Aug. 14, 1934. J. G. POPE 1,970,337

TELEPHONE SYSTEM

Filed Nov. 10, 1932 2 Sheets-Sheet 1

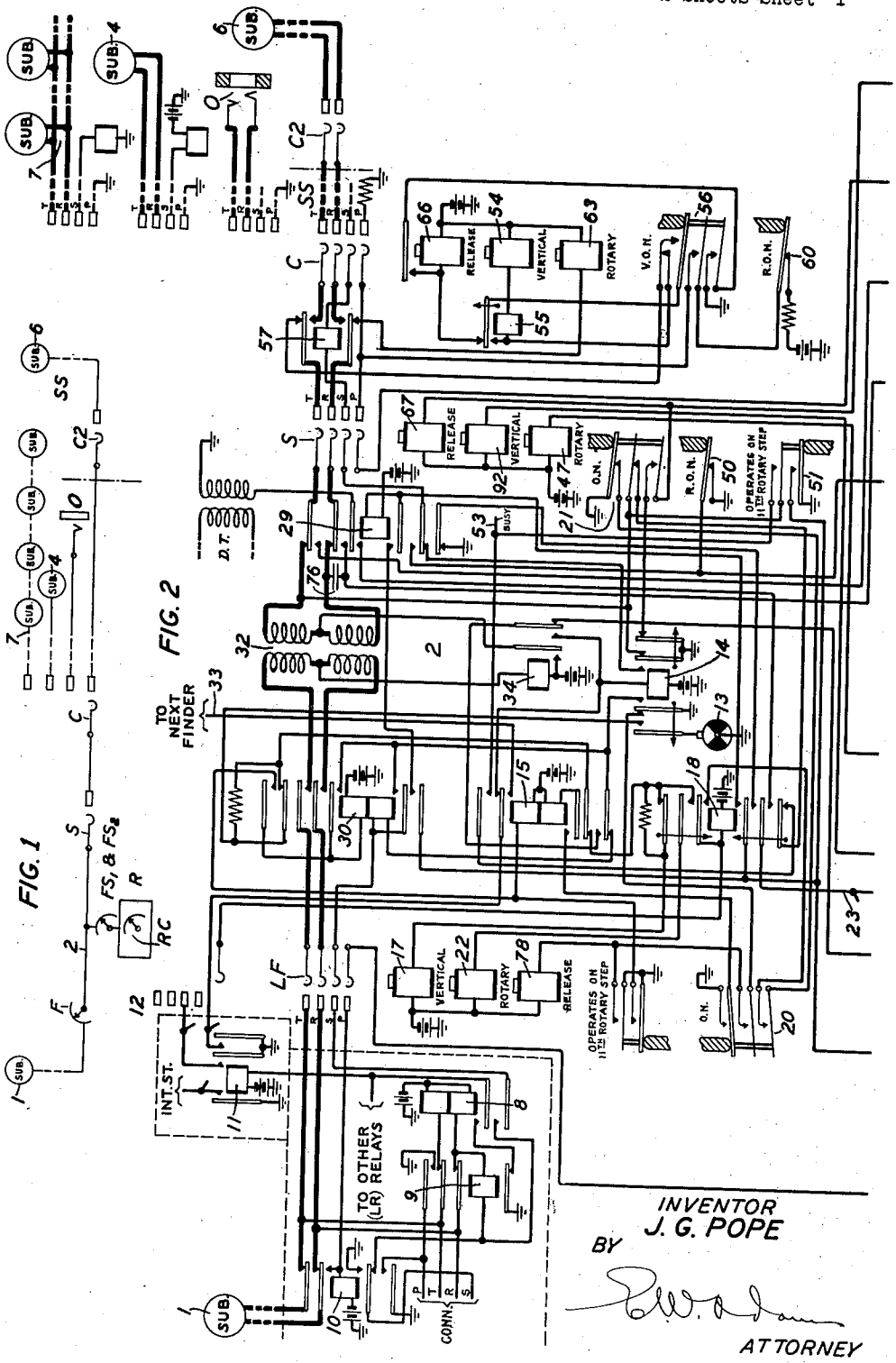

FIG. 1

FIG. 2

INVENTOR
J. G. POPE
BY
ATTORNEY

Aug. 14, 1934. J. G. POPE 1,970,337

TELEPHONE SYSTEM

Filed Nov. 10, 1932 2 Sheets-Sheet 2

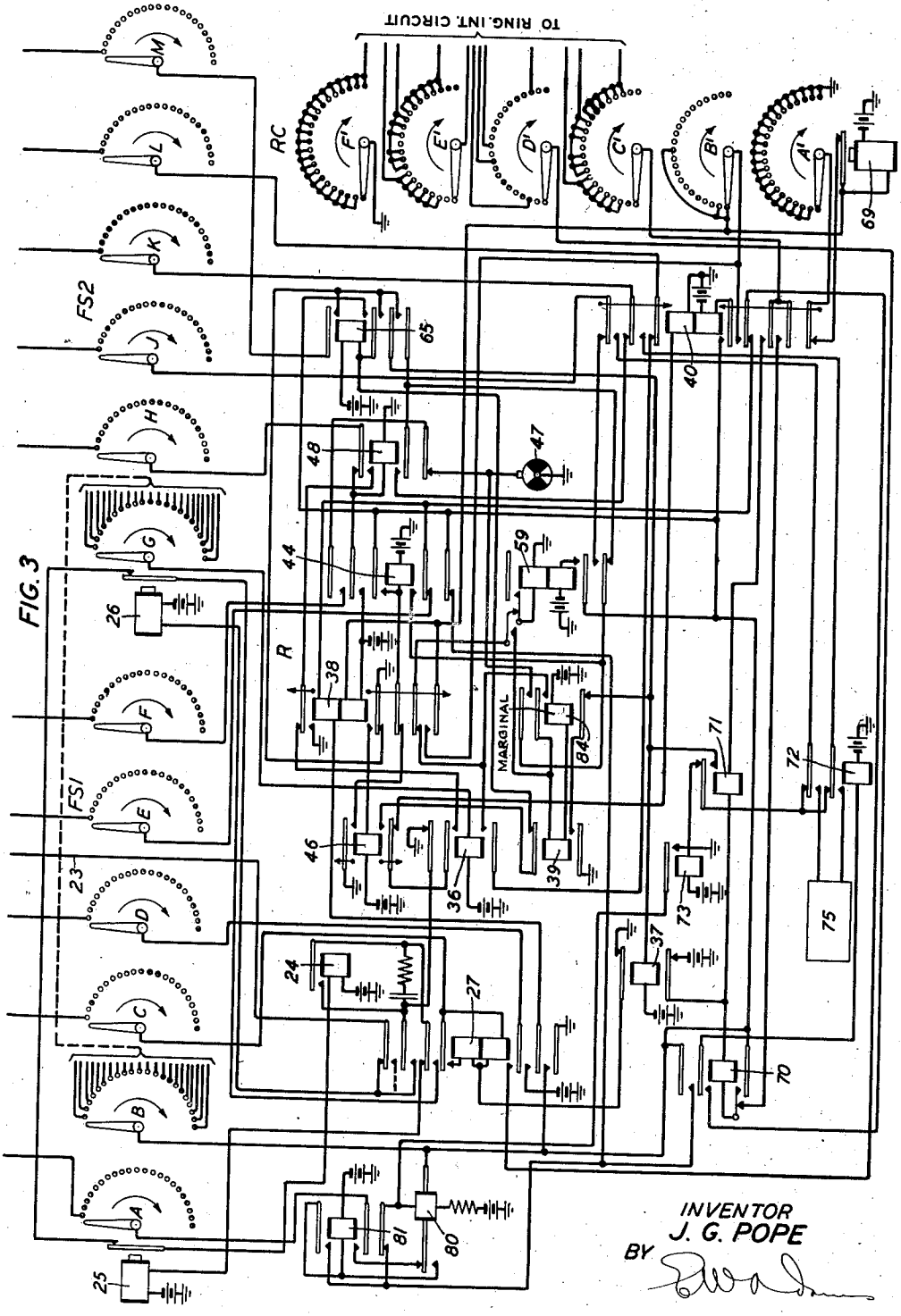

FIG. 3

INVENTOR
J. G. POPE
BY
ATTORNEY

Patented Aug. 14, 1934 1,970,337

UNITED STATES PATENT OFFICE

1,970,337

TELEPHONE SYSTEM

John G. Pope, Montreal, Quebec, Canada, assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application November 10, 1932, Serial No. 642,031

6 Claims. (Cl. 179—17)

This invention relates to telephone systems and particularly to improvements in automatic telephone systems. Its object is to simplify, concentrate and increase the utility of the equipment used in establishing automatic connection in such systems.

Heretofore, systems have been provided in which common registers or senders have been provided for receiving impulses to control the setting of the switches for establishing connections between subscribers and various other functions incident to the control of a connection.

It is a feature of this invention to concentrate in a register, common to a plurality of links each comprising a line finder and a selector used for the establishing of connections between subscribers' lines, means responsive to impulses received from a calling line for transmitting corresponding impulses to control selections in the selector and switches beyond, means responding to impulses received from the calling line to select different ringing code signals to be transmitted to the called party when the connection has been established, and means for releasing a seized link and the register a certain interval after seizure if no further action is taken by the calling subscriber towards the establishing of a connection or if the calling subscriber fails to dial or complete the dialing before the end of this interval or in case of a revertive call.

This invention is illustrated in the accompanying drawings in which:

Fig. 1 shows in diagrammatic form an automatic telephone system arranged in accordance with this invention, while Figs. 2 to 3 show the detail circuits of such a system embodying the features of this invention. Figs. 2 and 3 include a calling subscriber's line, a link circuit comprising a line finder and a selector, a register common to said links, a connector and called subscriber's line and trunks of various types.

