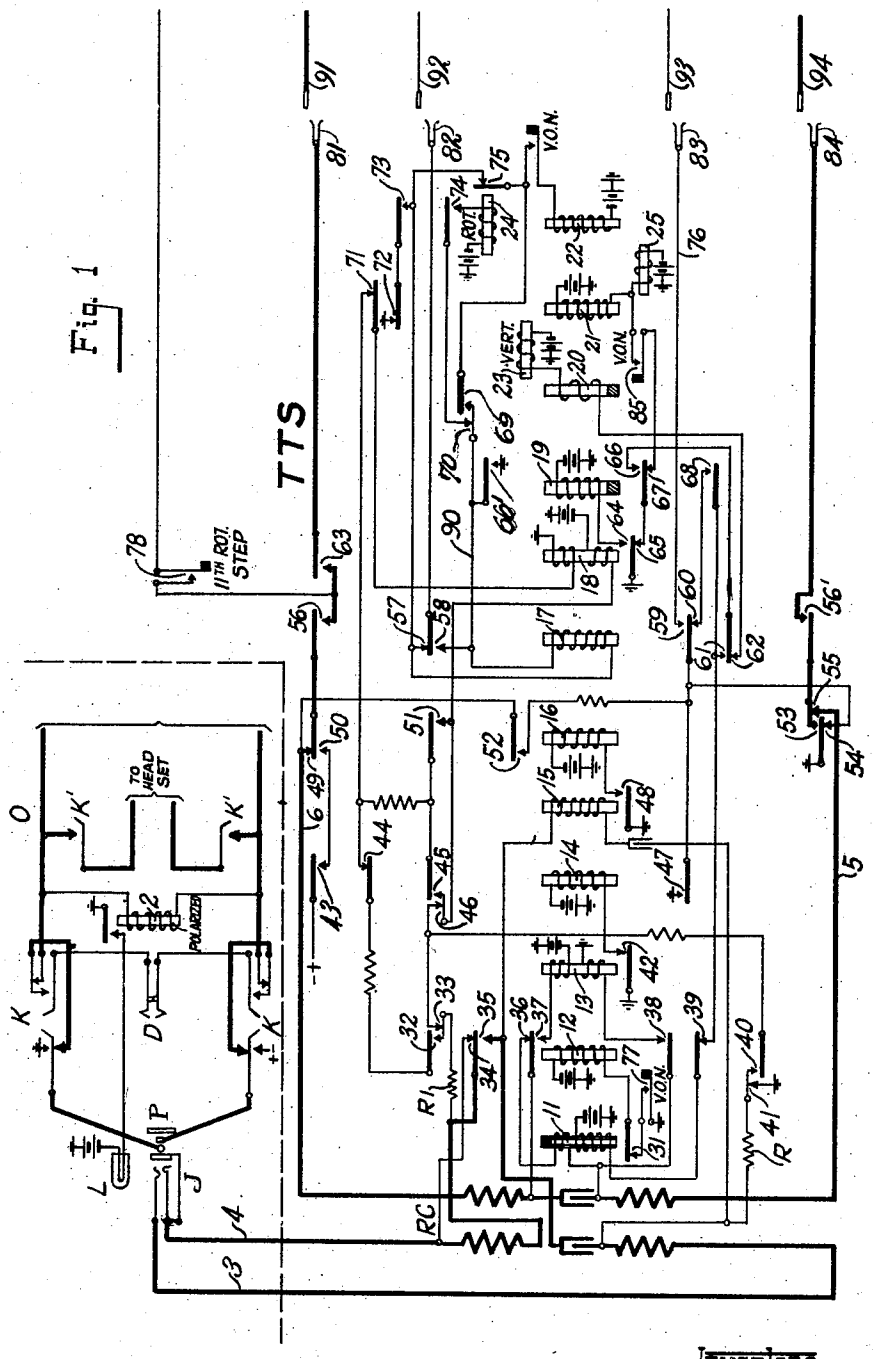
Dec. 23, 1930. V. S. THARP ET AL 1,786,041

