

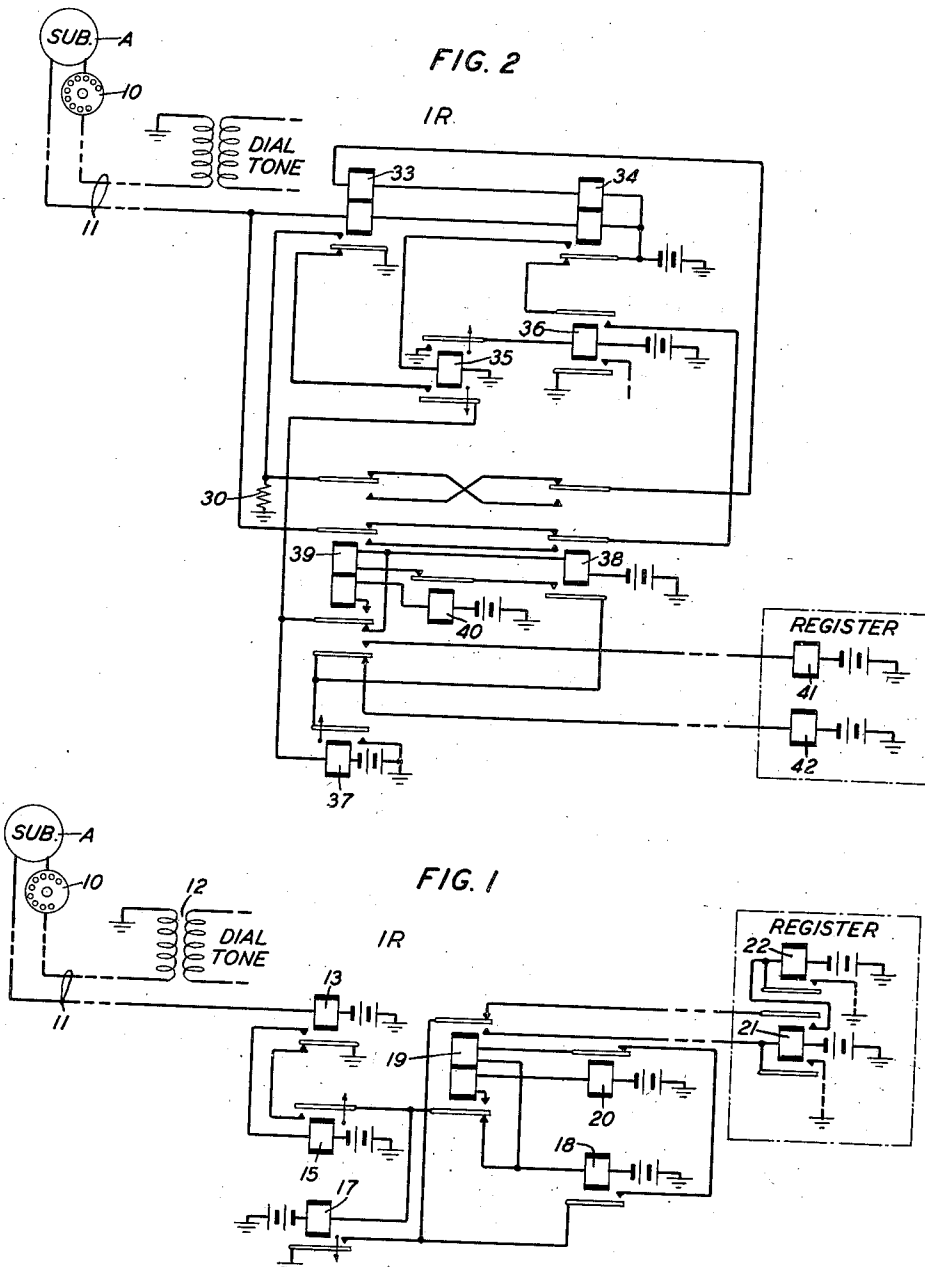
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SIGNALING SYSTEM

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SIGNALING SYSTEM

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

It is the object of the invention to provide a more reliable electromagnetic signal receiving means and to insure the response of a selective switching mechanism to the signal impulses received.

