

July 19, 1960

T. AAMODT
VAPOR SEAL LEADIN

2,945,914

Filed Dec. 16, 1958

2 Sheets-Sheet 1

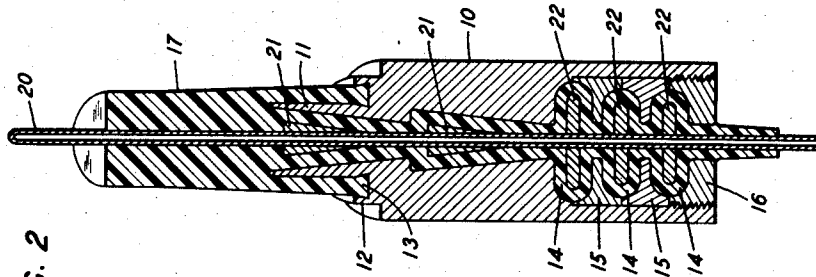


FIG. 2

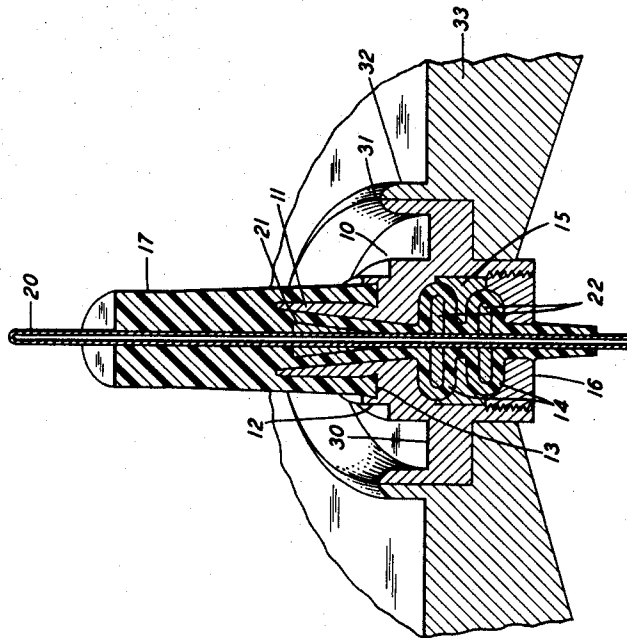


FIG. 1

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FIG. 4

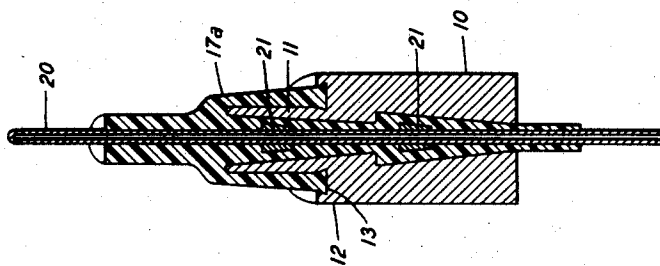
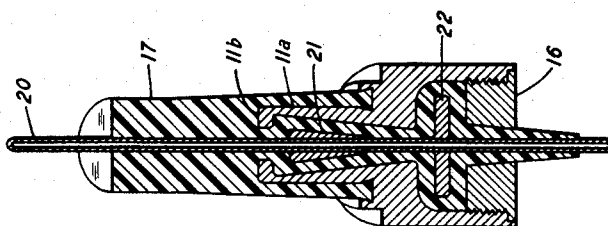


FIG. 3



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VAPOR SEAL LEADIN

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Filed Dec. 16, 1958, Ser. No. 780,870

9 Claims. (Cl. 174—151)

The invention herein disclosed relates to electrical lead-in structures capable of withstanding high pressures such as are encountered on the sea bottom at depths up to about three miles. More specifically, the invention is concerned with sealed lead-in devices for use between undersea cable and the housings of undersea repeaters, equalizers and like assemblies.

