Feb. 10, 1953 E. H. YONKERS, JR 2,628,322

LIGHTNING ARRESTER

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Fig. 1

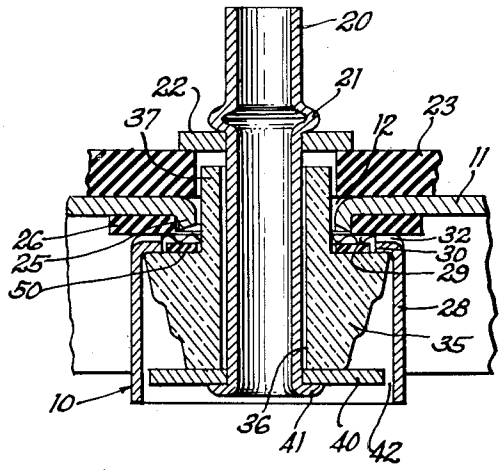


Fig. 2

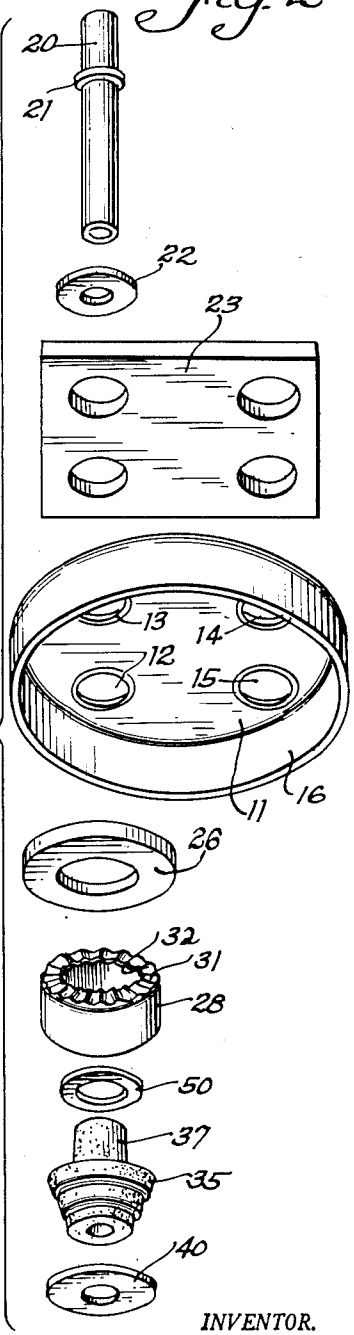
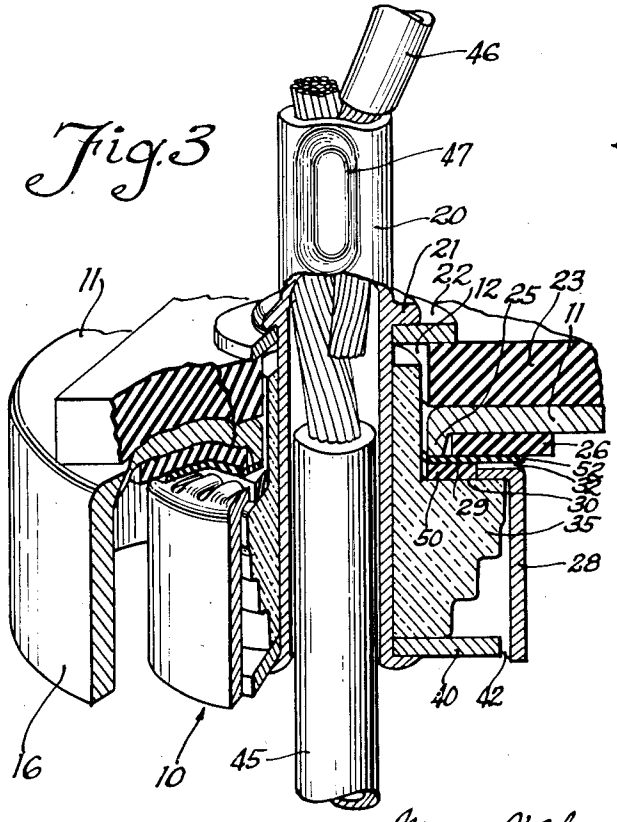


