

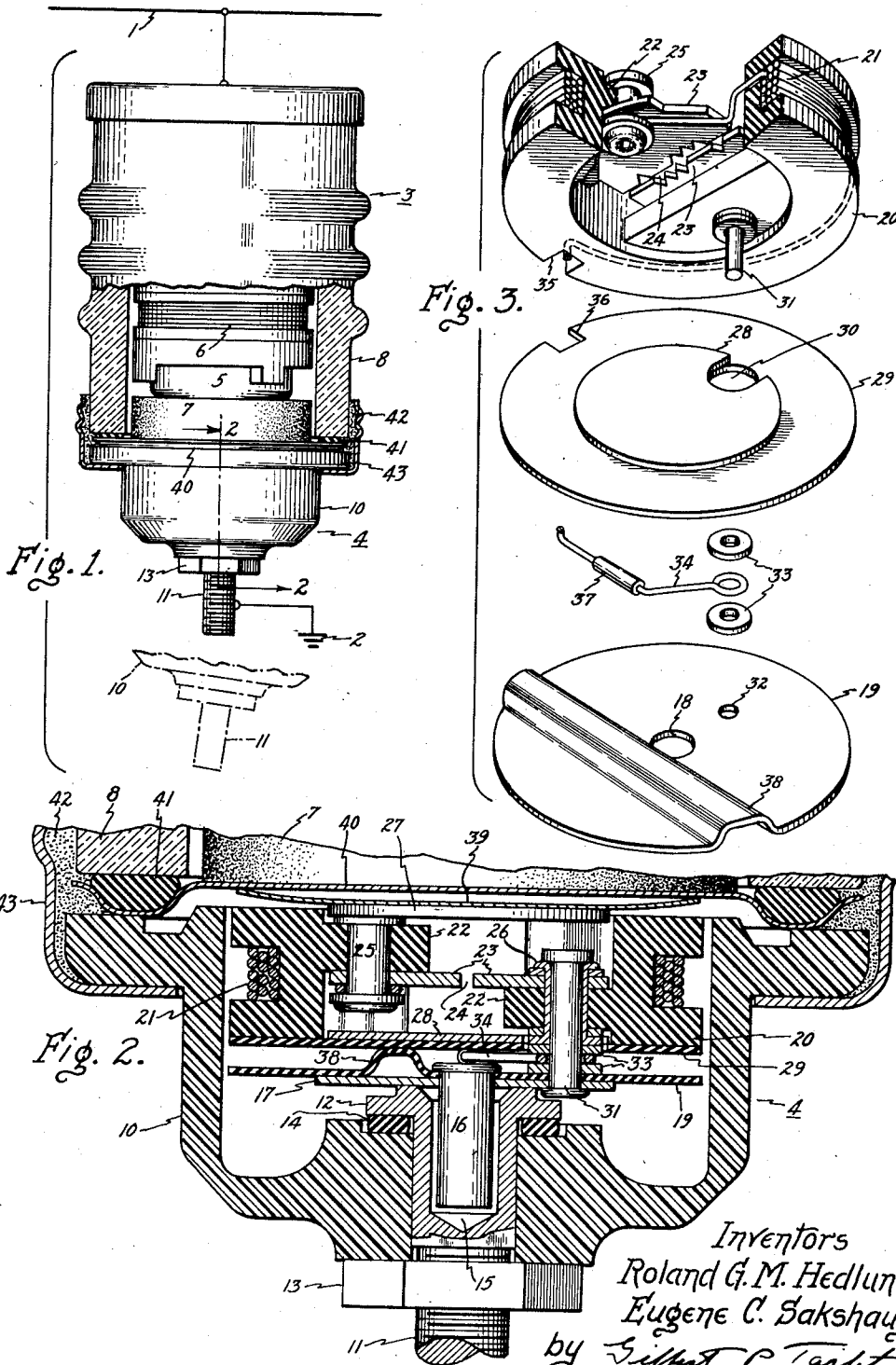
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CIRCUIT INTERRUPTER

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CIRCUIT INTERRUPTER

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This invention relates to a circuit interrupter of the inverse current-time responsive type, and more particularly, to an improvement in the type of circuit interrupter or lightning arrester isolator shown in McMorris Patent 2,305,436 issued December 15, 1942 and assigned to the same assignee as the instant patent application.

