

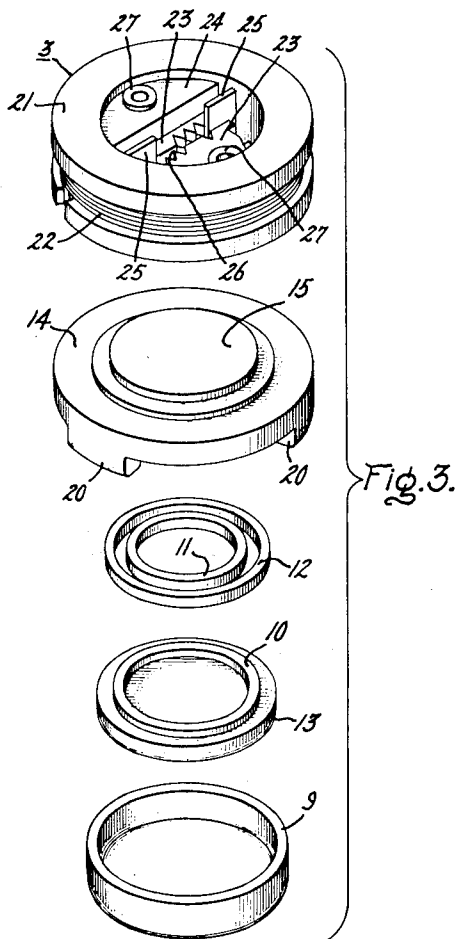
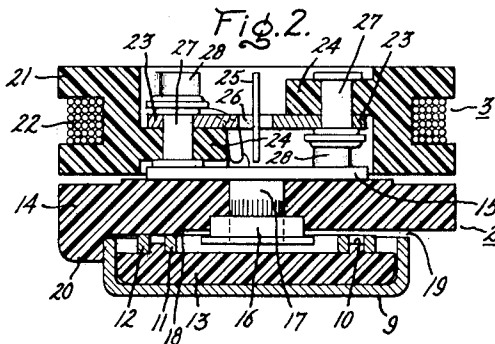
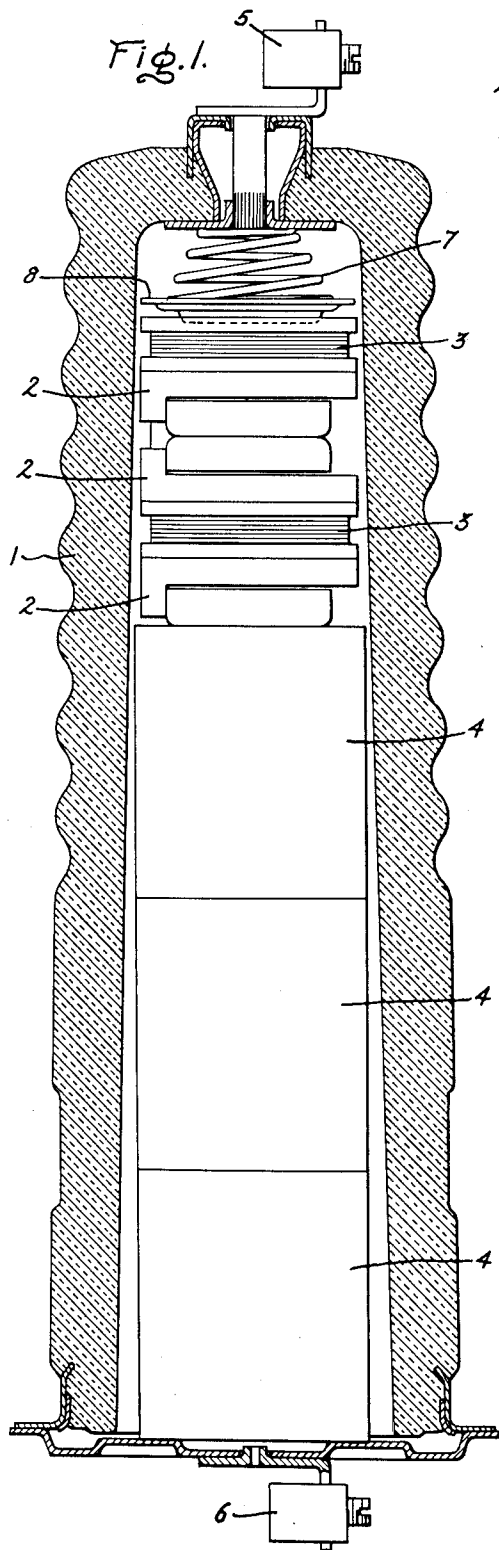
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D. W. CROUCH ET AL

