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SIGNALING SYSTEM

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This invention relates to signaling systems and more particularly to systems employing electromagnetically operated signal receiving mechanism.

The object of the invention is to increase the capability and reliability of impulse responsive apparatus in automatic signaling systems.

In systems comprising electromagnetic signal receiving mechanisms which may be operatively associated with any one of a plurality of impulsing circuits, the allowable variation in the character of the impulse circuits without causing failure on the part of the receiving mechanism is limited. If the signal receiving mechanism is provided with an impulse relay adapted for use in high resistance impulse circuits, this relay will be too slow in releasing when included in a low resistance impulse circuit; and an impulse relay adapted for use in a low resistance impulse circuit would be too slow in operating, or fail entirely to operate when included in a high resistance impulse circuit.

According to this invention an electromagnetically operated signal receiving means is provided with a plurality of impulse receiving relays of different characteristics and with means for selecting that one of the impulse relays which is best suited for use in any particular impulse circuit.

A feature of the invention is the provision of means for determining the character of the impulse loop with which it is desired to connect one of a plurality of impulse relays of different capabilities and for selecting that one of the impulse relays which is best suited for use with the impulse loop in question.

A telephone system arranged in accordance with this invention is represented schematically in the drawing which forms a part of this specification. The invention is, however, not limited in its application to this particular system and is, in general, applicable to all automatic telephone systems. The system shown in the drawing is of the well-known panel type which includes register-senders for revertively controlling the selector switches.

Referring to the drawing,—

A represents a subscriber's station in an office O—1, C represents a link comprising the line finder switch LF and the district selector switch DS, OS represents an office selector switch, D represents a link comprising the district finder switch DF and the register-sender finder switch SF, and RS represents a register-sender for use in registering the number dialed by a calling

subscriber and for use in controlling the selector switches employed in completing a connection between two lines. T represents a trunk extending from the banks of office selectors in office O—1 to an incoming selector switch IS in an office O—2. FS represents a final selector switch and B represents a subscriber's station in office O—2.

The subscriber's stations A and B are provided with telephone sets which include a dial or other impulse device for use in securing a connection with the station of any other subscriber with whom conversation is desired.

The line finder switch LF, district selector switch DS, office selector switch OS, incoming selector switch IS, and final selector switch FS, are all of the panel type such as is disclosed in Patent No. 1,123,696 granted to J. N. Reynolds, January 5, 1915. Reference may be had to Patent No. 1,505,171 granted to F. A. Stearn August 19, 1924 for a detailed description of the control and operation of these switches. The trunk finder switch DF and the sender finder switch SF may also be of the panel type and reference may be had to Patent No. 1,690,206 granted to A. Raynsford, November 6, 1928, for a description of the operation of these switches. The finder and selector switches are each represented by a set of brushes and a single set of terminals; all driving mechanism and control apparatus which is not necessary to a full and complete description of this invention has been omitted.

The register-sender RS comprises means, within the broken line enclosure E, for receiving dial impulses from a calling station. Office code and numerical registers are represented by the single magnet within the broken line enclosure F. For a complete description of such a register-sender and its operation, reference may be had to the aforementioned Patent No. 1,505,171, granted to F. A. Stearn. A modification of the sender of the Stearn patent is the provision of three impulse relays 207, 208 and 209, each being particularly adapted to respond to impulses over lines of different resistance characteristics. To select and connect the particular one of these impulse relays which is best adapted for use with a calling line, to which the register-sender is connected, three line relays 204, 205, and 206 and an auxiliary relay 203 are provided. Relay 204 is operatively responsive to its connection to all lines, but relays 205 and 206 are marginal so that relay 205 operates only when connected to a line of not more than medium resistance and relay 206 operates only when connected to a line

of low resistance. If line relay 204 operates and relays 205 and 206 do not operate, the calling line is connected to the most sensitive impulse relay 207; if line relays 204 and 205 operate, but relay 206 does not, the calling line is connected to the less sensitive impulse relay 208; and if line relays 204, 205 and 206 all operate in series with a calling line, the line is connected to the least sensitive impulse relay 209.

