

March 29, 1949.

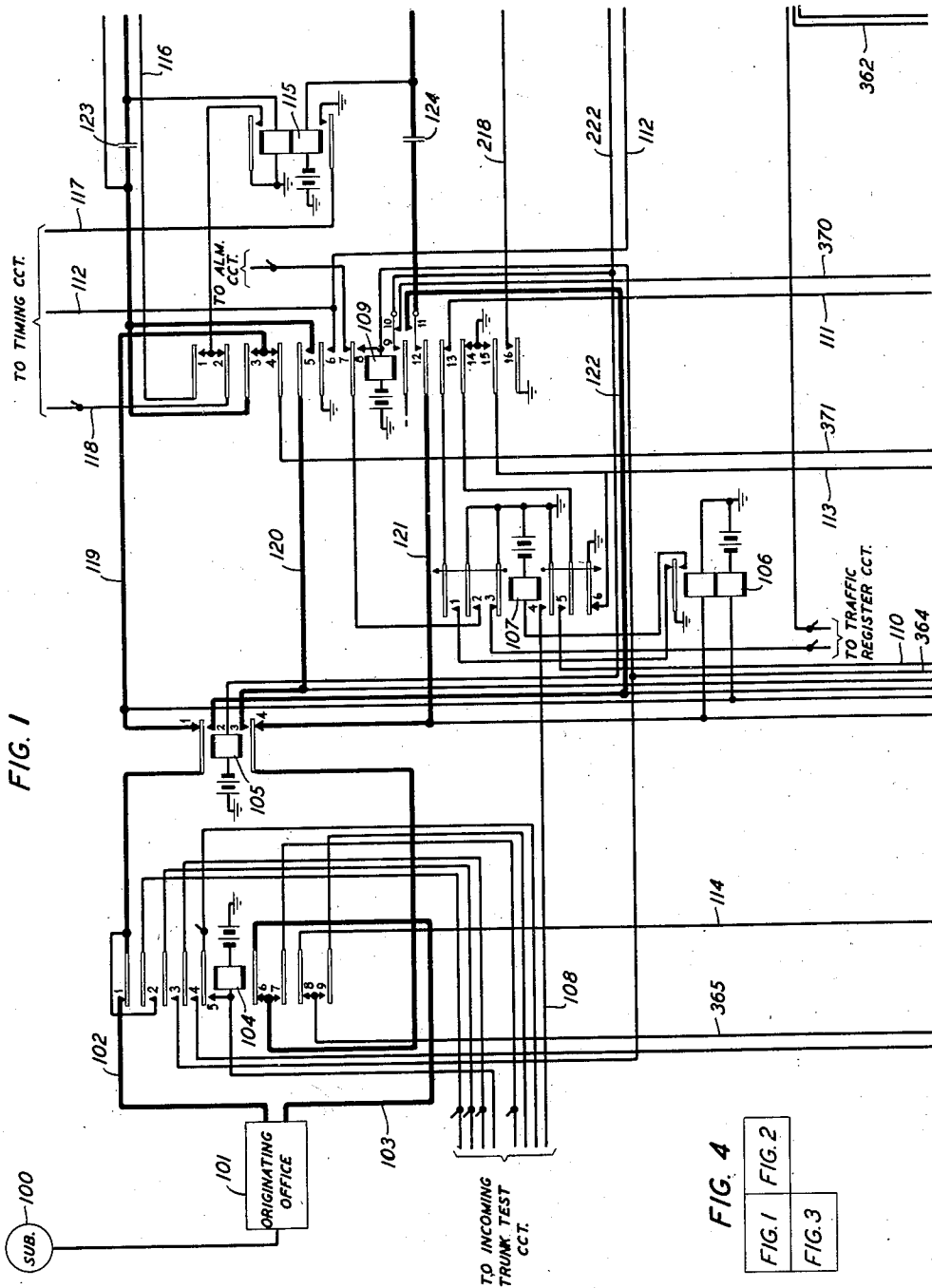
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2,465,539

