July 12, 1949. LE ROY W. KELSAY 2,475,787

TERMINATION FOR COAXIAL CABLES

Filed June 26, 1945

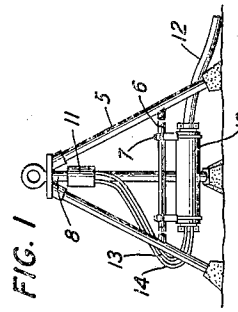

FIG. 1

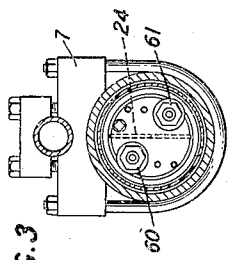

FIG. 3

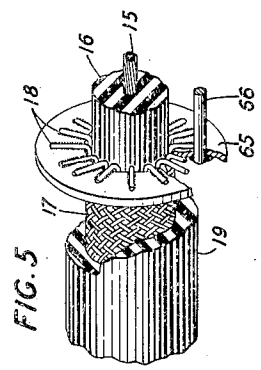

FIG. 5

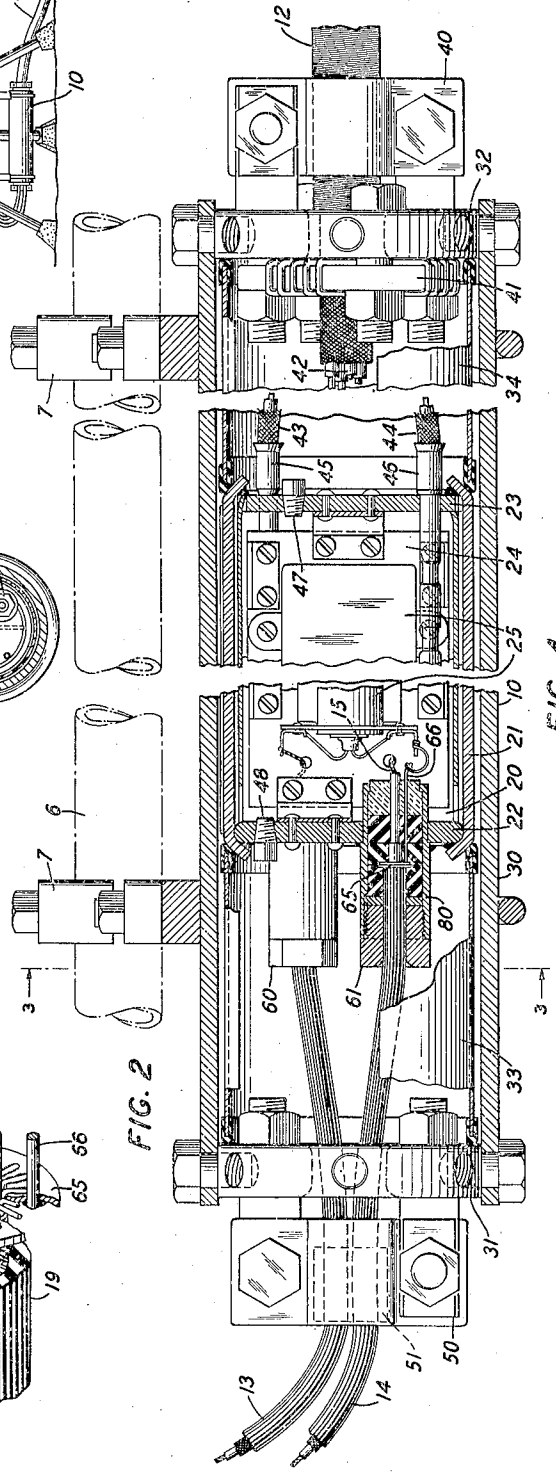

FIG. 2

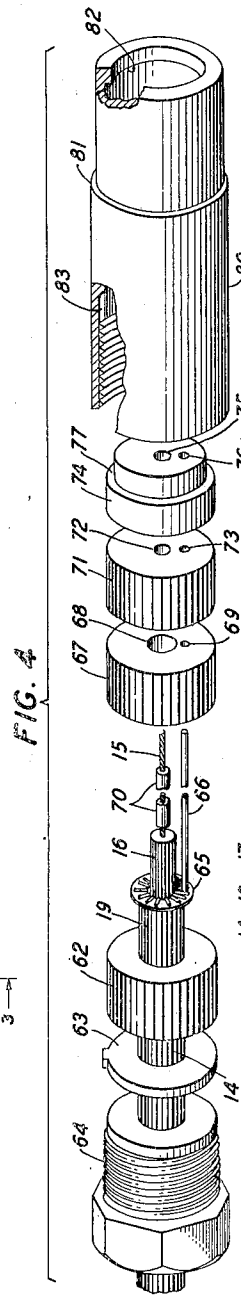

FIG. 4

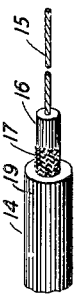

FIG. 6

INVENTOR
L. W. KELSAY
BY
O. E. Parmenter
ATTORNEY

Patented July 12, 1949

2,475,787

UNITED STATES PATENT OFFICE

2,475,787

TERMINATION FOR COAXIAL CABLES

Le Roy W. Kelsay, Summit, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application June 26, 1945, Serial No. 601,651

7 Claims. (Cl. 174—19)

1

This invention relates to under-water signaling systems and more particularly to systems of this type in which under-water cable connections must be severed to permit removal of apparatus for repairs or replacements.

It is an object of the invention to provide in a system of this kind suitable connecting means between cable sections which, when raised above the water surface, may be disassembled and again restored to operating condition in a simple and effective manner and without impairment of the equipment.

It is a more specific object of the invention to provide a simple and effective seal for a signaling cable which has two insulated and coaxially arranged conductors.

It is a particular object of the invention to provide a seal of the type referred to, which may be readily assembled and tightened to seal the end portions of the coaxial conductors and their intervening insulation against penetration of sea water when placed near the sea bottom for service during long periods of time, and which may be opened or disassembled and again assembled without destruction of its parts.

The invention is particularly useful in certain under-water signaling systems of a type in which a submerged listening post is placed in the sea at some distance from the shore to pick up sounds whereby signal indications may be transmitted over a cable to a shore station that a ship or other sound producing source is in the region of the listening post. The listening post is provided with a microphone or equivalent sound responsive device preferably supported above sea bottom at a depth sufficient to be clear of passing craft and in a position which exposes it to water-borne sounds. In order that the sound detecting equipment may receive occasional inspection for replacement or repair the listening post is provided with a flexible cable section extending from the sound responsive device to a junction box or apparatus housing which serves as a detachable coupling between the flexible cable section at the listening post and the armored cable section which extends from the junction box to the shore station at which the sound indications or signals are to be observed.

