Jan. 14, 1947. J. B. RETALLACK 2,414,123

HYDROPHONE SELECTING SYSTEM

Filed Nov. 8, 1943 2 Sheets-Sheet 1

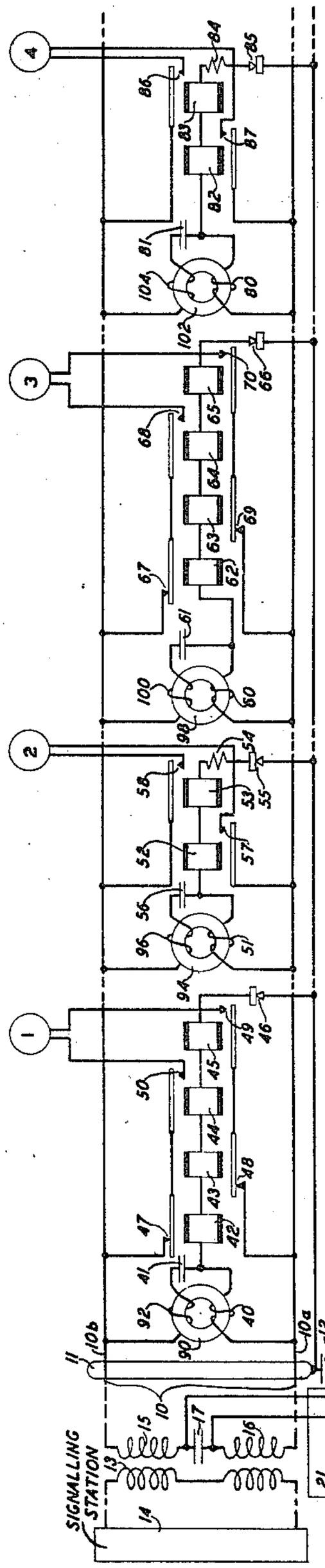

FIG. 1

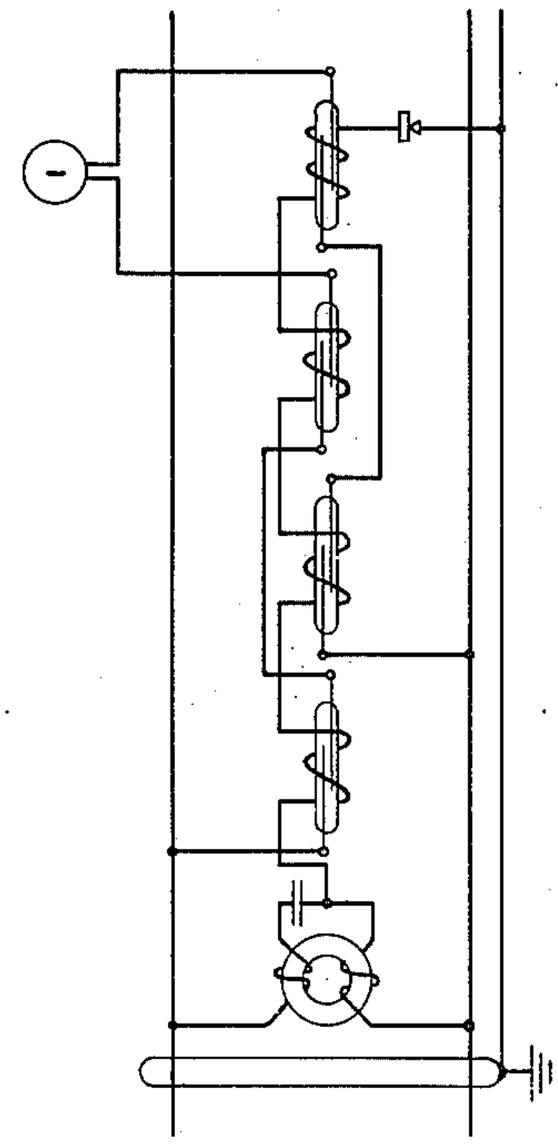

FIG. 3

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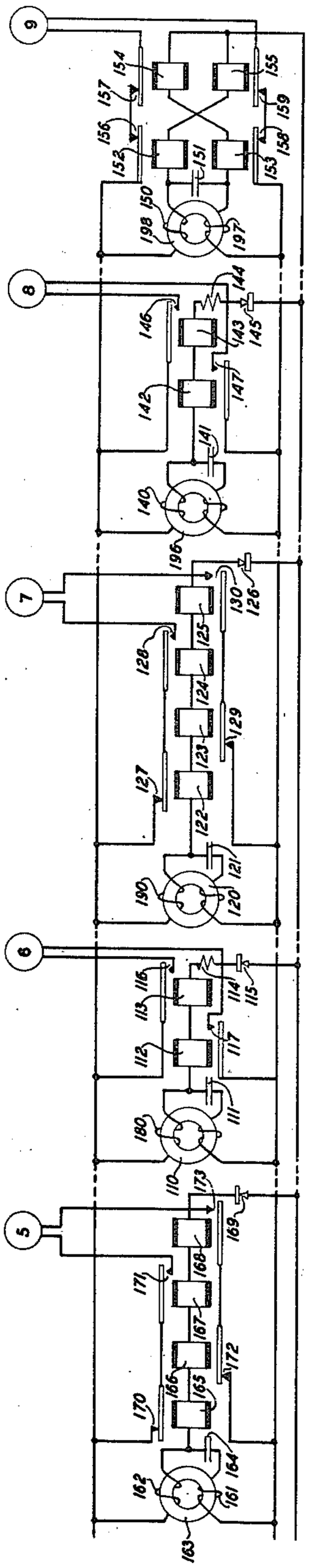

FIG. 2

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HYDROPHONE SELECTING SYSTEM

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4 Claims. (Cl. 177—353)

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This invention relates to hydrophone selecting systems. More particularly, this invention is a hydrophone selecting system in which selection is effected by discriminating between both the polarities and magnitudes of electromotive forces impressed on conductors connecting a signaling station and a plurality of hydrophones.

In the system herein a number of hydrophones, not exceeding nine, are spaced along a two-conductor submarine cable. Any one of eight of the nine hydrophone stations may be selectively connected to a signaling station through the two-conductor cable by impressing battery of a particular polarity and voltage of a particular one of two magnitudes on a particular one of the two conductors. The ninth hydrophone station is normally connected to the signaling station when no battery or voltage conditions are impressed on the conductors and is disconnected when battery of either polarity and voltage of either magnitude is impressed on the conductors.

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

Fig. 1 shows the left-hand portion of the circuit of the invention;

Fig. 2 shows the right-hand portion of the circuit of the invention; and

Fig. 3 shows an alternative embodiment of the selecting mechanism at a hydrophone station.

Refer to Figs. 1 and 2. The conductors extending to the right-hand margin of Fig. 1 connect to the conductors extending to the left-hand margin of Fig. 2 in corresponding positions.

In Figs. 1 and 2, nine hydrophone stations numbered 1 to 9 are spaced along a two-conductor submarine cable 10, which is enclosed in an impervious sheath 11, which is grounded at 12. The two-conductor cable is connected through a transformer 13 to a signaling station 14. The secondary of the transformers comprises two windings 15 and 16, the inner terminals of which are connected through a condenser 17. The inner terminals of windings 15 and 16 are connected also to a selecting station 18. At the selecting station there are eight keys 21 to 28. The individual operation of keys 21 to 28 effects the individual selection of the eight hydrophone stations 1 to 8 by impressing either full or reduced positive battery 30 or full or reduced negative battery 32 on the individual selecting apparatus sealed in the submarine cable at each hydrophone station.

The manner in which the system per Figs. 1 and 2 functions will now be described in detail.

