

July 14, 1942.

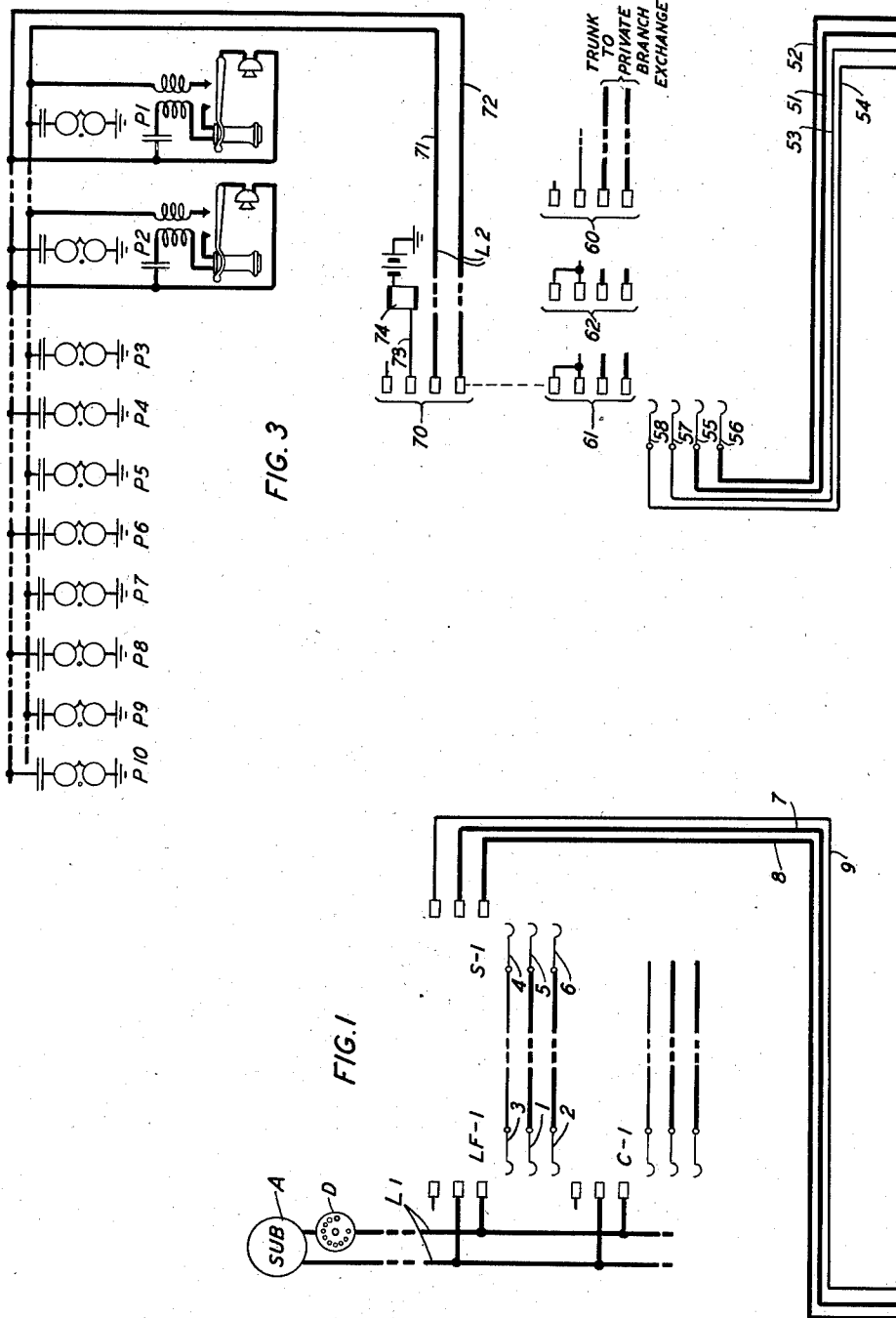
C. D. KOECHLING

2,289,503

TELEPHONE SYSTEM

Filed May 1, 1940

2 Sheets-Sheet 1



INVENTOR
C.D. KOECHLING
BY
R.O. Correll
ATTORNEY

July 14, 1942.

