

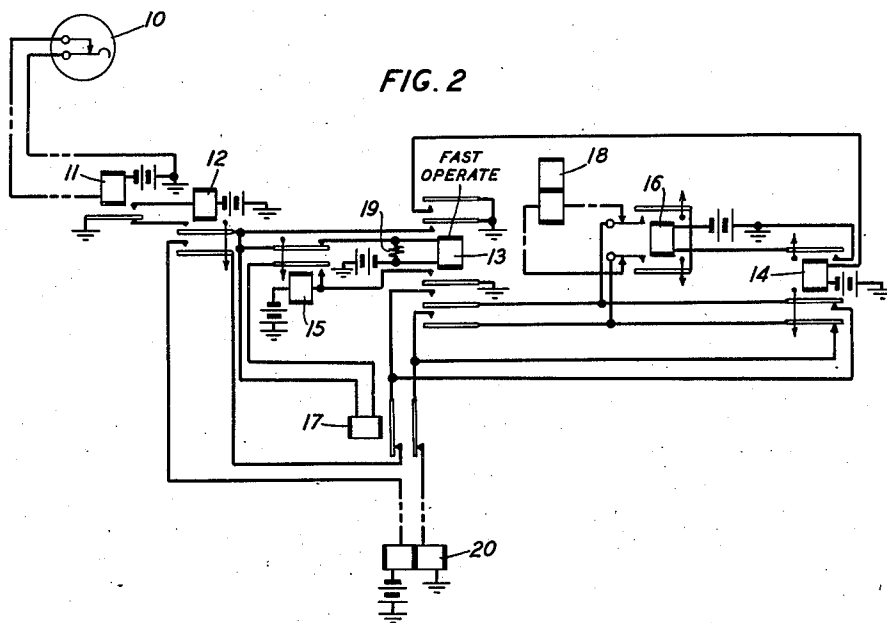
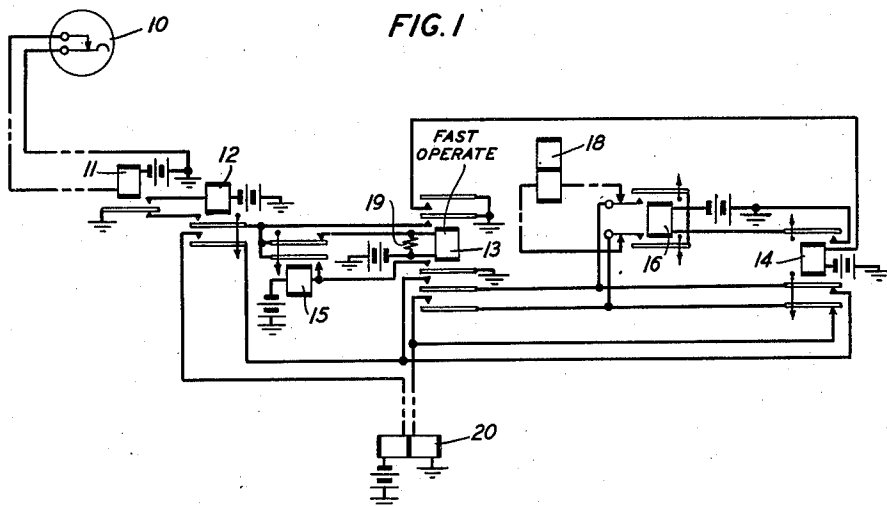
July 22, 1941.

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2,249,854

SIGNALING SYSTEM

Filed Oct. 28, 1939



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2,249,854

SIGNALING SYSTEM

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Application October 28, 1939, Serial No. 301,760

6 Claims. (Cl. 179—16)

This invention relates to signaling systems and particularly to systems in which trains of directive impulses are transmitted in an electrical circuit to effect desired switching operations.

Objects of the invention are a reduction in the probability of false operation of signal responsive devices and the satisfactory operation of such devices under more severe conditions and wider limits than heretofore possible.

This invention is an impulse correcting circuit comprising a fast-operate relay, a slow-operate relay and a slow-release relay effective in response to trains of signal impulses in one electrical circuit to repeat the impulses in a second electrical circuit, within the normal range of variations in the rate at which the impulses are transmitted. If the impulses are being received in the first electrical circuit at or in excess of a certain critical rate, the three aforementioned relays control the second electrical circuit to transmit impulses therein of a fixed and measured duration which is the minimum allowable duration when impulses are being transmitted at the maximum normal rate. If the impulses are being received in the first electrical circuit at a rate lower than the critical rate, the three relays control the second electrical circuit to transmit impulses therein with an interval of fixed and measured duration between successive impulses, the duration of this interval being the minimum allowable when impulses are being transmitted at the minimum normal rate.

Reference may be had to the patent to R. L. Stokely No. 1,861,196 of May 31, 1932, for an explanation of the necessity for measuring the impulses when the impulse rate is at or in excess of a critical rate and for measuring the intervals between impulses when the impulse rate is less than the critical rate.

