

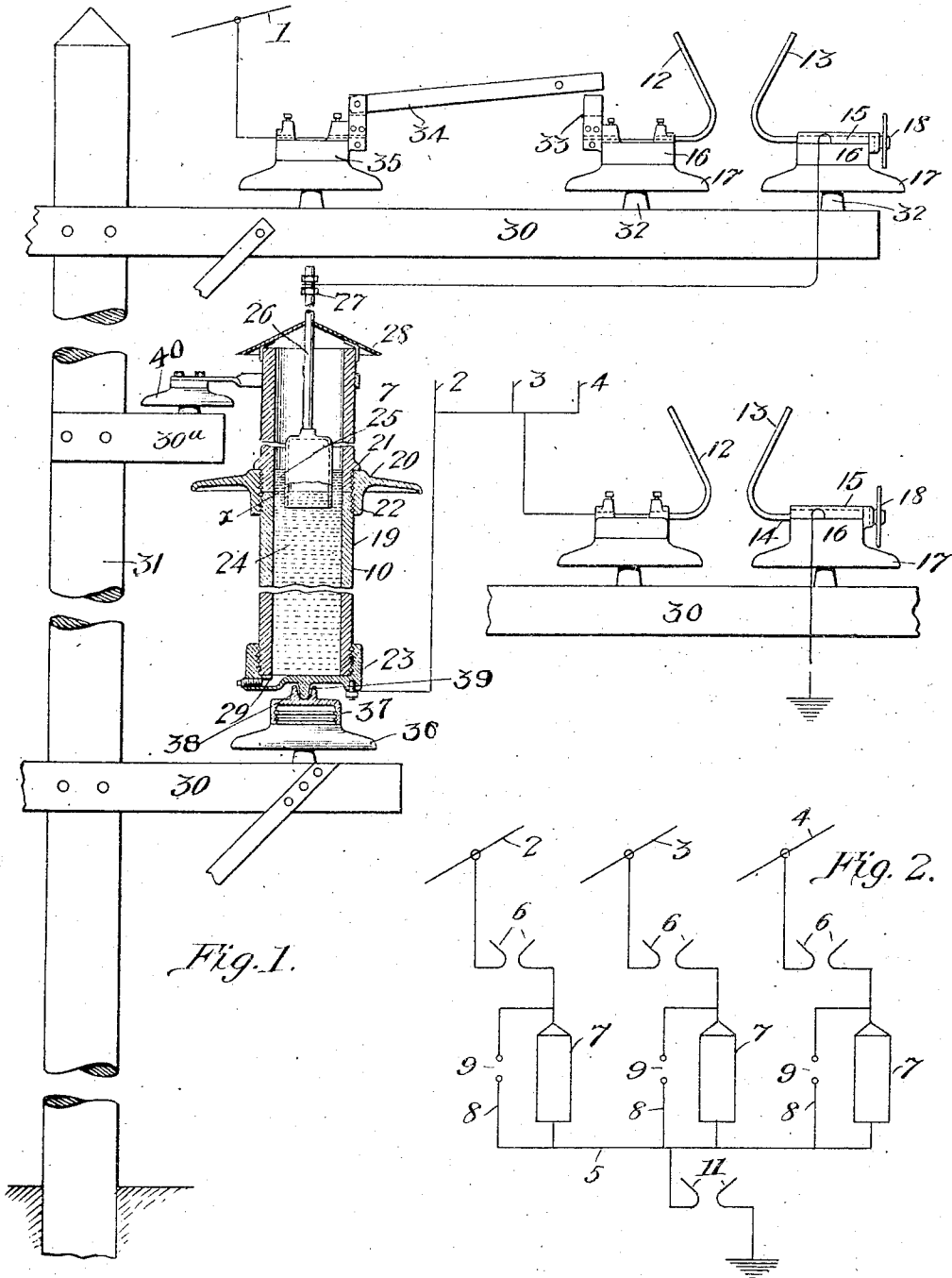
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LIGHTNING ARRESTER.

APPLICATION FILED JAN. 29, 1906.

1,061,671.

Patented May 13, 1913.



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# UNITED STATES PATENT OFFICE.

JOHN D. HILLIARD, JR., AND CHARLES E. PARSONS, OF GLENS FALLS, NEW YORK.

## LIGHTNING-ARRESTER.

1,061,671.

Specification of Letters Patent.

Patented May 13, 1913.

Application filed January 29, 1906. Serial No. 298,439.

*To all whom it may concern:*

Be it known that we, JOHN D. HILLIARD, Jr., and CHARLES E. PARSONS, citizens of the United States, residing at Glens Falls, in the county of Warren and State of New York, have invented certain new and useful Improvements in Lightning-Arresters, of which the following is a specification, reference being had therein to the accompanying drawing.

Our invention relates to safety systems and especially to lightning arresters therefor.

The object of the invention is the provision of means which will adequately take care of all discharges on the line.