CALL FAILURE SIGNALING ARRANGEMENT

Filed Dec. 20, 1946

3 Sheets-Sheet 1



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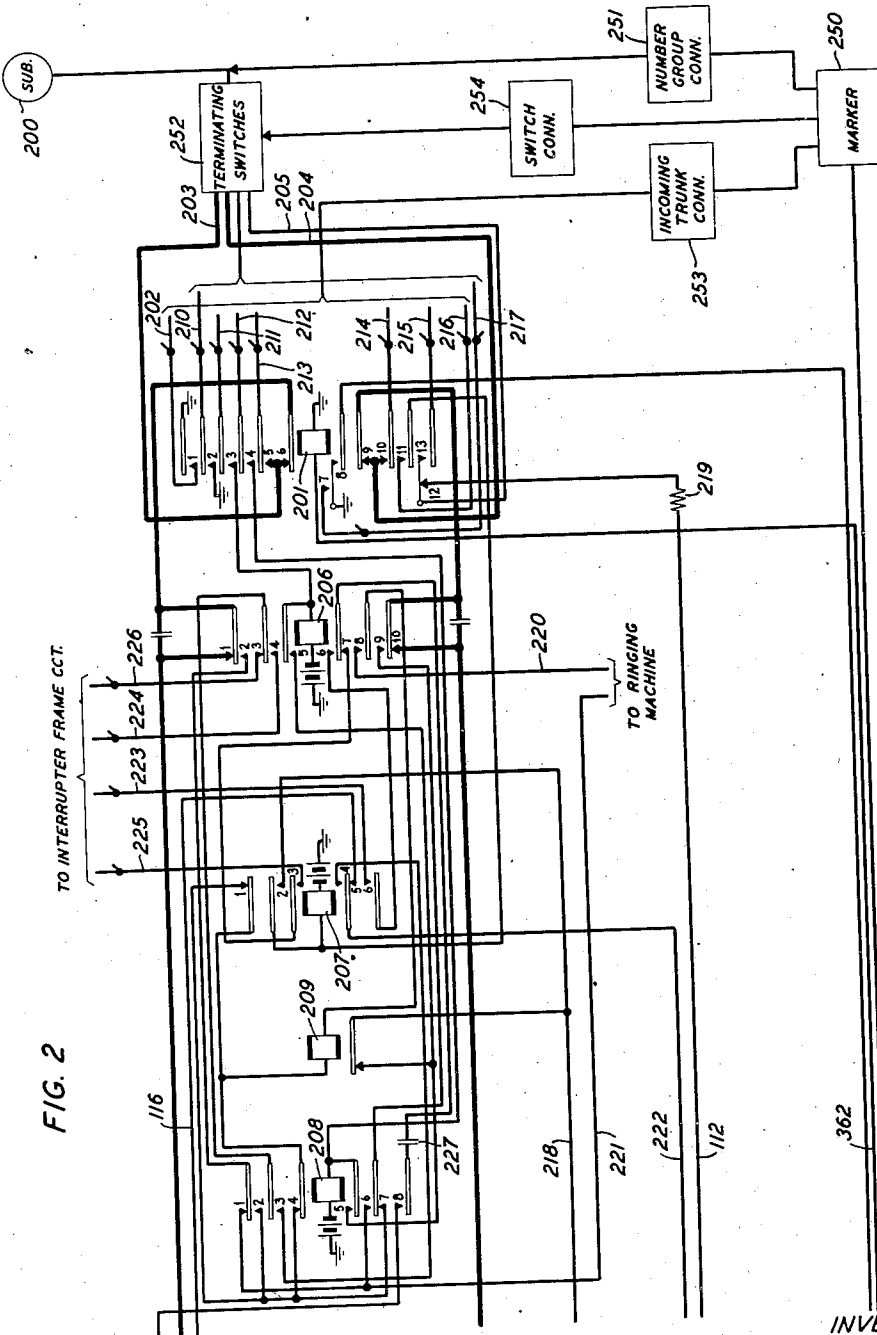
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3 Sheets-Sheet 2

