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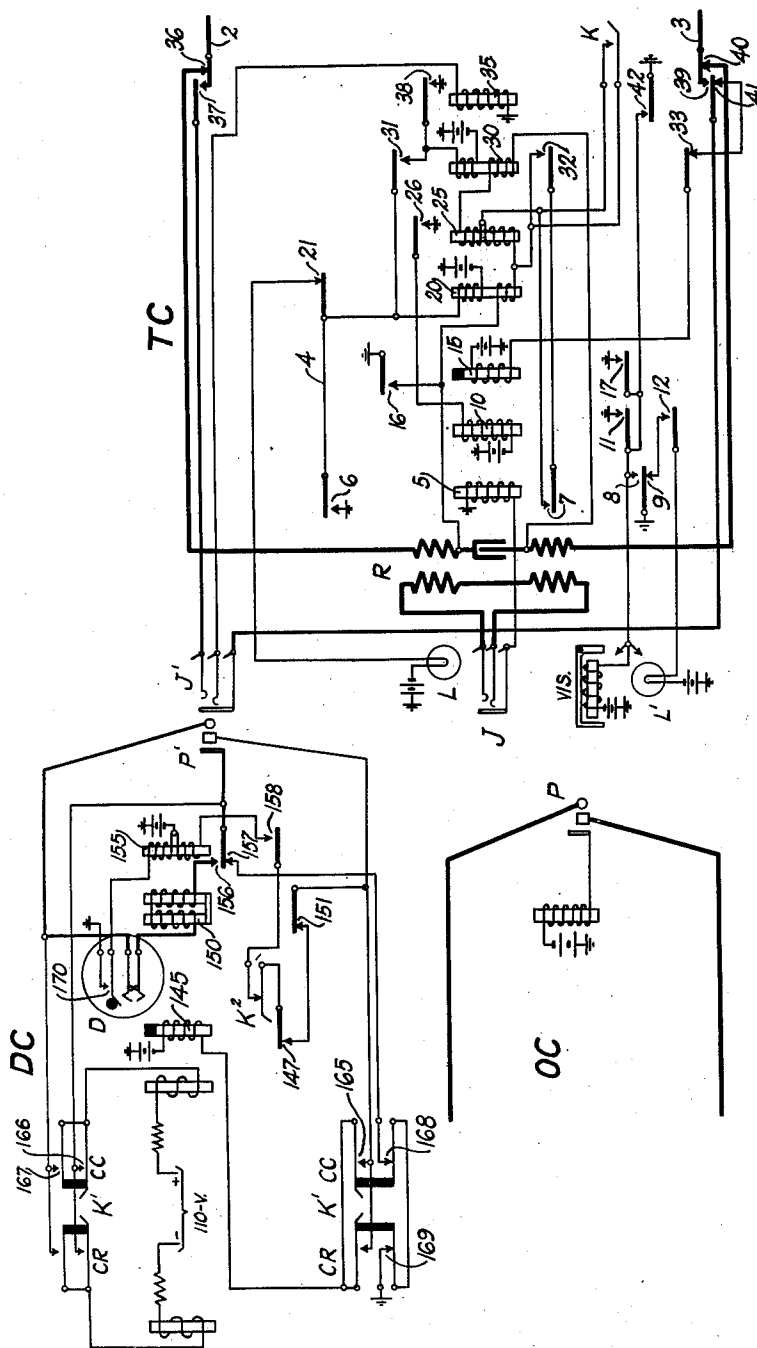
V. S. THARP ET AL

**1,792,452**

## TOLL TRUNKING SYSTEM

Original Filed Jan. 28, 1928 3 Sheets-Sheet 1

Fig. 1



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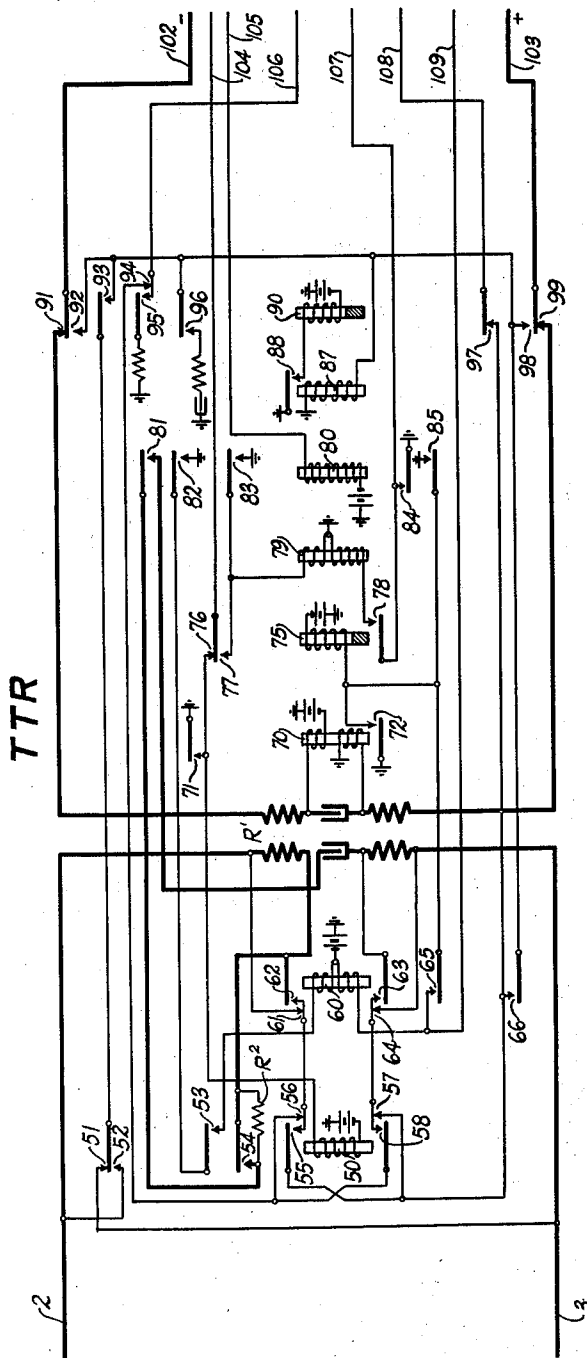
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3 Sheets-Sheet 2

