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TELEPHONE EXCHANGE SYSTEM

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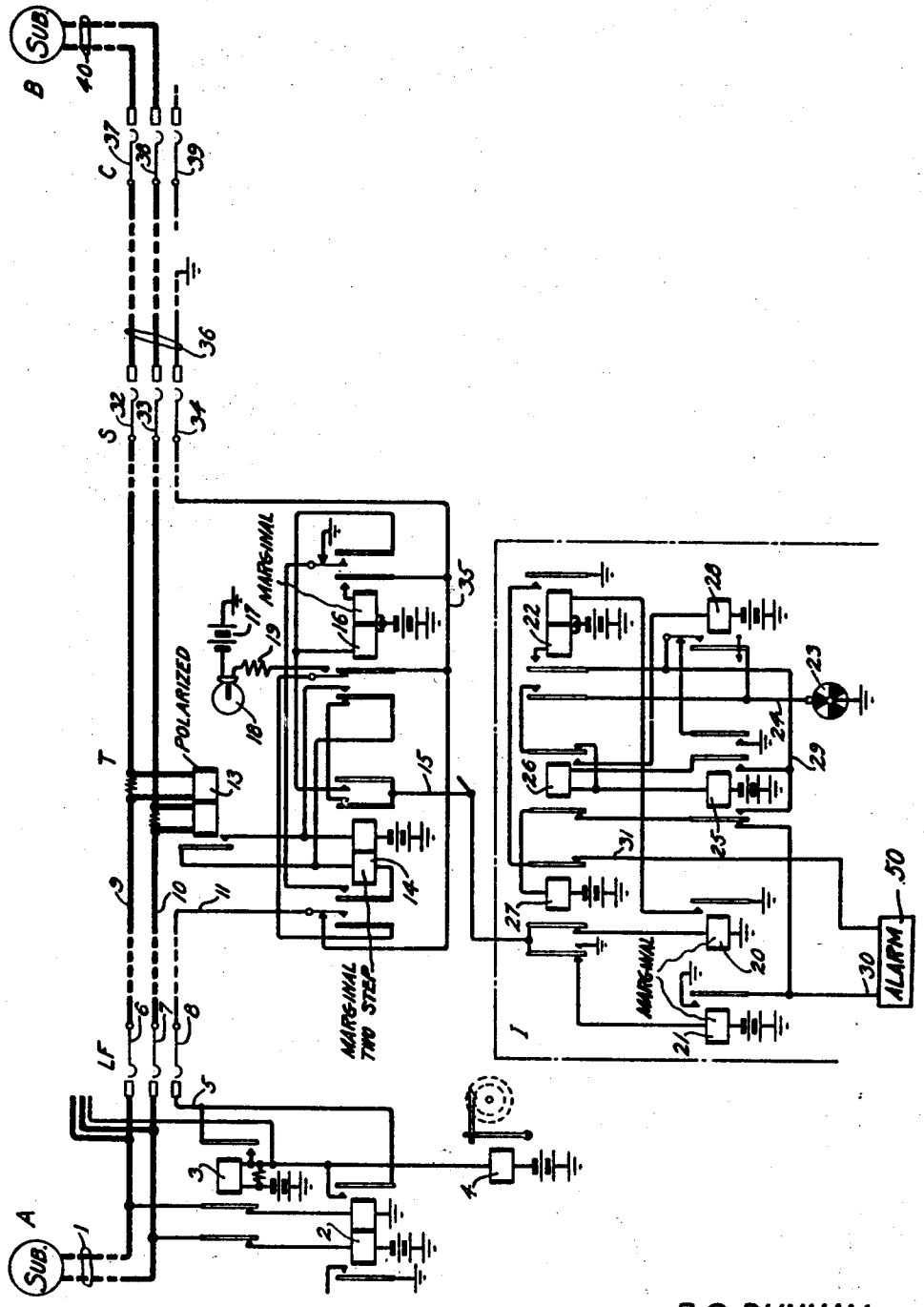

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TELEPHONE-EXCHANGE SYSTEM

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This invention relates to telephone exchange systems and more particularly to measured service telephone systems.

The object of this invention is to eliminate the possibility of charging a calling subscriber for a call in case the apparent answer of the called subscriber is caused by other conditions, or disturbances, which exist only momentarily.

