

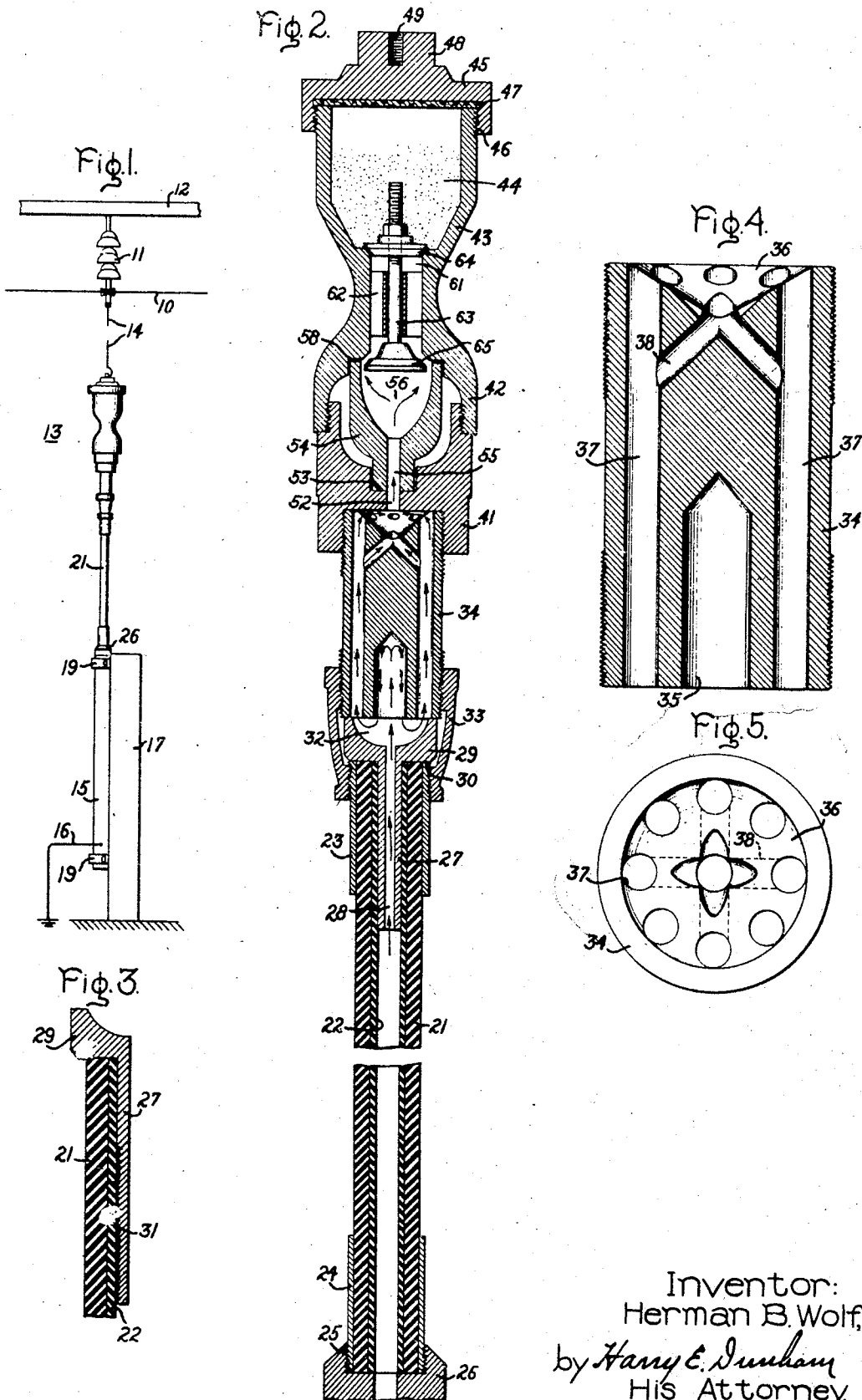
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LIGHTNING ARRESTER

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LIGHTNING ARRESTER

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This invention relates to electric protective devices, and more particularly to devices of this character known as lightning arresters and designed primarily for the protection of electrical equipment from damage by lightning discharges or other abnormal potentials.