The necessity for providing a coupling or connection whereby the flexible local cable at the listening post may be detached from the armored cable extending out to the shore gives rise to a problem of insulation and of preventing the ingress of sea water. Moreover the connecting device should be of such character that it readily

2

may be hoisted at sea, disassembled and reassembled without impairment of the electrical transmission properties of the system or of the insulating and water excluding properties of the reassembled coupling. Thus the operation of replacement or repair of the listening post apparatus and of the flexible cable section which connects it to the armored section may take place without the difficulties which would be involved were it necessary to open up the armored cable section itself.

In accordance with a feature of the invention the sound responsive device is connected through a flexible water-impervious cable of the coaxial type to the circuit from the armored cable, and the flexible cable is led through a water-tight seal or stuffing box into the water-tight apparatus housing in which the armored cable is terminated, the seal being constructed so that it may be taken apart during service for disconnection of the flexible cable from the apparatus housing and removal of the sound responsive device without impairment of the sealing elements.

In accordance with a more specific feature of the invention the end portion of such a flexible cable is prepared by exposing the various concentric layers in the usual staggered or stepwise manner and a disc is placed around and in contact with the outer conductor which is soldered to the disc. The disc carries a connecting post or wire near its rim for soldering to an external circuit connection and the central conductor has its end portion bared of insulation to permit soldering to a second external circuit connection. Before attaching the external connections, semi-hard insulating bushings are placed about the exposed portions of the cable end and the connecting post and on both sides of the said disc, and the entire assemblage is ultimately placed within a rigid tube and clamped tight by endwise pressure to insure a water-tight packing about the cable elements by compression of the insulating bushings. The central conductor and the connecting post project beyond the bushings and the tube for attachment to the external connections.