Refer now to Figs. 1 and 2. When the contacts

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of key 21 are closed, a circuit may be traced from ground through negative battery 32, lamp 33, resistance 20, contacts of key 21, winding 16 of the secondary of transformer 13, conductor 10*a*, coil 40 of inductance 90, windings of relays 42, 43, 44, 45 in series and rectifier 46 to ground 12. The rectifier 46 is a copper-oxide rectifier or the like. It is poled so as to offer negligible resistance to the flow of current from negative battery 32. It is particularly pointed out that the voltage of negative battery 32 is reduced by the effect of resistance 20 connected in series in this circuit. The resultant voltage impressed on the windings of relays 42 to 45 is such that relays 42 and 43 do not operate. The magnitude of the voltage is sufficient, however, to operate relays 44 and 45. Although other selecting paths are connected to conductor 10*a* in parallel with the path through the windnigs of relays 42 to 45, no one of the other paths is effective to establish a selection at this time for reasons which will be made apparent below.

A circuit may now be traced from the bottom terminal of winding 16 through conductor 10*a*, contact 48, contact 49, hydrophone 1, contact 50, contact 47 and conductor 10*b* to the top terminal of winding 15 of the secondary of transformer 13. Hydrophone 1 is thus connected to signaling station 14.

When the contacts of key 22 are closed, a circuit may be traced from ground through negative battery 32, lamp 33, contacts of key 22, winding 16, conductor 10*a*, coil 51 of inductance 94, windings of relays 52 and 53 in series, resistance 54 and rectifier 55 to ground 12. It is pointed out that resistance 20 is not connected in this circuit and that the magnitude of resistance 54 is relatively small. The rectifier 55 is poled so as to pass current from negative battery 32. Relays 52 and 53 are operated. A circuit may then be traced from the bottom terminal of winding 16 through conductor 10*a*, contact 57, hydrophone 2, contact 58 and conductor 10*b* to the top terminal of winding 15. Hydrophone 2 is connected to the signaling station. Attention is called to the fact that the polarities of rectifiers 46 and 55 are the same so that when key 22 is pressed, a path is also established through the windings of relays 42 to 45. Since resistance 20 is removed from the circuit the magnitude of the voltage impressed across the relay windings is such that all of relays 42 to 45 operate. Contacts 47 and 48 are open and hydrophone 1 is disconnected from the line.

When the contacts of key 23 are closed, a circuit may be traced from ground through positive bat-

tery 30, lamp 31, resistance 19, contacts of key 23, coil 16, conductor 10*a*, coil 60 of inductance 98, windings of relays 62, 63, 64, 65 in series and rectifier 66 to ground 12. The rectifier 66 is connected into this path in such manner that it presents a low resistance to current from positive battery 30. It is pointed out that resistance 19 is connected in series in the path extending through the windings 62 to 65. The magnitude of the potential of battery 30 is thus reduced. The potential impressed on the relay windings 62 to 65 is such that relays 64 and 65 operate. Relays 62 and 63 remain in the released condition. A circuit may then be traced from the bottom terminal of winding 16, conductor 10*a*, contact 69, contact 70, hydrophone 3, contact 68, contact 67 and conductor 10*b* to the top terminal of winding 15 connecting hydrophone 3 to selecting station 14.

When the contacts of key 24 are closed, a circuit may be traced from ground through positive battery 30, lamp 31, contacts of key 24, winding 16, conductor 10*a*, coil 80 of inductance 102, windings of relays 82 and 83 in series, resistance 84 and rectifier 85 to ground 12. Rectifier 85 is poled so as to present a low resistance to current from positive battery 30. Attention is called to the fact that resistance 19 is not connected in the selecting path extending through the windings of relays 82 and 83. The magnitude of resistance 84 is small. Substantially full potential of battery 30 is impressed across the windings of relays 82 and 83. Relays 82 and 83 operate. A circuit may then be traced from the bottom terminal of winding 16, conductor 10*a*, contact 87, hydrophone 4, contact 86 and conductor 10*b* to the top terminal of winding 15. Hydrophone 4 is thus connected to signaling station 14.

