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SIGNALING SYSTEM

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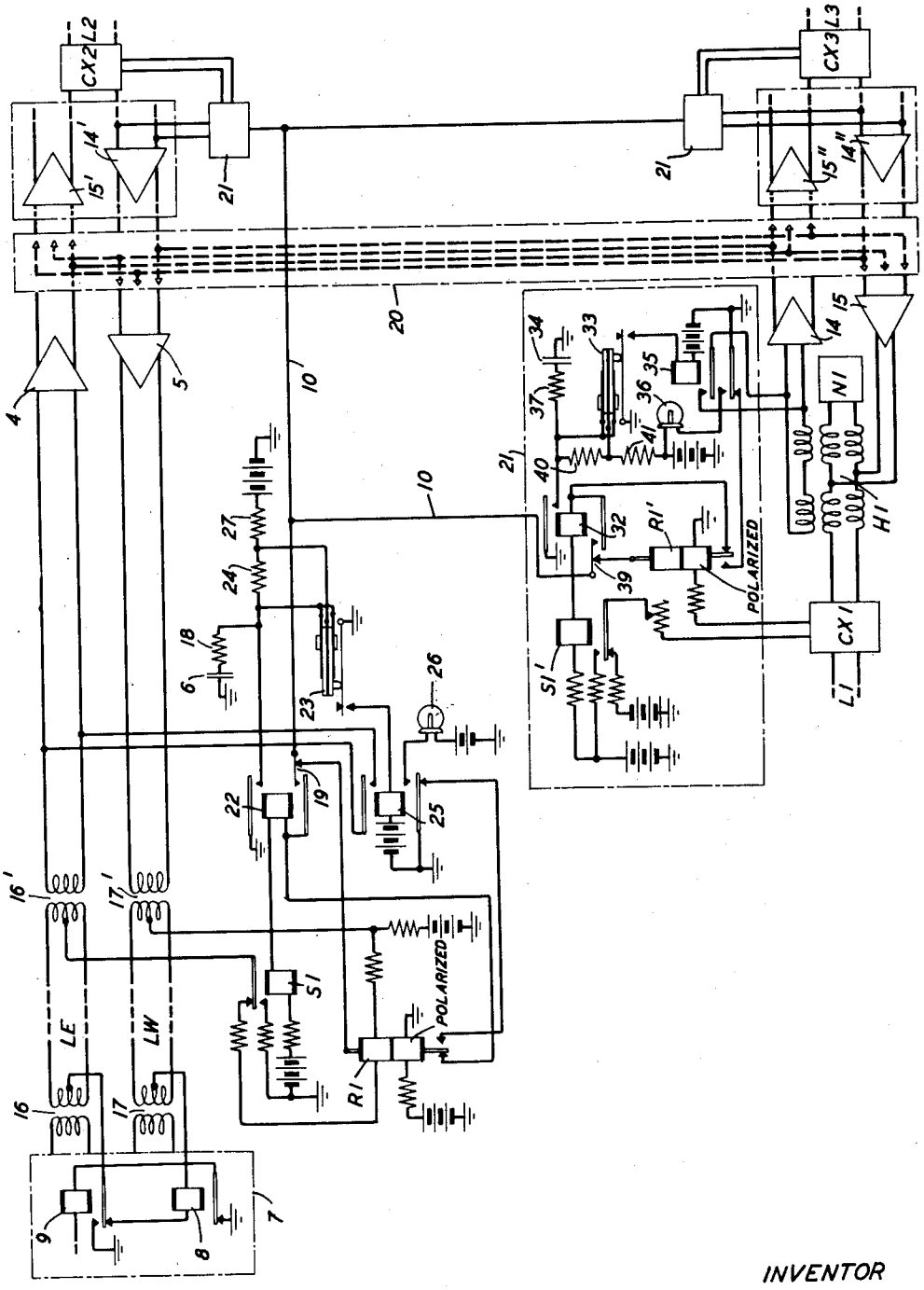

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SIGNALING SYSTEM

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2 Claims. (Cl. 179—170)

This invention relates to signaling systems and particularly to control circuit repeaters used for the control of transmission circuits.