Fig. 2



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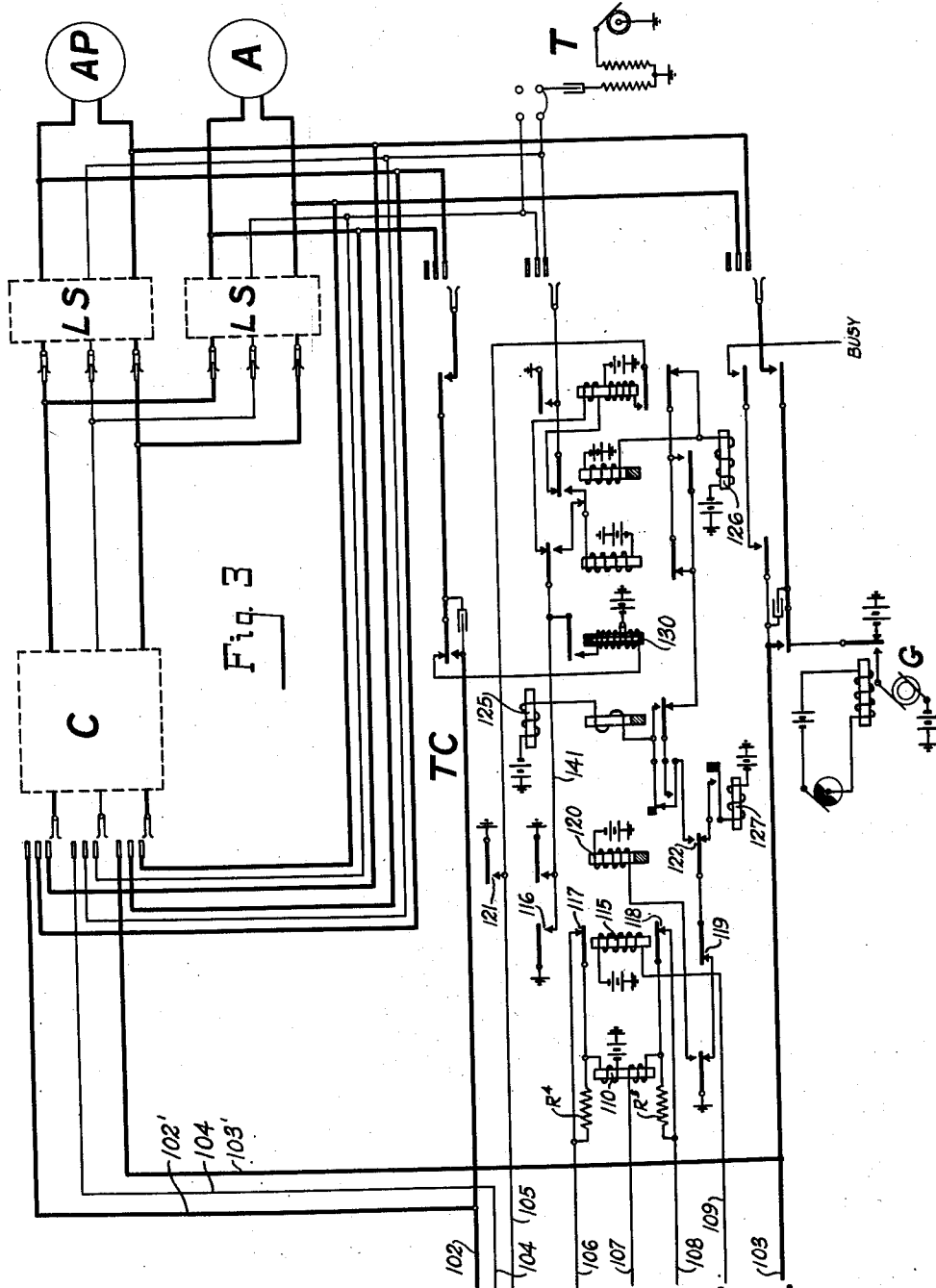
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TOLL TRUNKING SYSTEM

Original Filed Jan. 28, 1928 3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

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## TOLL TRUNKING SYSTEM

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This invention relates to telephone systems in general, but is more particularly concerned with automatic toll trunking systems.

