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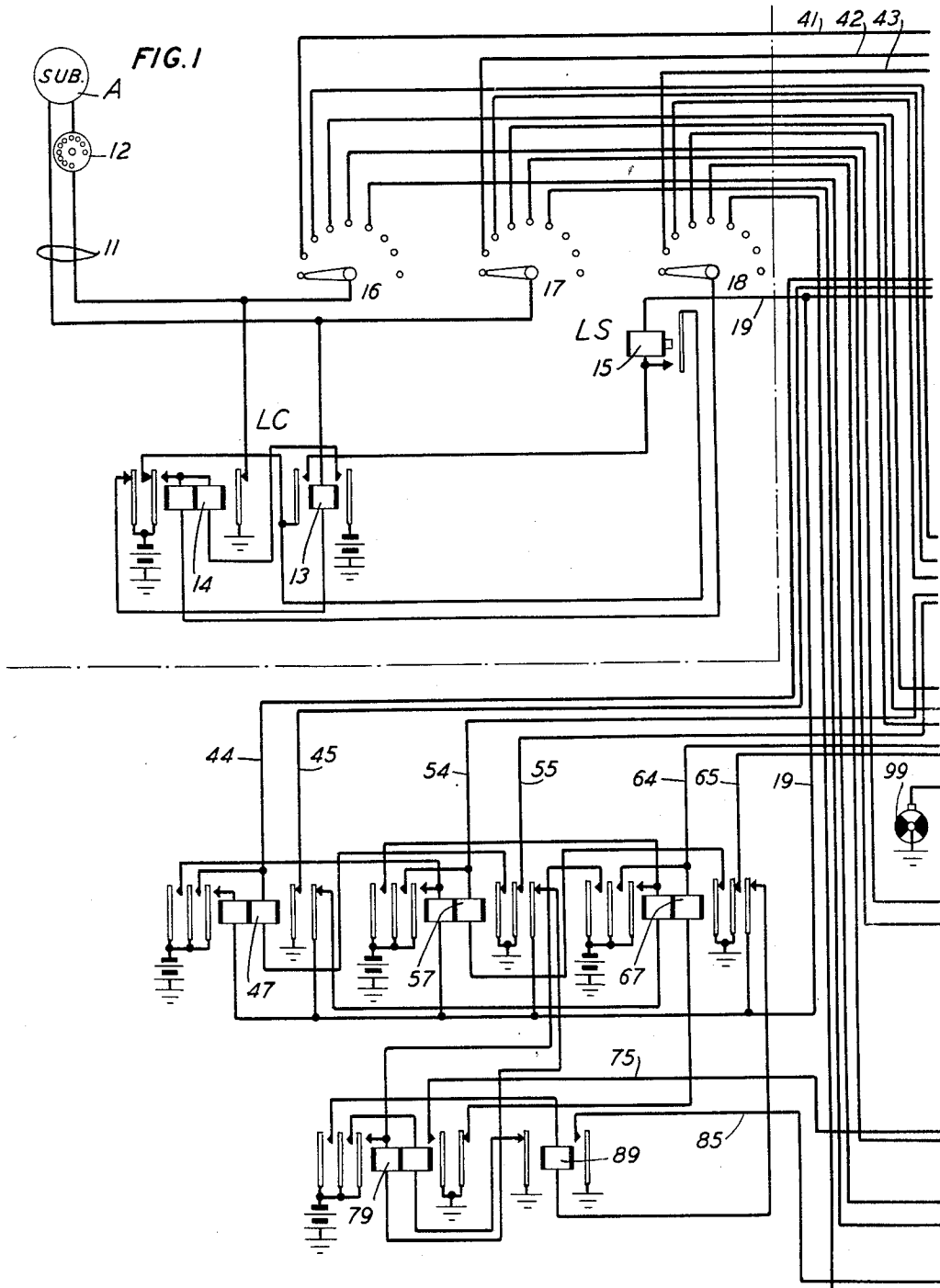
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1,934,402