AUTOMATIC TOLL SERVICE TRUNKING SYSTEM

Original Filed Oct. 10, 1927 2 Sheets-Sheet 1

Fig. 1



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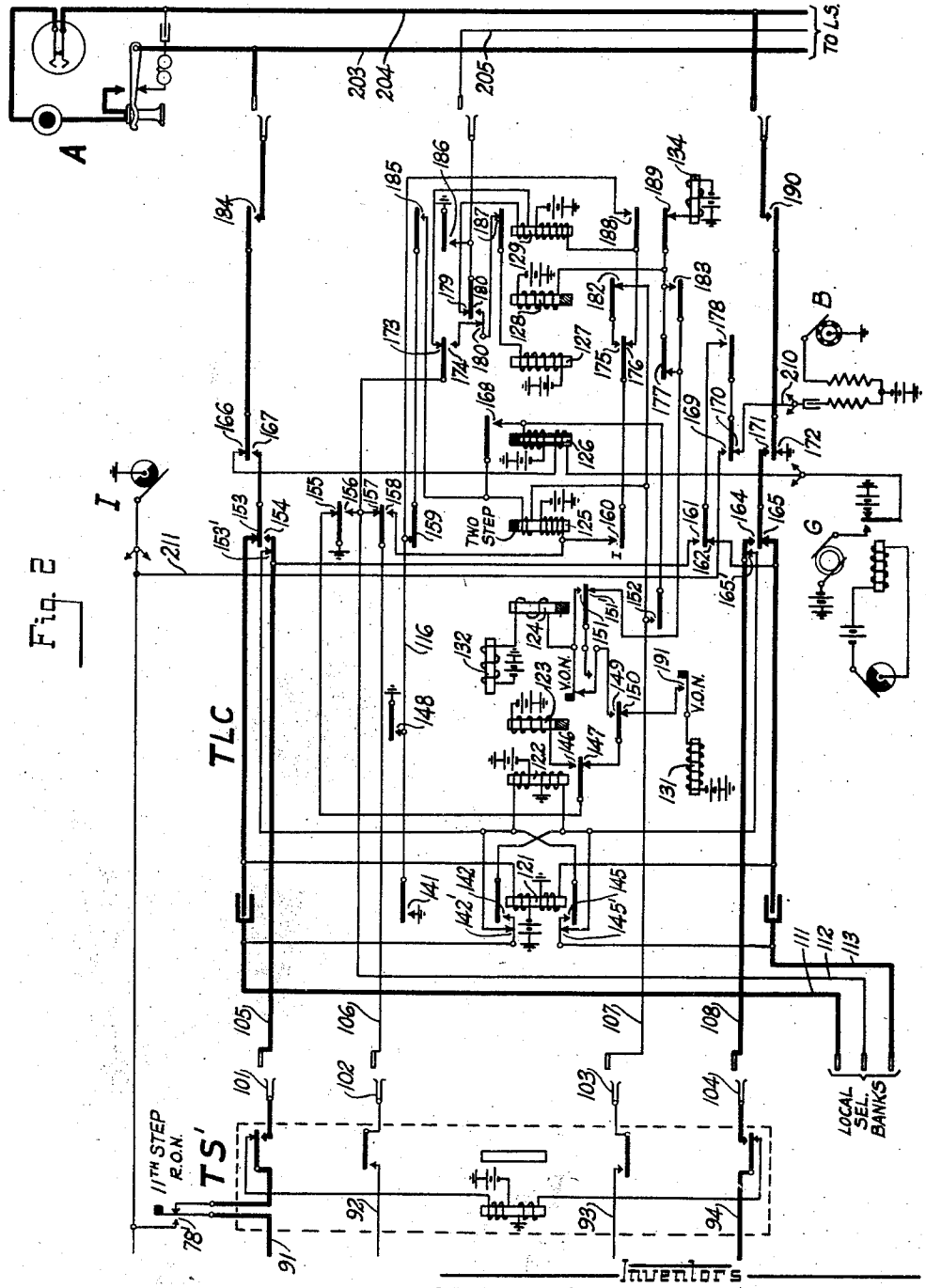

Fig. 2

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UNITED STATES PATENT OFFICE

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AUTOMATIC TOLL-SERVICE TRUNKING SYSTEM

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This invention appertains to automatic telephone systems in general, but more particularly to automatic toll service trunking systems for extending toll connections from an operator's switchboard to called subscribers' lines.

In toll service trunking systems most commonly used in automatic telephone practice, a toll operator completes a toll connection by dialling the directory number of the called subscriber, which causes one or more selectors, one of which is termed a toll transmission selector, and a connector to successively operate and extend the connection to the called line. If the called line is busy, the operator receives a busy signal, but if the called line is idle, a supervisory lamp at her position lights to apprise her of this fact. If the called line is idle as indicated by the lighted condition of the supervisory lamp, the toll operator initiates the signalling of the called subscriber, and when the called subscriber answers, the supervisory lamp is extinguished to apprise the toll operator accordingly.

The object of this invention is the production of a new automatic toll service trunking system having improved circuit arrangements and operating characteristics. A particular feature of the invention is that in the toll transmission selector the conversion from the dialling condition to the talking condition is controlled by a relay in the toll transmission selector maintained operated during the operation of the succeeding switches over a circuit including the two talking conductors of the extended trunk line and the line relay of the switch being operated in series, each switch having a line relay bridged across its talking conductors in series with the exchange battery.

The invention with its features will be described in detail in the following specification with the aid of the accompanying drawings comprising Figs. 1 and 2. These drawings, when arranged with Fig. 2 to the right of Fig. 1, show by means of the usual circuit diagrams a schematic layout of a toll switching system embodying the principles of this invention.

Fig. 1 shows the calling end of a toll operator's cord circuit O terminating in the plug P and equipped with a listening key K′ and a dialing and ringing key K. The dial D, common to the position, may be associated with the cord circuit O by operating the key K to the right. As many cords are provided as are necessary to take care of the service. The cord circuit O may be of any suitable type and is therefore not shown in full; only those elements which concern the invention are shown.

Trunk lines extend from the operator's switchboard, which is usually in the most centrally located exchange, to each of the other exchanges in the system. The trunk line comprising conductors 3 and 4 accessible at the toll switchboard at jack J and terminating in the toll transmission selector TTS at one of the other exchanges is one of these trunks.

The toll transmission selector TTS, mechanically, is of the well known vertical and rotary type and has access in its bank to a number of groups of toll second selectors, a separate group being accessible in each level. The circuit arrangements of the toll transmission selector TTS forms a particular part of this invention and will be described in detail subsequently.

