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INLET MEANS FOR INSULATION COVERED ELECTRIC CONDUCTORS

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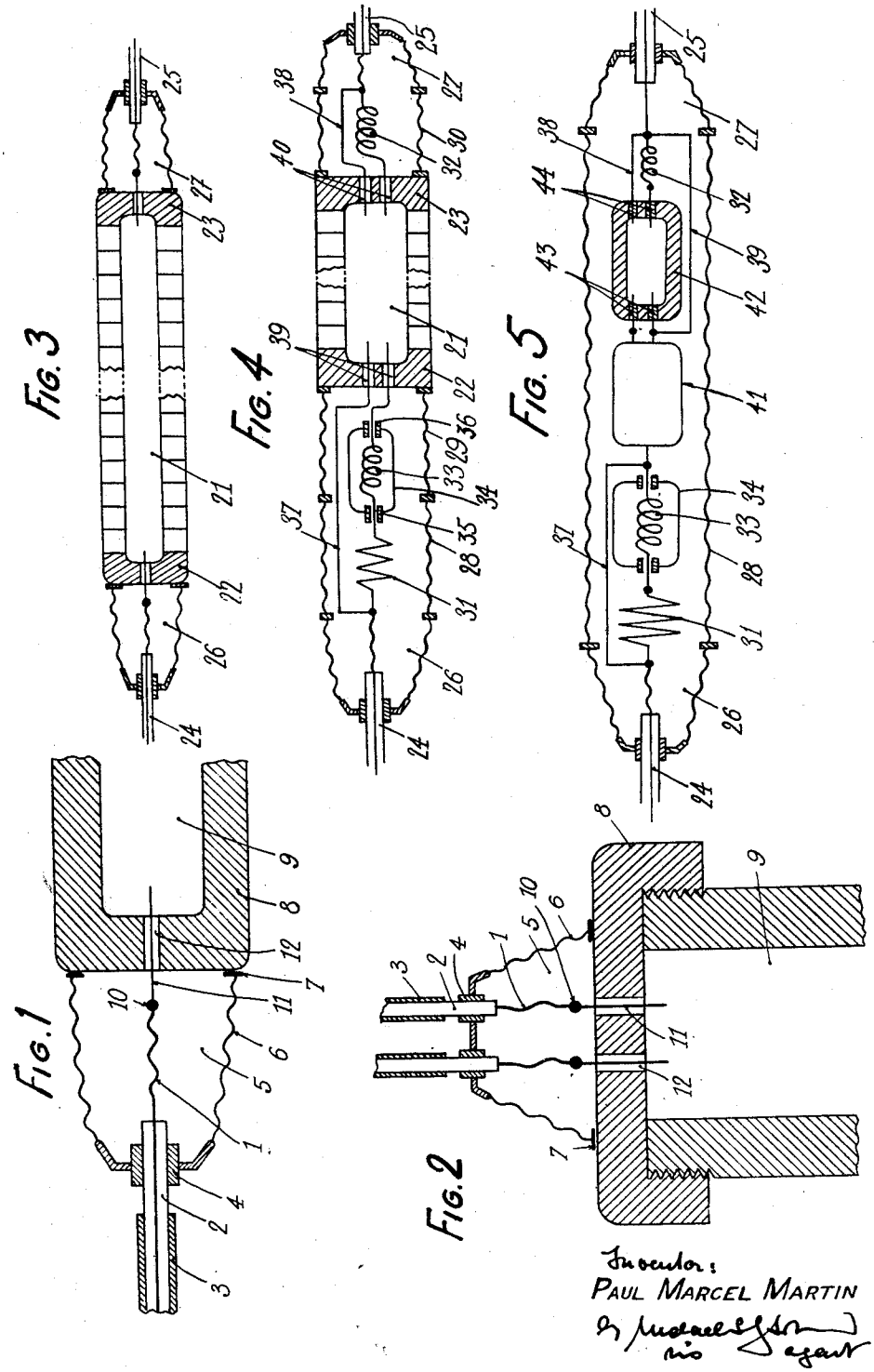

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

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INLET MEANS FOR INSULATION-COVERED ELECTRIC CONDUCTORS

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The present invention relates to inlet means or arrangements for an insulation-covered electric conductor, particularly for submarine cables with housings for repeater apparatus.