This invention is in the nature of an improvement over the construction shown in my prior Patent No. 1,960,653, issued May 29, 1934. The lightning arrester is of the type having a pair of spaced electrodes with a cylindrical fiber tube arranged therebetween. Initially, a small amount of conductive powder adhering to the inner side walls of the tube provides a relatively low resistance path for the discharge between the spaced electrodes. The flow of dynamic current following the ionization of the gap immediately vaporizes the conducting powder adhering to the tube wall which vapor is expelled together with the gas formed by the disintegration of a portion of the fiber tube. For reconditioning the lightning arrester for a subsequent operation, a reservoir of conductive powder is provided in the upper end of the structure together with valve means automatically operable by the increased pressure created by the arc gap, which valve operates to drop a small portion of powder down through the tube after the pressure therein has decreased indicating that the arc has been extinguished. In passing through the tube, the powder coats the side walls and the arrester is in readiness for a subsequent discharge.

Under severe operating conditions, such as prevail in connection with very high voltage power circuits, the correspondingly high discharge currents flowing through the arrester give rise to exceedingly high pressures and temperatures. Such pressures acting upon the valve of the arrester device may cause injury thereto, while the high temperature of the gas forcing past the valve into the reservoir may cause the ignition of the powder stored therein. It is a general object of this invention, therefore, to provide a new and improved lightning arrester of the type referred to having an extremely high current carrying capacity.

It is a more specific object of this invention to provide a new and improved lightning arrester of the general type described that is capable of withstanding extreme conditions of temperature and pressure as may occur upon a heavy current flow therethrough from the line to ground.

For a consideration of what I believe to be novel and my invention, attention is directed

to the following description and the claims appended thereto taken in connection with the accompanying drawing.

Fig. 1 is an elevational view illustrating one application of a lightning arrester constructed in accordance with the present invention; Fig. 2 is a sectional view of an embodiment of the invention; Fig. 3 is a fragmentary sectional view illustrating one detail of the construction; Fig. 4 is an enlarged sectional view of one portion of the arrester; and Fig. 5 is a top view of the portion shown in Fig. 4.

With reference to Fig. 1 of the drawing, the lightning arrester is illustrated in a typical installation for protecting a power line from lightning surges. The transmission line or bus bar 10 is suspended by insulators 11 from a suitable supporting arm or girder 12. The arrester is indicated generally at 13, and is connected in a high resistance electrical path between the transmission line 10 and ground, this path including a spark gap comprising spaced electrodes 14 and a metal pipe or conduit 15. The pipe 15 is grounded as indicated in the drawing by conductor 16 and is mounted on a suitable support 17 by means of brackets 19, this pipe being open at both ends and communicating with the interior of the arrester 13, as described more fully hereinafter.

The portion of the arresting device 13 in which the arc is formed during discharge is illustrated as consisting of a substantially cylindrical tube 21 of molded phenolic condensation product or other insulating material having an inner liner or shell 22 of fibrous material. The tube 21 is open at each end and is supported in metal ferrules 23 and 24 adjacent its upper and lower ends, respectively. The lower end of the ferrule 24 is threaded as indicated at 25 for connection to the pipe 15 through a suitable metal reducing coupling 26 whereby the device 13 may be adequately supported and grounded. The coupling 26 also forms an electrode at the lower end of the discharge chamber. A metal electrode, or anode 27 comprising an elongated cylindrical portion having an opening 28 therethrough extends downwardly in a tightly fitting relation within the upper end of the fiber liner 22. The upper end of the electrode 27 is provided with a head 29 having a shoulder 30 abutting against the upper ends of the tube 21 and the liner 22. The outer surface of the lower end of the electrode is provided with circumferentially extending serrations such as are shown at 31 in the enlarged fragmentary view of Fig. 3 to increase

the turbulency of the gas forced between the fiber tube and the lower end of the electrode. This effectively prevents a rise in pressure between the end of the fiber tube and the electrode head and eliminates stress between the tubes and the ferrule 23.

It will now be appreciated that the tube 21 and the inner shell 22 constitute a chamber of elongated shape in which a discharge may occur between the upper electrode 27 and lower electrode 26 upon the application of electrical energy of sufficient voltage and frequency thereto, and while it is found convenient to construct this chamber of tubular shape to facilitate manufacture of the device and reduce the cost of materials, the precise shape of the chamber is not of major importance.