The toll second selector TS′, indicated in Fig. 2 by a dotted rectangle, is accessible to the toll transmission selector TTS by way of trunk conductors 91—94. Mechanically and also in circuit arrangements the selector TS′ may be of the well known vertical and rotary type commonly used in automatic exchange systems, except that the ringing control conductor of the trunk terminating therein is connected to a fourth wiper by the operation of the switching relay.

The selector TS′ is also equipped with a set of eleventh step rotary off-normal springs, the purpose of which will be described subsequently. In the banks of the toll second selectors access is had to a number of groups of combination toll and local connectors, a separate group being accessible in each level.

The combination toll and local connector TLC is accessible to the toll second selector

TS′ by way of trunk conductors 105—108, and is also accessible to a group of local second selectors by way of trunk conductors 111—113. Mechanically, the toll and local connector TLC is of the well known vertical and rotary type, having horizontal rows or levels of bank contacts at which access is had to subscribers' lines, such as the line to substation A. The circuit arrangements of the toll and local connector TLS forms a particular part of this invention and will be described in detail presently. The ringing generator G, the busy tone machine B, and the interrupter I, shown in Fig. 2, are common to the exchange.

With this general description of the object of the invention and the apparatus involved in mind, a detailed description of the operation will now be given. For this purpose, it will first be assumed that the toll operator has received a toll call for the subscriber at substation A. To complete this connection, the toll operator inserts the calling plug of the cord used to answer the incoming toll call, plug P of the cord O for example, into the jack of an idle trunk extending to the exchange serving the subscriber at substation A, the jack J for example. Inserting the plug P into the jack J places a bridge across trunk conductors 3 and 4, thereby closing a circuit for the lower winding of line relay 18 which extends from ground at contacts 41, through resistance R, through the lower left hand winding of the repeating coil RC, trunk conductor 3, over the bridge including polarized relay 2 in the cord circuit O to trunk conductor 4, contacts 34, through resistance R1, contacts 33, contacts 46, through the lower winding of line relay 18 to battery. Relay 18 operates and closes a point in the talking circuit at contacts 63 and closes the circuit of release relay 19 at contacts 64. Relay 19 operates and grounds release conductor 90 at contacts 66′, prepares the impulsing circuit at contacts 66, and closes a circuit for the lower winding of switch-over-control relay 11, this latter circuit including contacts 54, 60, and 39. Relay 11 operates and opens a point in the circuit of switch-over relay 12 by separating contacts 31.

After inserting the plug P into the jack J, the toll operator throws the ringing and dialling key K to the right thereby disconnecting the polarized relay 2 from in bridge of the trunk conductors 3 and 4 and substituting the dial D therefor. The toll operator then dials the last four digits of the directory number of the subscriber at substation A (omitting the first or exchange designation digit), after which she again restores the key K to normal.

Responsive to the first digit dialled, vertical magnet 23 of the toll transmission selector TTS operates and steps the wipers 81—84 opposite the corresponding level of bank contacts after which the rotary magnet operates under the control of the stepping relay 22 and rotates the wipers into engagement with the set of bank contacts terminating an idle trunk. After the trunk selecting operation, switching relay 17 operates, performing the usual circuit changes including the closing of points in the talking circuit at contacts 56 and 56′, the connecting of the grounded release conductor 90 to test wiper 82 by closing contacts 58, and in addition, grounds the ring control conductor 76 by closing contacts 59, opens the initial holding circuit for the lower winding of relay 11 by separating contacts 60, and prepares another circuit for the lower winding of relay 11 by closing contacts 61. The operation of the toll transmission selector TTS as regards its vertical and rotary movement responsive to the dialling of the first digit is the regular selector operation well known in the art. A detailed description thereof is therefore deemed unnecessary.

It is assumed that the trunk selected is the one comprising conductors 91—94, terminating in the selector TS′. When the trunk line is seized, a circuit for the line relay of the selector TS′ is closed, which includes the upper winding of relay 11, contacts 36, the two right hand windings of the repeater coil RC, conductors 5 and 6, and conductors 91 and 94 in series. Relay 11 is now held operated over this circuit, the initial circuit for its lower winding having been opened at contacts 60. Relay 11 is made slow-acting to prevent its dropping back during the short interval after the circuit of its lower winding is opened and before the circuit including its upper winding and the line relay of selector TS′ is established.

Line relay 18 again operates responsive to the dialling of the next digit and at each deenergization opens the circuit of the line relay of the selector TS at contacts 63. The selector TS operates in the usual manner and raises its wipers opposite the level of the bank contacts corresponding to the digit dialled and then selects an idle trunk in that level. A circuit is also closed for the lower winding of relay 11 each time line relay 18 deenergizes, this circuit including contacts 65, 66, 61 and 39. Thus relay 11 is energized over its lower winding during the intervals when the circuit of its upper winding is opened to operate the line relay of selector TS′, and so relay 11 is maintained energized continuously.

It is assumed that the trunk selected is the one comprising conductors 105—108 terminating in the toll and local connector TLC. When this trunk line is seized, the line relay of the selector TS′ is disconnected from the talking conductors (by the operation of the switching relay of selector TS′) and a new circuit is established for the upper winding of relay 11 through the windings of the line relay 122 of the toll and local connector TLC.

