

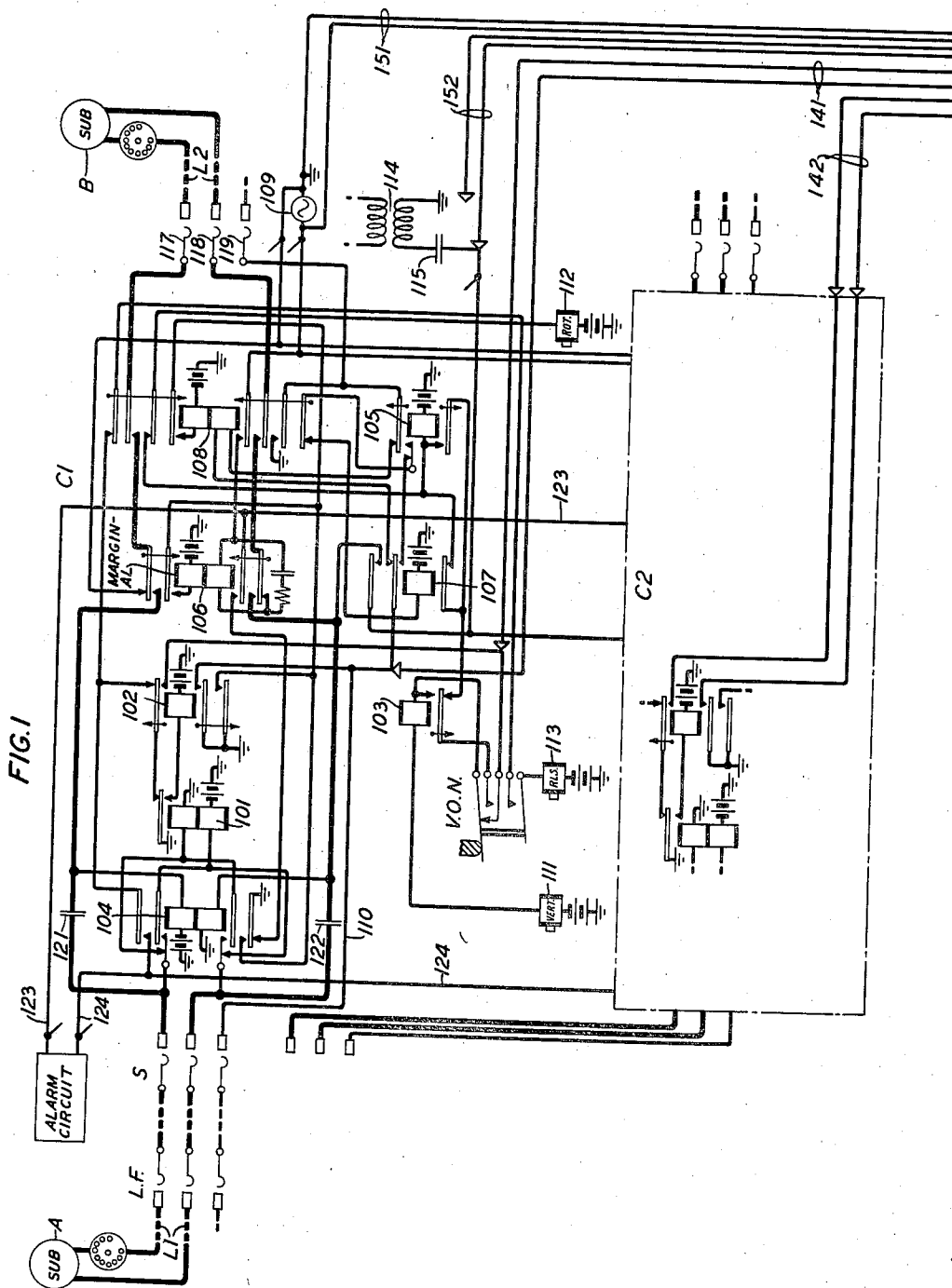
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H. HOVLAND
TELEPHONE SYSTEM