In signaling systems in which selective impulses are created by the opening and closing of a signaling circuit, the release and reoperation of an impulse relay under control of incoming impulses may be effective to directly control a switching mechanism or may be effective to set an impulse register. The time available for operating a selector or register magnet depends upon the frequency of the impulses in a series, and the selector magnet or register magnet must of necessity be fast in operating if its operating circuit is closed only during the time that the signaling circuit is open.

One feature of the invention is a new and improved impulse receiving circuit arrangement, for operating a selector mechanism or impulse register in response to a series of impulses received by an impulse receiving relay, by the use of which substantially the entire interval between the end of one impulse and the end of the next succeeding impulse of a series is available for operating the selector or register. The arrangement comprises an impulse receiving relay and a set of three auxiliary impulse relays so connected that the release of the impulse receiving relay at the beginning of one impulse of a series closes a circuit for operating a first one of the auxiliary relays; the reoperation of the impulse receiving relay at the end of the impulse closes a circuit for holding the first one and for operating a second one of the auxiliary relays; the release of the impulse receiving relay at the beginning of the next succeeding impulse of the series closes a circuit for holding the second and operating the third of said auxiliary relays; the operation of the third auxiliary relay causes the release of the first of the auxiliary relays; and the reoperation of the impulse receiving relay at the end of the second impulse causes the release of the second and third of the auxiliary relays. The second of the auxiliary relays is, therefore, operated at the end of one impulse to close a register operating circuit and is released at the end of the next succeeding impulse to open the first-mentioned register operating circuit. A particular advantage attaching to this arrangement

as compared with prior art impulse distributing arrangements is its ability to respond to and distribute impulses received at a high impulse rate, all shunt release and other conditions which result in slow response having been avoided.

Another feature of the invention is a circuit arrangement comprising an impulse receiving relay and a set of auxiliary relays controlled thereby for closing one register operating circuit in response to one impulse of a series and for opening the one and closing another register operating circuit in response to the next succeeding impulse of a series, one circuit being closed by the release of the impulse receiving relay, at the beginning of the one impulse, for preventing the reoperation of the impulse receiving relay until the auxiliary relays have responded to the release of the impulse receiving relay and another circuit being closed by the reoperation of the impulse receiving relay at the end of the one impulse for preventing the release of the impulse receiving relay in response to the next succeeding impulse of the series until the auxiliary relays have responded to the reoperation of the impulse receiving relay. Since a limited number of contacts are obtainable on a sensitive impulse receiving relay, two impulse receiving relays in series may be used to provide the necessary contacts for controlling the auxiliary relays.

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 having a single impulse relay 13;

Fig. 2 also represents an automatic telephone system comprising a subscriber's station A and impulse receiving means IR, the impulse receiving means having two impulse relays 33 and 34, the one more sensitive than the other.

The apparatus at station A includes a dial 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 III 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 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 reversely 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, shown in Fig. 1 of the drawing, comprises an impulse receiving relay 13, slow-to-release relays 15 and 17, auxiliary impulse relays 18, 19, and 20, and register relays 21 and 22. Upon removal of the receiver at station A and the extension of the line 11 to the impulse receiving means IR, the impulse receiving relay 13 is operated by the energization of its winding in series with the conductors of line 11, the contacts of dial 10 and one winding of the dial tone transformer 12. The operation of relay 13 closes a circuit for operating the slow-to-release relay 15. No further action occurs until the subscriber at station A operates the dial 10 to establish a desired connection, the circuit over line 11 being thereupon alternately opened and closed at the dial contacts to transmit series of impulses corresponding to the digits 40 dialed.

Upon the opening of the impulse circuit at the contacts of dial 10 to transmit the first impulse of a series, relay 13 releases, thereby closing circuits through the front contact of relay 15 for operating the auxiliary impulse relay 18 and the slow-to-release relay 17. As soon thereafter as relay 13 reoperates due to the closing of the dial contacts at the end of the first impulse, the upper winding of relay 19 is energized in series with the winding of relay 18 to cause the operation of relay 19 and to hold relay 18 operated. Relay 15, being slow in releasing, remains operated during the receipt of dial impulses by relay 13. As soon as the impulse receiving relay 13 again releases, due to the opening of the impulse circuit to transmit the next succeeding dial impulse of the series, the lower winding of relay 19 is energized in series with the winding of relay 20 to cause the operation of relay 20 and to hold relay 19 operated. The operation of relay 20 causes the release of relay 18 and as soon as relay 13 reoperates, at the end of the second impulse, relays 19 and 20 are also released.