According to this invention the trunk circuits, used in extending connections from calling lines, are each provided with means for delaying the establishment of a charging circuit after the called subscriber has apparently answered the call, as indicated by the operation of a supervisory relay. The delay thus introduced prevents charging for a call in case the apparent answer of the called subscriber is simulated by momentary conditions or disturbances. A two-step relay is used, in combination with an auxiliary relay and an interrupter which alternately closes and opens a connection to ground, for producing the desired delay. The frequency of the ground connections supplied by the interrupter is such as to introduce the desired delay and the duration of the ground connections is such as is required for holding the charging circuit closed long enough to operate a message register or coin-box magnet.

Referring to the drawing which diagrammatically illustrates one embodiment of this invention, A represents a calling subscriber's station connected by the line 1 to terminals in the bank of a line-finder switch LF which is represented by the brushes 6, 7 and 8. The line-finder is connected by the tip and ring conductors 9 and 10 of the trunk T to an associated selector switch S which is represented by the brushes 32, 33 and 34 and terminals with which the brushes are in contact. The brushes 37, 38 and 39 represent a connector switch C which is connected by the trunk 36 to the terminals with which the brushes of selector S are in contact. The line 40 connects the terminals, with which the brushes 37 and 38 are in contact, to the called station B. I represents an interrupter circuit arrangement which converts intermittent ground connections at one frequency into intermittent ground connections of a different frequency. The ground conections at said different frequency are then made available for timing the operation of the charge control relays in trunk circuits such as T which are used in extending connections from calling to called subscribers' stations. Any other source of intermittent ground connections of the desired frequency and duration might be used instead of the interrupter circuit I.

The line-finder LF is similar to that disclosed in U. S. Patent 1,711,682 issued to Hovland May 7, 1929. The brushes 6, 7 and 8 in the drawing accompanying this specification correspond to one of the two sets of brushes of the line-finder disclosed in Patent 1,711,682. The selector switch S and connector switch C are of the Strowger type; for a detailed description of their operation reference may be had to pages 57 to 65 inclusive of the second edition of "Automatic Telephony" by Smith and Campbell. Only those portions of the line-finder, selector and connector switches are shown as are required in explaining the operation of a system in which this invention is embodied. The portions which have been omitted are represented by the broken lines which connect to the brushes of these switches.

When a call is originated by the removal of the receiver from the receiver hook at the calling station A, the line relay 2 operates, thereby causing a line-finder such as LF to hunt for the calling line 1. Assume that the line-finder LF has found the calling line and has connected a busy potential to the sleeve terminal to prevent seizure of the line by any of the connector switches which have access thereto, that the line relay 2 has been released by the operation of the cut-off relay 3 in the usual manner, that the selector switch S has extended the connection under the control of the calling device at the calling station to the connector switch C, that the connector switch C has extended the connection under the control of the calling device at the calling station to the line 40 of the called station B, that the cut-off relay 3 is being held over the sleeve conductors of the line-finder

LF, trunk T, selector S and connector C to ground at the connector, that a ringing potential has been connected to the line 40 and that the subscriber at the called station B has answered the call.

When the subscriber at the called station answers the call the connections between the talking battery (not shown) in the connector C and the calling station A are reversed so that the current through the windings of the polarized supervisory relay 13 of the trunk T is effective to operate this relay. Relay 13 closes a circuit from battery through the right-hand winding of charge control relay 14, front contact of relay 13, outer left-hand back contact of the auxiliary charge control relay 16, inner right-hand back contact of relay 14, over conductor 15 (which is common to a group of trunks including the trunk T) to the interrupter I, through the inner left-hand back contact of relay 27, and through the winding of the interrupter starting relay 20, to ground. Another branch of this circuit may be traced from lead 15 through the outer left-hand back contact of relay 27 and through the winding of alarm relay 21 to battery. Although the windings of relays 20 and 21 are normally in a closed circuit through the back contacts of relay 27 both of these relays are marginal and neither of them operates in this normally closed circuit. As soon, however, as conductor 15 is connected, by the operation of the polarized supervisory relay in any of the trunks to which conductor 15 is multiplied, to the winding of a charge control relay (such as 14), as hereinbefore described, the starting relay 20 is operated. Since the charge control relay 14 is also a marginal relay the closing of the circuit through the winding of the starting relay 20 is ineffective to operate relay 14.