This type of water-tight seal may be used either as a termination for a coaxial cable or, by combination with another similar seal for another coaxial cable, it may be used in a joint between two coaxial cable sections, in which latter case both seals would be placed in a common tube and clamped tight.

The invention will now be described more in detail as embodied in a preferred form and refer-

ence will be made to the accompanying drawing in which:

Fig. 1 shows a typical signaling station or listening post located on the sea bottom;

Fig. 2 is a longitudinal sectional view showing a terminal casing or junction box containing electrical apparatus and adapted for termination both of the armored shore cable and of the flexible connecting cables;

Fig. 3 is a cross-sectional view of the casing to a reduced scale taken on line 3—3 in Fig. 2;

Fig. 4 is an exploded view of the seal for one of the coaxial flexible cables;

Fig. 5 is a detail view of the seal, showing the disc connected to the outer conductor; and

Fig. 6 shows an end portion of the coaxial cable as prepared for forming of the seal.

Whereas the more specific features of the invention will be described as used in a specific under-water system it should be understood that it is applicable to other types of systems and under other conditions than those described in detail hereinafter.

As shown in Fig. 1 the signaling station on the sea bottom may comprise a mounting structure such as the tripod 5 with cross-pieces 6 between its legs and weighted by concrete blocks. An armored shore cable 12 is terminated in the apparatus housing or junction box 10 and the connections are continued through flexible stub cables 13 and 14 to two signal producing or listening devices 11 attached by any desired means 8 to the tripod near its top. The casing 10 may be securely fastened by means of clamps 7 to the cross-piece 6 of the tripod.

As shown more in detail in Fig. 2 the tubular apparatus housing 10 encloses a central water-tight chamber 20 spaced between two end pieces 31 and 32 of the housing by means of tubular spacing members 33 and 34. The spaces within the housing between the chamber 20 and the end plates 31 and 32 are open to the sea water.

The hermetically sealed chamber 20 comprises a tube 21 with end pieces 22 and 23 soldered in position. In the chamber a longitudinal mounting plate 24 carries a plurality of different electrical apparatus 25 and the chamber is filled with a neutral oil.

The shore cable 12 is of conventional type and has four insulated conductors 42 encased in jute and protected by armor wires having an outer layer of jute. The end plate 32 of the housing supports a cable clamp 40 and the armoring of the cable 12 is brought about the clamping plate 41 bolted to the plate 32. By this arrangement the tripod with the housing attached thereto may be lowered with the cable 12 anchored in the end plate of the housing 10. The conductors 42 are spliced to other conductors, such as 43 and 44, leading out from permanent water-tight outlets 45 and 46 from the chamber 20. Details of these splices and outlets are omitted because they form no part of the invention.

At the opposite end of the housing 10 the two flexible stub cables 13 and 14 from the listening devices 11 are clamped in position by means of the clamp 50 with sufficient bedding material 51 to insure against strain being transmitted from the cables to the seals or stuffing boxes 60 and 61 leading into the oil chamber. The two cables pass through the detachable seals 60 and 61 and the two conductors of each cable are connected in a similar manner to the electrical apparatus 25 within the chamber 20 from which the circuit extends into the shore cable 12.

As shown in Figs. 2 and 3 the housing 10 is placed in two suitable mountings 7 which are clamped about the cross-tube 6 of the tripod, thereby securing the housing in a fixed position.

As shown in Fig. 3 the seals 60 and 61 are placed on a diameter at an angle with the vertical so that the conductors extending from the seals within the chamber 20 will appear at opposite sides of the partition 24.

Referring now more particularly to the sectional view of the seal 61 included in Fig. 2 and the more detailed views of the seal shown in Figs. 4 and 5 and to the view in Fig. 6 of the prepared end portion of the cable, it will be noted that the cable 14 comprises a central conductor 15 surrounded by insulation 16, which may be vulcanized rubber particularly treated to resist penetration of sea water during years of service; the outer conductor is in the form of a braid 17 of copper wires 18 placed tightly about the insulation 16 and is in turn surrounded by the outer insulation 19, which may be similar to the insulation 16 or which may differ from the insulation 16 by being more abrasion resistant. The cable end is bared as shown in Fig. 6 by removing the different layers in a stepwise formation, so that an end portion of each layer will be exposed.