Fig. 3



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LIGHTNING ARRESTER

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9 Claims. (Cl. 313—231)

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The present invention relates to lightning arresters, and more particularly to lightning arresters of the expulsion gap type, and the invention has for an object the provision of a lightning arrester of this type which is suitable for protecting encased electrical apparatus from voltage surges on conductors entering the apparatus and is characterized particularly by its simplicity of construction, low cost, and dependability of operation. Specifically, the present application constitutes a continuation-in-part of my copending application, Serial No. 177,487, filed August 3, 1950, which is assigned to the same assignee as the present invention.

Another object of the present invention resides in the provision of a new and improved lightning arrester unit wherein a double gap surge path is provided, one of the gaps in the path being of the expulsion type and the other gap being of the isolating type, and wherein the component parts of the arrester unit may be quickly and easily assembled with a minimum of time and effort involved.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which:

Fig. 1 is a sectional side elevational view of a lightning arrester unit constructed in accordance with the present invention;

Fig. 2 is an exploded view of the component parts of the lightning arrester unit shown in Fig. 1; and

Fig. 3 is a sectional side elevational view of an alternative embodiment of the lightning arrester of the present invention.

Referring now to the drawings, and more particularly to Figs. 1 and 2 thereof, the lightning arrester unit of the present invention, which is indicated generally at 10, is illustrated in conjunction with the casing 11 of an enclosed electrical apparatus. In the illustrated embodiment the casing 11 comprises the bottom wall of a street lighting control unit of the type described and claimed in the copending application identified above. However, it will be understood that the lightning arrester unit of the present invention may be employed with any suitable encased electrical apparatus to provide protection for the apparatus against voltage surges appearing on conductors incoming to the apparatus. The bottom wall 11 of the casing is provided with a plurality of apertures 12, 13, 14, and 15 through

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which apertures conductors extend to the interior of the control unit, and the bottom wall 11 is provided with a downturned flange 16 partially to enclose the lightning arrester units which are positioned within the apertures 12 to 15, inclusive, and surround the incoming conductors associated therewith.

The lightning arrester unit 10, per se, comprises a hollow tubular rivet-like bushing or terminal member 20 which is preferably of copper and is provided with an outwardly extending flange portion 21 intermediate the length thereof. The flange 21 engages a steel washer 22 which is seated upon a terminal supporting and spacing member 23 of insulating material. The spacing member 23 is positioned upon the inner surface of the bottom wall 11 of the casing and the members 22 and 23 are provided with apertures which are aligned with the aperture 12 in the wall 11 through which aligned apertures the hollow terminal member 20 extends. The terminal member 20 is hollow and is adapted to receive an incoming conductor such as the conductor 45 (Fig. 3) and one or more conductors 46 which are internal of the casing. The upper portion of the terminal member 20 may be crimped as illustrated at 47 to clamp the bare end portions of the conductors 45 and 46 within the terminal member 20 and provide electrical contact between these conductors.

The wall 11 is provided with a downwardly extending flange portion 25 adjacent the aperture 12 therein and there is provided a washer-like spacer 26 of insulating material which is positioned around the flange 25 concentrically therewith. An inverted cup-shaped metal electrode 28 is positioned below the insulating spacer 26 and is provided with a relatively large opening in the upper surface thereof to define a gap 29 between the inner edge 30 of the electrode 28 and the bottom edge of the flange 25. The upper surface of the cup-shaped electrode 28 is provided with radially extending corrugations 31 (Fig. 2) which define radially extending grooves or passageways 32 between the spacer 26 and the electrode 28. The passageways 32 serve as vent openings to permit the escape of gases produced in the above-described air gap 29 in a manner to be described in more detail hereinafter.