A clear and complete understanding of the invention will be facilitated by reference to the impulse correcting circuit arrangement shown in the drawing, which arrangement is one embodiment of the invention. The invention is not limited in its application to the particular arrangement shown but is generally applicable to any impulse receiver or repeater.

Referring to the drawing,

Fig. 1 shows an impulse correcting repeater comprising an impulse receiving relay 11, a fast-operate relay 13, a slow-to-release relay 14 and a slow-to-operate relay 15; and

Fig. 2 shows a modification of the repeater shown in Fig. 1.

In each of Figs. 1 and 2, the impulse relay 11

is controlled by an impulse sender 10 in a first electrical circuit. Relay 20 is an impulse relay to which the corrected impulses are transmitted in a second electrical circuit. The impulse sender 10 may be located at a subscriber's station in which case the initiation of a call by the subscriber effects the connection of the calling line to an impulse receiving circuit in the central office in any well-known manner. Upon closure of the connection between the dial, impulse sender 10 and impulse relay 11, relay 11 operates closing a circuit for operating the slow-to-release relay 12. Relay 12 prepares for the receipt of dial impulses by connecting the back contact of relay 11 to the winding of relay 13 and by closing a circuit including the lower winding of coil 18 and back contacts of relays 14 and 15, for operating relay 20. When the dial 10 is operated, it alternately opens and recloses the impulse circuit one or more times depending upon the digit dialed. Relay 11 releases and reoperates in response to each impulse thus transmitted by the dial 10. Being slow in releasing, relay 12 remains operated during the response of relay 11 to dial impulses. The release of relay 11 in response to the first impulse of a series closes the circuit for operating relay 13. Relay 13 is fast in operating and the opening of the impulse circuit may be as short as the operating time of relay 13. The resistor 19, which is connected in parallel with the winding of relay 13 does not substantially effect the operating time of relay 13 but increases its releasing time. Relay 13 locks under control of relay 15, closes a circuit for operating relay 14, and closes a circuit for operating relay 15. Relay 14 is a slow-to-release relay which remains operated, while all the impulses in the series are being received and repeated, unless the impulses are being received at a rate lower than a critical rate. We will first assume that the impulses are being received at the critical rate or a faster rate and that relay 14 remains operated until all of the impulses in the series have been repeated. The operation of relay 13 closes a circuit for holding relay 20 operated after relay 14 operates. Relay 14 closes a circuit for operating relay 16 and, being slow in releasing, relay 16 remains operated until all of the impulses in the series have been received and repeated. With relay 16 operated, the circuit for repeating impulses to relay 20 excludes the lower winding of coil 18 thereby insuring the reoperation of relay 20 between impulses. The circuit for energizing relay 20 remains closed after relay 13 operates until relay 13 releases. When relay 15 operates, it locks un-

der the control of relay 11 if relay 11 has not reoperated. The operation of relay 15 causes the release of relay 13 and the release of relay 13 opens the outgoing impulse circuit to cause the release of relay 20. The release of relay 13 also opens the operating circuit of relay 14 but being slow in releasing and the rate of impulse transmission being at or above the critical rate relay 14 remains operated. When relay 13 releases, relay 15 releases unless relay 11 has not reoperated in which case relay 15 remains operated until relay 11 reoperates. When relay 11 releases in response to the second impulse of a series, relay 13 reoperates thereby closing the outgoing impulse circuit to reoperate relay 20. Relay 13 again closes the circuits for energizing relays 14 and 15. When relay 15 operates, relay 13 again releases, opening the outgoing impulse circuit to release relay 20. The release of relay 13 and reoperation of relay 11 at the end of the second impulse causes the release of relay 15. This cycle of operations is repeated for each succeeding impulse received by relay 11. When relay 13 releases after the last impulse of the series has been received, relay 14 releases to close the outgoing loop and reoperate relay 20. Thus the last impulse of each series transmitted to relay 20 is measured by the release of relay 14 and the interval during which the outgoing impulse circuit is closed between impulses is measured by just two relays, that is, the operating time of relay 15 plus the release time of relay 13. Relay 15 is so designed that its operate time is such as to make certain that the outgoing impulse circuit is closed and remains closed for the minimum allowable interval between impulses when the impulses are being repeated at or in excess of the critical rate.

If now the rate at which impulses are being received by relay 11 is less than the critical rate, relay 14 releases after relays 13 and 15 have responded to an impulse, because the operation of relay 13 in response to a second impulse does not occur within the release time of relay 14. The release of relay 14 closes the outgoing impulse circuit to reoperate relay 20. When relay 11 releases in response to the second impulse, relay 13 reoperates and again closes the circuits for operating relays 14 and 15. The outgoing impulse circuit is again opened when relay 13 releases and reclosed when relay 14 releases. Thus, when the impulse rate is lower than the critical rate, it is the opening of the outgoing impulse circuit which has a fixed duration and which is measured by the release time of relay 14. When relay 14 releases at the end of a train of impulses, the release of relay 16 reinserts the lower winding of coil 18 in the outgoing circuit. When relay 11 releases due to release of the connection by the calling subscriber, an impulse is transmitted in the outgoing impulse circuit to relay 20, the impulse being ended by the release of relay 14. When relay 12 releases, the outgoing impulse circuit is opened to cause release of relay 20 as a disconnect signal.

