

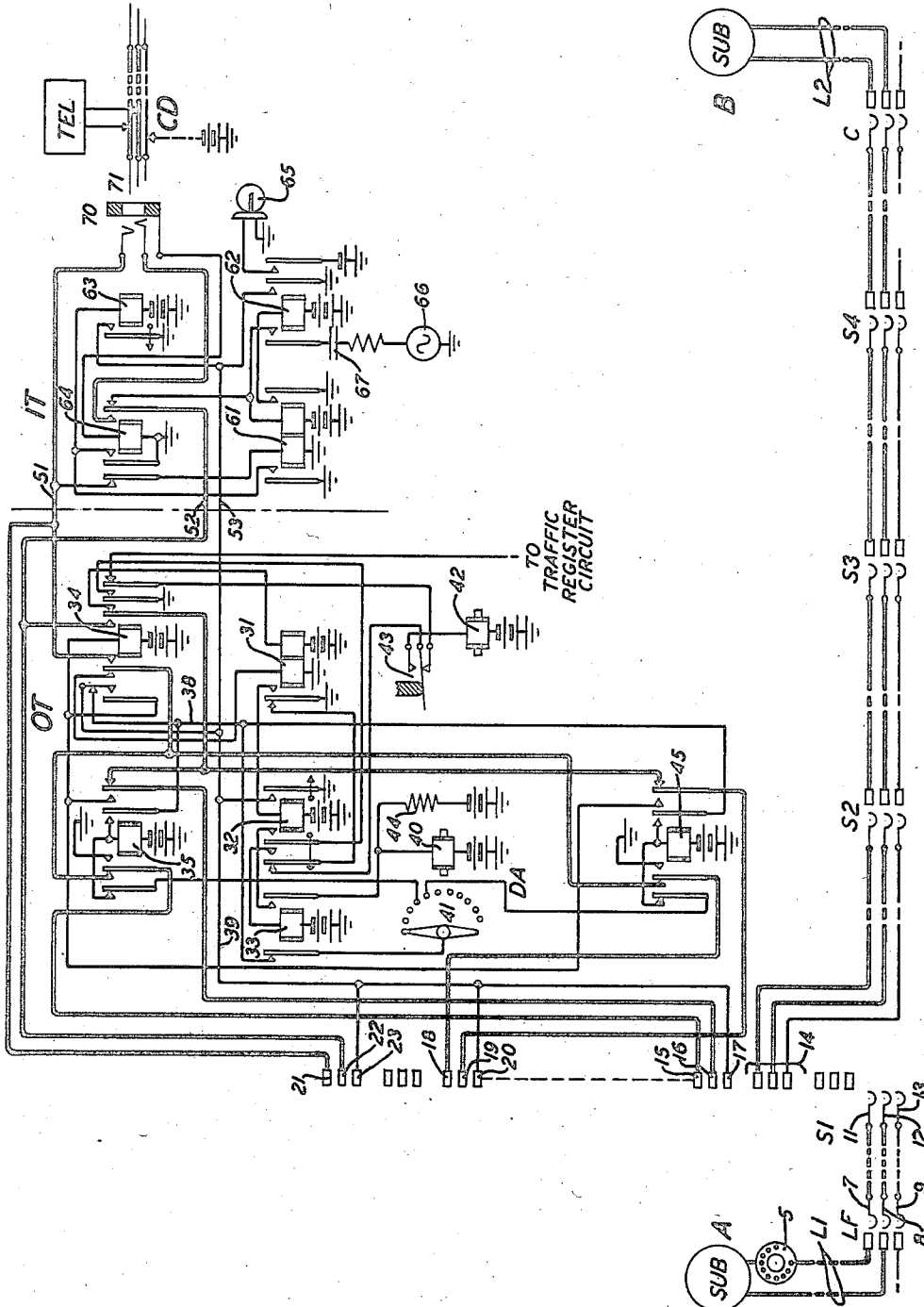
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and more particularly to dial telephone systems.

The object of the invention is to provide an improved and economical trunking arrangement for dial systems in which the numbering system is such as to require the absorbing of a varying number of dialed digits.