2,216,532

Filed March 20, 1937

4 Sheets-Sheet 1



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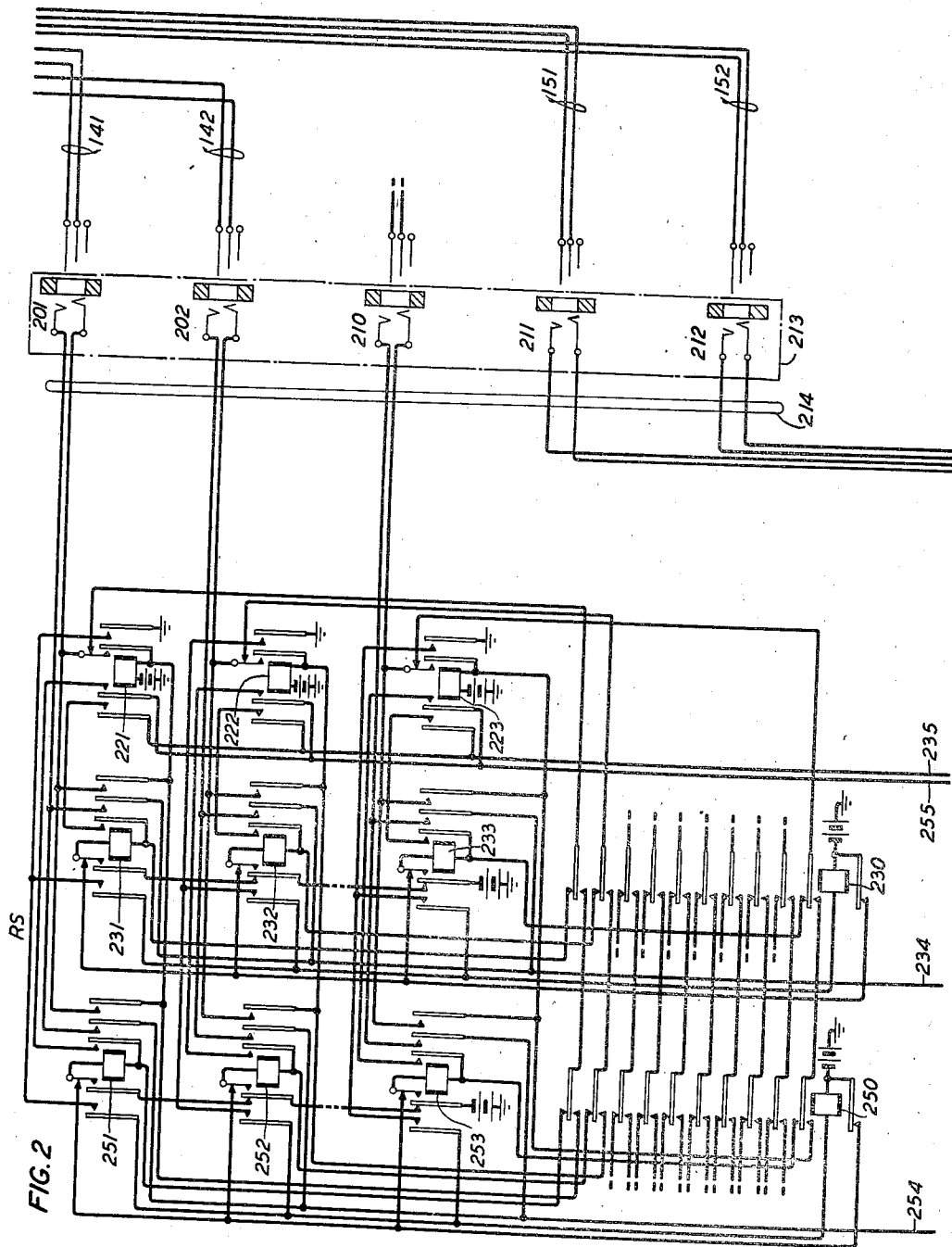
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