Thus relay 11 in the toll transmission selector TTS is now maintained energized over its upper winding in series with the line relay 122 of the toll and local connector TLC. Line relay 122 also operates over this circuit and at contact 126 closes the circuit for release relay 123. Release relay 123 operates and grounds the holding conductor 116 at contacts 128 and prepares the impulsing circuit at contacts 149.

Line relay 18 of the toll transmission selector TTS again operates responsive to the dialling of the third digit opening the circuit of line relay 122 of connector TLC a corresponding number of times, causing the operation of the vertical magnet 132 to step the wipers of the switch opposite the corresponding level of bank contacts. Series relay 124 operates in series with magnet 132 in the usual way and at contacts 152 closes a circuit for the ring cut-off relay 126, ring control conductor 107 being connected to the grounded ring control conductor 76 of the toll transmission selector TTS. Relay 126 operates and closes a locking circuit for itself to the ring control conductor 107 in series with the upper winding of toll-switching relay 125 at contacts 168, and opens points in the ringing circuit at contacts 166 and 172. Relay 125 is energized over its upper winding just sufficiently to cause it to operate to its first step and close contacts 160 thereby preparing an energizing circuit for its lower winding. At the end of this series of impulses, relay 124 deenergizes preparing the circuit for the rotary magnet 124 in the usual manner by closing contacts 151.

Responsive to the last digit dialled by the toll operator, rotary magnet 134 is operated under the control of the line relay 122 in the usual manner and rotates the switch wipers into engagement with the bank contacts terminating the line to substation A. Relay 128 operates in multiple with rotary magnet 134 and prepares the testing circuit for relay 127 at contacts 180.

If the line to sub-station A is busy at this time, test relay 127 operates and in addition to performing its usual circuit operation including the closing of a locking circuit for itself at contacts 174, the opening of a point in the impulsing circuit at contacts 177, the closing of a point in the busy-signalling circuit at contacts 178, prepares a circuit for the lower winding of two-step relay 125 at contacts 175, this circuit being closed as soon as relay 128 deenergizes and closes contacts 182 which it does at the end of the rotary motion. In energizing over its lower winding, two-step relay 125 operates to its second step and performs the following circuit changes: By the separation of contacts 153 and 165, back-bridge relay 121 is disconnected from the talking conductors. By the separation of contacts 153′ and 165′ line relay 122 is disconnected from the talking conductors. By the closure of contacts 154 and 165 points in the talking circuit are closed. A point in the circuit of release magnet 131 is opened by the separation of contacts 155 and the release conductor 112 extending to the banks of the local selector is grounded directly at contacts 156. A locking circuit for the lower winding of relay 125 is closed to grounded release conductor 106 at contacts 168; and at contacts 161 the interrupted ground conductor 211 from the interrupter I is connected to the upper talking conductor 105 by way of contacts 169 and 178.

When line relay 122 is disconnected from the talking conductors, the circuit over which the upper winding of relay 11 in the toll transmission selector TTS is held energized is interrupted. This relay thereupon deenergizes and completes the circuit for relay 12 by closing contacts 31, off-normal springs 77 having closed upon the first vertical step of the switch wipers. Relay 12 energizes and by separating contacts 33 and 41 and closing contacts 32 and 40 reverses the direction of current flow over trunk conductors 3 and 4, the lower winding of line relay 18 now being connected to the trunk conductor 3 and the upper winding of line relay 18 now being connected to the trunk conductor 4. At contacts 39 a point in the circuit of the lower winding of relay 11 is opened. By the separation of contacts 36 another point in the circuit of the upper winding of relay 11 is opened, and by the closure of contacts 37 and 38 the battery feed relay 13 is connected via the right hand windings of repeating coil RC to the trunk conductors 5 and 6. By the separation of contacts 34, the short-circuit around the upper left hand winding of repeating coil RC is opened, and by the closure of contacts 35 the upper and lower left hand windings of repeating coil RC are connected via the condenser. Due to the reversal of current flow over the trunk conductors 3 and 4, polarized relay 2 in the operator's cord O energizes and causes the lighting of the lamp L.

Since ground potential is intermittently applied to the trunk conductor 105 at the toll and local connector TLC by the interrupter I connected thereto as previously described, a circuit is intermittently opened and closed for the upper winding of battery-feed relay 13. Relay 13 therefore operates accordingly and successively opens and closes the circuit of relay 14. Each time relay 14 energizes, it disconnects the windings of relay 18 from trunk conductors 3 and 4 and by separating contacts 46 and 44, and thus intermittently opens and closes the circuit of the polarized relay 2 in the operator's cord. This causes the lamp L to flash which signal indicates to the toll operator that a busy condition has been encountered. During the time that relay 14

operates and disconnects the windings of relay 18 from the trunk conductors, it also closes a circuit for the two windings of relay 18 in series by closing contacts 45 in order to maintain relay 18 energized.

Upon noting the flashing of the lamp L, the toll operator removes the plug P from the jack J thereby releasing the connection as will be described in detail subsequently.

