F. S. CHAPMAN.

LIGHTNING ARRESTER.

APPLICATION FILED FEB. 2, 1910.

1,017,649

Patented Feb. 20, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

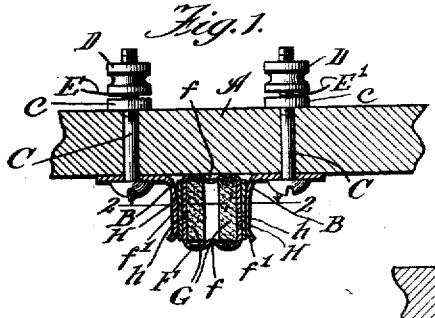


Fig. 4.

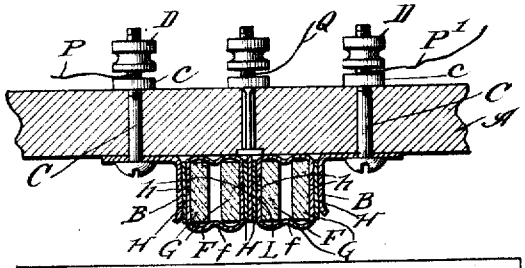
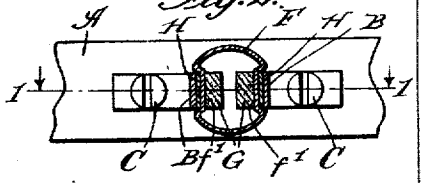


Fig. 2.



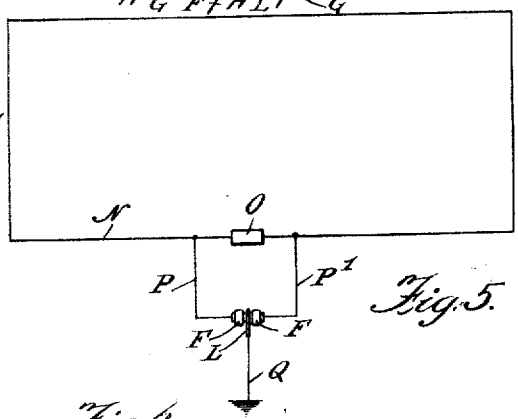


Fig. 5.

Fig. 3.

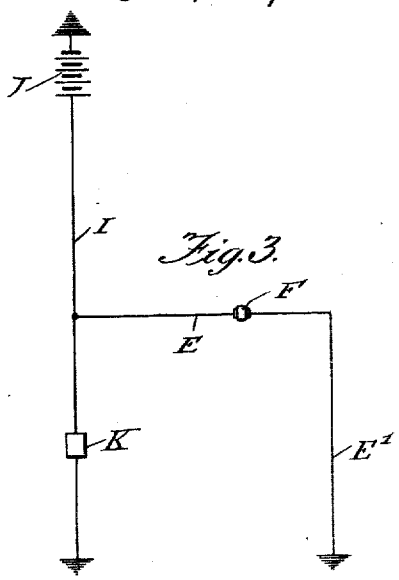
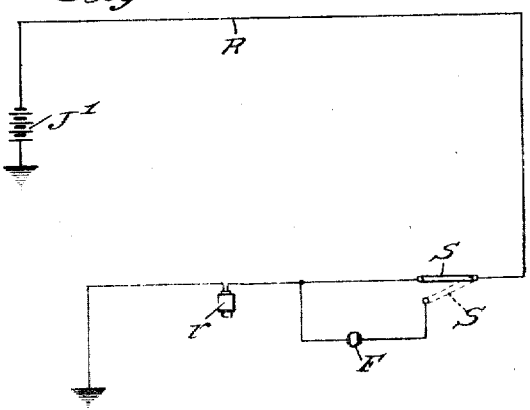


Fig. 6.



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2 SHEETS—SHEET 2.

Fig. 7.

