposed in the shell and surrounding said resistance element, a foot piece mounted upon the shell and provided with means permitting the introduction of the filler after mounting the foot piece on the shell, means removably securing the foot piece to said base and means interposed between the foot piece and said base for sealing said first means.

4. In combination a shell of insulating material, a cap on the end of said shell, said cap having outer and inner concentric flanges, the outer flange being adapted to fit upon the shell and the inner flange to receive the end of a resistance element, a resistance element disposed within the shell with one end in said inner flange, a filler disposed within the shell and surrounding the resistance element, said cap having an opening in its base and between said inner and outer flanges for the introduction of the filler after mounting the cap on the shell means for sealing said opening and a cap at the other end of the shell and electrically connected to the other end of said resistance element.

In witness whereof I hereunto subscribe my name this 25th day of June, 1920.

ERNEST H. JACOBS.