Let us assume now that when the wipers of the toll and local connectors TLC are rotated into engagement with the contacts terminating the line to station A the line tests idle. In this case test relay 127 is not operated. Instead, switching relay 129 operates as soon as relay 128 releases at the end of the rotary motion, being energized over its upper winding in series with the cut-off relay of the called subscriber's lineswitch (not shown). In energizing, relay 129 performs its usual circuit operations including the closing of points in the talking circuit at contacts 184 and 190, the grounding of the test wiper at contacts 186, the closing of a locking circuit for its lower winding at contacts 188 to the grounded holding conductor 116. By the closure of contacts 188 a circuit for the lower winding of two-step relay 125 is also closed, this circuit including contacts 176 and 160. Two step-relay 125 then operates to its second step, performing the circuit changes as previously described, including the disconnection of the line relay 122 from the trunk conductors which results in the deenergization of relay 11 in the toll transmission selector TTS held up during the setting up of the connection, which in turn causes reversal of the direction of current flow over trunk conductors 3 and 4 and the lighting of the lamp L at the operator's cord circuit O. Since in this case there is no interrupted ground connected to the upper talking conductor 105, busy relay 127 being deenergized, lamp L lights steadily. The steady lighting of the lamp L indicates to the toll operator that the called line has been connected with and has been found idle.

As soon as the toll operator is ready to signal the called subscriber, she throws the key K to the left to apply ringing current to the trunk conductors. Ringing relay 15, which is bridged across trunk conductors 3 and 4, responds to ringing current and closes the circuit of relay 16 at contacts 48. Relay 16 energizes and by separating contacts 54 disconnects ground from the ring control conductor 76 connected via conductor 93 to ring control conductor 107 to which ring cut-off relay 126 is locked. As a result, ring cut-off relay 126 deenergizes and by permitting contacts 166 and 172 to close, starts the regular automatic interrupted ringing to signal the called subscriber. Relay 16 in operating also closes a local circuit for line relay 18 by closing contacts 51 to maintain relay 18 energized while ringing current is applied to the trunk conductors 3 and 4. (Contacts 50 and 53 are provided to enable the operator to apply ringing current to the called line conductors to signal a called subscriber after he has removed his receiver, battery feed relay 13 being held operated during such signalling over its upper winding over a circuit closed at contacts 52 from ground at contacts 47).

When the called subscriber answers, ring-cut-off relay 126 operates, being energized over its lower winding over the called line loop in the usual manner, again closing its locking circuit to conductor 107, and closing points in the talking circuit at contacts 167 and 172. After the ring cut-off relay 126 is operated, the battery feed relay 13 in the toll transmission selector TTS also energizes over the called line loop and at contacts 42 closes the circuit of relay 14. Relay 14 energizes and as previously described disconnects the windings of the relay 18 from the trunk conductors 3 and 4 by separating contacts 44 and 46, closing a local circuit for relay 18 by closing contacts 45. The disconnection of the windings of the relay 18 from the trunk conductors 3 and 4 interrupts the circuit of polarized relay 2 in the cord circuit O. Relay 2 thereupon deenergizes and extinguishes the lamp L. The extinguishment of the lamp L notifies the toll operator that the called subscriber has answered. After receiving this signal, the toll operator takes the necessary steps to complete the talking connection between the calling and the called subscribers, after which the two may hold conversation.

When the subscriber at substation A replaces his receiver at the termination of the conversation, the circuit of the battery feed relay 13 is interrupted, which thereupon deenergizes and opens the circuit of relay 14. Relay 14, in deenergizing, reconnects the windings of line relay 18 to trunk conductors 3 and 4, thus again establishing the circuit for polarized relay 2 in the operator's cord circuit O. Relay 2 energizes and lights the lamp L. The lighting of the lamp L indicates to the toll operator that the called subscriber has replaced his receiver whereupon she will remove the plug P from the jack J. Removing the plug P from the jack J opens the circuit of line relay 18 which thereupon deenergizes and opens a circuit of release relay 19. Relay 19 deenergizes, and disconnects ground from release conductor 90 by separating contacts 66′ thereby opening circuit of switching relay 17, the switching relay of selector TS′, and the holding circuits of relays 125 and 129 in connector TLC, whereupon these relays deenergize and restore to normal. Relay 17, in restoring, disconnects ground from the ring control conductor 76 by separating contacts 59. The removal of

ground from the ring control conductor 76 connected to conductor 107 opens the holding circuit of ring cut-off relay 126 of the toll and local connector TLC. Relay 125, in restoring, closes the circuit of release magnet 131 which thereupon operates and restores the connector wipers to normal. The release of the switching relay of selector TS′ also initiates the release of the wipers of selector TS′. The closure of contacts 67 by the release of relay 19 closes the circuit for release magnet 31, vertical off normal springs 85 having closed upon the first vertical step of the switch wipers. Magnet 31 then operates and restores the switch wipers 81—84 to normal. All the switches used in completing the above described connection are now in their normal condition and are ready to be used in the establishment of other connections.

As previously mentioned, the toll and local connector TLC is also accessible in the banks of the local selectors and therefore may be used in the extension of an ordinary local connection. The operation of the connector TLC in the establishment of such a connection, however, is identical with the regular connector operation well known to those skilled in the art, and for this reason, it is deemed that a description thereof is unnecessary. In such a connection the two-step relay 125 remains inoperative. It should also be noted that when the connector is used in an establishment of a local connection and is operated to connect with the busy line, the operation of the test relay 127 connects the busy tone conductor 210 from busy tone machine B to the lower talking conductor to give the regular busy tone signal to the calling subscriber in the well known manner.