In the more common telephone exchange systems, in the establishment of a toll connection, a calling subscriber in calling long distance extends a connection to an operator over a toll recording trunk to give her the information concerning the wanted long distance connection. The toll operator, after she has established the wanted connection recalls the calling subscriber over a separate toll service trunk. The main object of this invention is the production of a combination toll recording and toll service trunk over which a calling subscriber may call a toll operator and over which the toll operator may also call a subscriber.

In telephone systems having both flat rate lines and pay station lines a toll operator in answering a call is usually informed in some manner, as by a distinctive tone, when she answers the call as to the kind of line over which the call is being originated. A particular feature of this invention is the production of suitable trunk circuits and toll transmission repeater circuits for the combination trunk which functions to give the operator a distinctive tone when a call is extended to her from a pay station line and which permit the toll operator to remove the tone from the trunk line prior to the establishment of the talking connection with the calling subscriber.

The invention will be described in detail in the following specification with the aid of the accompanying drawings comprising Figures 1, 2, and 3, which show by means of the usual circuit diagrams a schematic layout of a toll service trunking system embodying the principles of the invention. The drawings are to be placed in numerical order from left to right with the corresponding lines in alignment.

The apparatus shown in Figure I is located at the main toll board. The trunk comprising conductors 2 and 3 extends from the main toll board to an automatic exchange. At the toll board the trunk is provided with a talking jack J, a dialling jack J', a busy

visual VIS, a call lamp L', a supervisory lamp L, and the controlling trunk circuit TC. A toll operator's cord circuit OC terminating in the plug P is shown in skeleton. The toll operator is furnished with one dialling cord DC terminating in the plug P' with which the dial D and the coin collect and refund equipment is permanently associated.

At the automatic exchange, the trunk comprising conductors 2 and 3 terminates in a toll transmission repeater TTR, which is permanently associated with the toll connector TC. The toll connector TC has access to subscribers' lines such as the flat-rate line of substation A and the pay-station line of substation AP. The subscribers' lines terminate in lineswitches, such as lineswitches LS and LS', which may be of the regular rotary type. The lineswitches have access to switching through rotary connectors, such as connector C. The switching through rotary connectors may be like the connector shown and described in the Patent No. 1,582,226 granted to Arthur J. Ray, April 27, 1926. The connectors such as C have access in common with the toll connectors to the subscribers' lines, and in addition have access in their switching through level to the combination trunks extending to the toll board by way of the toll transmission repeaters.

It is assumed that the paystations such as AP are of the type in which the collection or refund of coins is controlled by the application of either positive 110 volts or negative 110 volts to the talking conductors. A distinctive tone current generated by the tone machine T is superimposed on the private normal conductors of the paystation lines for the purpose to be described presently.

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 subscriber at the paystation AP desires a connection with a subscriber at some distant point. To initiate this connection, the subscriber at paystation AP removes his receiver and dials the long distance number. Responsive to the

removal of the receiver, lineswitch LS operates in the usual manner and extends the connection to an idle connector which will be assumed to be connector C. Responsive to the dialling of the long distance number, connector C operates to raise its wipers opposite the level of bank contacts corresponding to the digit dialled and then automatically selects an idle trunk accessible in that level.

The trunk selected will be assumed to be the one comprising conductors 2 and 3 accessible by way of conductors 102', 103', and 104, and the toll transmission repeater TTR.

When the connection is extended to this trunk, a bridge is placed across the conductors 102 and 103 closing the circuit of the battery feed relay 70 in the toll transmission repeater TTR. Relay 70 energizes and closes a circuit for relay 50 at contacts 71, and closes a circuit for release relay 75 at contacts 72. Relay 75 energizes and connects the grounded upper winding of the tone transformer 79 to the release conductor 104 at contacts 77, and connects the grounded lower winding of the tone transformer 79 to conductor 107 connected to the normally free upper terminal of the lower winding of impulsing relay 110 of the toll connector TC at contacts 78.