When the contacts of key 25 are closed, a circuit may be traced from ground through negative battery 32, lamp 33, resistance 20, contacts of key 25, upper winding 15 of the secondary of transformer 13, conductor 10*b*, coil 162 of inductance 163, windings of relays 165, 166, 167, 168 and rectifier 169 to ground 12. The rectifier 169 is poled so as to offer a low resistance to current from negative battery 32. The full voltage of battery 32 is reduced by the effect of the resistance 20 which is interposed in the series circuit. Relays 165 and 166 remain in the released condition and relays 167 and 168 operate. A circuit may then be traced from the bottom terminal of winding 16 through conductor 10*a*, contact 172, contact 173, hydrophone 5, contact 171, contact 170 and conductor 10*b* to the top terminal of winding 15. Hydrophone 5 is connected to signaling station 14.

When the contacts of key 26 are closed, a circuit may be traced from ground through negative battery 32, lamp 33, contacts of key 26, winding 15, conductor 10*b*, coil 180 of inductance 110, windings of relays 112 and 113, resistance 114 and rectifier 115 to ground 12. Rectifier 115 is connected into the circuit in such manner as to offer a low resistance to current from negative battery 32. The magnitude of resistance 114 is low. Substantially the full voltage of battery 32 is impressed across the windings of relays 112 and 113 to close the circuit to hydrophone 6. This circuit may be traced from the bottom terminal of winding 16 through conductor 10*a*, contact 117, hydrophone 6, contact 116 and conductor 10*b* to the top terminal of winding 15.

When the contacts of key 27 are closed, a circuit may be traced from ground through positive battery 30, lamp 31, resistance 19, contacts of key 27, winding 15, conductor 10*b*, coil 190 of inductance 120, winding of relays 122, 123, 124, 125 and rectifier 126 to ground 12. Rectifier 126 is connected into the selecting path in such manner as to present a low resistance to current from positive battery 30. It is pointed out that resistance 19 is connected in series with the windings of relays 122 to 125. The magnitude of the voltage impressed across the windings of relays 122 to 125 is such that relays 124 and 125 operate. Relays 122 and 123 remain released. A circuit may then be traced from the bottom terminal of winding 16, conductor 10*a*, contact 129, contact 130, hydrophone 7, contact 128, contact 127 and conductor 10*b* to the top terminal of winding 15. Hydrophone 7 is thus connected to signaling station 14.

When the contacts of key 28 are closed, a circuit may be traced from ground through positive battery 30, lamp 31, contacts of key 28, winding 15, conductor 10*b*, coil 140 of inductance 195, windings of relays 142 and 143, resistance 144, and rectifier 145 to ground 12. The polarity of rectifier 145 is such that it offers a low resistance to current from positive battery 30. The magnitude of resistance 144 is small. It is pointed out that resistance 19 is not connected in the path through the windings of relays 142 and 143. Substantially the full potential of battery 30 is impressed across the windings of relays 142 and 143 which operate to connect hydrophone 8 to signaling station 14. A circuit may be traced from the bottom terminal of winding 16, conductor 10*a*, contact 147, hydrophone 8, contact 146 and conductor 10*b* to the top terminal of winding 15.

When no potential of either polarity and of either magnitude is impressed on either one of conductors 10*a* and 10*b*, hydrophone 9 is connected to signaling station 14. A circuit may be traced from the bottom terminal of winding 16 through conductor 10*a*, contact 158, contact 159, hydrophone 9, contact 157, contact 156 and conductor 10*b* to the top terminal of winding 15. When potential of either polarity and either magnitude is impressed on conductor 10*a*, a circuit extends through coil 197 of inductance 198 and the windings of relays 153 and 154 to ground 12 operating relays 153 and 154. This disconnects hydrophone 9 from signaling station 14. When battery of either polarity and either magnitude is impressed on conductor 10*b*, a circuit extends through coil 150 of inductance 198 and the windings of relays 152 and 155 to ground 12 operating relays 152 and 155. Contacts 156 and 159 are opened, disconnecting hydrophone 9 from signaling station 14.

From the above, it should be apparent that the invention herein is a system wherein any one of nine hydrophone stations may be selected for connection to a signaling station over a two-conductor cable. One of the nine stations is normally connected to the cable and is disconnected automatically when any of the other eight stations is selected. Four of these eight stations are selected by impressing positive or negative battery on one of the two conductors and the remaining four of the eight stations are selected by connecting positive or negative battery to the other of the two conductors. Of the four stations selected by impressing positive or negative battery on a particular conductor, two are selected by impressing positive battery on the hydrophone selecting mechanism and the remaining two are

selected by impressing negative battery on the selecting mechanism. Of each of the two stations in each group of four selected by positive battery, one is selected by positive battery of high potential and the other by positive battery of low potential. Of the two stations in each group of four selected by negative battery impressed on a particular conductor, one is selected by negative battery of high potential and the other by negative battery of low potential.

Refer now to Fig. 3. Fig. 3 shows an alternative selecting arrangement for a hydrophone at a particular selecting point. Electrically, it corresponds to the arrangement shown for selecting station 1 in Fig. 1. Instead of ordinary relays, however, in Fig. 3 each individual pair of relay contacts is enclosed in an individual seal such as an envelope of glass or the like. Relays having such contact protective arrangements are well known in the art. The employment of relays having contacts enclosed in separate impervious envelopes, in addition to the impervious sheath which encloses the cable conductors and the selecting mechanism, provides additional protection against failure due to moisture and fine silt, etc.

What is claimed is:

1. In combination in a hydrophone selecting system, a submarine cable having a grounded impervious sheath, two conductors only in said cable, eight hydrophones spaced individually along said cable, four individual selecting mechanisms for a first four of said eight hydrophones effectively connected to a first one of said conductors, four individual selecting mechanisms for a second four of said eight hydrophones effectively connected to a second one of said conductors, a high voltage enabling relay and a low voltage disabling relay in a first two of each of said four mechanisms, a high voltage enabling relay in a second two of each of said four mechanisms, a single rectifier in each of said eight mechanisms and an individual circuit for each of said mechanisms, said circuit extending from said grounded sheath through said rectifier and through an individual winding of all of the relays in an individual mechanism all in series, responsive to voltage of one of two magnitudes and of a particular polarity impressed on one or another of said two conductors, to selectively connect any particular one of said eight hydrophones to both of said two conductors.

2. A system in accordance with the preceding claim including a ninth hydrophone having an individual selecting mechanism, means for connecting said ninth hydrophone effectively to said conductors when none of said eight hydrophones is effectively connected to said conductors and means for effectively disconnecting said ninth hydrophone from said conductors when any of said eight hydrophones is effectively connected to said conductors.

3. In a submarine cable hydrophone selecting system, a cable having a first and a second conductor enclosed in a grounded impervious sheath, eight hydrophones distributed along said cable, a first four selecting circuits each having the winding of a high potential responsive relay and a rectifier in series, each of said circuits connected individually between said conductors and said sheath, two of said first four circuits connected effectively to each of said conductors, a second four selecting circuits each having the winding of a high potential responsive relay, the winding of a low potential responsive relay and a rectifier in series, each of said second four circuits connected individually between said conductors and said sheath, two of said second four circuits connected effectively to each of said conductors, sources of positive and negative high and low potential, a first four control means for impressing said potentials selectively on said first conductor, a second four control means for impressing said potentials selectively on said second conductor, means comprising the poling of said rectifiers, responsive to the actuation of any particular one of said control means for actuating a corresponding one of said selecting circuits, and means responsive to the actuating of said selecting circuit for connecting a corresponding one of said hydrophones between said first and said second conductors.

4. A system in accordance with claim 3, a ninth hydrophone, a ninth selecting circuit and means in said ninth selecting circuit for connecting said ninth hydrophone between said first and said second conductor when no potential is impressed on either of said conductors.

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