July 1, 1947. J. B. RETALLACK 2,423,119

HYDROPHONE SELECTING SYSTEM

Filed Nov. 8, 1943 2 Sheets-Sheet 1

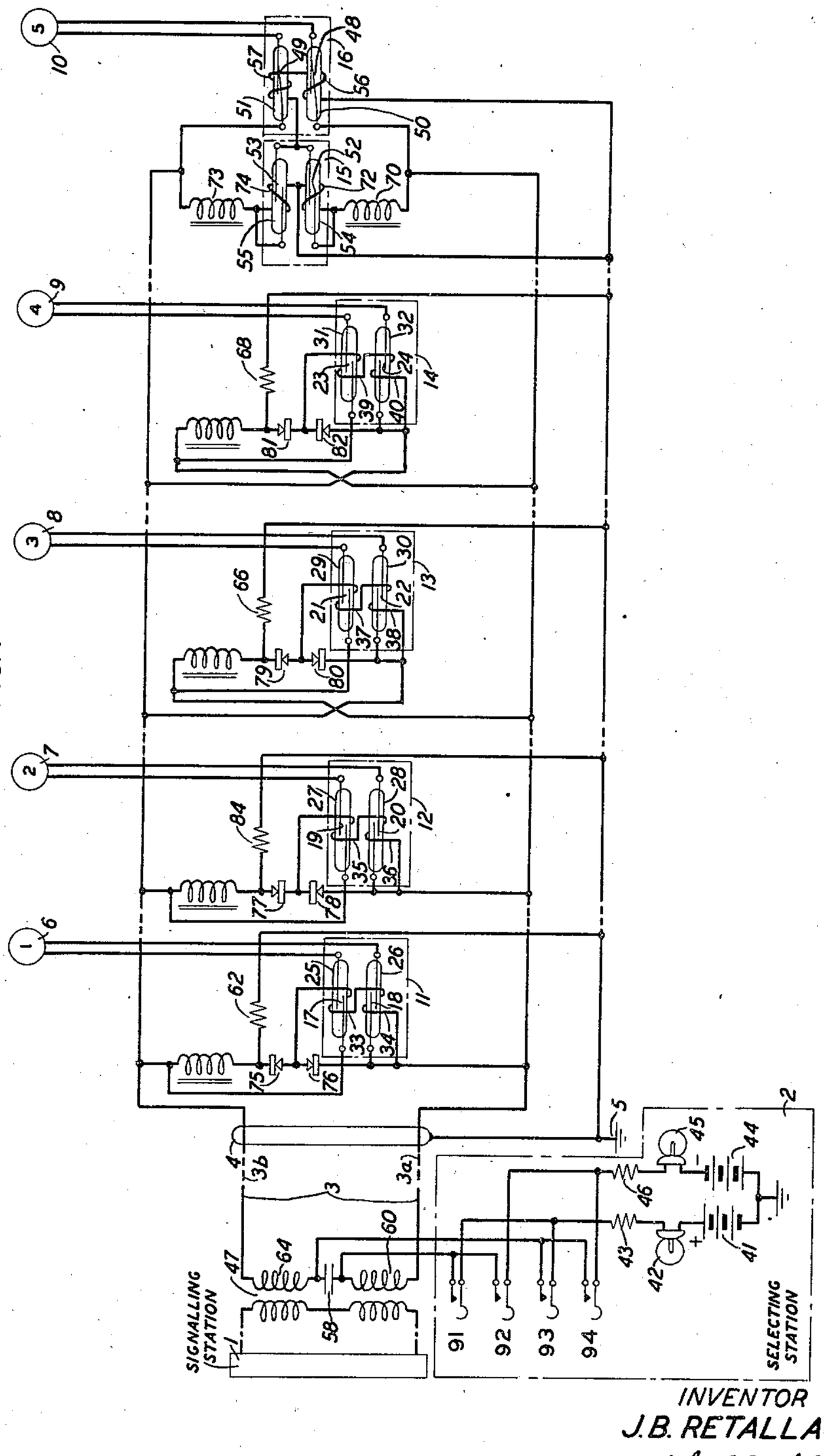

FIG. 1

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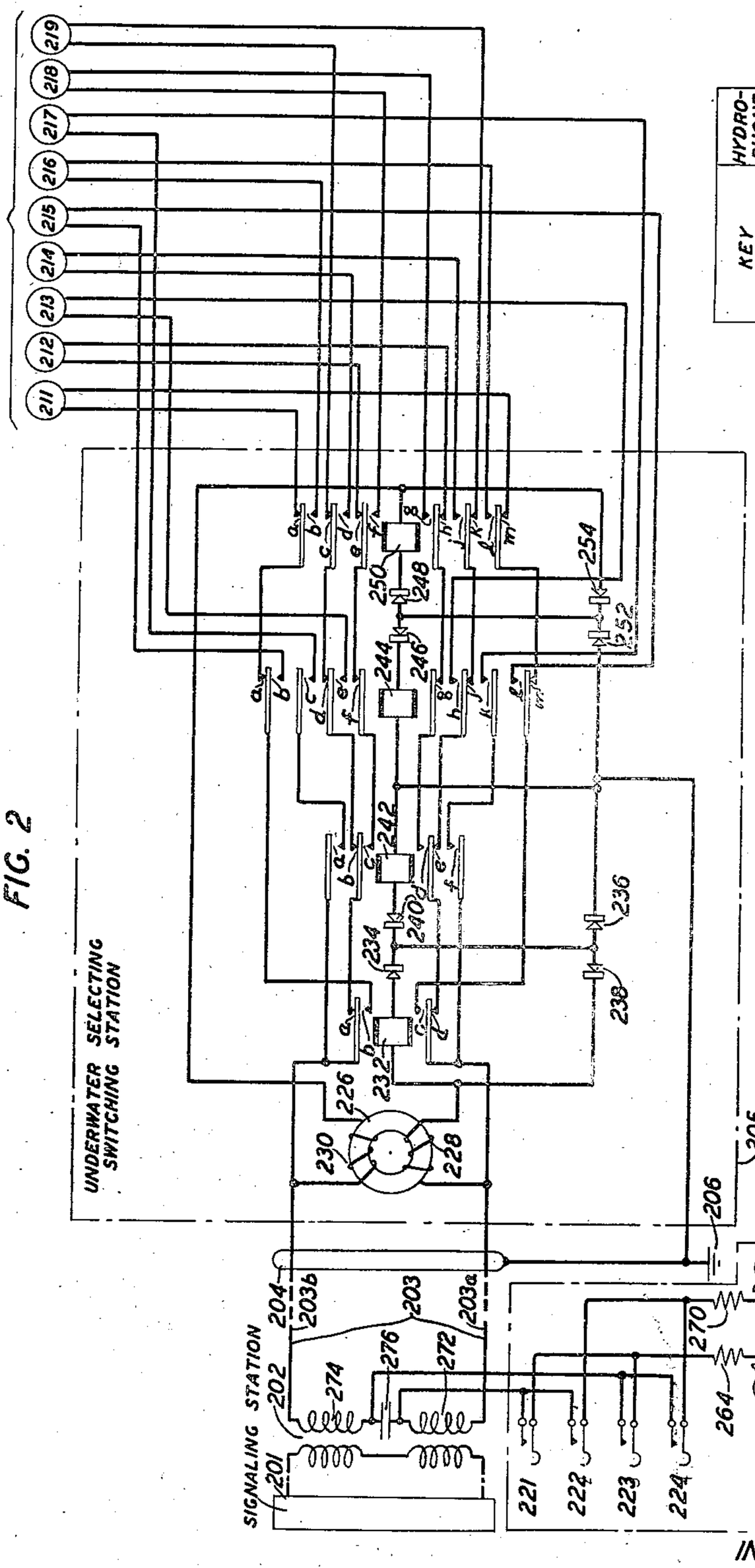

HYDROPHONE	211	212	213	214	215	216	217	218	219
KEY									
221									
222									
223									
224									
221, 223									
221, 224									
222, 223									
222, 224									
—									

FIG. 3

FIG. 2

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HYDROPHONE SELECTING SYSTEM

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3 Claims. (Cl. 177—353)

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This invention relates to hydrophone systems and more particularly to a selecting system for connecting a particular one of a number of hydrophone stations to a central station for signaling.

An object of this invention is the improvement of hydrophone systems.

