Dec. 15, 1942. H. K. WATSON 2,305,398

LIGHTNING ARRESTER

Filed March 18, 1940

Fig. 1

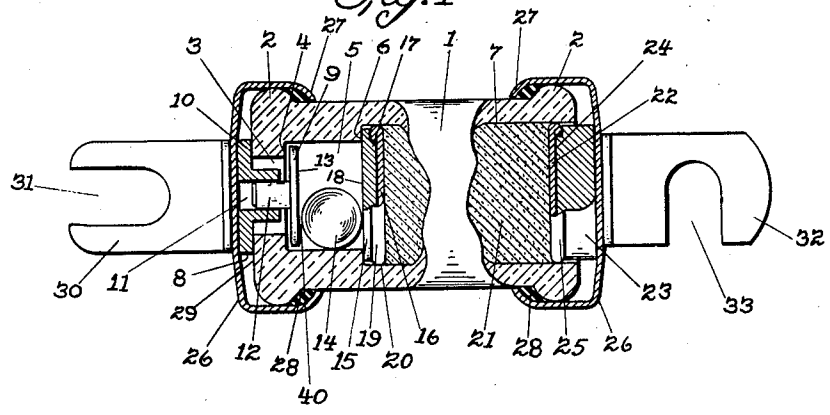


Fig. 2

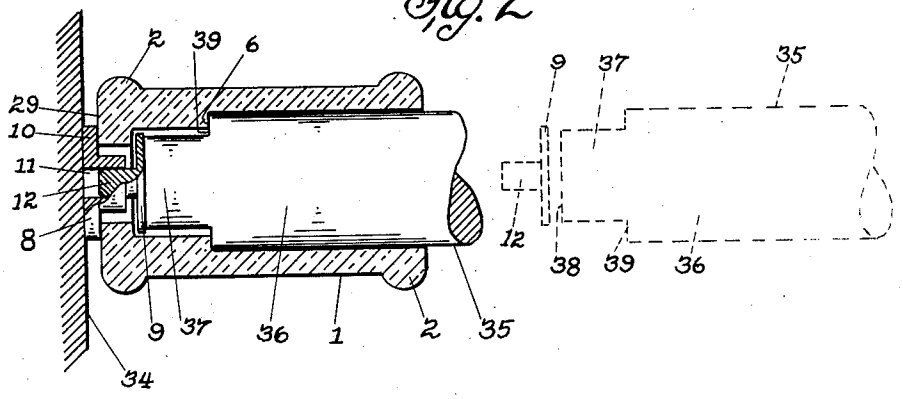
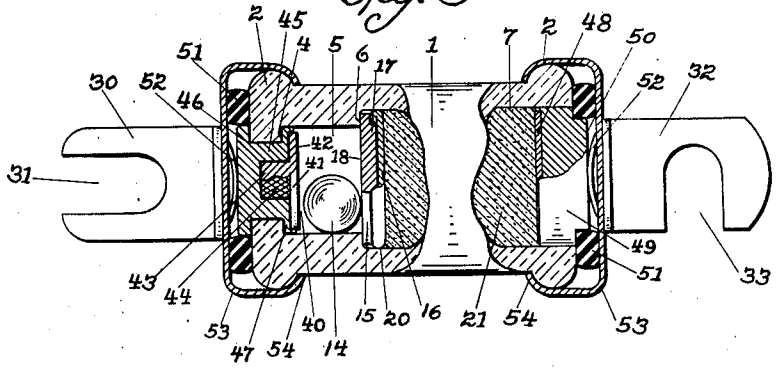


Fig. 3



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Patented Dec. 15, 1942

2,305,398

UNITED STATES PATENT OFFICE

2,305,398

LIGHTNING ARRESTER

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Application March 18, 1940, Serial No. 324,596

7 Claims. (Cl. 175—30)

This invention relates to lightning arresters and, more especially, to arresters for use on low voltage circuits.