C. D. KOECHLING

2,289,503

TELEPHONE SYSTEM

Filed May 1, 1940

2 Sheets-Sheet 2

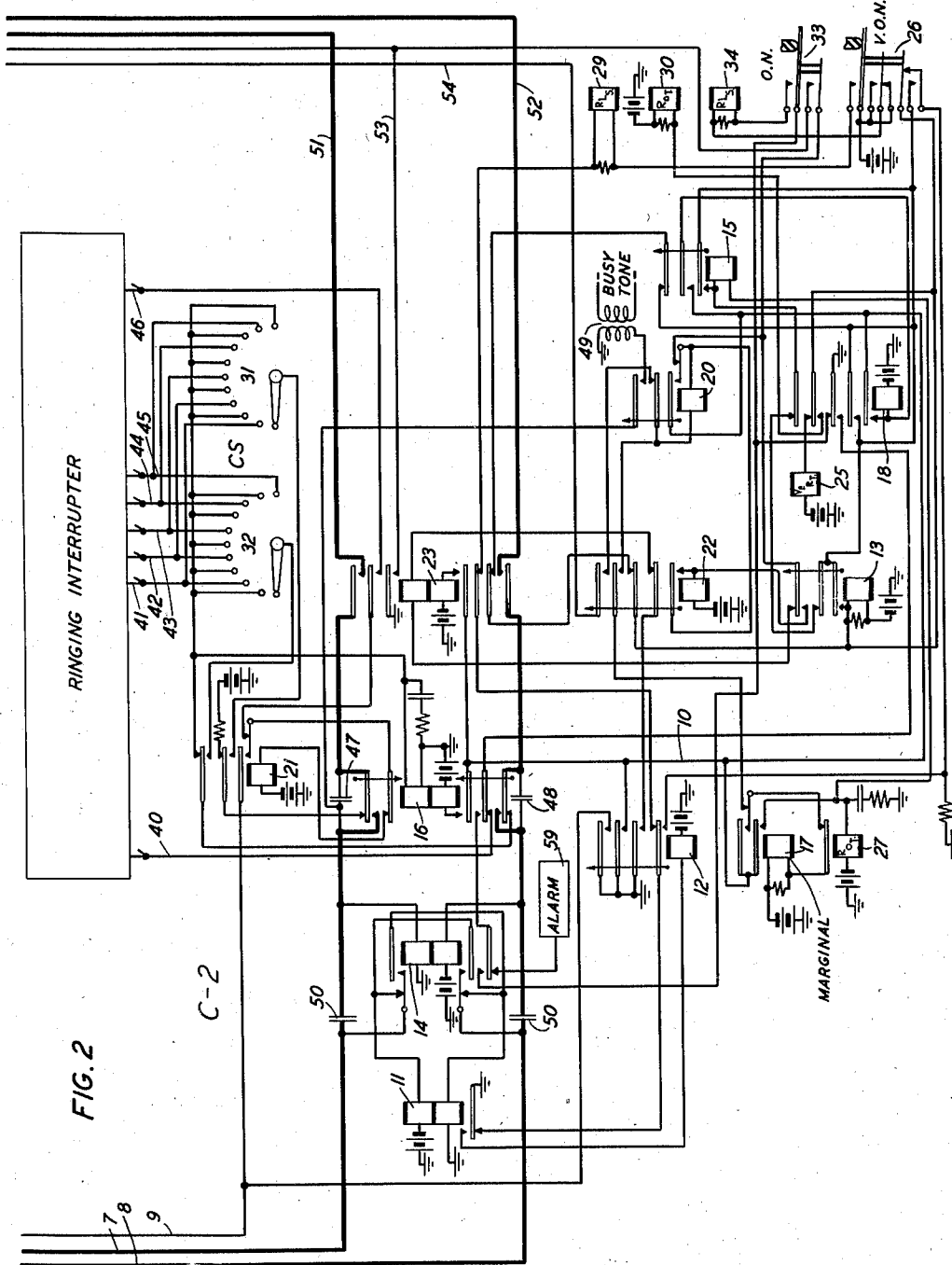


FIG. 2

C-2

INVENTOR
BY C.D. KOECHLING

R. O. Covell

ATTORNEY

UNITED STATES PATENT OFFICE

2,289,503

TELEPHONE SYSTEM

Charles D. Koechling, Floral Park, N. Y., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application May 1, 1940, Serial No. 332,623

8 Claims. (Cl. 179-17)

This invention relates to telephone systems and particularly to systems in which connections between calling and called stations are effected by switching mechanism under the control of the calling subscribers.

Objects of the invention are an increase in the efficiency of automatic switching equipment in telephone systems and a resultant economy in the amount of equipment needed for completing connections.

In small dial offices in which some of the lines are party lines which require code-ringing connectors and in which rotary-hunting connectors are required for connecting with trunks to private branch exchanges, it is sometimes desirable to provide only one type of connector in which all lines terminate in the banks of connectors arranged both for rotary hunting and for code ringing. In such a case all subscribers' numbers include one or more digits for selecting the particular ringing code with which a called station is signaled. If the ringing-code digit is the last digit of the number, the ringing code is selected after connection with the called line; and it is known to arrange code-ringing connector circuits so as to delay the making of the busy test of a called line until the ringing-code selector has been positioned by the dialing of the last digit. Since the busy test of individual lines is completed in a very short time, completion of the connection is thereupon effected with only slight delay due to making the busy test after the setting of the code selector. If a connector which is arranged to make the busy test after the ringing code has been selected is also arranged to hunt for an idle trunk in a group to a private branch exchange, and hunting for an idle trunk is not started until ringing-code selection is completed, there is a substantial delay in starting the trunk-hunting operation and an increase in the holding time of all of the switches employed in completing a connection, with a resulting decrease in the efficiency and load-carrying capacity of the switches.

This invention is a connector switch having access to multiparty lines and also to groups of trunk lines serving a single subscriber and comprising a ringing-code selector directly responsive to a train of impulses created by the dialing of the station-identifying or ringing-code digit of the called subscriber's number, trunk hunting in a selected group being initiated upon the receipt of the first impulse of the station-identifying digit. When so arranged, trunk hunting proceeds during the setting of the ring-

ing-code selector and there is no unnecessary delay in making the busy test.

A clear and complete understanding of the invention will be facilitated by considering a telephone system and a connector switch therein arranged in accordance with this invention, one such system and switch being shown schematically in the drawings which form a part of this specification.

Referring to the drawings:

Fig. 1 shows, in an automatic telephone office, a subscriber's station A and line L1, a line-finder switch LF-1, a first selector switch S-1 and a connector switch C-1; and

Figs. 2 and 3 show a connector switch C-2, a ten-party line L2 and one trunk line of a group to a private branch exchange.