It is apparent that relay 19 is operated at the end of each odd numbered impulse of a series received by relay 13 and released at the end of each even numbered impulse received by relay 13, the above described cycle of operations for relays 18, 19, and 20 being repeated for each two succeeding impulses of the series. Relay 17, being slow in releasing, remains operated during the response of relay 13 to all of the impulses in the series. The first operation of relay 19 is effective to close a circuit for operating the register relay 21, this circuit being closed from the end

of the first impulse of a series received by relay 13 to the end of the second impulse of the series; and the first release of relay 19 is effective to close a circuit for operating the second register relay 22, this circuit being closed, upon opening of the circuit for operating relay 21, at the end of the second impulse, until the end of the third impulse of the series received by relay 13. Each of the register relays, when operated, locks independently of the impulse receiving means IR. Each succeeding operation and release of relay 19 effects the operation of the next succeeding one of the register relays, the odd numbered register relays being operated through the front contact of relay 19 and the even numbered register relays being operated through the back contact of relay 19. When the last impulse of a series has been received, relay 13 remains operated long enough to cause the release of relay 17. In case the series of impulses consists of an odd number of impulses, the release of relay 17 causes the release of relays 18 and 19 and renders the release of relay 19 non-effective to cause the operation of another register relay. Other contacts of relay 17, which contacts are not shown in the drawing, are effective to prepare the register for operation in response to each succeeding series of dial impulses; this function of relay 17 is one well-known in automatic telephone systems.

The impulse receiving means IR, shown in Fig. 2 of the drawing, comprises the impulse receiving relays 33 and 34, slow-to-release relays 35 and 37, relay 36 auxiliary to relay 35, auxiliary impulse relays 38, 39, and 40, and the register relays 41 and 42. Upon removal of the receiver at station A and extension of line 11 to the impulse receiving means IR, the impulse receiving relays 33 and 34 are operated due to the energization of their lower windings in series with the conductors of line 11, the contacts of dial 10 and one winding of the dial tone transformer. Relay 33 closes a short circuit across resistor 30. Relay 34 closes a circuit for operating the slow-to-release relay 35 and relay 35 closes a circuit for operating relay 36. No further action occurs until the subscriber at station A dials the number of a line with which connection is desired. Upon the opening of the impulse circuit at the contacts of the dial to transmit the first impulse of a series, relays 33 and 34 release, the release of relay 33 being effective to cause the operation of the slow-to-release relay 37 and the operation of relay 38. The release of relay 33 opens the short circuit across resistor 30 and the release of relay 34 closes a short circuit, through the front contact of relay 35 and inner upper back contacts of relays 38 and 39, around the lower windings of relays 33 and 34 to prevent their reoperation until relay 38 has responded to the release of relay 33. The operation of relay 38 closes a circuit through the upper windings of relays 33 and 34 in series, uppermost front contact of relay 38, uppermost back contact of relay 39 and through resistance 30, the current in this circuit being effective to aid the reoperation of relays 33 and 34 upon the closing of the circuit through their lower windings at the end of the first impulse. The reoperation of relay 34, at the end of the first impulse, reenergizes the winding of relay 35; and the reoperation of relay 33 opens the circuit through the winding of relay 37 and again short-circuits resistance 30 so as to increase and maintain the energization of the upper windings of relays 33 and 34 and thus prevent their release until relay 39 responds to the reoperation of relay 33. The reoperation of