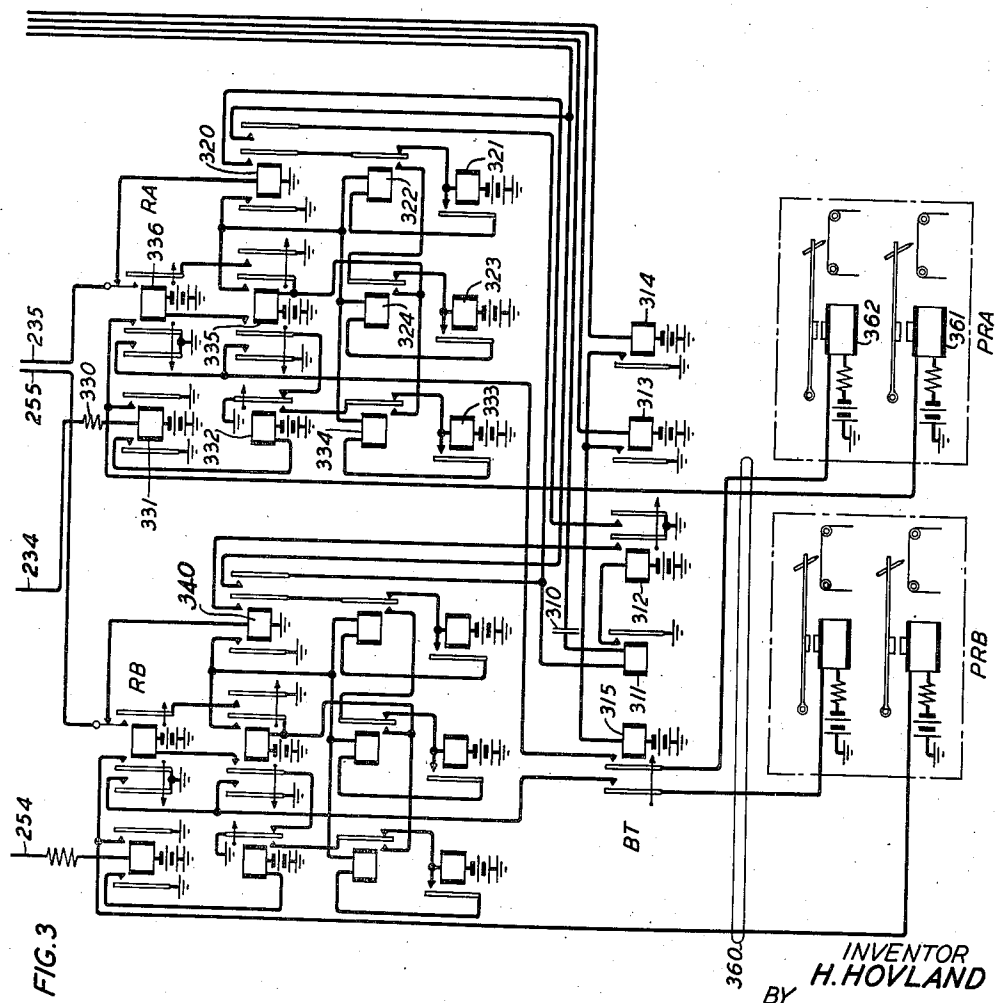
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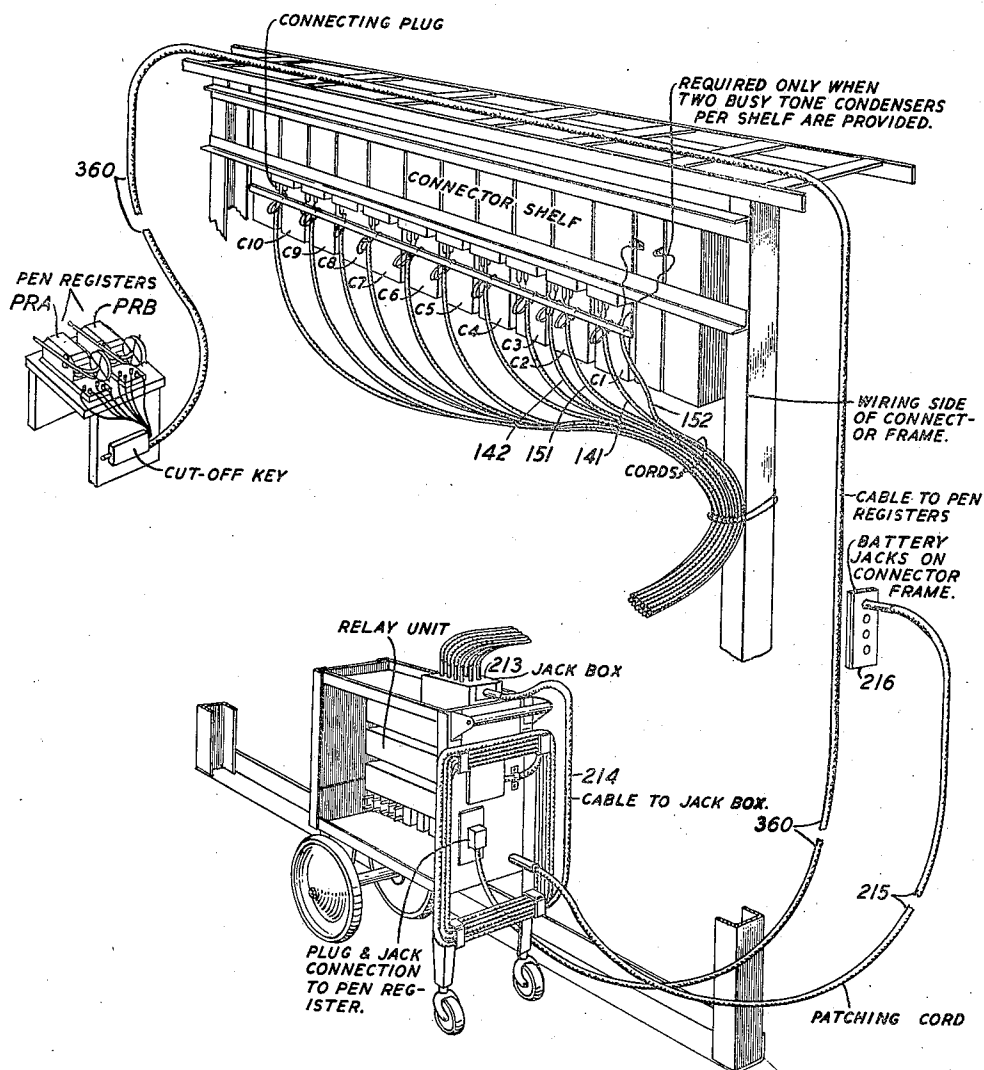
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FIG. 4