In the description of the establishment of the connection from the toll board to the subscriber at substation A, it was assumed that the toll transmission selector TTS and also the toll second selector TS′ found an idle trunk in performing the rotary trunk hunting movement. Under certain conditions of heavy traffic, however, there is a possibility of all of the trunks accessible in a selector level being busy at the particular time that the selecting operation is performed. When a selector encounters an all-trunks-busy condition, its wipers are rotated to the eleven rotary position and the toll operator is given the busy signal. For example, when the toll transmission selector TTS, in performing its rotary movement, encounter an all-trunks-busy condition, it rotates its wipers 81—84 to the eleventh rotary position, in which position the eleventh-rotary-step off-normal springs 78 are closed. Switching relay 17 is also operated in the usual manner, since in this position, test wiper 82 engages no grounded test contact. Switching relay 17, in operating, opens the circuit for the lower winding of relay 11 by separating contacts 60, whereupon relay 11 deenergizes and causes the energization of relay 12, which in turn reverses the connections of the windings of line relay 18 to the trunk conductors 3 and 4, causing the energization of the polarized relay 2. Relay 12, in operating, also connects the windings of the battery feed relay 13 to the trunk conductors 5 and 6. With springs 78 closed, interrupter I is again connected to the upper talking conductor and a circuit is again established intermittently for relay 13, which as previously described causes the lamp L in the operator's cord circuit to flash (after the operator restores her dialing key K). The flashing of lamp L, as before, indicates that a busy condition has been encountered.

The operator receives the busy signal in the same manner when a toll second selector, such as selector TS′, encounters in all trunks busy condition. In this case, the relay 11 in the toll transmission selector TTS is normally held up from current fed through the windings of the line relay of the selector TS′. When the selector TS′ rotates to the eleventh rotary step, the switching relay is operated, thus disconnecting the line relay from the talking conductors, which in turn causes the deenergization of relay 11 in the toll transmission selector TTS. Interrupter I is again connected to the upper talking conductor by the closure of eleventh-rotary-step off-normal springs 78′.

This completes the description of the operation of the invention. What is considered new and is desired to have protected by Letters Patent is specifically stated in the appended claims.

What is claimed is:

1. In a telephone system, two automatic switches, means for successively operating said switches to extend a connection, a double wound relay in the first switch, means for continuously energizing said relay over a local circuit including one of its windings responsive to the seizure of and during the operation of the first switch, means for energizing said relay over its other winding over a circuit extending to the second switch at the completion of the operation of the first switch, means including said local circuit for maintaining said relay energized during the operation of the second switch, means in the second switch for opening said second circuit at the completion of the operation of the second switch, and a signal controlled by said relay.

2. In a telephone system, a switchboard, two automatic switches, means for operating the first switch to extend a connection from said switchboard to said second switch via an interconnecting trunk line, a line relay in the second switch bridged across the conductors of said trunk line in series with the

exchange battery, a signal control relay in said first switch, means for closing a circuit including said line relay and said control relay in series, means for intermittently opening said circuit to operate said line relay, means controlled by said line relay for operating said second switch to extend the connection to a called line, means responsive to the completion of the connection for opening said circuit to deenergize said signal control relay, a signal at said switchboard, and means responsive to the deenergization of said signal control relay for operating said signal.

3. In a telephone system, a switchboard, two automatic switches, means for operating the first switch to extend a connection from the switchboard to the second switch, a control relay in the first switch for controlling a signal at said switchboard, means for operating said relay over a local circuit during the operation of the first switch, a line relay in the second switch bridged across the talking conductors thereof in series with the exchange battery, means for closing a second circuit for said control relay in series with said line relay at the completion of the operation of the first switch, means for intermittently opening said second circuit to cause said line relay to operate the second switch to extend the connection to a called line, and means responsive to the completion of the connection for opening said second circuit to deenergize said control relay.

4. In a telephone system, two automatic switches, means for operating the first switch to extend a connection from a switchboard to the second switch, a double wound relay in said first switch for controlling a signal at said switchboard, means for energizing said relay over a local circuit including one of its windings during the operation of said first switch, a line relay in said second switch for controlling the operation of said second switch, means for opening said local circuit and for closing a second circuit including the other winding of said first relay and said line relay in series at the completion of the operation of said first switch, means for intermittently opening said second circuit to cause the second switch to operate and extend the connection to a called line, means for closing another circuit for said one winding of said first relay each time said second circuit is opened to operate said second switch, and means in the second switch for opening said second circuit at the completion of the connection to deenergize said double wound relay.

5. In a telephone system, in which connections from a switchboard to a called line are established by means of operator controlled automatic switches successively operated and in which a signal at the switchboard is controlled by a control relay held energized during the setting up of the connection, a line relay in the first switch, contacts on said line relay for controlling the operation of the first switch, and means for including said contacts in a circuit for said control relay during the operation of the succeeding switches.