If the interior walls of this chamber are coated with conducting material, for instance an aluminum powder, the resistance of the path between the anode 27 and the pipe 15 will be materially reduced and the formation of an arc between these conductors will be facilitated. The heat of this arc, however, will rapidly vaporize the conducting coating, thus materially increasing the resistance between the conductors, and the heated gas including the vapors of the coating will be expelled violently from the lower end of the chamber and through the pipe 15 to a point adjacent the ground where they are exhausted harmlessly, this expulsion of gas serving to blow out or extinguish the arc formed within the chamber. It will be understood that the opening of the circuit is facilitated by the destruction of the conducting coating and the consequent increase in electrical resistance of the path between the anode 27 and the pipe 15.

The ferrule 23 is threaded at its upper end to receive a coupling member 33 which in turn is threaded onto the lower end of the baffle member 34. The upper surface of the anode head 29 is recessed defining a chamber 32 and the outer rim of the anode head 29 is securely clamped by the coupling 33 between the upper end of the ferrule 23 and the lower end of the baffle member 34.

The baffle member 34, as is more clearly illustrated in Figs. 4 and 5, is provided at its lower end with a recessed expansion chamber 35, conical in shape at its upper extremity, and which chamber is in central alignment with the passage 28 through the anode 27. The upper end of the baffle member 34 is provided with a conical recess 36, while a plurality of circumferentially arranged tubular passages 37 extend longitudinally through the baffle member 34 communicating between the chamber 32 and the recess 36. From the lowermost portion of the recess 36 a plurality of radially extending and downwardly sloping passages 38 are provided for reasons which will become obvious as the description proceeds. The outer ends of the passages 38 communicate with passages 37.

The upper end of the baffle member 34 is threaded into the lower end of a coupling member 41, the upper end of the coupling member 41 being in turn threaded to a flanged portion 42 of the reservoir head 43. The upper end of the reservoir 44 is normally closed by means of a cap 45 which is threaded thereon as indicated at 46, a washer 47 being provided between the cap and the reservoir to effectively seal the latter.

The upper portion of the cap 45 is provided with a boss 48 having a threaded aperture 49

into which a conducting element comprising a portion of one of the electrodes 14 described in connection with Fig. 1 of the drawing may be secured.

The coupling member 41 is provided with an axially extending opening 52 and is recessed to form a shoulder 53 for cooperatively receiving the lower end of the funnel 54. The lower end of the funnel 54 is provided with a central opening 55 in alignment with the opening 52 while the side walls of the upper portion thereof define a chamber 56. The funnel 54 is securely clamped between a suitable shoulder 58 provided in the inner surface of flange 42 and the shoulder 53 of coupling member 41.

Communicating between the chamber 56 and the interior of the reservoir 44 is a cylinder 61 provided with a plurality of inwardly extending lugs 62 which serve as guide means for a reciprocating valve stem 63. At its upper end the valve stem 63 is provided with an adjustable valve head 64 cooperating with a suitable seat formed at the lower end of the reservoir. At its lower end the valve stem is provided with a valve head 65 which is designed for cooperation with a suitable seat formed at the lower end of the cylinder 61.

It will thus be seen that the valve stem 63 is supported for free vertical sliding movement in the guide lugs, and when in the lower position as shown in Fig. 2 of the drawing, the valve head 64 engages with its seat to seal the lower end of the reservoir 44. When the valve stem 63 is raised to engage the valve head 65 with its valve seat, coating material may flow out of the reservoir 44 and between the lugs 62 substantially filling the cylinder 61. When the valve stem 63 now drops to the lower position in which it is shown in Fig. 2, the coating material collected in the cylinder will flow downwardly into the funnel chamber 56 through openings 55 and 52 into the conical recess 36 of the baffle member 34. From the conical recess 36 the material will flow downwardly through the sloping passages 38 and passages 37 into the chamber 32 and through the anode opening 28 into the discharge chamber defined by the fiber liner 22. In passing through the discharge chamber the powdered material will lodge principally on the surface of the fiber liner 22 reconditioning the arrester for a subsequent operation and any excess material will flow on through the pipe 15 to the ground.

The operation of the device will now be apparent. Upon the occurrence of an abnormal condition on the power line 10, such as the setting up of a high voltage disturbance thereon as the result of a flash of lightning or other abnormal voltage, a discharge will be effected across the external arc gap 14 and through the metal parts of the device 13 to the anode 27. The current will continue to flow readily between the anode 27 and the grounded pipe 15 by reason of the deposit of conductive coating, for instance powdered aluminum, on the fibrous liner 22. As the result of the heat developed by the current, the conductive coating will be vaporized and the heated air, gas, or vapor will be forcibly expelled from the lower end of the device 13 into the pipe 15 to a point adjacent the ground as hereinbefore explained.

