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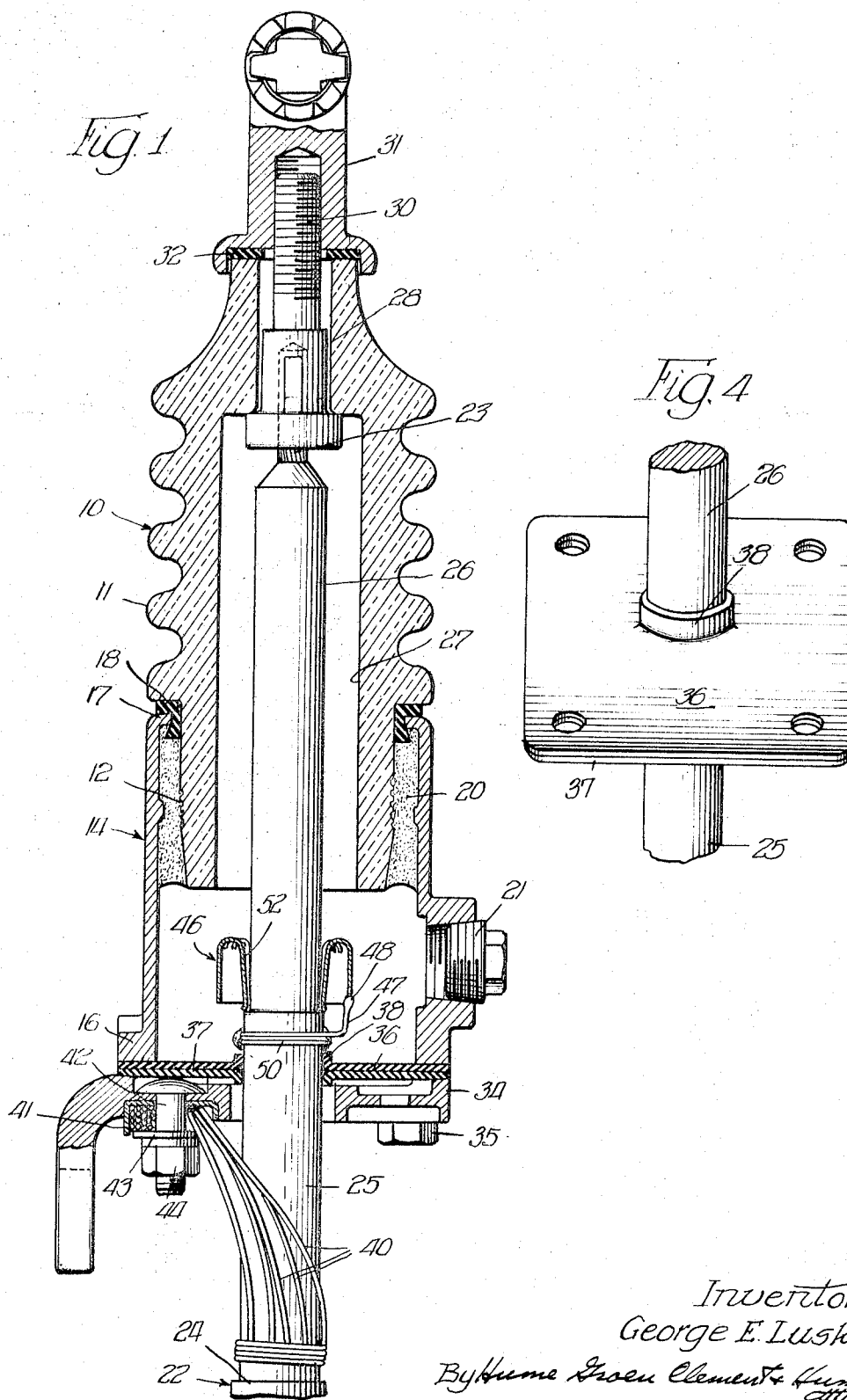
G. E. LUSK

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POTHEAD CONSTRUCTION WITH GIRDLE SHIELD