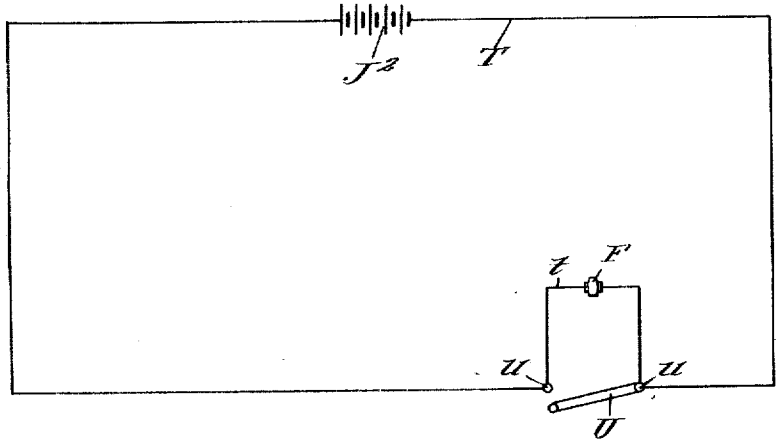
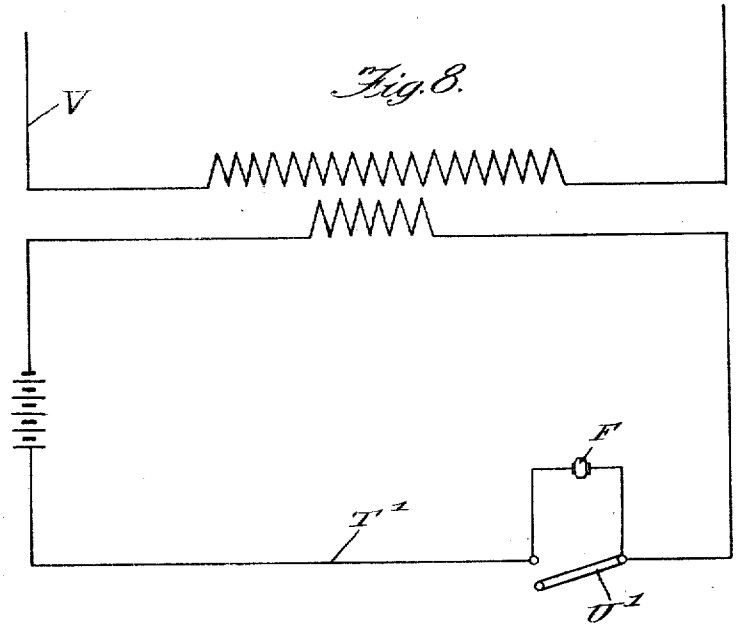


Fig. 8.



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UNITED STATES PATENT OFFICE.

FRANK S. CHAPMAN, OF TOLEDO, OHIO, ASSIGNOR TO THE NATIONAL ELECTRIC SPECIALTY COMPANY, OF TOLEDO, OHIO, A CORPORATION OF OHIO.

LIGHTNING-ARRESTER.

1,017,649. Specification of Letters Patent. Patented Feb. 20, 1912.

Application filed February 2, 1910. Serial No. 541,549.

To all whom it may concern:

Be it known that I, FRANK S. CHAPMAN, a citizen of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Lightning-Arresters, of which the following is a specification.

My invention relates to a device most commonly employed for reducing abnormal potentials on electric circuits so as to protect such circuits at points where excessively high voltages would be destructive or detrimental; devices of this general class being ordinarily termed "lightning arresters", although obviously they may be employed for shunting off high potential charges from a circuit, whether due to lightning or to other causes, either external to the circuit or within the same.

Lightning arresters have been constructed in a number of different ways. Most commonly, they involve a grounded line in which are electrodes spaced apart so as to form a gap, this gap being through the air. Because of the high resistance of air the gap between the electrodes is necessarily narrow. A narrow gap, however, is very soon clogged because of the disintegrating action of the electric current on the electrodes, which are commonly carbon. As a result the ordinary lightning arresters of carbons, held apart by a mica spacer, will seldom satisfactorily stand more than one static discharge of high voltage. After such a discharge, or in any event after several such discharges, the gap between the electrodes is partly or wholly bridged over, with the result that a part or all of the service current escapes to the ground necessitating the removel and scraping of the electrodes or the substitution of new electrodes. In order to obviate these disadvantages in the ordinary constructions of lightning arresters, I have devised a lightning arrester, the salient characteristic of which is that the discharge takes place in a vacuum instead of in the air, this arrangement permitting the electrodes to be spaced farther apart so that the danger of bridging over the gap is very materially diminished. Several different forms of appartus involving this general principle have been shown and described in my co-pending applications Nos. 541,548 and 541,550, filed February 2, 1910, respectively.