The subscriber's set at station A is of the usual type comprising a dial D for use in controlling the establishment of desired connections. The subscribers' sets at the stations connected to line L2 are arranged so that the ringers at stations P1, P3, P5, P7 and P9 are connected to the conductor 71 of line L2 and the ringers at stations P2, P4, P6, P8 and P10 are connected to conductor 72 of line L2. Stations P1 and P2 are shown complete but each of the other eight stations is represented by its ringing condenser and ringer. Although not shown in the drawings, each of stations P1 to P10, inclusive, may include a dial for use in establishing desired connections. Each of the line-finder, selector and connector switches is of the well-known two-motion step-by-step type. Reference may be had to pages 53 to 65, inclusive, of the second edition of "Automatic Telephony" by Smith and Campbell for a clear and complete disclosure of such switches and their operation when used as selectors and connectors. Reference may be had to the patent to R. L. Stokely, No. 1,799,654 of April 7, 1931, for a description of the operation of such switches when used as line finders. Each of the switches LF-1, S-1 and C-1 is represented in the drawings by a set of brushes and a single set of terminals, the associated relays and other apparatus not being shown. As shown in the drawings, the selector S-1 has direct access to groups of connector switches but it is to be understood that intermediate selectors may be provided, the total number of selectors depending upon the size of the system and the number of digits in the subscribers' telephone numbers. The connector switch C-2 comprises a set of brushes 55, 56, 57 and 58, a bank of terminals, one level of which is represented by three sets of terminals

60, 61 and 62 and another level by a single set of terminals 70, a vertical-stepping magnet 25, vertical off-normal springs 26, a rotary-stepping magnet 27, and a release magnet 29. An associated ringing-code selector CS is of the single-motion rotary type and comprises a stepping magnet 30, brushes 31 and 32, off-normal springs 33, and a release magnet 34. The brushes of the connector switch are positioned in response to the two trains of impulses created by the dialing of the tens and units digits of a called subscriber's number at a connected calling subscriber's station; and the brushes of the code selector are positioned in response to the train of impulses created by the dialing of a party-identifying and code-selecting digit, which is the last digit of the called number. The code selector selects one of the five ringing-code conductors 41 to 45 of a ringing interrupter which is common to all connectors. The ringing interrupter may be of the revolving drum type disclosed in the patent to Ray et al. No. 1,624,007 of April 12, 1927 or comprise a rotary step-by-step switch as in the patent to Baker No. 1,963,929 of June 19, 1934.

Assume now that a call is originated at the subscriber's station A, and that a line finder LF—1 is operated to connect with the terminals of the calling line in usual and well-known manner, whereby the conductors of line L1 are connected through brushes 1, 2 and 3 to the associated first selector S—1. When the calling subscriber dials the first digit of the number of the subscriber's station with which connection is desired, the selector S—1 is directly operated to select a group, and automatically operated to select an idle trunk in the selected group, the seized terminals being connected to a connector C—2.

Upon connection of the line L1 through brushes 1 and 2 of the line finder LF—1 and brushes 5 and 6 of selector S—1 to the connector C—2, a circuit is closed from battery through the upper winding of the line relay 11, upper back contact of relay 14, conductor 7, terminal engaged by brush 5 of selector S—1, brush 1 and engaged terminal of line finder LF—1, through line L1 and the telephone at station A, terminal engaged by brush 2 of switch LF—1, brush 6 and engaged terminal of switch S—1, conductor 8, inner lower back contact of relay 14, and through the lower winding of relay 11 to ground. Relay 11 is operatively energized by the current in this circuit, thereby closing a circuit for operating relay 12. Relay 12 connects ground potential through its outer front contact to conductor 9 to hold the selector S—1 and line finder LF—1 in usual manner.

No further action occurs until the subscriber at station A dials the tens digit of the called subscriber's number. Each opening and closure of the circuit through line L1 by the dial D causes the release and reoperation of relay 11. The first release of relay 11 closes circuits including a front contact of relay 12 and the lower normally closed contact of the vertical off-normal springs 26 for operating relay 13 and the vertical-stepping magnet 25. The operation of magnet 25 steps the brushes 55, 56, 57 and 58 up to the first level of the terminal bank, the vertical off-normal springs 26 being actuated by movement of the shaft out of normal position. After springs 26 are actuated, the circuits for energizing magnet 25 and relay 13 include the locking contact of relay 13 and lower front contact of springs 26. When relay 11 reoperates at the end of the first impulse of the train, magnet 25 releases. Each

succeeding release and reoperation of relay 11 in response to the impulses created by the dialing of the tens digit of the called subscriber's number effects the reoperation and release of magnet 25, thereby stepping the brushes up to a level corresponding to the digit dialed. Being slow in releasing, relay 13 remains operated until all of the impulses in the train have been received by relay 11. Being slow in releasing, relay 12 does not release during the response of relay 11 to dial impulses. When relay 13 releases, due to the continued operation of relay 11 after the last impulse, it opens the connection between the back contact of relay 11 and the vertical-stepping magnet 25, and connects this contact, through a back contact of relay 18 and the winding of relay 15, to the rotary-stepping magnet 27.