Filed Dec. 6, 1965

2 Sheets-Sheet 1



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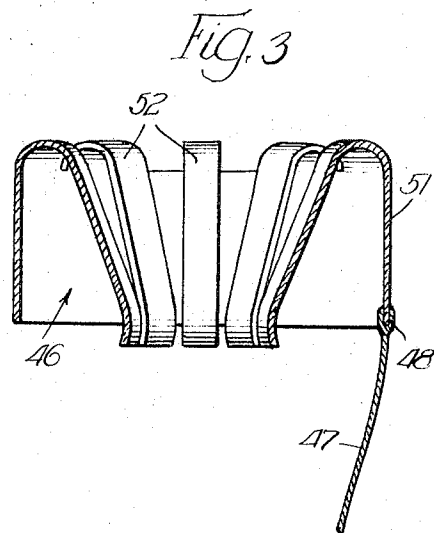
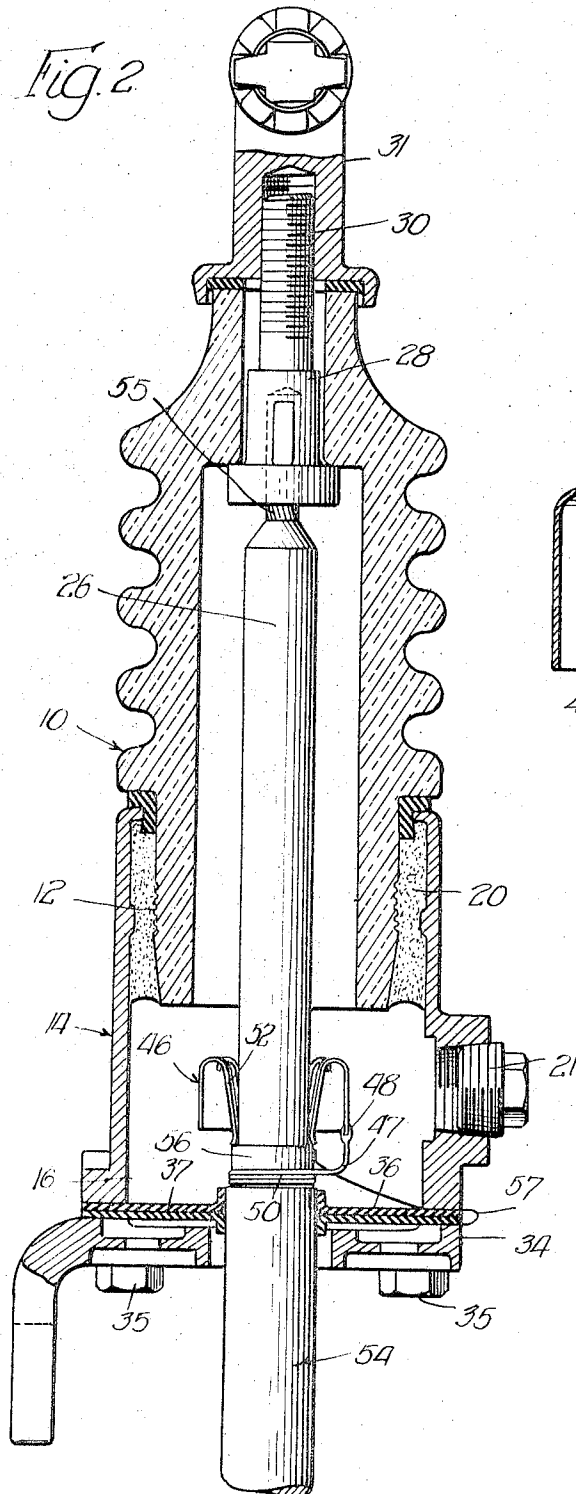
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POTHEAD CONSTRUCTION WITH GIRDLE SHIELD

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3 Claims. (Cl. 174-73)

ABSTRACT OF THE DISCLOSURE

The cable termination pothead of the invention has been especially designed for polyethylene insulated cables of the type using extruded semi-conductive shield and concentric wire strands or metallic tape shield ground return systems. For sealing the entrance end of the pothead a pair of resilient diaphragms are employed which have sealing contact with the pothead and with the cable and a girdle shield is provided in the form of a metal ring providing spring fingers having resilient contact with the insulation portion of the cable.

The invention relates to cable termination systems and has reference in particular to a cable termination pothead especially designed for polyethylene insulated cables of the type using wire strand or metallic ground return systems.