It should be noted that the upper terminal of the upper winding of impulsing relay 110 is normally connected via contacts 117, conductor 106, contacts 94, 56, and 61, to trunk conductor 2, while the lower terminal of the lower winding of impulsing relay 110 is normally connected via contacts 118, conductor 108, contacts 97, 57, and 64, to trunk conductor 3. Relay 50 operates when its circuit is closed at contacts 71 by the operation of relay 70 and prepares the circuit of relay 60 at contact 53, short-circuits resistance R2 at contact 54, and reverse the connections of the impulsing relay 110 with respect to the trunk conductors 2 and 3. By the connection of ground through the tone transformer 79 to the normally free terminal of the lower winding of the impulsing relay 110, this relay is bridged across trunk conductors 2 and 3 thus completing a circuit which includes the lower winding of relay 20, both windings of relay 25 and the lower winding of relay 30 normally bridged across the trunk conductors at the toll board. Due to the relatively high resistance of the lower winding of relay 25, relay 25 alone operates in this circuit at this time, closing the circuit of relay 10 at contacts 26. Relay 10, in operating, closes a circuit for the busy visual VIS at contacts 11 and closes the circuit of the call lamp L' at contacts 12. Visual VIS operates, indicating that this trunk is busy. The lighting of the lamp L' indicates to the toll operator that a call is being extended.

Noting the lighted condition of the lamp L', the toll operator inserts the plug of an idle cord, such as plug P, into jack J to answer the call. Inserting plug P into jack J closes the circuit for sleeve relay 5. Relay 5, in energizing, opens the circuit of lamp L' by separating contacts 9 and closes a holding circuit for busy visual VIS at contacts 8, and grounds conductor 4 at contacts 6, thereby closing a circuit for the polarizing winding of relay 20. The direction of the current over the trunk conductors 2 and 3 at this time is such as to cause the operation of relay 20 when polarized, which by separating contacts 21 prevents the lighting of the supervisory lamp L at this time.

Since a tone current from the tone machine T is superimposed on the private normal conductor of paystation AP now connected to the release conductor 104 and the upper winding of the tone transformer 79, a tone current is induced in the lower winding of the tone transformer 79 which is now connected to trunk conductor 2. A tone is therefore heard by the toll operator, which informs her that the call has been initiated from a paystation.

After being so informed, the operator presses key K thereby short-circuiting the high resistance lower winding of relay 25. The current in the circuit including the trunk conductors 2 and 3 is thereby sufficiently increased to cause the operation of relay 30 at the toll board, and the operation of impulsing relay 110 in the toll connector TC at the automatic exchange. Relay 30, in operating, closes a holding circuit for itself to conductor 4 at contacts 31, short-circuits the lower winding of relay 35 independent of key K at contacts 32, contacts 7 being closed, and incidentally disconnects relay 15 from the sleeve of jack J' at contacts 33. Relay 110, in energizing, closes the circuit of release relay 120. Release relay 120, in operating, grounds conductor 105 at contacts 121, thereby closing the circuit of the tone removal relay 80 in the toll transmission repeater TTR. Relay 80, in operating, short-circuits the upper and lower windings of the tone transformer 79 at contacts 83 and 84, respectively. Thus no more tone current can be induced in the lower winding of the tone transformer 79 and as a result the tone is removed from the line. Relay 80, in operating, also prepares the talking circuit by closing contacts 81 and closes a circuit for the repeating coil control relay 60 at contacts 82. Relay 60, in energizing, places relay 110 in bridge of conductors 2 and 3 in series with the left hand windings of the repeating coil R' instead of directly across conductors 2 and 3 by separating contacts 61 and 64 and closing contacts 62 and 63. Relay 60, by closing contacts 65 closes a holding circuit for its lower winding and closes a circuit for relay 115 in the toll connector

TC, and by closing contact 66 prepares the circuit for the high voltage coin control relay 87. Relay 115, in operating, places an additional ground connection on holding conductor 141 at contacts 116, opens a point in the release magnet circuit at contacts 119, and removes the short-circuit from resistances R4 and R5 at contacts 117 and 118, the purpose of which will be described later. Though the current in the circuit of relay 110 is reduced, relay 110 remains operated.

Thus, by the operation of key K, the tone is removed, and the talking circuit is completed. The toll operator may now converse with the calling subscriber to obtain the necessary information concerning the desired connection.

Having heard the tone, the toll operator knows that the call is coming from a paystation and therefore requests the calling subscriber to deposit the required coins. With the present connection remaining intact, the toll operator now completes the connection to the distant point in the usual manner, after which conversation between the calling subscriber and distant called subscriber may take place.

Should the toll operator wish to replace the tone on the line for verification purposes anytime before she finally completes the talking connection, she may do so by momentarily removing plug P from jack J. When plug P is removed from jack J, relay 5 falls back and opens the holding circuit of relay 30 at contacts 6, and also opens the shunt around the high resistance lower winding of relay 25 at contacts 7. Relay 30 falls back and opens another point in its locking circuit at contact 31 and also another point in the shunt circuit at contacts 32. The current in the circuit of impulsing relay 110 in the toll connector is now sufficiently reduced to cause relay 110 to fall back, which in turn causes release relay 120, to also fall back. Relay 120, in restoring, opens the circuit of relay 80, and relay 80, in restoring, removes the short-circuit around the windings of tone transformer 79. As a result, the tone is again placed on the line.

When the operator again inserts the plug P into jack J, she again hears the tone. It is removed when she again operates key K, as previously described.