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MULTIPLE CONCENTRIC ELECTRODE GAP CONSTRUCTION

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Inventors:
Donald W. Crouch,
James H. Snell, Jr.
Thomas J. Carpenter,
by *Gilbert P. Tarleton*
Their Attorney.

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MULTIPLE CONCENTRIC ELECTRODE GAP CONSTRUCTION

Donald W. Crouch, Ancramdale, N. Y., and James H. Snell, Jr., and Thomas J. Carpenter, Pittsfield, Mass., assignors to General Electric Company, a corporation of New York

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This invention relates to a multiple concentric electrode gap construction, and more particularly, to a multiple concentric electrode gap construction suitable for incorporation into lightning arresters for the interruption of high power follow currents.

In some of the prior known gap unit constructions for lightning arresters a pair or plurality of gap electrodes are positioned between two insulating plates. Once an arc is struck across the electrodes of the gap unit an arc is continuously maintained at a relatively fixed position with respect to the gap unit parts. This is undesirable. For instance, with a fixed arc metallic vaporization of the electrodes may occur as well as a burning of the insulating plates. Also, since the arc is fixed, the conduction of heat from the arc by the electrodes and insulating plates is relatively limited. These factors limit the magnitude of the power follow currents that can be interrupted.

It is an object of this invention to provide a gap unit construction whereby the arc within the gap unit is continuously moving with respect to the gap unit parts.

Our invention comprises a multiple concentric electrode gap unit comprising a plurality of narrow ring-like concentric spaced metallic electrodes positioned between two electrical insulating material plates.

Our invention further comprises the combination of magnetic means and a multiple concentric electrode gap unit, said unit comprising a plurality of annular narrow concentric spaced metallic electrodes positioned between two electrical insulating material plates, whereby the magnetic field of the magnetic means transverse to the plane of the insulating plates will react with the magnetic field produced by a radial arc struck across said electrodes to cause said arc to continuously rotate within said gap unit.

The invention will be better understood by considering the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawing, Figure 1 is a view of a lightning arrester assembly embodying our invention. Figure 2 is a view in section of our multiple concentric electrode gap unit with a magnetic means cooperative therewith. Figure 3 is an exploded view in perspective of the multiple concentric electrode gap unit parts and magnetic means of Figure 2. Like reference numerals throughout the various figures indicate like parts.

Referring particularly to Figure 1, shown therein is a weather proof lightning arrester assembly embodying our invention comprising an insulating material, as porcelain, housing 1 enclosing a plurality of stacked gap units 2, magnetic means units 3, and non-linear resistance units 4. At the upper and lower ends of housing 1 are terminals 5 and 6 respectively so that the assembly can be connected between a source of electrical energy or apparatus to be protected and ground. Positioned between terminal 5 and uppermost magnetic means unit 3 is an electrical conducting spring 7 and contact plate

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8. Spring 7 ensures good electrical contact between the various stacked gap, magnetic means, and non-linear resistance units and the terminals.