According to one feature of this invention, a trunk circuit selectable through more than one level of a selector switch is provided with an auxiliary switch operative in response to incoming impulses, and is arranged to further extend the connection after absorbing a varying number of digits dependent upon the level through which the trunk is seized.

A further feature of the invention is the arrangement of a digit absorbing trunk circuit to render the further extension of the connection, after receipt of the required number of digits, dependent upon the continued closure of the calling line loop.

The drawing which forms a part of this specification represents in schematic form a telephone system in which the features of this invention are incorporated.

Referring to the drawing, A represents a calling subscriber's station; LF represents a line-finder having access to a group of lines including the line L1 of station A; S1 represents a first selector permanently associated with the line-finder LF; S2, S3, and S4 represent respectively second, third and fourth selectors; and C represents a connector having access to a group of lines represented by the line L2 of the subscriber's station B. OT represents an outgoing trunk circuit connected to terminals in each of the third, eighth and tenth levels of the bank of selector S1 and arranged for absorbing a variable number of digits depending upon the level through which it is seized. IT represents a jack ended incoming trunk circuit permanently connected over the trunk conductors 51, 52 and 53 to the outgoing trunk circuit OT and also to a set of terminals in the tenth or "O" level of selector S1. CD represents one of a group of common battery cord circuits common to the operator's position at which the trunk IT terminates.

The subscribers' numbers in this system are four, five and six digit numbers. Calls to lines having numbers comprising six digits are completed through the second level of the bank of the first selectors or other levels giving access to second selectors such as S2. Calls to lines having numbers comprising four digits are extended through the third level of the banks of the first

selectors to digit-absorbing trunks such as OT, the first digit of these numbers being 3. Calls to lines having numbers comprising five digits are extended through the eighth level of the banks of first selectors to the same digit-absorbing trunks, the first digit of these numbers being 8.

The equipment at station A is of the type usually employed in automatic telephone systems and includes a dial 5. The switches LF, S1, S2, S3, S4 and C may all be of the well-known step-by-step two-motion type. For a detailed description of the construction and operation of selector and connector switches of this type, reference may be had to pages 53 to 65, inclusive of the 2nd edition of "Automatic Telephony" by Smith and Campbell published in 1921. The line-finder may be similar to that described in the patent to H. Hovland 1,711,682, granted May 7, 1929. Each of the selector and connector switches is represented in the drawing by a set of brushes and one or more sets of terminals, all of the operating magnets and associated relay equipment being omitted.

The outgoing trunk circuit OT includes the line relay 31, release relay 32, auxiliary relays 33 and 34, and a rotary step-by-step switch DA comprising the stepping magnet 40, brush 41 and associated bank of terminals, the release magnet 42 and the off-normal contacts 43. The trunk circuit is connected to terminals 15, 16 and 17 in the third level of selector S1, to terminals 18, 19 and 20 in the eighth level, and to terminals 21, 22 and 23 in the tenth level. The trunk circuit OT also includes a relay 35 associated with the terminals 15, 16 and 17 and a relay 45 associated with the terminals 18, 19 and 20.

The incoming trunk circuit IT comprises the line relay 61, release relay 62, sleeve relay 64 and an auxiliary relay 63 and terminates at the jack 79 of an operator's position which is represented by the cord CD.

Upon origination of a call at station A the line L1 is extended by the operation of a line-finder such as LF to an associated first selector S1. In response to the dialing of the first digit of a called subscriber's number, the connection is further extended by the operation of the first selector S1 through its brushes 11, 12 and 13 and an idle set of terminals in the level corresponding to the digit dialed. If the terminals in the selected level are connected to second selectors, the dialing of the remaining digits of the called number causes the selective extension of the connection through second, third and fourth selectors and a connector switch to the line of the

called subscriber. To illustrate such a connection, the terminals 14 representing the second level of the bank of selector S1 are shown connected to the second selector S2. The third and fourth selectors and the connector through which such a call is completed are represented by S3, S4 and C; the called line and station are represented by L2 and B.