At the termination of the conversation, the calling subscriber replaces his receiver. This opens the circuit of the battery feed relay which, in deenergizing, opens the circuit of reversing relay 50 at contacts 71, and opens the initial energizing circuit of release relay 75 at contacts 72. Relay 75, however, remains energized over the circuit including contacts 85. Relay 50, in deenergizing, reverses the connections of the impulsing relay 110 with respect to the trunk conductors 2 and 3, thereby reversing the current over the

trunk conductors 2 and 3. This reversal of current over the trunk conductors 2 and 3 causes the polarized relay 20 at the toll board to deactuate and close the circuit of lamp L at contacts 21. The lighting of the lamp L indicates to the toll operator that the calling subscriber has replaced his receiver.

After receiving the disconnect signal, the toll operator proceeds to collect the coins deposited by the calling subscriber. To do this the toll operator inserts the plug P' of the cord DC into the jack J', and then throws the key K' to the right (coin-collect position). A circuit is thereby closed for relay 145 in the cord DC in series with relay 35 of the trunk circuit TC, the circuit including contacts 165 and the ring of plug P' and jack J'. Relay 35 operates and connects the sleeve of jack J' to conductor 3 at contacts 39 and connects the tip of jack J' to conductor 2 at contacts 37. By the closure of springs 166 and 167, 110 volts positive potential is applied by way of the tip and sleeve of plug P' and jack J' to conductors 2 and 3. The application of 110 volts to conductor 3 causes the operation of the high voltage coin control relay 87 over the circuit extending from conductor 3, through the lower left hand repeating coil winding of repeating coil R', contacts 63, contacts 57, 66, through winding of relay 87. Relay 87, in operating, closes the circuit for relay 90 at contacts 88. Relay 90, in energizing, places a short-circuiting bridge across conductors 102 and 103 at contacts 92 and 98 and connects conductor 3 to this bridge at contacts 93 via contacts 51, thereby causing 110 volts to be applied to the two trunk conductors 102 and 103 which brings about the collection of the coins at the paystation in the well known manner. During this time relay 110 is disconnected from the trunk conductors 2 and 3 at contacts 94 and 97, though a holding circuit for its upper winding is maintained at contacts 95. It should be noted that before relay 90 is operated, there is a circuit for the 110 volt supply to ground through the windings of relay 110, but, since the short-circuits around resistances R4 and R5 have been removed by the operation of relay 115 insufficient current is shunted to ground through relay 110 to interfere with the operation of relay 87.

By following the same procedure, the operator may collect the coins before the calling subscriber has hung up. In such case, relay 50 is still energized, and therefore the initial circuit for energizing relay 87 extends from conductor 2, through the upper left hand winding of repeating coil R', contacts 62, 55, and 66. The 110 volt potential is then applied to conductors 102 and 103 by way of conductor 2, contacts 52 and 93.

Had the connection not been completed, and had the toll operator wished to refund the coins for that reason or any other reason,

she would likewise have inserted the plug P' into the jack J' and operated the key K' to the left (to the coin-return position). Such operation results in the application of negative 110 volts to the conductors 102 and 103 and causes the refund of the coin in the usual manner.

After the toll operator has collected (or refunded) the coins she removes the plug P from the jack J, and the plug P' from the jack J'. Removing plug P from jack J causes the release of relay 5 which in turn opens the short-circuit around the high resistance lower winding of relay 25, and by removing ground from conductor 4 opens the holding circuit of the upper winding of relay 30 and the polarizing circuit of relay 20. By the removal of the short-circuit around the high resistance lower winding of relay 25, the current in the circuit including trunk conductors 2 and 3 and the windings of the impulsing relay 110 in the toll connector TC at the automatic exchange is decreased sufficiently to cause relay 110 to deenergize. Relay 110, in deenergizing, opens the circuit of release relay 120 which in turn deenergizes and removes ground from the conductor 105 thereby opening the circuit of relay 80. Relay 80, in deenergizing, opens the circuit over which relays 75, 60, and 115 are being held by separating contacts 85, and also removes direct ground from the release conductor 104 by separating contacts 83. Relay 75, in deenergizing, disconnects ground through the upper winding of tone transformer 77 from the release conductor 104 whereupon the connector C and the lineswitch LS return to normal.

A connection from a flat rate line to the toll operator is completed in the same way as the previously described connection. In such a connection, however, since the private normal conductor of flat rate lines are free from tone, the operator hears no tone upon inserting the plug of her cord into the jack of the trunk over which the call is extended. In not hearing a tone, the toll operator is informed that the line over which the call is being initiated is a flat rate line and thus makes the proper charge for the call rather than asking for coins to be deposited. It should be noted, however, that in this case as in the previous case, to establish a talking connection the operator must operate the tone removal key K to cause the operation of the impulsing relay in the toll connector and the tone removal relay in the toll transmission repeater, as previously described.