The invention may be considered as an alternative to the arrangement disclosed in Patent 2,018,494 issued to me on October 22, 1935, and reference may be had to that patent for a description of the general objects and functions of repeaters of this type.

The object of this invention is to improve the operating characteristics of control circuit repeaters and at the same time to achieve economy through the use of less expensive apparatus. In the arrangement shown in my Patent 2,018,494 certain relays are shown as slow-releasing and this characteristic action is achieved through the use of a condenser which through its charging current maintains an electromagnetic relay operated for a given time after the operating circuit of such relay is opened. The condenser therein used must be of fairly high capacity and the precious metal contacts of the relay used for closing the operating circuit of such relay must be rugged to withstand the wear and tear incident to the use of such heavy capacity. A specific object of the present invention is therefore to achieve economy through the use of smaller capacities and less expensive contact arrangements and at the same time to gain greater latitude in the timing characteristics of slow-releasing relays.

A feature of the invention is the use of what may be termed a condenser relay, that is, one which responds to a difference in potential and requires for its operation only that amount of energy which may be measured by the charging current of a condenser. By way of example, such a relay is shown herein as a crystal relay having a movable element similar in construction and operation to the motor element used by Sawyer in his Reissue Patent 20,213, December 22, 1936. In general also a relay of this nature is shown in an application for Letters Patent by Warren P. Mason, Serial No. 131,160 filed March 16, 1937. Piezo-electric bodies such as quartz, tourmaline and Rochelle salt crystal are the type of materials contemplated for use in the relay elements of this invention.

In the drawing there is shown in schematic form so much of a complete picture transmitting and talking circuit with direct current control equipment as is necessary to a complete understanding of the invention.

Four different lines are shown radiating from the central switching or branch point indicated by the rectangle **20**. These four lines comprise first the four-wire subscriber's loop including the east line LE and the west line LW and the three two-wire interoffice lines L1, L2 and L3. The circuits enclosed in the rectangle **20** are preferably an interconnecting network of the type described and claimed in Letters Patent of C. W. Green No. 2,019,603, issued November 5, 1935. Each of the lines radiating from the branching point is connected with each of the other lines so that transmission received over the one line is sent out over each of the other lines. For this purpose, as disclosed more fully in the Green patent, each of the lines as it enters the network **20** is in the form of a four-wire circuit comprising a transmitting branch and a receiving branch. The lines LE and LW are already a four-wire circuit and contain the four-wire repeater comprising elements **4** and **5**. The line L1 is provided with a hybrid coil arrangement H1 and balancing network N1 to provide in a manner common in the repeater art two one way branches, one leading through the amplifier **14** toward the network **20**, and the other leading through the amplifier **15** from the network **20** toward the line L1. In similar manner, line L2 terminates in a pair of one-way branches containing repeaters **14'** and **15'** and line L3 is similarly provided with one-way branches including amplifiers **14''** and **15''**, the hybrid coil arrangements for these latter lines not being shown. All of these lines could be four-wire lines like LE, LW or two-wire lines like L1, etc.

The dotted lines and arrows inside the rectangle **20** show the paths taken by the message waves transmitted and received over the various one-way circuits radiating from the network **20**. For example, waves received over the line LE through the amplifier **4** divide between the three outgoing branches leading to the lines L1, L2 and L3, respectively, as shown by the arrows. Similarly, the waves received over any line entering the network **20** are sent out over each of the other lines but are prevented from reentering the same line or the opposite side of the same four-wire line by the nature of the interconnecting network, as shown more fully in the Green patent.