If the digit dialed is 0, the brushes 11, 12 and 13 are advanced into engagement with an idle set of terminals in the tenth level. The terminals 21, 22 and 23 represent such a set, the connection from line L1 being extended directly over trunk conductors 51 and 52 through the outer back contacts of relay 64 of the incoming trunk circuit IT, through the windings of line relay 61 to ground and battery. Relay 61 is thereby operated, closing obvious circuits for causing the operation of relays 62 and 63. Relay 62 connects a holding ground over the sleeve conductor 53 and through terminal 23 to hold the selector S1 and line-finder LF in the usual manner. Relay 62 also lights the answering lamp 65 associated with jack 70 and connects the ringing source 66 through condenser 67 and the left front contact of relay 62 to conductor 52 to transmit an audible ringing signal to the calling subscriber. Relay 63 also connects ground to the sleeve conductor 53. When the answering plug of an operator's cord such as CD is inserted in the jack 70 to answer the call, the relay 64 is operated, thereby disconnecting the windings of relay 61 from the conductors 51 and 52. Relay 61 and 62 release, thereby extinguishing the lamp 65. Relay 64 also closes a circuit for holding relay 63 until the plug 71 is removed from jack 70. Talking current is supplied to the calling station from the operator's cord CD. When the calling subscriber replaces the receiver on the receiver hook and the operator removes the plug 71 from jack 70, the successive release of relays 64 and 63 disconnects the holding ground from conductor 53, thereby causing the return of switches S1 and LF to normal in the usual manner.

If the first digit dialed is 3, the brushes 11, 12 and 13 of selector S1 are advanced into engagement with an idle set of terminals in the third level. The terminals 15, 16 and 17 represent such a set, the connection from line L1 being, in this case, extended through the left inner and right back contacts of relay 35, through the inner back contacts of relay 34, and through the windings of line relay 31 of the outgoing trunk circuit OT to ground and battery. The operation of relay 31 closes an obvious circuit for operating relay 32; and relay 32 connects ground through its right front contact over sleeve conductor 39 to terminal 17 to hold the selector S1 and line-finder LF in well-known manner. The first digit having been 3, the number is a four digit number and it is necessary to absorb the last three digits. When the second digit is dialed by the calling subscriber, the line relay 31 releases and reoperates in response to each of the dial impulses thus created. The release of relay 31 in response to the first impulse of the train closes a circuit for operating relay 33, this circuit being traced from battery through the winding of relay 33, through the outer left front contact of relay 32 to ground at the back contact of relay 31. Being slow in releasing, relay 32 does not release during the receipt of impulses by relay 31. Relay 33 is also slow to release and remains operated until after the last impulse of a train has been received. The operation of relay 33 closes a circuit from

battery through the winding of stepping magnet 40 of switch DA, in parallel with the resistance 44, through the front contact of relay 33 and inner left front contact of relay 32, to ground at the middle right back contact of relay 34. When relay 33 releases, after all of the impulses created by the dialing of the second digit have been received, magnet 40 releases. The operation of magnet 40 advances the brush 41 from normal into engagement with the first off-normal terminal of its bank. When the third digit is dialed relays 31 and 33 and magnet 40 operate in like manner to advance the brush 41 into engagement with the second off-normal terminal; the dialing of the fourth digit causes the advance of brush 41 into engagement with the third off-normal terminal of its bank. The release of relay 33 after all of the impulses corresponding to the fourth and last digit have been received closes a circuit from battery through the winding and outer left back contact of relay 35, third off-normal terminal and brush 41 of switch DA, back contact of relay 33, conductor 39, back contact of the continuity springs of relay 34, and over conductor 39 to ground at release relay 32. Relay 35 locks through its inner right front contact, over conductors 38 and 39 to the same ground. The operation of relay 35 disconnects the windings of relay 31 from the line L1 and closes a circuit from battery through the winding of relay 34, outer right front contact of relay 35 through terminal 16 and brush 12 of selector S1, brush 8 of line-finder LF, over line L1 and through the telephone at station A, back through brush 7 of line-finder LF, brush 11 and terminal 15 of selector S1, and through the left front contact of relay 35 to ground. Relay 34 is thereby operated unless the calling subscriber has replaced the receiver on the receiver hook immediately after dialing the fourth digit. Relay 34 closes a locking circuit through the front contact of its continuity springs to ground at the right front contact of relay 32.

