

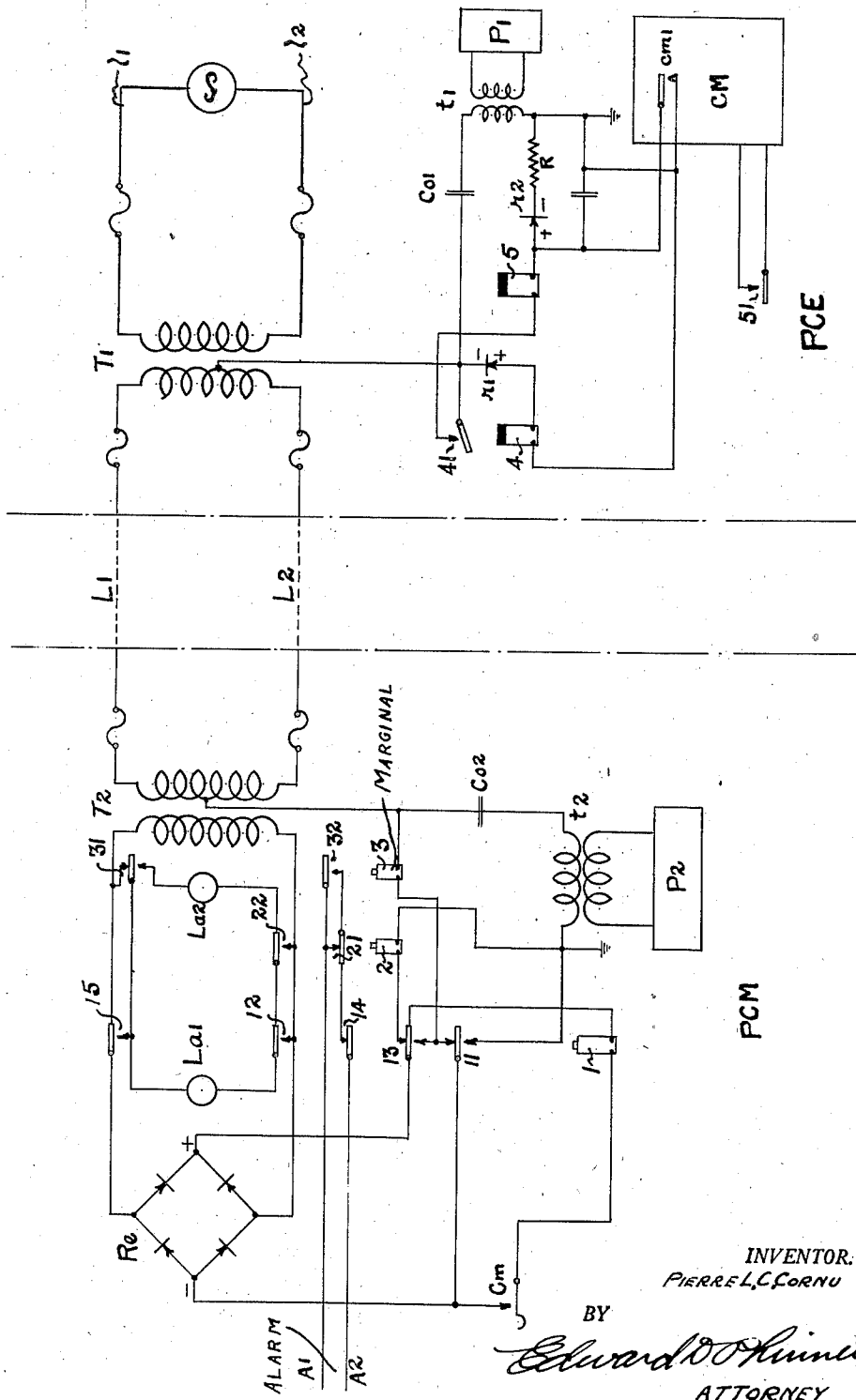
July 29, 1947.

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2,424,554

ELECTRICAL SIGNALING SYSTEM

Filed March 1, 1943



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2,424,554

ELECTRICAL SIGNALING SYSTEM

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Application March 1, 1943, Serial No. 477,648
In France August 23, 1939

7 Claims. (Cl. 177-311)

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The present invention is concerned with improvements in control, signaling and/or similar systems, the purpose of which is to eliminate for all practical purposes any possibility of a wrong control or wrong signaling while obtaining immediate signaling of trouble likely to affect the operation of the system.

One of the objects of this invention is to provide a system in which the energy required for the transmission of control or signaling is transmitted from the controlled station to the control station and retransmitted either transformed or not from the control station to the controlled station in order to cause the desired control or signaling.