The overlapping tape method of forming the conventional stress cone produces an inherently non-uniform surface which in dry insulation cone build-ups can produce a plurality of air pockets between the tape layers where the turns of the tape overlap. Corona discharge can occur in these pockets. Although the short time strength of an insulation structure may not be affected by the presence of the corona discharge, the life of the insulation may be drastically reduced due to the eroding effect of such discharge. Accordingly, it is an object of the present invention to provide new and improved terminating means for shielded electrical power cables.

A further and more specific object of the invention is to provide a termination system in the form of a pothead for polyethylene insulated cables which will employ a girdle shield in combination with two self-energizing resilient diaphragms in back-to-back relation for sealing the cable entrance end of the pothead structure.

A further object of the invention resides in the provision of a pothead assembly of the character described wherein the diaphragms for sealing the entrance end of the pothead have tight sealing contact with the cable or with the cable jacket, since the periphery of the opening in each diaphragm will be in tension. Also, the invention contemplates that the diaphragms will be formed of a silicone or other weather resistant elastomer to afford the greatest possible protection against environment degradation such as ozone attack, ultraviolet radiation and oxidation.

Another object is to provide pothead structures for power cable termination which will employ an improved entrance seal between the pothead and the cable in combination with a contact ring in the form of a girdle shield for the cable and special compounds capable of maintaining a void free area within the pothead and particularly in the vicinity of the girdle shield.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation as will be more fully described and particularly pointed out in the specification, drawings and claims appended thereto.

In the drawings which illustrate an embodiment of the device and wherein like reference characters are used to designate like parts—

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FIGURE 1 is a vertical sectional view of a pothead assembly showing a cable termination system incorporating the improved features of the invention;

FIGURE 2 is a vertical sectional view of a pothead assembly showing a modified form of cable termination coming within the invention;

FIGURE 3 is a vertical sectional view taken substantially diametrically through the improved girdle shield employed in the pothead assemblies of FIGURES 1 and 2; and

FIGURE 4 is a perspective view illustrating structural details of the back-to-back resilient diaphragm for sealing the cable entrance end of the pothead.

FIGURE 1 shows the invention applied to a polyethylene insulated concentric strand cable wherein the numeral 10 indicates an insulator formed of any suitable ceramic material and having projecting skirts 11 and the serrations 12. The base member 14 is combined with the insulator 10 to form the pothead assembly, the said base member comprising a metal casting having a reinforced bottom section 16 and a top end which is curved inwardly at 17 for engaging contact with the resilient gasket 18. By means of the sealing material 20 and the resilient gasket 18 the insulator and the base member are physically connected and the parts are effectively sealed. For admitting a compound for filling the interior of the pothead assembly, the base member 14 is provided with the threaded releasable plug 21.

The cable indicated in its entirety by the numeral 22 provides the copper wires 23 which form the core of the cable and which is conveniently covered and shielded by the cable jacket 24, by the cable overshield 25 and by the polyethylene cable insulation 26. The terminal end of the cable core 23 is placed within the bore 27 of the insulator 10 to extend axially within the pothead assembly so that the assembly has telescoping relation therewith. The terminal end of the cable is stripped to expose the cable core 23 to which the metal connector 28 is secured so as to have good electrical conductivity therewith. The metal connector in turn provides the threaded extension 30 to which is threadedly secured the metal cap nut 31, the same providing the exterior electrical connection for the cable. The gasket 32 which is confined between the cap nut 31 and the insulator 10 functions to seal this end of the pothead assembly.

The opposite bottom end of the pothead assembly is closed by the entrance plate 34 consisting brass or other suitable metal and which is fixedly secured to the member 14 by a plurality of securing screws 35. The said securing screws have their hexagonal shaped heads located below and in contact with the underside of the entrance plate 34. The seal between the base member 14, the cable jacket 25 and the entrance plate 34 is provided by a pair of resilient and flexible diaphragms in back-to-back relation. The top diaphragm 36 is located over and the same has contact throughout its area with the bottom diaphragm 37. Accordingly the diaphragms are in back-to-back relation as will be evident from FIGURES 1 and 4, and both diaphragms are confined around their periphery between the reinforced base 16 of the member 14 and the entrance plate 34.

