(No Model.)

A. WURTS.

UNIVERSAL NON ARCING LIGHTNING ARRESTER.

No. 509,784. Patented Nov. 28, 1893.

FIG. 1.

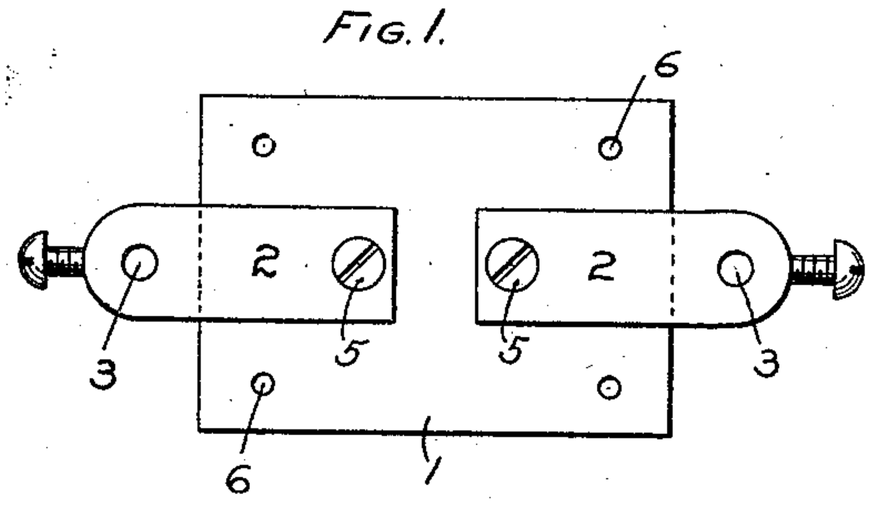


FIG. 2.

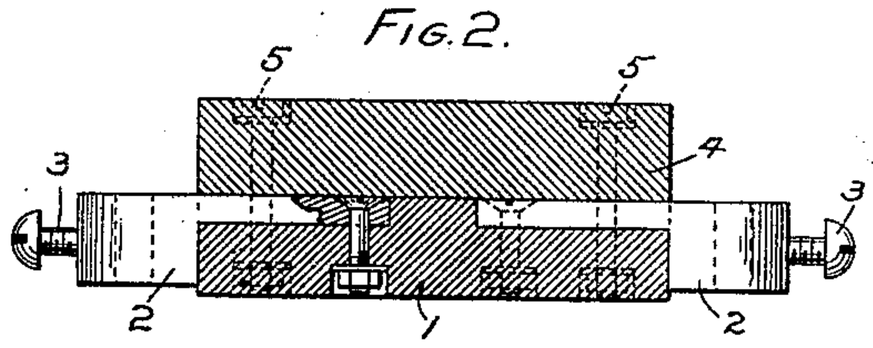


FIG. 3.

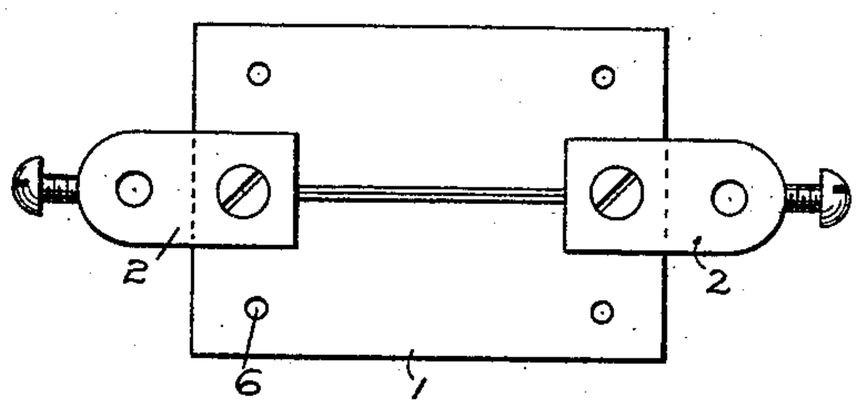


FIG. 4.