A further feature of this invention is presented in the fact that the energy required for the transmission of control or signaling is transmitted from the controlled station to the control station in the form of alternating current, transformed into continuous current at the control station and returned in this form to the controlled station in order to cause the desired control or signaling.

A still further feature of the invention is presented in the fact that the alternating current energy is transmitted from the controlled station to the control station over two conductors of a line linking the two stations, transformed into continuous current at the control station, and sent back to the controlled station over the two line conductors in order to effect the desired control or signaling.

A still further advantage of the invention resides in the fact that the energy transmitted from the controlled station to the control station is utilized during the interval between controlling or signaling operations to effect a continuous testing of the installation and signaling any trouble developing and likely to affect its operation.

Another feature of the invention resides in the fact that the polarity of the continuous current applied to the line conductors during the interval between controlling operations, to effect the continuous testing of the line and associated equipment, is reversed at the moment of transmitting the control or the signaling current.

Still another feature of the invention is found in the arrangement in the control or signaling circuit of telephone circuits allowing establishment of telephone communication between the

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control station and the controlled station, such communication being under no circumstances capable of producing interference with the control or signaling functions of the system.

These, as well as other objects and advantages of this invention will be apparent from the following detailed description of one embodiment thereof, which is not given in a limiting sense, but rather by way of example.

This invention resides substantially in the combination, construction, arrangement and relative location of parts, all as will be described in detail below.

In the accompanying drawing the single figure comprises a schematic and diagrammatic illustration of the embodiment thereof selected for the purpose of disclosing the invention.

The control station has been generally indicated by the reference numeral PCM and the controlled station is generally indicated by the reference numeral PCE. The line comprising the conductors L1 and L2 extends between the two stations which may be separated any required distance as indicated by the broken line portions of these conductors. The signal and/or control current is supplied from any suitable alternating current source by the fused line 11, 12 to the primary of the transformer T1. The secondary of this transformer is connected as shown through proper protection devices such as fuses to the controlled station end of the line conductors L1, L2. These conductors extend to the control station and are connected to the primary of a transformer T2. The secondary of this transformer has its terminals connected across the input terminal of a suitable rectifier Re. As those skilled in the art will appreciate, the rectifier may be of several acceptable forms, and may include as illustrated a plurality of rectifying devices connected in a bridge circuit as shown. A circuit for the signal lamps La1 and La2 is arranged as shown in conjunction with the switches 12, 15, 22 and 31, as will be later described.

The positive terminal of the rectifier Re is connected by a line to the movable contact of switch 13 which is also connected by a wire to one terminal of the magnet 1. The other terminal of this magnet is connected to one of the contacts of a switch Cm. The other terminal of this switch is connected to the negative terminal of the rectifier and to the movable contact of switch

11. The signal or alarm circuit comprising the conductors A1 and A2 includes the series switch 14 and the shunt switches 21 and 32. The back contact of switch 13 is connected to the magnet 2 which is grounded as shown. The back contact of switch 11 is connected to the magnet 3, which in turn is connected to the mid-point of the primary of the transformer T2. This point is also connected through a condenser C02 to the secondary of a transformer t2 for coupling the telephone equipment P2 to the line. The other terminal of the secondary of transformer t2 is grounded as shown.

The midpoint of the secondary of transformer T1 is connected to the negative terminal of a rectifier r1 whose positive terminal is connected to the magnet 4, which in turn is grounded at its other terminal and connected to one contact of the switch cm1. The negative terminal of the rectifier r1 is connected to one terminal of a switch 41, the other terminal of which is connected to one terminal of magnet 5, and to the positive terminal of a rectifier r2. This terminal is also connected to the other terminal of switch cm1 and through a condenser as shown to ground. The negative terminal of rectifier r2 is connected through the resistance R to ground. The telephone equipment P1 is connected to the transformer t1, the secondary of which has one terminal grounded and the other terminal connected through condenser C01 to the midpoint of the secondary of transformer T1.

As diagrammatically illustrated in the drawings, the contacts or switches controlled by the various magnets are shown in vertical alignment therewith. Thus the switches 15, 12, 14, 13 and 11 are operated by the magnet 1. Switches 22 and 21 are operated by the magnet 2. Switches 31 and 32 are operated by the magnet 3. Switch 41 is operated by the magnet 4. Switch 51 is operated by magnet 5 and controls the equipment CM or a signal associated therewith. The diagrammatic illustration of the equipment CM is provided to indicate that either the control thereof or a signal in connection therewith is really independent of the nature of the equipment, as will be obvious to one skilled in the art. The various magnets and switches controlled thereby are represented by well known electro-magnet relays, of which many practical forms are available.