Undersea cables having repeaters and other transmission appurtenances inserted at intervals therein have been in use for some time. One of the problems involved in such systems is that of adequate sealing between the cable and repeater housing while maintaining the insulation integrity of the electrical circuit. The instant invention presents a new solution of the sealing problem by way of several embodiments of a metal-to-plastic seal of unique configuration.

It has been proposed to make so-called "armorless" undersea coaxial cable having a high strength metal core and an external sheath of plastic insulation such as polyethylene or the like. The present invention, with this cable in mind, proposes to use as seal insulation a polyethylene the same as or closely compatible with the cable insulation.

An object of this invention is the improvement of high pressure, sealed lead-in devices by enhancing their ability to prevent the passage of water vapor therethrough, while maintaining a high degree of insulation integrity in the electric circuit, both over a long period of time.

A further object of this invention is to facilitate the joining of a high pressure seal to a cable of the kind used in undersea, repeater cable systems.

An illustrative embodiment of a seal in accordance with this invention comprises a generally cylindrical outer conductive body of metal having an annular flange or skirt at its high pressure end and a grooved annular shoulder surrounding the flange. The metal body includes a coaxial, through orifice having spaced portions of enlarged diameter. At least one of said enlarged diameter portions, namely, the one nearest the high pressure end of the seal, is frustoconical in contour with its larger diameter toward said high pressure end. A central or inner conductor of metal is located coaxial to the orifice of the outer conductor and has spaced protuberances within and matching in contour the enlarged portions of the orifice. The space between the inner and outer conductors is completely filled with insulating material, which extends over the annular flange and into the grooved portion of the annular shoulder surrounding the flange. The outer conductive body may have a contour suitable for attachment to a repeater housing or the like or may be made integral with the housing. As the body and the housing are ordinarily of metal, the attachment if required may be by means of a suitable weld.

Accordingly, a feature of this invention resides in a metal conductor and plastic insulation, coaxial lead-in having a long and tortuous interface between said conductor and insulation.

Another feature of this invention lies in a coaxial lead-

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in structure in which the insulation between the outer and inner conductors is extended over a flanged portion of the outer conductor, thereby embracing said flange.

An additional feature flows from the particular novel structure of the lead-in, which allows the use of an insulation material the same as or closely compatible with that of a cable with which the lead-in is to be used.

Other and further objects and features of this invention will appear more fully and clearly from the following description of exemplary embodiments thereof along with appended drawings, in which:

Fig. 1 is a longitudinal section of one embodiment of this invention including one frusto-conical portion and two disc stopper portions, the lead-in assembly being welded to a repeater housing, a portion only of which is shown;

Fig. 2 is a longitudinal section of another embodiment of this invention having two frusto-conical portions and three disc stopper portions;

Fig. 3 is a longitudinal section of still another embodiment of this invention having single frusto-conical and disc portions and in which the end of the body flange is turned; and

Fig. 4 is a longitudinal section of an embodiment of this invention having two frusto-conical portions and in which the insulation is more dense than that of the other three embodiments.

The embodiments illustrated in Figs. 2, 3 and 4 have been shown without any provision for attachment to a repeater or like housing in the interest of simplicity of illustration. Each of these embodiments may be constructed in the manner illustrated in Fig. 1, may be otherwise suitably formed for adequate joinder with whatever means the lead-in is to be attached, or the outer conductor may be an integral part of the wall through which the connection is made.

As shown in Fig. 1, this particular embodiment of the seal of the present invention comprises an outer conductor including a longitudinally orificed, generally cylindrical body 10 of metal, such as beryllium copper, brass or the like. An integral flange or skirt 11 projects from one end of the body. An annular shoulder 12 surrounding the base of the flange 11 includes an undercut locking groove 13. The annular shoulder 12 may be made to project as far axially as the skirt 11 forming a deep groove 13, which need not be undercut as in the illustration. The flange 11 and that portion of the body 10 adjacent thereto are internally tapered with the outer end the larger. The flanged end of the body comprises the high pressure side of the seal.