It is an object of the present invention to adapt inlet means of the kind described to the pressure prevailing at the bottom of the sea.

The invention comprises a closed casing having a wall, an inlet opening in the wall of the closed casing, a closed outer housing having a wall including a flexible wall portion and being tightly secured exteriorly to the wall of the closed casing around the inlet opening in the same, an inlet opening in the wall of the closed outer housing through which the end portion of the insulation-covered electric conductor tightly passes and protrudes into the closed outer housing, a metallic conductor portion without insulating covering arranged within the closed outer housing electrically connected with the end portion of the insulation-covered electric conductor and protruding through the inlet opening in the wall of the closed casing into the same, and a substantially non-compressible insulating substance enclosed within the closed outer housing and completely filling the same.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a partial section of a first embodiment of the present invention;

Fig. 2 is a partial section of a second embodiment of the present invention;

Fig. 3 is a sectional side elevation of an entire repeater housing having similar inlet means as shown in Fig. 1; and

Figs. 4 and 5 are sectional elevations of two more embodiments of the present invention, respectively.

Figure 1 shows an outer housing according to the invention. The core of the submarine cable, comprising the central conductor 1 and insulating body 2, is stripped of its return conductor 3, and protrudes through fluid-tight inlet means such as a stuffing box 4 in the outer housing 5, which is closed in by a bell 6 having thin, flexible walls and being tightly secured exteriorly by means of a joint 7 to the terminal wall 8 of the thick-walled

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low pressure chamber or casing 9 containing the amplifying apparatus.

In the interior of the outer housing 5 the central conductor 1 is stripped of its insulating body 2.

The outer housing 5 is filled with a material which is substantially non-compressible, a good electric insulator, does not attack the various materials contacting therewith, moistens the walls of the outer housing 5 and does not harden at the temperature prevailing at the bottom of the sea.

This material may be liquid, pasty or plastic. The material within the outer housing may be heterogeneous, for example, be pasty in the center and liquid near the walls.

Owing to the flexibility of the wall 6, the material, for instance the liquid filling the outer housing is under a pressure being in near equilibrium to that of the medium surrounding the outer housing. The stuffing box 4 being pressed against the insulating body 2 of the core, is therefore not subjected to large pressure differences: it may, for example, be built like an ordinary stuffing box. Its pressure on the insulating body 2 is low, the area upon which pressure is exerted is small, and the insulating body will not flow at this point.

The central conductor 1 is connected at point 10 to a metallic conductor 11 protruding through an inlet opening 12 in the wall 8 of the low pressure casing 9. If this wall is electrically conductive, the opening is stopped by means of a material which insulates the conductor 11 from the wall 8 and prevents the liquid in the outer housing 5 from penetrating into the casing 9. This material may, for example, be vitreous. If the wall is not electrically conductive the function of this material is accordingly simplified. It may even be dispensed with, if the nature of the wall 8 is such as to allow the conductor 11 to be embedded in its mass such as for example, in the case of a wall made of a vitreous substance.

The return conductor 3 is preferably connected electrically with the mass of the wall 8 by means of a connection not shown in the drawing.

Figures 2 and 3 illustrate examples of adaptations of the invention to some types of housings.

Figure 2 shows the entry of the two parts of a submarine cable into the housing of a rigid repeater, i. e., a repeater having its amplifying apparatus accommodated in a casing 9 having rigid thick walls such as 8. Each of the two cores 1 protrudes through a stuffing box 4 into an outer housing 5 where they are connected to

two individual metallic conductors 11 extending through two openings 12 provided in the wall 8.

The repeater illustrated in Fig. 2 has the general appearance of a Pupin pot in that the two cable-ends enter the box containing the several apparatus side by side through the cover, this box being filled with air under low pressure.

Fig. 3 shows the inlet of the two ends of a submarine cable into a flexible repeater housing of a known type; the term flexible repeater being meant to denote a repeater having its amplifying apparatus arranged within a flexible envelope, capable of resisting the pressure at the bottom of the sea.

