Feb. 16, 1937 F. K. LOW 2,071,078

SIGNALING SYSTEM

Filed April 27, 1935

FIG. 1

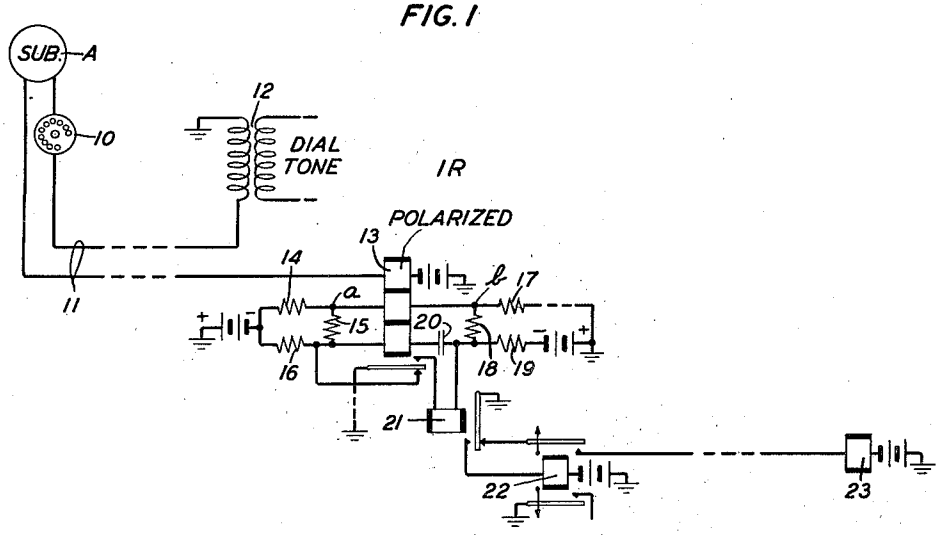
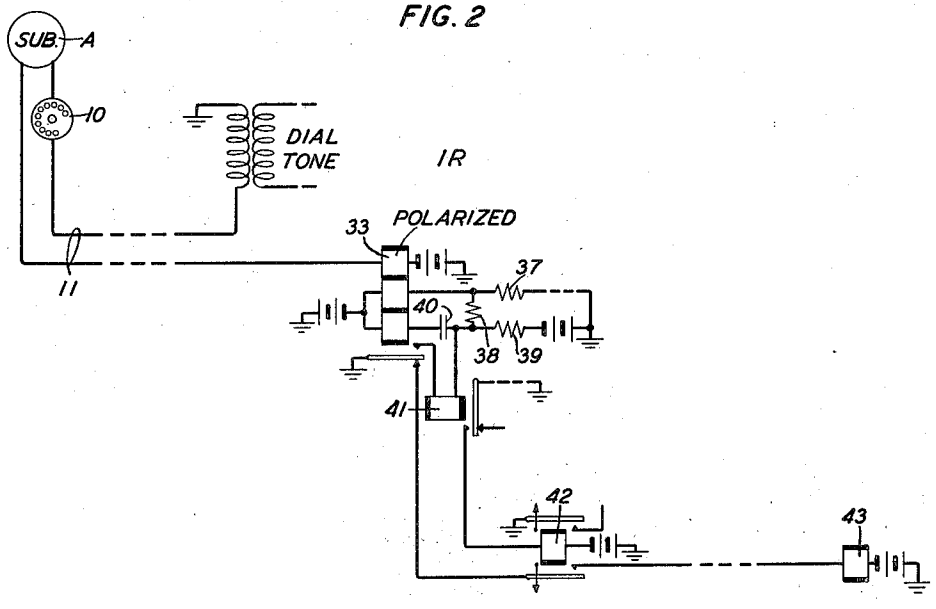


FIG. 2



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SIGNALING SYSTEM

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20 Claims. (Cl. 179—16)

This invention relates to signaling systems and particularly to systems comprising electromagnetic signal receiving means.

The object of the invention is to provide a more sensitive electromagnetic signal receiving means and to insure the accurate response of such a means to incoming signals under wider limits of line resistance, line insulation, and line capacity.

In signaling systems in which selective signals are created and transmitted by the alternate opening and closing of a signaling circuit, it is usual to employ an impulse relay for operation upon the closing of the signaling circuit and release in response to the opening of the signaling circuit. In such a system, the lines over which the signaling circuit is closed vary in length, in insulation resistance and in capacity; and the frequency with which the selective impulses are transmitted varies within certain limits.