A bushing 35 of suitable insulating material such as porcelain or the like, is provided with a central bore 36 which is adapted to receive the terminal member 20, and is further provided with a shank portion 37 of reduced diameter

which extends through the aligned apertures in the casing wall 11 and the supporting member 23. The shank 37 thus functions to separate the conductive terminal 20 from the flanged portion 25 of the container wall 11. A steel disk electrode 40 is positioned on the bottom end of the terminal member 20 adjacent the exposed end of the bushing 35 and is held in place by upsetting or spinning over the end 41 of the bushing 20. The relative proportioning of the parts is such that the periphery of the disk electrode 40 is spaced from the rim portion of the cup-shaped electrode 28 to define an isolating air gap 42 between these members.

In order to extinguish an arc which may be set up in the air gap 29 there is provided an insulating washer 50 which is positioned within the air gap 29 and is formed of a suitable gas evolving or gas emitting material, such as methyl methacrylate, horn fibre, or the like. The washer 50 acts as a spacer to position the cup-shaped electrode 28 in concentric relation to the shank of the bushing 35, and the disk electrode 40 carried thereby.

It will be evident from the foregoing description that the lightning arrester unit is rigidly secured to the casing wall 11 due to the fact that the flange 21 on the terminal member 20 and the spun over end portion 41 thereof cooperate to clamp the component elements of the lightning arrester unit to the sides of the casing wall 11. It will further be evident from the exploded view of Fig. 2 that the component parts of the arrester unit may be quickly and easily assembled on the casing wall in the order shown therein to produce a complete arrester unit.

Considering now the operation of the above-described lightning arrester, when an over voltage occurs on a conductor extending through the central bore of the terminal member 20, it will be evident from the foregoing description that a breakdown path for voltage surges appearing on this conductor is established through the bottom end of the terminal member 20 and the disk or line electrode 40, the air gap 42, the cup-shaped electrode 28, and the air gap 29 to the flanged edge 25 of the casing wall 11. If the potential on the disk electrode 40 is raised to the arrester sparkover voltage there will be an immediate discharge from this electrode through the above-described breakdown path to the casing wall 11 and if the casing is grounded the voltage surge will be conducted to ground. If the casing is ungrounded, as for example if the enclosed apparatus is supported on an insulating member, the voltage surge will break down another lightning arrester unit associated with the ground conductor so that the voltage surge is conveyed to ground without harming the encased components of the apparatus. When there is a discharge from the disk electrode 40 through the isolating air gap 42 and through the cup-shaped electrode 28 to the expulsion gap 29, the heat of the arc evolves gases from the fiber washer 50 positioned within the gap 29 which cool and de-ionize the arc stream and result in arc extinction at the first current zero. With this arrangement, continued arcing and damage from the 60-cycle power follow current is prevented. The vent openings 32 which are provided in the cup-shaped electrode 28 permit the escape of the generated gases so that these vent openings act as arc chutes to facilitate extinction of the arc. In this connection it will be understood that the air gap 42 acts as an isolating gap to remove potential from the expulsion gap 29 to prevent carbonizing of the insulating members in the vicinity of this gap. It will also be understood that the sparkover voltage of the lightning arrester units is coordinated with the voltage ratings of the component elements within the enclosed casing so that complete protection is obtained for all of the enclosed components even when direct lightning strokes are applied to the incoming conductors.

In the alternative embodiment shown in Fig. 3, the expulsion gap 29 is lined on both sides with horn fiber material to promote the production of gases from the heat of the arc. More specifically, there is provided in the alternative embodiment of Fig. 3 another insulating washer 52, which is of a gas evolving or gas emitting material such as horn fibre or the like, is positioned between the insulating spacer 26 and the corrugated upper edge of the cup-shaped electrode 28. With this arrangement the air gap 29 is completely fiber lined by means of the washers 50 and 52 so that arc extinguishing gases are immediately evolved when an arc is struck between the cup-shaped electrode 28 and the casing wall 11. In other respects the lightning arrester unit of Fig. 3 is identical to the embodiment shown in detail in Figs. 1 and 2 and described heretofore in connection therewith. A lightning arrester unit of the type shown in Fig. 3 has been tested on a 120-volt circuit having an available short circuit current of 4000 amperes. Under these conditions the operation of the lightning arrester unit showed that the power arc was extinguished in less than one-half of one current cycle due to arc resistance.

