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Hess et al.

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[45] **May 22, 1973**

[54] **FLEXIBLE WEATHER CASING FOR A GAS FILLED BUSHING**

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[52] **U.S. Cl.**.....**174/31 R,** 174/14 BH, 174/179, 174/209

[51] **Int. Cl.**.....**H01b 17/26,** H01b 17/36

[58] **Field of Search**.....174/12 BH, 14 BH, 174/15 BH, 16 BH, 18, 30, 31 R, 142, 143, 152 R, 167, 176, 177, 178, 179, 209

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[57] **ABSTRACT**

An improved insulating device comprising a main tubular insulating structure on which are mounted a plurality of overlapping flexible weather sheds.

6 Claims, 7 Drawing Figures

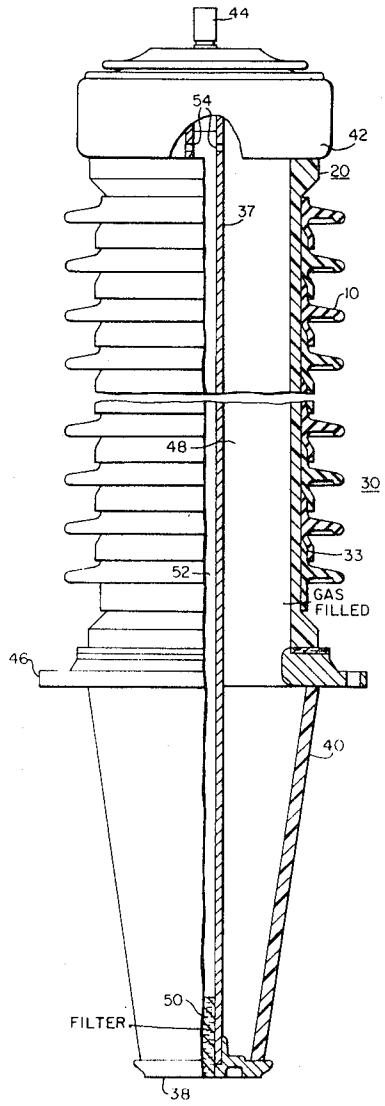


FIG. 1

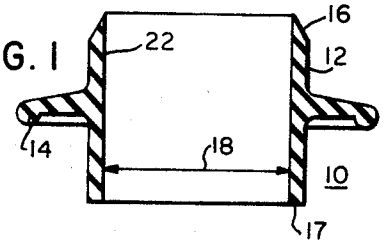
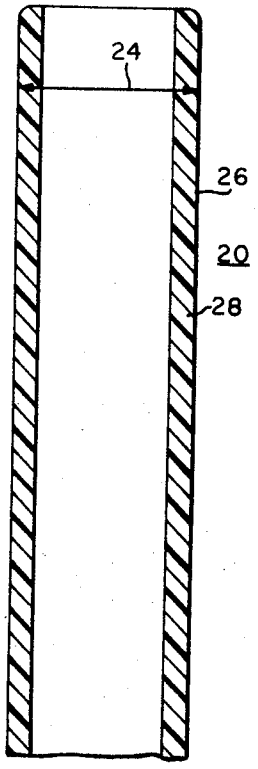