When the calling subscriber dials the units digit of the called subscriber's number, each release of relay 11 closes a circuit including the inner front contact of relay 12, lower front contact of springs 26, inner back contact of relay 13, outer back contact of relay 18, winding of relay 15, and winding of rotary-stepping magnet 27 to battery. Relay 15 and magnet 27 are operated by the current in this circuit. Magnet 27 steps the brushes 55, 56, 57 and 58 into engagement with the first set of terminals of the selected level. Relay 15 locks through its inner front contact in series with the winding of magnet 27, independent of relays 13 and 18, and closes a circuit including conductor 10 and the middle front contact of relay 12 for operating relay 18. Relay 18 locks, independent of relay 15, to ground at the middle front contact of relay 12, and connects ground to conductor 40 to start the ringing interrupter, if not already operating. When relay 11 reoperates at the end of the first impulse, magnet 27 releases. Relay 15 is slow in releasing and remains operated during the response of relay 11 to the succeeding impulses of the units digit of the called subscriber's number, each release and reoperation of relay 11 causing a corresponding operation and release of magnet 27. The brushes of switch C—2 are thereby advanced into engagement with the set of terminals corresponding to the dialed number. When relay 15 releases, after the last impulse of the units digit, it opens the connection between the back contact of relay 11 and the windings of magnet 27 and relay 15 to prevent further operation of magnet 27, and closes a connection from the back contact of relay 11, through the front contact of relay 12, lower front contact of springs 26, a front contact of relay 18, and back contacts of relays 15, 23 and 22 to the winding of relay 13, and further through the outer front contact of relay 18 to the winding of stepping magnet 39 of code selector CS.

When the calling subscriber dials the party-identifying and ringing-code selecting digit, the first release of relay 11 closes circuits, including back contacts of relays 15, 23 and 22, for again operating relay 13 and for operating stepping magnet 30. Relay 13 locks through the lower front contact of springs 26 independent of relays 22, 23 and 15. The operation of magnet 30 advances the brushes 31 and 32 into engagement with the first set of terminals. When relay 11 reoperates, magnet 30 releases, but relay 13 remains operated until all of the impulses created by the dialing of the ringing-code digits have been received. The movement of the brushes of the code selector out of normal position actuates the off-normal springs 33 thereby connecting

the test brush 57 of switch C—2, through conductor 53, lower contact of springs 33, outer front contact of relay 13 to the winding of relay 22. If the line connected to the terminals engaged by brushes 55, 56, 57 and 58 is idle, relay 22 does not operate; but, if this line is busy or becomes busy before relay 13 releases, the ground potential encountered by brush 57 causes the operation of relay 22. If relay 22 operates, it locks under control of relay 20, independent of relay 13, to the same ground. Each of the succeeding impulses of the train causes the successive release and reoperation of relay 11, and a resulting operation and release of magnet 30 to advance the brushes of the code selector to a set of terminals to which the required one of ringing-code conductors 41 to 45 is connected. When relay 13 releases after the last impulse, it opens the operating circuit of magnet 30, and opens the operating circuit of relay 22.

If the selected line is idle when selected and does not become busy before relay 13 releases after the setting of code selector CS, relay 22 does not operate and the release of relay 13 closes a circuit for operatively energizing the upper winding of relay 23 and the cut-off relay of the selected line. Assuming the selected idle line to be the line L2 connected to terminals 10, the circuit for operating relay 23 is traced from battery through the winding of cut-off relay 14, brush 57, conductor 53, lower contact of springs 33, outer back contact of relay 13, upper winding of relay 23, a back contact of relay 22, and through a front contact of relay 12 to ground. The cut-off relay 14 disconnects the line relay (not shown) from the conductors of line L2 in usual manner and the cut-through relay 23 of connector C—2 is operated sufficiently by the energization of its upper winding to close its inner lower front contact and thereby completely operate and lock through conductor 10 and a front contact of relay 12. Relay 23, when completely operated, initiates the signaling of the called subscriber as hereinafter described.

If the selected line is busy when selected or becomes busy before relay 13 releases after the setting of the code selector CS, the above-described operation of relay 22 closes a circuit from battery through the winding of relay 17, back contact of rotary-stepping magnet 27, back contact of relay 17, a front contact of relay 22, winding and back contact of relay 20, lower contact of springs 33, through conductor 53 and brush 57 to the grounded test terminal of the selected line. If the selected line is not the first one of a group of private branch exchange trunks, the terminals engaged by brushes 57 and 58 are not strapped together and the current in this circuit effects the operation of relay 20; but relay 17 is marginal and does not operate in series with relay 20. The make-before-break springs of relay 20 close locking circuits for relays 20 and 22 through conductor 10 and then open the connection between the windings of these relays and the test brush 57. Relay 20 connects busy-tone source 49 through one of the talking condensers 50 to conductor 7 to transmit a busy tone to the calling subscriber.