A more particular object of this invention is the improvement of hydrophone station selection.

In hydrophone systems a number of hydrophone stations are ordinarily connected to a central signaling station. The various hydrophone stations must be arranged so that they may be selectively connected to the central station for signaling purposes. The invention herein provides improvements in the selecting apparatus so that the selecting apparatus is better adapted for hydrophone service.

One of the chief difficulties encountered in hydrophone operation is the failure of such systems due to corrosion of metal parts of the system caused by moisture. In the selecting arrangements herein failure due to corrosion of metal parts of the selecting apparatus is substantially eliminated.

In one form of the invention in which the hydrophone stations are spaced at intervals along a single two-conductor marine cable, relay contacts enclosed in sealed envelopes of glass or the like are employed to protect the contacts against moisture. Further in order to simplify the selecting apparatus copper-oxide rectifiers or the like are employed in series with the windings of selecting relays. This permits the employment of a single neutral relay to perform the function of two relays or of a polarized relay thus minimizing trouble conditions.

In another form of the invention where the marine area served by the hydrophones makes it feasible the marine cable is run under water to a position of vantage where all of the selecting apparatus is located in a single sealed container. This forms an underwater central selecting station. From the selecting station, shorter individual lengths of marine cable radiate to the positions of the various hydrophones. In this arrangement also the selecting apparatus is simplified by the employment of a network of copper-oxide rectifiers or the like in series with the windings of neutral relays.

The invention may be understood from the following description when read with reference to the associated drawings in which:

Fig. 1 shows a selecting arrangement in which the individual selecting apparatus for each of the

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hydrophone stations is spaced along a single two-conductor submarine cable.

Fig. 2 shows a selecting arrangement in which the selecting apparatus is located in a single sealed container at an underwater vantage point from which individual marine cables radiate to the various hydrophone stations.

Fig. 3 shows a selecting code used in explaining Fig. 2.

Refer to Fig. 1. In this figure a signaling station 1 and a selecting station 2, both located on land, are connected to a two-conductor submarine cable 3. The submarine cable is enclosed in an impervious sheath 4 which is connected to ground 5. The submarine cable is laid on the earth beneath a body of water such as a channel, bay, etc. At intervals along the length of the submarine cable, five hydrophones 6, 7, 8, 9 and 10 are located. Each hydrophone, the details of which are not shown but are well known in the art, is connected to the two conductors of the submarine cable by means of an individual selecting mechanism. Each of four of the five selecting mechanisms, those for hydrophones 6, 7, 8 and 9 has one electromagnetic relay unit 11, 12, 13 and 14, each consisting of two pairs of cooperating relay contacts 17 and 18, 19 and 20, 21 and 22, 23 and 24. Each pair of contacts is sealed in an individual glass envelope 25 and 26, 27 and 28, 29 and 30, 31 and 32. Surrounding each of the envelopes is an individual magnetic winding 33 and 34, 35 and 36, 37 and 38, 39 and 40. Each of the two windings forming a pair at a particular station is connected in series to the other, so that their two sets of associated contacts are opened and closed in unison when the electrical paths through the windings are opened and closed in a manner to be described below.

Two of the four hydrophones 6, 7, 8 and 9, namely, hydrophones 6 and 7, are arranged to be selected by current transmitted from the selecting station over the lower conductor 3*a*. Of these two hydrophones, hydrophone 6 is arranged to be selected by current of positive polarity and the other hydrophone, hydrophone 7 is arranged to be selected by current of negative polarity transmitted over conductor 3*a*. Hydrophones 8 and 9 are arranged to be selected by current transmitted over conductor 3*b*. Hydrophone 8 is selected by battery of positive polarity transmitted by battery of negative polarity transmitted over conductor 3*b*. Hydrophone 9 is selected by battery of negative polarity transmitted over conductor 3*b*.

At each of the four hydrophones 6, 7, 8 and 9

there are a pair of rectox rectifiers such as 75 and 76, 77 and 78, 79 and 80, and 81 and 82, connected into the selecting circuit. The rectifiers are poled in such manner that each of the four stations 6, 7, 8 and 9 responds only to current of the proper polarity transmitted over the proper conductor.