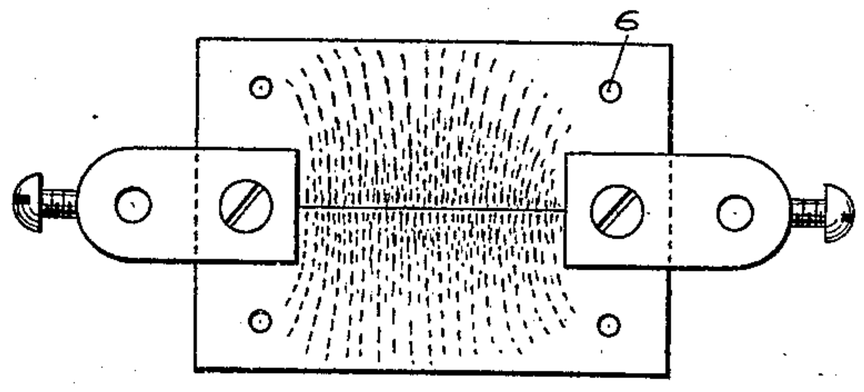


FIG. 5.

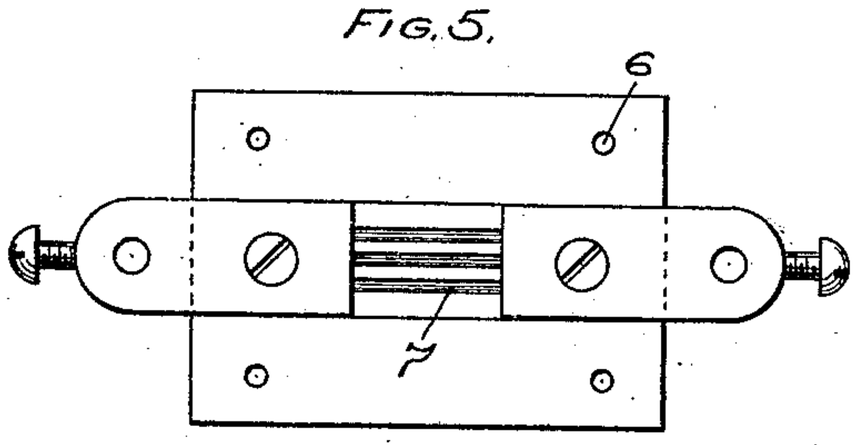


FIG. 6.

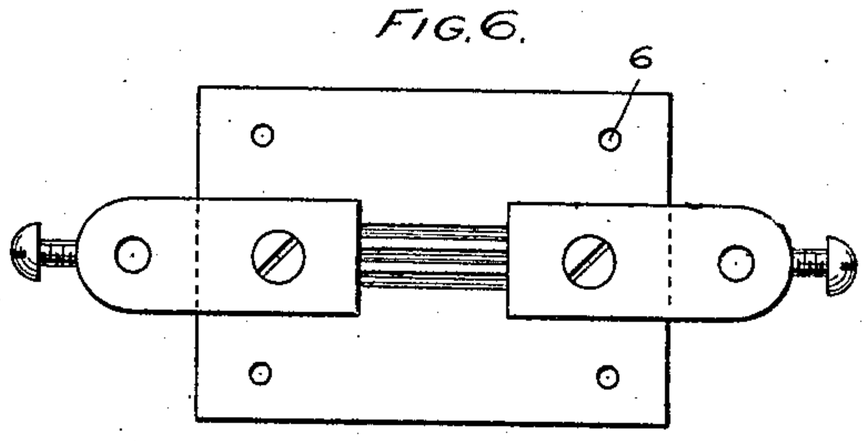


FIG. 7.

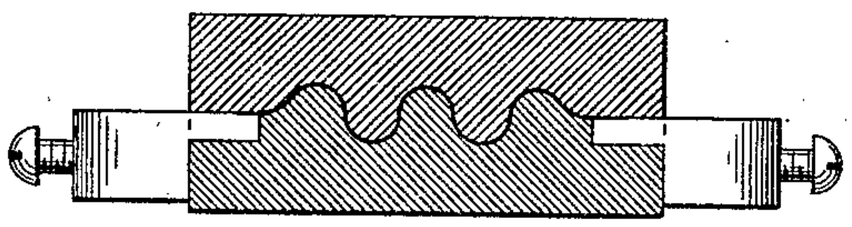


FIG. 8.