The pressure developed in the arcing chamber will be communicated through the anode opening 28, the passages 37 in the baffle member 34, the openings 52 and 55, to the funnel chamber

56. The increase in pressure within the funnel chamber 56 acting upon the lower surface of the valve head 65 will force the valve stem 63 upwardly, moving valve 65 to the closed position and opening the valve 64. A fresh supply of coating material will pass from the reservoir 44 into the cylinder 61. As the pressure is released by the expulsion of gas from the lower end of the device, the valve stem 63 will fall to its initial position, and the fresh supply of coating will be discharged downwardly through the funnel chamber 56 as hereinbefore described and upon the walls of the fiber liner 22 reconditioning the latter for the next discharge.

It will be understood that during and immediately subsequent to a high capacity discharge, the gas pressure at the lower end of the anode 21 is many thousand pounds per square inch and the temperature is momentarily that of the electric arc. The high temperature gas jet flowing upwardly through the relatively narrow opening 28 in the anode will be somewhat throttled thereby and in emerging from the upper end of the opening will expand in the chambers 32 and 35. The temperature of the gas jet will be cooled considerably due to the expansion thereof and in impinging upon the relatively cool surfaces defining the expansion chamber 35. After striking the upper end of the chamber 35 the gas will flow downwardly along the side walls into the chamber 32 and then upwardly through the passages 37, 38, 52, 55 into the funnel chamber 56 where further expansion of the gas and further cooling thereof will take place. Due to the successive throttling, expanding and baffling of the gas, the pressure rise in the funnel chamber 56 will be relatively slow so that the motion of the valve assembly resulting from this pressure increase is sufficiently slow to prevent overstressing of any part thereof. It will be understood of course that before the valve head 65 can be moved to the closed position, a certain amount of gas will pass into the cylinder 61 and upon the opening of the valve 64, this gas will pass on into the reservoir 44. The gas entering into the reservoir 44 will be of a relatively low temperature, that is, materially below the melting point of the stored powder.

Due to the relatively long path taken by the powder discharged from the cylinder 61 to the discharge chamber, ample time exists for all of the extremely hot gases to be cleared from the expansion chamber before the powder reaches it, so that the reconditioning powder will not be immediately vaporized.

It will be observed that the arrangement described is of a relatively simple nature, is light and readily constructed, and may be quickly installed in any protective system. The occurrence of an abnormal condition in the line is readily detected by the flash of a discharge

through the lower end of the device so that any necessary steps to correct the condition may be taken promptly.

Having described the principle of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that I do not wish to be limited thereto, since many modifications may be made and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an electric protective device, the combination of a discharge chamber having a pair of spaced electrodes associated therewith, said chamber having a portion receiving a finely divided conducting coating disposed in the electrical path between the electrodes and destructible when heated, a reservoir constituting a source of supply of such coating, a valve for controlling the supply of coating from said reservoir to said chamber, an opening communicating with said discharge chamber, a baffling member having an expansion chamber disposed over said opening, and passages through said baffling member communicating between said valve and said opening.

2. In a lightning arrester of the type having a discharge chamber adapted to be automatically reconditioned following an electrical discharge therethrough by finely divided material from a quantity thereof in a reservoir positioned in the upper part of said lightning arrester, the combination of a valve operable by pressure generated in said discharge chamber for passing a portion of the material in said reservoir to said discharge chamber, a passage extending between said discharge chamber and said valve, baffling means including an expansion chamber arranged in said passage whereby said valve is protected against the direct force of the pressure gases generated in said discharge chamber.

3. In an electric protective device, the combination of a discharge chamber having a pair of spaced electrodes therein, said chamber having a portion for receiving a finely divided conducting coating disposed in the electrical path between said electrodes and destructible when heated, a reservoir constituting a source of supply for such coating, a valve for controlling the supply of coating from said reservoir to said chamber, a passage through one of said electrodes for material passing from said reservoir to said chamber, a member arranged between said one electrode and said reservoir having an expansion chamber in alignment with said passage, and passages through said member for material flowing from said reservoir to said chamber.

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