Referring now particularly to Fig. 1, which shows in diagrammatic form the general outline of a system embodying this invention, if the subscriber 1 calls, an idle line finder LF is operated to connect the associated link 2 with his line and to associate a common idle register R with this seized link. When the operator dials the first digit the selector S associated with the link 2 is operated in its primary movement to select a group of connectors and to hunt for an idle connector C. The second and third series of impulses sent out by the operator will then actuate the connector C in its primary and secondary movements to select the desired single line 4, or a party line 7, or a group of manual trunks leading to an operator's position O or a group of trunks leading to a distant step-by-step office SS. The connector C then hunts for an idle manual trunk line in the selected group or hunts for an idle trunk outgoing to office SS and terminating in a connector such as C—2 which is then operated by succeeding digits to select a desired subscriber's line 6. If a local subscriber's line 4 or a party line 7 is selected the next series of impulses will operate the ringing code switch RC in the register R to select the proper ringing code signal. If the operator's position O is connected with, then the code switch is also operated but in this case the usual line lamp may be actuated at the operator's position over the selected trunk by the selected code signal. The code switch is similarly operated when a step-by-step office is selected after the desired subscriber's line has been reached.

Descriptions will now be made in detail of the establishing of the connection mentioned with special reference to Figs. 2 and 3. If the calling subscriber at 1 removes his receiver from the switchhook to make a call a simplex ground is placed on the tip and ring conductors over the line from the calling party's telephone causing the operation of relay 8 in the line circuit from battery and ground through the windings of this relay, armatures and back contacts of relays 9 and 10 to ground at the subscriber's telephone set at 1. Relay 8 operating closes an obvious circuit for the operation of relay 11 which is associated with the particular group to which the calling line belongs. This relay may be common to ten lines. The operation of relay 8 also prepares a circuit at its lower outer armature and front contact for the operation of relay 9 from the sleeve terminal on the line finders having access to this group of lines. Relay 11 places a ground connection on the line finder commutator 12 on the terminal representing the level in which the group of lines are located to which line 1 belongs. As shown in the drawing this is the second level. Relay 11 also closes at its left-hand armature and front contact a connection to ground for an interrupter starting circuit not shown, the interrupter supplying interrupted ground connection on the lead 13. This relay also prepares a circuit for the operation of relay 14 from battery, winding of this relay, upper inner armature and back contact of relay 15, right-hand outer armature and front contact of relay 11 to ground. Relay 14 in operating connects the interrupted ground connection on lead 13 to the

vertical stepping magnet 17 for the line finder LF. Magnet 17 now steps the line finder in a vertical direction until the commutator wiper finds the ground on its second level when relay 18 is operated from battery through the winding of this relay through the commutator wiper, the terminal on the second level to the ground at relay 11, relay 18 locks at its upper inner armature and front contact to off-normal contacts 20 of the line finder LF to ground supplied at the off-normal contact 21 of the selector switch S. Relay 18 also transfers the pulsing circuit to the rotary stepping magnet 22 at the upper middle armature and front contact and places a ground at its lower middle armature and front contact for a start lead 23 leading to the register R for the association of the register with the link 2. Relay 24 now operates over a circuit from battery through the winding of this relay, armatures and back contact of stepping magnets 25 and 26, second upper armature and back contact of relay 27, start lead 23, second lower armature and front contact of relay 18 to ground at the lower outer armature and back contact of relay 29. The association of the register with the trunk will be described hereinafter.

The rotary stepping magnet 22 now steps the brushes of the line finder LF over the second level until the ground placed on the sleeve terminal of the calling line is found, when a circuit is completed for the operation of relays 30 and 9 from battery through the lower winding of relay 8, winding of relay 9, lower outer armature and front contact of relay 8, sleeve lead and terminal of the calling line, the sleeve brush of the line finder LF, lower winding of relay 30, lower outer armature and back contact of relay 15 to ground at the inner left-hand armature and front contact of relay 14. Relay 30 locks from battery through its other winding, upper inner armature and front contact to the ground at relay 14 independent of the connection through the sleeve lead. Relay 30 also connects the tip and ring conductors from the calling line at the second and third upper armatures and front contacts through the left-hand windings of the repeating coil 32 and opens the circuit for the rotary stepping magnet 22 at its upper outer armature and back contact to stop the line finder on the terminals of the calling line. A circuit is also closed for relay 15 from battery through the upper winding of this relay, upper outer armature and front contact and upper inner armature and front contact of relay 30 to ground at relay 14 causing relay 15 to operate. Relay 15 in operating transfers the start circuit above mentioned to the conductor 33 to the next line finder. Relay 15 also provides a locking circuit for itself from battery through its lower winding and lower inner armature and front contact to ground at the off-normal contact 20 of the line finder LF.

Relay 9 operates in the above mentioned circuit in series with relay 30 and remains held up by the ground at relay 14. Relay 9 opens the circuit for the relay 11 to prevent the next finder from operating and removes the relay 8 from the connection to the tip and ring conductors to the calling line. Relay 8 is however held operated by the circuit through its lower winding. Relay 9 closes a connection from ground at its upper outer armature and front contact to the P lead terminating in the banks of connectors. The ground connecting at relay 14 on the sleeve lead serves as a busy indication for the calling line in terminals of line finders as well as on the sleeve lead leading to connectors which is extended at the lower inner armature and back contact of relay 10. Due to the operation of relays 9 and 30 the simplex ground from the calling subscriber's set at 1 is now extended through the link circuit to cause the operation of relay 34 from battery through the winding of this relay, left-hand windings of the repeating coil 32, tip and ring conductors, simplex ground at the calling subscriber's set. Relay 34 in operating causes a circuit to be closed for maintaining relay 14 operated. This transfer to a holding circuit for relay 14 may take place due to the fact that relay 14 is slow in releasing. The new circuit for relay 14 may be traced from battery, winding of this relay, outer right-hand armature and front contact of relay 34, third lower armature and front contact of relay 15 to ground at the inner left-hand armature and front contact of relay 14.

