

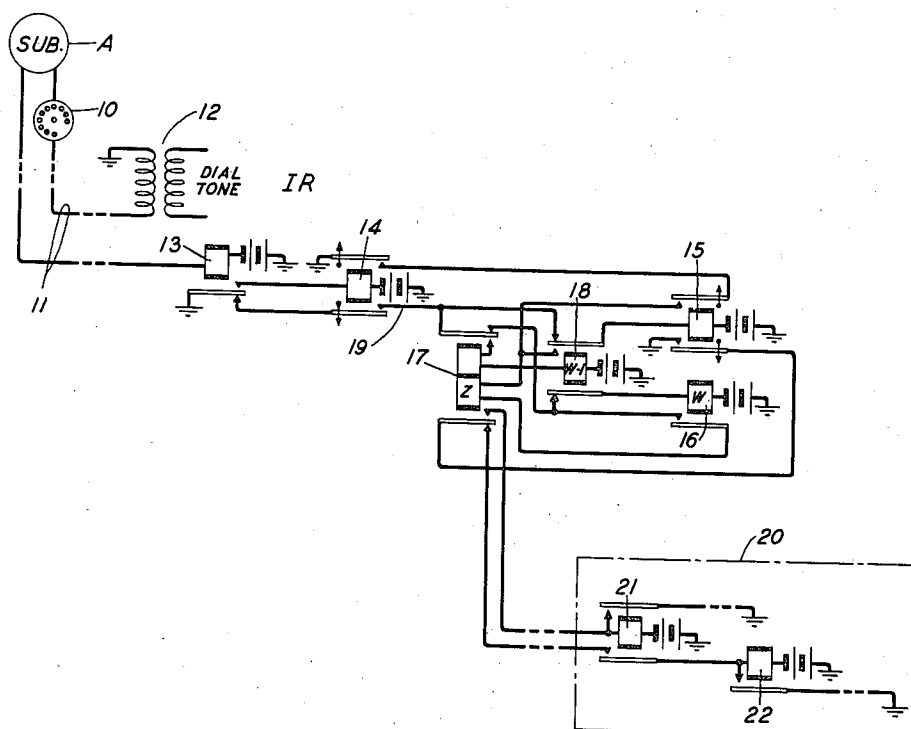
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SIGNALING SYSTEM

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SIGNALING SYSTEM

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5 Claims. (Cl. 179-16)

This invention relates to signaling systems and particularly to systems in which automatic switching mechanism is selectively operated by current impulses.

The object of the invention is to provide circuit means adapted to respond to current impulses received at a higher frequency than has been usual heretofore and to improve the reliability of impulse responsive circuit arrangements.

10 In signaling systems, and particularly dial telephone systems, it is well known to employ relay means controlled by an impulse relay for operating an impulse register or selective mechanism. Such a relay means is disclosed in Patent
15 No. 1,438,743, granted to E. H. Clark December 12, 1922. Clark's relay combination, comprising relays 207 and 209, involves a marginal operation and is not capable of responding to impulses at as high a frequency as may otherwise be employed
20 in impulse controlled systems. Three-relay combinations are also known. Applying the designations W, W-1, and Z to the relays of a three-relay combination, the arrangement is one in which a slow-to-release relay and the relay
25 W are operated at the beginning of the first impulse of a train received by the impulse relay, relay Z is operated at the end of the first impulse, relay W-1 operates and relay W releases at the beginning of the next succeeding impulse,
30 and relays Z and W-1 release at the end of said next succeeding impulse. This cycle of operations continues until all of the impulses in the train have been received at which time the slow-to-release relay releases restoring the three-relay combination to normal if not already normal.
35 The contacts of the Z relay control the impulse register or selector, this relay being operated in response to each odd numbered impulse of a train and released in response to each even numbered impulse of a train.
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This invention is a circuit arrangement in which the slow-to-release relay, which operates in response to the first impulse of a train received by an impulse relay and releases after all of the impulses in the train have been received,
45 is so connected as to aid the operation of the Z relay of a three-relay W, W-1, Z combination in response to the odd numbered impulses without interfering with the release of the Z relay in response to the even numbered impulses.