Before proceeding with the description of the operation of the trunk T the operation of the interrupter circuit arrangement I will be explained. The aforementioned operation of relay 20 closes an obvious circuit for operating relay 22. When relay 22 operates, or as soon thereafter as interrupter 23 connects ground to lead 24, counting relay 25 is operated in the circuit from battery through its winding, right-hand back contact of auxiliary counting relay 26, outer left-hand front contact of relay 22, and through conductor 24 to ground at interrupter 23. In operating, relay 25 closes a circuit for holding relay 22 operated after relay 20 releases. This circuit may be traced from ground through the outer right-hand front contact of relay 25, through the normally closed contacts of relay 28, conductor 29, inner left-hand front contact of relay 22, and through the left-hand winding of relay 22, to battery. Relay 25 also closes a circuit for operating the interrupter relay 27. This circuit may be traced from ground through the outer right-hand front contact of relay 25, through the normally closed contacts of relay 28, conductor 29, left-hand front contact of relay 25, left-hand back contact of relay 26, and through the winding of relay 27 to battery. In operating, relay 27 connects ground through its front contact directly to conductor 15 and disconnects conductor 15 from the windings of relays 20 and 21. Relay 20 releases thereby opening the circuit through the right-hand winding of relay 22; but relay 22 is held operated by the aforementioned circuit through its left-hand winding and front contact to the ground at relay 25.

Another circuit which is closed by the aforementioned operation of relay 25 may be traced from ground through the outer right-hand front contact of relay 25, through the normally closed contacts of relay 28, conductor 29, inner right-hand front contact of relay 25, winding of relay 26 and through the winding of relay 25 to battery. As long after the operation of relay 25 as the ground at interrupter 23 is connected to conductor 24 the winding of relay 26 is short-circuited and relay 26 does not operate. But as soon as the interrupter 23 disconnects ground from conductor 24 relay 26 is operated and relay 25 is held by the circuit through their windings in series to the ground at the outer right-hand front contact of relay 25. The operation of relay 26 causes the release of interrupter relay 27 and the release of relay 27 disconnects the ground at its front contact from conductor 15 and reconnects the windings of relays 20 and 21 to conductor 15.

As soon, after the operation of relay 26, as ground is again connected by interrupter 23 to conductor 24 relay 28 is operated in the circuit from battery through its winding, through the front contact of relay 26, front contact of relay 22, and through conductor 24 to ground at interrupter 23. In operating, relay 28 disconnects conductor 29 from the ground at the outer right-hand front contact of relay 25 but it also connects conductor 29 to conductor 24 so that relays 22, 25 and 26 are all held operated to the ground at interrupter 23. As soon thereafter as interrupter 23 again disconnects ground from conductor 24, relays 25, 26 and 28 all release. Relay 28 is slow in releasing to allow sufficient time for relay 25 to disconnect the ground at its outer right-hand front contact from the back contact of relay 28 before this back contact is again closed. If relay 20 has reoperated relay 22 does not release since it is held by the circuit through its right-hand winding.

Relay 20 reoperates, when relay 27 releases, if any of the trunks to which conductor 15 is multipled are making use, or are ready to use, the interrupted ground connection over conductor 15. As long as relay 22 is held operated (by the reoperation of relay 20 after

relay 27 releases) the cycle of operations as above described is repeated. At every second closure of ground through interrupter 23 to conductor 24 ground is connected, by the operation of relay 27, to conductor 15. The frequency with which conductor 15 is connected to ground is such as to control the operation of the charge control relays (of the trunks to which conductor 15 is multipled) so that sufficient delay is introduced, after the associated polarized supervisory relay has operated, to prevent the operation of the calling subscriber's message register in case the operation of the polarized supervisory relay has been caused by some momentary condition or disturbance.

Should conductor 15 become permanently grounded relay 21 connects ground to lead 30 to operate the alarm circuit 50. Should ground be connected to the winding of interrupter relay 27 otherwise than by the operation of relay 25, this ground is also connected through the back contact of relay 25 to lead 30 to operate the alarm circuit 50. If interrupter relay 27 fails to operate after the starting relay 20 has caused the operation of relay 22, ground is connected from the right-hand front contact of relay 22 to lead 31 to operate the alarm circuit 50.