FIG. 2



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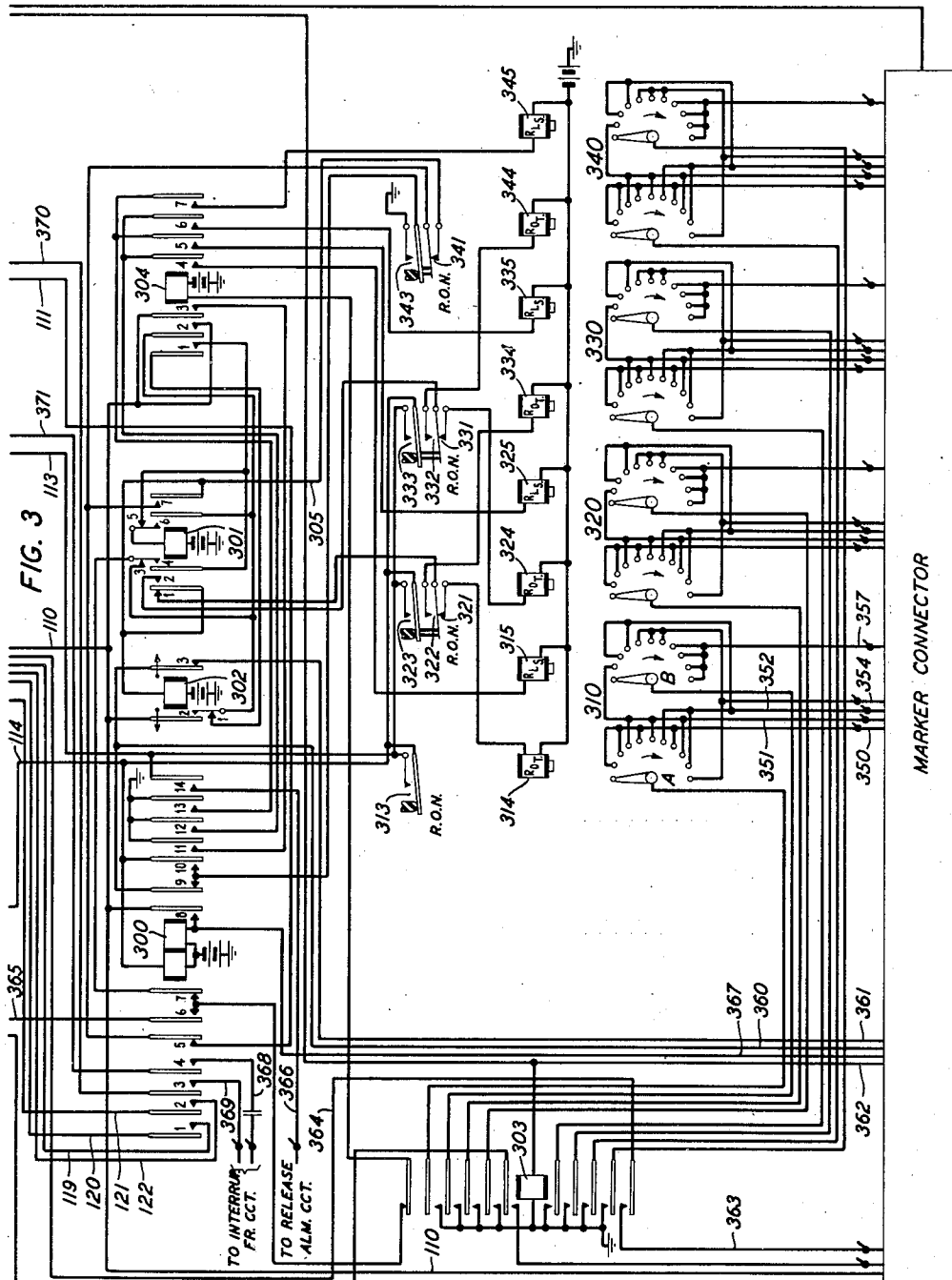
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CALL FAILURE SIGNALING ARRANGEMENT

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3 Sheets-Sheet 3



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2,465,539

CALL FAILURE SIGNALING ARRANGEMENT

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Application December 20, 1946, Serial No. 717,519

10 Claims. (Cl. 179—18)

1

This invention relates to telephone systems and has for its object the simplification of interoffice connections.

In telephone exchange systems employing cross-bar switches, the switches are operated under the control of common circuits called markers which receive the information required for their operation from register senders. In general, two types of senders and markers are employed. At the originating office, the register sender receives the complete office and numerical designation of the wanted line by means of dial pulses, transmits the office designation to the originating marker which sets up the connection to the wanted office, and transmits the numerical designation to a terminating sender by means of reverteive pulses. At the terminating office the function of the sender is chiefly to control a marker which controls the completion of the connection to the called line.

This arrangement presents a problem where offices employing step-by-step switches are employed in the same area, since special means must be provided either for receiving dial pulses in connection with the terminating equipment at the cross-bar office, or for transmitting reverteive pulses at the step-by-step office. Where there are only a limited number of trunks connecting such offices, one simple solution of the problem is to provide a set of simple registers for each such trunk.

The present invention concerns such an arrangement and more specifically is concerned with means for transmitting a trouble signal to the originating office when the call cannot be handled at the terminating office.

One feature of the invention lies in means for transmitting an overflow signal from the individual register circuit when no marker can be reached.

Another feature lies in providing register releasing means which is effective to transmit an overflow signal over the incoming trunk.

In addition the register releasing means is also provided with means for maintaining the battery supply to the incoming trunk during the transmission of the overflow signal.

A clearer understanding of the invention may be obtained from a consideration of the following description in connection with the drawings in which:

Figs. 1 and 2 show a trunk circuit incoming from a distant office;

Fig. 3 shows a register circuit individual to the trunk circuit of Figs. 1 and 2; and

2

Fig. 4 shows the proper arrangement of Figs. 1 to 3, inclusive.

The trunk and register circuits of the present disclosure are particularly adapted to be used in a telephone office employing cross-bar switches for the purpose of completing calls originated at an office employing step-by-step switches. In the establishment of such an interoffice connection certain of the digits dialed by the calling subscriber are used in establishing the connection to the office at which the wanted line terminates, while the remaining digits are transmitted directly to the terminating office for use there in selecting the called line and extending the incoming trunk thereto. Such a trunk and register would likewise serve for the completion of calls from any office from which the number of the wanted subscriber is transmitted by dial type pulses.