FIG. 2



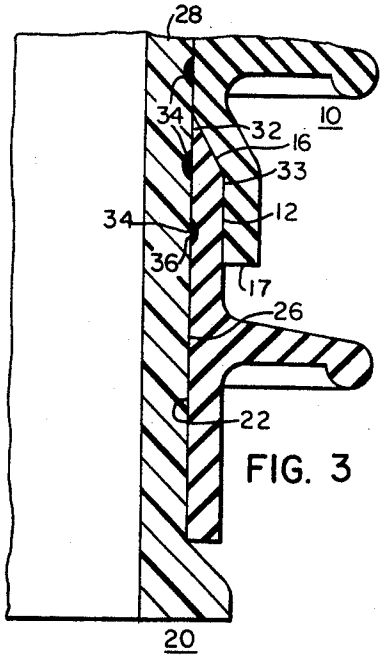


FIG. 3

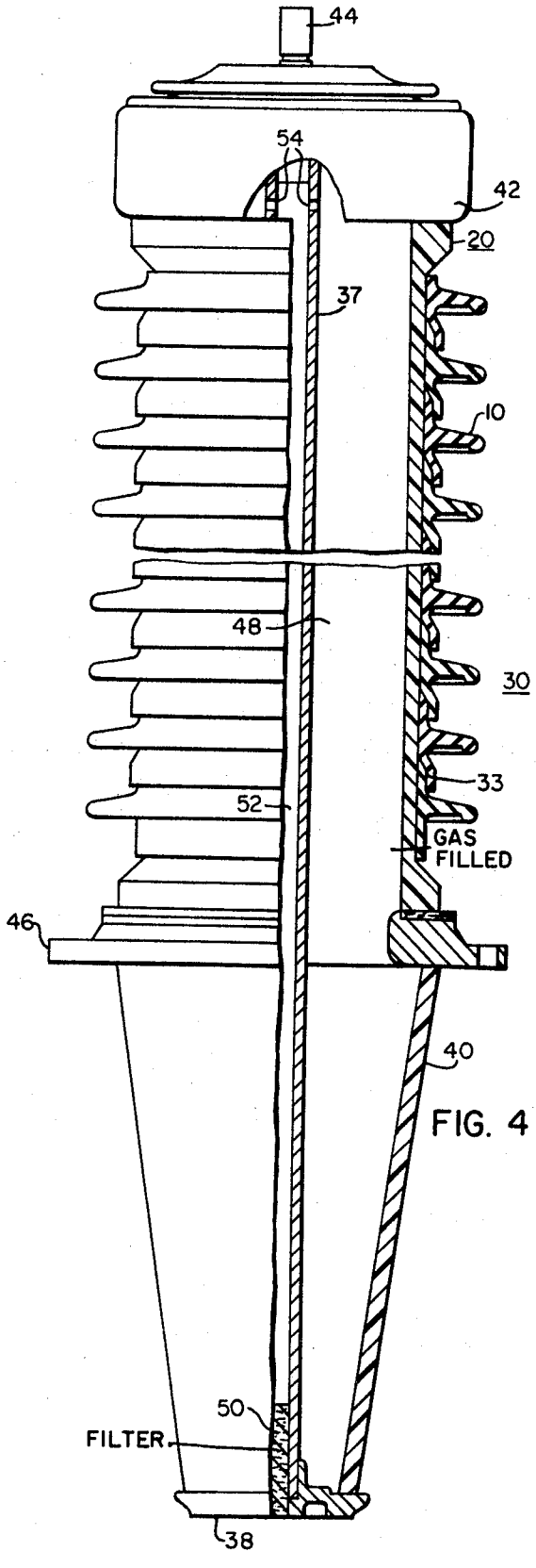


FIG. 4

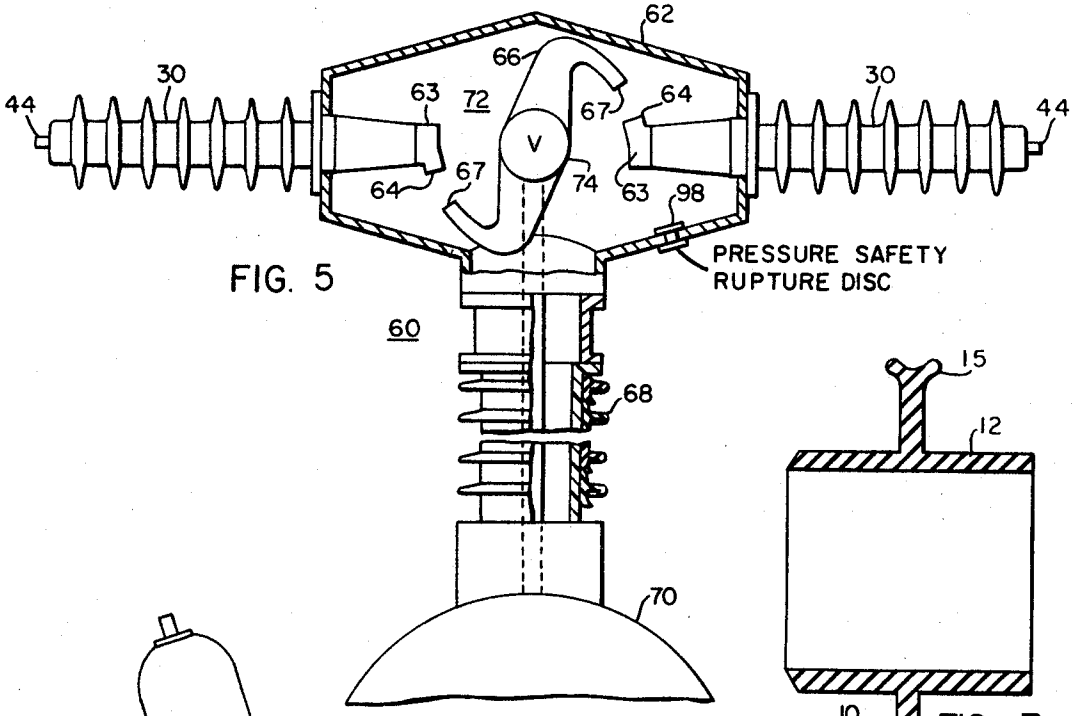


FIG. 5

FIG. 7

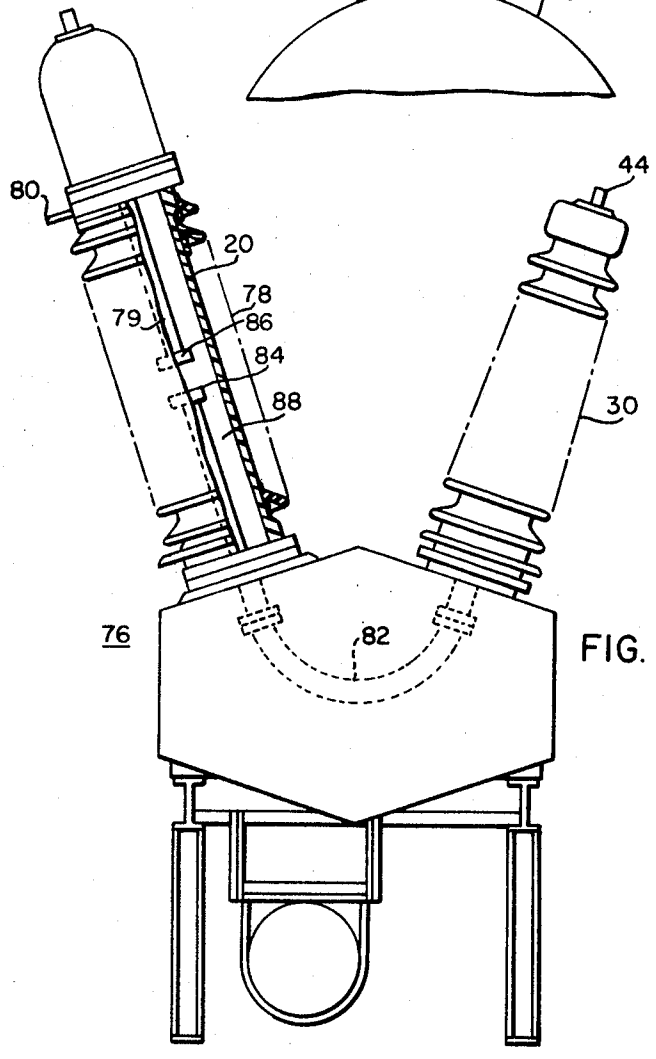


FIG. 6

FLEXIBLE WEATHER CASING FOR A GAS FILLED BUSHING

BACKGROUND OF THE INVENTION

This invention relates generally to electrical insulating devices, and more specifically to a construction for interrupter weather casings, terminal bushing weather casings, and insulating support weather casings.

In certain types of outdoor apparatus, the use of a pressurized gas such as sulfur hexafluoride, SF_6, as an insulating medium is common. Porcelain weather casings which have given good service on conventional oil circuit breakers have several objectional disadvantages when used on equipment which uses a pressurized gas as an insulating medium, due to porcelain mechanical properties. Porcelain weather casings are mechanically weak under tension, and they have a low impact strength. These properties make them hazardous to use with an internal gas pressure.

Various designs of interrupter bushings and insulating supports utilize porcelain weather casings under internal gas pressure. The internal pressure to which the porcelain is subjected is usually in the area of 25 psi to 50 psi. However, due to a malfunction in the system or a damaged component, the internal pressure might go above 100 psi. If a porcelain weather casing which has internal gas pressure is damaged, there is a high probability that there will be a violent failure or explosion of the porcelain casing. These problems with porcelain necessitate special care in the manufacturing, testing, handling, shipping, and use of electrical apparatus on which porcelain weather casings are used.

A further disadvantage of the porcelain weather casing is that it is difficult and expensive to manufacture in the large sizes.

Another disadvantage of the conventional porcelain weather casing is that it is difficult or impossible to repair even though there might only be slight damage to one weather shed.