To describe the manner in which a connection is established from the toll operator to an automatic exchange subscriber, let us assume that the toll operator has received a long distance call for the subscriber at substation AP. Upon receiving such a call, the toll operator inserts the plug P' of her

dialling cord DC into the dialling jack of an idle trunk extending to the automatic exchange, jack J' for example, and then dials the directory number of the called subscriber. Inserting plug P' into jack J' closes a circuit which extends from ground by way of contacts 169, 168, 157, sleeve of plug P' and jack J', contacts 41, 33, through the winding of relay 15 to battery. The relay 15 operates and closes a circuit for the busy visual VIS at contacts 17 and at contacts 16 closes a circuit which extends from ground, through the upper right hand winding of repeating coil R, contacts 36, over conductor 2 to the automatic exchange, contacts 61, 56, 94, conductor 106, contacts 117, through the upper winding of impulsing relay 110 of toll connector TC to battery. Relay 110 operates over this circuit and closes the circuit of release relay 120. Release relay 120 operates and grounds conductor 105 at contacts 121 and prepares the connector TC for operation in the usual manner. Relay 80 operates from ground on the conductor 105 and connects ground to the upper terminal of the lower winding of relay 110 at contacts 84, thereby bridging relay 110 directly across the conductors 2 and 3 as previously described. Relay 80, in operating, also prepares the circuit for relay 60 at contacts 82, closes a point in the talking circuit at contacts 81, and closes a circuit for release relay 75 at contacts 85. Relay 75 operates and at contacts 77 grounds the release conductor 104 via closed contact 83 to mark this trunk busy to the local connectors having access thereto.

When the dial D is moved off normal to be set for the first digit, springs 170 are closed and a circuit is established for the upper winding of relay 155. Relay 155 operates and closes a locking circuit for itself at contacts 158 in series with relay 35 over the circuit including springs of key K<sup>2</sup>, contacts 147, 151, and ring plug P' and jack J'. By the closure of contacts 156, dial D is bridged across the tip and sleeve of jack J' in series with polarized relay 150. Relay 35, in operating, closes another circuit for busy visual VIS at contacts 42, opens the circuit of relay 15 at contacts 41, causes relay 30 to operate by closing a circuit for its upper winding at contacts 38 and connects the tip and sleeve conductors of jack J' directly to trunk conductors 2 and 3 at contacts 37 and 39. Relay 15 deenergizes and removes the ground potential from conductor 2 by separating contacts 16.

Impulsing relay 110 in the toll connector TC at the automatic exchange is now under the control of the dial D, now being energized over its two windings and conductors 2 and 3 in series, and in response to the impulses of the first digit causes the vertical magnet 125 to step the wipers of the connector TC

opposite the level of bank contacts corresponding to the digit dialled. Upon the dial returning to normal, the initial energizing circuit of relay 155 is opened but the relay remains operated over its holding circuit including its lower winding. Responsive to the dialling of the second digit, impulsing relay 110 in the toll connector TC again operates, causing the rotary magnet 126 to rotate the switch wipers into engagement with the set of bank contacts terminating the line to substation AP.

It should be noted that during impulsing, the impulsing relay 110 is bridged by the left hand windings of repeating coil R', condenser CC and resistance R2 in series, which, as shown by test, greatly improves the operating characteristics of relay 110.

If the operator did not insert the plug of the cord selected to extend the talking connection into the jack J before she commenced dialling, she will do so immediately after she has finished dialling. When she does so, relay 5 energizes and closes another circuit for the visual VIS and lights the lamp L. If the subscriber's line is busy, the operator will receive the busy tone, in the usual manner. If the subscriber's line is idle, however, the toll operator will hear the usual ring-back tone and the called subscriber will be signalled.

When the called subscriber responds, the ring cut-off relay 130 in the toll connector TC operates to open the ringing circuit and close points in the talking connection, after which relay 70 in the toll transmission repeater TTR operates and at contacts 71 closes the circuit of reversing relay 50. Relay 50, in operating, reverses the current over the trunk conductors 2 and 3 thereby causing the operation of polarized relay 150 in the dialling cord DC. Relay 150, in energizing, opens the holding circuit of relay 155, which includes relay 35 in series, by separating contacts 151. Relay 35 deenergizes and disconnects the tip and sleeve of jack J' from conductors 2 and 3 and again connects the conductors to the right hand windings of repeating coil R, thereby completing the talking connection. The lower winding of relay 20, the upper winding of relay 25, and the lower winding of relay 30 of the trunk circuit TC are now bridged across the trunk line, the lower winding of relay 25 being short-circuited at contacts 7 in series with contacts 32, and since relay 50 in the toll transmission repeater is energized, the current in this circuit is such as to cause the operation of relay 20. Relay 20, in operating, opens the circuit of lamp L. The extinguishing of lamp L indicates to the toll operator that the called subscriber has answered.

The toll operator may remove the plug P' from the jack J' as soon as she has completed dialling, or anytime later. As described above she will be notified when the called sub-

scriber answers even though the plug P' is in the jack J'. When the called subscriber replaces his receiver, at the termination of the conversation, the lamp L at the toll board lights in the manner previously described and the connection is released responsive to the removal of the plug P from the jack J by the toll operator.