When a subscriber at the distant office originates a call, his substation 100 is associated with the equipment at that office, indicated at 101, which responds to the dialing of the proper office code to connect the calling line with an idle trunk leading to the wanted office, where it terminates in a pair of trunk conductors such as 102 and 103.

When this connection has been established, a circuit is completed from battery through the lower winding of relay 106, conductor 119, contact 1 of relay 105, contact 1 of relay 104, conductor 102, through the equipment 101 at the originating office to the bridge supplied by that equipment or by the subscriber's line and back to conductor 103, contact 6 of relay 104, contact 4 of relay 105, conductor 121 to ground through the upper winding of relay 106. Relay 106 operates in this circuit, closing an obvious circuit for relay 107, which operates to prepare a pulsing path to the register circuit of Fig. 3, supplies ground over contact 4 to conductor 108 to mark the trunk busy to the test circuit, and at contact 5 extends ground from contact 14 of relay 109 to conductor 110 to provide locking ground for relays of the register circuit.

When dial pulses are received from the originating office, relay 106 releases and reoperates in response to each pulse. Relay 107, being slow to release, remains operated. Each time that relay 106 releases, it closes a pulsing circuit leading to the register circuit by connecting ground over its back contact, contact 1 of relay 107, and contact 13 of relay 109 to conductor 111. In the register circuit, conductor 111 extends over contact 5 of 55 relay 300, over normal contact 341 of register

3

340 and conductor 305 to the winding of relay 302 and battery. Relay 302 operates in response to the first closure of the pulsing circuit and, being slow to release, remains operated throughout the pulses of each digit.

During the first digit the pulsing circuit extends in parallel with the winding of relay 302, from conductor 305, over contact 1 of relay 301, normal contact 321 of register 320, to battery through the winding of magnet 314 which controls the first register 310. Magnet 314 operates in response to each closure of the pulsing circuit and advances register 310 to a position corresponding to the first digit dialed. When register 310 advances from its normal position, off-normal contact 313 is closed.

When relay 302 operated as above described, it closed a circuit from ground on conductor 110, contact 2 of relay 302, contact 3 of relay 301, contact 7 of relay 300, back contact of relay 303, winding of relay 304 to battery. Relay 304 operates in this circuit, closing a locking circuit for itself which extends from ground on conductor 110 over contact 2 of relay 304 to contact 3 of relay 301 and thence to the winding of relay 304 as above traced. Relay 304 therefore remains operated when relay 302 releases at the end of the first digit.

When relay 106 remains operated during the interval between the first and second digits, relay 302 releases and a circuit is closed from battery through the winding of relay 301, contact 5 of that relay, contact 1 of relay 304, contact 1 of relay 302, contact 2 of relay 304 to ground on conductor 110. Relay 301 operates in this circuit and locks over its contact 6 and contact 2 of relay 304 to conductor 110, independent of relay 302. Relay 301 at its left make-before-break contacts 3 and 4 closes an alternate holding circuit for relay 304 and opens the one above traced. The new holding circuit for relay 304 may be traced from battery through the winding of relay 304, back contact of relay 303, contact 7 of relay 300, contact 4 of relay 301, contact 1 of relay 304, contact 1 of relay 302, contact 2 of relay 304 to grounded conductor 110, thereby placing relay 304 under the control of relay 302.

When relay 106 releases to ground conductor 111 in response to the first pulse of the second digit, relay 302 operates as before. However, with relay 301 operated, the parallel pulsing circuit extends from conductor 305 over contact 2 of relay 301, normal contact 331 of register 330 to the winding of magnet 324, and battery so that register 320 is positioned in accordance with the second digit. The advance of register 320 opens normal contact 321 and closes off-normal contacts 322 and 323.

The operation of relay 302 opens the holding circuit for relay 304 which releases, but closes a substitute holding circuit for relay 301 which may be traced from battery through the winding of relay 301, contact 6 of relay 301, contact 2 of relay 302 to ground over conductor 110. When relay 302 releases at the end of the second digit relay 301 also releases.

At the beginning of the third digit, relay 302 is reoperated as previously described. However, since register 320 has been moved from normal and relay 301 is released the pulsing circuit is now extended from conductor 305 over contact 1 of relay 301, off-normal contact 322 of register 320 to the winding of magnet 334 of register 330, thereby positioning register 330 in response to the third digit. The advance of register 330

4

opens normal contact 331 and closes off-normal contacts 332 and 333.

Relay 304 is operated and locked in response to the operation of relay 302 as described in connection with the recording of the first digit, in turn preparing the previously traced circuit for relay 301 which becomes effective when relay 302 releases at the end of the digit, relay 301 when operated placing relay 304 under the control of relay 302 as previously described.