The spark gap in an arrester of the aforementioned character is, of necessity, very short and must be held within extremely close limits of tolerance in order to meet standard requirements—a factor which has a tendency to increase production costs.

One of my objects is to provide a lightning arrester of the low-voltage, short gap variety which can be manufactured without entailing extra cost as a result of the necessity of maintaining a high degree of precision as to spark gap length, notwithstanding dimensional variations likely to occur in the dielectric housing in which the electrodes are mounted.

With ordinary arresters having extremely short spark gaps, it is difficult to determine visually whether the gap is open and thus in condition to function or has been put out of order by welding together of the gap electrodes as a result of a heavy current surge. And, of course, if the arrester gap is entirely enclosed within an opaque housing it is impossible to determine its condition visually.

Another object of this invention, therefore, is to make it possible to determine the condition of a lightning arrester in a quick and simple manner—visually or otherwise—so as to avoid the necessity for time-consuming electrical tests.

Still another object is to provide a lightning arrester of the low voltage type which can be manufactured at a minimum of cost, but which, nevertheless, is dependable in operation and long-lasting.

One of the characteristic features of the present invention resides in a constructional arrangement and design of parts which makes it possible to achieve a very high degree of precision in the spacing of the electrodes which form the spark gap without necessitating any time-consuming adjustments and without requiring the employment of skilled workmen to perform the assembling operations. This is accomplished in part through the use of a telescopic two-part electrode and partly through the use of a moulded dielectric housing so formed, as will be explained hereinafter, as to facilitate pressing together of the aforesaid parts to the exactly correct degree, with the result that the precise spacing of electrodes is achieved automatically even though the housings may vary dimensionally far more than the limits of tolerance prescribed for the spark gap. It is not possible adequately to explain this feature without reference to the drawing, but it will be apparent to those skilled in the art that a considerable manufacturing advantage is achieved by reason of avoiding the necessity for maintaining close limits on the moulded housings and, further, by reason of avoidance of the need for skilled assemblers or adjusters.

A second feature has to do with the matter of quickly determining the condition of a lightning arrester and entails the use of a movable conductive element disposed between the stationary electrodes—which movable conductive element is preferably a metal sphere which is free to roll on the surface of one of the stationary electrodes so long as the spark gap is open and in normal operating condition. Normally, the movement of the ball or other movable element can be brought about by tilting or slightly shaking the arrester and its failure to move in response to such tilting or shaking is a reliable indication that the arrester is out of order and should be replaced.

The preferred embodiments of this invention will now be described with reference to the accompanying drawing.

In the drawing:

Fig. 1 is a longitudinal sectional view depicting a preferred embodiment of my improved lightning arrester.

Fig. 2 is a longitudinal sectional view illustrating the method employed for accurately adjusting one of the stationary electrodes for the purpose of securing automatically an accurate spark gap spacing irrespective of dimensional variations in the housing.

Fig. 3 is a longitudinal sectional view illustrating a modified form of the invention.

Like parts are designated by the same reference numerals throughout the several views.

The device shown in Fig. 1 is what is commonly known as a signal arrester and comprises a moulded tubular housing 1 made preferably of transparent glass and having shoulder portions 2—2 integrally formed on the periphery of the housing adjacent the corresponding ends thereof.

A bore portion 3 extends a short distance into the housing 1 and abruptly enlarges into a shoulder at 4 and then continues as an intermediate bore portion or spark-gap chamber 5 which in turn extends into the housing a short distance and abruptly enlarges into a spacing shoulder at 6 and then continues as a relatively larger bore portion or valve chamber 7 throughout the remainder of the housing.

The bore portion 3 is provided with an elec-

trode assembly comprising a pair of telescoped conductor portions 8 and 9. The conductor 8 is flanged at 10 and provided with an aperture 11 which receives the shank 12 of the conductor 9 in predetermined position and in press-fit relationship as more fully described hereinafter. The conductor 9 is provided at 13 with a flat disc-like contact surface against which a spherical electrode 14 may make contact.