relay 33 also opens the operating circuit for relay 38 thereby causing the energization of the upper winding of relay 39 in series with the winding and lower front contact of relay 38. Relay 38 is thus held operated and relay 39 operated, the operation of relay 39 being effective to open the holding circuit through the upper windings of relays 33 and 34. Upon the opening of the contacts of dial 10 to transmit a second impulse, and relay 39 being operated, relays 33 and 34 release. The release of relay 33 closes a circuit through the lower front contact of relay 35 for reenergizing relay 37 to prevent its release until all of the impulses in the series have been received and closes a circuit through the front contact of relay 35, inner lower front contact and winding of relay 39 and the winding of relay 40 for holding relay 39 operated and for operating relay 40. The release of relay 34 closes a short circuit through the inner upper front contacts of relays 38 and 39 around the lower windings of relays 33 and 34 to prevent the reoperation of these relays until relays 40 and 38 have responded to the release of relay 33. The operation of relay 40 causes the release of relay 38, thereby closing a circuit through its uppermost back contact in series with the uppermost front contact of relay 39 and resistor 39 for reenergizing the upper windings of relays 33 and 34. As soon as the impulse circuit is again closed at the dial contacts, the reoperation of relays 33 and 34 causes the release of relays 39 and 40. The above described cycle of operations for relays 33, 34, 38, 39, and 40 is repeated for every two succeeding impulses in the series, so that relay 39 is operated in response to each odd numbered impulse of the series and is released in response to each even numbered impulse of the series. If the series consists of an odd number of impulses, the release of relay 37, after the last impulse has been received, causes the release of relays 38 and 39 and renders the release of relay 39 non-effective to cause the operation of another register relay.

The operation of relay 39 at the end of the first impulse received by relays 33 and 34 closes a circuit for operating the first register relay 41. The release of relay 39 at the end of the second impulse of a series received by relays 33 and 34 opens the circuit for operating the first register relay 41 and closes a circuit for operating the second register relay 42. Each succeeding operation of relay 39 closes a circuit for operating an odd numbered one of the register relays and each release of relay 39 closes a circuit for operating an even numbered one of the register relays. Thus, the circuit for operating each register relay is closed for substantially the entire period from the end of one impulse until the end of the next impulse and the registering of impulses received at the highest dial impulse frequency is thus assured. The arrangement shown in Fig. 2 is one in which the energization of relay 33 merely to the point where it barely closes its front contact coupled with the deenergization of relay 34 merely to the point where it barely opens its back contact is sufficient to insure the registration of dial impulses. It is also to be noted that the closing of the circuit through the upper windings of relays 33 and 34, in series with resistor 30, by the response of relay 38 to an opening of the impulse circuit, hastens the reoperation of relays 33 and 34 upon the closing of the impulse circuit at the end of the impulse; and that this circuit through the upper windings of relays 33 and 34 is opened by the response of relay 39 to the

closing of the impulse circuit at the end of an impulse so as to hasten the release of relays 33 and 34 upon the opening of the impulse circuit to transmit another impulse.

What is claimed is:

1. In a signaling system, a line, a signal sender, a signal receiving relay, a signaling circuit including said line and sender and one winding of said signal receiving relay, a signal register, a set of auxiliary relays controlled by said signal receiving relay to operate said register in accordance with the signal impulses received by said one winding of the signal receiving relay, and one winding of the signal receiving relay, and circuit means for preventing the reoperation of said signal receiving relay until said auxiliary relays have responded to the release of said signal receiving relay.

2. In a signaling system, a line, a signal sender, a signal receiving relay, a signaling circuit including said line and sender and one winding of said signal receiving relay, a signal register, a set of auxiliary relays controlled by said signal receiving relay to operate said register in accordance with the signal impulses received by said one winding of the signal receiving relay, and a circuit including another winding of said signal receiving relay for aiding the reoperation of said signal receiving relay, said last-mentioned circuit being closed by the response of the auxiliary relays to the release of said signal receiving relay.

3. In a signaling system, a line, a signal sender, a signal receiving relay, a signaling circuit including said line and sender and one winding of said signal receiving relay, a signal register, a set of auxiliary relays controlled by said signal receiving relay to operate said register in accordance with the signal impulses received by said one winding of the signal receiving relay, and a circuit including another winding of said signal receiving relay for holding said signal receiving relay operated until said auxiliary relays have responded to the reoperation of said signal receiving relay.

4. 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 signal repeating relay, means including two auxiliary relays and said signal receiving relay for operating said signal repeating relay in response to one signal impulse in said circuit and for releasing said signal repeating relay in response to the next succeeding signal impulse in said circuit, and means comprising contacts of said signal repeating relay and one of said auxiliary relays for preventing the reoperation of said signal receiving relay until said one of the auxiliary relays has responded to the release of said signal receiving relay.

5. 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 signal repeating relay, means including two auxiliary relays and said signal receiving relay for operating said signal repeating relay in response to one signal impulse in said circuit and for releasing said signal repeating relay in response to the next succeeding signal impulse in said circuit, and circuit means including contacts of one of said auxiliary relays and said signal repeating relay for aiding the reoperation of said signal receiving relay.

