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FLEXIBLE SUBMARINE REPEATER

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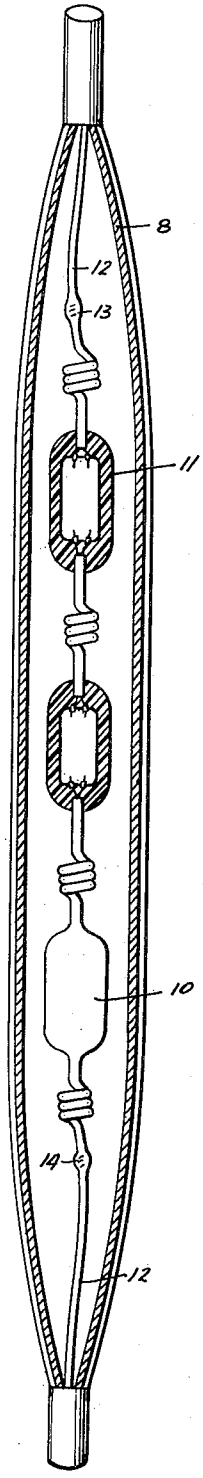

FIG. 2

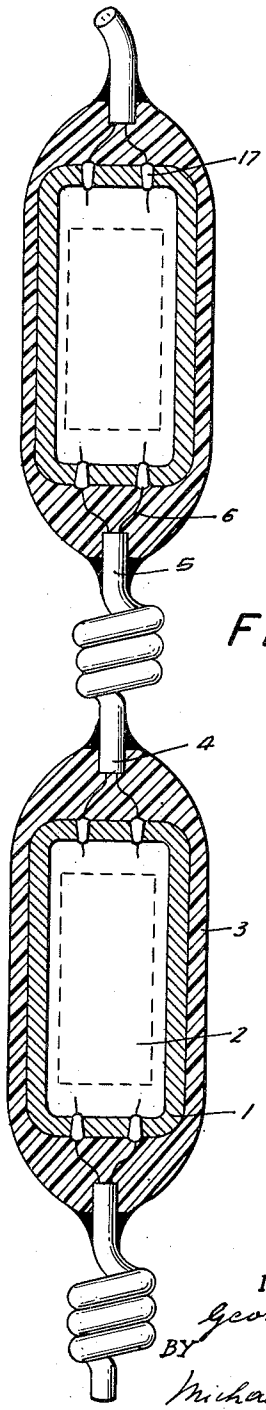

FIG. 1

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FLEXIBLE SUBMARINE REPEATER

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8 Claims. (Cl. 174—70)

This invention relates to repeaters for underwater cables.

The development of under-water telephonic and telegraphic transmission apparatus has shown that it is necessary for the fluid-tight pressure-resisting containers in which the submerged elements of the repeaters are mounted to have a larger volume than would otherwise be necessary. It is in fact necessary to be able to group the different elements of telephonic repeaters in such manner as to avoid interfering inter-actions, particularly when a repeater is arranged for amplification in both directions of transmission. The same problem exists when the relatively large elements necessitated by the amplification of telegraphic signals have to be installed.

Furthermore, it is necessary that such repeater remains sufficiently deformable to be capable of being rolled on the laying drum of cable-laying ships so that the laying of the repeater is effected under the same conditions as those of the cable itself.

The known flexible under-water repeaters generally comprise a flexible fluid-tight container in which are mounted all the elements of the repeater. These are mounted directly in the flexible container when the latter is itself resistant to pressure. In another instance, they are fitted in one or more pressure-resisting containers placed inside the flexible casing, which may or may not contain a pressure equalising liquid surrounding the containers. It is also known to enclose all the pressure-resisting containers and also the connection wires which inter-connect the electric elements contained in the various containers, in a single insulating and impermeable compact plastic mass bonded to the insulation of the under-water cable.

However, these various methods of construction do not eliminate the danger of the flexible casing or the compact plastic mass splitting at the moment when the containers pass on to the laying drum of the cable-laying vessel.

The present invention, by which it is possible to overcome this disadvantage, has for its object to provide a flexible repeater for under-water cable, the electric members of which are fitted in a number of fluid-tight and pressure-resisting containers and are connected to one another by conductors passing through the walls of the containers in sealed insulated terminals, the repeater being characterised in that each container is individually lined with a fluid-tight plastic envelope and that the electrical connections between the members disposed in the adjacent containers as well as between the members of the two extreme containers and the lengths of under-water cable are effected by means of lengths of flexible cable which are fluid-tight longitudinally, and covered with a fluid-tight sheath bonded to the plastic envelope of the containers or to the insulation of the cable.