The finder switch for associating a register such as R with the link circuit 2 has been shown as two separate switches FS—1 and FS—2 controlled respectively by the stepping magnets 25 and 26. When the ground was placed on the register starting lead 23 as hereinbefore traced relay 24 operated. A circuit is thereby closed for rotary magnet 25 from battery through the winding of this magnet, second upper armature and back contact of relay 27, armature and front contact of relay 24 to ground at the upper outer armature and back contact of relay 36. When the rotary magnet 25 operates the circuit for relay 24 is opened causing it to release and thereby releasing the magnet which then closes the circuit for relay 24 so that the magnet and the relay operate and release alternately until a ground on the wiper of terminal bank C when the finder switch FS—1 finds a battery connection on the terminal of the seized link, which in this case has been shown as the first of the group, the finder switch having a capacity of 22 links. This battery connection causes the operation of relays 27 and 29 over a circuit as follows: Battery, winding of relay 29, lower inner armature and front contact of relay 18, wiper and first terminal of bank C, lower winding of relay 27, upper armature and back contact of relay 37 to ground. The operation of relay 27 closes a circuit through its upper winding in substitution of the lower winding, the upper winding being of lower resistance. This is to supply a low resistance busy ground at the first terminal of bank C as a partial shunt to prevent the operation of relays corresponding to relay 27 in other registers which are searching for a seized link. Relay 27 also opens a circuit for the stepping magnet 25 and closes a circuit for the stepping magnet 26 from battery winding of magnet 26, second upper armature and front contact of relay 27, armature and front contact of relay 24 to ground at the upper outer armature and back contact of relay 36. Relay 27 also transfers the start lead 23 at the upper outer armature and front contact to the next register. The stepping magnet 26 now alternately operates and releases with relay 24 and operates to step the finder switch FS—2 to the seized link. It should be noted that the terminals of banks B and G are connected together so that when the switch FS—2 has made one step the wiper of bank G will find a ground on the first terminal supplied at the lower outer armature and front contact of relay 27 to the brush of bank B on its first terminal. This ground now causes the operation of relay 36 from battery, winding of this relay, wipers of banks G and B and their first

terminals to ground at relay 27. The operation of relay 36 opens the circuit for the stepping magnet 26 by removing the ground at the upper outer armature and back contact. The register R is now fully associated with the link 2.

Referring now to the operation of relay 29 which operated in series relay 27, this relay provides a locking circuit through its lower inner armature and front contact to the ground supplied by relay 37. Relay 29 removes the ground on the start lead for the register at the lower outer armature and back contact and by operating its two upper outer armatures to their front contacts places the tip and ring conductors of selector S under the control of the register R. Relay 29 also connects a dial tone circuit over the tip and ring conductors back to the calling subscriber to indicate that dialing may now take place. This circuit may be traced from the dial tone stored at 41, upper inner armature and front contact of relay 29, lower outer armature and front contact of relay 18, off-normal contact 21 of switch S to the tip conductor of the link, upper right-hand winding of repeating coil 32 to battery at the inner right-hand armature and front contact of relay 34 and inductively through the left-hand windings of this coil to the calling subscriber's set. The sleeve conductor of the switch S is also put under control of the register by connecting it at the middle lower armature and front contact to bank H of the finder switch FS—2.