6. In a signaling system, a line, a signal sender, a signal receiving relay, a signaling circuit including said line and sender and a primary winding of said relay, a signal repeating relay, means

including two auxiliary relays and said signal receiving relay for operating said signal repeating relay in response to one signal impulse in said circuit and for releasing said signal repeating relay in response to the next succeeding signal impulse in said circuit, and means comprising a secondary winding of said signal receiving relay for holding said signal receiving relay operated until said signal repeating relay has responded to the operation of said signal receiving relay.

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 signal repeating relay, means including two auxiliary relays and said signal receiving relay for operating said signal repeating relay in response to one signal impulse in said circuit and for releasing said signal repeating relay in response to the next succeeding signal impulse in said circuit, and means comprising contacts of said signal repeating relay and one of said auxiliary relays for insuring the response of said one of said auxiliary relays to the release of said signal receiving relay.

8. In a signaling system, a line, a signal sender, a signal receiving relay, a signaling circuit including said line and sender and a primary winding of said relay, a signal repeating relay, means including two auxiliary relays and said signal receiving relay for operating said signal repeating relay in response to one signal impulse in said circuit and for releasing said signal repeating relay in response to the next succeeding signal impulse in said circuit, and means comprising a secondary winding of said signal receiving relay for insuring the response of said signal repeating relay to the operation of said signal receiving relay.

9. In a signaling system, a line, a signal sender, two signal receiving relays, a signaling circuit including said line and sender and primary windings of said relays, a signal repeating relay, means including two auxiliary relays and said signal receiving relays for operating said signal repeating relay in response to an opening of said circuit and for releasing said signal repeating relay in response to the next succeeding opening of said circuit, means comprising secondary windings of said signal receiving relays for holding said signal receiving relays operated until said signal repeating relay has responded to the operation of said signal repeating relays, and means comprising contacts of said signal repeating relay and one of said auxiliary relays for preventing the reoperation of said signal receiving relays until said one of the auxiliary relays has responded to the release of said signal receiving relay.

10. In a signaling system, a line, a signal sender, a first relay, a second relay, a third relay, a fourth relay, a fifth relay, a signaling circuit including one winding of each of said first and second relays and said line and signal sender all in series, the current in said circuit being effective to operate said first and second relays, a circuit closed in response to the release of said first relay following the operation of said second relay for operating said third relay, a circuit effective upon reoperation of said first relay to operate said fourth relay and hold said third relay, a circuit closed by the next succeeding release of said first relay for operating said fifth relay and for holding said fourth and fifth relays being effective to cause the release of said third relay and the

next succeeding reoperation of said first relay being effective to cause the release of said fourth and fifth relays, and a circuit including a second winding of each of said first and second relays and controlled by said third and fourth relays for holding said first and second relays operated.

11. In a signaling system according to claim 10, a circuit including contacts of said third and fourth relays for preventing the reoperation of said first and second relays.

12. In combination, a first relay, means for operating said relay, means for alternately releasing and reoperating said first relay a desired number of times in succession, other relays for operation in succession one at a time in response to each successive release and reoperation of said first relay, and means comprising a set of three auxiliary relays controlled by said first relay for closing circuits for operating said other relays, the circuit for operating any one of said other relays being closed for an interval substantially equal to the elapsed time between one reoperation of said first relay and the next succeeding reoperation of said first relay.

13. In combination, a set of three impulse responsive relays and a set of contacts for transmitting to said impulse responsive relays a series of impulses, the closing of said contacts to transmit an impulse of a series being effective to operate a first one of said impulse responsive relays, the opening of said contacts at the end of said impulse being effective to operate a second one and hold said first one of the impulse responsive relays operated, the closing of said contacts to transmit the next succeeding impulse being effective to operate the third one and hold the second one of said impulse responsive relays operated, the operation of said third one being effective to cause the release of said first one of the impulse responsive relays, and the opening of said contacts at the end of said next succeeding impulse being effective to cause the release of said second and third one of the impulse responsive relays.