SUMMARY OF THE INVENTION

This invention provides an improved weatherproof casing consisting of a main tubular insulating member around which are mounted longitudinally, in series, overlapping flexible weather sheds or shells. The main tubular insulating member has a high tensile strength, a high impact resistance and the ability to withstand high internal gas pressure. Such an insulating tube can be made from wound glass filament sheet, or other high strength material, impregnated with epoxy or other suitable binder.

The flexible weather shells or sheds are molded of a synthetic elastomeric material such as butyl or other suitable moldable or castable material. Each of the flexible weather shells or sheds comprises a longitudinal tubular portion and at least one shed portion extending from the tubular portion. The flexible weather shells or sheds are positioned in overlapping relationship in series along the longitudinal axis of the main tubular insulating member. The inner diameter of the longitudinal tubular portion of the flexible weather shell or shed is slightly less than the outer diameter of the main tubular insulating member to insure a snug fit and to eliminate voids between the longitudinal tubular portion of the flexible weather shells or sheds and the insulating tube. An insulating grease such as a silicone grease or an insulating adhesive may be applied to the

outer surface of the main tubular insulating member to fill any small air spaces which might occur between the main insulating tube and the longitudinal tubular portion of the weather shell or shed when the flexible weather shells or sheds are positioned on the main insulating tube.

A minimum number of different sizes of flexible weather shells or sheds may be used to provide bushings and interrupters of many different voltage ratings by using a different number of flexible weather shells in series; since, the main tubular insulating member in these applications must usually vary in length and not in diameter.

The shed portion of the flexible weather shed can be formed in various sizes and shapes to suit the user's requirements. A weather shed molded of an elastomeric material can be formed into shapes which cannot be duplicated by porcelain.

This invention provides an improved insulating device in which the disadvantages associated with porcelain which is customarily employed for weatherproof casings are overcome. This invention provides a more rugged casing than porcelain and it is less susceptible to damage than the prior art porcelain casing. If damaged, either intentionally as by a rock or a bullet or unintentionally as by dropping, the failure of the weatherproof casing will not be violent. Any gas which escapes through the main tubular insulating member may exhaust between the overlap of the shell or shed sections without causing abrupt rupture or catastrophic destruction of the casing. If a weather shell or shed is damaged, it can be replaced easily and quickly without replacing the entire weatherproof casing.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a sectional view, in side elevation, of a flexible weather shell or shed;

FIG. **2** is a partial sectional view, in side elevation, of the main tubular insulating member;

FIG. **3** is an enlarged partial sectional view of the gas filled terminal bushing illustrated in FIG. **4**;

FIG. **4** is a partial sectional view of a gas filled terminal bushing constructed in accordance with the present invention;

FIG. **5** is a view partially in front elevation and partially in section of a power circuit breaker having two gas bushings and a standoff insulator embodying the present invention;

FIG. **6** is a view partially in front elevation and partially in section of a power circuit breaker comprising a gas filled interrupter and a gas terminal bushing embodying the present invention; and,

FIG. **7** is a sectional view, in side elevation, of a flexible weather shell or shed for use on horizontally mounted apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in detail and FIG. **1** in particular, there is shown a flexible weather shell or shed **10** having a generally tubular portion **12** and a weather shed portion **14** located longitudinally on and molded around the tubular portion **12** and extending in a slightly downward angle from the longitudinal portion

12. The flexible weather shell 10 is molded of a synthetic elastomeric material, such as butyl rubber or other suitable moldable or castable materials. The flexible weather shell or shed 10 as viewed in FIG. 1 has a beveled edge 16 at the top end of the tubular portion 12. The shed portion 14 is molded or cast integrally with the tubular portion 12 and is made of the same material as the tubular portion 12.

FIG. 2 shows a main tubular insulating member 20 made from a high strength material, such as wound glass filaments, fiber glass sheets, or other suitable high strength electrical insulating material. The tubular member 20 is impregnated with epoxy resin or other suitable high strength compatible resins. The outer diameter 24 of the tubular member 20 is slightly larger than the inner diameter 18 of the tubular portion 12 of the weather shell or shed 10 so that the weather shell or shed 10 can be fitted snugly around the main tubular insulating member 20.