The link 2 and register R are now in condition for the reception of a first digit to be dialed by the calling subscriber. This digit will operate the vertical stepping magnet 42 of the switch S as follows: The stepping relay 34 operates and releases as the impulses are sent by the calling subscriber. This relay in releasing closes a circuit for magnet 42 as follows: from battery, winding of this magnet, the first terminal and wiper of bank E, lower inner armature and back contact of relay 44, second lower armature and back contact of relay 40, lower inner armature and front contact of relay 27, first terminal and wiper of bank D, outer right-hand armature and back contact of relay 34, third lower armature and front contact of relay 15, to ground at the inner left-hand armature and front contact of relay 14. The succeeding impulse will now operate the stepping magnet 42 to advance the switch S to the desired level in which connectors, such as C, are connected. The off-normal contacts 21 of switch S are operated on the first step to remove the dial tone and release relay 18. Relay 14 being slow in releasing does not release during pulsing. The circuit for relay 38 is now also completed in parallel with the circuit to ground established by the release of relay 34 on the reception of the first impulse, from battery at the second lower armature and front contact of relay 27, upper winding of relay 38, second lower armature and front contact of relay 40 and from thereon to the ground at relay 14. This relay is slow in releasing so that it will remain operated during the sending of the first series of impulses. Relay 38 in operating closes an obvious circuit for the operation of relay 46. At the end of the first digit relay 38 is released and closes a circuit for relay 44 from battery, winding of relay 44, second lower armature and back contact of relay 34, upper armature and front contact of relay 46 to ground. This circuit is possible due to the slow-to-release characteristics of relay 46. Relay 44 locks at its upper inner armature and front contact to the ground supplied by relay 27. Relay 44 now transfers the impulse circuit to the rotary stepping magnet 47 for the switch S which now operates to hunt for an idle connector such as C. The operating circuit for this magnet may be traced from battery, winding of magnet 47, first terminal and wiper of bank F, upper outer armature and front contact of relay 44, lower outer armature and back contact of relay 48, to the interrupter and ground at 49. The brushes of switch S are now stepped around under control of relays 44 and 48 until an idle connector C is found. When the brushes are passing over terminals of busy trunks a ground is received over the sleeve terminal and sleeve leads, second lower armature and front contact of relay 29, first terminal and wiper of bank H, upper armature and back contact of relay 48 to shunt the winding of this relay which is connected to ground to prevent this relay from operating which it would ordinarily do as relay 44 has established a connection to battery for the winding of this relay at the second upper armature and front contact. Relay 48 is thus prevented from operating as long as the ground is found on the sleeve lead of switch S thus permitting the rotary magnet 47 to be stepped from one busy connector to another. To prevent relay 48 from operating immediately on the operation of relay 44 it should be noted that rotary off-normal contacts 50 are closed to ground and on the first step of the rotary stepping magnet 47 these contacts are opened to permit relay 48 to be controlled by the ground on the sleeve leads. When an idle connector is reached this shunt to ground is removed allowing relay 48 to operate. Relay 48 in operating remains under the control of relay 44 and transfers the sleeve lead to ground through the upper winding of relay 40 over a circuit through the lower armature. This ground and back contact of relay 46, upper armature and front contact of relay 36, upper armature and back contact of relay 38 and upper armature and front contact of relay 48, through a winding of relay 40, serves as a busy potential for the sleeve terminal of the selected connector.

If all of the connectors should be busy the switch S rotates to the eleventh position and thereby causes the operation of contacts 51. The operation of these contacts provides a ground for the shunt of relay 27 to cause the release of the connection as will hereinafter be described and sends a busy tone from a source at 53 to the calling subscriber to indicate that there is no available connection to the called party.

If it is assumed that an idle connection has been found the subscriber will dial the second digit. When this digit is dialed impulses from relay 34 are supplied to the vertical stepping magnet 54 of the connector C from battery through the winding of this magnet, winding of relay 55, vertical off-normal contacts 56, upper armature and back contacts of relay 57, the tip conductor back to the switch S, upper outer armature and front contact of relay 29, first terminal and wiper of bank K, second upper armature and back contact of relay 40, lower inner armature and front contact of relay 48, lower outer armature and back contact of relay 59, lower inner armature and front contact of relay 44 and over the pulsing circuit as hereinbefore traced to the ground at relay 14 under control of relay 34. The stepping magnet 54 will now operate under control of these impulses to advance the connector to the desired level in which the called subscriber's line may be

found. Relay 55 operates in series with the vertical magnet 54 and locks over the vertical off-normal contacts after the first impulse and as it is slow in releasing remains operated during pulsing. When the pulsing ceases relay 38 releases as heretofore and relay 59 operates as at the first step of the vertical magnet, the vertical off-normal contacts 56 supplies battery through a resistance over a circuit through the rotary off-normal contacts 60, P lead, the first terminal and wiper of bank L of switch FS—2, upper inner armature and back contact of relay 40, lower armature and front contact of relay 36, third lower armature and back contact of relay 38, make-before-break contacts of relay 59, upper winding of this relay to ground. Relay 59 in operating locks through its lower inner armature and lower windings from battery to ground supplied at relay 27 and opens the pulsing circuit for the vertical magnet 54. The operation of relay 59 transfers the pulsing circuit at its lower outer armature and front contact to the ring conductor leading to the connector C so that if now the operator dials a third digit the impulses will be transmitted through this connection prepared by relay 69 over the upper outer armature and back contact of relay 40, the first terminal and wiper of bank J of switch FS—2, second upper armature and front contact of relay 29, ring conductor, lower armature and back contact of relay 57, winding of the rotary stepping magnet 63 to battery. The operation in this case is the same as in connection with the sending of the preceding digit except that the rotary off-normal contacts 60 are open to remove the battery from the P lead. When the desired line is reached at the end of this digit the connection will be established as hereinafter described. A called line may be either a party line, such as 7, or a local line, such as 4, or a group of local trunks or outgoing trunks may have been selected. In case the local line 4 or a party line 7 has been selected and the selected line is busy a ground will be present on the sleeve lead in the usual manner and this will be connected through the winding of relay 57, the sleeve lead in the switch S, the second lower armature and front contact of relay 29, first terminal and wiper of bank H, upper armature and front contact of relay 43, upper armature and back contact of relay 38, upper armature and front contact of relay 36, lower armature and front contact of relay 46 before it releases after the release of relay 38, upper armature and back contact of relay 39, winding of relay 65 to battery. Relay 65 operates and locks to ground at relay 27. Relay 65 then closes a circuit for the operation of the release magnet 66 of the connector C, from battery, winding of release magnet 66, armature and back contact of relay 55, vertical off-normal contact 56, upper armature and back contact of relay 57, tip conductor, upper outer armature and front contact of relay 27, first terminal and wiper of bank K, middle upper armature and back contact of relay 40, lower inner armature and front contact of relay 43, lower outer armature and front contact of relay 65 to ground at the lower inner armature and back contact of relay 38. The connector C releases and restores its off-normal contact to normal position. It should be noted that this ground from relay 38 is also applied through the upper armature and front contact of relay 65, over the first terminal and wiper of bank M, through the winding of the release magnet 67 to battery to cause switch S to be released. Relay 65 also closes a circuit for the operation of relay 37 from battery, winding of this relay, second lower armature and front contact of relay 65 to ground at relay 38. Relay 37 in operating removes the ground from the holding circuit for relay 27 which is thereby released. Relay 27 in releasing opens the circuit for relays 38, 44, 40 and 65. The stepping magnets 25 and 26 are not operated on the release of the register but remain in their last position until this register is taken for use again. When the switch S is released the off-normal contact 21 places a busy tone through the repeating coil 32 to inform the calling party that the called line is busy. The release of the link circuit and the line finder is under control of the calling party. The release of the line finder takes place when the calling party hangs up his receiver as will be described hereinafter in connection with the release of a connection after a call is terminated.