The operation of this system will now be described. When the system is in use the alternating current source connected to the conductors L1 and L2 is supplying current to the network. This current is applied to the transmission line L1 and L2 through the transformer T1 and from the line through the transformer T2, across the input terminals of the rectifier Re. This condition exists throughout normal operation of the system. As a result of this a circuit will be completed to the relay magnets 2 and 4 as follows: from ground through magnet 2, the movable finger of switch 13 and the back contact normally engaging it to the positive terminal of rectifier Re, from the negative terminal of this rectifier through the movable contact of switch 11 and its back contact, magnet 3, mid-point of the primary of transformer T2 over the conductors L1 and L2 in parallel to the midpoint of the secondary of transformer T1 and from there to and through the rectifier r1, and the winding of magnet 4 to ground. The magnets 2 and 4 in this circuit are energized while the magnet 3 remains de-energized owing to the relative

resistance between it and the relays 2 and 4 and the number of ampere turns on these magnets respectively. Thus switches 31 and 32 remain in the position shown, but switch 41 is opened, switches 15 and 12 are opened, switch 14 is closed, switch 13 is on its back contact, and switch 11 is on its back contact. One of the results of this circuit alignment is as will be seen that signal lamp Lal is connected across the secondary of transformer T2 through switches 31 and 22 and is therefore energized. So long as this light remains energized the operator at the control station is signaled that the circuit is in good operating condition.

If it be assumed that an open circuit on the line comprising the conductors L1 and L2 occurs, it follows that the circuit for magnet 2 is opened, with the result that switch 22 first opens and switch 21 which was open closes. Signal lamp Lal is extinguished, indicating trouble on the line. The closing of switch 21 completes the alarm circuit A1—A2 setting a suitable alarm, not shown, in operation, further signaling to the operator that something is wrong with the line.

In the event that the ground connection at either station or both of them developed a very high resistant condition the same result, namely the extinguishing of light Lal and the energization of the alarm will follow, indicating that the system is not operating properly.

Should either or both of the line conductors L1 or L2 become grounded, magnet 4 becomes short-circuited in an obvious manner, with the result that magnet 3 is energized to operate switches 31 and 32. The operation of switch 31 opens the circuit for lamp Lal, extinguishing it. The operation of switch 32 will complete the alarm circuit A1—A2 giving a further signal of trouble on the line.

In the event that energy either ceases to be transmitted from the controlled station PCE to the control station PCM, or ceases for any reason to be received at PCM, the supply of energy for the relay 2 will be cut off so that as before, lamp Lal will be extinguished and the alarm circuit will be completed. Thus it will be seen that so long as the signal by supervisory lamp Lal is energized the circuit is in operating condition, but as soon as it is extinguished from any one of the several possible reasons explained above, trouble on the line will be indicated.

In order to cause transmission of a control signal to the controlled station the switch Cm is closed, completing a circuit for the magnet 1 which is held as long as this switch is closed. This circuit is obvious from the drawing. The energization of magnet 1 closes switches 15 and 12, opens switch 14, shifts the positive side of the rectifier Re to the front contact of switch 13, and shifts the negative connection of the rectifier to the front contact of switch 11. The closing of switches 12 and 15 during this period maintains the circuit for the supervisory lamp Lal. The opening of switch 14 breaks the signal alarm circuit during this period. The operation of switches 11 and 13 connects the rectifier Re in circuit with them and ground, as will be readily seen from the drawings. At this time magnet 4 is not effectively energized and switch 41 is closed. The shifting of switch 13 breaks the circuit for magnet 2 so that switch 22 opens and switch 21 closes. The circuit for magnet 3 upon the closing of switch 41 is completed through switch 41, magnet 5, rectifier r2 and resistance R to ground. Magnet 5 remains energized but magnet 3 does

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not remain energized owing to the high value of resistance R in series with the resistance of magnet 5.

The energization of magnet 5 closes switch 51, causing the equipment CM to undergo the desired control, or causing the operation of the signal device associated therewith. When the signaling operation has been effectively completed switch *cm1* is closed by the operation of the control or signal apparatus, so that rectifier *r2* and resistance R are short-circuited. As a result the current for the magnet 3 is strong enough to energize the magnet so as to close switch 32 and operate switch 31. The closing of switch 32 does not complete the alarm circuit because switch 14 is open. However, the operation of switch 31 causes the signal lamp *La2* to be energized through closed switch 15, the front contact of switch 31, and closed switch 12, indicating at the control station that the control signal has been properly transmitted and the desired control or signaling at the controlled station has been effected. Upon the opening of switch *Cm* at the completion of this operation, the control circuit is broken and the parts returned to the normal position shown in the drawings, at which time, of course, the alarm circuit is open at switch 21 and the supervisory lamp *La1* is operated.