In said McMorris patent is shown a lightning arrester isolator comprising a series connected inductance coil and a fusible element imbedded in an explosive cartridge, both of said elements being shunted by a gap. When lightning strikes the line to be protected the high frequency surge passes through the lightning arrester and the isolator to ground. At high frequency surge conditions the inductance coil presents a high impedance to the passage of surge current through the fuse whereby the gap sparks over to pass most of the high frequency surge current therethrough to ground while 60 cycle power follow current flows through the coil and fuse since the coil presents a low impedance to 60 cycle current. After the surge has been dissipated to ground 60 cycle power follow current will not maintain the arc since insufficient voltage is developed across the coil. Assuming the lightning arrester is not damaged or faulty the lightning arrester will interrupt normal relatively low power follow current within the first half cycle thereof. If the lightning arrester does not interrupt the power follow current after the first half cycle thereof power follow current will continue to flow through the coil and fuse. The fuse is designed to blow if it carries several half cycles of normal relatively low power follow current to detonate the explosives and thereby isolate the faulty arrester from ground. However, in event of abnormal relatively high 60 cycle power follow currents due to a fault in the arrester it is also desirable that the fuse melt in less than one half cycle lest line fuses or breakers operate before the isolator operates.

It will be obvious that in the above-described lightning arrester isolator costs are increased inasmuch as the combined explosive cartridge and imbedded fuse wire must be rather finely calibrated if the lightning arrester isolator is to reliably distinguish between normal relatively low and abnormal relatively high fault power follow currents.

Accordingly, it is an object of this invention to provide a lightning arrester isolator which is low cost and reliably distinguishes between normal relatively low and abnormal relatively high fault power follow currents.

In our invention the fuse wire is not imbedded in the explosive cartridge but disposed outside thereof and not in contact therewith whereby it may more easily be calibrated. Additionally, the internal magnetic field of the inductance coil is utilized to drive an arc established across a fused portion of the fusible element into contact with the detonating cap or head of the cartridge only when the lightning arrester is faulty.

The features of our invention which we believe to be novel are set forth with particularity in the appended claims. Our invention itself, however, both as to its

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organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing.

In the drawing, Fig. 1 is a partly broken away side elevation view of a lightning arrester having our invention incorporated therein. Fig. 2 is a partly broken away sectional view of our invention taken along the line 2—2 of Fig. 1. Fig. 3 is a partly broken away exploded perspective view of some of the internal elements of our invention. Like reference numerals will be used throughout the various figures to indicate identical parts.

Referring now particularly to Fig. 1, illustrated therein is a distribution line 1 connected to ground 2 through a distribution lightning arrester 3 and a lightning arrester isolator 4. The lightning arrester 3 constitutes no part of our invention but is merely illustrative of several different kinds of conventional lightning arresters with which our invention is usable. Lightning arrester 3 broadly comprises one or more alternately stacked gap units 5, coil units 6, and nonlinear resistors or valve elements 7 enclosed within a generally cylindrical porcelain or other electrical insulating material housing 8. As is probably more clear from Fig. 2, the lower open end of housing 8 is closed by the lightning arrester isolator 4.

The lightning arrester isolator 4 comprises a generally circular hollow cup-shaped plastic or other frangible electrical insulating material member 10. The bottom of member 10 has a central through bore formed therein which receives a metallic grounding stud 11. Stud 11 is secured to member 10 by virtue of a shoulder 12 formed on the upper end of stud 11 and a nut 13, and the through bore for stud 11 is sealed by a sealing gasket 14 compressed between shoulder 12 and the interior surface of member 10. The upper end of stud 11 has a blind bore 15 formed therein and positioned in bore 15 is an explosive cartridge 16. The upper end of cartridge 16 protrudes through an aperture formed in a metallic contact plate 17 which engages the upper end of stud 11, as well as a central aperture 18 formed in a generally circular electrical insulating material plate 19 which is superposed with respect to plate 17. The apertures formed in plates 17 and 19 are aligned with respect to the blind bore 15 and the cartridge 16 is retained in its illustrated position by an outer shoulder or bead formed on the upper detonating cap portion of cartridge 16. However, it will be obvious that blind bore 15 can be constructed to snugly receive and position the cartridge 16 in which event the aligned apertures formed in plates 17 and 19 can be made large enough to permit fitting of plates 17 and 19 over the cartridge 16 after they have been attached to a spool 20.