Assuming, however, that the called line is idle, whether party line 7 or single line 4, relay 40 will operate on the release of relays 38 and 46 to prepare the circuits for dialing for the singing code of the called subscriber. Relay 40 locks over its lower winding to ground at relay 27. Relay 57 is also operated in series with relay 40 and the cut-off relay in the called subscriber's line to cut through the connection over the tip and ring conductors. The code switch RC is operated by ringing code selecting impulses regardless of whether the called party is on a single line or on a party line. The number for ringing code selection comprises two digits. The first digit causes the code switch RC to be stepped either to position 1 or position 10 depending on the digit dialed. The pulsing circuit for operating the step-by-step magnet 69 of the code switch may be traced from battery, winding of this magnet, the zero terminal and wiper of the bank B_1 of the code switch RC, second lower armature and front contact of relay 40 to the pulsing circuit to ground at relay 14. Relay 38 is also operated from battery, lower winding of relay 38, to the ground at relay 14 over the pulsing circuit and maintained operated during pulsing through the circuit closed at its lower outer armature and front contact. The stepping magnet 69 is now actuated either one step or ten steps depending as stated upon the digit dialed. When this digit has been dialed the circuits are prepared for the operation of the stepping magnet in accordance with the second digit. The pulsing circuit for the operation of stepping magnet 62 in accordance with the second digit is the same as described for the first digit. The dialing of this digit places the wipers of the code switch on the desired combination for transmitting the code signals. The wiper D' is the one that is placed on the desired code from ringing interrupter circuit that is connected in any well known manner to the terminals of this bank. The wiper of bank B' of this switch is placed on an open contact to prevent further stepping in case another digit is dialed. The wiper C' prepares a restoring circuit, the wiper A' closes pick-up circuits for relays 70 and 71 and wipers E_1 and F_2 close the start circuit for the interrupter. As soon as the ringing interrupter circuit is in position to begin a code signal, ground is supplied over the connected pick-up lead to operate relays 70 and 71. The circuit may be traced from battery, lower armature and back contact of relay 37, winding of relay 71, third lower armature and front contact of relay 40, wiper of bank C' and the ground on

the pick-up lead connected to this brush. The circuit for relay 70 originates from the same battery, winding of relay 70 and its make-before-break contacts, the fourth lower armature and front contact of relay 40, wiper of bank C' to ground. Relay 70 locks at its lower armature and front contact to ground at relay 27 and closes a circuit for the operation of relay 72 from battery, winding of this relay, upper inner armature and front contact of relay 70, wiper of bank D' to the ringing interrupter circuit over the particular terminal selected. Relay 72 is thus controlled by the ringing interrupter circuit operated and released in accordance with the code selected. That is the ringing interrupter may provide a ground on the terminal of bank D' interrupted in accordance with different codes. Each time relay 72 operates in accordance with the code, ringing current is supplied from the ringing current source at 75 over the line to the called party's bell. This ringing circuit may be traced from the ringing current generator at 75 over the two leads closed at the armatures and front contacts of relay 72, the upper outer and middle armatures and front contacts of relay 40, first terminals and wipers of banks J and K, upper outer and middle armatures and front contacts of relay 29 out over the tip and ring conductors to the called subscriber's telephone.

When the called subscriber answers, a simplex ground connection is placed on the line causing the operation of relay 73. As soon as relay 71 releases which takes place at the beginning of a code and as relay 71 is maintained released during the transmission of a code, relay 73 is operated whenever relay 72 is released during the transmission of a code. The circuit for relay 73 may be traced from battery, winding of this relay, armature and back contact of relay 71, armatures and back contacts of relay 72, to ground at the operator's telephone set. One of the purposes of relay 73 is to absorb the line charges caused by ringing. When relay 71 is operated between each code and the calling subscriber has answered, relay 37 will operate, that is during the so called silent period to prevent the tripping of the ringing during the transmission of a code. Relay 37 operates over the same circuit as relay 73 and in operating opens the holding circuit for relay 27 as well as the circuits for relays 71 and 70. Relay 70 releases and prevents further ringing by opening the circuit for relay 72. The release of relay 27 causes the release of the register circuit as hereinbefore described. During ringing part of the ringing current was by-passed through condenser 76 to give the calling subscriber an audible ring-back tone. When the register restores to normal relay 29 is also released to close the tip and ring conductors of the switch S through to the repeating coil 32 thus completing the transmission circuit and opening the register start circuit. Relay 29 also places a ground on the sleeve terminal to busy the called line as well as causing cut-off relay in the called subscriber's line to operate and relay 57 to be maintained operated.

