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[73] Assignee **McGraw-Edison Company**
Milwaukee, Wis.
Continuation of application Ser. No. 766,752, Oct. 11, 1968, now abandoned.

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[54] LIGHTNING ARRESTER VENTING MEANS 3 Claims, 11 Drawing Figs.

[52] U.S. Cl..... **313/325,**
313/148, 313/174, 313/220, 313/231, 315/36

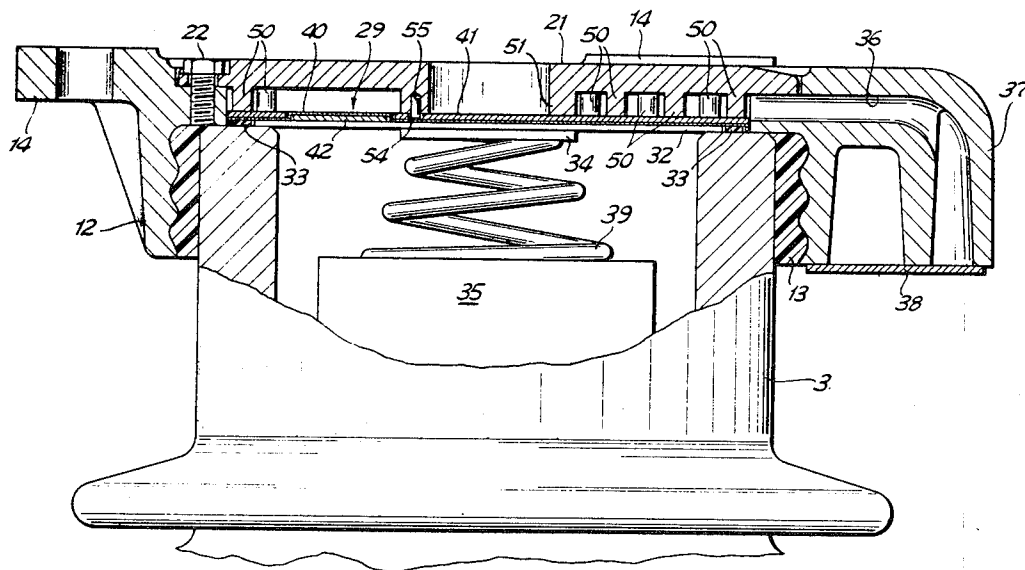
[51] Int. Cl..... **H01k 1/52**

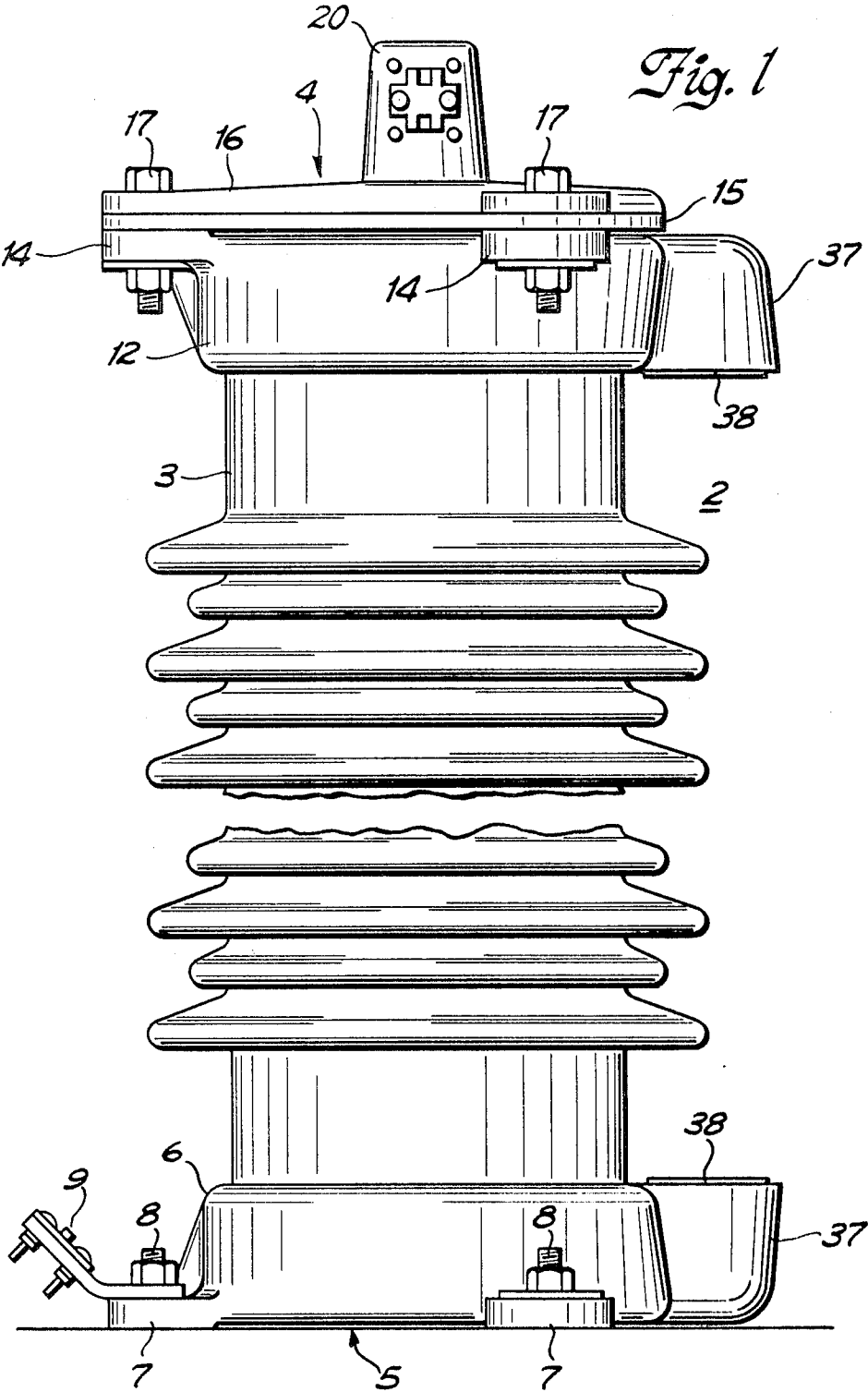
[50] Field of Search..... 313/204,
205, 174, 220, 231, 146—148; 315/35, 36, 149