If the selected line is busy when selected or becomes busy before relay 13 releases after the setting of the code selector CS, and if the selected line is the first one of a group of private branch exchange trunks, the busy, ground potential encountered by test brush 57 is also encountered by brush 58 since the terminals engaged by these

brushes, in terminal sets which are connected to trunks to a private branch exchange other than the last trunk in the group, are strapped together as set forth on pages 99 and 100 of the hereinbefore mentioned second edition of "Automatic Telephony." The ground potential encountered by brush 58 is connected through conductor 54, the uppermost front contact of relay 22, and back contact of relay 20 to operate the marginal relay 17 and to short-circuit the winding and thus prevent the operation of relay 20. Relay 17 locks under control of, and closes a circuit for operating, the rotary-stepping magnet 27. The operation of magnet 27 advances the brushes 55, 56, 57 and 58 into engagement with the next set of terminals and causes the release of relay 17. The release of relay 17 causes the release of magnet 27. If the line connected to this next set of terminals is also busy, relay 22 remains operated; and if the line connected thereto is not the last trunk of the group, relay 17 is reoperated to again advance the brushes. These operations are repeated until an idle trunk is selected or until the last trunk is reached. If an idle trunk is found, relay 23 is operated in series with the cut-off relay as above described and ringing is effected as hereinafter described. If all trunks in the group are busy the brushes are advanced to the terminals of the last trunk, brush 57 alone encountering the busy, ground potential because the two test terminals of the last trunk are not strapped together. Since brush 58 does not encounter ground potential, relay 17 does not reoperate, and the brushes are stopped on the terminals of the last trunk; and, since relay 20 is not short-circuited, relay 20 operates to transmit busy tone to the calling subscriber.

The complete operation of relay 23, when the called line is idle, or upon selection of an idle private branch exchange trunk, connects ground to conductor 53 to hold the cut-off relay and prevent seizure of the line by any other connector having access thereto. Relay 23 disconnects the winding of relay 13 from the back contact of relay 11 to prevent any further operation of relay 13 and magnet 30 of the code selector. Relay 23 also closes a connection from battery through the winding of relay 21, a back contact of relay 16, back contact of relay 21 and front contact of relay 23 to the pick-up conductor 46 leading to the ringing interrupter. When the ringing interrupter is next in position to start a ringing code, it connects ground to conductor 46 operating relay 21; and relay 21 locks under control of relay 16 to ground on conductor 9. After relay 23 operates and before relay 21 operates, battery is connected through the middle upper back contact of relay 21, a back contact of relay 16, a front contact of relay 23, conductor 51 and brush 55 to one conductor of the seized line; and ground is connected through the upper winding of relay 16, back contacts of relays 21 and 16, a front contact of relay 23, conductor 52 and brush 56 to the other conductor of the line. If the seized line is one of a group of private branch exchange trunks, the connection of battery and ground to the line effects the immediate marking of the line as busy in the branch exchange; but relay 16 does not operate until the attendant answers. When relay 21 operates, it closes the ringing circuit. If the party-identifying digit is odd (1, 3, 5, 7 or 9) the ringing circuit is traced from the selected one of ringing conductors 41, 42, 43, 44 and 45, through conductor 51 and

brush 55; and, if the party-identifying digit is even (2, 4, 6, 8 or 0), the ringing circuit is traced from the selected one of the ringing conductors through conductor 52 and brush 56. Assuming, for instance, that station P1 of the line L2 is being called, the ringing-code selector is set in position 1 and the ringing circuit is traced from an A. C.—D. C. source of ringing current through the code 1 interrupter, conductor 41, brush 31 and terminal 1 of the code selector CS, a front contact of relay 21, a back contact of relay 16, a front contact of relay 23, conductor 51, brush 55, conductor 71 of line L2, to ground through the ringing condenser and ringer at station P1 in parallel with the similar path at each of stations P3, P5, P7 and P9. Or, assuming that station P2 of line L2 is called, the ringing circuit is traced from conductor 41, through brush 32 and terminal 2 of code selector CS, a front contact of relay 21, a back contact of relay 16, a front contact of relay 23, conductor 52, brush 56, conductor 72 of line L2, to ground through the ringing condenser and ringer at station P2 in parallel with the similar path at each of stations P4, P6, P8 and P10. Ringing tone is transmitted to the called station through condenser 47 or through condenser 48 depending upon which of conductors 51 or 52 is included in the ringing circuit. When the receiver is removed to answer the call at the called station, the upper winding of relay 16 is connected in parallel with the ringers on the one or the other side of the line. If one of the odd-numbered stations is being called, this parallel circuit path includes one winding of the induction coil and the transmitter at the called station, conductor 72, brush 56, conductor 52, a front contact of relay 23, a back contact of relay 16, a front contact of relay 21, brush 32 and engaged terminal of selector CS, and upper winding of relay 16, to ground. If one of the even-numbered stations is being called, this branch circuit path includes the transmitter and winding of the induction coil at the called station, conductor 71, brush 55, conductor 51, a front contact of relay 23, a back contact of relay 16, a front contact of relay 21, brush 31 and engaged terminal of selector CS, and the upper winding of relay 16 to ground. In either case the energization of the upper winding of relay 16 is sufficient to close its inner lower front contact and complete a circuit for energizing its lower winding, to ground on conductor 10; and relay 16 is thereby completely operated. The complete operation of relay 16 opens the ringing interrupter, disconnects ground from the ringing interrupter start conductor 40, releases relay 21, and closes the talking connection from conductors 7 and 8, through talking condensers 50, outer front contacts of relays 16 and 23, to conductors 51 and 52. Talking battery is connected through the windings of relay 14 and through conductors 51 and 52 to the called station, relay 14 being operated as long as the receiver is off the hook at the called station. Relay 14 reverses the direction of the current through conductors 7 and 8 as an answering supervisory signal, and closes a circuit for operating the release magnet 34 of code selector CS, to restore brushes 31 and 32 to normal. The circuit for operating release magnet 34 includes a front contact of the VON springs 26, a front contact of off-normal springs 33, and front contacts of relays 14, 16 and 18. When the brushes of code selector CS reach normal, springs 33 restore to normal, releasing magnet 34.