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2,216,532

TELEPHONE SYSTEM

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Application March 20, 1937, Serial No. 132,009

14 Claims. (Cl. 179-8)

This invention relates to telephone systems and particularly to systems in which automatic switches are employed for establishing connections between calling and called lines.

It is the object of the invention to facilitate the recording of traffic data in automatic telephone systems and to provide means for indicating whether or not a subscriber is in need of one or more additional lines.

This invention is a line-busy recording equipment comprising a register common to a group of final selector or connector switches and means for operatively connecting the register to only one of the connector switches at a time. According to a feature of the invention two registers are provided with selective switching means for operatively connecting any one of a group of connectors to one of the registers and at the same time operatively connecting any other one of the connectors in the group to the other of the registers. According to another feature of the invention, a line-busy recording equipment comprises a register common to a group of connector switches and means effective upon seizure of any one of said connectors for operatively connecting the register to the seized switch.

The invention will be more easily understood by considering a telephone system arranged in accordance therewith, one such system being shown schematically in the drawing which forms a part of this specification. The invention is, however, not limited in its application to the particular system shown but is, in general, applicable to any telephone system in which automatic switching equipment is employed in establishing connections with called subscribers' lines.

Referring to the drawings,

Fig. 1 shows a calling subscriber's line L1 and station A, a line-finder switch LF, first selector switch S, two connector switches C1 and C2 of a group of connectors, and a called subscriber's line L2 and station B;

Fig. 2 shows a register selector RS together with a jack box 213 and plug-ended cords for use in connecting the recorder equipment to a group of ten connectors;

Fig. 3 shows two register control relay groups RA and RB, a busy and timing relay group BT and two pen registers PRA and PRB; and

Fig. 4 shows a frame of connectors and a portable line-busy recording equipment.

The subscribers' sets at stations A and B are of the usual type employed in automatic telephone systems and include dial impulse senders for use in establishing connections with any other

station with which connection is desired. The line-finder switch LF, selector S, and connectors C1 and C2 are of the well-known two-motion step-by-step type. For a description of the structure of such switches and their operation when used as selectors and connectors, reference may be had to pages 53 to 67 inclusive of the second edition of "Automatic Telephony" by Smith and Campbell. For a description of the operation of such a switch when used as a line finder, reference may be had to Patent 1,799,654 granted to R. L. Stokely, April 7, 1931. The line finder LF is represented by a single set of brushes and one set of terminals, and the selector S is represented by a set of brushes and two sets of terminals; all operating magnets and relays associated with switches LF and S are omitted. The connector switch C1 is represented by a set of brushes and a single set of terminals, the associated magnets and relays being shown; the connector C2 is represented by a set of brushes, a single set of terminals and two of the associated relays.

The register selector RS, register control relay groups RA and RB, and the busy and timing relay group BT are preferably mounted as a unit on wheels, as shown in Fig. 4, so as to be readily movable to any desired and convenient position. The register selector RS comprises ten sets of control relays, one for each of ten connectors and two additional control relays, relay 230 for the relay group RA and relay 250 for the relay group RB. Only three of these sets of control relays are shown; the relays 221, 231 and 251 are associated with jack 201; the relays 222, 232 and 252 are associated with jack 202; and the relays 223, 233 and 253 are associated with jack 210; the other seven sets of relays are indicated by the broken lines between relays 232 and 233 and between relays 252 and 253 and by the seven intermediate sets of contacts on relays 230 and 250. Ten jacks and ten cords are provided for connecting the register selector to any group of ten connectors. Three of these jacks 201, 202 and 210 and two of the cords 141 and 142 are shown in Figs. 1 and 2. The cords terminate in plugs at the register selector and control unit and in connecting clips or special connecting plugs at the connector end. Two additional jacks 211 and 212 and cords 151 and 152 are provided for connecting the busy and timing relay group BT to the ringing current conductors and the busy tone leads of the shelf of connectors to which the ten cords including cords 141, 142 are connected. If only one busy tone lead is pro-

