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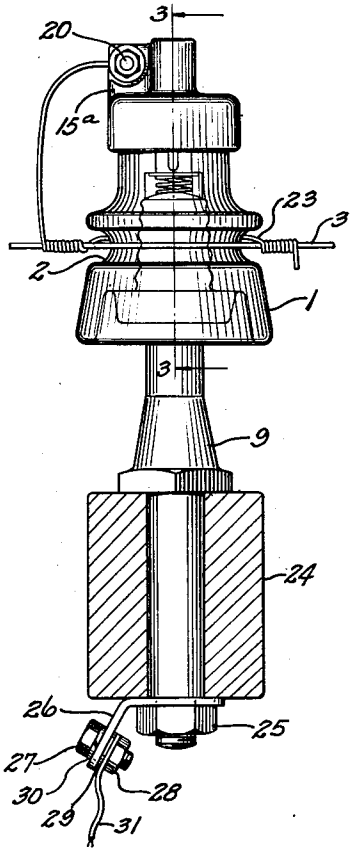
COMBINED SPARK-GAP AND INSULATOR

Filed Jan. 18, 1943

Fig. 1



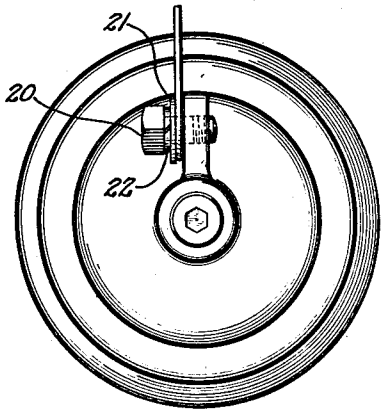
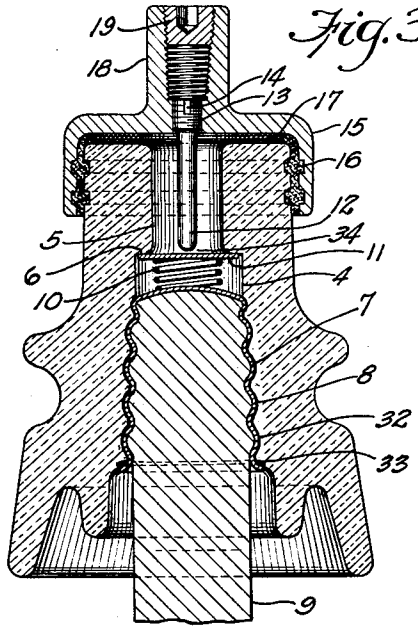


Fig. 2

Fig. 3



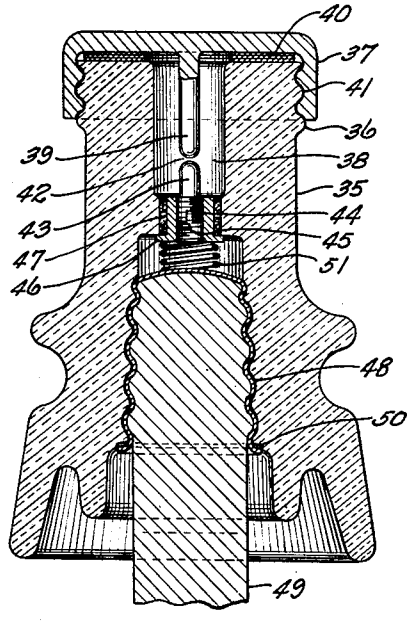


Fig. 4

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COMBINED SPARK GAP AND INSULATOR

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16 Claims. (Cl. 174—140)

This invention relates to combination insulator and spark-gap devices—the primary object being to provide a pin-type insulator having an accurately adjustable enclosed spark-gap which is particularly suitable for use on signaling circuits and which can be manufactured to sell at a low enough price to warrant its substitution, to a large extent, in place of ordinary line insulators.

Another object is to devise a combined pin-type insulator and spark-gap wherein all the component parts are of simple design and capable of being quickly and accurately assembled by unskilled workers.

A further object is to devise a combined pin-type insulator and spark-gap wherein the surface leakage paths, and especially the exposed paths, are all long enough to obviate the possibility of disturbances arising therefrom.

Still another object is to avoid the use of fastening means such as screws and bolts which might become loose and thus cause the device to become either inoperative or defectively operative and which might also give rise to radio disturbances.