During the reception of the fourth digit, relay 302 is operated, releasing relay 304 and holding relay 301 as described for the second digit. The pulsing circuit at this time extends from conductor 111, contact 5 of relay 300, over contact 7 of relay 301 in parallel with normal contact 341, conductor 305, over contact 2 of relay 301, off-normal contact 332 to the winding of magnet 344 of register 340 and battery so that it remains closed after the advance of register 340 opens normal contact 341. Therefore register 340 is positioned in accordance with the fourth digit and closes off normal contact 343. At the end of the digit relay 302 releases, in turn releasing relay 301.

The closure of contact 343 and release of relay 302 connects ground over contact 343, contact 9 of relay 300 and contact 3 of relay 302 to conductor 361 to initiate the operation of the marker connector to associate an idle marker, for example, marker 250, with the register circuit. Ground is also connected to conductor 360, independent of relay 302, to provide a holding circuit for the marker connector, which will not be interrupted if an additional digit is dialed in error. The marker connector also connects ground to conductor 110 to prevent release of the trunk and register while the marker is functioning. A marker connector suitable for use with this type of trunk and register is disclosed in applicant's copending application, Serial No. 719,354, filed December 31, 1946.

When an idle marker such as marker 250 has been connected with the register, it connects battery to conductor 352 to operate relay 303 in the register circuit and relay 201 in the trunk circuit.

Relay 303, in operating, opens the circuit of relay 304 to prevent its operation while the marker is operating and connects ground to the brushes of registers 310 to 340. These grounds indicate to the marker the positions in which each of these switches have been placed by grounding two out of five leads to give one of ten possible combinations.

Following is a table indicating by way of example which of the leads 350, 351, 352, 354 and 357 are grounded by brushes A and B of register 310 for each number registered.

Number registered

	1	2	3	4	5	6	7	8	9	0
Brush A	350	350	351	350	351	352	350	351	352	354
Brush B	351	352	352	354	354	354	357	357	357	357

The marker receives the called line designation and employs that information to obtain, by means of the number group connector 251, an indication whether the line is busy or idle and, if idle, an indication of the location of the line terminals in the terminating switches 252.

When relay 201 in the trunk circuit operates, at contact 4, it connects ground to conductor 202 to operate a relay in the incoming trunk con-

5

necter 253 to permit the marker to connect with this trunk. Relay 201 at contacts 6 and 5, 9 and 10 and 12 and 13 transfers the tip, ring and sleeve conductors 203, 204 and 205 from the trunk circuit to conductors leading to the trunk connector 253 to permit the marker to test the connection through the terminating switches 252 when it has been established. In addition, at contacts 2 and 7 it grounds conductors 210 and 217 to prepare the terminating switches for operation.

With relay 201 operated, relays 206, 207 and 208 are connected over contacts 3, 11 and 4 to conductors 211, 216 and 212 and through the trunk connector 253 to the marker for selective operation to determine the ringing or other signaling current to be employed.

Relay 206 is operated whenever ringing current is to be transmitted to the called line and normally connects the ringing source to the ring conductor. If the called number represents the tip party on a two-party line, relay 208 will be operated to cause the ringing source to be connected to the tip conductor. If the connection cannot be completed, relay 207 will be operated in combination with relay 208 if the called line is busy and in combination with both relays 206 and 208 if there are no channels available over which to reach an idle line. If the called line is a line for which no charge is made relays 207 and 206 are operated. Relay 207, when operated, locks directly to conductor 218 which is grounded as described hereinafter, while relays 206 and 208 lock over the back contact of relay 209 to the same conductor.

After the marker has completed its functions and is ready to release, it connects ground to conductor 363, completing a circuit over the lowermost contact of relay 303, conductor 364, through the winding of relay 109 to battery. Relay 109 locks over its contact 8 to ground at contact 2 of relay 107. This locking ground is a signal to the marker that the transmission circuit has been closed through the trunk.

Relay 109 in operating at contacts 3 and 12 closes the incoming tip and ring conductors 119 and 121 to condensers 123 and 124 to establish the talking circuit. At contact 16 it connects ground to conductor 218 to hold the ringing control relays operated after the release of relay 201 opens their operating circuits. At contact 6, relay 109 connects ground over conductor 112 to resistance 219. At contact 13 relay 109 opens the pulsing circuit and at contact 14 disconnects ground from conductor 110, thereby opening one holding circuit for the register circuit.

At contact 15, relay 109 closes a release circuit for the register circuit. This circuit may be traced from ground, contact 15 of relay 109, conductor 113, over off-normal contacts 313, 323 or 333 to the left winding of relay 300 and battery. Relay 300 operates, locking over its contact 10 to ground over off-normal contact 343 and through its right winding and contact 8 to ground supplied to conductor 110 by the marker connector. At contact 9 relay 300 opens the start and holding circuits for the marker connector, previously traced to conductors 361 and 360. The opening of these circuits causes the marker to remove battery from conductor 362, thereby releasing relays 303 and 201. The release of the marker and marker connector disconnects ground from conductor 110.