Returning now to the operation of the charge control relays associated with the trunk T, when the interrupter circuit arrangement I connects ground (by the operation of relay 27) directly to conductor 15 the current through the right-hand winding of the marginal two-step relay 14 is strong enough to cause the partial operation of relay 14. When thus energized, relay 14 closes its inner left-hand front contact but does not open or close any of its right-hand contacts. If supervisory relay 13 remains operated, a circuit is closed from battery through the right-hand winding of relay 14, front contact of relay 13, left-hand winding and inner front contact of relay 14, and through the right-hand back contact of relay 16 to ground. The left-hand winding of relay 14 is short-circuited by the ground on conductor 15 until relay 27 of interrupter I releases, at which time both windings of relay 14 are energized to completely operate relay 14. The complete operation of relay 14 places the connection, from the sleeve conductor 11 of the line-finder LF to the sleeve conductor 35 of the selector S under the joint control of relays 14 and 16. The complete operation of relay 14 also disconnects conductor 15 from the windings of relay 14 and connects it to the left-hand winding of relay 16. Relay 16 is marginal and does not operate in series with relay 20 but relay 20 of the interrupter I is operated and the interrupter circuit repeats its cycle of operation as hereinbefore described.

When ground is again connected by the interrupter I directly to conductor 15 the current through the left-hand winding of relay 16 is strong enough to operate relay 16. Relay 16 closes a circuit for operating the calling subscriber's message register. This circuit may be traced from booster battery 17 through lamp 18 and resistance 19, inner left-hand front contact of relay 16, outer left-hand front contact of relay 14, sleeve conductor 11 and brush 8 of line-finder LF, conductor 5, front contact of cut-off relay 3, and through the windings of cut-off relay 3 and message register 4 in parallel, to battery. The cut-off relay 3 holds and the message register 4 operates, thereby charging the calling subscriber for the call.

In operating, relay 16 disconnects the windings of relay 14 from the ground at the right-hand back contact of relay 16, but relay 14 holds, independently of the continued operation of relay 13, until ground is again disconnected from conductor 15. The circuit for holding relay 14 may be traced from battery through its right-hand winding, outer left-hand front contact of relay 16, left-hand winding and front contact of relay 14, outer right-hand front contact of relay 16, right-hand front contact of relay 14, over conductor 15, to ground at relay 27 of interrupter I. As soon as ground is disconnected from conductor 15, relay 14 releases but relay 16 does not release since a locking circuit was closed by its operation from battery through its right-hand winding and front contact, over sleeve conductor 35 and brush 34 of selector S, to the sleeve ground at connector C. The release of relay 14 disconnects the booster battery 17 from the sleeve conductor 11 of line-finder LF and reestablishes the connection between the sleeve conductor 11 of line-finder LF and the sleeve conductor 35 of selector S. The cut-off relay 3 and the auxiliary control relay 16 hold to the ground at connector C until the connection is released. The message register may release at this time or may remain operated until the connection is released.

When the receiver is replaced on the receiver hook at the calling station A the line relay (not shown) in the connector C releases thereby causing the sleeve ground to be disconnected from conductor 35. Relay 16 of trunk T and cut-off relay 3 both release. The connector C, selector S and line-finder LF are then returned to normal in the usual manner.

The invention is not limited to systems using the charging means shown in the drawing nor to systems employing Strowger type switches. It may be applied to any system in which means are provided for charging automatically the subscribers for completed calls.

What is claimed is:

1. In a telephone system, a calling subscrib-

er's station, a called subscriber's station, means including a trunk for establishing a connection between said stations, means for charging the calling subscriber if said called subscriber answers the call, and means associated with said trunk and including a two-step relay for delaying the operation of said charging means.

2. In a telephone system, a calling subscriber's station, a called station, means for establishing a connection between said stations, means for charging the calling subscriber, means including an interrupter for delaying the operation of said charging means, and means including said interrupter for limiting the time during which said charging means are operated.

3. In a telephone system, a calling subscriber's station, a called station, means for establishing a talking connection between said stations, means dependent upon the completion of said talking connection for charging the calling subscriber, means including an interrupter for delaying the operation of said charging means, and means including said interrupter for limiting the time during which said charging means are operated.