The release of the connection is under the control of the calling party. When the calling party hangs up his receiver, relays 34 and 14 are released, relay 14 closing a circuit to the release magnet 78 on the line finder LF and the release magnet 67 of the switch S to cause the line finder and switch S to release. Relay 14 in releasing also opens the circuit for the cut-off relay of the called subscriber's line and for the relay 57 in the connector C. Relay 57 in releasing completes a circuit for the release magnet 66 from battery over the tip conductor to the ground applied at the inner right hand armature and back contact of relay 14. Magnet 66 locks to ground at the off normal contacts 56 until the connector C is released. It should be understood that the ground for the operation of release magnet 66 is applied before the ground for the release magnet 67 by the armatures of relay 14 so as to permit the connector to release first. Relay 30 in the switch S is released as the release of relay 14 and relay 15 is released on the release of the line finder by the opening of the off-normal contacts 20.

In case the calling subscriber fails to commence dialing of the called party or the called party does not answer within a predetermined time, or in case of a revertive call the connection is released. The means for accomplishing this is also located in the register R. In case of the subscriber failing to dial or of a revertive call, it will be noted that on the operation of relay 27 a circuit is completed for the thermostatic element 80 from battery through the winding of this element, the lower outer armatures and back contacts of relays 81 and 44, lower outer armature and front contact of relay 27 to ground. As the bimetallic thermostatic spring of element 80 heats to a certain temperature, it bends and gradually moves towards the front contact. When making this front contact relay 81 is operated from battery, winding of this relay, front contact of element 80 to the ground at relay 27. Relay 81 operates and locks under control of the lower armature and back contact of relay 44 and the ground at relay 27. Relay 81 in operating prepares a circuit for relay 10 in the line circuit from battery, winding of this relay, the P terminal and wiper of the line finder, first terminal and wiper of bank A, lower inner armature and front contact of relay 81, and since the circuit for the element 80 was opened by the operation of relay 81 the spring gradually cools off and returns slowly to normal. When it has returned to normal ground is connected to this circuit for relay 10 from relay 27. Relay 10 operates and locks at its upper armature and front contact to the simplex ground on the tip and ring conductors for the calling subscriber's line. Relay 10 also opens the circuit for relay 34 causing the release of the link and register to normal as hereinbefore described.

If the calling subscriber should commence dialing before the element 80 has fully operated and restored, the operation of relay 44 after the first digit is dialed will open the circuit for the relay 80. The locking circuit for relay 81 will be opened so that this relay will release and prevent the release circuit from operating.

The release due to delay caused by the called party not answering within a predetermined time operates as follows: Under this condition relay 70 is operated during ringing operations and closes a circuit for the element 80 at the upper outer armature and front contact. Relay 81 is then operated by the circuit closed by the spring of element 80. If the called party should answer during a ringing code, that is when relay 71 is released, relay 73 will operate and thus prevent the release of the connection by maintaining the element 80 in condition to prevent it from cooling off until relay 71 is again operated

to cause the release of the register as hereinbefore described.

If instead of calling lines 4 or 7, a trunk group is called leading to an operator's position O, when the wipers of the connector C land on the first trunk in this group and this trunk is busy, the ground on the P terminal causes the operation of relays 39 and 84 from battery through the winding of these relays in series, make-before-break contacts of relay 59, third lower armature and back contact of relay 38, lower armature and front contact of relay 36, upper inner armature and back contacts of relays 40, first terminal and wiper of bank H, the P terminals and wipers of switches S and C to ground; relay 39 opens the circuit of relay 65 so that this relay will not operate and prevent the release of relay 27. Relay 84 supplies interrupted ground from source 49 at its upper outer armature and front contact through the lower outer armature and front contact of relay 49, upper outer armature and back contact of relay 40, first terminal and wiper of bank J, second upper armature and front contact of relay 29 over the ring conductor of switch S, lower armature and back contact of relay 57, winding of the rotary magnet 63 to ground. This causes the operation of the rotary magnet 63 until an idle trunk line has been found. When the idle trunk is reached the circuit for relays 39 and 84 is opened to stop the stepping of the rotary magnet 63. The operation from this point on is the same as in connection with the calling of the local connection.

