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2,155,841

PROTECTIVE GAP

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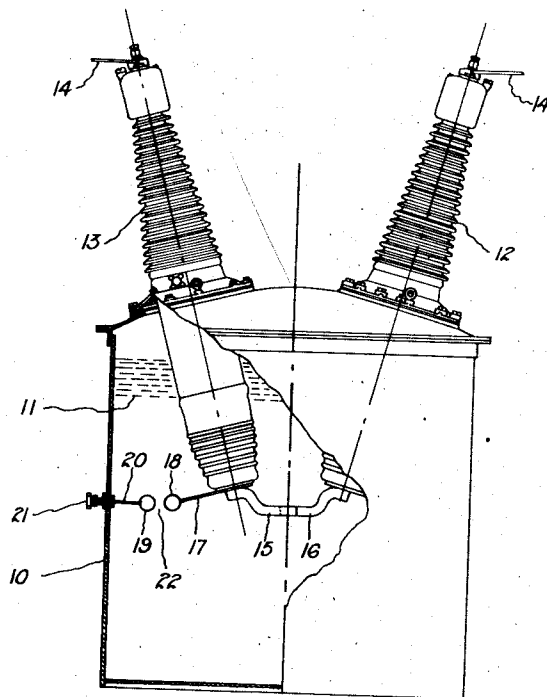


Fig. 1

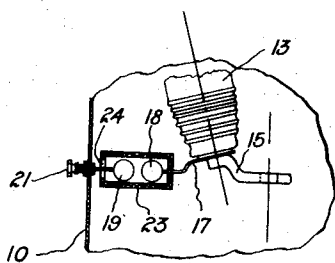


Fig. 2

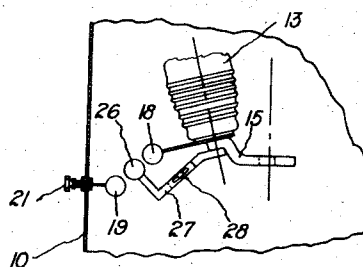


Fig. 4

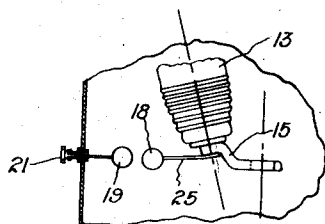


Fig. 3

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PROTECTIVE GAP

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6 Claims. (Cl. 200—150)

This invention relates to arcing gaps for the protection of electrical apparatus against over-voltages and has for one of its objects the provision of a protective gap which shall be free from the influence of weather conditions, which shall have a negligible time lag characteristic compared to the failure of apparatus it protects, which will be simple and economical to manufacture and operate, and in which a power arc will not be formed following the flashover or if formed will be extinguished quickly.

A further object of the invention is to provide a device of the class named which shall be of improved construction and operation.

Other objects and advantages will appear from the following description.

The invention is exemplified by the combination and arrangement of parts shown in the accompanying drawing and described in the following specification, and it is more particularly pointed out in the appended claims.

In the drawing:

Fig. 1 is an elevation of a circuit breaker with part of the housing broken away, the breaker being equipped with one form of the present invention.

Figs. 2, 3 and 4 are fragmentary elevations with parts in sections showing modified forms of the invention.

It is a well known practice in the electrical art to provide transmission lines and other charged conductors with an arcing gap to ground which will break down under excess voltages and transmit to the ground, abnormal charges on the line to prevent injury to apparatus connected with the line. It is, of course, desirable that such a protective gap should operate with as short a time lag as possible after it is subjected to flash-over voltage, in order that it may flash over ahead of any other apparatus connected to the line and intended to be protected by the gap. It has been found in practice that the operation of gaps having spherical discharge surfaces and short time lag characteristics are seriously affected by weather conditions. A gap of this kind in air also requires rather large and expensive electrodes or terminals in connection with high voltages. Also, it frequently happens that when discharge takes place between two electrodes in air, a power arc is apt to follow the path formed by the impulse discharge and this arc may be very difficult to extinguish without an interruption to normal service.

I have found that by submerging the electrodes of the gap in an insulating fluid, such as oil, many

of the objectionable characteristics heretofore experienced are eliminated and a gap is provided which is free from atmospheric conditions and in which the electrodes may be much smaller and placed much closer together than is the case where the gap is between electrodes supported in air. Also, the insulating fluid serves to prevent or quench the power arc which tends to follow the initial discharge. By associating the electrodes of the gaps directly with electrical apparatus provided with an oil filled housing, the same housing and filling liquid may serve both for the apparatus and for the protective gap. A still further advantage may be gained by combining the gap with a circuit breaker in such a way that as the circuit breaker operates, the electrodes of the gap will be separated so as to assist the circuit breaker in opening the circuit to extinguish the power arc following the discharge.