When relay 303 releases, a circuit is closed from battery through the winding of relay

6

304, back contact of relay 303, contact 6 of relay 300, conductor 365, contact 8 of relay 104, conductor 114, contact 10 of relay 300 to ground over off-normal contact 343. A parallel circuit extends from conductor 114 over off-normal contacts 313, 323 and 333 to ground on conductor 113 so that relays 300 and 304 remain operated until all of the registers have restored to normal. In addition relay 300 locks through its right winding and contact 8, contact 3 of relay 304, to ground at contact 11 of relay 300. At contact 5 relay 300 opens the circuit of relay 302 and the operating magnets of the registers. At contact 14 relay 300 extends ground from conductor 113 to conductor 366 to prepare for sounding an alarm if the restoration of the registers is unduly delayed.

With relays 300 and 304 operated, circuits are closed for operating the release magnets 315, 325, 335 and 345. These circuits extend from ground over contact 12 of relay 300, contacts 4 and 6 of relay 304 to the windings of release magnets 315 and 335 and battery, and from ground over contact 13 of relay 300, contacts 5 and 7 of relay 304 to the windings of release magnets 325 and 345 and battery.

When all of the registers are normal, the circuits for relay 304 are opened and that relay releases, in turn releasing relay 300, thereby restoring the register circuit to normal.

In the trunk circuit, the release of relay 201 restores the connection of the tip and ring conductors to conductors 203 and 204 leading through the terminating switches 252 to the called line 200. At contact 12, relay 201 connects ground through resistance 219 to the sleeve conductor 205 to hold the switch magnets operated. The closure of the tip and ring conductors establishes the circuit for signaling the called subscriber. Assuming that line 200 is an individual line, relay 206 will be operated alone and the ringing circuit will extend from the ringing source over conductor 220, contact 8 of relay 206, winding of relay 209, contact 1 of relay 207, contact 7 of relay 208, contact 9 of relay 206, contact 9 of relay 201, over the ring conductor 204 through the terminating switches 252 to the ringer at the called substation, back through the terminating switches 252 to tip conductor 203, contact 6 of relay 201, contact 2 of relay 206, contact 1 of relay 208, to ground over conductor 221.

When the called subscriber answers, relay 209 operates, opening the locking circuit for relay 206 which releases, removing ringing current from the called line. With relay 206 released, the tip and ring conductors from the called line are extended to the condensers 123 and 124 and to the windings of relay 115 which operates, closing a circuit from ground over its upper contact, contact 1 of relay 109, conductor 116, contact 5 of relay 207, conductor 222 to the winding of relay 105, which operates and reverses the connection of battery and ground through the windings of relay 106 to the incoming tip and ring conductors 102 and 103 as a signal that the called line has answered. Battery is now connected through the lower winding of relay 106, conductor 119, over contacts 3 and 5 of relay 109, conductor 120, contact 3 of relay 105 and contact 6 of relay 104 to the ring conductor 103, while ground is connected through the upper winding of relay 106, conductor 121, contacts 11 and 12 of relay 109, conductor 122, contact 2 of relay 105 and contact 1 of relay 104 to the tip conductor 102.

When the calling subscriber disconnects, the equipment at the originating office 101 releases,

opening the circuit of relay 106 which in turn releases, followed after an interval by relay 107. Relay 107 opens the locking circuit of relay 109 which also releases. Relay 109 releases relay 105, thereby restoring the connection of relay 106 to the incoming trunk. At contact 6 relay 109 disconnects ground from conductor 112, but, since conductors 117 and 112 are normally connected together in the timing circuit, the terminating switches 252 are held operated under the control of relay 115 which is held operated over the called line. When the called line disconnects, relay 115 releases, removing ground from conductor 112 and permitting the switches to restore.

With relay 109 released and relay 115 operated, ground is connected over the upper contact of relay 115, contact 2 of relay 109 and conductor 118 to start a timing operation in the timing circuit, at the end of which conductor 117 is disconnected from conductor 112 and the terminating switches release, in turn releasing relay 115.

If the marker is unable to complete the connection, because the called line is busy, it operates relays 207 and 208, and releases, operating relay 109 as above-described. When relay 109 operates, interrupted ground on conductor 226 is extended over contact 3 of relay 208, contact 3 of relay 208, contact 4 of relay 207 to conductor 222 and the winding of relay 105, causing that relay to operate intermittently to reverse the connection of relay 106 to the trunk circuit as a busy signal to any operator whose position may have been included in the incoming connection. At the same time, tone on conductor 225 is connected over contact 3 of relay 207, contact 7 of relay 206, through condenser 227, contact 8 of relay 208 and over contact 3 of relay 109 to conductor 119 and thence to the calling subscriber's line.

If the marker cannot complete the connection because no path is available to the wanted line, it operates relay 206 as well as relays 207 and 208 and interrupted ground of a different rate and a different tone, are supplied over conductors 223 and 226 as an overflow signal.