The seal 61 is so constructed that it may be disassembled without destruction of its parts. The seal comprises a semihard rubber washer 62 fitting slidably on the insulation 19, a metal washer 63 and a threaded compression bushing 64 of metal. The elements 62, 63 and 64 are temporarily placed some distance back on the insulation 19 before the seal is assembled. The seal further comprises the conducting disc 65 which fits about the braiding 17 and which carries the connecting wire or rod 66; the wire 66 may be fastened in any desired manner near the periphery of the disc, such as by riveting and soldering. The disc 65 is mounted against the shoulder of insulation 19 with the wire 66 extending parallel with the central conductor 15. For the purpose of establishing a reliable electrical connection with the braiding 17 the wires 18 of the braiding extending beyond the disc 65 are unbraided and fanned out against the free side of the disc and soldered thereto; this arrangement is shown in detail in Fig. 5. The seal further comprises an insulating bushing 67 having openings 68 and 69 fitting slidably upon the insulation 16 and the wire 66; the length of the bushing 67 is the same as the protruding portion of the insulation 16 beyond the washer 65. A metal tube 70 of suitable length to extend slightly beyond the end of the seal is placed over the central conductor 15 for reinforcement and is soldered thereto near the free end. The seal further comprises an insulating bushing 71 having openings 72 and 73 fitting slidably about the tube 70 and the wire 66. The insulating end bushing 74 has openings 75 and 76 also fitting slidably on the tube 70 and the wire 66; the bushing 74 has a shoulder portion 77 for taking up the longitudinal pressure on the sealing elements.

Whereas the bushings 62, 67 and 71 may be of semihard rubber and therefore capable of slight deformation under pressure, the bushing 74 is of a hard insulating material which will not materially change its shape under appreciable pressure. A suitable material for this purpose is a commercially available glass having mica dust dispersed throughout the body thereof to reduce its brittleness.

The outer casing 80 of the seal is in the form

of a metal tube or sleeve with an outer shoulder portion 81 for seating against the end plate 22 of the chamber 20. The end extending into the chamber 20 has an inner shoulder 82 for seating of the bushing 74 and the general dimension of the inner diameter is such that the tube 80 fits slidably over the elements 63, 62, 67, 71 and 74. The end of the tube remote from the shoulder 82 is threaded to match the thread of the clamping plug 64 and a longitudinal groove 83 is cut through the thread to accommodate a projection on the washer 63 to lock the washer against rotation while the seal is being tightened up. The tube 80 is seated in the end plate 22 and soldered thereto.

The seal may be assembled by forcing the various bushings from both sides against the disc 65 and inserting this assemblage into the tube 80 followed by the washer 63 and the compression plug 64. The plug is screwed tight until its hexagonal head engages the end of tube 80. The dimensions of the semisoft bushings 62, 67 and 71 should be such as to secure a tight packing against both their inner and their outer surfaces when the plug 64 is screwed in position. The washer 63 serves to protect the bushing 62 against friction with the plug 64.

The chamber 20 is so arranged that a unit is formed of the two end plates 22 and 23 and the mounting plate 24, so that upon completion of the seals in both end plates the connections may be made to the various apparatus 25. Thereafter the cylindrical wall 21 is passed over the end plates 22 and 23 and locked in position by rolling the edges of the tube down over the edges of the end plates and hermetically sealing the seams as by soldering. The chamber may thereafter be filled with oil to replace the entrapped air, through suitable plugs 47 and 48.

When desired the housing 10 and chamber 20 may be taken apart for purposes of repairs or replacements, in which case the seals 60 and 61 may readily be disassembled for disconnection of the cables 13 and 14 from the apparatus 25. Thereafter the seals may again be assembled and tightened to make them water-tight. In fact the two ends of the coaxial cables 13 and 14 with attached parts of the seals may be interchanged in the two seals 60 and 61, if desired, or one of listening devices with its stub cable may be replaced by another and the water-tight connection through the seal reestablished to the new device.

What is claimed is:

1. A water-tight end-seal for a water-impervious coaxial cable capable of being disassembled and reassembled and comprising in combination a terminal portion of the cable having end portions of the two coaxially disposed conductors bared, a conducting member connected and attached to the outer conductor and disposed in parallel relation to the bared portion of the inner conductor of the cable, an outer tubular casing enclosing said terminal portion and said conducting member and having clamping plugs at opposite ends thereof, and a plurality of solid bodies of insulating material disposed within said casing and being differently shaped to fill the spaces about said terminal portion and said conducting member, to be clamped water-tight against them by said clamping plugs, said parallel conducting portions extending beyond said seal for connection to an external circuit.