The object of my present invention is to provide a vacuum lightning arrester—using the term in its widest significance—which shall have certain new and improved features relating particularly to convenience in handling and using the device, inserting it in and removing it from the circuit and to facilitate manufacture, which will be hereinafter fully described.

The invention has for a further object to provide a device of the character to be hereinafter described which can be used for other purposes than as a lightning arrester or device for shunting high potential charges from an electric circuit. Certain of these other uses will be described herein, it being my object to cover the new combinations of my present invention, regardless of the use to which they may be put.

The invention in certain preferred embodiments is illustrated in the accompanying drawings, wherein—

Figure 1 is a sectional view through a switch-board taken on line 1—1 of Fig. 2. Fig. 2 a sectional view on line 2—2 of Fig. 1. Fig. 3 a diagram illustrating one useful application of the device of my invention. Fig. 4 a sectional view similar to that of Fig. 1, illustrating the use of the device in connection with a metallic circuit. Fig. 5 is a diagram illustrating the circuits in such an installation, and Figs. 6, 7 and 8 are diagrams illustrating different uses to which my invention can be put.

Like characters of reference indicate like parts in the several figures of the drawings.

Referring first to Figs. 1 and 2, A represents the insulating base of a switch-board, or other supporting device, B, B a pair of spring clips which are secured to the base A by the screws C and nuts *c*; the screws C being also provided with the nuts D, by which they may be used as binding posts for the conductors E and E'. Between the clips or terminals B is placed a preferably glass vessel F from the interior of which the air has been partially exhausted. Within the vessel F are the electrodes G, G, preferably made of carbon. Preferably, the electrodes are spaced apart by turning in the ends of the vessel at the points indicated by the letters *f*. Preferably, the vessel *f* is formed with recesses and with the flat sides *f'*, *f'* and secured to the outside of the vessel at these places are the contact

plates H, H, the latter being electrically connected through the sides of the vessel with the electrodes respectively adjacent thereto by means of the short conductors *h*.

In Fig. 3 I have shown the device above described employed as a lightning arrester in connection with a grounded circuit or service line. The latter is indicated by the letter I and is supplied by a battery or other source of current J and contains an instrument K, such as a telephone or other device which it is desirable to protect from the destructive effects of a high voltage discharge. The lightning arrester, the vacuum chamber of which is indicated by F, is interposed in a grounded line E, E'. If the line I becomes charged with electricity at an abnormally high potential, whether because of lightning or any other cause, the high voltage will be shunted off through the arrester F, the electrodes of which G are spaced apart at a sufficient distance and the vacuum in which is of sufficient intensity to prevent the normal service charge from going to the ground over the line E, E', while permitting the static to so discharge.

In Fig. 4 I have shown two vacuum chambers, of the character described, arranged so as to connect with a circuit at two different points, for example, with the two aerials of a metallic circuit.

Fig. 5 is a diagram of the circuits. In these figures the spring terminals B, B are spaced wide enough apart for two vacuum chambers F, F, between which extends a contact plate L, connected with the binding post M. The non-grounded circuit N is connected at two points on opposite sides of the device O to be protected with the binding posts C, C, respectively, by the conductors P, P'. Q is a grounded line leading from the binding post M of contact L. Obviously, this protects the instrument or other device O from abnormal charges on either aerial of the circuit N.

In Fig. 6 I have shown an application of the device of my invention. When a discharge passes between the electrodes G, G, contained within the vacuum chamber H, a violet glow is clearly discernible. In Fig. 6 I have illustrated how this circumstance enables the device to be used to determine whether a conductor is charged, and by a proper design of the device, whether the charge is sufficiently strong. For example, it is desirable that the sparking apparatus of an automobile gasolene engine should be provided with some means for determining whether the spark plugs of the various cylinders are operating properly.