50 A telephone system, in which the invention is embodied, is shown schematically in the drawing which forms a part of this specification. The invention is not, however, limited in its application to telephone systems and is, in general, ap-

plicable to any electrical system in which a switching or register mechanism is selectively operated by a series of current impulses according to the number of impulses in the series.

Referring to the drawing, A represents a subscriber's telephone station equipped with an impulse dial 10 and connected by a line 11 to a central office in which impulse controlled selector switches are provided for completing connections between calling and called subscribers' stations. IR represents impulse receiving means in the central office which may be operatively associated with a calling line. Switching equipment (not shown), of either the line-switch or line-finder type, is provided for automatically extending a calling line to an idle impulse receiver IR in response to the removal of the receiver at a calling station. The impulse receiving means IR may be used to directly control, in succession, each of a train of selectors 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 Telephone" 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 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.
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The impulse receiving means IR comprises an impulse relay 13, slow-to-release relays 14 and 15, a set of relays 16, 17, and 18 which is known as a W, W-1, Z combination and an impulse register, or impulse controlled selector, 20 which is represented by electromagnets 21 and 22. Upon removal of the receiver at station A, to originate a call, and extension of line 11 to the impulse receiver IR, a circuit is closed from battery through the winding of relay 13 over the lower conductor of line 11 to station A, through the receiver hook contacts (not shown) and the contacts of dial 10, back over the upper conductor of line 11 to the central office and through the left winding of dial tone transformer 12 to ground. Relay 13, operated by the current in this circuit, closes a circuit for operating relay 14. No further action occurs until the subscriber dials the first digit of the number of
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another station with which connection is desired.

Upon the dialing of the first digit, the circuit over line 11 is alternately opened and closed at the contacts of dial 10 as many times as there are units in the digit dialed. Relay 13 is thereby alternately released and reoperated a corresponding number of times. Upon release of relay 13, in response to the first dial impulse, the back contact of relay 13 closes circuits for operating relays 15 and 16. The circuit for operating relay 15 includes the upper back contact of the W—1 relay 18, conductor 19, and the lower front contact of relay 14; and the circuit for operating the W relay 16 includes the lower back contact of the W—1 relay 18, the upper back contact of Z relay 17, conductor 19 and the lower front contact of relay 14. With relays 15 and 16 operated, the winding of relay 15 is connected through the upper back contacts of relays 18 and 17, in parallel with the connection of relay 16 through the lower back contact of relay 18, to the front contact of relay 16, thence through the lower winding of relay 17 and the upper front contact of relay 15 to ground at the upper front contact of relay 14. As long as the back contact of relay 13 is closed, the lower winding of relay 17 is short-circuited; but when relay 13 reoperates at the end of the first dial impulse, the short circuit is opened and relay 17 is operated and relays 15 and 16 are held operated by current in the aforementioned circuit through the lower winding of relay 17. In this arrangement, the Z relay 17 is made fast in operating, due to the connection of the winding of relay 15 in parallel with the winding of the W relay 16. Relay 15 remains partially energized in series with the lower winding of relay 17, after relay 13 reoperates until relay 17 breaks its upper back contact, so as to aid the slow-to-release relay 15 in maintaining the closure of its contacts during the time relay 13 is operated between the first and second dial impulses. The operation of relay 17 connects the winding of relay 18 and upper winding of relay 17 in series to conductor 19 to which the winding of relay 15 is also connected; so that the energization of relay 15 is further continued, after relay 17 operates, by the current through these three windings in series resulting from the self-inductance of relay 15. Relay 14 is a slow-to-release relay and maintains its contacts in operated position while relay 13 is responding to dial impulses. The release of relay 13, in response to the second opening of the line circuit by the dial, again closes the circuit over conductor 19 for energizing the winding of relay 15 and also closes a circuit over conductor 19 for operating relay 18 and holding relay 17 operated. The operation of relay 18 causes the release of relay 16 and closes a holding circuit for relay 15 which is traced through the upper front contacts of relays 18, 15, and 14. When relay 13 reoperates at the end of the second dial impulse, the circuit through the windings of relays 17 and 18 is opened and these relays both release.