4. In a telephone system, a calling subscriber's station, a called station, means for establishing a connection between said stations, means for charging the calling subscriber, means including a two-step relay and an interrupter for delaying the operation of said charging means, and means including said relay and interrupter for limiting the time during which said charging means are operated.

5. In a telephone system, a calling subscriber's station, charging means individual to said station, a called station, means for establishing a connection between said calling and called stations, means effective upon the answer of the subscriber at said called station for closing a circuit for operating said charging means, an interrupter, means including said interrupter for delaying the closing of said charging circuit, and means including said interrupter for limiting the duration of the closure of said charging circuit.

6. In a telephone system, a calling subscriber's station, a message register for said calling station, a called subscriber's station, means including a trunk for establishing a connection between said calling and called stations, a supervisory relay, means for operating said supervisory relay when said called subscriber answers the call, means rendered effective by the operation of said relay to operate said message register, and means including a two-step relay for delaying the operation of said register.

7. In a telephone system, a calling subscriber's station, a called subscriber's station, means including a trunk for establishing a connection between said stations, means for charging the calling subscriber if said called subscriber answers the call, a supervisory relay, means for operating said supervisory relay when said called subscriber answers the call, and means including a two-step relay effective in case said supervisory relay is momentarily operated for preventing the operation of said charging means.

8. In a telephone system, a calling subscriber's station, a message register individual to said calling station, a called station, a group of trunks, means including one of said trunks for establishing a connection between said stations, a conductor common to the trunks in said group, an interrupter arranged to alternately close and open its contacts at a given frequency, means including said interrupter for alternately connecting ground to and disconnecting ground from said conductor at a desired frequency which is different from that at which the contacts of said interrupter are actuated, a supervisory relay individual to said trunk, means rendered effective by the operation of said supervisory relay for operating said message register, and means including a two-step relay and including said conductor for delaying the operation of said register.

9. The combination in a telephone system of a control relay, an auxiliary relay, a conductor, means for intermittently connecting ground to said conductor, means for partially operating said control relay upon ground being connected to said conductor, a circuit closed by the partial actuation of said control relay for completely energizing said relay as soon as ground is disconnected from said conductor, means effective as soon as ground is again connected to said conductor for operating said auxiliary relay, a circuit closed by the operation of said auxiliary relay for holding said control relay operated until ground is again disconnected from said conductor, and means for holding said auxiliary relay operated after said control relay has released.

10. In a telephone system, a calling subscriber's station, a message register individual to said calling station, a called station, means including a trunk for extending a connection from said calling station to said called station, a supervisory relay, a register control relay, an interrupter which alternately connects ground to and disconnects ground from said register control relay, means jointly controlled by said supervisory relay and said interrupter for partially actuating said register control relay, means controlled by said supervisory relay and dependent upon said partial actuation for completely operating said register control relay as soon as the ground is disconnected at said interrupter, and means dependent upon said supervisory relay being operating at the time that ground at said interrupter is again connected to said

register control relay for operating said message register.

11. In a telephone system, a calling subscriber's station, a message register for said calling station, a called subscriber's station, a group of trunks, means including one of said trunks for extending a connection from said calling station to said called station, a supervisory relay whose windings are in series with the tip and ring sides of said trunk, means for reversing the current over said trunk when said called subscriber answers to cause the operation of said supervisory relay, a charge control relay, an auxiliary relay, a conductor common to said group of trunks, an interrupter which alternately connects ground to and disconnects ground from said conductor, a circuit including a contact of said supervisory relay and said conductor for partially actuating said charge control relay, a circuit including a contact of said supervisory relay closed by said partial actuation and effective to completely actuate and hold said charge control relay as soon after said partial actuation as said interrupter disconnects ground from said conductor, a circuit closed as soon after the complete actuation of said charge control relay as ground is again connected by said interrupter to said conductor for operating said auxiliary relay, a circuit including said conductor closed by the actuation of said auxiliary relay for holding said charge control relay completely operated, a circuit closed by the actuation of said auxiliary relay and opened by the release of said charge control relay when ground is again disconnected by said interrupter from said conductor for operating said message register, and means for preventing the reoperation of said charge control relay.

In witness whereof, I hereunto subscribe my name this 24th day of June, 1929.

BERT G. DUNHAM.

In witness whereof, I hereunto subscribe my name this 21st day of June, 1929.

RHYS A. FAIRBAIRN.