If the receiver is replaced at the called station before the connection is released at the calling station, relay 14 releases thereby connecting ground through front contacts of relays 18 and 16 and a back contact of relay 14 to an "alarm" device 59 which is operative in usual manner after a predetermined interval of time to signal a maintenance attendant.

When the receiver is replaced at the calling station, relay 11 releases, opening the operating circuit of relay 12. Relay 12 releases, disconnecting ground potential from conductor 9 thereby releasing the switches S—1 and LF—1 which return to normal in usual manner. The release of relay 12 also disconnects ground from conductor 10 thereby releasing relays 16, 18 and 23. The release of each of relays 16 and 23 disconnects the windings of relay 14 from conductors 51 and 52 thereby releasing relay 14 if not already released. The release of relay 18 disconnects ground from the "alarm" device 59. With relays 23, 12 and 11 released, a circuit is closed for operating the release magnet 29 of the connector switch to restore brushes 55, 56, 57 and 58 to normal. When the shaft reaches normal, springs 26 restore to normal, opening the operating circuit of release magnet 29.

In case the calling subscriber replaces the receiver after the ringing-code selector CS is set but before the called subscriber answers, relay 14 is not operated and the code selector is not restored to normal until after the brushes of the connector switch reach normal. In this case, the return of springs 26 to normal closes a circuit, including a back contact of relay 18, for operating the release magnet 34 of the code selector CS. When the brushes 31 and 32 reach normal, the off-normal springs 33 restore to normal, opening the operating circuit of magnet 34.

What is claimed is:

1. In a telephone system, subscribers' lines including party lines, a connector switch having access to a plurality of said lines, a group of trunks connected to terminals in the bank of said switch, means for connecting a calling line to said switch, means under the control of the calling subscriber for advancing the brushes of said switch into engagement with the terminals of a called line or the first set of terminals connected to a trunk in said group, a ringing-code selector associated with said switch and controlled by the calling subscriber, means operative during the advance of said code selector for testing the selected set of terminals in the bank of the connector switch, and means effective if the selected set of terminals is connected to a busy trunk in said group for advancing the brushes of the connector switch into engagement with terminals connected to an idle trunk in said group.

2. In combination, a trunk-hunting code-ringing connector switch of the two-motion step-by-step type, a ringing interrupter arranged to transmit ringing current of any one of a plurality of codes, means responsive to trains of dial impulses for advancing the brushes of the connector switch into engagement with the called line or the first trunk in a called group, means responsive to a train of dial impulses for selecting the particular ringing code with which a called station is signaled, means rendered effective in response to the first impulse of the code-selecting train for testing the terminals engaged by the connector brushes, means effective if the engaged terminals test busy and are connected to a trunk other than the last trunk in

a called group of trunks for advancing the brushes to hunt for an idle trunk while said ringing code is being selected, and means including said interrupter for transmitting ringing current of the selected code over the called line or selected trunk.

3. In a telephone system, subscribers' lines including party lines, a connector switch having access to a plurality of said lines, a group of trunks connected to terminals in the bank of said switch, means for connecting a calling line to said switch, means under the control of the calling subscriber for advancing the brushes of said switch into engagement with the terminals of a called line or the first set of terminals connected to a trunk in said group, a ringing-code selector associated with said switch and controlled by the calling subscriber, means operative during the advance of said code selector for testing the selected set of terminals in the bank of the connector switch, and means effective if the selected set of terminals is connected to a busy trunk in said group for advancing the brushes of the connector switch into engagement with terminals connected to an idle trunk in said group, said advance to select an idle trunk occurring during the selective advance of said code selector.

4. In a telephone system, subscribers' lines including party lines and trunks to private branch exchanges, a connector for completing connections from calling lines to called lines, a ringing current source and interrupter associated with said connector for generating code-ringing signals for signaling the different stations on a party line, said connector comprising a two-motion switch having a set of brushes and a terminal bank and comprising a single-motion switch for selecting the ringing code with which a called station is signaled, the terminals in the bank of said two-motion switch being connected to said lines and trunks, means for connecting a calling line with said connector, a dial device at a connected calling station for creating current impulses to control the operation of said switches, said connector further comprising a line relay responsive to dial impulses, means comprising said line relay and a release relay for maintaining the connection between a calling line and the connector until the connection is released by the calling subscriber, a first slow-to-release control relay, a second slow-to-release control relay, a vertical-stepping magnet for stepping the brushes of said two-motion switch to select a level in which a called line or a called group of trunks is accessible, a rotary-stepping magnet for stepping the brushes of said two-motion switch into engagement with the terminals of a called line or an idle trunk in a called group of trunks, a stepping magnet for advancing the brushes of said single-motion switch, means comprising a contact of said release relay for operatively connecting an impulse contact of said line relay to said vertical-stepping magnet, means comprising said first control relay for maintaining the connection between said impulse contact and the vertical-stepping magnet until all of the impulses in a first train of impulses incoming from said calling line are received and for then operatively connecting said impulse contact with said rotary-stepping magnet, means comprising said second control relay for maintaining the connection between said impulse contact and said rotary-stepping magnet during the receipt of a second train of impulses