vided for the ten connectors on a shelf, only one of the two conductors of cord 152 is used. The ten jacks represented by jacks 201, 202 and 210 and the two jacks 211 and 212 are mounted in a jack box 213 which is carried by, but removable from, the register selector and control unit; a twelve pair cable 214 is provided for connecting the jack box to the control unit. This arrangement permits the jack box to be placed close to the connector frame on which is located the ten connectors to be connected to the register selector and control unit, while the control unit is located at an advantageous position remote from this connector frame. A jack is provided on the control unit for supplying battery and ground to the relays and magnets; a patching cord 215 is used to connect this jack to any convenient source of battery and ground potential, for instance to a battery and ground supply jack 216 on the connector frame as shown in Fig. 4. The pen registers PRA and PRB are removably mounted on the relay unit and connected thereto by a four-wire cord 360. To facilitate connection and disconnection of the pen registers, jacks, plugs, or keys may be used to terminate the cord 360 and the conductors of the relay groups and pen registers. As shown in Fig. 4, the cord 360 is key connected to the pen registers and plug and jack connected to the relay unit. This arrangement permits the placing of the pen registers in a desired location remote from the relays. Each of the pen registers comprises two pens, one for marking on the tape the impulses of the last two digits of the number of a called line and the other for marking on the tape the busy condition if this called line is busy. The impulse recording pen is also operated to make a long dash after the units digit has been recorded or to make a similar dash if the timing relays of group BT and one of register groups RA or RB complete the measurement of a predetermined interval of time after the operative association of a connector therewith, before the tens and units digits have been received and recorded. The busy marking pen may mark the tape if the brushes pass over busy lines during their advance to the terminals of the called line, but makes a long dash on the tape when the associated connector finds the called line busy.

Assume the line L1 to have been connected, by the operation of switches LF and S and any intermediate selectors (none shown), to the connector C1. Upon seizure of connector C1, the line relay 101 is operated by the current in a circuit from battery through the lower winding of relay 101, inner lower back contact of relay 104, middle terminal and brush of each of switches S and LF, over the lower conductor of line L1, through the telephone at station A, back over the upper conductor of line L1, top terminal and brush of switches LF and S, upper back contact of relay 104, and through the upper winding of relay 101 to ground. Relay 101 closes a circuit for operating the slow-to-release relay 102; and relay 102 connects ground, through its inner lower front contact, to sleeve conductor 110 to mark connector C1 busy in the banks of other selectors and to hold the switches S and LF in usual manner.

When the subscriber at station A dials the next to the last digit of the number of the station B with which connection is desired, relay 101 releases at each interruption of its circuit by the dial. The first release of relay 101 closes a circuit for operating relay 103 and vertical-stepping

magnet 111; this circuit is traced from battery through the winding of magnet 111, winding of relay 103, normally closed contact of the vertical off-normal springs VON, upper front contact of relay 102, to ground at the back contact of relay 101. The operation of magnet 111 raises the brushes 117, 118 and 119 up to the first level of the bank, the VON springs being actuated as soon as the shaft moves out of normal position. After relay 103 operates and the VON springs are actuated, the operating circuit for magnet 111 and relay 103 includes the front contact of relay 103 and upper front contact of springs VON instead of the normally closed contact of the VON springs. Being slow in releasing, relay 102 remains operated during the response of relay 101 to dial impulses and relay 103 remains operated until all of the impulses in the train have been received. The operation of magnet 111 in response to each dial impulse, steps the brushes up to the level corresponding to the digit dialed. When relay 103 releases, the rotary-stepping magnet 112 and relay 105 are connected to the impulse contact of relay 101; this connection is traced through the upper front contact of relay 102, upper front contact of the VON springs, back contact of relay 103, lower back contact of relay 107, to the winding of relay 105, and through the inner upper back contact of relay 108 to the winding of magnet 112. Each release of relay 101 in response to the impulses created by the dialing of the last digit of the called station's number is therefore effective to energize relay 105 and magnet 112. Each operation of magnet 112 rotates the brushes 117, 118 and 119 one step in the selected level, the terminals of the called line being thereby selected. The operation of relay 105 connects the winding of busy-test relay 107 to sleeve brush 119; this connection is traced through the lower back contact of relay 103 and the upper front contact of relay 105. Relay 105 is slow in releasing and, after its operation in response to the first impulse, it remains operated until all of the impulses in the train have been received. The operation of relay 107, in case brush 119 engages the terminal of a busy line during advance of the brushes to the terminals of the called line, does not interfere with the further operation of magnet 112 since the lower front contact of relay 105 is in parallel with the lower back contact of relay 107. If the called line is idle, brush 119 encounters a battery potential and busy test relay 107 does not operate; and, when relay 105 releases, a circuit is closed from this battery potential through brush 119, upper outer back contact of relay 105, lower winding of relay 108, upper back contact of relay 107, to ground at the inner lower front contact of relay 102. Relay 108 is sufficiently energized by the current through its lower winding to actuate its inner upper front contact and thereby close a circuit through its upper winding to ground at the lowermost front contact of relay 102. Relay 108, completely operated by the energization of its upper winding connects ground through its lowermost front contact and sleeve brush 119 to the sleeve terminal of the called line to mark the line as busy. Relay 108 also closes a circuit from ringing current source 109 through the inner lower front contact of relay 108, lower winding and lower back contact of relay 106, middle lower front contact of relay 108, brush 118, lower conductor of line L2, through the ringer (not shown) at station B, upper conductor of line L2, brush 117, outer upper front contact