The four-wire line LE, LW leads out to a station **7** which may contain any suitable transmitting and receiving apparatus but will be assumed for purposes of disclosure to include picture transmitting and talking apparatus which may be of the type shown, for example, in application for Letters Patent by A. Weaver, Serial No. 734,152, filed July 7, 1934. Of this apparatus only the

sending relay 9 and the receiving relay 8 are shown in the drawing. Speech currents or currents representing the picture are sent out from the station 7 over the line LE and currents of similar character are received at the station over the line LW. The receiving relay 8 may be arranged as in the Weaver application or otherwise to actuate a signal notifying the attendant that a picture is about to be received. The sending relay 9 may be operated manually or otherwise associated with the picture transmitting machine so that this relay is actuated when the pictures are to be sent out over the line LE. The circuit details of this terminal apparatus are more fully disclosed in the Weaver application referred to.

It will be understood that a similar station is present on each subscriber's loop entering offices to which the lines L1, L2 and L3 extend so that, when a picture is sent out or speech is transmitted from any one station, it is received at the corresponding station on each of the other subscriber's lines.

Associated with each of the four lines coming into the switching point shown is a direct current repeater as shown diagrammatically herein. The repeater associated with the line LE, LW comprises polarized receiving relay R1 and sending relay S1, an auxiliary sending relay 22 and a slow-release relay 23, made slow through the proper proportioning of the condenser 6 and resistances 18, 24 and 27, and a local or switching relay 25.

The control circuit repeater associated with the line L1 is generally indicated at 21 and differs from that associated with the line LE, LW only in the difference in type of control current sent out on the line. The repeaters for the lines L2 and L3 may be identical with that for line L1 and are similarly numbered as 21, 21. Each of these repeaters is associated with its corresponding line through suitable composite arrangements CX1, CX2 or CX3 which may be of any suitable type known in the art for enabling direct current to be sent over the corresponding line without interfering with the transmission of speech or picture currents.

Let it be assumed that a picture is to be sent from the station 7 on the line LE, LW to corresponding stations on other subscriber lines. The attendant at station 7 prepares the transmitting machine to transmit the picture and connects it to the terminals of the outgoing line LE, at the same time closing a suitable energizing circuit for the sending relay 9, causing this relay to attract its armature, breaking at its back contact the energizing circuit for the receiving relay 8 and closing at its front contact a circuit from ground over the simplex circuit comprising the two sides of the line LE between the repeating coils 16 and 16', normal contacts of the sending relay S1 of the repeater circuit and the upper winding of receiving relay R1 to battery, causing the latter relay to become energized. The circuit just traced remains closed for the duration of the transmission of the picture.

The receiving relay R1, when energized, closes a circuit from ground at the lower armature and back contact of relay 25, right-hand contact and armature of relay R1, normal contact 19 of relay 22, to the control lead 10 which leads to all of the other repeaters. The effect at the various repeaters can be seen from considering the effect of this ground on the lead 10 at the repeater 21 associated with line L1. This ground on conductor 10 causes the energization of the sending relay S1' and the auxiliary relay 32, the circuit extending from conductor 10 through normal contact 39, armature and contact of receiving relay R1' and the windings of relays 32 and S1' to battery. Relay S1', in shifting its armature, reverses the current on the line L1, the effect of which is described later on. Relay 32 causes the energization of relay 33 by placing ground potential on the outer conducting sheets while the inner common conducting sheet is connected to battery. This causes a distortion of the two crystals placed between the two conducting sheets with the result that a mechanical movement takes place which closes the armature of relay 33 to its contact and causes the energization of relay 35. Relay 32, through the movement of its lower armature locks relay 32 and S1' directly to the ground on conductor 19 and allows relay R1' to become deenergized. Relay 35, upon energization, closes a shunt across the input side of repeater 14, thus disabling this side of the four-wire circuit terminating the line L1. At the lower armature and back contact of relay 35 the normal ground extending to the left-hand contact or relay R1' is broken and at the front contact a circuit is closed for signal lamp 36, to indicate that transmission is taking place through this station in a direction from the network 20 toward the line L1.