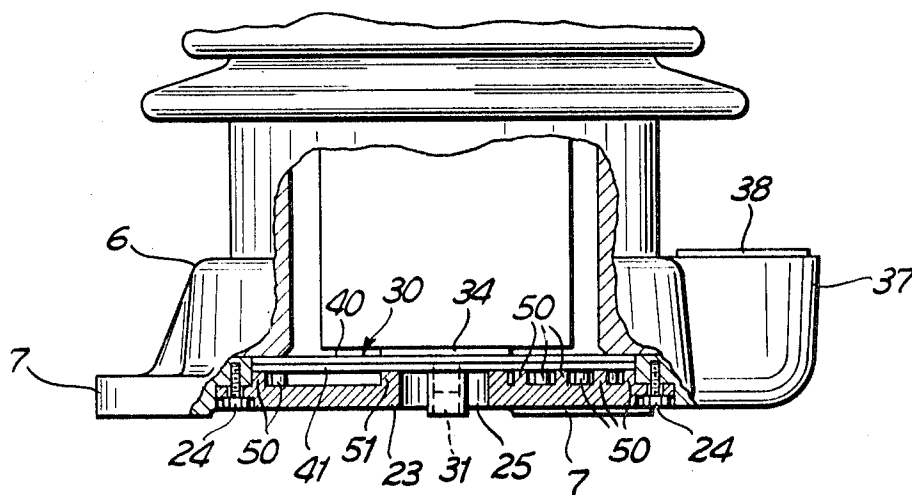
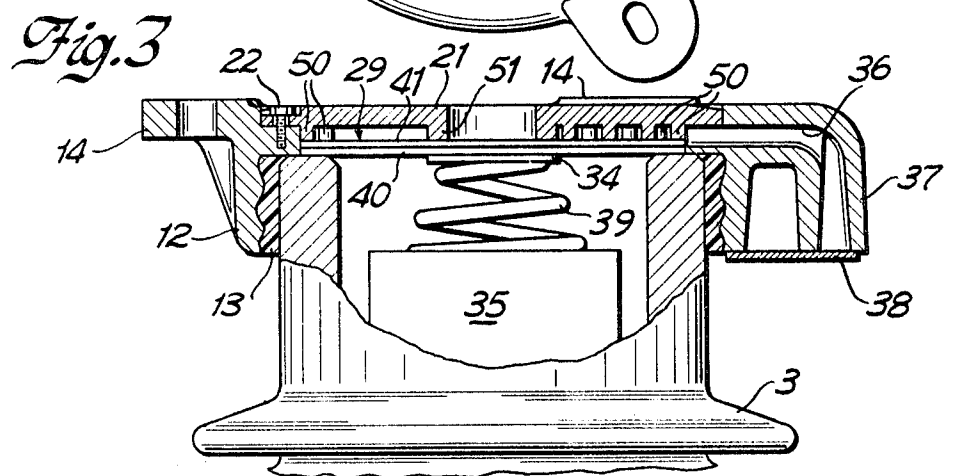
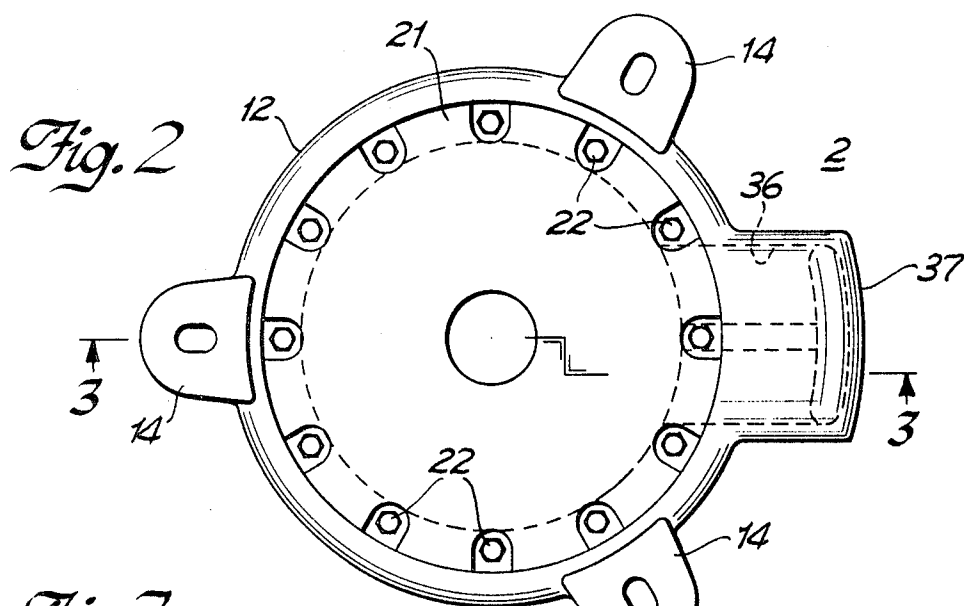
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ABSTRACT: A lightning arrester having its ends sealed by vent diaphragms of a composite construction arranged to provide uniform diaphragm bursting pressures. The lightning arrester further comprises an end cap structure including labyrinth means to prevent clogging of the vents by parts expelled from the interior of the arrester during the failure of an arrester to thereby prevent excessive pressure buildup in the interior of the arrester.