- 10 The register-sender RS also includes three stepping relays 214, 215 and 216 and the usual set of counting relays which are represented by relays 222, 225 and 226 within the broken line enclosure G. Relay 216 is most sensitive and is adapted for use in controlling selections over trunks of high resistance; relay 215 is less sensitive and is adapted for use in controlling selections over trunks of medium resistance; and relay 214 is least sensitive and is adapted for use in controlling selections over local trunks or other trunks of low resistance. The cam 213 which controls the insertion of the stepping relays in the selector switch control circuits is one of the cams of a sequence switch which is set in accordance with the routing of the call and the particular selection being made; so that the stepping relay which is included in the control circuit for any selection will be of the proper sensitivity for that particular selection. This arrangement is a substitute for the insertion of compensating resistance in the fundamental switch control circuits and increases the length of trunks over which the selectors may be satisfactorily controlled.
- 35 Assume now that the subscriber at station A originates a call by removing the receiver from the switchhook, that the links C and D are allotted for use on the call, that the calling line is extended through the brushes of line finder switch LF, district finder switch DF, and sender finder switch SF to the register-sender RS.

A signaling circuit is thereupon established with the calling subscriber's line over which the dial impulses are made effective in registering the wanted subscriber's number. This circuit may be traced from ground through balancing coil 201 in the register-sender RS, terminal 104 and brush of finder switch SF, brush and terminal 105 of finder switch DF, conductor 106 of link C, brush and terminal 107 of line finder switch LF, thence over one side of line 100 and through the impulse contacts (not shown) of dial 108, thence through the calling subscriber's set A and back over the other side of the line through terminal 109 and brush of line finder LF, conductor 110, terminal 111 and brush of district finder DF, brush and terminal 112 of sender finder SF, conductor 202, back contact of relay 203 and through the upper windings of line relays 204, 205 and 206 in series to battery.

Assuming first that the line 100 is a long or high resistance line, relay 204 operates, but relays 205 and 206 do not operate, in series with this line. Relay 204 closes a locking circuit through its lower winding to the holding ground of the register-sender and closes a circuit for operating relay 203. With relay 203 operated and relay 205 normal, the calling line is disconnected from the upper windings of relays 204, 205 and 206 and is connected over conductor 202, through the front contact of relay 203 and back contact of relay 205, to the winding of impulse relay 207. Impulse relay 207 operates and causes the operation of relay 210. With relay 210 operated and relays 208 and 209 normal, the response of relay

207 to the impulses created by the dialing of the number of the station with which a talking connection is desired is effective to set the office code and numerical registers in usual manner. Relay 210 is a slow-to-release relay and remains operated during dialing.

If the line 100 is a medium length line, that is a line of medium resistance, both of relays 204 and 205 are operated upon extension of the line to the register sender RS but relay 206 does not operate. Each of relays 204 and 205 closes a locking circuit through its lower winding to the holding ground of the register sender. The operation of relay 204 also causes the operation of relay 203; and with relays 203 and 205 both operated, the calling line is disconnected from the upper windings of relays 204, 205 and 206 and is connected, over conductor 202 and through front contacts of relays 203 and 205 and the back contact of relay 206, to the winding of impulse relay 208. Relay 208 operates in series with the calling line and in turn causes the operation of relay 210. With relay 210 operated and with relays 207 and 209 normal, the response of relay 208 to the impulses created by the operation of the dial 108 is effective to set the office code and numerical registers in usual manner.

If the line 100 is a short or low resistance line, all of relays 204, 205 and 206 are operated upon extension of the line to the register sender RS. Each of relays 204, 205 and 206 closes a locking circuit through its lower winding to the holding ground of the register sender. The operation of relay 204 also causes the operation of relay 203; and with relays 203, 205 and 206 all operated the calling line is disconnected from the upper windings of relays 204, 205 and 206 and is connected, over conductor 202 and through front contacts of relays 203, 205 and 206, to the winding of impulse relay 209. Relay 209 operates in series with the calling line and in turn causes the operation of relay 210. With relay 210 operated and with relays 207 and 208 normal, the response of relay 209 to the impulses created by the operation of the dial 108 is effective to set the office code and numerical registers in usual manner.