In order to make a selection of one of the four hydrophones 6, 7, 8 and 9, some one of the four keys 91, 92, 93 or 94 is actuated to connect battery of the proper polarity to the proper conductor. When no key is actuated, no current is connected to either conductor. For this condition hydrophone 10 is connected to the line. The selecting circuit at hydrophone 10 is arranged so that it is connected to the line when no current is connected to either conductor and hydrophone 10 is disconnected from the line when current of either polarity is connected to either conductor.

In the system of the invention therefore it is possible to select any of the five hydrophones. One of the five is normally connected to the line and is disconnected when current of either polarity is conducted over either of the two cable conductors. Each of the other four is selected when current of a particular polarity is impressed on a particular one of two conductors.

The operation of the circuit per Fig. 1 will now be described in detail.

When the circuit per Fig. 1 is in the condition shown on the drawing, that is with none of the contacts of keys 91, 92, 93 or 94 closed, positive battery 41 and negative battery 44 are disconnected from the submarine cable conductors 3*a* and 3*b*. Under these circumstances signaling station 1 is connected to hydrophone 10. Signaling station 1 is connected by means of a pair of conductors to the primary of transformer 47. The secondary of the transformer comprises an upper winding 64 and a lower winding 60, the inner terminals of which are connected to opposite plates of condenser 58. The outer terminals of windings 60 and 64 are connected to conductors 3*a* and 3*b* of the submarine cable. The contacts 48 and 49, in glass envelopes 50 and 51 respectively, of relay unit 16 are closed when windings 56 and 57 are deenergized. The circuit extends from the bottom terminal of the secondary winding 60 of transformer 47 through conductor 3*a*, contact 48, through hydrophone 10, contact 49, and conductor 3*b* to the top terminal of the secondary winding 64 of transformer 47.

When the contacts of key 91 are closed, a circuit may be traced from ground through positive battery 41, lamp 42, resistance 43, contacts of key 91, winding 60, conductor 3*a*, relay windings 34 and 33, rectifier 75 and resistance 62 to ground 5. Contacts 17 and 18 close, connecting hydrophone 6 across conductors 3*a* and 3*b*.

When the contacts of key 92 are closed, a circuit may be traced from ground through negative battery 44, lamp 45, resistance 46, contacts of key 92, winding 60, conductor 3*a*, relay windings 36 and 35 in series, rectifier 77, and resistance 84 to ground 5. Contacts 19 and 20 close, connecting hydrophone 7 across conductors 3*a* and 3*b*.

When the contacts of key 93 are closed, a circuit may be traced from ground through positive battery 41, lamp 42, resistance 43, contacts of key 93, winding 64, conductor 3*b*, relay windings 38 and 37 in series, rectifier 79 and resistance 66 to ground 5. Contacts 21 and 22 close, connecting hydrophone 8 across conductors 3*a* and 3*b*.

When the contacts of key 94 are closed, a circuit

may be traced from ground through negative battery 44, lamp 45, resistance 46, contacts of key 94, winding 64, conductor 3*b*, relay windings 40 and 39 in series, rectifier 81 and resistance 68 to ground 5. Contacts 23 and 24 close, connecting hydrophone 9 across conductors 3*a* and 3*b*.

When either positive or negative battery is impressed on conductor 3*a* through the operation of a selecting key, a circuit is extended through inductance coil 70 and winding 72 to ground 5 closing contact 52. This establishes a second circuit from conductor 3*a*, inductance 70, contact 52 and relay windings 57 and 56 in series to ground 5 to open contacts 48 and 49, which are normally closed, disconnecting hydrophone 10 from conductors 3*a* and 3*b*.

When either positive or negative battery is connected to conductor 3*b* by the operation of a selecting key, a circuit extends from conductor 3*b* through inductance 73 and relay winding 74 to ground 5 closing contact 53. This in turn extends the circuit from conductor 3*b* through inductance 73, contacts 53 and relay windings 57 and 56 in series to ground 5. Contacts 48 and 49 open disconnecting hydrophone 10 from conductors 3*a* and 3*b*.

The magnitudes of resistances 62, 84, 66 and 68 are low relative to the magnitudes of the resistances of the relay windings so as to provide a low resistance shunt around the relay windings to ground when selections are being made over the opposite conductor.