TELEPHONE SYSTEM

Filed Oct. 30, 1931

2 Sheets-Sheet 1



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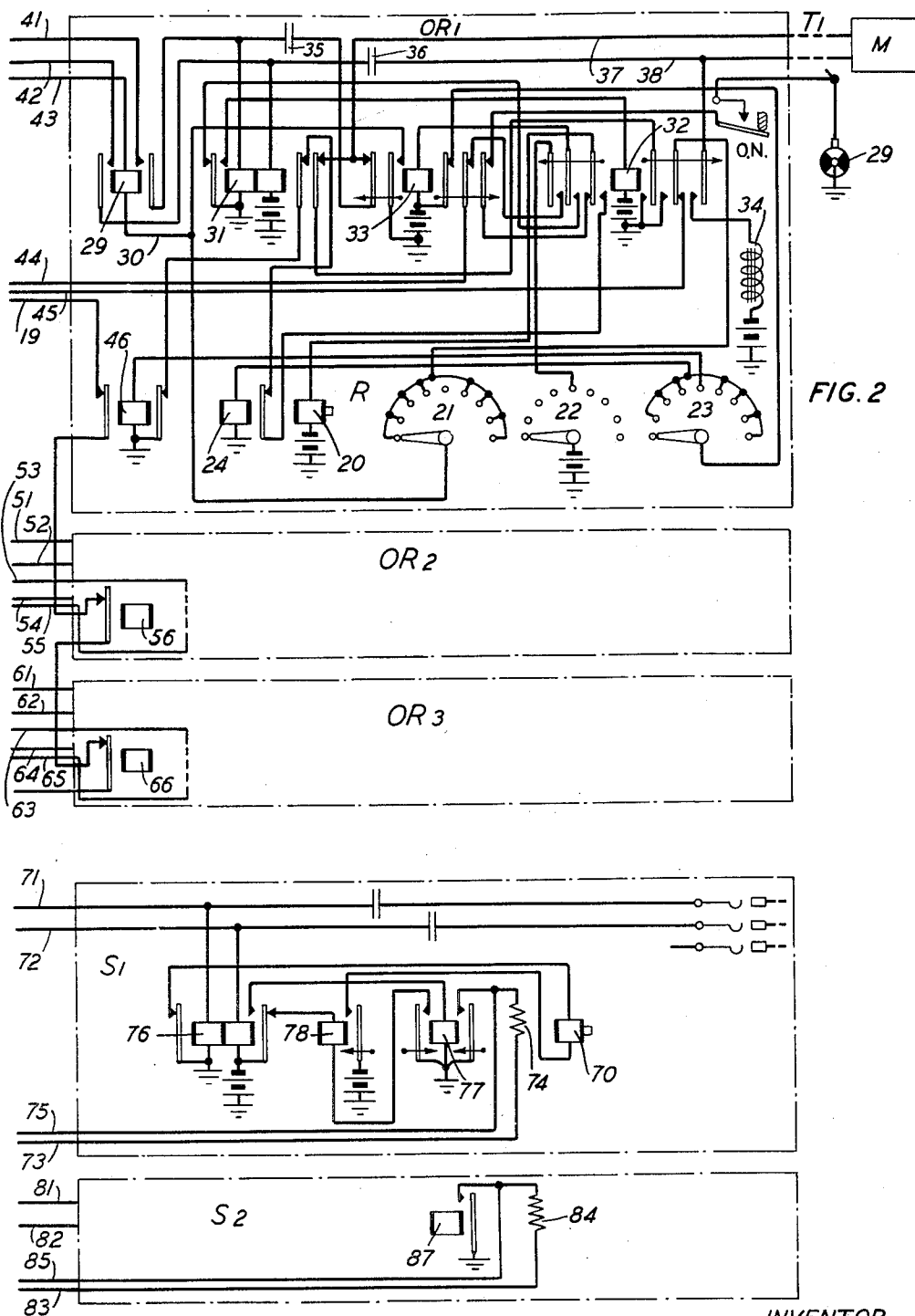
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## UNITED STATES PATENT OFFICE

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## TELEPHONE SYSTEM

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and in Austria January 22, 1931

9 Claims. (Cl. 179-18)

This invention relates to telephone exchange systems, and more particularly to automatic telephone systems comprising a main office and one or more branch offices.

