E. E. F. CREIGHTON.

PROTECTIVE DEVICE.

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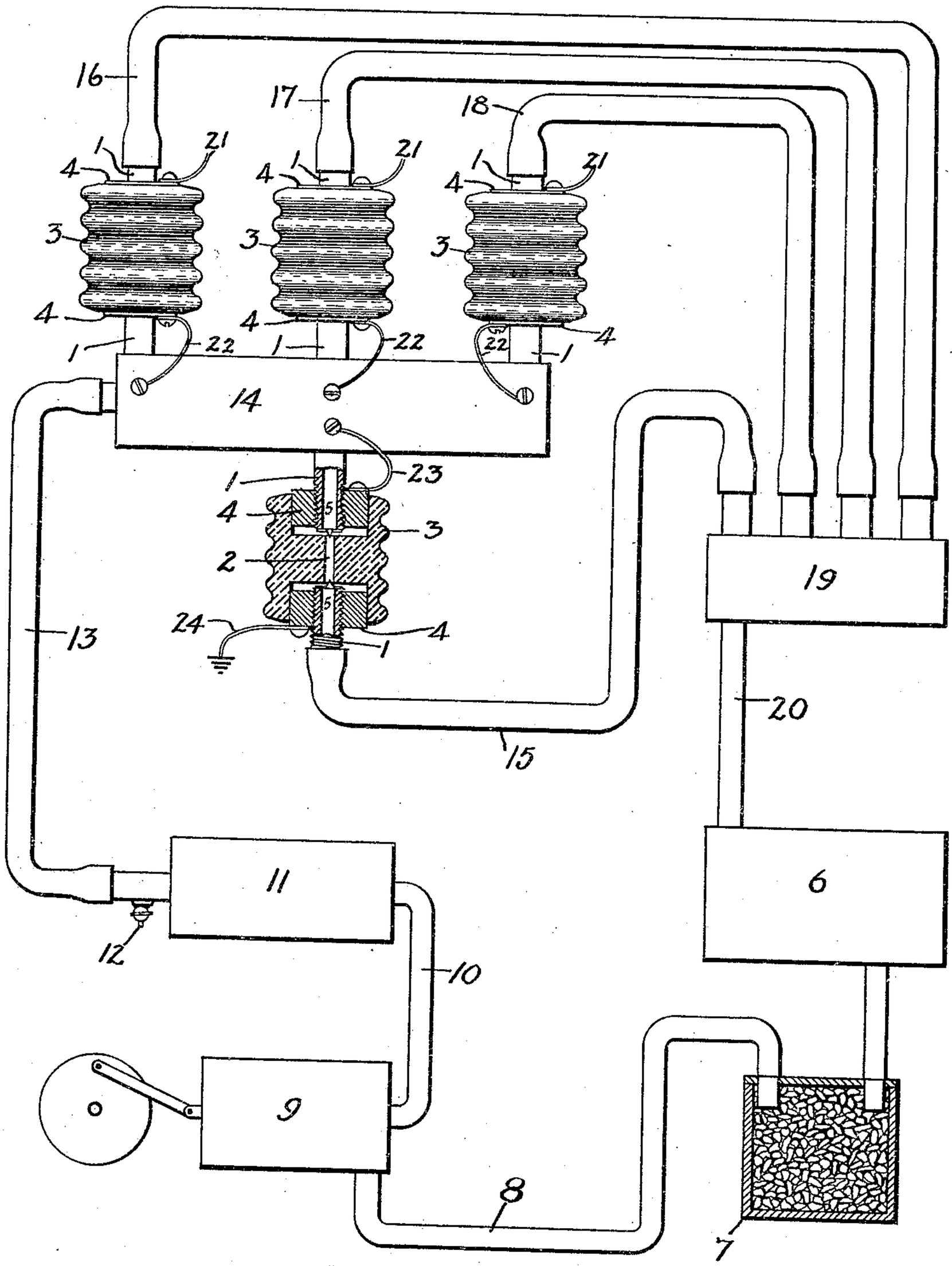
991,483.