From the above it should be apparent that normally hydrophone 10 is connected to signaling station 1. When any one of selecting keys 91 to 94 is actuated to its alternate position some one hydrophone of hydrophones 6 to 9 is connected to signaling station 1 and hydrophone 10 is disconnected from signaling station 1.

Refer to Fig. 2. In this arrangement a signaling station 201 is connected through transformer 202 and a two-conductor submarine cable 203, enclosed in an impervious sheath 204, to an underwater selecting switching station which is enclosed in a sealed container 205. Connected individually to the underwater selecting switching station are nine hydrophones 211 to 219. Hydrophone 219 is normally connected to signaling station 201. Hydrophone 219 is disconnected from signaling station 201 and any one of the other eight hydrophones may be selected by operating either a single key or two keys of the group of four keys 221 to 224 at selecting station 207.

The key numbers of the selecting keys 221 to 224 the contacts of which are closed to select a particular hydrophone are indicated in the code table per Fig. 3. Reference to this table shows a dash in the bottom left-hand column which indicates that hydrophone 219, as shown in the corresponding right-hand column of Fig. 3 is connected to signaling station 201 when no keys are operated. The circuit which connects hydrophone 219 to signaling station 201 may be traced from the bottom terminal of the winding 272 of the secondary of transformer 202 through conductor 203*a*, contact 232*d*, contact 242*e*, contact 244*j*, contact 250*k*, hydrophone 219, contact 250*c*, contact 244*d*, contact 242*b*, contact 232*a* and conductor 203*b* to the top terminal of the secondary of winding 272 of the transformer 202.

When the contacts of key 221 are closed, a circuit may be traced from ground through positive battery 260, lamp 262, resistance 264, contacts of key 221, bottom winding 272 of the secondary of transformer 202, conductor 203*a*, winding 228

of inductance coil 226, winding of relay 232, rectifier 234 and rectifier 236 to ground 206. Relay 232 is operated. A circuit may then be traced from the bottom terminal of winding 272 through conductor 203*a*, contact 232*c*, contact 244*m*, contact 250*m*, hydrophone 211, contact 250*a*, contact 244*a*, and contact 232*b* to the top terminal of winding 274. The inner terminals of transformer windings 274 and 272 are interconnected through condenser 276.

When the contacts of key 222 are closed, a circuit may be traced from ground through negative battery 266, lamp 268, resistance 270, contacts of key 222, winding 272, conductor 203*a*, winding 228, rectifier 238, rectifier 240 and the winding of relay 242 to ground 206 operating relay 242. A circuit may then be traced from the bottom terminal of winding 272, conductor 203*a*, contact 232*d*, contact 242*d*, contact 244*g*, contact 250*h*, hydrophone 212, contact 250*e*, contact 244*f*, contact 242*c*, contact 232*a* and conductor 203*b* to the top terminal of winding 274.

When the contacts of key 223 are closed, a circuit may be traced from ground, through positive battery 260, lamp 262, resistance 264, contacts of key 223, winding 274, conductor 203*b*, winding 230 of inductance 226, rectifier 254, rectifier 246, and winding 244 to ground 206 operating relay 244. A circuit may then be traced from the bottom terminal of winding 272, conductor 203*a*, contact 232*d*, contact 242*e*, contact 244*h*, hydrophone 213, contact 244*e*, contact 242*b* and contact 232*a* to the top terminal of winding 274.

When the contacts of key 224 are closed a circuit may be traced from ground through negative battery 266, lamp 268, resistance 270, contacts of key 224, winding 274, conductor 203*b*, winding 230, winding of relay 250 and rectifiers 248 and 252 to ground 206 operating relay 250. A circuit may then be traced from the bottom terminal of winding 272, conductor 203*a*, contact 232*d*, contact 242*e*, contact 244*j*, contact 250*j*, hydrophone 214, contact 250*d*, contact 244*d*, contact 242*b* and contact 232*a* to the top terminal of winding 274.

When the contacts of keys 221 and 223 are closed simultaneously, relays 232 and 244 are operated simultaneously over paths traced above. A circuit may then be traced from the bottom terminal of winding 272, through conductor 203*a*, contact 232*c*, contact 244*l*, hydrophone 215, contact 244*b* and contact 232*b* to the top terminal of winding 274.