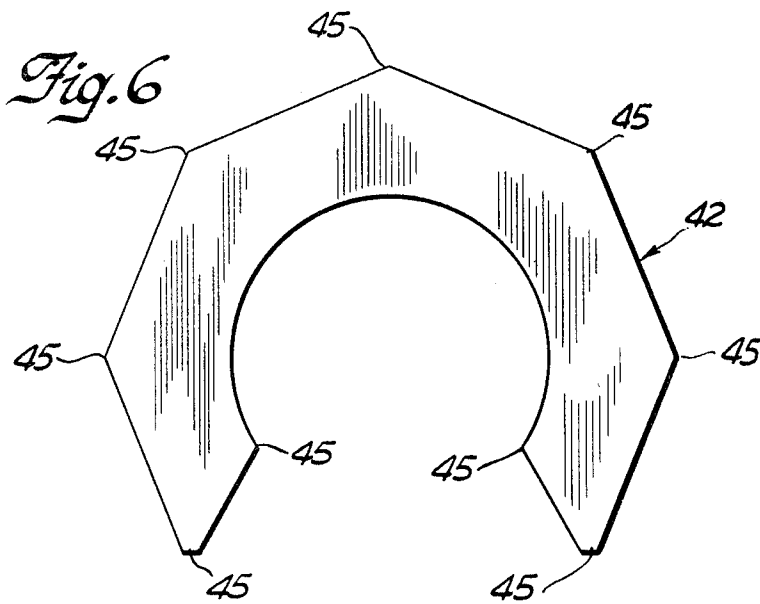
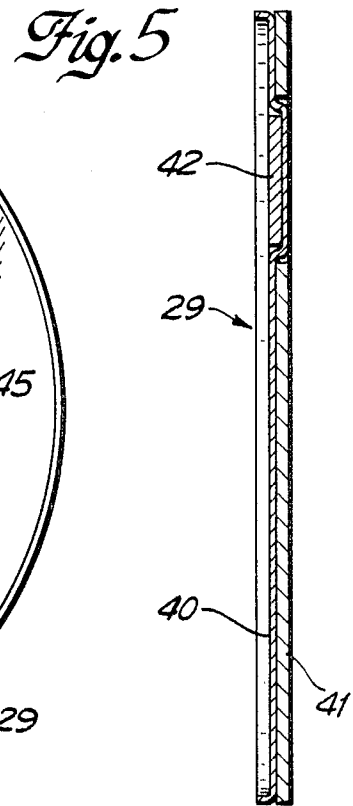
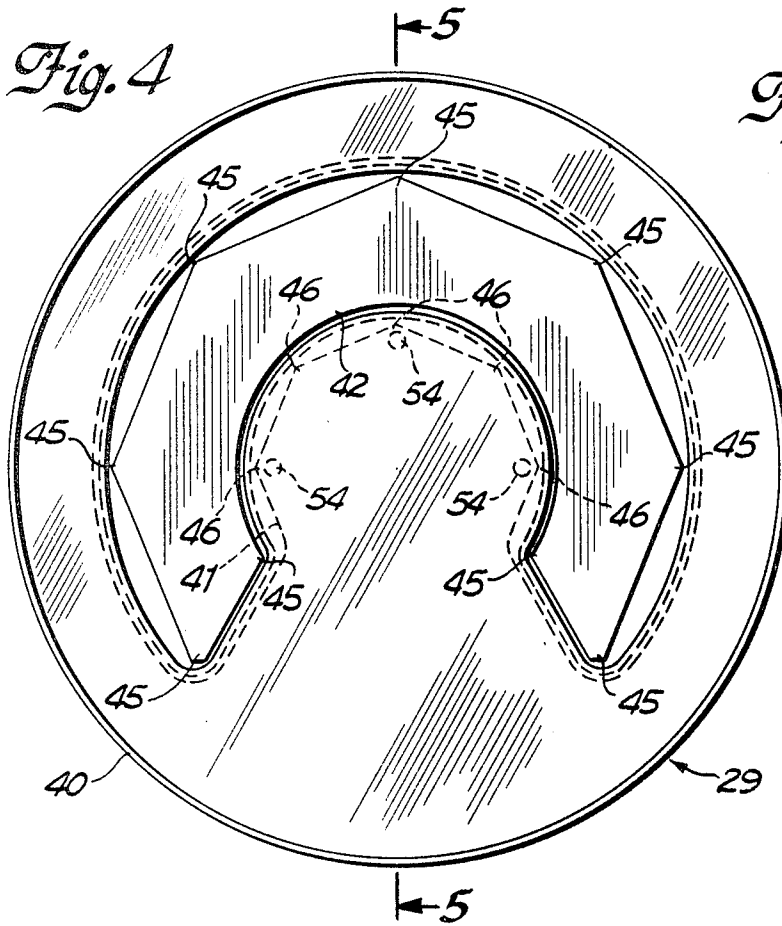