In order to secure adequate lightning protection an arrester scheme must meet the following conditions: First, it must furnish a discharge path between wires of the same circuit which will equalize the pressure whenever a dangerous difference of potential exists; second, it must perform the same function between the wires and the ground; third, whenever an arc is established across gaps between lines or between lines and ground, the arc must be automatically ruptured as soon as the line resumes its normal condition; fourth, in order that no discharge may cause a short circuit, suitable resistance must be inserted between the lines, and this resistance must have such a heat capacity that it can withstand repeated discharges without being destroyed; fifth, the resistance circuit must be as nearly non-inductive as possible. The voltage required to break down the gaps to ground must be greater than between lines, or in other words, the break down voltage between lines must be as nearly equal to the operating voltage as possible and allow a proper factor of safety so as to insure against a break down under normal operating conditions. This necessarily means a greater break-down voltage to earth, for if one wire of a circuit becomes grounded the condenser action between line and ground produces an excessive voltage across the gap or gaps and tends to establish an arc at the arrester which will eventually result in the destruction of the same. Experience has shown that in nearly every instance it is the outside turns of the coils at the outside of the transformer which are destroyed, or in other words it is a high voltage between lines rather than to ground which causes the

break-down, although in large transformers the transformer electrostatic capacity may be so great that the charging current to the transformer as a condenser may cause the break-down.

Our invention is designed to meet the foregoing conditions and to obviate all the difficulties mentioned.

It comprises a resistance which can withstand repeated high voltage and large energy discharges, with a gap which of itself regulates and limits the duration of arc discharges.

Further objects of the invention will appear upon reading the specification in connection with the accompanying drawing which forms a part of the application and in which—

Figure 1 is a diagram showing in detail the position of the gaps and resistances with relation to the lines and the ground. Fig. 2 is a diagram of the circuit used.

Referring to the drawings 1, 2, 3 and 4 represent four lines, three only of which are shown in the circuit diagram and between which and a common connection 5 to ground are interposed the arresters 6 and the resistances 7. In parallel with each resistance 7 is a special arrester shunt circuit 8, having the gap 9 which is adjusted to a high break down point so that an excessive stroke meeting too great opposition in the resistance will jump the gap and go to ground on a short circuit. The balls forming the terminals of the gaps are preferably mounted upon the several tile cases of the resistances 7. Interposed between the ground and the common connection 5 is a single "horn" arrester 11. The arresters 6 and 11 as used by us are similar to the common "horn" type in that two horns 12 and 13 are employed, diverging from their lower extremities to their outer ends. With our invention, however, the horn 13, is provided with a rearward extension 14, which is dove-tailed on its bottom and slidably mounted in a groove formed in an iron cap 15, cemented to an insulator 16, which is provided with a crown to receive the cap and the usual petticoat 17. The extension 14 is provided with a threaded end on which the thumbscrew 18, is mounted. By this means the horn 13 may be adjusted toward and away from the horn 12, thus making the point of break-down low or high. The resistances 7 are composed each of an outer

shell 19 of porcelain or other suitable material, which for high voltages may be constructed of a plurality of unit lengths, each pair of units being connected together by a collar or petticoat 20 cemented to the lengths in the following manner: The collar or petticoat is slipped over the lower end of the upper length of the shell while the same is held upside down and cement is inserted between the collar and the shell, which cement rests against a flange 21 formed on the shell or against a temporary stop held around the shell in the same position. The lower length of the shell is then placed within the flange 22 and a pitchy substance inserted so as to rest on top of the cement and to cover the joint between the upper and lower halves of the shell. Cement is then placed upon the pitchy substance between the lower length and the flange 22. The ends of the lengths of the shell are corrugated as shown so that a surface is provided to which the cement will hold with great tenacity. The lower portion of the shell is corrugated and the bottom 23, of metal, similarly corrugated so that it may be cemented to the shell in a like manner to the petticoat, with the pitchy substance at the joint between the shell and the bottom.

The receptacle is filled to a point marked X with acidulated water or saline solution 24, the strength of which regulates the resistance. This solution is covered with oil 25 to prevent evaporation. Floating on the top of the liquid is a hollow terminal member 25<sup>a</sup> open at the bottom so that its walls may be exposed to the same pressure within and without under all conditions to prevent collapsing. Projecting perpendicularly from this float is a vertical conducting rod 26 passing above the shell and serving both as a telltale to indicate the liquid level in the casing and also as one terminal. Clamping nuts 27 are threaded on the end of the rod, to which the line wire can be attached. A suitable top 28 is placed upon the shell to exclude rain, dust, etc., and the bottom 23 is provided with an outlet port 29 by which the contents of the shell may be drained.