A feature of the present invention is a new and improved circuit arrangement in which the impulse relay is polarized and has a plurality of windings, one winding being connected in combination with a condenser so as to increase the limits of line resistance, line insulation, and line capacity within which the relay will satisfactorily respond to signal impulses. An auxiliary impulse relay controls the operation of an impulse register or selector switch, the contacts of the polarized impulse relay being used for controlling the circuits for charging and discharging the condenser and the circuit for operating the auxiliary impulse relay.

Another feature of the invention is an impulse receiving means comprising a polarized relay having one winding connected in a signaling circuit, an auxiliary relay controlled by the polarized relay to repeat the incoming signals to operate a register, and a condenser so connected in combination with a winding of each of the relays that the condenser is charged in one direction in response to the operation of the polarized relay to hold this relay operated for a short interval of time and is charged in the other direction in response to the release of the polarized relay to hold this relay released for a short interval of time. The arrangement is, therefore, one adapted to correct for too short an opening of the impulse circuit and to correct for too short a closure of the impulse circuit between succeeding impulses of a series.

Another feature of the invention is a polarized impulse receiving relay having one winding connected in a signaling circuit and a biasing winding for holding the contact springs in a non-operated position when there is no current in the signal receiving winding, the biasing circuit being controlled so as to be more effective when the contact springs are in operated position than when in non-operated position.

A better and more complete understanding of the invention may be obtained by considering the specific embodiments of the invention shown in the drawing which forms a part of this specification. The invention is not, however, limited in its application to these specific arrangements and is, in general, applicable to any signaling system in which selective signals are created by the opening and closing of a signaling circuit.

Referring to the drawing,

Fig. 1 represents an automatic telephone system comprising a subscriber's station A and impulse receiving means IR;

Fig. 2 also represents an automatic telephone system comprising a subscriber's station A and impulse receiving means IR, the specific embodiment of the invention in the impulse receiving means of Fig. 2 being somewhat different from its embodiment in the impulse receiving means of Fig. 1.

The apparatus at station A includes a dial 10, or an equivalent impulse sender, and is connected by line 11 to a central office or exchange in which automatic switching equipment is provided for establishing a connection between the line 11 and an idle impulse receiving means IR in response to the removal of the receiver at station A to originate a call. The impulse receiving means IR may be used to directly control, in succession, each of a train of selective switches to complete a desired connection or may be used to operate a register which thereafter controls the various switches through which a desired connection is established. Reference may be had to chapter 3 of the second edition of Automatic Telephony, by Smith and Campbell, for a description of an automatic telephone system comprising switches of the well-known Strowger type which are controlled by the dial impulses when dialed. Reference may be had to Patent No. 1,395,977, granted to F. A. Stearn et al., November 1, 1921 for a description of a system comprising switches of the power-driven panel type which are revertively controlled by a register-controller, set in accordance with trains of impulses created by the operation of the dial at any calling subscriber's station to which the register-controller is connected.

The impulse receiving means IR in Fig. 1 comprises a polarized impulse relay 13, a condenser 20, an auxiliary impulse relay 21, a slow-to-

release relay 22, and a register or selector 23. The polarized impulse relay 13 has three windings, the upper winding being connected, upon extension of the line 11 to the impulse receiving means IR, in a signaling circuit which includes the conductors of line 11, the dial 10, and one winding of the dial tone transformer 12. The middle winding of relay 13 is a biasing winding which upon energization is effective to position the contacts of the relay as shown in the drawing. The biasing winding is connected between a network consisting of resistors 14, 15 and 16 and a network consisting of resistors 17, 18 and 19, the strength of the biasing current being automatically varied by the operation and release of relay 13 as hereinafter described. The lower winding of relay 13 is connected in series with condenser 20 between the network consisting of resistors 14, 15 and 16 and the network consisting of resistors 17, 18 and 19. Upon connection of the line 11 to the impulse receiving means IR, ground is connected to resistor 17 to complete a circuit through the biasing winding of relay 13; and ground is also connected to the armature of relay 13, thereby closing a circuit through the lower winding of relay 13 and resistor 19 for charging condenser 20. The charging of condenser 20 by the current in this circuit is interrupted as soon as relay 13 is sufficiently energized by the current in the signaling circuit to open its back contact; and whatever charge may have accumulated in condenser 20 is thereupon immediately discharged through the lower winding of relay 13, the direction of current being such as to aid the complete operation of relay 13. The closing of the front contacts of relay 13 causes the operation of the auxiliary impulse relay 21 and the charging of condenser 20 in the opposite direction to that in which it is charged when the back contacts of relay 13 are closed, the charging current being effective to energize the lower winding of relay 13 in the aiding direction with respect to the energization of the upper winding of relay 13. The condenser charging and discharging currents are, however, of no particular importance at the time the line is first connected to the impulse receiving means IR. The aforementioned operation of the auxiliary impulse relay 21 causes the operation of the slow-to-release relay 22 and nothing further occurs until the subscriber at station A operates the dial 10.