Fig. 7

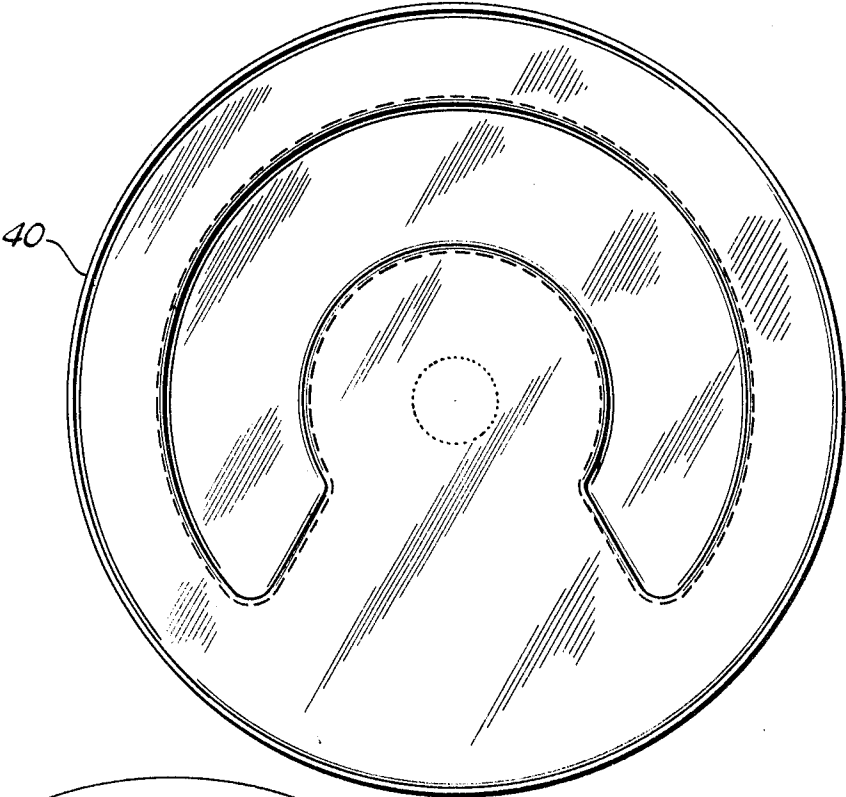


Fig. 8

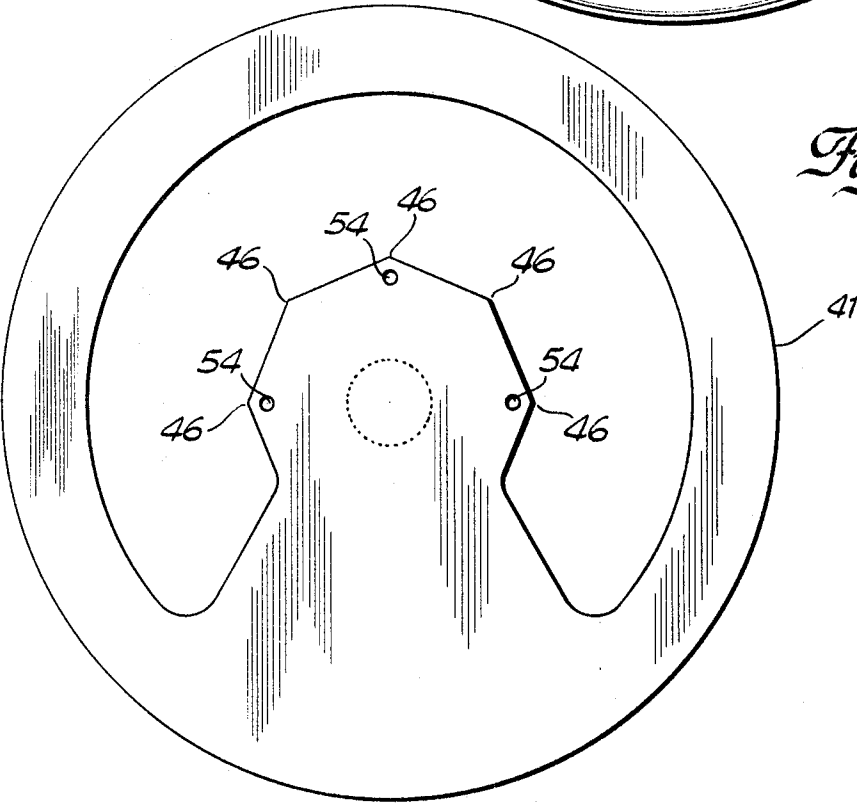


Fig. 9