In the form of the invention shown in Fig. 1, the gap is shown as applied to a circuit breaker having a housing 10 filled with an insulating liquid 11 such as transil oil or other fluid dielectric, suitable for this purpose. The breaker is provided with a pair of bushing insulators 12 and 13 in which the conductors passing through the insulators are mounted to rotate and are operated by any suitable mechanism connected to the conductors through links 14. One form of apparatus for operating a breaker of this kind is shown in Patent No. 1,894,339 issued January 17, 1933, to A. O. Austin and assigned to The Ohio Brass Company of Mansfield, Ohio. It will be understood, of course, that the invention is not restricted to any particular form of electrical apparatus, but the form shown is merely given by way of example. A pair of switch arms 15 and 16 are connected to the inner ends of the conductors and are moved into and out of contact with each other by rotation of the conductors. Electrically connected to the lower terminal of one of the bushings, 13, is a conductor rod 17 which carries a spherical discharge electrode 18 in position to cooperate with a similar electrode 19 supported on the housing 10. The electrode 19 is preferably carried by a circuit 20 mounted on the housing 10 and provided with adjusting mechanism 21 accessible from the outside of the housing by means of which the spacing of the gap 22 between the electrodes 18 and 19 may be varied. The electrode 19, of course, is grounded upon the housing and the gap 22 provides a path to ground for excess voltages on the line supported by the outer terminal of the bushing 13. In case of an abnormal surge on the line, the gap 22 will break down and

the abnormal charge will be carried off through the gap to ground. The size and spacing of the electrodes 18 and 19 will, of course, depend upon the voltage for which the device is designed and very small electrodes and close spacing will suffice for relatively high voltages as compared to the electrodes and spacing that would be required for a gap in air. The oil will normally prevent the formation of a power arc following the impulse discharge or quickly quench the arc in case one is formed.

For especially severe conditions, the gap may be encased as shown in Fig. 2 in a housing or tube 23 of some material, such as hard fiber, which when heated by a power arc, will give off a deionized gas which will assist in quenching the arc. The housing 23 is provided with an opening indicated at 24 for the escape of the deionized gas.

In the form of the invention shown in Fig. 3, the circuit 25 for the gap electrode 18, instead of being mounted on a stationary terminal for the bushing 13, is carried by the movable switch member 15. With a construction of this kind where the breaker is operated automatically on over current to open the circuit, the gap electrode 18 will be automatically moved away from the electrode 19 simultaneously with the opening of the switch, so as to increase the gap between the electrodes 18 and 19, thus assisting in extinguishing the arc and breaking the circuit.

In the form of the invention shown in Fig. 4, the electrodes 18 and 19 are supported in the manner disclosed in Fig. 1, but are separated a sufficient distance to permit one or more supplemental electrodes 26 to be interposed between the electrodes 18 and 19 to form a multiple gap. Electrode 26 is carried by an insulating arm 27 which may be provided with means 28 for adjusting the position of the electrode 26 and the arm 27 is carried rigidly on the end of the conductor which carries the switch arm 15. When the switch is opened, the electrode 26 will be moved away from both of the electrodes 18 and 19, thus providing a double break in the arc.

I claim:

1. In combination, electric apparatus, a housing enclosing said apparatus, an insulating bushing extending into said housing and having a conductor carried thereby and connected with said apparatus and insulated from said housing, a sphere gap electrode electrically connected with

said conductor, a second sphere gap electrode mounted in said housing and electrically connected to the wall thereof and providing a path through the gap between said electrodes to ground and insulating liquid in said housing and disposed in the space between said electrodes.

2. The combination with a circuit breaker of a protective gap having one terminal thereof connected with one terminal of said circuit breaker and having the other terminal thereof grounded, a housing for said circuit breaker and insulating liquid within said housing, said insulating liquid surrounding the electrodes of said gap and the contacts of said circuit breaker.

3. A circuit breaker having relatively movable contact members, a housing filled with insulating liquid in which said contact members are submerged and a protective gap having the electrodes thereof submerged in said liquid, one electrode of said gap being connected with one of the contact members of said circuit breaker and movable therewith to separate said gap electrodes when said circuit breaker is opened.

4. The combination with a circuit breaker having contact members, of a housing for said circuit breaker filled with an insulating fluid in which said contact members are submerged, a protective gap having the electrodes thereof submerged in said insulating liquid and means operatively connected with said circuit breaker for operation whenever said circuit breaker is opened for separating said gap electrodes when said breaker is opened.

5. A circuit breaker comprising a housing, a pair of contact members mounted in said housing, insulating liquid disposed in said housing and covering said contact members, a multiple arc gap disposed in said housing and submerged in said insulating liquid and means operated by said circuit breaker for increasing the spacing of said gap when said circuit breaker is opened.

6. The combination with electrical apparatus, a housing for said apparatus and insulating liquid disposed in said housing and surrounding said apparatus, of protective means for said apparatus comprising an arcing gap having spaced electrodes submerged in said liquid and supplemental means associated with said electrodes within said housing for extinguishing an arc formed between said electrodes.

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