5 The object of this invention is to simplify and minimize the automatic switching equipments used in an automatic branch office.

The invention is a subscriber's line-switch in a branch office having direct access to outgoing trunks leading to a main office and to local trunks. According to one feature of the invention, such a switch is arranged to automatically select an idle trunk to the main office in response to the removal of the receiver at the subscriber's station.

According to another feature of the invention, a branch office subscriber's line-switch which is arranged to select an idle outgoing trunk to the main office in response to the initiation of a call, is also arranged to release the outgoing trunk and to select an idle local trunk in response to the dialing of one or more digits which indicate that the call is to be completed locally.

According to a further feature of this invention, a branch office subscriber's line-switch which is arranged to select an idle outgoing trunk to the main office in response to the initiation of a call, is provided with auxiliary equipment for responding to one or more digits dialed by the calling subscriber, the auxiliary equipment being arranged to cause the release of the trunk to the main office and the reoperation of the line-switch to select an idle local trunk in case the call is one which is to be completed locally.

35 An automatic telephone system comprising a main office and a branch office arranged in accordance with this invention is disclosed in the drawing which consists of two figures.

Fig. 1 schematically represents a telephone subscriber's station A and line 11, line circuit LC, and the line-switch LS all located in a branch office.

Fig. 2 schematically represents three outgoing repeater circuits OR1, OR2 and OR3 in the branch office, a trunk T1 from the local office to the main office M, and two local selectors S1 and S2 located in the branch office.

The subscriber's station A is equipped with the usual common-battery telephone set including a dialing device 12 for use in establishing desired connections. The line circuit LC includes the line relay 13 and the cut-off relay 14. The line-switch LS is a rotary step-by-step switch comprising the stepping magnet 15, the brushes 16, 17 and 18 and the corresponding banks of terminals. The terminals of the banks 16, 17 and 18 are divided into two groups; the terminals of one group are connected to outgoing-trunk repeaters for use in completing calls to and through the main office, and the terminals of the other group

are connected to local selectors for use in completing local calls. The line-switch has no normal position.

The outgoing-trunk repeaters OR1, OR2 and OR3 are connected to terminals 2, 3 and 4 of banks 16, 17 and 18 and to corresponding terminals in the banks of other line-switches similar to LS. The repeater OR1 is shown in detail but the repeaters OR2 and OR3 are represented by the broken-line enclosures. Each of these repeaters is arranged to receive dial impulses incoming over a calling subscriber's line and repeat these impulses over an associated outgoing trunk to the main office. Each repeater is further arranged to register the digit or digits which indicate whether the call is a local or an interoffice call. In the repeater OR1, the register switch R comprises the brushes and banks 21, 22 and 23 and the stepping magnet 20, and is adapted to register the first digit dialed by a calling subscriber. The brushes of switch R are shown in their normal position and the terminals of banks 21, 22 and 23 are connected so that the digit 4 indicates that the call is a local call.

The local selectors S1 and S2 are connected to terminals 5 and 6 of banks 16, 17 and 18 of line-switch LS and to corresponding terminals in the banks of other line-switches. As much of selector S1 is shown as is required in describing this invention; the selector S2 is represented by the broken-line enclosure.

When the subscriber at station A removes the receiver from the receiver-hook to originate a call, the line relay 13 operates in an obvious circuit. Relay 13 closes a circuit from battery at the inner left back contact of relay 14, through the left contact of relay 13, through the winding of stepping magnet 15, over conductor 19, through the back contacts of relays 46, 56 and 63 and through interrupter 99, to ground. Magnet 15 closes its contacts to render its energizing circuit independent of the continued operation of relay 13. Magnet 15 releases when the interrupter opens the connection from conductor 19 to ground, the operation and release of magnet 15 being effective to advance the brushes 16, 17 and 18 one step. The magnet 15 continues to operate and release under the control of interrupter 99 until the brushes reach a set of terminals connected to an idle outgoing-trunk repeater, at which time the cut-off relay 14 operates to prevent further operation of magnet 15. Assuming that the repeater OR1 is the first idle repeater, the circuit for operating relay 14 may be traced from battery at the right contacts of relay 13, through the windings of relay 14, brush 18 and terminal 2, conductor 43, winding of relay 29, conductor 30, brush 21 and normal terminal, right back contact of relay 32, over conductor 45, to ground at the inner back contact of relay 47.