As regards both diaphragms 36 and 37 a hole is punched or molded in the same centrally of the diaphragm and which is smaller than the diameter of the cable jacket to which it is to be applied. The size of the hole depends upon the amount of ultimate elongation desired when the diaphragm is telescoped over the cable. Since each diaphragm is provided with an opening smaller than the size of the cable it is necessary to stretch the opening in sliding the same over the cable and as a result the peripheral edge 38 of the opening in each diaphragm is placed in tension. Accordingly, a close and

tight fit is provided as regards each diaphragm with the cable for effectively sealing the cable entrance end of the pothead assembly.

The cable 22 as shown in FIGURE 1 has a multiple strand layer of copper wires identified by the numeral 40 interposed between the cable jacket and the cable overshield. The said copper wires which may total 16 or more in number present a problem in regards to termination of the standard type of entrance system. The entrance seal of the present invention is entirely suitable for terminating this concentric strand type of polyethylene insulated cable since the copper wires 40 are terminated by gathering the wires together and securing the same at a common location to the metal entrance plate 34. Accordingly the wires 40 are gathered together within the inverted retaining cup 41 of metal and are conveniently secured within said cup to the entrance plate 34 by the securing bolt 42. The head of the bolt is located within a recess in the upper surface of the entrance plate 34 and the same extends through the plate and through the retaining cup to receive the washer 43 and the fastening nut 44.

The shielding of the cable with respect to the pothead assembly is effectively accomplished by a girdle shield in the form of a contact ring 46 shown in detail in FIGURE 3. The contact is preferably formed of beryllium copper alloy, although other conductive metals may be used. The ring is grounded by the conductor 47 which is electrically secured at 48 to the ring and wrapped several times at 50 around the cable overshield. Several layers of pressure sensitive tape may be applied to the turns 50 for holding the same in place on the cable.

As best shown in FIGURE 3 the metal contact ring 46 consists of an outer continuous wall 51 and an inner wall formed by a plurality of resilient fingers 52. The fingers are preferably integral with the metal of the outer wall and when the ring is telescoped over the cable the said resilient fingers will yieldingly contact the cable insulation portion 26 thereof.

The compound contemplated by the invention for filling the interior of the pothead assembly has a dielectric constant or specific inductive capacitance closely approximating that of the polyethylene used for the cable insulation. Because of this the compound will provide a dielectrically compatible system of isotropic nature. The preferred compound consists of a mixture of high molecular weight polybutenes and low molecular weight polyolefins or thixotropic type insulating compound and is characterized by a high tack value to the polyethylene insulation, to the porcelain shell of the pothead and also to the metal of the girdle shield down to temperatures as low as minus twenty degrees Fahrenheit. The filling compound should also retain its flexibility at low temperature levels and the same should have a relatively low coefficient of expansion. These characteristics are highly important in the successful operation of the present termination system since a void free area must be maintained within the pothead assembly and particularly within the girdle shield area. The obvious advantages of employing the girdle shield and which is made possible by the special compound resides in the elimination of the construction time for the usual tape cone system and also in the elimination of the dependency of the installation personnel in the field in building up the stress cone to the proper dimensions and shape.

The materials employed for the back-to-back diaphragms 36 and 37 will depend to a certain extent upon the type of cable installation being terminated. Two materials have been successfully used, one comprising a high temperature Buna N elastomer and the other comprising the high temperature, high strength silicone elastomer. The silicone elastomer is preferred for the diaphragm and particularly for the lower diaphragm 37 which is exposed to the elements in order to afford the greatest possible

protection against environmental degradation such as ultraviolet radiation, ozone attack and oxidation. The special silicone material employed should provide a completely compatible system capable of operating at temperatures of minus sixty degrees Fahrenheit.

In the modification of FIGURE 2 the cable termination system of the invention has been applied to a polyethylene cable 54 of the type having semi-conductive tape and a metallic conductive shield. As regards cable 54, the concentric ground wires are not employed. As previously described with respect to FIGURE 1 the terminal end of the cable 54 is stripped to expose the cable conductor 55 to which the metal connector 28 is secured so as to have good electrical conductivity therewith. The pothead assembly consisting of the insulator 10 and the base member 14 is telescoped over the stripped end of the cable and the metal cap nut 31 is threadedly secured to the threaded end 30 of the member 28. The opposite end of the pothead assembly is closed by the back-to-back diaphragms 36 and 37 and by the metal entrance plate 34.