A similar action takes place in each of the other repeaters 21 associated with the line L2 and L3 since the lead 10 is connected in a similar manner to these repeaters. The corresponding amplifier elements 14' and 14'' are disabled by the closure of a short circuit by relays similar to 35. Transmission can now take place from the station 7 over the line LE to the branching network 20 and thence over each of the lines L1, L2 and L3.

The effect of reversing the current on line L1 can be seen from considering the repeater 21 to be receiving from the similar repeater at the distant office to which line L1 leads. Suppose that the sending relay at such distant station is operated in response to control current received from a subscriber's line or another interoffice trunk. Such current reversal would energize relay R1' and ground would have been placed on the conductor 10 through the left-hand contact of relay R1' and the back contact and lower armature of relay 35. This ground would have had the effect of energizing all of the auxiliary and sending relays associated with each of the other lines including auxiliary sending relay 22 and sending relay S1 in the repeater associated with the line LE, LW. This would cause the relays 22, S1, 23 and 25 of that repeater to energize sending current out over the loop comprising lines LE and LW and the winding of relay 8 and at the central station lighting the lamp 26, closing a short circuit across the input of repeater 4 and breaking the connection at the lower armature and back contact of relay 25. Thus, the picture apparatus at the substation on line LE, LW would have been conditioned for receiving.

If a sudden disturbance occurs on the lines after the direct current repeaters have been operated to condition the circuit for transmission in one direction, the momentary operation of the receiving relays causing their armatures to shift to their opposite contacts or to vibrate will not have the effect of changing the conditioning of the line for the message transmission. For example, assuming as at first that transmission is taking place from the station 7 on the line LE, LW to the other

lines, relays 32 and S1' (as well as the corresponding relays in the repeaters associated with lines L2 and L3) will be operated and the relays 33 and 35 will likewise be operated. If now a disturbance on the lines momentarily causes relay R1 to shift its armature to the opposite contact, this will not have the effect of releasing the relay 35 nor energizing relays S1 and 22 because of the slow-release characteristics of relay 33. Should the ground on conductor 10 be momentarily removed and relay 32 momentarily deenergized, condenser 34, which has during the period of energization of relay 32 been short-circuited, will now begin to charge and the flow of charging current into condenser 34 will maintain the outer conducting sheets of condenser relay 33 at practically ground potential for a short interval. Thus, relay 35 is maintained energized through such short disturbances and the shunt across the input of repeater 14 from the armature and front contact of relay 35 remains unbroken and the lamp 36 remains illuminated.

A prolonged opening of the circuit of the lead 10 will restore the apparatus to normal. For example, after the picture has been transmitted from the station 7 on the line LE, LW and the relay 9 has been released for a sufficient length of time, receiving relays R1, 32 and S1' will fall back and after a sufficient time allowing for the condenser 34 to become charged relay 33 will become deenergized. The time required for the latter relay to become deenergized is determined by the constants of circuits, particularly the resistances 37, 40 and 41 and condenser 34, as heretofore explained. This same action occurs at each of the other repeaters 21 associated with the other lines such as L2 and L3.

The receiving relay corresponding to the relay 8 of the substation 7 is restored when the relay S1 releases since positive battery is now applied to each side of the line LE, LW, one connection being through the back contact of relay S1 and winding of relay R1 and the other being to repeating coil 17'.

It is to be understood that the invention is not limited to particular circuit details disclosed herein but is capable of wide modification and variation within the scope of the appended claims.

What is claimed is:

1. A signaling system comprising a plurality of transmission paths, a circuit for each of said lines for repeating auxiliary control signals between said lines, said circuit including a relay responsive to incoming signals, a relay for transmitting outgoing signals and a slow-releasing relay, a common path under the joint control of each associated pair of incoming signal and slow-releasing relays for controlling the outgoing signal relays of the other of said circuits, said slow-releasing relays being constructed of piezoelectric crystals faced in condenser-like manner with conducting sheets and arranged to respond to potential differences set up by their said associated outgoing signal relays.

2. A signaling system as claimed in claim 1 wherein said piezoelectric crystals are constructed from the crystals of Rochelle salt.

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