Telephone communication can be effected over the circuit from either station P1 and P2. The secondary of transformer *t2* is grounded at one terminal and its other terminal is connected through the capacitor *Co2* to the primary of transformer *T2*, over the line conductors *L1-L2* in parallel to the midpoint of the secondary of transformer *T1*, and thence through the capacitor *Co1* and the secondary of transformer *t1* to ground. Thus the telephone circuit is ready for operation at all times without interference with the other functions of the circuits.

From the above description it will be seen that the subject matter of this invention can be applied in various physical forms without departure from the novelty thereof. For example, those skilled in the art will appreciate that capacitive coupling devices could be employed in place of the transformers without affecting the basic operation of the system. I do not, therefore, desire to be strictly limited to the disclosure as given herein for illustrative purposes, but rather by the scope of the appended claims.

What is claimed is:

1. In a control and signal system a controlled station, a control station, a circuit comprising two line wires connecting the stations, means at the controlled station applying an alternating current to said circuit for transmission to the control station, means at the control station for rectifying said current and applying it with a given polarity to a second circuit between the stations comprising the line wires in multiple and the ground, means at the control station for reversing the polarity of application of the rectified current to said second circuit, and means at the controlled station responsive to such reversal for accomplishing a desired control.

2. In a control and signal system a controlled station, a control station, a circuit comprising two line wires connecting the stations, means at the controlled station applying an alternating current to said circuit for transmission to the control station, means at the control station for rectifying said current and applying it with a given polarity to a second circuit between the

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stations comprising the line wires in multiple and the ground, means at the control station for reversing the polarity of application of the rectified current to said second circuit, means at the controlled station responsive to such reversal for accomplishing a desired control, means responsive to said accomplished control to cause a variation of said reversed current, and means at the control station responsive to said variation of current for indicating the accomplishment of said control.

3. In a control and signal system a controlled station, a control station, a circuit comprising two line wires connecting the stations, means at the controlled station applying an alternating current to said circuit for transmission to the control station, means at the control station for rectifying said current and applying it with a given polarity to a circuit between the stations comprising the line wires in multiple and the ground, means in said first circuit at the control station for indicating a variation of the current flowing in said circuits, means in the second circuit for controlling the connection of the indicating means in circuit and thereby supervising the first and second circuits and the alternating current applying means, means at the control station for reversing the polarity of application of the rectified current to said second circuit, means at the controlled station responsive to such reversal for accomplishing a desired control, means responsive to said accomplished control to cause a variation of said reversed current, and means at the control station responsive to said variation of current for indicating the accomplishment of said control.

4. In a control and signal system a controlled station, a control station, a circuit comprising two line wires connecting the stations, means at the controlled station applying an alternating current to said circuit for transmission to the control station, means at the control station for rectifying said current and applying it with a given polarity to a circuit between the stations comprising the line wires in multiple and the ground, means in said first circuit at the control station for indicating a variation of the current flowing in said circuits, means in the second circuit for controlling the connection of the indicating means in circuit and to thereby supervise the first and second circuits and the alternating current applying means, means at the control station for reversing the polarity of application of the rectified current to said second circuit, means at the controlled station responsive to such reversal for accomplishing a desired control, means responsive to said accomplished control to cause a variation of said reversed current, a second indicating means in the first circuit, and means responsive to said variation of current for controlling the connection of the second indicating means and thereby indicate the accomplishment of said control.

5. In a system of the type described including a control station and a controlled station, the combination including a pair of conductors extending between the control station and the controlled station, means at the controlled station end for generating alternating current and connected with both conductors as a complete circuit to transmit the current to the control station end of the conductors, a rectifier connected to the parallel conductors at the control station to transmit direct current to the controlled station, a grounded direct current circuit between the control station and the controlled

station connected with the output terminals of said rectifier including said conductors in parallel, a supervisory circuit at the controlled station, means for opening and closing said supervisory circuit, and means at the control station for controlling said means at the controlled station over said rectifier circuit, whereby direct and alternating currents are simultaneously transmitted between said control and controlled stations without interference between said currents. 10

6. In the combination of claim 5, a signal device at the control station, and means at the controlled station for energizing said signal device upon the opening of said supervisory circuit.

7. In the combination of claim 5, a signal device at the control station, and means for connecting said signal device to said conductors upon the completion of the operation requiring the actuation of the supervisory circuit. 15

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