In Fig. 6, R represents one of the spark plug circuits, the spark plug being indicated at *r* and the battery at J'.

S is a switch which, as shown in the full lines, normally closes the circuit R but which can be turned to the dotted line position to include in the circuit one of the devices F, above described. If the latter is properly designed with reference to the intensity of the vacuum and the size and spacing of the electrodes G when the discharge is passed through it by turning the switch S to its dotted line position, the presence of the glow will indicate that the discharge is sufficient to produce a proper spark, the absence of the glow indicating the reverse. Obviously the arrangement may be such that each of the spark plug circuits may be so tested. The use of the device in this connection, as a detector is not specifically claimed herein, the combination being made the subject matter of a co-pending application filed by me February 2, 1910, Serial No. 541,550.

In Fig. 7 the device of my invention is employed for preventing or reducing a surge from the opening of a switch in the circuit. The circuit T contains the battery J^2 and the switch U, a conductor *t* connects the switch terminals U and contains an arrester F of the character described, the vacuum chamber of which is indicated at F. When the switch is opened, the potential, resulting from the surge, is shunted around through the arrester, the latter permitting the discharge of the abnormal potential while not allowing the flow through the conductor *t* of a normal charge. The value of the device is increased in the case shown in Fig. 8 in which the circuit T' is the primary circuit of an induction coil for transforming the current into one of higher voltage, a secondary being shown at V. In such case the opening of the switch U' results in the further increase of the voltage at the air gap, due to the inductive influence of the charge in the circuit V on the circuit T'.

The employment of the arrester in Figs. 7 and 8 prevents destructive arcing at the switches.

It will be seen that my invention contemplates an arrangement of parts permitting the vacuum chamber and electrodes to be readily removed from the circuit and replaced. When one of the vacuum chambers becomes worn out or broken it can be simply slipped out from between the terminals and a new one put in its place.

The terms "vacuum" and "vacuum chamber" have been used in their strictly accurate sense as implying the nearest possible approximation to the complete removal of air and gases but in the whole general sense as indicating a considerable reduced pressure.

It is obvious that the intensity of the vacuum, that is the degree to which the exhaustion of the air may be carried in any case, will depend upon the normal voltage

of the line on which the device is to be used or upon other circumstances dependent upon the particular use of the device in a given installation. The resistance afforded by the vacuum gap varies with the degree of vacuum, and with the residual gases in the vacuum chamber.

While the device as described is particularly intended to be used on relatively low tension lines, such for example as telephone lines, it is capable, by a design of the parts which will be obvious, of being used in connection with circuits carrying higher voltages.

I claim:

1. In a device of the character described, the combination with holding means comprising two terminals, one of which at least is a spring, of a sealed evacuated glass vessel provided exteriorly on opposite sides with contact plates adapted to make contact with said terminals and interiorly with electrodes electrically connected with said contact plates respectively; the walls of said vessel being formed so as to provide inward projections which hold the electrodes in fixed position and spaced apart.

2. In a device of the character described, the combination with holding means comprising two terminals, one of which at least is a spring, of a sealed evacuated glass vessel formed exteriorly on opposite sides with recesses and provided with contact plates in said recesses, said vessel being adapted to be held between said terminals with the contact plates in contact therewith, and a pair of electrodes arranged in said vessel and electrically connected with said contact plates; the walls of said vessel being formed with inward projections between said electrodes which hold the electrodes in fixed position and spaced apart.

FRANK S. CHAPMAN.

Witnesses:
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Correction in Letters Patent No. 1,017,649.

It is hereby certified that in Letters Patent No. 1,017,649, granted February 20, 1912, upon the application of Frank S. Chapman, of Toledo, Ohio, for an improvement in "Lightning-Arresters," an error appears in the printed specification requiring correction as follows: Page 2, line 121, after the word "used" insert the word *not;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 26th day of March, A. D., 1912.

[SEAL.]

C. C. BILLINGS,

Acting Commissioner of Patents.