In the working embodiment of the invention the "horn" arresters and the resistances are mounted in the following manner on cross-arms 30 secured to the pole 31: The insulators of the horn arrester are secured upon wooden pins 32 set a proper distance apart. The insulator holding the horn 12 is provided with the receiving member 33 of a knife switch 34 supported on an insulator 35 similar to the insulators 16, and adapted to form the terminal of the line wire. An insulator 36 secured to one of the cross-arms 30 is provided with an iron cap 37 having a cup-shaped portion 38 adapted to receive a stud 39 integral with the bottom 23 on the shell 10. This pivots the shell 10 so

that it can be rotated if desired or necessary. Surrounding the shell at the top is a band of metal connected to an insulator 40, mounted on a cross-arm 30<sup>a</sup> and adapted to permit rotation of the shell and at the same time hold it in a vertical position.

When the line is affected by heavy charges so that its potential is raised to a dangerous point, an arc springs from one horn to the other, reducing the potential difference, and gradually rises along the diverging horns, thus eventually breaking itself. If it is the pressure to ground which is raised the current jumps the gap at the arrester 11. When a discharge arcs from one side of the arrester to the other, metallic gases are formed affording a low resistance path for the current. This arc is continued sometimes long after the abnormal condition of the line has ceased to exist and is of course very detrimental to the arrester. To avoid this we interpose the resistances 7 which are sufficient to prevent current at normal potential from leaking to ground. Should the points of the arrester be too close to each other and the resistances 7 inadequate, part of the acidulated water or saline solution may be drained through the port 29 and fresh water added by removing the top 28 and the points may be adjusted by revolving the thumb-screw 18. This increases the air gap and also increases the resistance. When opposite conditions occur, more acid may be added and the points of the arrester moved toward each other which will decrease the resistance by decreasing the length of the air gap.

Having thus described our invention what we claim and desire to secure by Letters Patent is—

1. The combination with a three conductor electrical circuit, of three bridge circuits connecting the three main conductors to a common point, an arrester and a switch in each bridge circuit, an adjustable resistance shunted by a gap in each bridge, and a connection from the said common point through an arrester to ground, whereby any one of the phases or conductors can be disconnected without disconnecting the others and a balance is maintained under normal conditions.

2. A protective system for multiphase circuits comprising the following instrumentalities: a bridge circuit from each conductor to a point common to all of them, a switch, and a high potential discharge means in each bridge between its conductor and a common point, and separate high potential discharge means connected between said common point and the ground.

3. A protective system for multiphase circuits comprising the following instrumentalities: line conductors carried on insulators, separate insulators associated with each line

conductor, a switch, a high potential discharge means and a resistance carried on said associated insulators, a bridge wire from each of the line conductors through its switch, discharge means, and resistance, to a common point; and a separate high potential discharge means connected between said common point and the ground, the switch connected with each bridge wire arranged to be accessible and movable independently of the other switches, whereby any one or more phases can be disconnected from ground, a balance being maintained under normal conditions.

4. The combination with a three-conductor electrical circuit, of three bridge circuits connecting the three main conductors to a common point, an adjustable resistance shunted by a gap in each bridge, and a connection through an adjustable gap from the common point to ground, substantially as described.

5. A protective system for multi-phase circuits comprising the following instrumentalities: a bridge circuit from each conductor to a point common to all of them, high potential discharge means and a resistance in each bridge between its conductor and the common point, and separate high potential discharge means connected between said common point and the ground, substantially as described.

6. A protective system for multi-phase circuits comprising the following instrumentalities: a bridge between each of the line conductors and a common point, an adjustable high potential discharge means and an adjustable resistance in each bridge, and separate adjustable high potential discharge means connected between said common point and the ground, substantially as described.

7. A protective system for multi-phase circuits comprising the following instrumentalities: a bridge from each of the line conductors to a common point, means in each bridge adapted to resist the passage

of current at normal line voltages, but to break down and permit the passage of current at an excessive voltage, and high potential discharge means connected between the common point and ground, substantially as described.

8. A protective system for transmission circuits comprising the following instrumentalities: a line conductor carried on insulators, separate insulators associated therewith, a switch and an adjustable high potential discharge means carried on said associated insulators, a bridge wire from the line conductor through said switch and discharge means in series to ground, the said switch arranged to be accessible, visible, and movable from a distance, whereby an operator before and after adjusting the high potential discharge means may disconnect and thereafter connect the line conductor to the high potential discharge means with certainty and without risk.

9. A protective system for transmission circuits comprising the following instrumentalities: a line conductor carried on insulators, a triple set of separate insulators associated therewith, a switch blade and an adjustable high potential discharge means mounted across said insulators, the middle insulator carrying connected cooperating terminals of both the switch and the discharge means, an electrical connection from the line conductor to one terminal of the switch and in series through the switch and discharge means to ground, whereby an operator when adjusting the discharge means may disconnect the same with absolute certainty and safety.

In testimony whereof we affix our signatures in presence of two witnesses.

JOHN D. HILLIARD, JR.  
CHARLES E. PARSONS.

Witnesses:

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WM. B. SMITH, JR.