Patented May 9, 1911.



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UNITED STATES PATENT OFFICE.

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PROTECTIVE DEVICE.

991,483. Specification of Letters Patent. **Patented May 9, 1911.**

Application filed September 18, 1907. Serial No. 393,450.

To all whom it may concern:

Be it known that I, ELMER E. F. CREIGHTON, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Protective Devices, of which the following is a specification.

My invention relates to protective devices for electrical conductors and more particularly to protective devices of the type in which a spark gap is interposed between a conductor and the ground to relieve the conductor of abnormal voltages.

A common type of protective devices comprises two electrodes separated by a gap of certain length, the one electrode connected to ground and the other to a conductor. If the potential on the conductor increases beyond the normal, a disruptive discharge takes place between the two electrodes and reduces the voltage on the conductor to normal. The disruptive discharge vaporizes minute particles of the electrodes and this vapor tends to move across the gap with a velocity depending upon the molecular weight of the material of which the electrode is composed. As soon as the vapor from either electrode extends across the gap, a conducting path is formed through which current flows, forming an arc. Since an arc from the conductor to ground will destroy the electrodes if it persists and is usually of a character to form an arcing ground and set up very severe electrical disturbances on the conductor, various devices for extinguishing the arc as quickly as possible have been used, none of which are operative until after the arc has been established, so that the disturbances on the conductor and damage to the apparatus due to the presence of an arcing ground on the system are not prevented.

The object of my invention is to provide a protective device which will quickly relieve the conductor of abnormal voltage and entirely prevent the formation of an arc between the conductor and the ground, so that the disadvantages arising from the presence of the arc are avoided.

A further object of my invention is to arrange a protective device having electrodes separated by a spark gap so arranged that any desired insulating fluid or gas may be used as a dielectric between the electrodes.

In carrying out my invention I arrange the protective device so that a disruptive discharge may take place and relieve the conductor of abnormal voltage, but the formation of an arc to ground is prevented. In the preferred arrangement an electrode connected to the conductor is separated from another electrode connected to ground by a spark gap which breaks down as soon as the voltage in the conductor becomes abnormal, and a jet or blast of insulating fluid, such as air, is caused to flow over the electrodes with such velocity that the arc never forms. This result is attained when the velocity of the insulating fluid is greater than the velocity with which the vapor of the electrode moves away from the electrode, so that the vapor from the electrode is carried away from the spark gap so rapidly that the gap is never bridged by the vapor from either electrode. The fluid between the electrodes which has been ionized by the disruptive discharge is continually swept away and replaced by fresh, cool insulating fluid, so that the disruptive discharge ceases the instant the voltage for the conductor becomes normal.

The arc always starts from the negative electrode and the blast or jet of insulating fluid should be directed so as to carry the vapor from the negative electrode away from the spark gap. Many different arrangements may be used to make sure that the jet of insulating fluid will carry the vapor from the negative electrode away from the spark gap, but in the preferred arrangement two spark gaps are connected in series and the insulating fluid is caused to flow in one direction in one gap and in the other direction in the other gap, so that the discharge may start through the two gaps in either direction and a jet of insulating fluid will be flowing in the proper direction to carry the vapor of the negative electrode away from the spark gap.

To permit the use of any desired insulating fluid, such as nitrogen or other inert

gas, the electrodes are placed in a closed system of piping through which the desired insulating fluid is circulated at the proper speed, and if desired, a drier may be inserted in the system of the piping to abstract all moisture from the insulating fluid, thereby rendering it more effective.

My invention will best be understood in connection with the accompanying drawing which is merely an illustration of one embodiment of my invention as applied to a three-phase system, although the invention is applicable to any electrical conductor which is subjected to abnormal voltages.