In some cases it is desirable that the sending of an impulse, when the calling subscriber releases the connection, be prevented to avoid the possibility of false operation; or it may be desirable to secure a faster release of the impulse correcting circuit and succeeding circuits involved in a connection. The repeater shown in Fig. 2 is similar to Fig. 1 except that relay 17 is added to prevent the sending of a false impulse to relay 20 when relay 11 releases due to release of the

connection. The winding of relay 17 is connected in the locking circuit of relay 15 so that, when relay 13 releases, relay 17 operates and relay 15 is held through the back contact of relay 11. Relay 17 holds the outgoing impulse circuit open so that relay 20 does not reoperate after its release due to the release of relay 13.

While the outgoing impulse circuit is shown as being a loop impulse circuit and one in which the impulses consist of openings of the circuit, it is obvious that the outgoing impulse circuit may be any type of circuit, for instance, single wire, simplex, phantom, etc., that the impulses may consist either of openings or closures of the circuit, and that the circuit may be either an alternating-current or a direct-current circuit.

What is claimed is:

1. In combination, a first circuit including an impulse sender and an impulse receiving relay, a second circuit, and means for repeating in said second circuit a train of impulses received by said relay, said means comprising a single, slow-to-release relay for measuring and fixing the duration of the impulses transmitted in said second circuit when and if the impulse rate is lower than a critical rate, and comprising only two relays, one a fast-operating relay and the other a slow-operating relay, for measuring and fixing the interval between succeeding impulses transmitted in said second circuit when and if the impulse rate is equal to or in excess of said critical rate.

2. In combination, an incoming impulse circuit, an impulse receiving relay in said circuit for responding to impulses, a fast-operating relay, a slow-operating relay, a slow-releasing relay, a circuit closed by the release of the impulse relay for operating said fast-operating relay, said circuit including a back contact of the slow-operating relay, a circuit closed by the operation of the fast-operating relay for operating the slow-operating relay, a circuit closed by the operation of the fast-operating relay for operating the slow-releasing relay, circuits for holding said slow-operating relay operated until the impulse relay reoperates and the fast-operating relay releases, an outgoing impulse circuit, contacts on said fast-operating relay for opening the outgoing impulse circuit in response to each release of said impulse relay, and contacts on said slow-releasing relay for closing the outgoing impulse circuit a predetermined interval of time after the opening of this circuit by the release of the fast-operating relay, said contacts of the fast-operating relay being effective to close the outgoing impulse circuit in case said fast-operating relay is reoperated due to the response of the impulse relay to a second impulse prior to the release of said slow-releasing relay.

3. An impulse repeater comprising an impulse relay, a fast-operate relay, a slow-operate relay and a slow-release relay, a circuit closed by said impulse relay at the beginning of each incoming impulse for operating said fast-operate relay, a circuit closed by the operation of said fast-operate relay for operatively energizing said slow-operate relay, the operation of said slow-operate relay effecting the release of said fast-operate relay, a circuit for holding said slow-operate relay until the end of each incoming impulse, a circuit closed by each operation of said fast-operate relay for operatively energizing said slow-release relay, and an outgoing impulse circuit controlled by a front contact of said fast-

operate relay in parallel with a back contact of said slow-release relay.

4. In an impulse repeater according to claim 3, a relay having a contact in said outgoing impulse circuit, the winding of said relay being connected in series with the winding and a locking contact of said slow-operate relay to prevent reclosure of the outgoing impulse circuit when said impulse relay releases and does not reoperate prior to the release of said slow-release relay.

5. In combination, a first circuit including an impulse sender and an impulse receiving relay, a second circuit, and means for repeating in said second circuit a train of impulses received by said relay, said means comprising a single, slow-to-release relay for measuring and fixing the duration of the impulses transmitted in said second circuit when and if the impulse rate is lower than a critical rate, and comprising only two relays, one a fast-operating relay and the other a slow-operating relay, for measuring and fixing the interval between succeeding impulses transmitted in said second circuit when and if the impulse rate is equal to or in excess of said critical rate,

each of said fast-operating, slow-to-release, and slow-operating relays comprising a single winding.

6. An impulse repeater comprising an impulse relay, a fast-operate relay, a slow-operate relay and a slow-release relay, each of said fast-operate, slow-operate and slow-release relays comprising a single winding, a circuit closed by said impulse relay at the beginning of each incoming impulse for operating said fast-operate relay, a circuit closed by the operation of said fast-operate relay for operatively energizing said slow-operate relay, the operation of said slow-operate relay effecting the release of said fast-operate relay, a circuit for holding said slow-operate relay until the end of each incoming impulse, a circuit closed by each operation of said fast-operate relay for operatively energizing said slow-release relay, and an outgoing impulse circuit controlled by a front contact of said fast-operate relay in parallel with a back contact of said slow-release relay.

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