Relay 14 locks through its left winding and front contact and opens the connection from battery to the winding of line relay 13. Relay 29 also operates in the above described circuit over conductor 43, thereby extending the line 11 through brushes 16 and 17, over conductors 41 and 42, and through the front contacts of relay 29 to the windings of line relay 31 of the repeater OR1. Relay 31 closes an obvious circuit for operating relay 32. Relay 32 connects battery through retard coil 34 and the outer right front contact of relay 32, to conductor 38 of the associated outgoing trunk T1. With relay 32 operated, the circuit for energizing relay 14 and relay 29 is traced from conductor 39 through brush 21 and the normal terminal, to ground at the middle right front contact of relay 32.

When the calling subscriber dials the first digit of the number of the subscriber with whose station connection is desired, relay 31 is alternately released and reoperated in response to the current impulses created by the operation of the dial. The release of relay 31 closes a circuit for operating relay 33, this circuit being traced from battery through the winding of relay 33, middle left front contact of relay 32, to ground at the left back contact of relay 31. With relay 31 released, ground is connected from inner right front contact of relay 32, through the outer right back contact of relay 31 to conductor 37 thereby transmitting a current impulse over this conductor of trunk T1 to the main office. Relay 33 connects a holding ground to conductor 30 which is independent of the position of brush 21 and disconnects conductor 37 from talking condenser 35. With relay 31 released and relay 33 operated, a circuit is closed for operating stepping magnet 20 of the register switch R; this circuit may be traced from battery through the winding of magnet 20, inner left front contact of relay 32, back contact of relay 24, inner right back contact of relay 31, to ground at the right back contact of relay 46. Magnet 20 thus advances brushes 21, 22 and 23 to the first off-normal terminal of their banks. The reoperation of relay 31 causes the release of magnet 20 and disconnects the ground from conductor 37. Each succeeding release and reoperation of line relay 31 is effective to cause this ground to be connected to and disconnected from conductor 37 to repeat the impulses over trunk T1 to the main office M. Each succeeding release and reoperation of line relay 31 is also effective to cause the reoperation and release of stepping magnet 20, thereby advancing the register switch brushes to a position which corresponds to the first digit dialed. Relay 32 is slow in releasing so that it does not release during the receipt of dial impulses and relay 33 is also slow in releasing so that it does not release until all of the impulses in a train have been received.

If the call is one completed through the main office, the first digit dialed may be any other than the digit 4, in which case the release of relay 33, after all of this train of impulses have been received, is effective to close a circuit for operating relay 24; this circuit is traced from ground, through the winding of relay 24, through one of the off-normal terminals and brush of bank 23 excepting the fourth off-normal terminal, to battery at the inner right back contact of relay 33. The operation of relay 24 prevents the impulses created by the dialing of the succeeding digits of the called subscriber's number from causing the further operation of register switch R, these

impulses being repeated over conductor 37 of trunk T1 to the main office in the same manner that the impulses of the first digit were repeated. When the receiver is replaced on the receiver-hook at station A to release the connection, relays 31, 32 and 29 release in the order named. Relay 14 is also released to reconnect the line relay 13 to the line 11.