The housing 21 is shown schematically; it is closed at both ends by a rigid thick wall 22 and 23, respectively; the cores 24 and 25 of the cable ends protrude into the outer housings 26 and 27, respectively, and from here through the walls 22 and 23 into the casing 21.

Figs. 4 and 5 each show a flexible repeater casing in which the thick walled envelope capable of resisting the pressure exerted thereon is partially or totally eliminated.

Before describing these arrangements in more detail it is remarked that the elements constituting the apparatus can be divided in two categories, namely:

(*a*) Those having an enclosure under vacuum or which must operate in the air; and

(*b*) Those that are adapted to operate under high pressure.

The first category comprises more particularly the thermionic tubes.

The second category includes, for example, the fixed or adjustable resistance and inductance coils.

Fig. 4 shows a repeater in which the outer housings 26 and 27 for the cable intake are filled with a liquid and are extended in length.

The cores 24 and 25 of the cable ends extend into the outer housings 26 and 27, respectively. The edges of each of the bells having thin and flexible walls, delimiting the outer housings, are secured, either to one of the terminal parts 22 and 23 of the low pressure casing 21, or to cylindrical tube elements 28 and 30 with thin and flexible walls.

In Fig. 4 the outer housing 26 is extended by two tube elements 28 and 29 and the outer housing 27 by one tube element 30; the edges of the elements 29 and 30 are secured to the terminal parts 22 and 23. The attachment of the edges of the outer housings 26 and 27 and the tube elements 28—30 to one another or to the terminal parts 22 and 23, respectively, is accomplished by means of tight joints, analogous to joint 7 shown in Fig. 1.

The whole, formed by an outer housing and the adjacent tube elements, is filled with liquid as hereabove described, which enters into a pressure equilibration with the outer medium; the amplifier elements of the second category are placed in this liquid.

Several of the elements of the second category are shown schematically by way of example. The elements 31 and 32 are immersed in the liquid; the element 33 is enclosed in a box or casing 34 having thin and flexible walls and being filled with a liquid that may be different from the surrounding liquid. The connections of this element 33 protrude into the box 34 and pass through stuffing boxes 35 and 36 which, if required, electrically insulate the connections from the body of the box 34, and prevent a possible mixing of the two liquids being under substantially the same pressure. Only two stuffing boxes are shown in the drawing, but their number may be higher according to the connections extending to element 33.

Interconnecting means 37 and 38 for the various elements of the amplifying apparatus are shown schematically by way of example; the number of these internal connections depends on the wiring diagram of the repeater; they are immersed in the liquid.

Certain of these internal connections protrude into casing 21 through openings 39 and 40 analogous to opening 12 in Fig. 1. The elements of the first category of the amplifying apparatus are arranged in casing 21 filled with air under low pressure.

Fig. 5 shows a repeater devoid of a low pressure casing separating the right and left-hand parts of the repeater.

The cores 24 and 25 protrude into the outer housings 26 and 27 which are interconnected by a tube 28 preferably made in one piece and having thin and flexible walls; its ends are adapted to form the walls of the outer housings 26 and 27. The tube may also be formed by a series of elements such as elements 28, 29 and 30 shown in Fig. 4.

The space enclosed by the walls of the outer housings and the tube is filled with liquid as hereabove mentioned. The elements constituting the amplifying apparatus or the boxes containing some are immersed in this liquid.

In Fig. 5 are shown, by way of example elements of the second category 31 and 32 immersed directly in the liquid, one element 33 of the second category being enclosed within a thin walled box 34, similar to box 34 (Fig. 4), and two boxes 41 and 42 containing elements of the first category adapted to operate in air having a low pressure. The box 42 is shown schematically in cross section. The boxes 41 and 42 are formed with thick walls capable of resisting the pressure prevailing at the bottom of the sea and filled with air under low pressure. The outer dimensions of the boxes 41 and 42 must be such as to present no obstacle to the deflections of the tube 28 to which the same may be subjected while being placed in position. The connections between the amplifying and other elements pass through the walls of the boxes 41 and 42 by means of openings such as 43 and 44. In the sectional view of the box 42 are shown, by way of example, four connections passing through the wall of the box.