Each of the containers thus constitutes an independent assembly, which, as regards the members which it contains, ensures at the same time resistance to pressure

and the water-tight protection against sea-water. The electrical connections by flexible cable between consecutive containers enable the different containers to be fitted freely on the drum of the machines at the time of laying without any appreciable mechanical stress occurring either on the fluid-tight envelopes or on the electric connections.

The articulated repeater is fitted beneath the same armouring as the cable, which makes it possible for the laying to take place under the same conditions as the cable itself without stopping the movement of the ship.

One embodiment of the arrangement according to the invention, given by way of non-limitative example, is shown in the accompanying drawings, wherein:

Figure 1 shows two elements of an articulated repeater in partial longitudinal sectional view; and

Figure 2 is a partial longitudinal sectional view of an entire repeater section.

Referring to the drawings and more particularly to Fig. 1, container **1**, preferably made of steel is shown and formed in such manner as to resist pressure such as water pressure at a sea bed. This container contains the elements **2** of the repeater; **3** represents the fluid-tight envelope moulded on the container **1** and bonded to the sheath **4** of a flexible connecting cable, the other end **5** of this sheath being bonded to the fluid-tight envelope of the adjacent container.

The insulated conductors of the cable, such as **6**, pass into the pressure-resisting container by means of insulating terminals **7** sealed in the container wall.

The fluid-tight envelope **3** of each container and the sheath of the cables **4** are formed by a material of the same nature as the insulation of the under-water cable, such for example as a material having a base of rubber, polythene or any other similar material.

As shown in Figure 2, the articulated chain formed by the different containers is fitted in a flexible metallic tube **8** which is not fluid-tight and inside which it has a certain amount of play both radially and longitudinally in order to permit the relative displacement of the members during the flexing movements which they will have to withstand at the time of being rolled on to and off the laying drums of the cable-laying vessel.

The flexible tube is designed to support the armouring **9** of the under-water cable, beneath which armouring the repeater will be inserted, and to avoid the transmission of radial stresses to the elements of the repeater at the time of laying.

Figure 2 also shows the electric connection between the extreme containers **10** and **11** and the under-water cable **12** by means of flexible connections, the sheath of which is bonded at **13** and **14** to the insulation of the under-water cables.

Separately covering the pressure-resisting containers with a fluid-tight envelope which is an insulator enables these containers to be brought to a potential different from that of sea-water, for example, to the potential of one of the conductors of the under-water cable.

In particular, this arrangement enables the electronic tubes of the repeater to be surrounded by a simple means with an electrostatic screen brought substantially to the same potential as the filaments, thereby avoiding the placing of these tubes in a disturbing field.

I claim:

1. A repeater apparatus for underwater cables comprising, in combination, a plurality of pressure-resisting repeater element containers; a fluid-tight sheath bonded to and covering each of said containers; a plurality of flexible conductive interconnecting leads, each extending between adjacent containers and having a length substantially longer than the distance between said adjacent containers;

a fluid-tight sheath bonded to and covering each of said leads and bonded at the ends thereof respectively to each fluid-tight sheath covering said adjacent containers between which said leads extend; and an elongated, flexible, reinforcing tubular housing pervious to water and spaced from and surrounding all of said containers, said housing providing protection against mechanical damage to said containers and leads.

2. A repeater apparatus for underwater cables comprising, in combination, a plurality of pressure-resisting metal repeater element containers; a fluid-tight sheath bonded to and covering each of said containers; a plurality of flexible conductive interconnecting leads, each extending between adjacent containers and having a length substantially longer than the distance between said adjacent containers; a fluid-tight sheath bonded to and covering each of said leads and bonded at the ends thereof respectively to each fluid-tight sheath covering said adjacent containers between which said leads extend; and an elongated, flexible, reinforcing tubular housing pervious to water and spaced from and surrounding all of said containers, said housing providing protection against mechanical damage to said containers and leads.

3. A repeater apparatus for underwater cables comprising, in combination, a plurality of pressure-resisting metal repeater element containers; a fluid-tight sheath formed of a plastic material bonded to and covering each of said containers; a plurality of flexible conductive interconnecting leads, each extending between adjacent containers and having a length substantially longer than the distance between said adjacent containers; a fluid-tight sheath formed of a plastic material bonded to and covering each of said leads and bonded at the ends thereof respectively to each fluid-tight sheath covering said adjacent containers between which said leads extend; and an elongated, flexible, reinforcing tubular housing pervious to water and spaced from and surrounding all of said containers, said housing providing protection against mechanical damage to said containers and leads.