When the dial 10 is operated and the signaling circuit over the conductors of line 11 is opened at the contacts of the dial to transmit the first impulse of a series, relay 13 begins to release and as soon as its front contacts are opened the auxiliary impulse relay 21 releases, thereby closing a circuit for operating the register or selector 23. The opening of the front contacts of relay 13 causes the discharge of condenser 20 through the lower winding of relay 13, the current through this winding being in a direction to aid the complete release of relay 13. As soon as the back contacts of relay 13 are closed, the current through the lower winding of relay 13 is continued in the same direction to charge condenser 20 in the opposite direction to that in which it is charged with relay 13 operated, this current being effective to insure that relays 13 and 21 remain released for a certain minimum interval of time, which interval is long enough for the register 23 to be operated. Upon the closing of the signaling circuit at the contacts of the dial at the end of the first impulse, relay 13 begins to reoperate and as soon as its back contacts are opened, condenser 20 is discharged through the lower winding of relay 13, the current through this winding being in a direction to aid the complete reoperation of relay 13. As soon as the front contacts of relay 13 are again closed, relay 21 reoperates and condenser 20 is again charged, the charging current being in the aiding direction with respect to the current through the upper winding of relay 13 and effective to insure that the front contacts of relay 13 remain closed for a definite minimum interval of time which is sufficient to permit the response of register 23 and prevent the release of relay 22.

Thus the lower winding of relay 13 in combination with condenser 20 is effective, in response to the opening of the signaling circuit through its upper winding, to aid its complete release and insure that it remain released for a certain minimum interval of time and, in response to the closing of this signaling circuit, to aid its complete operation and insure that it remain operated for a certain minimum interval of time.

When relay 13 is released, that is with its back contacts closed, the junction point *a* between resistors 14 and 15 and the biasing winding is at its highest potential above the negative pole of battery, and the junction point *b* between resistance 17 and 18 and the biasing winding is at its lowest potential above the negative pole of battery, the biasing current being at its minimum so as to render the relay more easily operated. When relay 13 is operated, that is with its front contacts closed, the junction point *a* is at its lowest potential above the negative pole of battery and the junction point *b* is at its highest potential above the negative pole of battery, the biasing current being at its maximum so as to render the relay more easily released. Thus, when the relay operates, it is automatically put in condition to be more quickly responsive to the opening of its operating circuit; and, when the relay releases, it is automatically put in condition to be more quickly responsive to the closing of its operating circuit. The changes in biasing current take place immediately when the relay contacts shift from one position to the other and tend to have an effect opposite to that of the condenser 20, but are not large enough to materially affect the advantages gained by the condenser charging and discharging currents through the lower winding of relay 13.

The impulse receiving means IR in Fig. 2 is similar to that shown in Fig. 1 and comprises the polarized impulse relay 33, a condenser 40, auxiliary impulse relay 41, slow-to-release relay 42 and register or selector 43. Whereas in Fig. 1 there are six resistors for controlling the impulse relay biasing and condenser circuit and the back contact of the auxiliary impulse relay is used for operating the register or selector, in Fig. 2 three of these resistors have been omitted. Due to the use of only the three resistors 37, 38 and 39 and the use of the back contact of relay 33 for operating the register 43, the condenser 40 is charged in only one direction instead of being charged first to battery potential in one direction and then to battery potential in the opposite direction as in the arrangement of Fig. 1. For the same reason, the biasing of the polarized relay 33 is changed only upon the closing of its front contact instead of being changed both upon the breaking of its back contact and also upon the closing of its front contact. To obtain the de-