of relay 108, and through the upper back contact of relay 106 to ringing source ground. When the receiver is removed at station B, relay 106 is sufficiently energized by the current through its lower winding to close its inner upper front contact and thereby energize its upper winding. The complete operation of relay 106 connects the windings of relay 104, through the outer front contacts of relay 106, front contacts of relay 108, and through brushes 117 and 118 to the line L2. Relay 104 operates and remains operated under the control of the called station while relay 101 remains operated under control of the calling station, the talking circuit being completed through condensers 121 and 122. When both the calling and called subscribers replace the receivers, relays 101 and 104 release. The release of relay 101 causes the release of relay 102 thereby disconnecting ground from conductor 110 to release the preceding switches in usual manner. With both of relays 102 and 104 released, relays 106 and 108 release. The release of relay 108 closes a circuit for operating release magnet 113; this circuit is traced from ground at the back contact of relay 101, through the upper back contact of relay 102, upper most back contact of relay 108, lower contact of the VON springs and the winding of magnet 113 to battery. The operation of magnet 113 restores the switch to normal in usual manner. If only the called subscriber releases the connection, ground is connected to conductor 123; and if only the calling subscriber releases the connection, ground is connected to conductor 124. In either case an alarm is operated in usual manner, if both subscribers have not released within a predetermined interval such as from twenty to forty minutes.

If the called line L2 happens to be busy when the brushes of switch C1 are advanced into engagement with the terminals of this line, the ground potential, marking the line as busy, causes the operation of test relay 107. When relay 105 releases, relay 107 is held operated through the lowermost back contact of relay 108, inner back contact of relay 105, inner front contact of relay 107, to ground at the inner lower front contact of relay 102. Busy tone is transmitted from source 114 through condenser 115, outer front contact of relay 107, and through condenser 122 to the calling station. When the calling subscriber releases, relays 101 and 102 release, relay 107 releases, magnet 113 operates, and the switches LF, S and C1 are restored to normal.

If now the connector C1 is connected by cord 141 to jack 201, the operation of relay 102, upon seizure of connector C1, connects ground through its inner lower front contact, over one of the conductors of cord 141 to the ring of jack 201; and connects the back contact of line relay 101, through the upper front contact of relay 102, over the other conductor of cord 141, to the tip of jack 201. Assuming that neither of registers PRA and PRB is then operatively engaged, the ground at the inner lower front contact of relay 102 is further connected through the ring conductor of jack 201 and back contact of relay 221, uppermost back contact of relay 230, winding and back contact of relay 231, and through the lower back contact of relay 230 to battery. Relay 231 operates and it locks through its inner left front contact, the back contacts of relay 232 and the corresponding intermediate relays, to battery at the back contact of relay 233. This chain locking circuit prevents the locking of more than one of

relays 231, 232, 233 if two connectors in the group are seized simultaneously. At its middle right front contact, relay 231 connects the tip conductor of jack 201, over conductor 234, through resistor 330 to the winding of impulse relay 331 of the register control relay group RA; and at its outer right front contact, relay 231 connects the winding of relay 221 to and through the ring conductor of jack 201 to the ground at relay 102. Relay 221 operates and it locks through its inner right front contact to the same ground. Relay 221 closes a circuit for holding relay 231 and operating relay 320 of the relay group RA; this circuit is traced from ground through the winding of relay 320 and back contact of relay 336 of relay group RA, over conductor 235, left outer front contact of relay 221, inner right front contact and winding and inner left front contact of relay 231, thence to battery at the back contact of relay 233. At its outer right front contact, relay 221 closes a circuit, which includes the left outer front contact of relay 231, for operating relay 230. The operation of relay 230 disconnects the windings of relays 232 and 233 and the seven intermediate relays from the ring conductors of the associated jacks and connects the windings of relays 252 and 253 and the seven intermediate relays to these conductors so that, if another of the connectors in the group is seized while relay group RA is operatively associated with connector C1, this other connector will be connected over conductors 254 and 255 to relay group RB by the operation of the associated one of relays 252 and 253 and the seven intermediate relays, the operation of the corresponding one of relays 222 and 223 and the seven intermediate relays, and the operation of relay 250 in the same manner in which relays 221, 231 and 230 are operated as hereinbefore described. In this case a circuit is closed for holding the operated one of relays 252 and 253 and intermediate relays and for operating relay 340, this circuit being similar to that above described for holding relay 231 and operating relay 320. If any other connector is seized while both of the pen registers are operatively engaged, the corresponding one of the relays, similar to relay 221, is operated through front contacts of relays 250 and 230; but this other connector is not connected to either of the register groups RA or RB since the two associated relays, similar to relays 231 and 251, are not operated and cannot be operated to connect one of the register units to the connector in question. If one of relays 221, 222, 223 operates at a time when both of the pen registers are operatively engaged, it is held operated until the associated connector releases so that, if one of the pen registers becomes idle before this connector is released, this connector will not be operatively connected to the idle register.