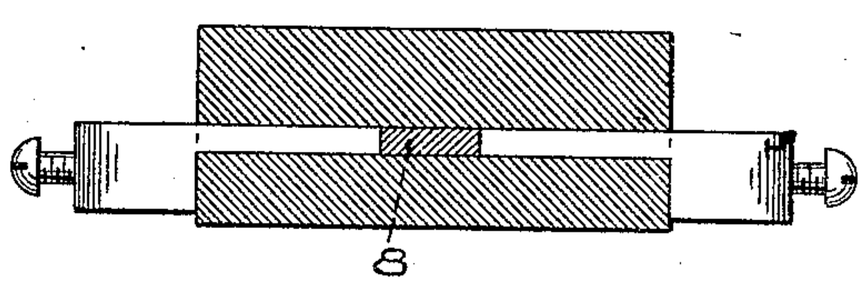
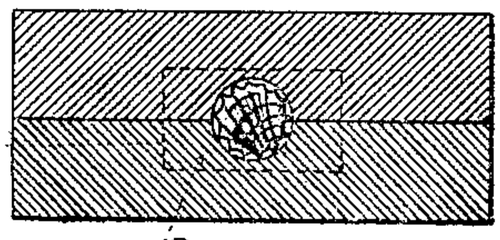


FIG. 9.



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UNIVERSAL NON-ARCING LIGHTNING-ARRESTER.

SPECIFICATION forming part of Letters Patent No. 509,784, dated November 28, 1893.

Application filed May 16, 1893. Serial No. 474,462. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER WURTS, a citizen of the United States, residing in Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Universal Non-Arcing Lightning-Arresters, (Case No. 533,) of which the following is a specification.

My invention has relation to means for protecting electric circuits from the injurious effects of static discharges, and relates particularly to that class of means including provision for preventing the dynamo current from following the static discharge and thus forming an injurious arc.

One object of my invention is to accomplish the above-named ends by the cheapest and simplest means, and such as will occupy the minimum space.

Another object of my invention is to provide a device of this class which shall be non-arcing with both direct and alternating circuits, as distinguished from those devices which permit the formation of a dynamo arc and depend upon the subsequent rupture of the same. My device does not permit even incipient dynamo arcs to form.

My invention depends upon the discovery of the fact that a dynamo arc cannot be developed save in a space of certain minimum dimensions, depending upon the length of the arc to be developed, and the potential of the dynamo current. I have also found it to be true that a disruptive static discharge, while requiring a certain space to develop, will take place in a space of much smaller dimensions than are required by a dynamo arc. Moreover, when a sufficient static potential accumulates, it will provide its own space, if need be. I have made the further discovery that, where the two terminals of a spark gap are necessarily separated a considerable distance on account of the use of high dynamo potentials, the striking potential of the static electricity may be greatly diminished by providing between the terminals what I term a discharge wedge through the dielectric. This consists of a conducting path, of high resistance, and in its preferred form, of extreme tenuity. Such a wedge is found not to facilitate the passage of the dynamo current to any appreciable extent, and yet practice has shown that it greatly facilitates the static discharge. I have made these discoveries practical by the invention hereinafter described, and illustrated in the accompanying drawings, wherein—

Figure 1 is a plan of the terminal plate as used in the simplest form of my invention. Fig. 2 is a central longitudinal section of the same, showing the cover plate in place. Figs. 3 to 6 inclusive are views of different terminal plates as used in various modifications of my invention. Fig. 7 is a longitudinal section of a further modification, and Fig. 8 is a section of a form of my device wherein a wedge is used having an appreciable thickness. Fig. 9 shows a sectional view of a modification.

My invention as above stated depends upon the principle that the static discharge requires much less space than a dynamo arc, and the broad idea of my invention is therefore the use of a spark gap or gaps, wherein the space between the terminals is extremely restricted. The dimensions of this space will of course differ with the potential of the circuit to be protected, and the striking potential calculated for. The form of this space is of course immaterial, but I prefer to use a film of air between two plates or blocks, as more particularly shown in the accompanying drawings. Such a plate or block is shown at 1, and in one of the simplest and most elemental forms of my invention I have made this block of marble, or other non-conducting material. Where the simple restricted space is used, as in the form shown in Figs. 1 and 2, stone is an appropriate material. The plate shown in Fig. 1, I call the terminal plate, because it carries the terminals of the spark gap, which are preferably embedded in the plate as shown more clearly in Fig. 2. These terminals may be made of any good conductor, whether non-arcing or not, and they are respectively connected to the ground and line, as is usual in lightning arresters. The binding posts 3 are provided for this purpose. If now, the spark gaps be used uncovered, as shown in Fig. 1, the static discharge will form