An additional object is to provide a combined pin-type insulator and spark-gap wherein the ground connection can be made directly to the supporting pin and wherein the ground connection terminal can be secured by the same nut that secures the pin to the cross-arm.

Another object is to devise a pin-type insulator having a fully enclosed spark-gap which is wholly visible from the exterior of the insulator.

The preferred embodiment of this invention consists essentially of a pin-type transparent glass insulator having an internal cavity in which is housed the spark-gap and which is sealed at one end by a terminal cap and at the other end by a metal liner or thimble which is screw threaded to receive a metal supporting pin. The enclosed spark-gap is formed between a plate electrode and the end of a threaded stud which is adjustably movable toward and away from the plate—the gap being so positioned that it is plainly visible through the insulator; by virtue of which fact the gap can easily be adjusted to the proper length without the use of special tools and gauges. The plate electrode, as employed in the preferred embodiment, is a plain metal punching which is merely dropped in place and is held by a coil spring which is also dropped in place and secured in position by the aforementioned metal thimble—the whole assembling operation requiring but a few seconds to consummate and entailing no screws or bolts which could possibly work loose.

Referring to the drawing which accompanies this specification:

Fig. 1 is an assembly view, in elevation, showing the combined insulator and spark-gap mounted on a cross-arm and supporting a line conductor—the connections between line and ground through the spark-gap being also depicted.

Fig. 2 is a top plan view.

Fig. 3 is an enlarged sectional view taken along the line 3—3 of Fig. 1.

Fig. 4 is a vertical sectional view depicting an alternative embodiment of the invention.

The device of Figs. 1–3 comprises a molded insulator 1, preferably of transparent glass, having an external peripheral groove 2 for reception of the line conductor 3. The insulator has an axial bore 4 which is reduced in diameter at 5 to form a shoulder at 6. The enlarged portion of the bore is formed with a slightly tapered internal thread 7 designed to accommodate the correspondingly formed thread of a shell-like sheet metal thimble 8. The latter, usually made of brass, serves as a buffer between the insulator and the metal pin 9 which is threaded externally to fit the internal thread of the thimble. One function of the thimble is to absorb differences of expansion between the insulator and the metal pin and thus obviate possible insulator breakage consequent upon extremes of temperature. Another function of the thimble is to seal off bore 4 at the lower end and thereby effect complete isolation for the spark-gap against exposure to corrosive atmosphere. The thimble also affords a seat for the helical spring 10, the purpose of which is to hold the metal disc 11 against shoulder 6 while at the same time maintaining an electrical connection between those parts. This avoids the need for any other fastening means for securing the disc in place and is a very cheap and quick method of accomplishing that end. Moreover, it does not entail the use of any parts or constructional arrangement which could possibly become loose or disarranged and thereby interfere with the accuracy of the gap or introduce radio disturbances.

Disc 11 constitutes one of the spark-gap electrodes—the other being the stud 12 which is preferably rounded at its lower end, threaded at 13 and provided with a screw-driver slot at 14. The gap itself is identified by reference numeral 34.

The metal cap 15 is secured to the top of the insulator and sealed thereto by means of joint-

filling cement 16. A gasket 17 is interposed between the top of the insulator and the underside of the cap. The latter is threaded axially to receive thread 13 of stud 12 and has an upstanding boss 18 which is drilled and tapped for a plug 19. This is preferably a pipe-threaded plug as indicated.

Cap 15 has an integral lug 15a which is drilled and tapped to accommodate a terminal binding screw 20 on which (see Fig. 2) are mounted a plain washer 21 and lock washer 22.

Line conductor 8 is fastened to the insulator in groove 2 by means of a wire loop 23 which serves also as an interconnecting pigtail between the line conductor and the terminal on cap 15.

Metal pin 9 is a stock part commonly used with ordinary pin-type insulators. It is secured to the cross-arm 24 as indicated in Fig. 1. Nut 25 not only serves to secure the pin to the cross-arm but also as a means for attaching a terminal clip 26 to the pin. The clip is provided with a screw 27 having a nut 28 together with a plain washer 29 and lock washer 30 which serve as connector means for a ground lead 31.

For the purpose of protecting the spark-gap elements against the intrusion of moisture and corrosive gases, the joint between thimble 8 and the threaded internal surface of the insulator is filled with a suitable sealing compound 32; and as a further measure of precaution, there is provided a sealing gasket 33 which is secured in place by the flange at the lower edge of the thimble.

To prevent rotation of the thimble when being removed from pin 9, it is preferable to form in the insulator one or more indentations (not shown) into which gasket 33 and the lower flanged edge of the thimble can be pressed by means of a prick punch or similar tool.

The mode of assembling the device is self-evident from the drawing, and it will be apparent that the spark-gap at 34 is easily adjustable by rotating stud 12 with a screw-driver. The assembler can, when a glass insulator is used, see the gap while making this adjustment. In any event, it is feasible for him to screw stud 12 down until it just touches plate 11 and then rotate it in the opposite direction a prescribed number of revolutions, which will incidentally produce a gap spacing of the desired length within very close limits of tolerance—especially if thread 13 is of fine pitch. After adjusting the gap the head of stud 12 is prick punched for the purpose of locking it against rotation due to vibration, and plug 19 is screwed tightly into place to form a further seal against intrusion of moisture and corrosive gases.

By reason of the fact that spring 10 is compressible and extensible and is normally under compression, variations of the space dimension between the top of the thimble and the under side of plate 11 have no effect on the length of the gap and, therefore, it is unnecessary to maintain close limits either in the manufacture of the thimbles or in the assembly thereof with the insulator bodies.

The transparency of the insulator and placement of the gap where it is readily visible through the wall of the insulator makes it possible to determine at all times, by visual inspection, whether the gap is still open and in working condition; and it greatly facilitates inspection at the factory after final assembly and helps to avoid shipping out of devices which may not have been correctly adjusted.

By reason of the fact that the spark-gap chamber is hermetically sealed, it cannot become contaminated with foreign matter and for that reason cannot give rise to surface leakage such as would be likely to cause disturbances on the line; and the exposed surface path from groove 2 to the metal pin is long enough to obviate such disturbances.

In the alternative structure of Fig. 4 the glass insulator 35 has an external thread 36 at its upper end, which is engaged by a correspondingly threaded metal cap 37 having a terminal lug or equivalent provision which is not shown. Said cap serves to close and seal bore 38 of the insulator at its upper end and has a downwardly projecting center teat 39 constituting one of the spark-gap electrodes. To insulate the spark-gap chamber against intrusion of moisture and corrosive gases, a sealing gasket 40 is interposed between the cap and the upper surface of the insulator. As a further preventive measure the threaded joint preferably is filled with a suitable sealing compound 41.

The spark-gap is identified by reference numeral 42, and the lower gap electrode comprises a stud 43 which is threaded at 44 and provided with a screw-driver slot 45. The opposing ends of electrodes 39 and 43 are preferably rounded, as shown.

A metal bushing 46 is internally threaded to receive the thread of stud 44 and is rigidly secured in the bore of the insulator by means of a cement filler 47. Metal thimble 48 is identical with thimble 8 previously described and, likewise, metal pin 49 may be identical with pin 9.

The joint between thimble 48 and the adjoining threaded glass surface is filled, preferably, with sealing compound, and a gasket 50 is provided, similarly to gasket 33 and for the same purpose.

A helical spring 51 provides an electrical connection between the lower end of bushing 46 and the top surface of thimble 48.

Gap 42 is adjusted by rotating stud 43, and this must be done before inserting thimble 48. In each instance the length of the gap is adjusted to afford protection for apparatus connected to the line and which might be injured by surge voltages.

It will be observed that in both illustrated embodiments of the invention the leakage path within the spark-gap chamber is extremely long compared to the length of the gap. This contributes materially to disturbance prevention.

It is advantageous on many signaling systems to distribute the lightning protection along the line as distinguished from lumping it at distantly separated points in lightning arresters immediately adjacent the delicate apparatus to be protected, but the cost of providing many closely spaced arresters along the line has heretofore been such as to render the practice economically unfeasible. The very inexpensive but reliable device of the present invention makes it practicable to drain the line at closely spaced points so that the surge voltage build-up at the points to be protected would never be excessive unless lightning strikes the line in the immediate vicinity thereof.

What is claimed is:

1. In combination: a transparent insulator of the pin type having an axial bore extending therethrough, a metal cap secured to one end of said insulator and forming a sealed closure for one end of said bore, a sheet metal thimble threaded into the other end of said bore and forming a closure for said other end, said cap

and thimble defining a sealed spark-gap chamber within said bore, and a pair of spaced spark-gap electrodes within said chamber, one of said electrodes being connected to said cap and the other to said thimble, said electrodes being relatively adjustable to vary the length of the gap therebetween, the spark-gap between said electrodes being visible through said insulator from the exterior thereof, whereby the adjustment of the gap may be observed after assembly of the electrodes.