Positioned in the upper portion of the cavity of member 10 above cartridge 16 and plates 17 and 19 is a coil unit which is similar in construction to the coil units 6 of lightning arrester 3. Said lightning arrester isolator coil unit comprises a generally circular electrical insulating material spool 20 having an inductance coil 21 wound thereabout. The inner hollow portion of spool 20 has an integral pair of ledges 22 which support a pair of metallic electrode plates 23 which define a gap 24 therebetween. The electrode plates 23 are fastened to the ledges 22 by eyelets 25 and 26. The upper end of the hollow of spool 20 is closed by a circular metallic plate 27 which has an outer diameter slightly less than the inner diameter of spool 20 and makes electrical contacts with the upper end of eyelet 25. The lower end of the hollow of spool 20 is closed by a metallic plate 28 similar to plate 27. The plate 28 is covered by a circular electrical insulating material plate 29 which has an outer diameter roughly equal to the outer diameter of spool 20. The plates 28 and 29 have aligned aper-

tures 30 formed therein which will permit positioning of the plates 28 and 29 in their illustrated location without interference from the eyelet 26 or a pin 31 disposed within eyelet 26.

The lower end of pin 31 extends through an aperture 32 formed in insulating material plate 19 as well as another aperture formed in plate 17 and aligned with respect to aperture 32. Positioned about pin 31 between the lower end of eyelet 26 and the upper surface of plate 19 are a pair of metallic washers 33. A fuse wire or element 34 is electrically connected to the pin 31 between the washers 33. One end of the inductance coil 21 is connected to the lower end of eyelet 25 and then coil 21 is wound about the spool 20 in a clockwise direction when viewing Fig. 3. The opposite end of coil 21 leaves the spool 20 through a groove 35 formed in the spool 20, passes through a registering groove 36 formed in the plate 29, and then extends to the lefthand end of fuse wire 34 and is connected thereto by a metallic sleeve 34 or the like. The fuse wire 34 is disposed approximately level with, but radially outside of the upper end of cartridge 16. That is, fuse wire 34 is generally tangential to an imaginary circle concentric with respect to the bead of cartridge 16. The plate 19 has a raised portion or ridge 38 formed therein to the left of aperture 18 which extends between opposite side edges of plate 19 and engages the bottom surface of plate 29. The upper end of cartridge 16 is generally between fuse wire 34 and ridge 38 which together define therebetween a generally sector-shaped arcing area or chamber.

Superposed with respect to plate 27 and in electrical contact therewith is a metallic disk spring 39 which in turn electrically engages another metallic plate 40 which makes electrical contact with the bottom surface of valve element 7. A gasket 41 is disposed between plate 40 and the lower open end edge of porcelain housing 8, and the member 10 is connected to housing 8 by cement 42 and a flanged collar 43.

When lightning strikes the line 1 the high frequency surge will be dissipated to ground 2 through the lightning arrester 3 and lightning arrester isolator 4. From valve element 7 to grounded stud 11 two parallel paths are provided. One of said paths comprises plate 40, spring 39, plate 27, eyelet 25, coil 21, sleeve 37, fuse wire 34, pin 31, and plate 17. The other of said paths comprises plate 40, spring 39, plate 27, eyelet 25, gap 24 formed by electrode plates 23, eyelet 26, pin 31, and plate 17. Neither of said paths includes cartridge 16 inasmuch as cartridge 16 is spaced from the fuse 34.

During dissipation of the high frequency current surge to ground 2 the gap 24 will be arced over and most of the surge current will seek the easier path to ground 2 through gap 24 due to the high impedance of coil 21. Power follow current will flow through coil 21 and fuse 34 inasmuch as coil 21 presents a low impedance to 60 cycle current. Also, since the impedance of coil 21 decreases at low frequencies the arc across gap 24 will be extinguished after dissipation of the surge current to ground 2. The fuse 34 is calibrated to withstand at least one half cycle of normal relatively low 60 cycle power follow current but to melt at less than one half cycle of abnormal relatively high 60 cycle power follow current. If the lightning arrester 3 fails to interrupt normal low power follow current within the first cycle thereof thereafter the fuse 34 will blow, and for abnormal high power follow currents the fuse 34 will blow in less than one half cycle. The magnetic field passing through the hollow of spool 20 will react with the magnetic field of the fuse arc current in accordance with the lefthand motor rule to move the arc across the fused portions of fuse wire 34 into contact with the upper end of cartridge 16 to cause detonation thereof. The fuse arc will not overtravel the cartridge 16 before the cartridge 16 has an opportunity to explode because of the barrier or stop

presented by ridge 38 along the left side of cartridge 16. When cartridge 16 explodes the thinner portions of frangible member 10 will be ruptured and stud 11 will fall to isolate the lightning arrester 3 from ground 2.