While there have been described what are at present considered to be the preferred embodiments of the invention, it will be understood that various modifications may be made therein which are within the true spirit and scope of the invention as defined in the appended claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A lightning arrester unit for protecting an encased electrical apparatus from voltage surges on an incoming conductor thereof, comprising a conductive tubular member extending through an aperture in the wall of said casing and adapted to pass an incoming conductor therethrough, an insulating bushing having a head portion external to said casing and a shank portion extending through said aperture and having a central bore therethrough receiving said tubular member, a disk electrode carried by said tubular member adjacent the head portion of said bushing, a cup-shaped electrode adapted to enclose the head portion of said bushing and having a rim portion spaced from the periphery of said disk electrode to form a first air gap therebetween, and an insulating spacer positioned between said casing and the bottom edge of said cup-shaped electrode to provide a second air gap therebetween.

2. A lightning arrester unit for protecting an encased electrical apparatus from voltage surges on an incoming conductor thereof, comprising a conductive tubular member extending through an aperture in the wall of said casing and adapted to pass an incoming conductor therethrough, an insulating bushing having a head portion external to said casing and a shank portion extending through said aperture and having a central bore therethrough receiving said tubular member, a conductive disk electrode car-

ried by said tubular member adjacent the head portion of said bushing, a conductive cup-shaped electrode adapted to enclose the head portion of said bushing and having a rim portion spaced from the periphery of said disk electrode to form a first air gap therebetween, an insulating spacer positioned between said casing and the bottom edge of said cup-shaped electrode to provide a second air gap therebetween, and gas evolving means positioned within said second air gap.

3. A lightning arrester unit for protecting an encased electrical apparatus from voltage surges on an incoming conductor thereof, comprising a tubular conductive terminal member extending through an aperture in the wall of said casing and adapted to surround an incoming conductor, an insulating bushing having a head portion external to said casing and a shank portion extending through said aperture and having a central bore therethrough adapted to receive said tubular terminal member, a conductive disk electrode carried by said terminal member adjacent the head portion of said bushing, a cup-shaped conductive electrode adapted to enclose the head portion of said bushing and having a rim portion spaced from the periphery of said disk electrode to form a first air gap therebetween, an insulated spacer positioned between said casing and the bottom edge of said cup-shaped electrode to provide a second air gap therebetween, and gas evolving means positioned within said second air gap, a portion of the side wall of said terminal member internally of the casing being deformed inwardly to clamp a plurality of bare conductors therein and provide an electrical connection therebetween.

4. A lightning arrester unit for an apertured casing enclosing an electrical apparatus and having an outwardly extending flange portion surrounding the aperture thereof, comprising a conductive tubular member extending through said aperture and adapted to pass an incoming conductor therethrough, an insulating bushing having a head portion external to said casing and a shank portion extending through said aperture and having a central bore therethrough adapted to receive said tubular member, a conductive disk electrode carried by said tubular member adjacent the head portion of said bushing, a conductive cup-shaped electrode concentric with said tubular member and opening outwardly to enclose the head portion of said bushing, said cup-shaped electrode having a rim portion spaced from the periphery of said disk electrode to form a first air gap therebetween and having an aperture in the bottom wall thereof adapted to receive the shank portion of said bushing therethrough, an insulating washer surrounding said flange portion and positioned between said cup-shaped electrode and said casing to define a second air gap between the flanged portion of said casing and the inner edge of said cup-shaped electrode, and a washer of gas evolving material positioned within said second air gap, said cup-shaped electrode having radially extending grooves in the bottom surface thereof to provide vent openings communicating with said second air gap.