Before telescoping the pothead assembly on the stripped end of the cable, the girdle shield 46 is applied to the portion 26 comprising the polyethylene insulation for the cable and the said girdle shield is electrically connected to the conductive cable overshield 56 by means of the ground conductor 47 and the turns 50. In this modification an additional conductor is employed, namely a ground braid 57 from the cable shield 56 to the body of the pothead. This ground braid performs the desired grounding function.

The pair of resilient diaphragms 36 and 37 are in back-to-back relation, the same as described with respect to FIGURE 1 and the said diaphragms are confined around their periphery between the base 16 of the member 14 and the entrance plate 34. By forming the opening in the diaphragms of smaller size than the diameter of the cable to which they are applied, the diaphragms are placed in tension and a peripheral edge such as 38 is formed which has good sealing contact with the cable. Also, the invention contemplates that the modification of FIGURE 2 will be filled with a compound such as described for the pothead assembly of FIGURE 1. This compound is preferably a mixture of high molecular weight polybutenes and low molecular weight polyolefins or thixotropic type insulating compound, with the additional factor of a reduced pouring temperature for the compound which is well below the softening point of the polyethylene cable insulation.

The invention is not to be limited to or by details of construction of the particular embodiment thereof illustrated by the drawings, as various other forms of the device will, of course, be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

What is claimed is:

1. In a termination system for a power cable of the polyethylene insulated type having an encircling sheath comprising a concentric strand layer of metal wires, said terminal end of the cable being stripped to expose the insulation and the concentrically disposed layer of metal wires, in combination, a pothead assembly having telescoping relation with the stripped end of the cable, an entrance plate fixed to the entrance end of the pothead assembly and having a central opening through which the cable extends, a pair of resilient diaphragms in back-to-back relation and having a central opening through which the cable extends and with the edges of the openings in sealing contact with the cable, said resilient diaphragms being sealed around their peripheries by being confined between the pothead assembly and the entrance plate, means anchoring all of the metal wires to the underside of the metal plate at a common location, and a girdle shield in the form of a metal ring located on the insulation portion of the stripped cable within the pothead as-

sembly and immediately above the resilient diaphragms, said girdle shield having the shape of an inverted U in section and including an uninterrupted outer wall and an inner wall formed of a plurality of spring fingers, said spring fingers having contact with the insulation portion of the cable.

2. A termination system for a power cable as defined by claim 1, wherein the opening formed in each diaphragm is smaller than the cable to which it is applied so that the edges of each opening are in tension for maintaining a tight seal as regards the cable, and additionally including a grounding conductor having electrical connection with the girdle shield.

3. In a termination system for a power cable of the type wherein the metal core of the cable is encased in cable insulation which is in turn covered by the jacket of the cable, said terminal end of the cable being stripped to expose the core and the cable insulation, a pothead assembly having telescoping relation with the stripped end of the cable, an entrance plate fixed to the entrance end of the pothead assembly and having a central opening through which the cable extends, a pair of resilient diaphragms in back-to-back relation, said diaphragms having a central opening through which the cable extends with

the edges of the openings in resilient sealing contact with the cable, said diaphragms being sealed around their periphery by being confined between the pothead assembly and the entrance plate, a girdle shield in the form of a metal ring located on the insulation portion of the stripped cable within the pothead assembly and immediately above the inside resilient diaphragm, said girdle shield having the shape of an inverted U in section and including an uninterrupted outer wall and an inner wall formed of a plurality of spring fingers, said spring fingers having inherent resiliency which tends to bias the fingers inwardly for resilient contact with the cable insulation, and means for grounding the said girdle shield.

References Cited

UNITED STATES PATENTS

3,151,209 9/1964 D'Ascoli et al. ----- 174—77 X

FOREIGN PATENTS

232,556 3/1964 Austria.

564,029 6/1957 Italy.

LARAMIE E. ASKIN, *Primary Examiner*.

**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,336,435

August 15, 1967

George E. Lusk

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 47, after "consisting" insert -- of --.
Column 6, line 21, "232,556" should read -- 232,566 --.

Signed and sealed this 12th day of August 1969.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents