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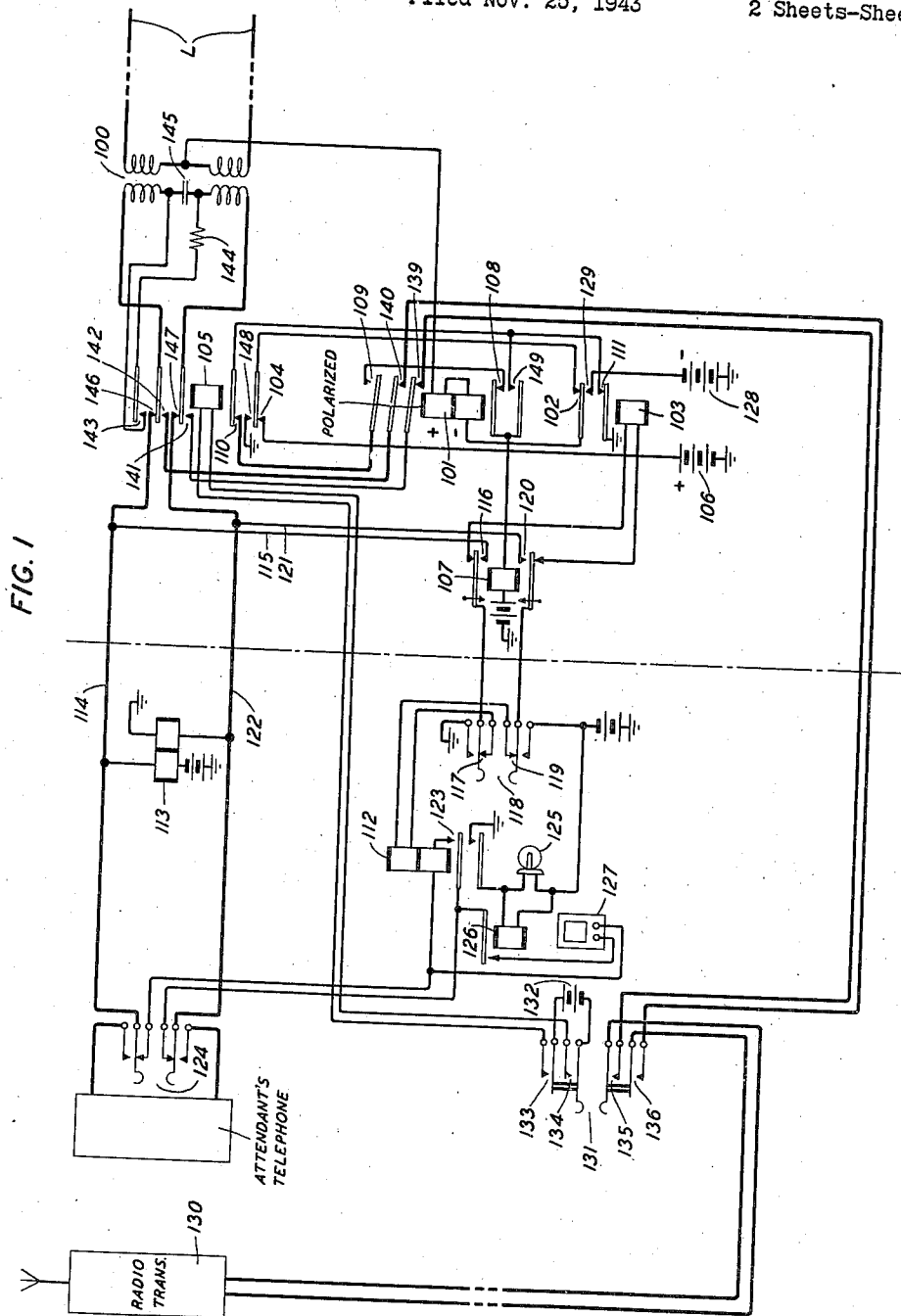
G. H. DUHNKRACK
SIGNALING SYSTEM

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Filed Nov. 25, 1943

2,365,689

2 Sheets-Sheet 1



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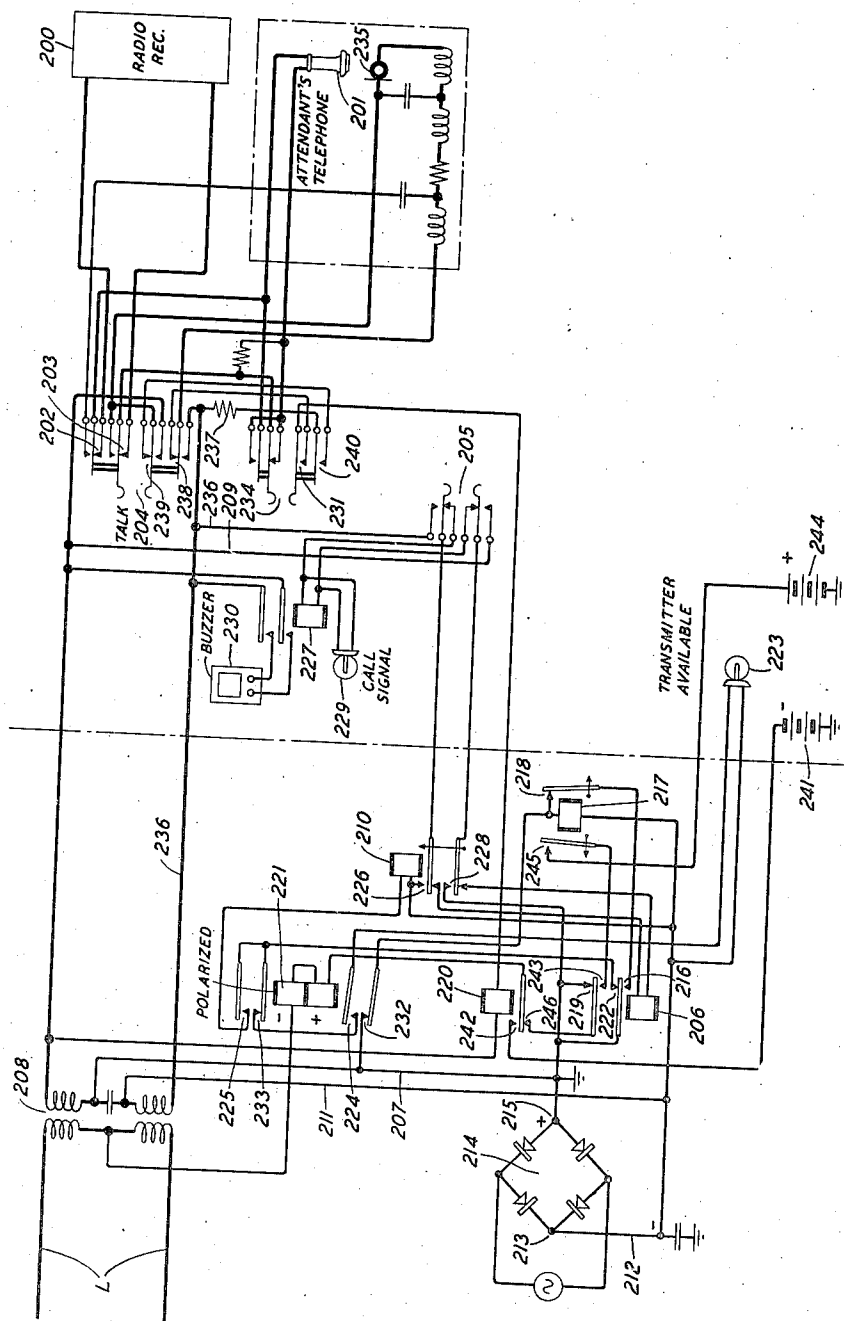
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FIG. 2



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SIGNALING SYSTEM

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3 Claims. (Cl. 179—2)

This invention relates to a circuit arrangement, and signal control means therefor, to provide two-way polar simplex signaling over a single pair of wires interconnecting two remotely distant attendants' stations whereby two different signals may be transmitted in one direction therebetween and three different signals in the opposite direction.

The invention will be understood from the following description when read in connection with the accompanying drawings, Fig. 1 of which shows a radio channel monitor control station having a radio transmitter associated therewith and Fig. 2 shows a distant attendant's station having a radio receiver associated therewith, both of said stations (Figs. 1 and 2) being interconnected by a single two-wire line.

Referring to Fig. 2 of the drawings, it will be noted that the attendant's telephone receiver 201 is normally connected to the output of the radio receiver 200 over contacts 202 and 203 of the attendant's talk key 204 thus enabling him to listen to incoming radio signals. In case the attendant (Fig. 2) desires to talk with the attendant at the radio channel monitor station (Fig. 1) as, for example, to gain control of the radio transmitter associated with that station, he operates key 205 which closes a circuit to operate relay 206 which can be traced from ground, conductor 207, upper right winding of repeating coil 208, conductor 209, lower make contact of key 205, lower back contact of relay 210, winding of relay 206, inner back contact of relay 210, upper make contact of key 205, conductor 236, lower right winding of coil 208, and conductors 241 and 242 to the non-grounded terminal 213 of rectifier 214 and through the rectifier to the opposite grounded terminal 215. It will be understood that a battery of the proper voltage may be substituted for the rectifier if desired.

The operation of relay 206, at its contacts 216, closes a holding circuit for normally operated relay 217 which can be traced from terminal 213 of rectifier 214, winding of relay 217, contacts 218 thereof, and contacts 216 of relay 206 to terminal 215 of the rectifier, and at its contacts 219 opens the simplex circuit extending to the distant station (Fig. 1) which is normally closed in the following circuit: ground, contacts 219 of relay 206, contacts 245 of relay 220, windings of relay 221, to the mid-point of the left-hand side of repeating coil 208, over the two sides of the line L in parallel to the midpoint of the right-hand side of repeating coil 100 at the distant control station (Fig. 1), windings of relay 101, contacts 102 55

of relay 103, contacts 104 of relay 105, to grounded positive battery 106. When the foregoing simplex circuit is opened relay 221 releases its lower armatures and relay 101 its upper armatures which restore to normal. It will be understood that relays 221 and 101 are of the type disclosed in United States Patent 2,309,945 to J. S. Garvin issued February 2, 1943, which relays close either their upper or lower contacts depending on the direction of the current flowing through the two windings in series.

Relay 206 in operating also opens its contacts 222 thereby preventing the "transmitter available" lamp 223 from lighting when the contacts 224 of relay 221 close. The release of relay 221 performs no useful function at this time.

The release of the upper armatures of relay 101, at the distant control station (Fig. 1), operates relay 107 in a circuit which is traced from battery, winding of relay 107, contacts 108 and 109 of relay 101, contacts 110 of relay 105 and contacts 111 of relay 103 to ground. Relay 107 in operating causes the operation of relay 112 in the following circuit: battery, left winding of impedance coil 113, conductors 114 and 115, contacts 116 of relay 107, contacts 117 of key 118, upper winding of relay 112, contacts 119 of key 118, contacts 120 of relay 107, conductors 121 and 122 and the right-hand winding of impedance coil 113 to ground.

Relay 112 at its contacts 123, locks itself operated, under control of talk key 124, to battery and ground in series with impedance coil 113, and at its lower contacts lights the calling lamp 125 and energizes relay 126 in parallel therewith which connects the buzzer 127 to battery and ground through the impedance coil 113, under control of the talk key 124, thus giving the attendant at that station both a visual and audible calling signal.

The operation of talk key 124 by the attendant releases both of these signals and connects his telephone to the line and when the talk key 204 at the calling station (Fig. 2) is operated, conversation between the two attendants proceeds.

It will be noted that in the preceding description of a call from the station at Fig. 2 to the station at Fig. 1 signaling is accomplished by opening the simplex circuit which normally is closed from positive battery to the station of Fig. 1 to ground at the station of Fig. 2.

In case the attendant at the station of Fig. 1 desires to call the attendant at the other station operation of signaling key 118 operates relay 103 which in turn, at its contacts 102, disconnects the

positive battery 106 from relay 101 and substitutes, at its contacts 129, negative battery 128 therefor and disconnects, at its contacts 111, the ground connection to prevent the later operation of relay 107. The battery reversal through relay 101 causes its upper armatures to release and its lower armatures to operate which, however, performs no useful function at this time.

Negative battery is thus applied to the mid-point of the right-hand side of repeating coil 100 which passes over the two conductors of the line to the mid-point of the left-hand side of repeating coil 208 at the distant station, through the relay 221, over contacts 246 of relay 220 and contacts 219 of relay 206 to ground which causes relay 221 to release its lower armatures and attract its upper ones. Release of the lower armatures opens contacts 232 thus releasing the normally operated relay 217 but performs no other useful function. Operation of the inner upper armature, however, opens its contacts 233 thus preventing lamp 223 from lighting when the lower contacts 224 of this relay close, and by closing its contacts 225 completes a circuit to operate relay 210 which can be traced from terminals 213 of the rectifier 214, conductor 212, winding of relay 210, contacts 225 of relay 221, and contacts 222 of relay 206 to ground.

Operation of relay 210 completes a circuit from terminal 213 of the rectifier 214, contacts 226 of relay 210, upper normal contacts of key 205, winding of relay 227 in parallel with lamp 229, lower normal contacts of relay 205, contacts 228 of relay 210, to ground. Lamp 229 lights in this circuit and relay 227 operates to connect the buzzer to the rectifier 214 in series with the right-hand windings of repeating coil 208.

When the distant calling key 118 is released the lamp 229 is extinguished and the buzzer 230 is silenced.

When both talk keys 124 at the calling station and 204 at the called station are operated conversation between the two attendants over the line is possible.

From the foregoing it will be observed that a call signal from the radio channel control station (Fig. 1) to the station of Fig. 2 is accomplished by connecting negative battery to the simplex circuit at the calling station (Fig. 1) to ground at the distant station (Fig. 2).

Remote control of the radio transmitter (Fig. 1) from the distant station (Fig. 2)

After the two attendants have agreed over the previously described intercommunicating circuit to give the attendant at the station of Fig. 2 control of the radio transmitter 130, associated with the station of Fig. 1, they release any operated keys thus restoring the system to normal and the attendant at the station of Fig. 1 operates key 131 thereby causing operation of relay 105 which can be traced from battery 132, contacts 133 and 134 of key 131 and winding of relay 105. Relay 105 in operating completes a connection from the radio transmitter 130 to the line over contacts 135 and 136 of key 131, contacts 139 and 140 of relay 101, and contacts 141 and 142 of relay 105. Relay 105 in operating also closes its contacts 143 to connect a resistance 144 in shunt to the condenser 145 in the repeating coil 100 to provide a direct current bridge across the line to the transmitter 130 for the purpose of operating certain relays therein, not shown.

Relay 105 in operating also opens its contacts 104 thus disconnecting positive battery 106 from

the simplex circuit and at its contacts 148 substitutes ground therefor thus releasing the upper armatures of relay 101 which thereupon open their contacts 139 and 140 to disconnect the transmitter from the line pending control from the distant station. Further, operation of relay 105 opens its contacts 110 thus preventing relay 107 from operating when contacts 109 of relay 101 are closed.

Connection of ground at contacts 148 of relay 105 in the simplex circuit in series with relay 101 causes relay 221 at the distant station (Fig. 2) to release its lower armatures thereby opening contacts 232 thus releasing relay 217 and closure of contacts 224 causes lamp 223 to light as an indication that the distant transmitter is now under the control of the attendant at this station. This circuit is traced from terminals 213 of the rectifier 214, conductor 212, lamp 223, contacts 224 and 233 of relay 221 and contacts 222 of relay 206 to ground. In the case just described it will be noted that the signal transmitted from the channel monitor control station (Fig. 1), to the distant station (Fig. 2) as an indication that the radio transmitter is available is accomplished by grounding both ends of the simplex circuit.

The attendant at the station of Fig. 2 now operates his "press-to-talk" key 234 thereby connecting his telephone transmitter 235 in series with the rectifier 214, the right-hand side of repeating coil 208, and relay 220, whereupon this relay operates. This circuit can be traced from terminal 213 of the rectifier 214, conductors 212 and 211, lower right winding of repeating coil 208, conductor 236, resistance 237, contacts 240 of key 234, contacts 239 of key 204, the telephone transmitter 235, contacts 238 of key 204, contacts 231 of key 234, winding of relay 220, upper right winding of repeating coil 208 and conductor 207 to ground.

Relay 220 in operating opens its contacts 246 thereby disconnecting ground from the simplex circuit including relay 221 and, by closing contacts 242, substitutes negative battery 241 therefor thus causing relay 221 to attract its lower armatures thereby opening contacts 224 to extinguish the lamp 223, and by closing its contacts 232, operates relay 217 which relay in operating performs no useful function at this time.

Application of negative battery to the simplex circuit causes relay 101 at the distant control station to attract its upper armatures thereby closing its contacts 139 and 140 and connecting the left-hand side of repeating coil 100 to the radio transmitter 130 and due to the direct current bridge across the condenser 145 in the repeating coil, which includes resistance 144 and contacts 143 of relay 105, the transmitter is conditioned for transmission.

When the attendant at the station of Fig. 2 finishes talking he releases key 234 thereby releasing relay 220 which opens contacts 242 to disconnect negative battery 241 from the simplex and by closing contacts 246 substitutes ground therefor. Due to the fact that ground is also connected at the other end of the simplex circuit, relays 221 (Fig. 2) and 101 (Fig. 1) release and open their previously closed contacts. The release of relay 221 closes its contacts 224 thereby relighting lamp 223 as an indication that the radio transmitter 130 at the distant station is still available but disconnected from the line L and the release of relay 101 opens its contacts 139 and 140 to disconnect the transmitter 130

from the left-hand side of repeating coil 100. The transmitter 130, however, remains under control of the "push-to-talk" key 234 as long as key 131 at the control station of Fig. 1 is operated.

Release of radio transmitter

When the attendant at the station of Fig. 2 is finished with the radio transmitter he releases his "press-to-talk" key 234 which as before described opens the connection between the line L and the transmitter and then operates his intercommunicating signal key 205 to call in the distant attendant at the radio channel control station to request him to release key 118 and free the transmitter.

At this time it will be noted that relays 221 and 217 are deenergized and released and therefore as key 205 is operated and relay 206 responds, as described at the beginning of the description, ground is disconnected at contacts 222 of relay 206 to extinguish lamp 223 and to prevent operation of relay 210 when relay 221 operates and closes its contacts 225. Relay 206 in operating also opens contacts 219 thus disconnecting ground from relay 221 and by closing its contacts 243 substitutes positive battery 244 therefor in a circuit from battery 244, contacts 245 of relay 217, contacts 243 of relay 206, contacts 246 of relay 220, windings of relay 221, over the simplex circuit, through relay 101 at the distant station to ground. Relay 221 attracts its upper armature in this circuit which, however, performs no useful function at this time.

At the distant control station, however, relay 101 attracts its lower armatures thus closing its contacts 149 to energize relay 107 from ground at contacts 111 of relay 103. Relay 107 in operating closes a circuit from battery and ground through impedance coil 113, contacts 116 and 120 of relay 107, contacts 117 and 119 of key 118 to relay 112 which lights the calling signal lamp 125 and sounds the buzzer 127. When the talk keys to both stations are operated, the attendants are able to converse with each other and the attendant at the station of Fig. 2 may instruct the attendant at the radio channel control station (Fig. 1) to disconnect the radio transmitter which he does by releasing key 131 and when all of the keys at both stations are released, the circuit arrangement of the system is restored to its normal condition with the simplex circuit connected to positive battery at the station of Fig. 1 and the other end connected to ground.

It will be noted that whereas a calling signal was transmitted from the station of Fig. 2 to the station of Fig. 1, as first described, by opening the simplex circuit when the radio transmitter is connected under control of the station of Fig. 2, a calling signal from Fig. 2 to Fig. 1 is transmitted by connecting positive battery to the simplex circuit of Fig. 2 which circuit is grounded at Fig. 1.

What is claimed is:

1. In a radio communication control system, a radio transmitter, an attendant's station associated therewith, a radio receiver and associated attendant's station, a line interconnecting said station, a calling signal device at each station, a second signal device at the receiver station, signaling means at each station for controlling operation of the calling signal device at the other

station, switching means at the transmitter station for preparing a connection between said radio transmitter and line and for actuating the second signal device at the receiver station, and other means including a switching device at said receiver station for controlling the completion of the prepared connection between the line and radio transmitter, characterized in this, that said line comprises a single pair of wires having a simplex circuit superimposed thereon serially including a three-position polar relay at each station and normally connected to a source of positive potential at the transmitter station and to ground at the other station, that control of the calling signal device at the transmitter attendant's station by the signaling means at the receiver station when said switching means at the transmitter station is not operated is effected by opening said simplex circuit at the receiver station and when the switching means at the transmitter station is operated by applying positive potential direct current to the simplex circuit at the receiver station, that control of the calling signal device at the receiver station by the signaling means at the transmitter station is effected by applying negative potential direct current to the simplex at the transmitter station, that operation of the second signal device at the receiver station by operation of the switching device at the transmitter station is effected by completing a short-circuit around said simplex circuit, and that completion of the prepared connection between said radio transmitter and line at the transmitter station by the switching device at the receiver station is effected by applying negative potential direct current to the simplex at the receiver station.

2. In a signaling system, a pair of remotely opposed control stations, interconnecting means therebetween, each control station having means therein for transmitting speech to the other station over said interconnecting means and also having a plurality of individual direct current signal transmitting means each for affecting a different signal control at the other station over said interconnecting means, each control station also having means therein for receiving and translating speech transmitted from the other station and having a plurality of individual direct current signal receiving means corresponding to the individual transmitting means at the other station and respectively responsive to signals transmitted thereby characterized in this, that said interconnecting means consists of a single pair of line wires, a simplex circuit superimposed thereon and a three-position polar relay in series with said simplex circuit at each control station.

3. In a signaling system, first and second attendant's stations, a ground return signaling channel interconnecting said stations, equal potential grounded sources of positive and negative direct current at each station, a predetermined one of said sources being normally connected to said channel at one station and ground at the other station, a switching device serially included in said simplex channel at each station adapted to assume three different switching positions depending on the direction or absence of current flowing in said channel, and means at each station for controlling the direction and flow of current in said channel.

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