The aforementioned operation of relay 17 at the end of the first impulse causes the operation of relay 21 of register 20 and the release of relay 17 at the end of the second impulse causes the operation of relay 22 of register 20. If the series consists of more than two impulses, the described cycle of operation is repeated in response to each succeeding set of two impulses. When all of the impulses in the series have been received relay 13 remains operated long enough to cause the release of relay 15. If the series consists of a

single impulse, or an odd number of impulses, the release of relay 15 causes the release of relays 16 and 17. If the series consists of only two impulses, or an even number of impulses, the release of relay 15 causes the release of relays 17 and 18.

The impulse receiver IR responds to succeeding series of impulses in like manner. When the circuit through the winding of relay 13 is opened, either upon release of the connection by the calling subscriber or upon disconnection of the line from the impulse receiver, relays 13 and 14 release.

The above described circuit arrangement is one in which the operation of the Z relay 17, at the end of each odd numbered impulse of a series, causes the operation of an odd numbered register relay; and the release of the Z relay 17, at the end of each even numbered impulse of the series, causes the operation of an even numbered register relay. In order that each of the register relays has the same length of time in which to operate, it is necessary that the Z relay 17 be capable of operating and of releasing in equal intervals of time. It is also desirable that the operating and releasing intervals be as short as possible in order that the register operating circuit can be closed as long as possible and thereby insure accurate registration of incoming impulses without using a very fast and expensive register. To this end the operating circuit for the Z relay 17 includes the windings of relays 15 and 16 in parallel, the holding circuit includes the winding of relay 18, and contacts are provided on relay 18 to disconnect the winding of relay 15 from the holding winding of relay 17 so as to insure the fast release of relay 17. If relay 18 were not provided with contacts for disconnecting the winding of relay 15 from the upper winding of relay 17 at the end of each even numbered impulse, relay 17 would be rendered slow in releasing since the self-inductance of the winding of relay 18 and the upper winding of relay 17 in series is larger than the self-inductance of the winding of relay 15.

What is claimed is:

1. In combination, an impulse receiving relay, a slow-to-release relay operated in response to the first impulse of a train received by said impulse relay and adapted to remain operated until all of the impulses in the train have been received, a third relay, means for operating said third relay in response to one impulse received by said impulse relay and for releasing said third relay in response to the next succeeding impulse received by said impulse relay, and means for connecting the winding of said slow-to-release relay to hasten the operation of said third relay without delaying the release of said third relay.

2. In combination, impulse contacts, means for alternately closing and opening said impulse contacts any desired number of times in succession, a first relay, a second relay, a third relay, and a fourth relay, the first closing of a continuous series of alternate closing and openings of said impulse contacts being effective to operate said first and second relays, the opening of said impulse contacts after said first closing being effective to operate said third relay and hold operated said second relay, the second closing of said impulse contacts being effective to operate said fourth relay, to hold operated said third relay and to reenergize said first relay, said first relay being a slow-to-release relay so as to remain operated during the time said impulse contacts

are open between succeeding closings of said impulse contacts in said series, the operation of said fourth relay being effective to release said second relay, the opening of said impulse contacts after said second closing being effective to release said third and fourth relays, said fourth relay having contacts for connecting the operating winding of said third relay in series with the windings of the first and second relays in parallel to render said third relay fast in operating, for connecting the winding of said first relay in parallel with the holding winding of said third relay and winding of said fourth relay in series, and for disconnecting the winding of said first relay from said holding winding of said third relay to insure the fast release of said third relay.