When the contacts of keys 221 and 224 are closed simultaneously, relays 221 and 250 are operated simultaneously over paths traced above. A circuit may then be traced from the bottom terminal of winding 272, through conductor 203*a*, contact 232*c*, contact 244*m*, contact 250*l*, hydrophone 216, contact 250*b*, contact 244*a* and contact 232*b* to the top terminal of winding 274.

When the contacts of keys 222 and 223 are closed simultaneously, relays 242 and 244 are operated simultaneously over paths traced above. A circuit may then be traced from the bottom terminal of winding 272, through conductor 203*a*, contact 242*f*, contact 244*k*, hydrophone 217, contact 244*c*, and contact 242*a* to the top terminal of coil 274.

When the contacts of keys 222 and 224 are closed simultaneously, relays 242 and 250 are operated simultaneously over paths traced above. A circuit may then be traced from the bottom terminal of winding 272, through conductor 203*a*, contact 232*d*, contact 242*d*, contact 244*g*, contact 250*g*, hydrophone 218, contact 250*f*, contact 244*f*, contact 242*c*, and contact 232*a* to the top terminal of coil 274.

What is claimed is:

1. In a switching system, a control station, a central switching station, four neutral relays only at said switching station, contacts on said relays, said contacts arranged in a modified fan circuit, nine two conductor paths establishable through said fan circuit, nine selectable elements, an individual two wire path connecting each of said selectable elements to a corresponding individual one of said nine two conductor paths, a winding on each of said relays, a plurality of rectifiers at said switching station connected to said windings to form a network, grounded positive and negative battery at said control station, a first and a second conductor each extending from said control station to said network, said first and said second conductor connected also to said fan circuit, a return conducting path from said network to said grounded battery, means at said control station for impressing permutated conditions of said grounded positive and negative battery through said first and said second conductor, through said network and through said return path to said grounded battery, and means, responsive to the impressing of said conditions, for selectively extending said first and second conductor through any particular one of said nine two conductor paths, and through its connected two wire path to its connected selectable element.

2. In a hydrophone station selecting system, a land signaling station, an underwater central switching station, a single submarine cable having two metallic conductors only and an impervious metallic sheath interconnecting said stations, said sheath connected to ground at said land station, no more than four relays at said central station, all of said relays neutral relays, a winding and contacts on each of said relays, said contacts arranged in a modified fan circuit, nine individual two conductor paths establishable through said fan circuit, nine selectable hydrophones each connected individually through a two wire path to a corresponding one of said nine paths, a plurality of rectifiers at said central station, all of said windings and all of said rectifiers interconnected in a network, connections from said two metallic conductors to both said network and said contacts, grounded positive and negative battery at said land station, means at said land station for impressing permutated conditions of said grounded positive and negative battery on said two metallic conductors, through said network and through said sheath to said ground connected to said sheath, and means, responsive to said impressing of said conditions, for selectively extending both of said two metallic conductors simultaneously through any particular one of said nine paths and its connected two wire path to its connected hydrophone.

3. In combination in a hydrophone station selecting system, a land signaling station, a land selecting station, an underwater selecting switching mechanism, five hydrophones each interconnected by means of two individual conductors only to said mechanism, a single transformer having a primary and a secondary winding, said secondary winding having two coils, said coils having their inner terminals interconnected through a condenser, one first pair of conductors only interconnecting said signaling station and said primary winding, one second pair of conductors only connecting said selecting station to the

junctions between said condenser and said coils of said secondary winding, one third pair of conductors only extending from the outer terminals of said secondary winding to said switching mechanism, an impervious sheath for said third pair, ground connected to said sheath, a first and a second pair of keys only, at said selecting station, connected to said first and second conductor of said second pair respectively, positive or negative battery connectable to one or the other key of each of said pair of keys, a plurality of neutral relays in said mechanism each having a winding connected through an individual rectifier network to said grounded sheath, a circuit effectively interconnecting said signaling station and a particular one of said five hydrophones through said first and third pairs of conductors and said mechanism, said circuit being established when all of said keys are normal, and means responsive to the actuation of any particular one of said keys for establishing a selecting control circuit extending through one of said relay windings and said sheath to said ground so as to effectively interconnect a corresponding one of the four other of said five hydrophones through said first and

said third pairs of conductors and said mechanism to said signaling station.

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