6. In a telephone system, in which connections from a switchboard to a called line are established by means of successively operated automatic switches and in which a signal at the switchboard is controlled by a control relay in the first switch held energized during the setting up of the connection, a line relay in the first switch having one set of contacts for controlling the operation of the first switch and a second set of contacts for repeating impulses to the succeeding switches, means for establishing an initial energizing circuit for the control relay when the first switch is taken for use, means for establishing another circuit for said control relay including said second set of contacts and for opening said initial circuit at the completion of the operation of the first switch, said means for establishing a holding circuit including said first set of contacts each time said second set of contacts are opened during the repeating of impulses to the succeeding switches.

7. In an automatic telephone system, a combination toll and local connector, normally operating as a local connector, means for operating said connector to connect with a called line and for then automatically signalling the called party, a ring cut-off relay in said connector operative when the called party answers for interrupting the signalling, means for operating said ring cut-off relay during the operation of the connector to prevent the automatic signalling from taking place at the completion of the connection when the connector is used in a toll connection, a two-step relay in said connector, means controlled by said ring cut-off relay when said connector is used in a toll connection for operating said two-step relay to its first step, and means responsive to the completion of the connection providing it has been operated to its first step for operating said relay to its second step for converting the connector from local operation to toll operation.

8. In an automatic telephone system, a combination toll and local connector, normally operating as a local connector, means for operating said connector to connect with a called line and for then automatically signalling the called party, a ring cut-off relay in said connector operative when the called party answers for interrupting the signalling, means for operating said ring cut-off relay during the operation of the connector to prevent the automatic signalling from taking place at the completion of the connection when the connector is used in a toll connection, a double wound two-step relay in said connector, means controlled by said ring cut-off

relay when the connector is used in a toll connection for closing a locking circuit for the ring cut-off relay in series with one winding of said two-step relay over which said two-step relay operates to its first step, and means responsive to the completion of the connection providing the two-step relay has been operated to its first step for closing a circuit for the other winding of said two step relay to cause it to operate in its second step and thereby condition the connector for toll operation.

9. In a telephone system, toll selectors, regular selectors, a combination toll and regular connector, a double wound line relay in said connector, a reversing relay, trunk conductors extending from the banks of said regular selectors to said line relay by way of contacts on said reversing relay, and trunk conductors extending from the banks of said toll selectors to said line relay over paths excluding the contacts of said reversing relay.

10. In a combination toll and regular connector, two sets of incoming talking conductors for use in toll and regular connections, respectively, means for connecting a tone source to one of the regular talking conductors in case the called line is busy when the connector is being used to establish a regular connection, and means for connecting a flasher to the non-corresponding toll talking conductor in case the party called in the establishment of a toll connection is busy.

11. In a toll service trunking system, a toll transmission selector, a toll selector, and a toll connector arranged to be operated in tandem to set up a connection, line relays in the toll selector and connector bridged across the talking circuit in series with the battery, a control relay in the toll transmission selector held up in series with one or the other of said line relays while the connection is being set up, means for cutting off the line relay at the connector to deenergize the said control relay, and a battery feed bridge at the toll transmission selector connected up responsive to the deenergization of said control relay.

12. In a toll service trunking system, a toll transmission selector, a toll selector, and a toll connector arranged to be operated in tandem to set up a connection, line relays in the toll selector and connector bridged across the talking circuit in series with the battery, a control relay in the toll transmission selector held up in series with one or the other of said line relays while the connection is being set up, means for cutting off the line relay at the connector to deenergize the said control relay, a trunk line extending from a switchboard to said toll transmission selector, and means responsive to the deenergization of said control relay for reversing the current over said trunk line.

13. In a toll service trunking system, a toll transmission selector, a toll selector, and a toll connector arranged to be operated in tandem to set up a connection, line relays in the toll selector and connector bridged across the talking circuit in series with the battery, a control relay in the toll transmission selector held up in series with one or the other of said line relays while the connection is being set up, means for cutting off the line relay at the connector to deenergize the said control relay, and a signal responsive to the deenergization of said control relay.

14. In an automatic telephone system, a combination toll and local connector for extending connections to called lines normally operating as a local connector, a busy relay in said connector for giving a signal in case said connector is operated to connect with a busy line, a switching relay in said connector for closing normally open contacts in the talking circuit in case said connector is operated to connect with an idle line, and means controlled by either relay when said connector is used to extend a toll connection for converting said connector from local operation to toll operation.

15. In an automatic telephone system, a combination toll and local connector for extending connections to called lines normally operating as a local connector, a busy relay in said connector for giving a signal in case said connector is operated to connect with a busy line, a switching relay in said connector for closing normally open contacts in the talking circuit in case said connector is operated to connect with an idle line, a two-step relay in said connector operated to its first step during the operation of said connector when operated to extend a toll connection, and means controlled by either said busy relay or said switching relay for causing said two-step relay to operate to its second step and convert said connector from local operation to toll operation, providing said two-step relay has previously been operated to its first step.

16. In a telephone system, an automatic switch, a line relay for controlling said switch, two pairs of talking conductors extending to said switch and terminating in the windings of said relay, a reversing relay, and contacts on said reversing relay inserted in one of said pairs of talking conductors only.

17. In a telephone system, an automatic switch, two talking conductors adapted to be extended by the wipers of said switch, a relay, a circuit normally connecting said conductors together through the winding of said relay, a battery feed relay, a third relay for connecting said conductors to the windings of said battery feed relay, and a circuit for said third relay extending through back contacts of said first relay and off-normal contacts of said switch.