With relay 34 operated, relay 35 releases whereby the connection from line L1 is extended from terminals 15 and 16, through the left inner and right back contacts of relay 35, the inner front contacts of relay 34, over trunk conductors 51 and 52, through the outer back contacts of relay 64 of the incoming trunk circuit IT, to the windings of the line relay 61. The operation of relay 61 causes the connection of a holding ground to sleeve conductor 53 and the lighting of the answering lamp 65 as hereinbefore described.

The release of relay 31, due to the operation of relay 35 and the subsequent operation of relay 34, opens the circuit for energizing relay 32, but relay 32 is slow in releasing so that holding ground is connected to conductor 53 in the incoming trunk circuit IT before relay 32 disconnects ground from conductor 39. The switching relay 34 is, therefore, held operated under the control of release relay 62 of the incoming trunk circuit IT until the operator answers the call and is thereafter held operated under the control of relays 63 and 64 until the connection is released by the operator.

The release of relay 32, upon extension of the connection to the incoming trunk circuit IT or upon failure of relay 34 to operate due to the abandonment of the call by the calling subscriber, closes a circuit from battery through the winding of release magnet 42 of switch DA, upper contact of the off-normal springs 43, through the back contact of relay 32, to ground at the back contact of relay 31. The operation of magnet 42 restores

the brush 41 of switch DA to normal at which time the circuit through the winding of magnet 42 is opened at the off-normal springs 43.

If the first digit dialed is 8, the brushes 11, 12 and 13 of selector S1 are advanced into engagement with an idle set of terminals in the eighth level. The terminals 18, 19 and 20 represent such a set of terminals, the connection from line L1 being, in this case, extended through the left inner and right back contacts of relay 45, thence through the inner back contacts of relay 34, and through the windings of line relay 31 of the outgoing trunk circuit OT to ground and battery. Relay 31 operates closing the circuit for operating relay 32. The first digit of the called number being 8, the number is a five digit number and it is necessary to absorb four digits. The switch DA is thus advanced one step in response to the impulse for each of the last four digits dialed. When the brush 41 engages the third off-normal terminal at the end of the impulses created by the dialing of the fourth digit, relay 35 operates as hereinbefore described, but relay 34 cannot operate since in this case the brushes 11 and 12 of selector S1 are in contact with terminals 18 and 19 instead of terminals 15 and 16 so that the calling line L1 is connected to the windings of line relay 31 through the contacts of relay 45 and not through the contacts of relay 35. As soon as the fourth and last digit is dialed, the operation of relay 33 and advance of brush 41 from the third off-normal terminal causes the release of relay 35, and when relay 33 releases after the last impulse a circuit is closed through brush 41 and the fourth off-normal terminal for operating relay 45. Relay 45 locks through its inner right front contact and the back contact of the continuity springs of relay 34 to the holding ground on conductor 39. The operation of relay 45 disconnects the windings of relay 31 from the line L1 and closes a circuit from battery through the winding of relay 34, outer right front contact of relay 45, through terminal 19 and brush 12 of selector S1, brush 8 of line-finder LF, over line L1 and through the telephone at station A, back through brush 7 of line-finder LF, brush 11 and terminal 18 of selector S1, and through the left front contact of relay 45 to ground. Relay 34 is thereby operated to release relay 45 and thus extend the connection from line L1 to the line relay 31 of the incoming trunk circuit IT. The answering lamp lights, the call is answered and the switch DA is returned to normal as hereinbefore described.

Should it be necessary to absorb a different number of digits, another relay similar to relays 35 and 45 would be provided, there being one such relay for each of the different number of digits which it is necessary to absorb. It is of course understood that the invention is not limited to the particular arrangement shown in the drawing, and that the arrangement might be such as to absorb any one of a plurality of different number of digits when the digit absorbing trunk circuit is seized through a particular level or any one of a plurality of particular levels.

What is claimed is:

1. In a telephone system, a trunk circuit, a plurality of branches incoming to said trunk circuit, trunk conductors outgoing from said trunk circuit, means for seizing said trunk circuit over any one of said plurality of incoming branches, impulse receiving means in said trunk circuit, switching means for connecting said incoming branches to said outgoing conductors, and means

for rendering said switching means operatively effective after a required plurality of series of impulses have been received, the required plurality of series of impulses varying in accordance with the particular branch over which said trunk circuit is seized.