a conducting path for the dynamo current which will immediately form a destructive arc, which will occupy the space immediately above the plate 1. This arc will usually occupy a curved path, as its name implies. If, however, this plate be covered by a second plate 4, called by me the cover plate, and shown in Fig. 2, the exceedingly narrow space or film of air between the two plates will not be of sufficient size to permit the formation of this arc. Whether this is due to the prevention of the passage of metallic vapor from one terminal to the other, under action of the current, or to a simple choking out of the arc by restriction of space, I do not know; the more likely theory would seem to me at present to be the former, but I do not intend to hereby commit myself to any theory. The fact I have established by frequent and various experiments.

If the cover plate 4 be simply laid on the terminal plate, and a static discharge takes place across the terminals, the cover plate will be thrown off, showing that there is an explosive action due to the formation of the spark. If, however, a mere scratch is made between the terminals in the surface of the plate, the discharge will take place without the least disturbance of the top plate, indicating that the explosive effect above noticed is confined to a very small space. In practice it is convenient to fasten the two plates together, as for instance by means of the screws 5 inserted in holes 6 in the two plates.

The arrangement shown in Fig. 1, is, as I have stated, the simplest form of my invention, and that embodying merely the fundamental elements thereof; it is, however, only adapted for use in connection with circuits of such low potential that the terminals may be brought quite near together without danger of formation of a dynamo arc. I have found that where the terminals are quite near together, and a dynamo current of high potential is used, an arc may form in spite of the use of this form of my invention. Thus it will be necessary, where such high potentials are employed, to place the terminals farther apart. Where this is done, however, the striking potential is so high as to greatly endanger the electrical apparatus to be protected, and it is then that I have recourse to the use of the principle of the discharge wedge, above mentioned.

In Fig. 3 the terminals will be seen to be arranged farther apart, and to be joined by three close parallel lines, in the drawings. The middle line represents a conducting thread of great tenuity, such as a mere pencil mark, or streak of graphite upon the surface of the marble or other material of the plate, which streak is preferably made in a scratch or hollow groove, represented by the outside lines. The materials which might be used at will for this conducting wedge are of course manifold, and I do not wish to be understood as limiting myself to the use of graphite in this connection. The degree of tenuity is moreover by no means an essential point. This will be seen in connection with the description of Fig. 8. I have found that when this conducting streak or its equivalent is used, the striking potential is greatly lowered, without any increased danger of the formation of a dynamo arc. The streak or thread seems to act as a wedge through the dielectric, which, being met by the static discharge at the terminals, helps the latter to break down the dielectric, and permits passage of the spark. In my experiments I have connected the two terminals 2 across the mains of a five hundred volt street railway circuit, and at the same time to the two terminals of a battery of Leyden jars, which latter were constantly charged by means of an influence machine run by a motor. Repeated discharges from the Leyden jars passed over the space between the blocks, but the dynamo current was not even established to a sufficient extent to blow out a one ampère fuse put in series with the terminals of the spark gap. This experiment was tried both with a second ordinary spark gap in series with the terminals 2 and the jars, and without this second gap. The results were identical, and it will be understood that in practice, the use of my invention in either arrangement is contemplated by me.

Fig. 4 shows the condition of the surfaces of the two plates after a few discharges of the Leyden jars, where I had employed the lead pencil streak mentioned above. The explosive action of the sparks had thrown the graphite out on each side, and blackened the surfaces of the blocks. Where the streak was made in a groove, as in Fig. 3, this scattering did not occur, but the spark acted to consume the graphite. Such action as this would evidently result before long in rendering my device useless, by raising the striking potential, through destruction of the wedge. In order to prevent this, the construction shown in Fig. 5 may be used. This is in all respects like that shown in Figs. 1 and 2, save that there is placed between the terminals, and preferably let into the terminal plate, a slab or block of carbonizable material, such as wood or fiber. The surface of this material is burned in one or more streaks, as shown, running from one terminal to the other, and preferably parallel. These burned streaks form at once the desired groove, and the conducting wedge, and the results obtained by the use of this modification of my invention, have proved in every respect satisfactory. The advantage of this form of device over that above shown in Fig. 3, is that the spark as it passes, far from tending to destroy the wedge causes further and further carbonization of the slab 7, and thus preserves the conducting threads. These carbonized streaks may be caused in the first instance by the use of the electric spark if desired.