There is shown in FIG. 3 an enlarged portion of a gas filled bushing 30 which is shown in FIG. 4. As is seen in FIG. 3, when the flexible weather shells or sheds 10 are stacked in series on the main tubular insulating member 20, the beveled edge 16 on a weather shell 10 allows the bottom edge 17 of the weather shell 10 to ride easily up the beveled edge 16 of the previously positioned shell or shed 10 and to fit over the top part of the tubular portion 12 of the previously positioned shell or shed 10. The beveled edge 16 also helps to keep the area shown at 32 where the bottom edge 17 of one weather shell or shed 10 fits over the top edge 16 of a previously positioned weather shell or shed 10 from being a void. It is desirable that this space between the outer surface 26 of the main tubular insulator 20 and the inner surface 22 of the flexible weather shell or shed 10 be free of voids since corona discharge can form in any small air pocket which might exist. If corona is present, this could cause radio interference and the ozone produced by the corona could over a period of time have an adverse effect on the insulation and cause the insulator to break down electrically. To prevent any air pockets from being present such as at 34, an insulating grease 36, such as silicone grease, is applied to the outer surface 26 of the insulating tube 20 or to the inner surface 22 of the flexible weather shell or shed 10. When the flexible weather shell or shed 10 is fitted around the main tubular insulating member 20, the insulating grease 36 as best shown in FIG. 3 coats the insulating tube 20 and fills any voids 34 present in the inner face between the main insulating tube 20 and weather shells or sheds 10. The same result as explained above can be achieved by using an insulating adhesive in place of the insulating grease 36.

Referring now to FIG. 4, there is shown a gas filled bushing 30, embodying the principal features of the invention, which comprises a conducting stud 37, a bottom terminal 38, a bottom arc shield 40, a bushing cap 42, a top terminal 44, a support flange 46 and flexible weather shells or sheds 10 mounted longitudinally in series on the main tubular insulating member 20. Connections are made to the bottom terminal 38 and to the top terminal 44 and the conducting stud 37 carries current between these terminals 44 and 38. The insulating medium for this gas bushing 30 is a gas with a high dielectric breakdown strength such as sulfur hexafluoride, SF_6. The bushing internal space surrounding the conducting stud 37 and indicated as 48 is filled with the insulating gas under pressure. This type of bushing 30 must be used on a device which is sealed and insulated with an insulating gas since the bushing 30 is not sealed. A gas passage is provided through the conducting stud 37 as can best be seen in FIG. 4. Gas can pass through a filter 50 up the internal passage 52 in the conducting stud 37 and through gas communication holes 54 into the main insulating space 48. The gas pressure in the gas space 48 is at the same pressure as the gas in the equipment casing on which the gas filled bushing 30 is mounted.

FIG. 5 shows a power circuit breaker 60 which utilizes gas bushings 30 as described above. The power circuit breaker comprises two gas bushings 30, a main housing 62, a set of fixed contacts 63, a movable contact 66, a stand-off support insulator 68, and a high pressure gas supply 70. The pressure in the high pressure gas supply 70 is approximately 250 psi. The normal working pressure on the inside 72 of the main housing 62 is approximately 45 psi. As described above, the gas bushings 30 are not sealed at the bottom terminal 38, as described for FIG. 4, so the pressure inside the bushings 30 is equal to the pressure in the main housing 62; that is, approximately 45 psi. During operation of the power circuit breaker 60 the contact faces 64 of the fixed contacts 63 are separated from the contact faces 67 of the movable contact 66. As the contact faces 64 and 67 are separated, an arc forms between the fixed contact faces 64 and movable contact faces 67. To extinguish this arc as fast as possible, high pressure gas is used to blow the arc out. The high pressure insulating gas is controlled by a blast valve 74 and, if the valve 74 malfunctions, the pressure in the main housing 62 and the bushings 30 can rise until a safety rupture disc 98 blows out. The rupture disc is designed to blow at a pressure above 100 psi. The use of porcelain with these internal gas pressures is dangerous. A defective or damaged porcelain could fail violently and cause catastrophic damage. With the present invention, as can best be seen in FIG. 2 and FIG. 3, if the internal wall 28 of the main tubular insulating member 20 should rupture or be punctured, the insulating gas would pass harmlessly through the wall 28 and between the overlaps 33 of the stacked flexible weather shells or sheds 10. A support insulator 68 made from a main tubular insulating member 20 around which are mounted longitudinally in series overlapping flexible weather shells or sheds 10 is also shown in FIG. 5. The support insulator 68 is also filled with gas under pressure.

FIG. 7 shows a flexible weather shell or shed 10 particularly suited for use on electrical apparatus which is mounted with the longitudinal axis horizontal. The weather shed comprises a tubular portion 12 and a weather shed portion 15 which has a generally dog bone shaped cross-section. The dog bone shaped weather shed 15 is located longitudinally on and molded around the tubular portion 12. The flexible weather shell or shed 10 is molded of a synthetic elastomeric material, such as butyl rubber.