In the case of trouble in the marker, a trouble release signal is given to the register circuit and the overflow signal is supplied by that circuit. In the case of trouble, either in the marker connector or the marker, none of the trunk relays 109, 206, 207 and 208 is operated by the marker, but ground is connected to conductor 367, operating relay 300 through its right winding. Relay 300 locks to conductor 110 and operates relay 304 to restore the registers to normal as above described. In addition, since relay 109 has not been operated, a circuit is closed from interrupted ground on conductor 369 over contact 3 of relay 300, conductor 370, contact 10 of relay 109 to conductor 222, winding of relay 105 and battery, operating relay 105 intermittently at the overflow rate. With relay 109 not operated, the connections from the windings of relay 106 over conductors 119, 120, 121 and 122 to the front contacts of relay 105 are opened. In order to assure a proper reverse battery signal and to prevent premature release of the incoming trunk, relay 300, at contact 1 connects conductor 119 to conductor 120 and, at contact 2, connects conductor 121 to conductor 122. At contact 4, relay 300 connects overflow tone on conductor 368, over conductor 371, contact 4 of relay 109 to conductor 119, and thence over contact 1 of relay 300 to conductor 120 to supply an overflow signal to the calling subscriber.

If the call is abandoned before dialing is com-

pleted, with one or more of the registers 310 to 340 off normal, the release of relay 106 followed by the release of relay 107 closes a circuit from ground at contact 6 of relay 107, over conductor 113 and the closed off-normal contacts 313, etc., to the left winding of relay 300 to restore the registers to normal as described.

If the trunk is re seized from the originating office before the called subscriber disconnects and the timing circuit releases the terminating switches, the number of the wanted line may be recorded and the marker start its functions. When the marker operates relay 201, that relay disconnects the ground supplied by relay 115 through resistance 219, from the sleeve conductor 205 leading to the terminating switches 252 thereby releasing the switches and preparing them for reoperation to connect with the new called line.

What is claimed is:

1. In a telephone system, trunk circuits, registers individual to each of said trunk circuits, means for setting said registers from said trunk, switches for completing connections from said trunk circuits, control circuits common to said trunks for controlling the operation of said switches, a source of signaling current, means responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, means operated by said control circuit for connecting said trunk with said source of signaling current if said control circuit fails to complete a connection from said trunk and auxiliary means associated with said registers for connecting said trunk with said source of signaling current if said registers cannot be connected with a control circuit.

2. In a telephone system, trunk circuits, registers individual to each of said trunk circuits, means for setting said registers from said trunk, switches for completing connections from said trunk circuits, control circuits common to said trunks for controlling the operation of said switches, a source of signaling current, a connector responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, means operated by said control circuit for connecting said trunk with said source of signaling current if said control circuit fails to complete a connection from said trunk and auxiliary means associated with said registers for connecting said trunk with said source of signaling current under the control of said connector if said connector cannot connect said registers with a control circuit.

3. In a telephone system, trunk circuits, registers individual to each of said trunk circuits, means for setting said register from said trunk, switches for completing connections from said trunk circuits, control circuits common to said trunks for controlling the operation of said switches, a source of signaling current, a connector responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, means operated by said control circuit for connecting said trunk with said source of signaling current if said control circuit fails to complete a connection from said trunk and auxiliary means associated with said registers for connecting said trunk with said source of signaling current under the control of said connector in case of trouble in said connector.

4. In a telephone system, trunk circuits, talking circuits to be completed through said trunk circuit, registers individual to each of said trunk

circuits, means for setting said registers from said trunk, switches for completing connections from said trunk circuits, control circuits common to said trunks for controlling the operation of said switches, a source of signaling current, a connector responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, a relay operated by said control circuit on a successful call to complete a talking circuit through said trunk, means controlled by said relay for restoring said registers, means operated by said control circuit for connecting said trunk with said source of signaling current if said control circuit fails to complete a connection from said trunk and auxiliary means associated with said register restoring means for connecting said trunk with said source of signaling current if said connector cannot connect said registers with a control circuit.

5. In a telephone system, trunk circuits, talking circuits to be completed through said trunk circuit, registers individual to each of said trunk circuits, means for setting said registers from said trunk, switches for completing connections from said trunk circuits, control circuits common to said trunks for controlling the operation of said switches, a source of signaling current, a connector responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, a relay operated by said control circuit on a successful call to complete a talking circuit through said trunk, means controlled by said relay for restoring said registers, means operated by said control circuit for connecting said trunk with said source of signaling current if said control circuit fails to complete a connection from said trunk, auxiliary means associated with said register restoring means for connecting said trunk with said source of signaling current if said connector cannot connect said registers with a control circuit a battery supply, normally closed circuits for connecting said battery supply to said trunk, means under the control of said signaling current for interrupting said normally closed circuits and means for closing supplementary circuits for maintaining the connection of said battery supply to said trunk while said signaling current is connected therewith.