If the called station is located in the same branch office as the calling station, the first digit dialed is the digit 4, in which case the ground at the middle right front contact of relay 32 is no longer connected to conductor 36 since the fourth off-normal terminal of bank 21 is not connected to the other terminals of this bank. When relay 33 releases, after all of the impulses for this digit have been received, the ground at its inner left front contact is also disconnected from conductor 30 so that relays 29 and 14 release. The release of relay 29 disconnects line 1 from relay 31 so that relay 31 releases. The release of relay 33 is also effective to close a circuit for operating relay 46; this circuit is traced from ground, through the winding of relay 46, and through the fourth off-normal terminal and brush of bank 23, to ground at the inner right back contact of relay 33. Relay 46 opens the operating circuit for magnet 20 so that the release of relay 31 will be ineffective to cause the register switch R to be advanced out of the fourth off-normal position until the slow-to-release relay 32 has also released. Relay 46 also disconnects conductor 19 from the interrupter 99 to prevent the further advance of line-switch LS until the register switch has advanced beyond the fourth off-normal position. The aforementioned release of relay 33 is also effective to close a circuit from battery through the brush and fourth off-normal terminal of bank 22, the outer left front contact of relay 32 (prior to the release of relay 32), the middle right back contact of relay 33, over conductor 44, through the right winding of relay 47, to ground at the inner right back contact of relay 57. Relay 47 operates in this circuit and locks in a circuit from battery through its middle left front contact and right winding to the same ground. With relay 47 operated, ground is disconnected from conductor 45 to prevent the re-seizure of repeater OR1. When the slow-to-release relay 32 releases, the connection from battery through retard coil 34 to conductor 38 is opened to release the equipment in the main office M, and the register switch R is advanced to normal under the control of interrupter 29; the circuit for successively operating the stepping magnet 20 is traced from battery through its winding, the left back contact of relay 32, the outer right back contact of relay 33, through the contacts of the off-normal springs ON to ground through the interrupter 29. When the brushes of switch R reach their normal position, the off-normal springs ON resume their normal position thereby preventing the further operation of magnet 20. Relay 46 releases when the brushes are advanced from the fourth off-normal terminal.

The aforementioned release of relay 14 reconnects the winding of line relay 13 to the line 11 and relay 13 reoperates; but the circuit for operating the stepping magnet 15 is held open at the left contacts of relay 46 until this relay releases. When relay 46 releases, and with relay 13 reoperated, the stepping magnet 15 of line switch LS is again operated under the control of interrupter 99. As soon as interrupter 99 connects ground to conductor 19, after relay 46 releases, these

relay 57 is operated in a circuit traced from battery at the outer left front contact of relay 47, through the left winding of relay 57, to ground on conductor 19. Relay 57 locks in a circuit from battery through its middle right front contact and right winding to ground at the inner right back contact of relay 67. The operation of relay 57 opens the locking circuit through the right winding of relay 47, but relay 47 remains operated in a circuit from battery through its inner left front contact and left winding to the ground on conductor 19 until this ground connection is opened by interrupter 99. Since the ground normally connected to conductor 55 has been disconnected from this conductor by the operation of relay 57 before brushes 16, 17 and 18 engage the terminals connected to repeater OR2, relay 14 cannot operate over test conductor 53 to stop the line-switch on these terminals. In this manner, the line-switch is advanced to engage conductors 51, 52 and 53 leading to repeater OR2, relay 47 being released to permit the seizure of repeater OR1 on another connection, and relay 57 being operated to prevent the seizure of repeater OR2.

When the interrupter 99 again connects ground to conductor 19, magnet 15 reoperates. When the interrupter opens this connection, magnet 15 releases thereby advancing the brushes 16, 17 and 18 into contact with the terminals which are connected by conductors 61, 62 and 63 to the repeater OR3. The ground connected to conductor 19 is also effective to operate relay 67 and thus disconnect ground from conductor 65, to prevent the operation of relay 14 and the seizure of repeater OR3. The circuit for operating relay 67 is traced from battery at the outer left front contact of relay 57, left winding of relay 67, outer right back contact of relay 47, over conductor 19 to the ground at interrupter 99. Relay 67 locks, in a circuit from battery through its middle left front contact and right winding to ground at the back contact of relay 79, and disconnects the ground from conductor 65 as above mentioned. Relay 67 also disconnects ground from the right winding of relay 57; but relay 57 remains operated in a circuit from battery through its inner left front contact and left winding to the ground on conductor 19, until interrupter 99 opens this ground connection.