sired results, resistor 38 has a somewhat lower resistance than the corresponding resistor 18 of Fig. 1 and the efficiency of the condenser charging and discharging current is therefore slightly less than in the arrangement of Fig. 1. As soon as the front contact of relay 33 opens, upon the opening of the signaling circuit over line 11 at the contacts of dial 10, the condenser 40 starts to discharge in a direction to aid its complete release and hold the back contacts closed for a definite minimum interval; but upon the closing of the dial contacts at the end of the impulse, relay 33 must close its front contact before there is a condenser charging current, which current is, therefore, only effective to hold the relay operated for a definite minimum interval of time.

It is to be noted that in Fig. 2 the register, or selector, operating circuit is controlled by the back contact of the polarized impulse relay 33, whereas in Fig. 1 the corresponding circuit is controlled by the back contact of the auxiliary impulse relay. The arrangement shown in Fig. 2 may, therefore, have an advantage, over that shown in Fig. 1, in that operation of the register, or selector, is effected directly by the primary impulse receiving relay, the possibility of impulse distortion resulting from the repeating of the impulses by an auxiliary impulse relay being thereby avoided.

What is claimed is:

1. In a signaling system, a line, a signal sender, a signal receiving relay, a circuit including said line and sender and a winding of said signal receiving relay, an auxiliary signal relay controlled by said signal receiving relay, and means comprising a condenser for aiding the complete operation of said signal receiving relay in response to the closing of said circuit.

2. In a signaling system, a line, a signal sender, a signal receiving relay, a circuit including said line and sender and a winding of said signal receiving relay, an auxiliary signal relay controlled by said signal receiving relay, and means comprising a condenser for aiding the complete release of said signal receiving relay in response to the opening of said circuit.

3. In a signaling system, a line, a signal sender, a signal receiving relay, a circuit including said line and sender and a winding of said signal receiving relay, an auxiliary signal relay controlled by said signal receiving relay, and means comprising a condenser for aiding the complete operation of said signal receiving relay in response to the closing of said circuit and for aiding the complete release of said signal receiving relay in response to the opening of said circuit.

4. In a signaling system, a line, a signal sender, a signal receiving relay, a circuit including said line and sender and a winding of said signal receiving relay, an auxiliary signal relay controlled by said signal receiving relay, and means comprising a condenser for insuring that upon operating in response to the closing of said circuit said signal receiving relay remains operated for not less than a certain interval of time.

5. In a signaling system, a line, a signal sender, a signal receiving relay, a circuit including said line and sender and a winding of said signal receiving relay, an auxiliary signal relay controlled by said signal receiving relay, and means comprising a condenser for insuring that upon release in response to the opening of said circuit said signal receiving relay remains released for not less than a certain interval of time.

6. In a signaling system, a line, a signal sender, a signal receiving relay, a circuit including said line and sender and a winding of said signal receiving relay, an auxiliary signal relay controlled by said signal receiving relay, and means comprising a condenser for insuring that upon operating in response to the closing of said circuit said signal receiving relay remains operated for not less than a certain interval of time and upon release in response to the opening of said circuit remains released for not less than a certain interval of time.

7. In a signaling system, a line, a signal sender, a signal receiving relay, a signaling circuit including said line and sender and a winding of said relay, a condenser, a first circuit including said condenser and another winding of said relay, a second circuit including said condenser and said other winding of said relay, and means comprising contacts of said signal receiving relay for closing said first circuit when said relay is released and for closing said second circuit when said relay is operated.

8. In a signaling system, a line, a signal sender, a signal receiving relay, a signaling circuit including said line and sender and a winding of said signal receiving relay, a condenser, a circuit including said condenser and another winding of said signal receiving relay, an auxiliary signal relay controlled by said signal receiving relay, and a circuit including said condenser and said other winding of said signal receiving relay and a winding of said auxiliary signal relay.

9. In a signaling system, a line, a signal sender, a polarized signal receiving relay, a signaling circuit including said line and sender and a winding of said relay, a biasing circuit including a second winding of said relay, the current in said biasing circuit being in electromagnetic opposition to the current in said signaling circuit, a condenser, a circuit including said condenser and a third winding of said relay and normally closed contacts of said relay, and a circuit including said condenser and said third winding of said relay and normally open contacts of said relay.