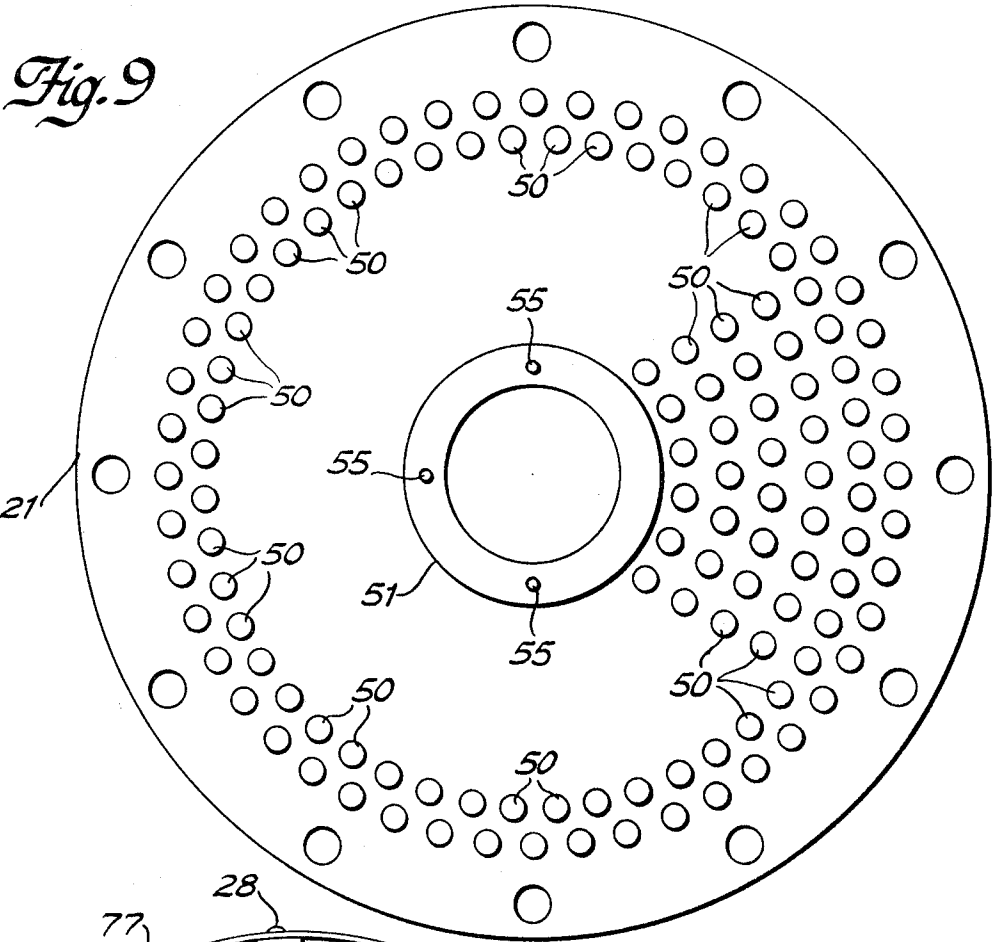


Fig. 10

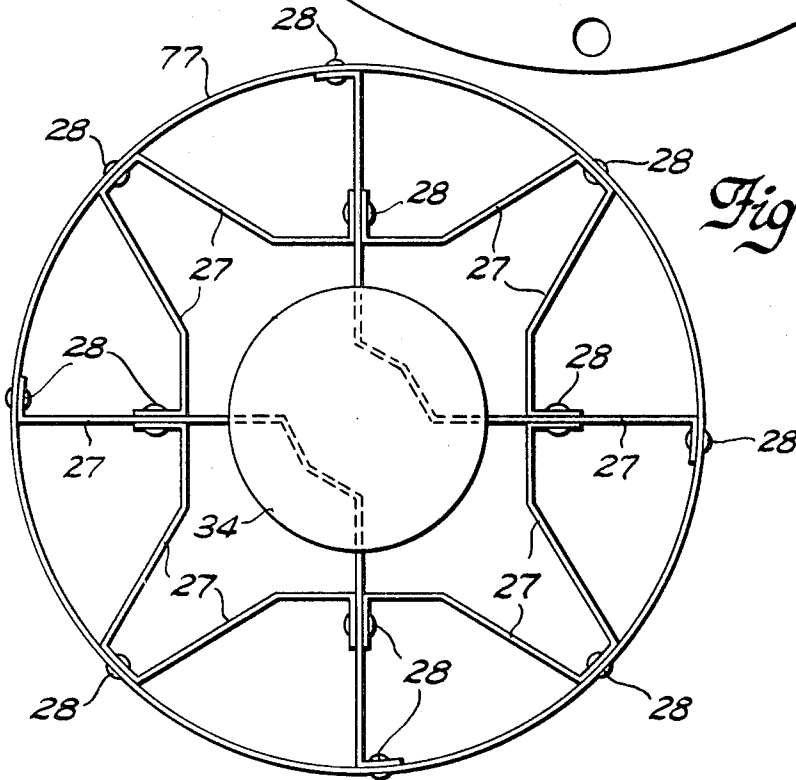
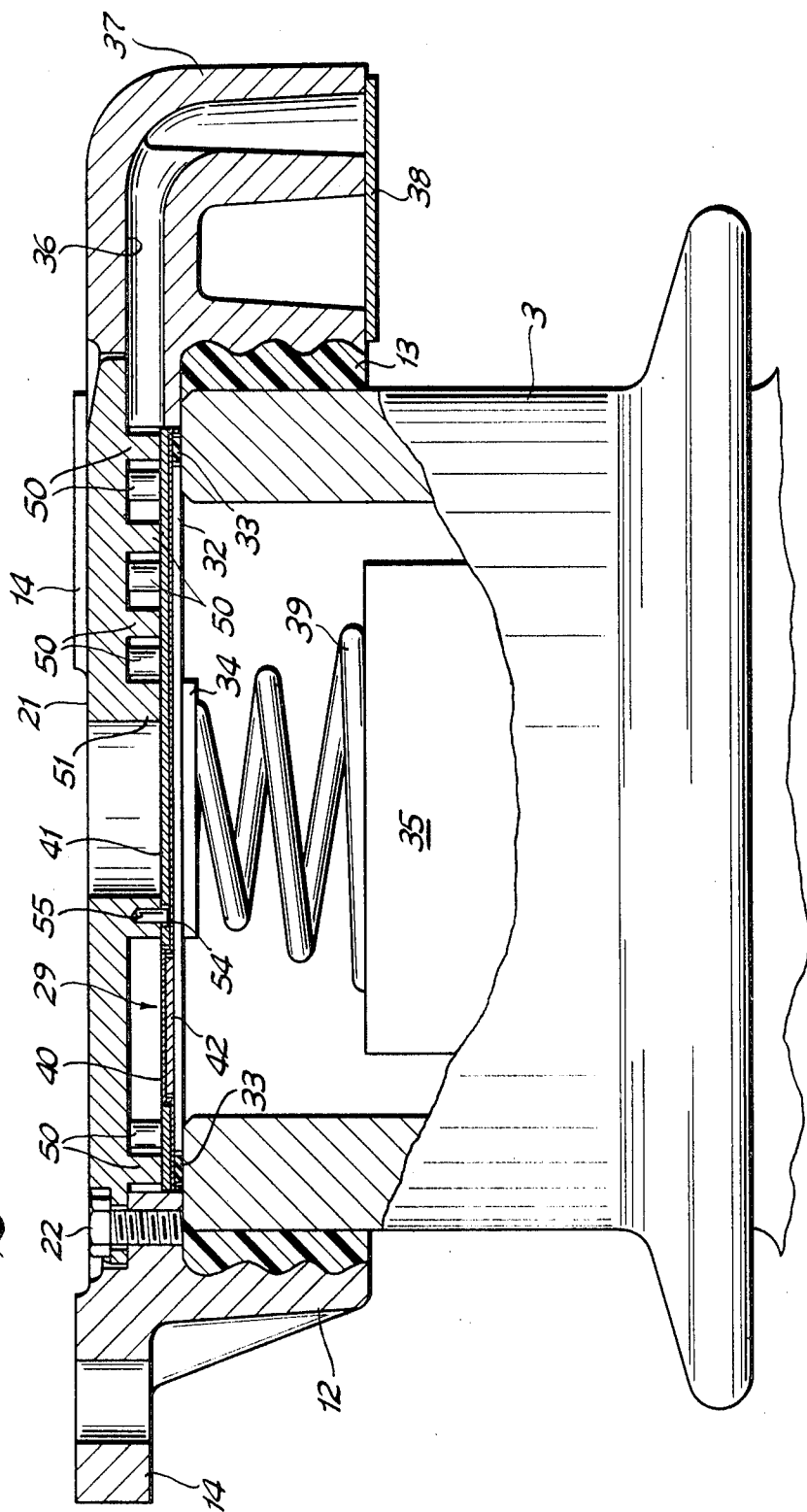