14. In combination, a set of three impulse responsive relays, a set of contacts, means for actuating said contacts to transmit a series of impulses, a circuit closed upon actuation of said contacts to transmit an impulse for operating a first one of said relays, a circuit closed by the operation of said first one of the relays and rendered effective by the opening of said contacts at the end of said impulse for operating a second one and holding said first one of the relays operated, and a circuit closed upon actuation of said contacts to transmit the next succeeding impulse of a series for operating the third one and holding said second one of the relays operated, the operation of said third one being effective to cause the release of said first one of the relays and the opening of said last-mentioned circuit being effective to cause the release of the second and third relays.

15. In combination, a set of circuit controlling contacts, means for actuating and restoring said contacts a plurality of times in succession, a first relay, a circuit closed by a first actuation of said contacts for operating said first relay, a second relay, a circuit including one winding of said second relay and the winding of said first relay closed by the operation of said first relay and rendered effective upon restoration of said contacts to normal for operating said second relay and for holding said first relay operated, a third relay, and a circuit including an-

other winding of said second relay and the winding of said third relay closed by the next succeeding actuation of said contacts for holding said second relay operated and for operating said third relay, the operation of said third relay being effective to cause the release of said first relay and the restoration of said contacts being effective to cause the release of said second and third relays.

16. In a combination according to claim 14, an electromagnetically controlled device, each operation and each release of said second one of the relays in response to impulses from said contacts being effective to close a circuit for operating said device.

17. In a combination according to claim 15, an electromagnetically controlled device, a circuit for operating said device closed by the operation of said second relay in response to an actuation of said contacts, and a circuit for operating said device closed by the release of said second relay in response to an actuation of said contacts.

18. In a combination according to claim 14, an electromagnetically controlled device, each operation and each release of said second one of the relays in response to impulses from said contacts being effective to close a circuit for operating said device, and means effective if the series of impulses consists of an odd number of impulses to cause the release of said second and third relays without closing a circuit for operating said device.

19. In a signaling system, a line, an impulse sender, an impulse relay, a signaling circuit including said line and sender and a winding of said relay, a first control relay, an operating circuit for said first control relay closed by the operation of said impulse relay upon closure of said signaling circuit, said first control relay being slow in releasing so as to remain operated during the response of said impulse relay to impulses transmitted by said sender, a second control relay, an operating circuit for said second control relay closed by the release of said impulse relay in response to the opening of said signaling circuit to transmit the first impulse of the series, said second control relay being slow in releasing so as to remain operated until all of the impulses in the series have been received, a set of three impulse distributing relays, a circuit closed by said release of the impulse relay for operating a first one of said distributing relays, a circuit rendered effective by reoperation of said impulse relay at the end of the first impulse of the series for operating a second one

and for holding operated said first one of the distributing relays, a circuit closed by the release of said impulse relay in response to the second impulse of the series for operating the third one and for holding operated said second one of the distributing relays, the operation of said third distributing relay being effective to cause the release of said first distributing relay and the reoperation of said impulse relay at the end of said second impulse being effective to cause the release of said second and third distributing relays, and an impulse register controlled by the contacts of said second distributing relay.

20. In a signaling system, a line, an impulse sender, an impulse relay, a signaling circuit including said line and sender and a winding of said relay, a first control relay, an operating circuit for said first control relay closed by the operation of said impulse relay upon closure of said signaling circuit, said first control relay being slow in releasing so as to remain operated during the response of said impulse relay to impulses transmitted by said sender, a second control relay, an operating circuit for said second control relay closed by the release of said impulse relay in response to the opening of said signaling circuit to transmit the first impulse of the series, said second control relay being slow in releasing so as to remain operated until all of the impulses in the series have been received, a set of three impulse distributing relays, a circuit closed by said release of the impulse relay for operating a first one of said distributing relays, a circuit rendered effective by reoperation of said impulse relay at the end of the first impulse of the series for operating a second one and for holding operated said first one of the distributing relays, a circuit closed by the release of said impulse relay in response to the second impulse of the series for operating the third one and for holding operated said second one of the distributing relays, the operation of said third distributing relay being effective to cause the release of said first distributing relay and the reoperation of said impulse relay at the end of said second impulse being effective to cause the release of said second and third distributing relays, an impulse register, and circuits controlled by the contacts of said second distributing relay and contacts of said second control relay for operating said register in response to a series of impulses transmitted by said sender.

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