The spherical metal electrode 14 of predetermined diameter is placed within the spark gap chamber 5 and held therein by the circular electrode 15 and the cup-like lead seal 16.

The electrode 15, provided at 17 with a reduced portion, is mounted with its contact face 18 against the shoulder 6 and secured in place by pressing the cup-like lead seal 16 by means of a tool against the reduced portion 17, thereby forcing its lip portion 19 radially outwardly against the wall of the housing 1 to make a tight seal at 20.

The valve chamber 7 is filled with a predetermined amount of valve material 21 which may comprise silicon carbide or any other suitable valve material, the function of which is well known to those skilled in the art. The valve material is sealed within the chamber 7 by means of a cup-like lead seal 22 and a metal electrode 23 provided at 24 with a reduced portion.

The cup-like lead seal 22, provided at 25 with a lip, is mounted against the valve material 21 and receives within the lip 25 the reduced portion 24 of the metal electrode 23 which is pressed into engagement with the seal 22 by means of a tool whereby the lip 25 is flattened into sealing contact with the walls of the housing.

It may be noted that the reduced portion of each electrode 15 and 23 is provided to insure the radial expansion of the lips 19 and 25 toward the housing 1, thereby providing a positive closure at each end of the chamber 7 to seal the comparatively small-mesh valve material 21 therein. For a more detailed description of the lead seals 16 and 22, reference may be had to the patent to Mittelstadt No. 2,163,697, Serial Number 74,880, issued June 27, 1939, for Lightning arrester and method of assembling, wherein the shape of the seal is shown prior to flattening.

The ends of the housing 1 are sealed by means of metal closure caps 26—26 which are spun at 27 into engagement with resilient rubber gaskets 28. The gaskets 28 are mounted on the housing 1 and anchored against the corresponding shoulder portions 2—2, thereby acting to bias the caps 26—26 correspondingly into positive electrical contact with the electrodes 9 and 23 and at the same time provide a seal for the arrester against the entrance of moisture. It may be noted that the cap 26 also holds the flanged portion 10 of the electrode 8 in firm contact with the bearing surface 29 of the housing 1.

One cap 26 is provided with a mounting lug 30 including an end slot 31 and the other cap is provided with a mounting lug 32 including a side slot 33, each lug being secured to the caps 26 in any convenient manner as by spot welding, not shown. The lugs are adapted to secure the arrester in mounting relationship with terminal posts, not shown, in an electric circuit.

A method of obtaining an accurate spacing between the electrodes 9 and 15 is disclosed in Fig. 2 wherein numeral 34 designates any supporting surface, preferably disposed in a horizontal position, which holds the flanged portion 10 of the electrode 8 against the bearing surface 29 of the housing 1 while the electrode 8 is being press-fitted into telescoped relationship with the electrode 9.

This press-fit assembly is done by means of a spacing tool 35 comprising a cylindrical shank 36 and a spacing head 37. The shank 36, a portion of which is broken away, is adapted to be connected to any suitable actuating machine, not shown. The spacing head 37 is dimensioned to provide a predetermined distance between the contact face 38 on the head 37 and the shoulder 39 on the shank 36.

The broken line illustration of the electrode 9 and the tool 35 shows these parts out of engagement respectively with the electrode 8 and the housing 1.

The electrode 9 is held against the face 38 in any convenient manner and the tool 35 is moved into the housing 1 until the tool shoulder 39 engages the spacing shoulder 6. During this operation the shank 12 of the electrode 9 is pressed into the aperture 11 of the electrode 8. After the tool 35 is withdrawn from the housing 1, the assembly of the arrester is completed as hereinbefore described.