Assuming the connector C1 to have been seized and connected to register group RA as hereinbefore described, the response of relay 101 to the impulses created by the dialing of the penultimate digit of the called subscriber's number causes relay 331 to be operated and released a corresponding number of times. Resistor 330 prevents the operation of relay 331 from excessive interference with the stepping magnets of the connector switch. At its right front contact, relay 331 closes a circuit for operating the magnet 361 of register PRA to register each of the impulses. At its left front contact, relay 331 closes a circuit for operating relay 332; and, being slow in releasing, relay 332 remains operated until all of the impulses in the series have been received and registered. Upon its operation, relay 332 closes a cir-

cuit for operating relay 333. At its front contact, relay 333 closes a circuit through its winding and the winding of relay 334, in series, to ground at the left front contact of relay 320; but the winding of relay 334 is short-circuited through the right back contact of relay 334 and front contact of relay 332 until relay 332 releases. When relay 332 releases, relay 334 operates and both of relays 333 and 334 are locked operated under control of relay 320. When the last digit of the called subscriber's number is dialed, the response of relay 101 to each impulse is repeated to relay 331; and each operation of relay 331 again closes the circuit for operating magnet 361 to register these impulses. The reoperation of relay 332, during the response of relay 331 to the impulses of the last digit, closes a circuit through the front contact of relay 334 for operating relay 335. Relay 335 locks through its inner right front contact to ground at the left front contact of relay 320. When relay 332 releases after all of the impulses in the train have been received and registered, a circuit is closed through the back contact of relay 332 and inner left front contact of relay 335 for operating relay 336. The operation of relay 336 disconnects the winding of relay 320 from conductor 235, thereby causing the release of relay 320, and connects conductor 235 to ground at the outer right front contact of relay 335. At its outer left front contact, relay 336 connects ground to the inner front contact of relay 315; and at its inner left front contact relay 336 connects ground to the winding of pen register magnet 361. The release of relay 320 causes the release of relays 333, 334 and 335; and the release of relay 335 causes the release of relay 336. Since relay 336 is slow in releasing, the release of relay 335 also causes the release of relay 231 of the register selector. When relay 336 releases, pen register magnet 361 releases. The dash recorded on the tape of the pen register, during the time that relay 336 is operated indicates that both of the tens and units digits were fully recorded.

If now the connector C1 has tested and found the called line busy, ground is connected through the lower winding of relay 104, outer front contact of relay 107, through the associated conductors of cord 152 and jack 212, to the winding of relay 313 or to the winding of relay 314. The operation of either relay 313 or relay 314 causes the operation of relay 315. With relay 315 operated and with either of relays 335 and 336 operated, ground is connected to the winding of magnet 362 of pen register PRA to record the busy condition of the called line. If any of the other connectors in the group are transmitting busy tone, relay 315 will be operated even though the line encountered by connector C1 is idle; but, if this is the case, the busy mark starts when relay 335 operates responsive to the first impulse of the units digit whereas if this is not the case the long dash indicating a busy line starts at the same time as the dash which indicates that dialing is completed. Relay 315 is slow in operating to delay the operation of busy recording magnet 362 and thereby distinguishes between a case in which the last digit of the called number is 1 and the called line is busy and a case in which the last digit is 1 and some other connector in the group is at that time transmitting busy tone.

If now after seizure of connector C1, the last digit of the called subscriber's number is not dialed within an interval or from 12 to 18 seconds, the register is released by means of timing relays 311 and 312. Relay 311 is operated once

every six seconds by ringing current from the ringing supply of the group of connectors to which jacks 201, 202, 203 are connected, over the conductors of cord 151, through jack 211 and condenser 310 and the winding of relay 311. Each operation of relay 311 closes a circuit for operating relay 312. Relay 312 closes a circuit through the inner right front contact of relay 320 and the back contact of relay 322 for operating relay 321. Relay 321 closes a circuit through its winding and front contact and winding of relay 322 to ground at the left front contact of relay 320. Until relays 311 and 312 release at the end of the usual two-second ringing period, the winding of relay 322 is short-circuited; but, when relay 312 releases, relay 322 operates and is locked in series with relay 321 under control of relay 320. When relays 311 and 312 reoperate during the next ringing period, relay 312 closes a circuit through the front contact of relay 322 and back contact of relay 324, for operating relay 323. When relay 312 again releases relay 324 is operated and locked in series with relay 323 to ground at relay 320. At the end of the following silent interval, relays 311 and 312 are again operated by the ringing current; and relay 312 closes a circuit through front contacts of relays 320, 322 and 324 for operating relay 335. The operation of relay 335 is followed by the operation of relay 336, release of relay 320, release of relay 335, release of relay 231, and the release of relay 336 as hereinbefore described. So that, if at the end of an interval of from 12 to 18 seconds after the operation of relay 320, the last two digits of the called number have not been registered and relay 335 operated, relay 335 is operated by the timing relays to effect disconnection of the pen register PRA and relay group RA from the connector C1.