18. In a telephone system, a toll trunk, a local trunk, a combination two-motion toll and local connector operable over either

trunk, a two-step relay in said connector, and means for operating said relay to its first step while said connector is executing its first motion and for operating said relay to its second step at the end of the second motion, providing said connector is operated over said toll trunk, to condition said connector for toll operation.

19. In a telephone system, a two-conductor trunk terminating in a selector, a connector accessible to said selector, a double-wound impulsing relay for the selector, means for controlling said relay over a circuit including only one winding of the relay and the two conductors of the trunk in series to operate the selector and connector, a double-wound switchover relay for the selector, means for energizing said switchover relay over a local circuit including one winding of the relay during the operation of the selector, means for energizing the switchover relay over a circuit extending to said connector and including the other winding of the relay at the completion of the operation of the selector, means for opening said second circuit for the switch-over relay at the completion of the operation of the connector, and means operative responsive to the deenergization of said switchover relay for completing a holding circuit for said impulsing relay, said circuit including the two windings of the impulsing relay and the two conductors of the trunk in series.

20. In a telephone system, a selector and a connector, a two-conductor trunk terminating in the selector, a double-wound impulsing relay for the selector, a control circuit for said relay including one winding of the relay, a source of current, and the two conductors of the trunk in series, means including said relay for operating the selector and connector to extend a call, a double-wound switchover relay for the selector energized over a local circuit including one winding during the operation of the selector, a holding circuit for the switchover relay extending to said connector and including the other winding of the relay effective on the completion of the operation of the selector, means for opening said holding circuit on the completion of the operation of the connector, and means responsive to the deenergization of the switchover relay for reversing the direction of current flow over said control circuit and for including both windings of the impulsing relay in that circuit.

21. In a telephone system, a selector and a connector, a double-wound impulsing relay for the selector, a trunk comprising two conductors, one conductor extending to one pole of a battery, the other conductor extending to the other pole of the battery through one winding of said relay, means including separate contacts of said impulsing relay for operating the selector and connector, respectively, to extend a call, a double-wound switchover relay for the selector energized over a local circuit including one winding during the operation of the selector, means for energizing said switchover relay over a circuit extending to said connector and including the other winding of the relay at the completion of the operation of the selector, means for opening said second circuit for the switchover relay at the completion of the operation of the connector, and means responsive to the deenergization of said switchover relay for disconnecting said one conductor of the trunk from said one pole of the battery and for extending it to the other pole of the battery through said one winding of the impulsing relay and for disconnecting said other conductor of the trunk from said one winding of the impulsing relay and for extending it to said one pole of the battery through the other winding of the impulsing relay.

22. In a telephone system, a two-conductor trunk terminating in a selector, a connector accessible to said selector, a double-wound impulsing relay for the selector, a control circuit including only one winding of said relay and the two conductors of the trunk in series for directively operating the selector and connector to extend a call, a double-wound switchover relay for the selector energized over a local circuit including one winding during the operation of the selector, means for energizing the switchover relay over a circuit extending to the connector and including the other winding of the relay at the completion of the operation of the selector, means for opening said last-mentioned circuit to deenergize said switchover relay at the completion of the operation of the connector, means operative responsive to the deenergization of the switchover relay for completing a holding circuit for the impulsing relay including the two windings of that relay and the two conductors of the trunk in series, and means responsive when the call is answered for disconnecting said impulsing relay from the trunk conductors.

23. In a telephone system, a selector and a connector, a trunk comprising two conductors terminating in said selector, a double-wound impulsing relay for the selector, a control circuit for said relay including one winding of the relay, a source of current, and two conductors of the trunk in series, means including said relay for directively operating the selector and connector to extend a call, a double-wound switchover relay for the selector energized over a local circuit including one winding during the operation of the selector, a holding circuit for the switchover relay extending to the connector and including the other winding of the relay effective on the completion of the operation of the selector, means for opening said holding cir-

cuit to deenergize said switchover relay on the completion of the operation of the connector, means responsive to the deenergization of the switchover relay for reversing the direction of current flow over said control circuit and for including both windings of the impulsing relay in that circuit, and means responsive when the call is answered for disconnecting the impulsing relay from said control circuit and for closing a holding bridge across the two windings of the relay.

24. In a telephone system, a trunk comprising two talking conductors terminating in a selector, a double-wound impulsing relay for the selector, a control circuit including only one winding of said relay and the talking conductors of the trunk in series for directively operating the selector and connector to extend a call, a double-wound switchover relay for the selector energized initially over a local circuit including one winding and maintained energized over this circuit during the operation of the selector, means for energizing said switchover relay over a circuit extending to the connector and including the other winding of the relay at the completion of the operation of the selector, means for opening said last-mentioned circuit to deenergize the switchover relay at the completion of the operation of the connector, means operative responsive to the deenergization of the switchover relay for completing a holding circuit for the impulsing relay including the two windings of that relay and the talking conductors of the trunk in series, and means responsive when the call is answered for disconnecting the impulsing relay from the trunk conductors and for completing a local holding circuit for that relay.

In witness whereof, I hereunto subscribe my name this fifth day of October, A. D. 1927.

VICTOR S. THARP.

In witness whereof, I hereunto subscribe my name this fifth day of October, A. D. 1927.

JOHN WICKS.