It may be noted that the contact face 13 of the electrode 9 is always spaced a predetermined distance from the contact face 18 of the electrode 15 regardless of the dimensional variations exceeding fixed tolerance values for the electrodes 8 and 9 or the relative spacing between the shoulder 6 and the bearing face 29. This predetermined distance is the fixed and accurate distance of the spacing head 37 between the face 38 and the shoulder 39. Thus it may be seen that any dimensional variations occurring in the cooperating parts of the arrester are compensated for by the telescoped arrangement of the electrodes 8 and 9 which are in turn accurately positioned by the tool 35.

When the arrester is mounted in an electric circuit by means of the lugs 30 and 32, the spherical electrode 14 automatically adjusts a gap 40 between itself and either or both electrodes 9 and 15, depending upon the mounting position of the arrester.

When an electrical disturbance of predetermined voltage value, caused for example by lightning, occurs in a circuit protected by the arrester, the excess voltage will break down the gap 40 and surge current will flow through the arrester to ground thereby relieving the circuit of its electrical stress. When the surge voltage is dissipated in the manner indicated, the arrester operates to interrupt the flow of circuit current through the arrester to ground. It may be observed that the breakdown of the gap under a voltage of given value is dependent upon the electrode spacing. Any increase in the gap spacing will alter the discharge characteristics of the device and render it non-protective under such conditions.

After the arrester has been in service for some time it is extremely important, especially when the arrester is being used on a railway signal system, to periodically inspect the arrester and determine its electrical operativeness. Frequently under predetermined surge conditions the spark gap electrodes vaporize and cause the ball electrode to be "welded" against one or both of the gap electrodes, thereby destroying the follow current interrupting characteristic of the arrester and causing a short on the system. This "welded" condition may be easily detected by removing the arrester and shaking it to determine whether the ball is "welded" in place or not. If the gap is

defective the operator will not hear the ball electrode striking against the housing as he shakes the arrester. In the case of a transparent glass housed arrester this same condition may be visually observed without removing the arrester from operating position, by noting whether or not the ball moves when the arrester is slightly disturbed by jarring.

Fig. 3 shows a low voltage arrester of modified design comprising a housing 1 similar in construction to the housing described with reference to Fig. 1.

An electrode 41 comprising a flat circular contact face 42 and a shank 43, knurled at 44, is mounted in the spark-gap chamber 5 with the face 42 held a predetermined distance from the shoulder 6 by means of the tool 35.

The tool 35 operates to produce the desired spacing in the manner described with reference to Fig. 2, except that the housing 1 is held in an upright position and the electrode 41 is supported on the tool face 38 with the knurled shank 43 extending into the chamber 3. With the electrode 41 held and spaced in this manner, an alloy 45, preferably lead, is cast about the shank 43 and allowed to overflow into a moulding means, not shown, adjacent the end of the housing, forming a flanged contact portion 46.

The spherical electrode 14 is placed in the chamber 5 and held therein by means of the electrode 15 and lead seal 16 in the manner described with reference to Fig. 1.

By assembling the electrodes 41 and 15 in the manner just described, an accurate spacing is provided between the electrode faces 42 and 18 regardless of dimensional variations of the electrode 41 and spacing between the shoulders 4 and 6. Any dimensional variations of these parts are compensated for by the spacing tool 35 operating in combination with the shoulder 6. The metal 45 appearing at 47 adjacent the shoulder 4 represents the dimensional variations of the parts from the ideal dimensions of the parts necessary to secure accurate spacing of the electrodes 41 and 15.

The valve material 21, placed in the chamber 7, is sealed therein by means of a metal electrode 48 held in place by an alloy 49, preferably lead, cast as shown to form a contact surface 50.

Rubber gaskets 51—51 are mounted adjacent the corresponding ends of the housing 1 and resilient arcuate contacts 52—52, formed of flat stock, are mounted against the alloy electrodes at each end of the arrester. The ends of the housing are closed by means of caps 53—53 spun over at 54 against the shoulders 2—2 to draw the top portion of the caps into electrical contact with the contacts 52—52 and into positive sealing relation with the gaskets 51—51.