A further modification of my invention is

shown in Fig. 6, wherein the terminal plate itself is made of carbonizable material, a hard grained wood or a mass of fiber being preferred. The streaks are burned into this plate, as shown, and the device will then act as in the case illustrated in Fig. 5.

Still another form of wedge is shown in Fig. 8 where in a body of high resistance material 8 is shown as lying between the terminals, and in contact with them. A compound composed of plaster of paris and graphite in the proper proportions will be found to answer every purpose admirably.

A multitude of ways will occur to the mind of one skilled in this art, whereby conducting paths or wedges may be produced between the terminals of a lightning arrester of this class, but it is to be understood that all such methods are included within my invention; the several modifications shown in the drawings being merely examples which might be indefinitely multiplied.

Although in the figures hitherto described I have disclosed only such forms of my invention as were constructed in two parts, which I have termed a terminal plate and a cover plate, respectively, it is nevertheless fully within the spirit of my invention to construct the terminal support in one piece, and to provide the restricted space for the static discharge within the substance of this piece. This form is shown in Fig. 9, wherein is shown a solid block of non-conducting material such as marble, wherein is bored a hole, in the middle of which is placed a plug of any desired shape, but corresponding to the shape of cross section of the receiving hole, made of carbonizable material, such as wood, and having the grooves burned into its surface. This plug is shown at 9. Of course the burned grooves may be replaced by any other form of discharge wedge as previously described, and indeed the wedge is not absolutely necessary, as has already been set forth.

One of the chief advantages of my invention is its extreme compactness; and in further amplification of this feature, the form shown in Fig. 7 may be employed where it is desirable to get a very great distance between the terminals. By the use of this form, wherein the surfaces of the blocks are shown to be curved and interlocking, the spark is obliged to pursue a long path, and yet the size of the whole structure is not necessarily increased.

I have found the lightning arrester above described to be well fitted for use either with the direct or with the alternating current.

Not only may my device be used to protect constant potential circuits, but it is eminently fitted for use with a constant current system, such as is used for arc lights. Indeed its applicability is universal, being small and light enough for convenient use on railway cars as well as in central stations.

What I claim is—

1. A universal non-arcing lightning arrester consisting of two adjacent spark terminals separated by a space substantially inclosed and too narrow in proportion to its length to permit formation of a dynamo arc upon occurrence of static discharge between said terminals, substantially as described.

2. A universal non-arcing lightning arrester consisting of two adjacent spark terminals separated by a space too small to permit formation of a dynamo arc, and a discharge wedge consisting of a tenuous conducting path of high resistance, substantially as described.

3. In a lightning arrester, two non-conducting plates and a pair of sparking terminals between them, said plates being arranged to form a substantially closed space between said sparking terminals substantially as described.

4. In a lightning arrester, two non-conducting plates, and a pair of sparking terminals let into the surface of one of them, said plates being arranged to form a substantially inclosed space between said terminals substantially as described.

5. In a lightning arrester, two non-conducting plates having correspondingly corrugated surfaces, and a pair of sparking terminals let into the surface of one of them, substantially as described.

6. In a lightning arrester, two non-conducting plates, a pair of sparking terminals let into one of them, and a discharge wedge or conducting path of high resistance on the surface of one of said plates, substantially as described.

7. In a lightning arrester a non-conducting terminal plate, sparking terminals let into the same, a groove between said terminals, and a discharge wedge or tenuous conductor in said groove; in combination with a cover plate placed upon said terminal plate, substantially as described.

8. In a lightning arrester, a non-conducting terminal plate provided with a carbonizable surface having grooves burned upon the same, and a sparking terminal on each side of said surface; in combination with a second non-conducting plate placed upon said terminal plate, substantially as described.

9. In a lightning arrester a terminal plate made of carbonizable material, sparking terminals borne thereon and grooves burned into said plate between said terminals; in combination with a non-conducting cover plate placed upon said terminal plate, substantially as described.

In testimony whereof I have hereunto subscribed my name this 11th day of May, A. D. 1893.

ALEXANDER WURTS.

Witnesses:
HAROLD S. MACKAYE,
JAMES WM. SMITH.