2. In combination: a transparent insulator of the pin type having an axial bore extending therethrough, a metal cap secured to one end of said insulator and forming a sealed closure for one end of said bore, an elongate electrode carried by said cap and extending axially into said bore, a second electrode within said bore and spaced endwise from said first-mentioned electrode to form a spark-gap which is visible through said insulator from the exterior thereof, one of said electrodes being screw-threaded to permit adjustment of said spark-gap, a sheet metal thimble screwed into and forming a sealed closure for the other end of said bore, said thimble being internally threaded to receive an insulator-supporting pin, and a helical spring interconnecting one of said electrodes with said thimble.

3. In combination: an insulator of the pin type having an axial bore with an internal peripheral shoulder, a metal thimble threaded into one end of said bore and spaced axially from said shoulder, said thimble forming a closure for one end of said bore, an electrode within said bore and bearing against said shoulder, a spring interposed between said thimble and said electrode, said spring interacting with said thimble and electrode to hold said electrode against said shoulder, a metal cap secured to one end of said insulator and forming a closure for the other end of said bore, and a stud supported by said cap and projecting axially into said bore toward said electrode, the end of said stud adjacent said electrode being spaced therefrom to form a spark-gap.

4. In combination: an insulator having an axial bore with an internal peripheral shoulder, a first and second conductive closure means at each end of said bore and having a terminal connection exteriorly of said insulator, a conductive disc within said bore, a helical spring pressing said disc against said shoulder and co-operating with said shoulder and said second closure means to locate said disc, and a conductive axial stud extending axially of and within said bore toward said disc, one end of said stud being spaced from said disc to form a spark-gap therewith and the other end being attached to said first closure means.

5. In combination: an insulator having an axial bore with an internal peripheral shoulder, a cap at one end forming a closure for said bore, a threaded stud carried by said cap and extending axially into said bore, the position of said stud being adjustable axially through rotation thereof, a metal disc bearing against said shoulder within said bore and held by said shoulder in predetermined spaced relation to an end of said stud to form a spark-gap therewith, metallic closure means for the end of said bore remote from said cap, and a helical spring interposed between said metallic closure means and said disc and serving to hold said disc against said shoulder.

6. In combination: an insulator of the pin type having an axial bore with an internal peripheral shoulder situated intermediately of its length, one end portion of said bore being internally threaded to receive the hereinafter specified thimble, a conductive disc within said bore and forming a partition therein, said disc bearing against said shoulder and being located thereby, a helical spring bearing at one end against said disc, a metal thimble threaded into the internally threaded end portion of said bore and constituting an abutment for the other end of said spring, a metal cap secured to said insulator and serving as a closure for the end of said bore remote from said thimble, and a stud carried by said cap and projecting therefrom axially along said bore toward said disc, said stud being spaced from said disc to form a spark-gap therewith and adjustably movable axially to vary the length of said spark-gap.

7. In combination: an insulator of the pin type having an axial bore with an internal peripheral shoulder situated intermediately of its length and an external peripheral groove for reception of a line conductor, one end portion of said bore being internally threaded to receive the hereinafter specified thimble, a conductive disc within said bore and forming a partition therein, said disc bearing against said shoulder and being located thereby, a helical spring bearing at one end against said disc, a metal thimble threaded into the internally threaded end portion of said bore and constituting an abutment for the other end of said spring, a metal pin engaging said thimble internally and serving as a support for said insulator, a metal cap secured to said insulator and serving as a closure for the end of said bore remote from said thimble, said cap having an external terminal connector, and a conductive stud carried by and threaded into said cap and projecting from said cap axially along said bore toward said disc, said stud being spaced from said disc to form a spark-gap therewith and adjustably movable axially to vary the length of said spark-gap.

8. In combination: an insulator of the pin type having an axial bore, a supporting conductive pin extending into said bore, a conductive cap closing the other end of said bore, a first spark electrode carried by said cap and a second spark electrode disposed within said bore and spaced from said first-mentioned electrode to form a spark-gap, said second electrode being electrically connected to said supporting pin, said second electrode being located in fixed relation to said first electrode by spacing means disposed within said bore.