The release of relay 231, due to the operation of relay 336 either when the tens and units digits have been recorded or when the predetermined interval has elapsed as above described, causes the release of relay 230, but relay 221 is held operated through the ring conductor of jack 201 and conductor of cord 141 to ground at the front contact of relay 102 of connector C1 so that a pen register cannot be twice connected to this connector on one call.

The register relay group RB functions to connect a connector to register PRB in the same manner that group RA functions to connect a connector to register PRA as above described.

What is claimed is:

1. In a signaling system comprising lines and a group of connector switches, each connector operative to select any one of said lines, an electromagnetic recorder, and switching means for operatively connecting the recorder to any one of said switches, said recorder being effective upon connection with a switch to record the number of the line selected by said switch and to record that the selected line is busy if such is the case.

2. In a signaling system comprising lines and a group of connector switches for selecting called lines, means for seizing and selectively operating any one of said switches, a busy-line recorder common to said switches, means responsive to the seizure of any one of said connectors on a call from one to another of said lines for operatively associating said seized connector and said recorder and means in said recorder for recording the number of the line selected by said seized connector.

3. In a signaling system comprising lines and connector switches for use in selecting called lines and means for extending connections from calling lines to said connectors, a called line number recorder, means comprising cords and jacks for associating said recorder with the connectors having access to any particular group of lines, and relays effective upon seizure of any one of said connectors on a call from one to another of said lines for operatively connecting the seized connector to said recorder.

4. In a signaling system comprising lines and a group of switches for selecting any one of said lines, a plurality of recorders less in number than the switches in said group, each of said recorders comprising means for recording the number of the line selected by any one of said switches and for recording that the selected line is busy if such should be the case, and means for operatively connecting each of said recorders to any one of said switches.

5. In a signaling system comprising lines and a group of switches for selecting any one of said lines, means for seizing and selectively operating any one of said switches, a plurality of recorders less in number than the switches in said group, each of said recorders comprising means for recording the number of the line selected by any one of said switches and for recording that the selected line is busy if such should be the case, and means responsive to seizure of any one of said switches for operatively connecting the seized switch to an idle one of said recorders.

6. In a signaling system according to claim 1, means for releasing the operative connection between any one of said connectors and said recorder.

7. In a signaling system according to claim 1, means for releasing the operative connection between any one of said connectors and said recorder, and means for preventing a second connection between any one of said connectors and said recorder while the connector in question continues to engage the same line.

8. In a signaling system according to claim 2, means responsive to the recording of the number of the selected line for releasing the operative association between any one of said connectors and said recorder.

9. In a signaling system according to claim 2, means responsive to the recording of the number of the selected line for releasing the operative association between any one of said connectors and said recorder, and means for preventing a second association between any one of said connectors and said recorder while the connector in question continues to engage the same line.

10. In a signaling system according to claim 1, means effective a predetermined interval of time after the operative connection of any one of said connectors to said recorder for releasing said connection.

11. In a signaling system according to claim 1, means effective a predetermined interval of time after the operative connection of any one of said connectors to said recorder for releasing said connection, and means for preventing another operative connection between any one of said connectors and said recorder until after the connector in question has been released for use on another call.

12. In a signaling system according to claim 2, means responsive to the recording of the number of a selected line or effective a predetermined interval of time after the operative association of any one of said connectors and said recorder for releasing said operative connection.

13. In a signaling system according to claim 2, means responsive to the recording of the number of a selected line or effective a predetermined interval of time after the operative association of any one of said connectors and said recorder for releasing said operative connection, and means for preventing a second association between any one of said connectors and the recorder until after the connector in question has been released for use on another call.

14. In a telephone system, lines, a group of impulse controlled connector switches for selecting called lines, means for seizing and operating an idle one of said connectors, a recorder common to said switches, means individual to each of said connectors and responsive to seizure of the associated connector for operatively associating said connector and said recorder, means in said recorder for recording the directive impulses received by an associated connector, means in said recorder for recording the busy condition of the line selected by an associated connector when such a condition exists, means responsive to completion of the recording of the directive impulses by which an associated one of said connectors is operated to select a desired line or effective a predetermined interval of time after the operative association of a connector and the recorder for releasing the connection between the connector and the recorder, and means individual to each of said connectors for preventing a second association of a connector and said recorder until after said connector has been released for use on another call.

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