When the interrupter 99 again connects ground to conductor 19, magnet 15 reoperates and when magnet 15 releases the brushes 16, 17 and 18 are advanced into engagement with the terminals which are connected by conductors 71, 72 and 73 to the local selector switch S1. This ground connected to conductor 19 is also effective to operate relay 79 in a circuit from battery through the outer left front contact of relay 67, left winding of relay 79, outer right back contact of relay 57, to the ground on conductor 19. Relay 79 closes a locking circuit from battery through its middle left front contact and right winding to ground at the back contact of relay 89. Relay 79 opens the circuit through the right winding of relay 67, but this relay remains operated in a circuit from battery through its inner left front contact and left winding, and through the outer right back contact of relay 47 until the ground at interrupter 99 is again disconnected from conductor 19. If the selector S1 is idle, relay 14 reoperates in a circuit from battery at the right front contact of line relay 13, through the windings of relay 14, brush and fifth terminal of bank 13, conductor 73, resistance 74, conductor 75, to ground at the right front contact of relay 79. The line 11 is thus

extended over conductors 71 and 72 to the windings of line relay 76 of selector S1. Relay 76 operates, in turn causing the operation of relay 77. With relay 77 operated, ground is connected through its right front contact, through resistance 74 to conductor 73, to hold relay 14 operated until the connection is released by the calling subscriber. Relay 14 again closes its locking circuit, disconnects relay 13 from line 11, and opens the circuit through magnet 15 to prevent the further advance of the line-switch. When ground is once more connected to conductor 19 by the interrupter 99, relay 89 operates in a circuit from battery through the outer left front contact of relay 79, winding of relay 89 and through the outer right back contact of relay 67 to conductor 19. Relay 89 opens the circuit through the right winding of relay 79, but relay 79 holds in the circuit through its inner left front contact and left winding to the ground on conductor 19 until this connection to ground is again opened at interrupter 99. The release of relay 79 causes the release of relay 89.

If the first local selector S1 is busy at the time the brush of bank 18 engages the terminal connected to conductor 73, relay 14 fails to operate since this conductor is then also connected to battery through the test brush of some other line-switch similar to LS and the winding of the associated relay which corresponds to relay 14. In this case, the brushes 17, 18 and 19 are advanced to the terminals to which conductors 81, 82 and 83 are connected; and if the local selector S2 is idle, relay 14 operates in a circuit which includes conductor 83, resistance 84, conductor 85, and the front contact of relay 89.

With the line 11 extended to the local selector S1, relay 76 responds to the impulses created by the dialing of the second digit. Each release and reoperation of relay 76 causes the operation and release of magnet 70 to advance the brushes of selector S1 to the desired group of terminals. The further extension of the desired connection is of no interest in connection with this invention. When the subscriber at station A releases the connection, relay 76 releases in turn causing the release of relay 77. Relay 77 removes the ground from conductor 73 to release relay 14 and thus renders the line-switch LS ready for use when the subscriber at station A originates another call, and to render the selector S1 available for use on another call through the switch LS or any of the other switches having access to this selector.

The release of each one of relays 47, 57 and 67 after the line-switch has advanced beyond the terminals to which the corresponding one of repeaters OR1, OR2 and OR3 is connected, renders the corresponding repeater available for use on another call.

While the register switch associated with the repeater OR1 is arranged to register a single digit, a switch capable of registering two or more digits may readily be substituted in case it is necessary that two or more digits be used to indicate whether the call is an interoffice or a local call.

What is claimed is:

1. In a telephone system, a branch office, a main office, a subscriber's line, a line-switch individual to said line, outgoing trunks to said main office connected to terminals in the bank of said switch, and local trunks connected to terminals in the bank of said switch, said switch being automatically operative in response to the initiation

of a call over said line to select an idle trunk to said main office.

2. In a telephone system, a branch office, a main office, subscribers' lines in said branch office, an impulse sender for each of said lines, selectors in said branch office for extending connections to said lines, trunks from said branch office to said main office, an automatic switch for each of said lines, one group of terminals in the banks of said switches connected to said selectors, another group of terminals in the banks of said switches connected to said trunks, means responsive to the initiation of a call over one of said lines for operating the associated switch to select an idle one of said trunks, and means associated with said selected trunk for responding to impulses created by the operation of the impulse sender at the calling station and for transmitting corresponding impulses over said selected trunk to the main office.