3. In combination, impulse contacts, means for alternately closing and opening said impulse contacts any desired number of times in succession, a first relay, said first relay being a slow-to-release relay, a second relay, a third relay having an operating winding and a holding winding, a fourth relay, normally closed contacts of said third and fourth relays for connecting the windings of said first and second relays in parallel for operation in response to a first closing of a series of closings and openings of said impulse contacts, normally open contacts of said first and second relays for connecting the operating winding of said third relay in series with the windings of said first and second relays connected in parallel, said operating winding of said third relay being short-circuited by said normally closed contacts of said third relay and said impulse contacts in series while said first closing of said impulse contacts is maintained, the operating winding of said third relay and the windings of said first and second relays being energized when said impulse contacts are opened after said first closing to cause the operation of said third relay and to hold operated said first and second relays, the opening of said normally closed contacts of said third relay being effective to disconnect the winding of said first relay from the winding of said second relay, normally open contacts of said third relay effective upon operation of said third relay to connect the winding of said first relay in series with a holding winding of said third relay and the winding of said fourth relay, the energization of the winding of said second relay and the operating winding of said third relay in series being maintained through one of said normally closed contacts of said fourth relay and said normally open contacts of said first and second relays, the next succeeding closing of said series of closings of said impulse contacts being effective to operatively energize the winding of said fourth relay and holding winding of said third relay in series and the winding of said first relay in parallel with the winding of said fourth relay and holding winding of said third relay in series, the operation of said fourth relay being effective to disconnect the winding of said first relay from the holding winding of said third relay and from said impulse contacts, to close a locking circuit for said first relay, and to cause the release of said second relay, the next succeeding opening of said impulse contacts being effective to cause the release of said third and fourth relays and thereby again connect the winding of said first relay through said normally closed contacts of said

third and fourth relays to the winding of said second relay, the specified cycle of operations being repeated for each two succeeding closings and openings of said impulse contacts, and all of said relays which are thus operated being released upon the last opening of said series of openings and closings of said impulse contacts.

4. In combination, impulse contacts, means for alternately closing and opening said impulse contacts any desired number of times in succession, a first relay, a second relay, a third relay, a fourth relay, a first circuit, a second circuit, a third circuit, a fourth circuit, a fifth circuit, a sixth circuit, said first circuit being completed by each closing of said impulse contacts for operatively energizing said first relay, said second circuit being completed by a first closing of a series of alternate closings and openings of said impulse contacts for operatively energizing said second relay, said third circuit being closed by the co-existing operation of said first and second relays and rendered effective by the first opening of said impulse contacts in said series to operate said third relay and hold operated said second relay, said fourth circuit being closed by said co-existing operation of said first and second relays and rendered effective upon said first opening of said impulse contacts to aid the operation of said third relay and maintain the energization of said first relay until said third relay is operated, said fifth circuit being completed by the second closing of said impulse contacts in said series for operating said fourth relay and holding operated said third relay, said sixth circuit being closed by the operation of said fourth relay for maintaining the energization of said first relay while said fourth relay is operated, and contacts on said fourth relay for entirely separating said fifth and sixth circuits.

5. In combination, impulse contacts, means for alternately closing and opening said impulse contacts any desired number of times in succession, a first relay, a second relay, a third relay, a fourth relay, a circuit completed by each closing of said impulse contacts for operating said first relay, a circuit completed by the first closing of said impulse contacts in a series for operating said second relay, a circuit closed by the simultaneous operation of said first and second relays and rendered effective upon the first opening of said impulse contacts in said series for operating said third relay and for holding operated said second relay, a circuit closed by the operation of said first and second relays and rendered effective upon said first opening of said impulse contacts for maintaining the energization of said first relay until said third relay is operated, said first relay being sufficiently slow in releasing to hold its contacts in operated position between each closing of said impulse contacts in said series, a circuit completed by the second closing of said impulse contacts in said series for operating said fourth relay and for holding operated said third relay and for holding operated said first relay until said fourth relay is operated, and a circuit closed by the operation of said fourth relay for maintaining the energization of said first relay while said fourth relay is operated.

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