9. In combination: a transparent glass insulator having an axial bore, a conductive cap closing one end of said bore, an adjustable electrode carried by said cap and projecting axially into and within said bore, stop means within said bore, a second electrode spaced from said adjustable electrode by said stop means to form therewith a spark-gap, and supporting means for said second electrode, said supporting means holding said second electrode against said stop means, said electrodes and spark-gap being so positioned as to be visible through said insulator from the exterior thereof, said supporting means being conductive.

10. In combination: a transparent insulator of the pin type having an axial bore extending therethrough, a metal cap secured to one end of said insulator and forming a sealed closure for one end of said bore, said cap having an elongate electrode portion extending axially into said bore, a metal bushing fixedly mounted in said bore and having an internal thread coaxial with said bore, a metal stud threaded into said bushing and car-

ried thereby, said stud extending toward said aforementioned electrode portion and forming a spark-gap therewith, said spark-gap being visible through said insulator from the exterior thereof, a sheet metal thimble threaded into and forming a sealed closure for the other end of said bore, said thimble being internally threaded to receive the threaded end of an insulator-supporting pin, and a helical spring interconnecting said bushing with one end of said thimble.

11. In combination: a transparent insulator of the pin type having an axial bore extending therethrough, a metal cap in threaded engagement with and carried by said insulator at the upper end thereof, said cap having an elongate teat extending axially into said bore and constituting a spark-gap electrode, a sealing gasket interposed between said insulator and said cap, a metal internally threaded bushing fixedly mounted within said bore, a stud in threaded engagement with said bushing and in end-to-end spaced relation to said teat, said stud and teat forming, conjointly, a spark-gap which is adjustable by rotating said stud, a sheet metal thimble threaded into and forming a sealed closure for the other end of said bore, and a helical spring interposed between and electrically interconnecting said bushing and said thimble.

12. In combination: an insulator having an axial bore therethrough, a metal cap secured to one end of said insulator and forming a sealed closure for said one end, an elongated electrode carried by said cap within said bore, a support within said bore intermediate the ends thereof, a second electrode within said bore spaced endwise of the first mentioned electrode by said support, one of said electrodes having a screw threaded connection with its support for adjustment relative to the other electrode, a supporting conductive pin extending into said bore opposite said cap, and a spring interconnecting said second electrode and pin.

13. In combination: a transparent insulator having an axial bore, a cap closing one end of said bore and including an electrode portion, an internally threaded conductive support in said bore spaced from said cap, an electrode threaded to said support and extending toward said electrode portion, a gap between said electrodes, said gap being visible through said insulator from the exterior thereof, and a conductive supporting pin including a conductive mounting secured in said bore opposite said cap, said electrode being in series relation to said pin electrically.

14. In combination: an insulator having an axial bore, a conductive cap closing one end of said bore, a first electrode carried by said cap and disposed within said bore, said first electrode being adjustably movable axially of said bore and accessible through an opening in said cap from the exterior thereof for effecting such adjustments, a removable closure normally sealing said opening against intrusion of moisture and corrosive gases to said bore, a second electrode within said bore in spaced relation to said first electrode and defining therewith a spark gap, and supporting means within said bore for said second electrode and said insulator, said supporting means being conductive.

15. In combination: an insulator having an axial bore, a conductive cap closing one end of said bore, a first electrode in threaded engagement with and carried by said cap, said first electrode being disposed within and extending axially along said bore and adjustably movable lengthwise by rotating the same, said first electrode being accessible through an opening in said cap for effecting adjustments thereof, a removable closure member carried by said cap for sealing the opening in said cap whereby to prevent intrusion of moisture and corrosive gases to said bore, a second electrode within said bore in spaced relation to said first electrode and defining therewith a spark gap, and supporting means within said bore for said electrode, said supporting means providing a ground connection exteriorly of said insulator, said supporting means being conductive.

16. In combination: an insulator of the pin type having an axial bore, a metal thimble threaded into one end of said bore, a conductive supporting pin extending into said thimble, a conductive cap closing the other end of said bore, an electrode supported by said cap and projecting into said bore, a second electrode disposed within said bore and spaced from said first mentioned electrode to form a spark gap, said second electrode being located relatively to said first electrode by a shoulder in said bore and by a spring interconnecting said second electrode and said thimble.

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