Fig. 11



LIGHTNING ARRESTER VENTING MEANS

This application is a continuation of Ser. No. 766,752, filed Oct. 11, 1968, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to lightning arresters for the protection of electrical apparatus.

In lightning arresters as heretofore constructed, it has been the usual practice to provide a ceramic casing with ends sealed by means of metal plates spun or otherwise secured to the ceramic casing to thereby hermetically seal the casing of the lightning arrester. The effective portions of the arrester are mounted within the sealed casing and usually consist of a spark gap or spark gaps and valve material connected in series. When a very severe stroke of lightning is discharged by the lightning arrester, or when the lightning arrester becomes damaged from excessive current through it, or from any other reasons whatsoever, abnormal pressures may be generated within the casing. The lightning arresters are commonly supplied with venting means to relieve excessive internal pressure. Lightning arrester venting standards state that the arrester housing must not rupture violently or explode. Such standards also state that the unit shall not violently expel its internal parts.

Lightning arresters are commonly supplied with vent diaphragms which rupture when the internal pressure of the lightning arrester exceeds a safe value. In the building of a vent diaphragm, the largest single problem is controlling the pressure at which the diaphragm ruptures. This is a problem because of the normal tolerance variations that occur in manufacturing parts, materials, and processes. Different procedures have been used, such as milling reduced cross sections into plates, providing a puncturing device on a remote part that a flexible diaphragm expands against, or fabricating a multipiece vent by soldering different materials together. Each of the foregoing types has its own disadvantages. The milled parts are costly and have a low reliability with normal manufacturing techniques. The remote puncturing device is not a self-contained unit. The fabricated parts can cause sealing problems by forming cracks in the joints.

As previously stated, the failed arrester must not expel its internal parts. In order that the internal pressure of the arrester does not exceed a dangerous level, such internal parts must also not clog the pressure relieving vents.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a venting diaphragm for a lightning arrester of the aforesaid-type which provides a reliable hermetic seal when intact and will rupture to provide venting within a relatively narrow band of internal pressures.

It is a further object of the invention to provide an end cover assembly with venting means and means to screen out parts blown from the interior of the lightning arrester to prevent clogging of the venting channels.

Other objects and advantages of the invention will become apparent upon reading the following description of the invention.

The objects of the invention are accomplished by providing a thin metal diaphragm which provides a continuous hermetic seal at the ends of the lightning arrester housing. A second metallic member is attached to the diaphragm so as to provide sharp corners or points of high stress between the diaphragm and the second member. When the internal pressure reaches the venting level, the points of high stress concentration cause the diaphragm to be punctured. The points of high stress concentration also cause the puncturing to take place within a relatively narrow band of pressure tolerances. Following initial puncture, a large area of the diaphragm tears open to provide an ample venting area.