In response to the registration of the called subscriber's number in the register sender RS, the office code is translated in terms of the class and route of the call and in terms of the district and office brush and group selections necessary to select a trunk leading to an incoming selector in the office in which the called line is located. Since the district selector is always in the same office as the register sender the least sensitive stepping relay 214 will be included in the fundamental selector control circuit for district brush and group selections. Since the office incoming and final selectors used in completing a call may be in a different office from that in which the register sender is located, the sequence switch, heretofore used to control the compensating resistance in the fundamental circuit will now be used to cut in that one of the three stepping relays 214, 215 and 216 which is best suited for operation during each particular selection.

Assuming district and office selections to have been completed and the trunk T to have been selected and tested, the sender sequence switch is advanced to close the fundamental circuit for incoming brush selection. The incoming selector IS, to which the trunk T connects, is shown in sufficient detail to permit the tracing of the

fundamental circuit from ground through cam contacts 301 and 300 of the incoming selector's sequence switch, over the lower conductor of trunk T, terminal 132 and brush of selector OS, terminal 122 and brush of selector DS, conductor 113, terminal 114 and brush of switch DF, brush and terminal 115 of switch SF, through the contacts of cam 213 of the sequence switch which is set in a position corresponding to the particular trunk route and selection being made, then through the winding of whichever one of stepping relays 214, 215 and 216 which is best adapted for use, as indicated by the position in which cam 213 is resting, conductor 221, back contact of relay 222 of the counting relays, conductor 223, terminal 116 and brush of switch SF, brush and terminal 117 of switch DF, conductor 118, brush and terminal 121 of selector DS, brush and terminal 131 of selector OS, upper conductor of trunk T, cam contacts 302, 303, 304 and 305 of the incoming selector's sequence switch and through the left winding of line relay 306 to battery. The operation of whichever of the stepping relays is included in the fundamental circuit is effective to operate the counting relays in well known manner so as to open the fundamental circuit and thus stop the incoming selector as soon as it has advanced to the proper position for the selection in question.

The operation of register sender RS is in all other respects the same as that of the sender described in the aforementioned Patent No. 1,505,171 to F. A. Stearn. The invention is, however, not limited in its application to the particular sender and system shown in the drawing but may be applied generally to all systems employing register-senders.

What is claimed is:

1. In a signaling system, subscribers' lines of different characteristics, signal receiving means comprising a plurality of impulse relays of different capabilities, means for operatively associating said signal receiving means with a calling one of said lines, and means effective upon association of said signal receiving means with a calling line for selecting that one of said impulse relays which is best suited for use with said calling line.

2. In a signaling system, lines of different characteristics, signal receiving means comprising a plurality of impulse relays of different capabilities, means for operatively associating said signal receiving means with any one of said lines, means for testing the line to which said receiving means is connected to determine its character, and

means for connecting to said line that one of the impulse relays which is best suited for use therewith.

3. In a signaling system, lines of different characteristics, signal receiving means comprising a plurality of impulse relays of different capabilities, switching means for operatively associating said signal receiving means with a calling one of said lines, and marginal relay means for selecting and connecting to the calling line that one of said impulse relays which is best adapted for use with said calling line.

4. In a signaling system, lines of different resistance, signal receiving means comprising three impulse relays, one of said impulse relays being adapted for use with lines of high resistance, another of said impulse relays being adapted for use with lines of medium resistance, and the other of said impulse relays being adapted for use with lines of low resistance, switching means for operatively associating said signal receiving means with a calling one of said lines, and testing means associated with said signal receiving means for determining the resistance characteristic of said calling line and for connecting to said line that one of said impulse relays which is best adapted for use with said line.

5. In a signaling system, lines of different resistance, a signal register comprising a plurality of test relays and a plurality of impulse relays, a first one of said impulse relays being adapted for use with lines of low resistance, a second one of said impulse relays being adapted for use with lines of somewhat higher resistance, and a third one of said impulse relays being adapted for use with lines of highest resistance, switching means for operatively associating said register with a calling one of said lines, a circuit comprising windings of said test relays in series with the calling line, all three of said test relays being operable in series with the lines of low resistance, only two of said test relays being operable in series with said lines of somewhat higher resistance, and only one of said test relays being operable in series with lines of highest resistance, means effective if all three of said test relays are operated for connecting the calling line to said first one of said impulse relays, means effective if only said two of the test relays are operated for connecting the calling line to said second one of said impulse relays, and means effective if only said one of the test relays is operated for connecting the calling line to the third one of said impulse relays.

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