Toward the low pressure side of the seal and adjacent the small end of the frusto-conical, tapered orifice portion are two annular pockets or enlargements 14 of the body orifice. These pockets may be formed in the body 10 or by means of an internally flanged or double-dished ring 15 intermediate a dished portion of the body 10 and a dished ring 16 threaded into the body.

The center conductor comprises a tube or rod 20 of metal having a frusto-conical protuberance 21 and discs 22 secured thereto as by brazing. The protuberance 21 and discs 22 are located within the tapered and pocketed portions of the orifice, respectively. The inner conductor and its appurtenances may be of beryllium copper, brass or the like.

Insulation 17, such as polyethylene, is pressure molded between the body 10 and the central conductor 20, over the projecting portions of the latter, on the outside of the flange 11, and in the undercut groove 13. The body 10 may be provided with a mounting ring 30 having an annular flange 31 fitting within and welded to a similar flange 32 on a repeater housing 33, a portion only of which is shown in Fig. 1.

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The embodiment of this invention illustrated in Fig. 2 is similar to that of Fig. 1 but includes two frusto-conical portions 21 and three disc portions 22 on the central conductor with corresponding mating portions within the body orifice.

Another embodiment of this invention illustrated in Fig. 3 is generally like the embodiments illustrated in Figs. 1 and 2 but with some specific structural differences. As may be seen in Fig. 3, the flange 11a has an inturned rim or edge 11b which reduces in diameter the spacing between the inner and outer conductor. This structure increases somewhat the labyrinthian configuration of the metal to insulation interface. The space between the inner and outer conductors must, however, be kept to some safe minimum providing adequate insulation properties. This particular embodiment, having but one disc portion, requires no intermediate rings as are used in the previously described embodiments.

The seal illustrated in Fig. 4 is like that shown in Fig. 2 with the disc and annular pocket portions omitted. The insulation material 17a in this seal is of a higher density and is more crystalline than that of the other modifications and is consequently less subject to cold flow, which is inhibited by the stoppers used with the devices made of the less dense and softer insulation.

It is believed to be obvious that various combinations of structural contour and materials may be used in still other lead-in seals conforming to the basic principles of this invention and be, therefore, included therewith.

What is claimed is:

1. A sealed leadin for making electrical connection through a wall subjected to a high difference of ambient pressure and including an outer conductor comprising a generally cylindrical, electrically conductive body having a longitudinal orifice therethrough, an annular flange at its high pressure end, and a grooved annular shoulder surrounding the flange; an inner conductor within said body coaxial to said orifice and extending beyond the ends thereof, said inner conductor having spaced protuberances within the body orifice, the protuberance adjacent the high pressure end being frusto-conical with the larger base toward said end, said orifice having portions of enlarged diameter juxtaposed to the protuberances and of mating configuration thereto; and molded insulating material filling the space between the conductors, extending over the extensions of the inner conductor, over the annular flange, and into the groove of the annular shoulder.

2. A sealed leadin for making electrical connection through a wall subjected to a high difference of ambient pressure and including an outer conductor comprising a generally cylindrical, electrically conductive body having a longitudinal orifice therethrough, an annular flange at its high pressure end, and a grooved annular shoulder surrounding the flange; an inner conductor within said body coaxial to said orifice, said inner conductor having spaced protuberances, the protuberance adjacent the high pressure end being frusto-conical with the larger base toward said end, said orifice having portions of enlarged diameter juxtaposed to the protuberances and of mating configuration thereto; and molded insulating material filling the space between the conductors, extending over the annular flange, and into the groove of the annular shoulder.