4. A repeater apparatus for underwater cables comprising, in combination, a plurality of pressure-resisting metal repeater element containers; a fluid-tight sheath formed of a plastic material bonded to and covering each of said containers; a plurality of flexible conductive interconnecting leads, each extending between adjacent containers and having a length substantially longer than the distance between said adjacent containers; a fluid-tight sheath formed of a plastic material bonded to and covering each of said leads and bonded at the ends thereof respectively to each fluid-tight sheath covering said adjacent containers between which said leads extend; and an elongated, flexible, reinforcing tubular housing formed with a plurality of apertures therein and being pervious to water, said housing being spaced from and surrounding all of said containers, said housing providing protection against mechanical damage to said containers and leads.

5. A repeater apparatus for underwater cables comprising, in combination, a plurality of pressure-resisting steel repeater element containers; a fluid-tight sheath bonded to and covering each of said containers; a plurality of groups of flexible conductive interconnecting leads, each group of leads extending between adjacent containers and each group of leads having a length substantially longer than the distance between said adjacent containers, a given lead of each group of leads being conductively connected at opposite ends thereof to said adjacent containers and the other leads of each group of leads being insulated from said adjacent containers and extending into said containers; a fluid-tight sheath bonded to and covering as a unit each group of leads and bonded at the ends thereof respectively to each fluid-tight sheath covering said adjacent containers between which said pair of leads extend; and an elongated, flexible, reinforcing tubular housing pervious to water and spaced from and surrounding all of said containers, said housing providing protection against mechanical damage to said container and leads.

6. A repeater apparatus for underwater cables comprising, in combination, a plurality of pressure-resisting repeater element containers; a fluid-tight sheath bonded to and covering each of said containers; a plurality of flexible conductive interconnecting leads, each extending between adjacent containers and having a length substantially longer than the distance between said adjacent containers, each of said leads being formed into a helix; a fluid-tight sheath bonded to and covering each of said leads and bonded at the ends thereof respectively to each fluid-tight sheath covering said adjacent containers between which said leads extend; and an elongated, flexible, reinforcing tubular housing pervious to water and spaced from and surrounding all of said containers, said housing providing protection against mechanical damage to said containers and leads.

7. A repeater apparatus for underwater cables comprising, in combination, a plurality of pressure-resisting steel repeater element containers; a fluid-tight sheath bonded to and covering each of said containers; a plurality of groups of flexible, conductive interconnecting leads, each group of leads extending between adjacent containers and each group of leads having a length substantially longer than the distance between said adjacent containers, each group of leads being formed together into a helix, a given lead of each group of leads being conductively connected at opposite ends thereof to said adjacent containers and the other leads of each group of leads being insulated from said adjacent containers and extending into said containers; a fluid-tight sheath bonded to and covering as a unit each group of leads and bonded at the ends thereof respectively to each fluid-tight sheath covering said adjacent containers between which said group of leads extend; and an elongated, flexible, reinforcing tubular housing pervious to water and spaced from and surrounding all of said containers, said housing providing protection against mechanical damage to said container and leads.

8. A repeater apparatus for an underwater cable having insulated conductors comprising, in combination, a plurality of pressure-resisting repeater containers; a fluid-tight sheath bonded to and covering each of said containers; a plurality of groups of flexible conductive interconnecting leads, one group of leads extending between an end of said cable and the first of said containers, another group of leads extending between another end of said cable and the last of said containers, and the remaining groups of leads extending between adjacent containers, each group of leads having a length substantially longer than the distance between the objects between which it extends, the ends adjacent a container of the leads of each group being bare, said bare ends extending into the fluid-tight sheath of said container and into the container itself; a fluid-tight sheath bonded to and covering as a unit each group of leads and bonded at the ends thereof adjacent containers respectively to each fluid-tight sheath covering said containers and bonded at the ends thereof adjacent said cable ends to the insulation covering the conductors to which the leads are respectively connected; and an elongated, flexible reinforcing tubular housing pervious to water connected at the ends thereof to said ends of said cable and spaced from and surrounding all of said containers, said housing providing protection against mechanical damage to said containers and leads.

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