If a subscriber at a distant office is desired the third digit will bring the terminals of connector C on the first of a group of trunks leading to this office and if the first trunk is busy the relays 39 and 84 will operate the same as in hunting for an idle trunk to an operator. When an idle trunk is found this is indicated by a connection to ground through a resistance on the C lead. When this condition is reached relay 39 remains operated but relay 84 is released due to its marginal characteristics, thus stopping the stepping of magnet 63. The release of relay 84 closes a circuit for the operation of relay 37 from battery, winding of this relay, lower armature and back contact of relay 84, lower armature and front contact of relay 39 to ground. Relay 27 is thereby released and causes the release of the register R. To dial the subscriber at the distant office the calling subscriber will then dial an additional number to operate the connector C—2. The pulses will in this case be repeated in simplex over the tip and ring conductors of the switches S and C and the selected trunk, as the operation of relay 34 closes such a connection from battery at its inner right-hand armature and front contacts.

While the invention has only been shown and described in connection with a single disclosure, it should be understood that it could readily be applied to other systems without departing from the spirit thereof.

What is claimed is:

1. In a telephone system, a calling subscriber's line having an impulse transmitter, a plurality of link circuits accessible to said calling lines, a register common to said links, means responsive to the calling subscriber removing his receiver from the switchhook for seizing an idle link circuit and the register, said register being responsive to said impulse transmitter, means in said register for releasing said link and register a certain interval after seizure if the calling subscriber fails to operate said transmitter, means in said register responsive to impulses received from the calling line for selecting different ringing code signals, and means in said register responsive to impulses from the calling line for transmitting corresponding impulses over the selected link to control selections beyond.

2. In a telephone system, a calling subscriber's line, a plurality of link circuits including a line finder and a selector, a register common to a plurality of links, means responsive to the calling subscriber removing his receiver from the switchhook for actuating the line finder of an idle link to connect said link to the calling line and to associate the register with said link, means in said register operative a certain interval after the seizure of the idle link for releasing if from the line of no further actions are taken by the calling subscriber toward the establishing of a connection beyond, means in said register responsive to the reception of impulses from the calling subscriber's line for controlling the selector of the seized link to establish connections beyond, and means in said register thereafter responsive to impulses received from the calling subscriber's line for selecting a ringing code signal for transmission over the established connection beyond.

3. In a telephone system, a calling subscriber's line, a called subscriber's line, a plurality of link circuits including a line finder and a selector, connectors accessible by said selector and having access to called subscriber's lines, means responsive to the calling subscriber removing his receiver from the switchhook for actuating the line finder of an idle link to connect said link to the calling subscriber's line and to associate the register with said link, means in said register responsive to the reception of series of impulses from the calling subscriber's line for controlling the selector of the seized link to extend the connection from the calling subscriber's line to an idle connector and for controlling the seized connector to extend the connection to a desired called subscriber's line, means in said register thereafter responsive to impulses received from the calling subscriber's line for selecting a ringing code signal and for transmitting the selected signal to the connected called subscriber's line, and means in said register for releasing a partially established connection to a called subscriber's line after a certain time interval provided no further actions are taken toward the completion of the connection by the calling subscriber within said time interval.

4. A calling subscriber's line, a called line, a plurality of link circuits, a register common to said links, means operative when the calling subscriber removes his receiver from the switchhook for seizing an idle link and the register, means for extending a connection between the seized link and the called line, means in said register for releasing the seized link and the register a certain interval after the calling subscriber has removed his receiver from the switchhook if no further actions are taken on the part of the calling subscriber toward the extending of the connection, means in said register responsive to current impulses received from the calling subscriber's line for controlling the establishing of a connection between the seized link and the called line, means in said register responsive to the current impulses from the calling subscriber's line for selecting ringing code signals, and means in said register responsive on the completion of the selection of a ringing code signal for transmitting the selected signal to said called line.

5. In a telephone system, a calling subscriber's

line, a called subscriber's line, a plurality of link circuits, a register common to said link circuits, means responsive to the calling subscriber removing his receiver from the switchhook for seizing an idle link and the register, switches, means in said register responsive to impulses from the calling subscriber's line controlling the setting of said switches to extend a connection from the seized link to the called subscriber's line, an auxiliary switch in said register responsive to impulses received from the calling subscriber's line for selecting different types of ringing code signals, means responsive on the completion of the selection of a ringing code signal for transmitting the selected signal to the called subscriber's line and means in said register for releasing said register a certain interval after the calling subscriber removes his receiver from the switchhook operative if no impulses have been received within this interval for controlling the setting of said switches.

6. In a telephone system, a calling subscriber's line, a plurality of link circuits accessible to said calling line, single lines, party lines, groups of trunks, a register common to said links, means responsive to the calling subscriber removing his receiver from the switchhook for seizing an idle link and the register, a switch connected to each link, other switches accessible by said first switch and having access to said party lines, individual lines and groups of trunks, means in said register responsive to impulses from the calling line for transmitting corresponding impulses over the selected link to control the associated switch to select an idle one of said other switches and to thereafter control the said selected second mentioned switch to select a party line, a single line, or a group of trunks, and if a group of trunks has been selected to hunt for an idle trunk in said selected group of trunks, means in said register thereafter responsive to impulses received from the calling line if an idle trunk has been found for transmitting impulses in simplex over said trunk, means in said register responsive to impulses received from the calling line for selecting different codes of ringing signals if a single or a party line has been selected, and means in said register for releasing a partially established connection to a single line, a party line or a trunk after a certain interval provided no further actions are taken by the calling subscriber towards the completion of the connection within said interval.

J. G. POPE.