Referring particularly to Figures 2 and 3, shown therein are the details of one of the gap units 2 and one of the magnetic means units 3. The gap unit 2 comprises a thin cup-like outer metallic electrode 9 which receives a non-gas evolving electrical insulating material plate 13. The insulating material plate 13 has an annular ridge 10 formed on its upper surface adjacent to but spaced from its outer circumference. The ridge 10 has positioned within its inner and about its outer circumference two narrow annular intermediate metallic electrodes 11 and 12 respectively. Obviously, more electrodes can be added merely by the formation of additional ridges on the upper surface of insulating material plate 13. Positioned above and opposite parts 9 to 13 is a non-gas evolving electrical insulating material plate 14. On the upper surface of insulating material plate 14 is a metallic contact plate 15. Positioned on the under surface of the insulating material plate 14 is an annular metallic electrode 16 spaced with respect to the upper surface of insulating material plate 13. Plate 15 and electrode 16 are in electrical contact and insulating material plate 14 is firmly clamped therebetween by connecting portion 17.

The two insulating plates 13 and 14 define therebetween a shallow arc chamber or space with the multiple concentric annular or ring-like electrodes positioned therein. The height or width of the electrodes 11, 12, and 16, and of the lip of the cup-like electrode 9 is considerably less than their diameters. The underside of the insulating plate 14 has a plurality of radially extending narrow ridges 18 formed thereon defining a plurality of grooves or vents 19 therebetween. Thus, when plate 14 is positioned opposite plate 13 the arc chamber or air space therebetween will be vented by grooves or vents 19.

Formed on the ridges 18 adjacent the circumference of plate 14 are cup centering ridges 20. That is, ridges 20 center the cup electrode 9, plus the electrodes 11 and 12 concentrically with respect to inner electrode 16. The electrodes 11, 12, and 16 as well as the lip of cup electrode 9 are positioned within the arc chamber defined by the spaced insulating plates 13 and 14. The base of cup 9 serves to make electrical contact with an adjacent gap unit or non-linear resistor as shown in Figure 1. Every adjacent pair of electrodes defines an annular unobstructed air gap therebetween so that when an arc is struck within the gap unit there will be a plurality of radial electrically series connected arcs therein. As will appear later, deionization is produced when the arcs are swept or rotated between and against the non-gas evolving walls of the insulating material plates. The insulating material plates may be of either porous or impermeable material.

The magnetic means unit 3 is not our invention but is a circular adaptation of the magnetic means unit disclosed in the copending application of Arthur A. Olsen and Wilfred F. Skeats, Serial No. 185,994 filed September 21, 1950, now Patent No. 2,644,116 issued June 30, 1953 and assigned to the same assignee as the instant application. The magnetic means unit 3 has a circular spool 21 with an electric coil 22 thereabout. The ends of said coil 22 are attached to conductor plates 23 resting on ledges 24 formed within the inner circumference of spool 21. The conductor plates 23 are spaced by mica sheets 25 and define therebetween coil shunting gap 26. The conductor plates 23 are clamped to ledges 24 and the ends of the coil 22 attached to said conductor plates by virtue of contact eyelets 27.

When the magnetic means unit 3 and gap unit 2 are

stacked together the contact plate 15 of gap unit 2 will make electrical contact with one of the contact eyelets 27. The plate 15 is correctly proportioned to fit within the inner circumference of spool 21 to make this electrical contact and auxiliary ledges 28 help steady the coil and gap units with respect to each other to make good electrical contact in a compact fashion.

As will be readily apparent to those skilled in the art, coil winding 22 is electrically connected in series with gap unit 2, and shunting gap 26 provides a by-pass or shunt around the winding 22 for its protection during the passage of a transient having components with rapid rates of current change. Following the establishment of a plurality of electrically series connected arcs within gap unit 2 and dissipation of the transient, the power follow current path to ground will include the winding 22 so that the magnetic field produced thereby within the periphery of the coil 22 transverse to the planes of the insulating plates 13 and 14 will react with the magnetic field produced by the current in the radial arcs struck across the multiple concentric electrodes 16, 11, 12, 9 to rotate said arcs. Since said arcs are continuously rotating within the shallow confines of the arc chamber between insulating plates 13 and 14, said arcs are continuously in contact with the adjacent cool surfaces of the plates 13 and 14. Also, since the arcs are continuously rotating there is little opportunity for metallic vaporization or localized erosion of the electrodes or insulating plates. The arcs can strike along any radial path. With this concentric design of the electrodes of the gap unit and continuous rotation of the arcs maximum use of the deionizing surfaces of the insulating material plates is attained. With a greater degree of cooling of the arcs and deionization the range of power follow currents that can be interrupted are accordingly higher. With a higher interrupting capacity gap unit the resistance of the valve elements or non-linear resistances 4 of Figure 1 can be reduced to provide lower arrester protective levels.