6. In a telephone system, trunk circuits, talking circuits to be completed through said trunk circuit, registers individual to each of said trunk circuits, means for setting said registers from said trunk, switches for completing connections from said trunk circuits, control circuits common to said trunks for controlling the operation of said switches, a source of signaling current, a connector responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, a relay operated by said control circuit on a successful call to complete a talking circuit through said trunk, means controlled by said relay for restoring said registers, means operated by said control circuit for operating said relay and connecting said trunk with said source of signaling current if said control circuit fails to complete a connection from said trunk, auxiliary means associated with said register restoring means for connecting said trunk with said source of signaling current if said connector cannot connect said registers with a control circuit a battery supply, normally closed circuits for connecting said battery supply to said trunk, means under the control of said signaling current for interrupting said normally closed

circuits and means under the control of said relay or under the control of said register restoring means for closing supplementary circuits for maintaining the connection of said battery supply to said trunk while said signaling current is connected therewith.

7. In a telephone system, trunk circuits, talking circuits to be completed through said trunk circuit, registers individual to each of said trunk circuits, means for setting said registers from said trunk, switches for completing connections from said trunk circuits, control circuits common to said trunks for controlling the operation of said switches, a source of signaling current, a connector responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, a relay operated by said control circuit on a successful call to complete a talking circuit through said trunk, means controlled by said relay for restoring said registers, means operated by said control circuit for operating said relay and connecting said trunk with said source of signaling current if said control circuit fails to complete a connection from said trunk, auxiliary means associated with said register restoring means for connecting said trunk with said source of signaling current if said connector cannot connect said registers with a control circuit, a battery supply, normally closed circuits for connecting said battery supply to said trunk, means under the control of said signaling current for interrupting said normally closed circuits and means under the control of said relay or under the control of said register restoring means independent of one another for closing supplementary circuits for maintaining the connection of said battery supply to said trunk while said signaling current is connected therewith.

8. In a telephone system, trunk circuits having incoming and outgoing conductors, registers individual to each of said trunk circuits, means for setting said registers over said incoming conductors, switches for completing connections from said outgoing conductors, control circuits common to said trunk circuits for controlling the operation of said switches, a connector responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, a first relay in said trunk operated by said control circuit on a successful call to connect said incoming and outgoing conductors into a talking circuit, a reversing relay, means operated by said control circuit for intermittently operating said reversing relay if said control circuit fails to complete a connection from said trunk, a release relay associated with said register, means normally under the control of said first relay to operate said release relay to restore said registers, means under the control of said connector for operating said release relay if said connector fails to connect a control circuit with said registers, and means under the control of said release relay to intermittently operate said reversing relay.

9. In a telephone system, trunk circuits having incoming and outgoing conductors, registers individual to each of said trunk circuits, means for setting said registers over said incoming conductors, switches for completing connections from said outgoing conductors, control circuits common to said trunk circuits for controlling the operation of said switches, a connector responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, a first relay in said trunk operated by said control circuit on a successful call to connect

11

said incoming and outgoing conductors into a talking circuit, a reversing relay, battery and ground connected to said incoming conductors when said reversing relay is deenergized, means operated by said control circuit for intermittently operating said reversing relay if said control circuit fails to complete a connection from said trunk, contacts on said first relay for maintaining the connection of battery and ground with said incoming conductors when said reversing relay is operated, a release relay associated with said registers, means normally under the control of said first relay to operate said release relay to restore said registers, means under the control of said connector for operating said release relay if said connector fails to connect a control circuit with said registers, means under the control of said release relay to intermittently operate said reversing relay and contacts on said release relay for maintaining the connection of battery and ground with said incoming conductors when said reversing relay is operated.

10. In a telephone system, trunk circuits having incoming and outgoing conductors, registers individual to each of said trunk circuits, means for setting said registers over said incoming conductors, switches for completing connections from said outgoing conductors, control circuits common to said trunk circuits for controlling the operation of said switches, a connector responsive to the operation of the registers individual to a trunk to connect said registers with one of said control circuits, a first relay in said trunk operated by said control circuit on a suc-

12

cessful call to connect said incoming and outgoing conductors into a talking circuit, a reversing relay, battery and ground connected to said incoming conductors when said reversing relay is deenergized, means operated by said control circuit for intermittently operating said reversing relay if said control circuit fails to complete a connection from said trunk, contacts on said first relay for maintaining the connection of battery and ground with said incoming conductors when said reversing relay is operated, a release relay associated with said registers, means normally under the control of said first relay to operate said release relay to restore said registers, means under the control of said connector for operating said release relay if said connector fails to connect a control circuit with said registers, means under the control of said release relay to intermittently operate said reversing relay and contacts on said release relay for maintaining the connection of battery and ground with said incoming conductors independent of said first relay when said reversing relay is operated.

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