In the form of the invention shown in the drawing, a spark gap arrester is used comprising electrodes 1 separated by a spark gap formed by a passage 2 in an insulating sleeve 3 of porcelain or other suitable material which carries the electrodes at each end on conducting plates 4 inserted in the sleeve. The insulating fluid flows into the sleeve and through the gap by means of passages 5 extending through the electrodes 1 and opening into the passage 2. The electrical connections to the arrester are made through the plates 4, and when abnormal voltage occurs a disruptive discharge takes place from one to the other of the electrodes 1 through the current of insulating fluid flowing through the passage 2.

In order to prevent an arc following the disruptive discharge between the electrodes 1, I provide means for causing a flow of insulating fluid through the passage 2 over one of the electrodes at a greater velocity than the velocity with which the vapor from the electrode moves through the gap so that the vapor from the electrode cannot follow the disruptive discharge across the gap or passage 2 to the other electrode and form a conducting path. Any suitable means for causing a flow of insulating fluid may be used, but the preferred arrangement as shown on the drawing, comprises an insulating fluid supply tank 6 connected through a drier 7 and a pipe 8 with a compressor or similar device 9, which delivers the insulating fluid under suitable pressure through a pipe 10 to a reservoir 11 provided with a drain-cock 12 by means of which the entrained moisture may be removed. The insulating fluid under pressure passes from the reservoir 11 through pipe 13 to a metallic manifold 14 connected to the various spark gap arresters through the pipes 5, and these arresters in turn are connected through the return pipes 15, 16, 17 and 18 to a collecting manifold 19, which delivers back to the reservoir 6 through a pipe 20. The whole arrangement constitutes a closed system of piping by means of which a constant circulation of the insulating fluid may be maintained at the proper speed through the various spark gap arresters.

The arrangement shown in the drawing is adapted for a three-phase system and three spark gap arresters are connected to the three phases of the system by means of wires 21. These wires are attached to the metallic heads 4 of the respective arresters and the opposite heads 4 of these arresters are connected through wires 22 to the metallic manifold and thence through a wire 23 to the upper electrode 1 of another spark gap arrester, which has its lower electrode 1 connected by a wire 24 to ground. There is therefore a path from each phase through a spark gap arrester to the manifold and thence through another spark gap arrester in series with the first to ground. The manifold 14 is connected to one electrode of each of the spark gap arresters, and insulating fluid is circulated through each of the arresters, at such a velocity that no arc can form. As shown in the drawing the manifold 14 acts as a bus-bar for the wires 22 from the three spark gap arresters and is in turn connected to ground through a single spark gap arrester.

The operation of the device is as follows: The compressor 9 maintains the insulating fluid in a closed system under such pressure that the rate of flow through the passages 2 of the various spark gap arresters is considerably greater than the velocity with which the vapor from the electrodes 1 moves across the spark gap. If the electrodes are made of platinum, the vapor will move across the spark gap at approximately 1400 feet per second, while the velocity with which the insulating fluid flows through the passage 2 would be about 2000 feet per second, so that it will be impossible for the platinum vapor to move across the gap against the stream of insulating fluid flowing at a considerable greater rate than that at which the vapor can move. If under these circumstances the voltage on the conductor becomes abnormal, the dielectric between the electrodes of the spark gap arrester breaks down and a disruptive discharge takes place through the passage 2 from one electrode 1 to the other, generating from one of the electrodes a small amount of vapor which tends to move through the passage 2 and establish a conducting path from one electrode to the other, but is unable to do so on account of the jet of insulating fluid, which is moving at such a velocity that it continually sweeps the electrode vapor back over the electrode and away from the passage 2. This also causes the ionized fluid between the electrodes to be continually removed and replaced by

fresh, cool insulating fluid, so that as soon as the voltage on the conductor becomes normal the resistance of the dielectric is so great that the disruptive discharge is no longer maintained and no disturbances are set up upon the conductor because an arc is never formed.