10. In a signaling system, a line, a signal sender, a polarized signal receiving relay, a signaling circuit including said line and sender and a winding of said relay, a biasing circuit including a second winding of said relay, the current in said biasing circuit being in electromagnetic opposition to the current in said signaling circuit, and means including contacts of said relay for altering the biasing circuit.

11. In a signaling system, a line, a signal sender, a polarized signal receiving relay, a signaling circuit including said line and sender and a winding of said relay, a biasing circuit including a second winding of said relay, the current in said biasing circuit being in electromagnetic opposition to the current in said signaling circuit, and means for altering the biasing circuit to aid the release of the relay.

12. In a signaling system, a line, a signal sender, a polarized signal receiving relay, a signaling circuit including said line and sender and a winding of said relay, a biasing circuit including a second winding of said relay, the current in said biasing circuit being in electromagnetic opposition to the current in said signaling circuit, and means for altering the biasing circuit to aid the operation of the relay.

13. In a signaling system, a line, a signal sender, a signal receiving relay, a signaling circuit including said line and sender and a winding of said relay, a condenser, two circuits each including said condenser and another winding of

said signal receiving relay, one of said two circuits being closed while said relay is operated and the other while said relay is released, and a third circuit including said condenser and said other winding of the signal receiving relay.

14. In a signaling system, a line, a signal sender, a signal receiving relay, a signaling circuit including said line and sender and a winding of said relay, a condenser, a circuit including said condenser and including contacts and another winding of said signal receiving relay, and a permanently closed circuit including said condenser and said other winding of the signal receiving relay.

15. In a signaling system, a line, a signal sender, a polarized signal receiving relay, a signaling circuit including said line and sender and a winding of said relay, a biasing circuit including a second winding of said relay, the current in said biasing circuit being in electromagnetic opposition to the current in said signaling circuit, a condenser, a permanently closed circuit including said condenser and a third winding of said relay, a circuit including said condenser and said third winding of said relay and normally close contacts of said relay, and a circuit including said condenser and said third winding of said relay and normally open contacts of said relay.

16. In a signaling system, a line, a signal sender, a polarized signal receiving relay, a signaling circuit including said line and sender and a winding of said relay, a biasing circuit including a second winding of said relay, the current in said biasing circuit being in electromagnetic opposition to the current in said signaling circuit, an auxiliary signal relay controlled by said signal receiving relay, a condenser, a permanently closed circuit including said condenser and a third winding of said signal receiving relay, a circuit closed through said condenser and third winding of said signal receiving relay by the operation of said signal receiving relay, and a circuit closed through said condenser and third winding of said signal receiving relay and the winding of said auxiliary signal relay by the release of said signal receiving relay.

17. In a signaling system, a line, a signal sender, a signal receiving relay having a line winding and a biasing winding, a circuit including said line and sender and the line winding of said signal receiving relay, a circuit including the biasing winding of said relay, the current in said biasing winding being electromagnetically opposed to the current in said line winding, and means comprising resistors and the contacts of said signal receiving relay for decreasing the biasing current when said relay is released.

18. In a signaling system, a line, a signal sender, a signal receiving relay having a line winding and a biasing winding, a circuit including said line and sender and the line winding of said signal receiving relay, a circuit including the biasing winding of said relay, the current in said biasing winding being electromagnetically opposed to the current in said line winding, and means comprising resistors and the contacts of said signal receiving relay for increasing the biasing current when said relay is operated.

19. In a signaling system, a line, a signal sender, a signal receiving relay having a line winding and a biasing winding, a circuit including said line and sender and the line winding of said signal receiving relay, a circuit including the biasing winding of said relay, the current in said biasing winding being electromagnetically opposed to the current in said line winding, and means comprising resistors and the contacts of said relay for increasing the biasing current when said relay is operated and decreasing the biasing current when said relay is released.

20. In a signaling system, a line, a signal sender, a signal receiving relay having a line winding, a biasing winding and a third winding, a circuit including said line and sender and the line winding of said relay, a circuit including the biasing winding of said relay, the current in said biasing winding being electromagnetically opposed to the current in said line winding, means comprising resistors for increasing the biasing current when said signal receiving relay is operated and for decreasing the biasing current when said signal receiving relay is released, an auxiliary signal relay controlled by said signal receiving relay, a condenser, and circuits including said condenser and said third winding of said signal receiving relay.

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