2. A water-tight end-seal for termination of two concentric conductors of a water-impervious coaxial cable and capable of being disassembled and reassembled, said seal comprising in combination a terminal portion of the cable having end portions of said conductors bared, a conducting member attached to the outer conductor and disposed in parallel relation to the inner conductor of said cable, an outer casing enclosing said terminal portion of the cable and said conducting member except short tip portions of the inner conductor and of said conducting member adapted for attachment of external connections thereto, said casing having at one end an end stop member with openings for passing said short tip portions and a clamping plug at the other end, said seal further comprising a plurality of solid insulating bodies substantially filling the spaces within said casing about said terminal portion of the cable and said conducting member and being compressible, said clamping plug being detachably attached to said casing and adjustable to clamp said insulating bodies tight against the surfaces internal of the seal including those of said terminal portion, conducting member, casing, stop member and clamping plug.

3. A water-proof seal for the terminal portion of a cable having a central conductor, an inner layer of insulation, an outer stranded conductor, and an outer layer of insulation arranged concentrically and being terminated in stepped relation along the terminal portion of the cable, said seal comprising an annular conducting member placed against the end of said outer insulation and about said outer conductor and connected to said outer conductor and having an eccentrically attached connecting wire disposed parallel with the terminal portion of said central conductor, an outer casing including a tubular member for enclosing the terminated cable parts and clamping means at opposite ends of said tubular member, and insulating material substantially completely filling the space within said casing about said terminated cable parts and connecting wire and adapted to be compressed into tight contact with all the surfaces within said casing by the clamping action of said clamping means, said casing having passages and being short enough to permit said central conductor and connecting wire to extend beyond said seal.

4. A water-proof seal in accordance with claim 3 in which said annular conducting member is disk-shaped and has one of its faces soldered to the flared strand ends of said outer conductor, said strand ends being flared.

5. A water-proof seal in accordance with claim 3 in which said tubular member has an internal shoulder at one end and an internal thread at the other end, in which said clamping means at one end comprises a hard insulation bushing adapted for engagement with said internal shoulder and having said passages for said central conductor and said connecting wire, and in which said clamping means at the other end comprises a threaded plug adapted to be screwed into said internal thread for the compression of said insulating material.

6. A water-proof seal in accordance with claim 3 in which said insulating material comprises a plurality of semihard bushings with passages for the different terminated cable parts and for said connecting wire and adapted to substantially completely fill the spaces within said casing when compressed.

7. A detachable terminal seal for a coaxial

cable having a central conductor and a concentric layer of conducting strands separated by insulation from said central conductor and having an outer sealing envelope about said layer, said seal comprising a metallic disk with a central passage fitting snugly about said layer and having one of its flat sides in engagement with an end surface of said envelope, and having its other side in contact with the flared end portions of said conducting strands and soldered thereto, said central conductor and insulation passing through and beyond said disk, a connecting wire fastened to said disk near its periphery and extending parallel to said central conductor, a packing ring of insulating material in engagement with the first said flat side of said disk and having a snug fitting passage for said envelope, a packing of insulating material in engagement with said other flat side and having snug fitting passages for said central conductor and connecting wire, and a clamping tube extending over and beyond said packing ring and packing and having an inside shoulder at one end, said clamping tube containing a rigid clamping bushing in engagement with said shoulder with openings for passing said central conductor

and connecting wire; and a clamping plug with an opening for passing said cable and in threaded engagement and cooperating with the other end portion of said tube for clamping said packing ring about said envelope and against said disk and for clamping said packing against said disk and about said central conductor and connecting wire and against said clamping bushing.

LE ROY W. KELSAY.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
793,896	Mundy	July 4, 1905
935,750	Gale	Oct. 5, 1909
1,411,948	Williams	Apr. 4, 1922
1,746,424	Hecht et al.	Feb. 11, 1930
1,780,686	Proos	Nov. 4, 1930
1,893,741	Hecht et al.	Jan. 10, 1933
2,110,457	Wentz	Mar. 8, 1938
2,147,418	Bahls	Feb. 14, 1939
2,419,592	Richardson	Apr. 29, 1947