It should be noted that should the toll operator remove the plug P from the jack J while the called subscriber still has his receiver to his ear, the connection would not be released. Relays 110 and 120 in the toll connector TC and relay 80 in the toll transmission repeater TTR would release, but relay 60, being locked under the control of relay 70 would maintain the circuit for relay 115 in the toll connector TC closed. Relay 115, in turn, would maintain the circuit of release magnet 127 open at contacts 119.

The inventor is aware that his invention lends itself to many modifications, he does not wish to be limited to the specific embodiment disclosed herein. For example, the invention can readily be adapted to larger exchange systems by terminating the incoming trunks in selectors having access to the toll transmission repeaters, or by associating selectors with the toll transmission repeaters, which then have access to the toll connectors, in the well known manner. What he considers new and desires to have protected by Letters Patent is specifically pointed out in the appended claims.

What is claimed is:

1. In a telephone system, a toll board, a trunk extending to said toll board, a calling line, means for extending a connection from said line to said toll board via said trunk, a line relay associated with said trunk, a source of tone current, means for bridging said relay across the conductors of said trunk in series with said source when said connection is extended, means controlled by the operator at said toll board for increasing the current in the circuit of said relay to cause said relay to operate, and means controlled by said relay for short-circuiting said tone source.

2. In a telephone system, a toll board, a trunk line, extending to said toll board, means for extending a connection to said toll board via said trunk, a source of tone current and means for connecting it to said trunk when a connection to said toll board is extended via said trunk, means at the toll board for increasing the current flow over said trunk, and means responsive to said increase for disabling said tone source.

3. In a telephone system, a toll board, an automatic exchange, an interconnecting trunk, an automatic switch terminating said trunk at said exchange, an impulsing relay in said switch for controlling the operation of the switch, a calling circuit at said toll

board, means for connecting it to said trunk, and means responsive to the connection of said calling circuit to said trunk for bridging said impulsing relay across the conductors of said trunk.

4. In a telephone system, a toll board, an automatic exchange, an interconnecting trunk, a calling circuit at said toll board and means for connecting it to said trunk, an impulsing relay at said exchange, means responsive to the connection of said calling circuit to said trunk for operating said impulsing relay, and means responsive to the operation of said impulsing relay for bridging said impulsing relay across the conductors of said trunk.

5. In a telephone system, a toll board, an automatic exchange, an interconnecting trunk, a calling circuit at said toll board and means for connecting it to said trunk, an impulsing relay at said exchange, means responsive to the operation of said impulsing relay for bridging said impulsing relay across the conductors of said trunk, means at said toll board responsive to the connection of said calling circuit to said trunk for operating said impulsing relay over one conductor of said trunk independent of the other conductor of said trunk.

6. In a telephone system, a trunk, a calling device and means for connecting it to one end of said trunk, an impulsing relay at the other end of said trunk operative responsive to the connection of said calling device to said trunk, and means responsive to the operation of said relay for placing said relay under the control of said calling device.

7. In a telephone system, a toll board, an automatic exchange, a calling circuit at said toll board and means for connecting it to said trunk, a battery, a double wound impulsing relay at said exchange having one of its windings connected to one conductor of said trunk and to one pole of said battery, means at said toll board responsive to the connection of said calling circuit to said trunk for operating said relay over said one winding, and means responsive to the operation of said relay for bridging the two windings of said relay across the conductors of said trunk in series with said battery.

8. In a telephone system, a trunk, a calling link and means for connecting it to one end of said trunk line, an impulsing relay at the other end of said trunk line, means responsive to the connection of said link to said trunk for bridging said relay across the conductors of said trunk, a calling device included in said link, and means responsive to the movement of said calling device for bridging the calling device across the conductors of said trunk.

9. In a telephone system, a trunk, an automatic switch terminating said trunk, an impulsing relay in said switch for controlling the

operation of the switch, a first branch normally connected to said trunk, a second branch normally disconnected from said trunk, a calling link and means for connecting it to said second branch, means responsive to the connection of said calling link to said second branch for bridging said relay across the conductors of said trunk, a calling device included in said link, and connecting means responsive to the movement of said calling device for connecting said second branch to said trunk to place said relay under the control of said calling device and for disconnecting said first branch from said trunk.

10. In a telephone system having a trunk line over which connections to and from paystations may be established, in which coins deposited at a paystation when a connection has been established therefrom over said trunk lines are collected by the application of high voltage to the trunk conductors, and in which the operation of an automatic switch to extend a connection to a paystation is controlled by a relay connected to said trunk, means for inserting a resistance in the circuit of said relay when a call extended from a paystation over said trunk is answered to prevent an appreciable flow of current through the line relay when high voltage is applied to the trunk conductors.

11. In a telephone system, a trunk, an impulsing relay and means for bridging it across the conductors of said trunk, a normally short-circuited resistance connected in series with said relay, an automatic switch, means for operating said relay to cause said switch to extend a connection, and means responsive when the call is answered for removing the short-circuit from said resistance.