3. A sealed leadin for making electrical connection through a wall subjected to a high difference of ambient pressure and including an outer conductor comprising a generally cylindrical and electrically conductive body having a longitudinal orifice therethrough, an annular flange at its high pressure end, and a grooved annular shoulder surrounding the flange; an inner conductor within said body coaxial to said orifice, said inner conductor having spaced protuberances within the body orifice, at least one of the protuberances adjacent the high pressure end being frusto-conical with the larger base toward said end,

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at least one of the protuberances remote from the high pressure end being disc like, said orifice having portions of enlarged diameter juxtaposed to the protuberances and of mating configuration thereto; and molded insulating material filling the space between the conductors, extending over the annular flange, and into the groove of the annular shoulder.

4. A sealed leadin for making electrical connection through a wall comprising a generally cylindrical outer conductor having a longitudinal orifice therethrough, an annular flange at its high pressure end, and a grooved annular shoulder surrounding the flange; an inner conductor within said body coaxial to said orifice, said inner conductor having spaced protuberances within the body orifice, the protuberances adjacent the high pressure end being frusto-conical with their larger bases toward said end, said orifice having portions of enlarged diameter juxtaposed to the protuberances and of mating configuration thereto; and molded insulating material filling the space between the conductors, extending over the extensions of the inner conductor, over the annular flange, and into the groove of the annular shoulder.

5. A coaxial lead-in vapor seal comprising an outer conductor including a generally cylindrical body of metal having an axially directed flange at one end, an annularly grooved shoulder around said flange, and a central axial orifice therethrough; said orifice including a plurality of end-to-end frusto-conical sections having their larger ends toward the flange; a center conductor extending axially through said orifice and including frusto-conical protuberances at spaced intervals, one within each orifice section; and a body of molded plastic insulation filling the remainder of the orifice and extending over said flange into the annularly grooved shoulder.

6. A coaxial lead-in vapor seal comprising a generally cylindrical outer conductor having an axially directed flange at one end, an annularly grooved shoulder around said flange, and an axial orifice therethrough; said orifice including a frusto-conical section having its larger end toward the flange; a center conductor extending axially through said orifice and including a frusto-conical protuberance within said orifice section; and a body of molded plastic insulation filling the remainder of the orifice and extending over said flange into the annularly grooved shoulder.

7. A hermetic seal for an electrical conductor passing through a wall separating a comparatively low pressure chamber from a region of much higher pressure, comprising a generally cylindrical body of metal bonded through said wall, said body having an axially directed flange at its high pressure end, an annularly grooved shoulder around the flange, and an axial orifice therethrough; said orifice including a plurality of enlarged sections, at least that section nearest the high pressure end being tapered with its larger end the high pressure end, said conductor extending axially through said orifice and including protuberances, one within and corresponding in contour to each enlarged orifice section; and a body of molded plastic insulation filling the remainder of the orifice and extending over said flange into the annularly grooved shoulder.

8. A hermetic seal for an electrical conductor passing through a wall separating a comparatively low pressure chamber from a region of much higher pressure, comprising a generally cylindrical body of metal extending through and bonded to said wall, said body having an axially directed flange at its high pressure end, an annularly grooved shoulder around the flange, and an axial orifice therethrough; said orifice including a plurality of tapered enlarged sections with their larger ends the high pressure ends, said conductor extending axially through said orifice and including protuberances, one within and corresponding in contour to each enlarged orifice section; and a body of molded plastic insulation filling the re-

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mainder of the orifice and extending over said flange into the annularly grooved shoulder.

9. A high pressure vapor seal comprising an outer conductor having an axially directed flange at one end, an annularly grooved shoulder around said flange, and a central orifice therethrough; an inner conductor within the body coaxial to the orifice, and having spaced protuberances thereon, at least one of said protuberances being frusto-conical with the larger base toward the high pressure end of the seal, said orifice having enlarged

portions juxtaposed respectively to the protuberances and of similar configuration thereto; and molded insulating material filling the space between the conductors, extending over the flange and into the groove of the shoulder.

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