FIG. 6 illustrates an interrupter-type power circuit breaker 76 comprising an interrupter side 78 and a gas filled bushing 30 embodying the principal feature of the invention. Connections are made to the interrupter terminal 80 and the bushing top terminal 44. Current flows through an interrupter 79, the internal connection 82 and the gas filled terminal bushing 30. When the circuit is to be opened, the interrupter's movable

contacts 84 pull away from the interrupter's fixed contacts 86 and opens the circuit. When the tubular insulating member 20 is used with an interrupter 79, the internal gas pressure in the space 88 enclosed by the insulating tube 20 in FIG. 6 is 250 psi. Due to the high pressure, this would be an especially hazardous place to use porcelain; but, with this invention, if the insulating tube 20 is punctured or ruptured, the high pressure gas fill pass harmlessly through the overlap 33 of the flexible weather shells or sheds 10. The above description of the operation of the interrupter 79 is adequate to show the merits of this invention. A detail description of the operation of an interrupter 79, such as shown herein, is set forth in U.S. Pat. No. 3,596,028, issued July 27, 1971, to R. E. Kane et al., and which is assigned to the same assignee as the present application.

The apparatus embodying the teaching of this invention has several advantages. For example, it is much more rugged than a porcelain device and less susceptible to damage. If the weatherproof casing does fail, the failure will not be violet and the gas which does escape through the main insulating tube 20 will be harmlessly vented to atmosphere through the overlap 33 of the stacked flexible weather shells or sheds 10. If any of the weather shells or sheds 10 are damaged, they can be removed from the tube 20 and replaced easily and quickly without replacing an entire weatherproof casing. This invention provides a novel weatherproof casing having a simple construction which is easy to assemble, easy to repair, and reliable in operation.

Since numerous changes may be made in the above described apparatus and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all the matter contained in the foregoing description as shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. A hollow electrical insulator to operate filled with an insulating gas under pressure, said insulator comprising a central longitudinal tubular insulating member for providing a gas chamber, a plurality of flexible weather sheds, each of said weather sheds comprising a hollow longitudinal portion and an integral shed portion, said flexible weather sheds being mounted on said central longitudinal tubular member in series relationship with a portion of the longitudinal portion of each succeeding weather shed overlapping a portion of the longitudinal portion of the preceding weather shed, the hollow longitudinal portion of said flexible weather sheds being sufficiently flexible so as to permit any gas escaping through said longitudinal tubular insulating member to vent through the overlaps of said flexible weather sheds, and means between the overlapped portions of the weather sheds for providing a flexible seal between the overlapped portion of the weather sheds, whereby said seal can easily be broken to permit internally trapped gas to pass through the overlaps of said flexible weather sheds.

2. The insulator as defined in claim 1 wherein said central longitudinal tubular insulating member is constructed from glass fibers impregnated with a resin.

3. The insulator as specified in claim 1 wherein said central longitudinal insulating member is made from glass filament impregnated with epoxy resin.

4. The insulator as specified in claim 1 wherein said longitudinal central insulating member comprises a tube wound from glass filament impregnated with epoxy resin and said flexible weather sheds comprise butyl rubber.

5. A hollow electrical insulator to operate filled with an insulating gas under pressure, said insulator comprising a central longitudinal tubular insulating member for providing a gas chamber, a plurality of flexible weather sheds, each of said weather sheds comprising a hollow longitudinal portion and an integral shed portion, said flexible weather sheds being mounted on said central longitudinal tubular member in series relationship with a portion of the longitudinal portion of each succeeding weather shed overlapping a portion of the longitudinal portion of the preceding weather shed, means between the overlapped portions of the weather sheds for providing a seal between the overlapped portion of the weather sheds, a central electrical conductor extending throughout the length of said insulator, terminal means attached to each end of said electrical conductor, said terminal means closing the ends of said central longitudinal tubular member to provide a gas chamber inside said longitudinal tubular member, and means at one end of said hollow electrical conductor for introducing gas into said hollow conductor, means adjacent the other end of said hollow conductor to permit gas introduced into said hollow conductor to fill the gas chamber defined by said central longitudinal tubular insulating member and said terminal means.

6. A hollow electrical insulator as claimed in claim 5 wherein the integral shed portion of said weather sheds has a generally dog-boned shape cross section.

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