With the arrangement shown in the drawing, if the electrode 1 connected to ground is negative, the jet of insulating fluid through the lower spark gap arrester is moving in the right direction to prevent the formation of an arc, while if one of the electrodes connected to the conductor is negative the jet of insulating fluid passing through the spark gap arrester between the manifold and the conductor is moving in the proper direction to prevent an arc.

My invention is not limited to the precise form shown, but may be embodied in many other forms than that shown and described, and the annexed claims are intended to cover all changes and modifications within the spirit and scope of my invention.

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

1. A lightning arrester comprising electrodes separated by a spark gap of constant length, and means for developing in a direction opposite to the movement of the vapor liberated from said electrodes a gas blast having a velocity greater than the velocity with which said vapor moves across said gap, whereby said vapor is carried away from the gap and thereby the formation of an arc is prevented when a disruptive discharge takes place between said electrodes.

2. In a protective device, the combination with electrodes separated by a gap of constant length, of means for causing a flow of insulating fluid away from said gap over one of said electrodes at a greater velocity than that with which the vapor from said electrode moves across the gap.

3. In a protective device, the combination with electrodes separated by a gap of constant length, of means for causing a flow of insulating fluid over the negative electrode at a velocity greater than the velocity with which the vapor from said electrode follows a disruptive discharge across the gap.

4. In a protective device, the combination with the line conductors of the distributing system, of two spark gaps between each conductor and ground, and means for causing a flow of insulating fluid through one of said gaps in one direction and through the other gap in the opposite direction.

5. In a protective device, the combination with electrodes connected to a conductor and to ground and separated by a gap of constant length, of means for causing a flow of insulating fluid away from said gap over both electrodes at a velocity greater than the velocity with which the vapor from either of said electrodes moves across the gap.

6. In a protective device, the combination with electrodes separated by gaps, of means for causing a flow of insulating fluid along the path of disruptive discharge so that the direction of flow over at least two gaps in series is in opposite directions.

7. In a protective device, the combination with electrodes arranged to form a plurality of spark gaps in series, of means for causing a flow of insulating fluid through one gap in one direction and through another gap in another direction to prevent the formation of arcs across said gaps.

8. In a protective device, the combination with electrodes separated by a gap of constant length, of a closed system of piping to direct a flow of fluid through said gap, and means for circulating insulating fluid through said system at a velocity greater than the velocity with which the vapor of said electrodes moves across said gap and thereby sweeping the electrode vapors out of said gap to prevent a flow of current across said gap.

9. In a protective device, the combination with electrodes separated by an air gap, of a closed system of piping to direct a flow of fluid through said gap, a drier included in said system, and means for circulating insulating fluid through said system to prevent the formation of an arc.

10. In a protective device for polyphase systems, the combination with a spark gap arrester comprising electrodes mounted in an insulating sleeve with a gap between them connected to each phase and all connected in series with a similar arrester to ground, of means for causing a flow of insulating fluid through said gaps toward the electrodes connected to the phases and toward the electrode connected to ground.

11. In a protective device for polyphase systems, the combination with a spark gap arrester comprising electrodes mounted in an insulating sleeve with a gap between them connected to each phase and all connected in series with a similar arrester to ground, of a manifold connected to the sleeves of all said arresters, means for applying insulating fluid under pressure to said manifold, and a return pipe from said sleeves to said means, whereby insulating fluid is circulated through the gaps of said arresters to prevent the formation of arcs.

12. In a protective device for polyphase systems, the combination with a spark gap arrester comprising electrodes mounted in an insulating sleeve with a gap between

them connected to each phase and all connected in series with a similar arrester to ground, of means for supplying insulating fluid under pressure to said sleeves at orifices opposite the gaps from the electrodes connected to the phases and orifice opposite the electrode connected to ground, and return pipes leading from said sleeves at orifices on the same side of the gaps as said electrodes to said means to form a closed circulating system.

In witness whereof, I have hereunto set my hand this 16th day of September, 1907.

ELMER E. F. CREIGHTON.

Witnesses:

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