from the calling station and for connecting said impulse contact to the stepping magnet of the code-selector switch after the last impulse of the second train of impulses has been received, means comprising said first control relay for maintaining the connection between said impulse contact and the stepping magnet of said code-selector switch during receipt of a third train of impulses from the calling station, a test relay for testing the line or trunk connected to the terminals engaged by the brushes of said two-motion switch, means comprising a contact of said first control relay and an off-normal contact of said code-selector switch for connecting said test relay to the test brush of said two-motion switch, means including said test relay effective if the terminals engaged by the brushes of said two-motion switch are connected to a busy trunk in a selected group other than the last trunk in the group to operate said rotary-stepping magnet to advance the brushes until the terminals of an idle trunk are engaged or until the terminals connected to the last trunk in the group are engaged, means for maintaining the connection of said test relay to said test brush while the brushes of the two-motion switch are being advanced to hunt for an idle trunk in a selected group, means for maintaining the operation of said test relay and for transmitting a busy tone to the calling station if the called line or all trunks in a called group are busy, the last-mentioned means becoming effective upon release of said first control relay after all of the impulses in said third train have been received, a relay for effecting the seizure of the line or trunk engaged by the brushes of said two-motion switch, and means including back contacts of said first control relay and said test relay for operating said seizure relay.

5. In a telephone system, subscribers' lines including party lines and trunks to private branch exchanges, a connector for completing connections from calling lines to called lines, a ringing current source and interrupter associated with said connector for generating code-ringing signals for signaling the different stations on a party line, said connector comprising a two-motion switch having a set of brushes and a terminal bank and comprising a single-motion switch for selecting the ringing code with which a called station is signaled, the terminals in the bank of said two-motion switch being connected to said lines and trunks, means for connecting a calling line with said connector, a dial device at a connected calling station for creating current impulses to control the operation of said switches, said connector further comprising a line relay responsive to dial impulses, means comprising said line relay and a release relay for maintaining the connection between a calling line and the connector until the connection is released by the calling subscriber, a first slow-to-release control relay, a second slow-to-release control relay, a vertical-stepping magnet for stepping the brushes of said two-motion switch to select a level in which a called line or a called group of trunks is accessible, a rotary-stepping magnet for stepping the brushes of said two-motion switch into engagement with the terminals of a called line or an idle trunk in a called group of trunks, a stepping magnet for advancing the brushes of said single-motion switch, means comprising a contact of said release relay for operatively connecting an impulse contact of said line relay to said vertical-stepping

ping magnet, means comprising said first control relay for maintaining the connection between said impulse contact and the vertical-stepping magnet until all of the impulses in a first train of impulses incoming from said calling line are received and for then operatively connecting said impulse contact with said rotary-stepping magnet, means comprising said second control relay for maintaining the connection between said impulse contact and said rotary-stepping magnet during the receipt of a second train of impulses from the calling station and for connecting said impulse contact to the stepping magnet of the code-selector switch after the last impulse of the second train of impulses has been received, means comprising said first control relay for maintaining the connection between said impulse contact and the stepping magnet of said code-selector switch during receipt of a third train of impulses from the calling station, a test relay for testing the line or trunk connected to the terminals engaged by the brushes of said two-motion switch, and means comprising a contact of said first control relay and an off-normal contact of said code-selector switch for connecting said test relay to the test brush of said two-motion switch.

6. In a telephone system, subscribers' lines including party lines and trunks to private branch exchanges, a connector for completing connections from calling lines to called lines, a ringing current source and interrupter associated with said connector for generating code-ringing signals for signaling the different stations on a party line, said connector comprising a two-motion switch having a set of brushes and a terminal bank and comprising a single-motion switch for selecting the ringing code with which a called station is signaled, the terminals in the bank of said two-motion switch being connected to said lines and trunks, means for connecting a calling line with said connector, a dial device at a connected calling station for creating current impulses to control the operation of said switches, said connector further comprising a line relay responsive to dial impulses, means comprising said line relay and a release relay for maintaining the connection between a calling line and the connector until the connection is released by the calling subscriber, a first slow-to-release control relay, a second slow-to-release control relay, a vertical-stepping magnet for stepping the brushes of said two-motion switch to select a level in which a called line or a called group of trunks is accessible, a rotary-stepping magnet for stepping the brushes of said two-motion switch into engagement with the terminals of a called line or an idle trunk in a called group of trunks, a stepping magnet for advancing the brushes of said single-motion switch, means comprising a contact of said release relay for operatively connecting an impulse contact of said line relay to said vertical-stepping magnet, means comprising said first control relay for maintaining the connection between said impulse contact and the vertical-stepping magnet until all of the impulses in a first train of impulses incoming from said calling line are received and for then operatively connecting said impulse contact with said rotary-stepping magnet, means comprising said second control relay for maintaining the connection between said impulse contact and said rotary-stepping magnet during the receipt of a second train of impulses from the calling station and for connecting said impulse

contact to the stepping magnet of the code-selector switch after the last impulse of the second train of impulses has been received, means comprising said first control relay for maintaining the connection between said impulse contact and the stepping magnet of said code-selector switch during receipt of a third train of impulses from the calling station, a test relay for testing the line or trunk connected to the terminals engaged by the brushes of said two-motion switch, means comprising a contact of said first control relay and an off-normal contact of said code-selector switch for connecting said test relay to the test brush of said two-motion switch, and means including said test relay effective if the terminals engaged by the brushes of said two-motion switch are connected to a busy trunk in a selected group other than the last trunk in the group to operate said rotary-stepping magnet to advance the brushes until the terminals of an idle trunk are engaged or until the terminals connected to the last trunk in the group are engaged.