Various internal connections 37, 38 and 39 are shown schematically in Fig. 5.

All internal connections are designed to have a flexibility sufficient to follow the deflections imparted thereupon by the movements of tube 28.

In Figs. 4 and 5, the return conductors are not shown in order to simplify the drawing. They do not enter the outer housings and can be hooked up by means of a metallic connection (not shown) at the outer side of the wall of the casing.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of inlet means for an insulation-covered electric conductor differing from the types described above.

While I have illustrated and described the invention as embodied in an inlet arrangement for an insulation-covered electric conductor forming part of a submarine cable, I do not intend to be limited to the details shown, since various modi-

fications and structural changes may be made without departing in any way from the spirit of my invention.

Without further analysis, the foregoing will so fully reveal the gist of my invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What I claim as new and desire to secure by Letters Patent is:

1. Inlet means for an insulation-covered electric conductor comprising in combination a closed casing having a wall; an inlet opening in said wall of said closed casing; a closed outer housing having a wall including a flexible wall portion and being tightly secured exteriorly to said wall of said closed casing around said inlet opening in the same; an inlet opening in said wall of said closed outer housing through which the end portion of said insulation-covered electric conductor tightly passes and protrudes into said closed outer housing; a metallic conductor portion without outer covering arranged within said closed outer housing electrically connected with said end portion of said insulation-covered electric conductor and protruding through said inlet opening in the wall of said closed casing into the same; and a substantially non-compressible insulating substance enclosed within said closed outer housing and completely filling the same.

2. Inlet means for an insulation-covered electric conductor comprising in combination a closed casing having a wall; a substantially bell-shaped closed outer housing having a wall including a flexible wall portion and being tightly secured along its edge to said wall of said closed casing; an inlet opening in said wall of said closed outer housing through which the end portion of said insulation-covered electric conductor tightly passes and protrudes into said bell-shaped closed outer housing; a metallic conductor portion without insulating covering arranged within said closed outer housing, electrically connected with said end portion of said insulation-covered electric conductor and protruding through the wall portion of said closed casing surrounded by said closed outer housing into said closed casing; and a substantially non-compressible insulating substance enclosed within said closed outer housing and completely filling the same.

3. Inlet means for an insulation-covered electric conductor comprising in combination a closed casing having a wall; a substantially bell-shaped closed housing having a wall including a flexible wall portion and being tightly secured along its edge to said wall of said closed casing; an inlet opening in said wall of said closed housing through which said insulation covered electric conductor tightly passes and protrudes into said closed housing, the end portion of said insulation-covered electric conductor within said closed housing having its insulation-covering removed and protruding through the wall portion of said closed casing surrounded by said closed housing into said closed casing; and a substantially non-compressible insulating substance enclosed within said closed housing and completely filling the same.

4. Inlet means for an insulation-covered electric conductor comprising in combination a closed casing having a wall; comprising in combination an inlet opening in said wall of said closed casing; a closed outer housing having a wall including a flexible wall portion and being tightly secured to said wall of said closed casing around said inlet opening in the same; an inlet opening in said wall of said closed outer housing through which said insulation-covered electric conductor tightly passes and protrudes into said closed outer housing, the end portion of said insulation-covered electric conductor within said closed outer housing having its insulation-covering removed and protruding through said inlet opening in said wall of said closed casing into the same; and a substantially non-compressible insulating substance enclosed within said closed outer housing and completely filling the same.

5. An inlet arrangement for an insulation-covered electric conductor comprising in combination a closed casing having a wall; a fluid-tight inlet means in said wall of said closed casing; a closed outer housing having a wall including a flexible wall portion and being tightly secured exteriorly to said wall of said closed casing around said fluid-tight inlet means in the same; a fluid-tight inlet means in said wall of said closed outer housing through which the end portion of said insulation-covered electric conductor protrudes into said closed insulating housing; a metallic conductor portion without insulating covering arranged within said closed outer housing electrically connected with said end portion of said insulation-covered electric conductor and protruding through said fluid-tight inlet means in the wall of said closed casing into the same; and a substantially non-compressible insulating substance enclosed within said closed outer housing and completely filling the same.