Our gap unit construction also gives control of the gap unit sparkover voltage. The potentials of the intermediate electrodes 11 and 12 are controlled by the electro-static field distribution through the insulating plates 13 and 14 from contact plates 9 and 15. Consequently, the current interrupting ability of the gap unit can be increased without affecting the voltage sparkover of the gap unit by increasing the gap spacings defined by electrodes 9, 11, 12, and 16 due to the control of the potentials of the intermediate electrodes 11 and 12 by the design of the insulating plates 13 and 14 which controls the electro-static field potentials.

An additional advantage of our invention is the compactness and simplicity of the gap unit. There is an efficient use of space and materials. Costs are radically reduced over the costs of other gap units of comparable interrupting capacity. Also, each gap unit is compactly enclosed to prevent flashover between stacked units with adequate venting of each gap unit. Additional electrodes in between inner electrode 16 and outer electrode 9 break the large gap therebetween into a series of small annular concentric unobstructed gaps to give a plurality of electrically series connected arcs without any appreciable elongation thereof. With proper cooling of the arcs and deionization there is no opportunity for the arcs to restrike.

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 that 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 gap construction comprising two circular electrical insulating plates, one of said plates positioned in the bottom of a shallow cup-like metallic electrode, the lip of said cup-like electrode protruding beyond the upper surface of said one plate, the other of said plates positioned above said one plate and cup lip, said two plates defining a shallow arc chamber therebetween, a centermost metallic electrode protruding through the center of said other plate into said chamber in spaced relationship with respect to said one plate, the lip of said cup-like electrode and said centermost electrode concentrically disposed with respect to each other defining an annular circular air gap therebetween, the depth of said shallow arc chamber being considerably less than the diameter of said lip.

2. A gap construction as in claim 1, wherein a narrow intermediate metallic electrode is positioned within said chamber between said centermost electrode and said lip, said lip, intermediate, and centermost electrodes being concentrically disposed with respect to each other whereby said annular circular air gap is divided into a plurality of electrically series connected annular circular air gaps, said intermediate electrode being spaced from said centermost electrode and said lip.

3. A gap construction comprising two circular electrical insulating plates, one of said plates positioned within the bottom of a thin cup-like metallic element, the lip of said cup-like element protruding beyond the upper surface of said one plate and constituting an outermost electrode, said one plate upper surface having a shallow annular ridge formed thereon between the center and periphery of said one plate, annular narrow intermediate metallic electrodes positioned within and about the inner and outer periphery of said ridge, the upper edges of said intermediate electrodes protruding beyond the upper edge of said ridge, the other of said insulating plates superimposed with respect to said lip and upper edges, said insulating plates defining a shallow arc chamber therebetween, a centermost metallic electrode protruding through the center of said other plate into said chamber in spaced relationship with respect to said one plate upper surface and centrally disposed with respect to said lip and intermediate electrodes, contact means on the upper surface of said other plate making electrical contact with said centermost electrode, all of said electrodes concentrically disposed with respect to each other and defining therebetween a plurality of concentric annular circular unobstructed air gaps, the lower surface of said cup like element bottom constituting a second contact means.

4. A multiple gap unit comprising two superposed electrical insulating plates closely spaced with respect to each other and defining a shallow arc chamber therebetween, at least three shallow ring-like metallic electrodes concentrically disposed and spaced with respect to each other within said arc chamber, each immediately adjacent pair of said three electrodes having only one shallow annular unobstructed air gap therebetween extending circumferentially of said pair of electrodes the depth of said electrodes and gaps being considerably less than their diameters.

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