3. In a telephone system, a branch office, a main office, a subscriber's line, trunks outgoing from said branch office to said main office, local trunks for completing local calls, a switch individual to said line and having direct access to said outgoing trunks and to said local trunks, said switch being automatically operative in response to the removal of the receiver by said subscriber to connect said line to an idle outgoing trunk, and switching equipment for rendering said line-switch operative to release said outgoing trunk and to select an idle local trunk.

4. In a telephone system, a branch office, a main office, a subscriber's line, an impulse sending device at said subscriber's station, trunks outgoing from said branch office to said main office, local trunks for completing local calls, a switch individual to said line and having direct access to said outgoing trunks and to said local trunks, said switch being automatically operative in response to the initiation of a call at said station to select an idle outgoing trunk, switching equipment operative in response to impulses created by the operation of said device for causing the release of said outgoing trunk and the reoperation of said switch to select an idle local trunk.

5. In a telephone system comprising a main office and a branch office, subscribers' lines, a line-switch in said branch office individual to one of said lines, selector switches in said branch office for extending connections to subscribers' lines terminating in said office, outgoing trunks for extending the line of a calling subscriber to the main office, said line-switch having direct access to said selector switches and to said outgoing trunks and being operative in response to the initiation of a call at the associated station for selecting an idle one of said trunks, means associated with said selected trunk and operative in response to impulses created by the operation of said impulse sender for causing the reoperation of said line-switch, and means for preventing the selection of any of the trunks succeeding said selected trunk.

6. In a telephone system comprising a main office and a branch office, a subscriber's line in said branch office, an impulse sender at the station of said subscriber for use in establishing a desired connection, a switch individual to said line, outgoing trunks from said branch office to said main office, local trunks in said branch office, said switch having direct access to said outgoing trunks and to said local trunks, means

responsive to the initiation of a call at said station for advancing said switch to select an idle outgoing trunk, means associated with said selected trunk for responding to the impulses created by the operation of said impulse sender and for transmitting corresponding impulses to the main office, and means effective if the call is to be completed over a local trunk for causing the reoperation of said switch to select an idle one of said local trunks.

7. In a telephone system comprising a main office and a branch office, a subscriber's line in said branch office, a dialing device at the station of said subscriber for use in establishing a desired connection, a switch individual to said line, outgoing trunks from said branch office to said main office, local trunks in said branch office, said switch having direct access to said outgoing trunks and to said local trunks, means responsive to the initiation of a call at said station for advancing said switch to select an idle outgoing trunk, means associated with said selected trunk for responding to the impulses created by the operation of said dialing device and for transmitting corresponding impulses to the main office, means individual to said selected trunk for registering the impulses corresponding to the first digit dialed, and means controlled by said registering means for causing the reoperation of said switch to select an idle one of said local trunks.

8. In a telephone system comprising a main office and a branch office, a subscriber's line in said branch office, a dialing device at the station of said subscriber for use in establishing a desired connection, a switch individual to said line, outgoing trunks from said branch office to said main office, local trunks in said branch office, said switch having direct access to said outgoing trunks and to said local trunks, means responsive to the initiation of a call at said station for advancing said switch to select an idle outgoing trunk, means associated with said selected trunk for responding to the impulses created by the operation of said dialing device and for transmitting corresponding impulses to the main office, means individual to said selected trunk for registering the impulses corresponding to the first digit dialed, means controlled by said registering means for causing the reoperation of said switch to select an idle one of said local trunks, and means for preventing the selection of any one of the outgoing trunks succeeding said selected trunk.

9. In a telephone system comprising a main office and a branch office, subscriber's lines, a line-switch in said branch office individual to one of said lines, selector switches in said branch office for extending connections to subscribers' lines terminating in said office, outgoing trunks for extending the line of a calling subscriber to the main office, said line-switch having direct access to said selector switches and to said outgoing trunks and being operative in response to the initiation of a call at the associated station for selecting an idle one of said trunks, means associated with said selected trunk and operative in response to impulses created by the operation of said impulse sender for causing the reoperation of said line-switch, and means comprising a chain of relays successively operated in synchronism with the reoperation of said switch to prevent the selection of any one of the trunks succeeding said selected trunk.

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