6. An inlet arrangement for an insulation-covered electric conductor comprising in combination a closed casing having a wall; a substantially bell-shaped closed outer housing having a wall including a flexible wall portion and being tightly secured along its edge to said wall of said closed casing; fluid-tight inlet means in said wall of said closed outer housing through which the end portion of said insulation-covered electric conductor protrudes into said bell-shaped closed insulating housing; a metallic conductor portion without insulating covering arranged within said closed outer housing, electrically connected with said end portion of said insulation-covered electric conductor and protruding through the wall portion of said closed casing surrounded by said closed outer housing into said closed casing; and a substantially non-compressible insulating substance enclosed within said closed outer housing and completely filling the same.

7. An inlet arrangement for an insulation-covered electric conductor comprising in combination a closed casing having a wall; fluid-tight inlet means in said wall of said closed casing; a closed outer housing having a wall including a flexible wall portion and being tightly secured exteriorly to said wall of said closed casing around said fluid-tight inlet means in the same; fluid-tight inlet means in said wall of said closed outer housing through which said insulation-covered electric conductor protrudes into said closed outer housing, the end portion of said insulation-covered electric conductor within said closed outer housing having its insulation-covering removed and protruding through said fluid-tight inlet means in said wall

of said closed casing into the same; and a substantially non-compressible insulating substance enclosed within said closed outer housing and completely filling the same.

8. Inlet means for an insulation-covered electric conductor comprising in combination a closed casing having a pressure resistant wall an inlet opening in said wall of said closed casing; a closed outer housing having a flexible wall and being tightly secured exteriorly to said wall of said closed casing around said inlet opening in the same; an inlet opening in said wall of said closed outer housing through which the end portion of said insulation-covered electric conductor tightly passes and protrudes into said closed outer housing; a metallic conductor portion without insulating covering arranged within said closed outer housing electrically connected with said end portion of said insulation-covered electric conductor and protruding through said inlet opening in the wall of said closed casing into the same; and a substantially non-compressible insulating substance enclosed within said closed outer housing and completely filling the same.

9. Inlet means for an insulation-covered electric conductor comprising in combination a closed casing having a wall; an inlet opening in said wall of said closed casing; a closed outer housing having a wall including a flexible wall portion and being tightly secured exteriorly to said wall of said closed casing around said inlet opening in the same; an inlet opening in said wall of said closed outer housing through which the end portion of said insulation-covered electric conductor tightly passes and protrudes into said closed outer housing; a metallic conductor portion without insulating covering arranged within said closed outer housing electrically connected with said end portion of said insulation-covered electric conductor and protruding through said inlet opening in the wall of said closed casing into the same; a substantially non-compressible insulating substance enclosed within said closed outer housing and completely filling the same; and means for subjecting said substantially non-compressible insulating substance within said closed outer housing substantially to the same pressure as the pressure prevailing in the medium surrounding said closed outer housing.

10. Inlet means for an insulation-covered electric conductor comprising in combination a closed casing having a wall; a substantially bell-shaped closed compressible outer housing having a wall and being tightly secured along its edge to said wall of said closed casing; an inlet opening in said wall of said closed compressible outer housing through which the end portion of said insulation-covered electric conductor tightly passes and protrudes into said bell-shaped closed compressible outer housing; a metallic conductor portion without insulating covering arranged within said closed compressible outer housing, electrically connected with said end portion of said insulation-covered electric conductor and protruding through the wall portion of said closed casing surrounded by said closed compressible outer housing into said closed casing; and a substantially non-compressible insulating substance enclosed within said closed compressible outer housing and completely filling the same, said substantially non-compressible insulating substance being subjected due to the compressibility of said compressible outer housing to substantially the same pressure as the pressure in the medium surrounding said compressible outer housing.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
895,978	Dearlove	Aug. 11, 1908
1,300,213	Freeman	Apr. 8, 1919
1,948,964	Gay	Feb. 27, 1934
2,078,219	Burr et al.	Apr. 27, 1937

FOREIGN PATENTS

Number	Country	Date
220,310	Switzerland	July 1, 1942