In view of the foregoing it will be apparent that at no time is the explosive cartridge 16 subjected to either surge or power follow current or the heat thereof unless the arrester proves to be faulty. Only if the arrester 3 fails to interrupt normal low power follow current within one half cycle or in less than one half cycle for abnormal high power follow currents is the cartridge 16 subjected to power follow current or the heat thereof. That is, there is no danger of the isolator 4 misfiring when the lightning arrester 3 is undamaged. Abnormally high power follow currents will flow for instance when the valve element 7 is punctured or flashed over. When valve element 7 is damaged the arrester 3 has failed even though the power follow current has not yet completed one half cycle.

Furthermore, the arc across the fused portions of fuse wire 34 will be caused to ignite cartridge 16 regardless of the place of occurrence of said arc along the length of fuse wire 34. That is, the magnetic field of coil 21 will ensure that the fuse wire arc will contact and ignite the cartridge 16.

Additionally, the performance of the fuse wire 34 can be accurately controlled and calibrated at relatively low cost inasmuch as it is not embedded in or in contact with the cartridge 16. For instance, if the fuse wire 34 were imbedded in or in contact with the cartridge 16 the cartridge 16 would have a cooling effect on the fuse wire 34 or different portions thereof which would be difficult to predict and account for in the performance of the fuse wire 34.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention, and therefore it is intended by the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. A circuit interrupter comprising an inductance coil, a fuse, and a pair of spaced electrodes which define a spark gap, said coil and fuse being connected in series and said spark gap being connected in parallel with said series connected coil and fuse, said fuse extending transverse to the internal magnetic field of said coil whereby said magnetic field will move an electrical arc which is established in said fuse, and an explosive, said explosive being spaced from said fuse and being positioned in the path of movement of said fuse arc by said magnetic field.

2. A circuit interrupter comprising an inductance coil, a fuse, and a pair of spaced electrodes which define an arc gap, said coil and fuse being connected in series and said arc gap being connected in parallel with said series connected coil and fuse, and an explosive, said fuse being disposed in spaced relationship with respect to said explosive, and said fuse being positioned across the internal magnetic field of said coil whereby said magnetic field will move an electrical arc which is established at said fuse to said explosive.

3. A lightning arrester isolator comprising a hollow spool of electrical windings, a generally elongated fusible element, and a pair of spaced electrodes which define an arc gap, said windings and element being connected in series and said arc gap being connected in parallel with said series connected windings and element, and an explosive, said element being disposed in spaced relationship with respect to said explosive, and said element being disposed generally perpendicular and adjacent to the axis of said spool whereby the internal magnetic field of said windings will move an electrical arc established along said element to said explosive.

4. A lightning arrester isolator comprising a hollow

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spool of electrical windings, a generally elongated fusible element, and a pair of spaced electrodes which define an arc gap, said windings and element being connected in series and said arc gap being connected in parallel with said series connected windings and element, and an explosive, said element being disposed in spaced relationship with respect to said explosive, and said element being disposed generally perpendicular and adjacent to the axis of said spool whereby the internal magnetic field of said windings will move an electrical arc established along said element to said explosive, and a barrier for confining movement of said arc to said explosive, said barrier being positioned adjacent to said explosive and said explosive being positioned between said barrier and element.

5. An inverse current-time responsive lightning arrester isolator comprising an inductance coil, a fuse, and a pair of spaced electrodes which define an arc gap, said coil and fuse being connected in series and said arc gap being connected in parallel with said series connected coil and fuse, said fuse being adapted to withstand one-half cycle of 60 cycle current of relatively low predetermined value but to melt in less than one-half cycle of 60 cycle current of relatively high predetermined value, and an explosive, said fuse being positioned in spaced relationship with respect to said explosive, and said fuse being positioned transverse to the internal magnetic field of said

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coil whereby said magnetic field will move an electrical arc which is established at said fuse to said explosive.

6. A lightning arrester isolator comprising a hollow generally cup-shaped frangible member, said member being adapted to have its open end close one end of a lightning arrester housing and the opposite end of said member having a grounding stud connected thereto, and an inductance coil, a fuse, a pair of spaced electrodes which define an arc gap, and an explosive being positioned within said member, said coil and fuse being connected in series, said arc gap being connected in parallel with said series connected coil and fuse, said fuse being positioned in spaced relationship with respect to said explosive, said explosive when exploded being adapted to disconnect said stud from said member by fracturing a portion of said member from the remainder of said member, and said fuse being positioned across the internal magnetic field of said coil whereby said magnetic field will move an electrical arc established at said fuse to said explosive to explode said explosive.

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