7. In a telephone system, subscribers' lines including party lines and trunks to private branch exchanges, a connector for completing connections from calling lines to called lines, a ringing current source and interrupter associated with said connector for generating code-ringing signals for signaling the different stations on a party line, said connector comprising a two-motion switch having a set of brushes and a terminal bank and comprising a single-motion switch for selecting the ringing code with which a called station is signaled, the terminals in the bank of said two-motion switch being connected to said lines and trunks, means for connecting a calling line with said connector, a dial device at a connected calling station for creating current impulses to control the operation of said switches, said connector further comprising a line relay responsive to dial impulses, means comprising said line relay and a release relay for maintaining the connection between a calling line and the connector until the connection is released by the calling subscriber, a first slow-to-release control relay, a second slow-to-release control relay, a vertical-stepping magnet for stepping the brushes of said two-motion switch to select a level in which a called line or a called group of trunks is accessible, a rotary-stepping magnet for stepping the brushes of said two-motion switch into engagement with the terminals of a called line or an idle trunk in a called group of trunks, a stepping magnet for advancing the brushes of said single-motion switch, means comprising a contact of said release relay for operatively connecting an impulse contact of said line relay to said vertical-stepping magnet, means comprising said first control relay for maintaining the connection between said impulse contact and the vertical-stepping magnet until all of the impulses in a first train of impulses incoming from said calling line are received and for then operatively connecting said impulse contact with said rotary-stepping magnet, means comprising said second control relay for maintaining the connection between said impulse contact and said rotary-stepping magnet during the receipt of a second train of impulses from the calling station and for connecting said impulse contact to the stepping magnet of the code-selector switch after the last impulse of the second train of impulses has been received, means comprising said first control relay for

maintaining the connection between said impulse contact and the stepping magnet of said code-selector switch during receipt of a third train of impulses from the calling station, a test relay for testing the line or trunk connected to the terminals engaged by the brushes of said two-motion switch, means comprising a contact of said first control relay and an off-normal contact of said code-selector switch for connecting said test relay to the test brush of said two-motion switch, means including said test relay effective if the terminals engaged by the brushes of said two-motion switch are connected to a busy trunk in a selected group other than the last trunk in the group to operate said rotary-stepping magnet to advance the brushes until the terminals of an idle trunk are engaged or until the terminals connected to the last trunk in the group are engaged, and means for maintaining the connection of said test relay to said test brush while the brushes of the two-motion switch are being advanced to hunt for an idle trunk in a selected group.

8. In a telephone system, subscribers' lines including party lines and trunks to private branch exchanges, a connector for completing connections from calling lines to called lines, a ringing current source and interrupter associated with said connector for generating code-ringing signals for signaling the different stations on a party line, said connector comprising a two-motion switch having a set of brushes and a terminal bank and comprising a single-motion switch for selecting the ringing code with which a called station is signaled, the terminals in the bank of said two-motion switch being connected to said lines and trunks, means for connecting a calling line with said connector, a dial device at a connected calling station for creating current impulses to control the operation of said switches, said connector further comprising a line relay responsive to dial impulses, means comprising said line relay and a release relay for maintaining the connection between a calling line and the connector until the connection is released by the calling subscriber, a first slow-to-release control relay, a second slow-to-release control relay, a vertical-stepping magnet for stepping the brushes of said two-motion switch to select a level in which a called line or a called group of trunks is accessible, a rotary-stepping magnet for stepping the brushes of said two-motion switch into engagement with the terminals

of a called line or an idle trunk in a called group of trunks, a stepping magnet for advancing the brushes of said single-motion switch, means comprising a contact of said release relay for operatively connecting an impulse contact of said line relay to said vertical-stepping magnet, means comprising said first control relay for maintaining the connection between said impulse contact and the vertical-stepping magnet until all of the impulses in a first train of impulses incoming from said calling line are received and for then operatively connecting said impulse contact with said rotary-stepping magnet, means comprising said second control relay for maintaining the connection between said impulse contact and said rotary-stepping magnet during the receipt of a second train of impulses from the calling station and for connecting said impulse contact to the stepping magnet of the code-selector switch after the last impulse of the second train of impulses has been received, means comprising said first control relay for maintaining the connection between said impulse contact and the stepping magnet of said code-selector switch during receipt of a third train of impulses from the calling station, a test relay for testing the line or trunk connected to the terminals engaged by the brushes of said two-motion switch, means comprising a contact of said first control relay and an off-normal contact of said code-selector switch for connecting said test relay to the test brush of said two-motion switch, means including said test relay effective if the terminals engaged by the brushes of said two-motion switch are connected to a busy trunk in a selected group other than the last trunk in the group to operate said rotary-stepping magnet to advance the brushes until the terminals of an idle trunk are engaged or until the terminals connected to the last trunk in the group are engaged, means for maintaining the connection of said test relay to said test brush while the brushes of the two-motion switch are being advanced to hunt for an idle trunk in a selected group, and means for maintaining the operation of said test relay and for transmitting a busy tone to the calling station if the called line or all trunks in a called group are busy, the last-mentioned means becoming effective upon release of said first control relay after all of the impulses in said third train have been received.

CHARLES D. KOECHLING.