The invention further provides an end cover structure containing venting channel means and labyrinth means to screen out internal parts of the failed lightning arrester to prevent clogging of the venting channel means.

The end cover assembly and venting diaphragm form an efficient assembly of minimum size and maximum reliability.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partly broken away elevational view of a lightning arrester incorporating the present invention;

FIG. 2 is a top view of the lightning arrester illustrated in FIG. 1;

FIG. 3 is a partly broken away elevational view, partially in section, taken on line 3-3 of FIG. 2;

FIG. 4 is a top view of a vent diaphragm assembly incorporated in the lightning arrester of FIGS. 1 to 3;

FIG. 5 is a sectional view taken on line 5-5 of FIG. 4;

FIG. 6 is a top view of one of the elements of the assembly illustrated in FIG. 4;

FIG. 7 is a top view of another of the elements of the assembly shown in FIG. 4;

FIG. 8 is a top view of still another element of the assembly illustrated in FIG. 4;

FIG. 9 is a view of the end cover structure incorporated in the lightning arrester of FIG. 1;

FIG. 10 illustrates another element of the lightning arrester of FIG. 1; and

FIG. 11 is a fragmentary view, partially in section and enlarged to illustrate the end structure of the lightning arrester of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is shown a station class lightning arrester 2 having a central cylindrical insulating portion 3, an upper cover assembly 4 and a lower cover assembly 5. The lower cover assembly 5 comprises a metallic end casting 6 which has three radially extending, equally spaced mounting pads 7. Bolts 8 pass through mounting pads 7 to secure lightning arrester 2 in place. End casting 6 also serves as one terminal of the lightning arrester electrical system. An electrical connector is fastened to one of pads 7 to provide for connection of electrical wires (not shown) to lower end casting 6.

At the upper end of lightning arrester 2 an upper end casting 12, which is similar to end casting 6, is fastened to insulator portion 3 in the same manner as end casting 6 by an appropriate cement material 13. As shown in FIG. 2, upper end casting 12 has three equally spaced, radially extending pads 14. A cover plate 15 and a cover 16 overlie the top of end casting 12 and are fastened thereto by bolts 17 passing through pads 14.

Upper end casting 12 comprises the upper electrical terminal of the arrester electrical system and electrical connection thereto is provided by a terminal member and connector 20 which is connected to cover 16.

FIGS. 2 and 3 illustrate arrester 2 with cover plate 15 and cover 16 removed. The central circular opening of casting 12 is covered by a plate 21 which is bolted at its periphery to casting 12 by 12 machine screws 22. An identical plate 23 covers the central opening of lower end casting 6 and is fastened at its periphery to casting 6 by 12 machine screws 24. Plates 23 and 21 are provided with central apertures so that access may be had to a leak test orifice 25 extending from the lower end of arrester 2. The upper end of arrester 2 is sealed by a rupturable venting diaphragm 29, details of which are illustrated in FIGS. 4 through 8, and which is shown more clearly in assembly in FIG. 11. Similarly, the lower end of arrester 2 is sealed by a diaphragm 30 which differs from diaphragm 29 only in that diaphragm 30 is provided with leak test orifice 25. Orifice 25 provides an opening through diaphragm 30 for testing the efficiency of the sealing of arrester 2, and orifice 25 is then sealed by a solder plug 31, shown in FIG. 3.

A spider assembly 32 of a configuration shown in detail in FIG. 10 is positioned against each of the inner faces of diaphragms 29 and 30 in the manner shown in FIG. 11 where one of the spider assemblies 32 is shown secured at its periphery between diaphragm 29 and the upper edge of insulator 3. Spider 32 is a latticework formed of thin metal strips

27 fastened together by rivets 28. A gasket 33 is placed around spider assembly 32 between diaphragm 29 and the upper edge of insulator 3 to provide a tight seal between diaphragm 29 and insulator 3. A similar gasket (not shown) provides a seal at the lower end of arrester 2 between the lower end of insulator 3 and diaphragm 30. A round plate 34, as shown in FIG. 11, is soldered to the center portion of each spider assembly 32.

The energy dissipating elements of arrester 2 are represented in FIG. 3 by a cylindrical member 35 mounted between plate 34 and an electrically connecting compression spring 39 which at its upper end contacts plate 34 in the center of spider assembly 32. Since the details of the structure of energy dissipating means 35 form no part of the present invention, the detailed structure is not illustrated. Such energy dissipating structures are conventional and typically would consist of series connected spark gaps and valve material. A spark gap and valve structure which could form the energy dissipating means 35 of the present structure is shown in the Fred J. Schultz U.S. Pat. No. 2,928,016, issued Mar. 8, 1960, and assigned to the assignee of the present invention.

End castings 6 and 12 include vent passages 36 which extend radially from the inner aperture of end castings 6 and 12 outwardly to oppositely facing but otherwise identical deflecting members 37. A pair of vent covers 38 is releasably secured to deflector members 37 to close the open ends of vents 36.

The rupturable diaphragm assembly 29, as best shown in FIGS. 4 and 5, comprises a thin circular metallic sheet 40, an outer plate 41 and an inner plate 42. Sheet 40, outer plate 41 and inner plate 42 are soldered together to form a unitary diaphragm structure. The three elements of diaphragm 29 are shown separately in FIGS. 6 through 8. Where FIG. 7 shows the diaphragm sheet 40, FIG. 6 shows the C-shaped inner plate, and FIG. 8 shows the outer plate with a C-shaped opening roughly corresponding in size and shape of inner plate 42. FIG. 7 shows diaphragm sheet 40 to have a C-shaped depression in the surface thereof, roughly corresponding in shape to the shape of inner plate 42 and the opening in outer plate 41. Inner plate 42 is assembled to diaphragm sheet 40 within the depressed area so that the exposed surface of inner plate 40 is substantially in the same plane as the surface of one side of diaphragm 40. Outer plate 41 is assembled to diaphragm sheet 40 on the opposite side of sheet 40 so that the exposed surface of outer plate 41 is substantially coplanar with the exposed surface of the C-shaped area of sheet 40, opposite to that of inner plate 42.

Inner plate 42 is formed with a plurality of relatively sharp corners 45 on the edges thereof, and outer plate 41 is formed with a plurality of relatively sharp corners 46 on the periphery of the inner portion of outer plate 41. Corners 45 and 46 serve to concentrate the stress on sheet 40 when pressure is applied to diaphragm 29 to cause rupture of sheet 40 at relatively low pressures. The vent diaphragm assembly 29 is direction-sensitive and is designed for operation with the pressure applied from the inside of arrester 2. When the internal pressure reaches the desired venting level, the points of high stress caused by corners 45 and 46 puncture sheet 40. If the internal pressure is relatively high, once this initial puncture has been made, a C-shaped portion of sheet 40 in the shape determined by inner plate 42 shears free, and inner plate 42 is expelled leaving a large vent opening through which the internal pressure escapes. If the internal pressure is relatively low the initial punctures may be enough to relieve the internal pressure.

Thus, the diaphragm assembly 29 comprises a completely self-contained vent orifice. The assembly 29 is quite rugged so that mounting is not a delicate operation. By interweaving sheet 40 through inner plate 42 and outer plate 41 an effective reduction in cross section is obtained without involving close tolerance and complicated milling or machining. The interweaving also holds the diaphragm assembly 29 to the minimum thickness. The built-in points of high stress give good reliability of puncture without the need of external or remote puncturing devices. The use of a single continuous sheet 40 insures reliable hermetic sealing.

The inner face of plate 21, as shown in FIG. 9, is formed with a large number of studs 50 extending from the surface thereof and integrally formed therewith. The lower plate 23 is identical to upper plate 21. Surrounding the central aperture of plate 21 there is a circular ridge 51. The protruding edge of ridge 51 is coplanar with the tops of studs 50.

Studs 50 are arranged in a pattern so that, together with circular ridge 51, they serve to support outer plate 41 against expulsion from arrester 2. The arrangement of studs 50 is such that there is a C-shaped open area behind inner plate 42, thus allowing movement of inner plate 42 and the sheared portion of sheet 40 upon rupture of diaphragm assembly 29. Stud 50 also serve to screen expelled parts of arrester 2 from gases vented from the interior of arrester 2 upon failure thereof. Thus, such expelled parts are prevented from clogging vents 36 in end castings 6 and 12. Because the rigid portion of the diaphragm assembly 29 remains on top of the vertical studs 50, all escaping gases and parts must go through the labyrinth formed by vertical studs 50. As parts arrive at the opening in diaphragm assembly 29, the large parts are stopped by studs 50. Any part small enough to get through the studs will be expelled through the deflectors 37 without difficulty. As parts pile up in front of these studs, the gas will go around the parts to seek a path through the other studs. The double row of vertical studs around the periphery of the vent chamber within plates 21 and 23 provides for maximum area for the escape of gases. By the time the entire face area of the studs has been covered, the jumble of loose parts piling up will have created their own labyrinth of gas escape paths. In this fashion the small area of vent channels 36 through end castings 6 and 12 can be kept free of parts and utilized only for the passage of vented gases to thus prevent excessive pressure buildup within arrester 2.

Inner plate 41 is provided with three small apertures 54 which receive three small extending lugs 55 extending from ridge 51 to provide for proper positioning of diaphragm assembly 29 on plate 21.

The dotted circle in the center of FIG. 7 and the similar circle in the center of FIG. 8 illustrate the position of the aperture in the center of lower diaphragm assembly 30 and the point of attachment of test orifice 25 at the lower end of arrester 2. Lower diaphragm assembly 30 is otherwise the same as upper diaphragm assembly 29 and functions in the same manner.

While the heretofore described device is effective to accomplish the objects of the invention, it is not intended that the invention be limited to the preferred embodiment since it is adaptable to modification without departing from the scope of the appended claims.

I claim:

1. A lightning arrester comprising:
 - a sealed housing;
 - a lightning arrester electrical system including spark gaps and valve material within said housing; and
 - a diaphragm assembly comprising a rupturable diaphragm attached to the housing to seal said housing, and a plate adjacent and attached to said diaphragm having a configuration adapted to concentrate stress on said diaphragm at selected points upon movement of said diaphragm assembly whereby said diaphragm is punctured at said stress points upon occurrence of selected movement of said diaphragm assembly resulting from selected pressure increases within said housing wherein said plate is adjacent the inside of the diaphragm and is shaped to form relatively sharp corners on edges thereof to concentrate stress on said diaphragm at said corners.
2. A lightning arrester as set forth in claim 1 also comprising a second plate adjacent and attached to the outside of said diaphragm having a configuration adapted to concentrate stress on said diaphragm at selected points.
3. A lightning arrester as set forth in claim 2 wherein said second plate is shaped to have relatively sharp corners on the edges of a cutout portion to form said stress concentrating points.