2. In a telephone system, a digit absorbing trunk circuit, a plurality of paths over which said trunk circuit may be seized for use, a rotary switch, means for advancing said switch in response to the receipt of impulses corresponding to the digits to be absorbed, one step for each digit, an outgoing trunk line, and means operative in varying positions of said switch for extending the path over which said trunk circuit is seized to said outgoing trunk line.

3. In a telephone system, a calling line, an impulse sender for said line, a digit absorbing trunk circuit, means for extending said calling line to said trunk circuit, an outgoing trunk, switching means rendered operative in response to the receipt of impulses corresponding to a certain number of digits for further extending said line to said outgoing trunk, and a circuit including the calling line for operating said switching means.

4. In a telephone system, a line, an impulse sender for said line, a selector comprising a set of wipers and a plurality of groups of terminals, means for connecting said line to said selector, a trunk circuit connected to terminals in a plurality of said groups, means responsive to a series of impulses created by the operation of said sender for operating said selector to seize the terminals of said trunk circuit in the group corresponding to the number of impulses in said series, means associated with said trunk circuit for receiving trains of impulses created by the operation of said sender, a switch, means for advancing said switch one step for each train of impulses incoming to said trunk circuit, outgoing trunk conductors, and switching means for extending the connection from said line to said conductors, said switching means being rendered operatively effective in a plurality of off-normal positions of said switch, the particular position in which said switching means is rendered effective depending upon the particular one of said groups of selector terminals through which said trunk circuit is seized.

5. In a telephone system, a line, means for transmitting current impulses over said line, a selector comprising a set of wipers and a bank of terminals, the terminals being arranged in groups, means for connecting said line to said selector, a trunk circuit connected to terminals in a plurality of said groups, means responsive to a series of impulses created by the operation of said impulse sender for operating said selector to seize the terminals of said trunk circuit in a group corresponding to the number of impulses in said series, outgoing trunk conductors, and switching means in said trunk circuit operative in response to the receipt of a varying plurality of series of impulses from said sender for extending the connection from said line to said trunk conductors, the required plurality of series of impulses being dependent upon the particular group of selector terminals through which said trunk circuit is seized.

6. In a telephone system, a calling line, an impulse sender for said line, a trunk, impulse receiving means individual to said trunk, means for connecting said line with said impulse receiving means, a register controlled by said impulse re-

ceiving means to register the number of series of impulses received, electromagnetic means for extending the connection from said calling line to the conductors of said trunk, and a circuit controlled by said register and including said calling line for operating said electromagnetic means.

7. In a telephone system, a calling line, an impulse sender for said line, a trunk, impulse receiving means individual to said trunk, means for connecting said line with said impulse receiving means, a rotary switch controlled by said impulse receiving means to register the number of series of impulses received, a test relay, and means rendered effective when the register switch is set in a particular position for disconnecting the calling line from said impulse receiving means and for connecting said line to the winding of said test relay, the operation of said test relay being effective to extend the connection from said line to the conductors of said trunk.

8. In a telephone system, a calling line, an impulse sender for said line, a trunk, impulse receiving means for said trunk, a selector comprising a set of wipers and a plurality of groups of terminals, said impulse receiving means being

connected to terminals in a plurality of said groups, means for connecting said line to said selector, means responsive to a series of impulses created by the operation of said impulse sender for operating said selector to extend the calling line through the terminals in the group corresponding to the number of impulses in said series to said impulse receiving means, a rotary switch controlled by said impulse receiving means for registering the number of series of impulses received, a switching relay for use in extending the connection from said calling line through the terminals in any one of said groups to the conductors of said trunk, other relays, each of said other relays for use in extending the connection from said calling line through the terminals in a different one of said groups to said impulse receiving means, circuits for operating said other relays, the operating circuit for each of said other relays being closed by said register switch in response to a different number of series of impulses, and an operating circuit for said switching relay including the calling line and contacts of any one of said other relays.

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