The lugs 30 and 32 are mounted on the corresponding caps 53—53 in the manner described with reference to Fig. 1. The arrester is mounted in an electrical circuit and functions electrically in the manner described with reference to Fig. 1.

From the foregoing description it is apparent that the objects of this invention have been attained by providing for a low voltage lightning arrester, an electrode assembly including a freely movable spherical electrode disposed adjacent one of a pair of telescoped electrodes adapted to be mounted in accurate relationship with the cooperating parts of the arrester by means of a spacing tool which automatically positions the assembly in accurate electrical relationship to each other regardless of dimensional variations of the arrester parts which are not dimensioned within a tolerable value.

It is further apparent that a novel combined biasing and sealing means has been provided which simplifies construction of the arrester and results in a more economical device.

I claim:

1. A lightning arrester comprising a housing including spaced supports, a plurality of electrode members held by said supports in spaced relation to each other and providing a gap therebetween, and a spherical conductive member disposed in said gap and contacting alternatively with either of said members.

2. A lightning arrester comprising a plurality of electrode members, a tubular insulating housing, a plurality of shoulder supports associated with said housing, said members being held by said shoulders to provide a gap therebetween, and a spherical conductive member disposed in said gap and contacting alternatively with either of said members.

3. A lightning arrester comprising a tubular housing in which the bore of the housing includes three successive bore portions of relatively increased dimensions, a first electrode held in fixed relation to the smallest bore portion adjacent the corresponding end of said housing, a second electrode in the largest bore portion in fixed relation to the intermediate bore portion and spaced from the first electrode, and a spherical conductor between said electrodes.

4. In a lightning arrester, a pair of stationary electrodes spaced apart and forming, conjointly, a gap defined by parallel conductive surfaces in vis-a-vis relation, said gap being of substantially uniform length, a conductive element in contact with and supported by one of said surfaces and out of contact with the other of said surfaces, the arrangement being such that said element cannot contact both said parallel conductive surfaces simultaneously, but can contact both said surfaces alternately and individually, said element being free to move about on said supporting surface and operative to so move about when the lightning arrester is suitably tilted or shaken, the movements of said element serving to indicate that the arrester is in operable condition.

5. In a lightning arrester, a pair of stationary electrodes spaced apart and forming, conjointly, a gap defined by parallel conductive surfaces in vis-a-vis relation, said gap being of substantially uniform length, a conductive rollable element disposed in said gap and having a diameter less than the length of said gap, the arrangement being such that said rollable element cannot contact both said parallel conductive surfaces simultaneously but can contact both of said surfaces alternately and individually, said rollable element being free to roll in said gap whereby to indicate the condition of the lightning arrester.

6. In a lightning arrester, a housing, a pair of stationary electrodes supported by said housing and insulated from each other, said electrodes being spaced apart and forming, conjointly, a gap defined by parallel conductive surfaces in vis-a-vis relation, said gap being of substantially uniform length and enveloped by said housing, a conductive rollable element disposed in said gap and having a diameter less than the length of said gap, the arrangement being such that said rollable element cannot

contact both said parallel conductive surfaces simultaneously, but can contact both said surfaces alternately and individually, said rollable element being free to roll in said gap, within the confines of said housing, whereby to indicate the condition of the lightning arrester.

7. In a lightning arrester, a tubular housing of moulded insulating material having an internal shoulder, a first electrode disposed within said housing and located lengthwise thereof by said shoulder, a second electrode supported by said housing and spaced from said first electrode to form a gap therebetween, said gap being defined by conductive surfaces in vis-a-vis relation within said housing, said second electrode consisting of two metallic parts pressed together telescopically whereby to facilitate obtainment of a high degree of precision in the length of said gap notwithstanding commercially permissible dimensional variations likely to occur in the production of moulded housings, and a conductive rollable element disposed in said gap between said electrodes, said rollable element being of a diameter less than the length of said gap and free to roll between said parallel surfaces within the confines of said housing.

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