5. A lightning arrester unit for an apertured casing enclosing an electrical apparatus and having an outwardly extending flange portion surrounding the aperture thereof, comprising a tubular conductive terminal member extending through said aperture and insulated from said casing and having an incoming conductor extending through the central bore thereof, a transverse conductive disk electrode carried by said terminal member externally of said casing, a cup-shaped conductive electrode concentric with said terminal member and opening outwardly from said casing, and means for spacing said cup-shaped electrode between said casing and said disk electrode to define a pair of series connected air gaps between the incoming conductor and said casing.

6. A lightning arrester unit, comprising an apertured casing having an outwardly extending flange portion adjacent the aperture thereof, an insulating washer concentric with said aperture and surrounding said flange portion, a conductive sleeve concentric with said aperture and having an inwardly extending flange portion seated on said insulating spacer and spaced from said outwardly extending flange portion to define a first air gap therebetween, an elongated insulated bushing having an axial bore therethrough and a shoulder portion thereof adapted to engage said inwardly extending flange and arranged to protrude through said aperture into the interior of said casing, a conductive disk electrode positioned on said bushing and spaced from the rim portion of said conductive sleeve to define a second air gap therebetween, said inwardly extending flange portion having corrugations therein to define vent openings for said first air gap, and gas evolving means positioned within said first air gap.

7. A lightning arrester unit for protecting an encased electrical apparatus from voltage surges on an incoming conductor thereof, comprising a tubular conductive member extending through an aperture in the wall of said casing and adapted to pass an incoming conductor therethrough, an insulating bushing having a head portion external to said casing and a shank portion extending through said aperture and having a central bore therethrough receiving said tubular member, a conductive disk electrode carried by said tubular member adjacent the head portion of said bushing, a cup-shaped conductive electrode adapted to enclose the head portion of said bushing and having a rim portion spaced from the periphery of said disk electrode to form a first air gap therebetween, and means including a pair of washers of gas evolving material positioned between said casing and the bottom edge of said cup-shaped electrode for providing a lined expulsion gap therebetween.

8. A lightning arrester unit for protecting an encased electrical apparatus from voltage surges on an incoming conductor thereof, comprising a tubular conductive member extending through an aperture in the wall of said casing and adapted to pass an incoming conductor therethrough, an insulating bushing having a head portion external to said casing and a shank portion extending through said aperture and having a central bore therethrough receiving said tubular member, a conductive disk electrode carried by said tubular member adjacent the head portion of said bushing, a cup-shaped conductive electrode adapted to enclose the head portion of said bushing and having a rim portion spaced from the periphery of said disk electrode to form a first air gap therebetween, an insulating spacer positioned between said casing and the bottom edge of said cup-shaped electrode, and a pair of washers of gas evolving material positioned between said spacer and the head portion of said bushing and defining therebetween an expulsion gap between said cup-shaped electrode and said casing.

9. A lightning arrester unit for protecting an encased electrical apparatus from voltage surges on an incoming conductor thereof, comprising a tubular conductive member extending through an aperture in the wall of said casing and adapted to pass an incoming conductor therethrough, an insulating bushing having a head portion external to said casing and a shank portion extending through said aperture and having a central bore therethrough receiving said tubular member, a conductive disk electrode carried by said tubular member adjacent the head portion of said bushing, a cup-shaped conductive electrode adapted to enclose the head portion of said bushing and having a rim portion spaced from the periphery of said disk electrode to form a first air gap therebetween, an insulating spacer positioned between said casing and the bottom edge of said cup-shaped electrode, and a pair of washers of gas evolving material positioned between said spacer and the head portion of said bushing and defining therebetween a lined expulsion gap between said cup-shaped electrode and said casing, the bottom of said cup-shaped electrode being corrugated to provide vent openings communicating with said expulsion gap.

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No references cited.