12. In a telephone system, an exchange, a trunk line extending to said exchange, a repeating coil, said trunk having two sections at said exchange inductively coupled by said repeating coil, a line relay at said exchange normally connected to the first section exclusive of any windings of said repeating coil, an automatic switch and means for operating it under the control of said relay to extend a call, a resistance, means for bridging windings of said repeating coil in series with said resistance across the windings of said relay, and means responsive when the call is answered for connecting said relay to said first section in series with windings of said repeating coil and for short-circuiting said resistance.

13. In a telephone system, a repeating coil, a trunk line terminating in said repeating coil, a line relay normally connected to said trunk independent of said repeating coil, means controlled by said relay for extending a call over said trunk line, a resistance, means for bridging said repeating coil across the relay in series with said resistance while the call is being extended, and means responsive

when the call is answered for connecting said relay to said trunk in series with said repeating coil and for short-circuiting said resistance.

14. In a telephone system, a toll board, an exchange, an interconnecting trunk accessible at the toll board for extending connections to the exchange and accessible at the exchange for extending connections to the toll board, a line relay at the exchange, a source of tone current, means responsive to the seizure of said trunk at the exchange for bridging said relay across the conductors of said trunk in series with said source of tone current and means controlled by the operator at the toll board after she answers a call from the exchange and also responsive to the seizure of said trunk at the toll board to extend a connection to the exchange for bridging said relay across the conductors of said trunk independent of said source of tone current.

19. In a telephone system, a toll board an automatic exchange, a combination toll recording and toll service trunk extending from the toll board to the exchange, an automatic switch having access to said trunk for extending a toll connection to the toll board, a second switch at said exchange terminating said trunk for extending toll connections to the exchange, a pay station at the exchange, and means controlled from the toll board for applying high voltage to the conductors of said trunk to collect or refund coins deposited when a call is extended to the toll board from the pay station over said trunk.

20. In a telephone system, a toll board, an automatic exchange, lines at said exchange, a combination toll recording and toll service trunk over which toll calls from any line in the exchange to the toll board and from the toll board to any line in the exchange may be completed, means associated with the trunk for applying a distinctive tone current to the trunk conductors when a call is extended over said trunk from a particular line in the exchange, and means controlled from the toll board over said trunk for removing said tone current from the trunk conductors.

21. In a telephone system, a toll board, an automatic exchange, lines at said exchange, a combination toll recording and toll service trunk over which toll calls from any line in the exchange to the toll board and from the toll board to any line in the exchange may be completed, means associated with the trunk for applying a distinctive tone current to the trunk conductors when a call is extended over said trunk from a particular line in the exchange, means controlled from the toll board over said trunk for removing the tone current from the trunk conductors, and means controlled from said toll board over said trunk for re-applying said tone current to the conductors of the trunk.

22. In a telephone system, a toll board, a trunk line extending to said toll board, means for extending a connection to said toll board over said trunk line, a source of tone current and means for connecting it to said trunk line when a connection is extended to the toll board over said trunk line, means controlled over said trunk line for short-circuiting said tone source and for removing the short circuit from said tone source.

23. In a telephone system, a toll board, an exchange, an interconnecting trunk accessible

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15. In a telephone system, a toll board, an exchange, an automatic switch, a two-way interconnecting trunk terminating at the exchange in said switch, means for applying a tone current to the conductors of said trunk when a call is extended over said trunk to the toll board, a line relay at the exchange for removing said tone current from the conductor of said trunk when a call is extended to the toll board and for controlling the operation of said switch when a call is extended to the exchange, and means at the toll board for controlling the operation of said relay.

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16. In a telephone system, a toll board, an exchange, an automatic switch, a two-way interconnecting trunk terminating at the exchange in said switch, means for applying a tone current to the conductors of said trunk when a call is extended over said trunk to the toll board, a line relay at the exchange for removing said tone current from the conductors of said trunk when a call is extended to the toll board and for controlling the operation of said switch when a call is extended to the exchange, a calling device at the toll board for controlling said switch, means for connecting said calling device to the trunk, a key for operating said relay when a call is extended to the toll board, and means responsive to the connection of said calling device to said trunk for operating said relay.

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17. In a telephone system, a toll board, an automatic exchange, lines at said exchange, a combination toll recording and toll service trunk over which toll calls from any line in the exchange to the toll board and from the toll board to any line in the exchange may be completed, and means associated with the trunk for applying a distinctive tone current to the trunk conductors when a call to the toll board is extended over said trunk from a particular line in the exchange.

65 18. In a telephone system, a toll board, an

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ble at the toll board for extending connections to the exchange and accessible at the exchange for extending connections to the toll board, a line relay at the exchange, a source of tone current, means responsive to the seizure of said trunk at the exchange for bridging said relay across the conductors of said trunk in series with said source of tone current, means including said line relay controlled by the operator over said trunk for short circuiting said source of tone current and for removing the short circuit from said source of tone current.

24. In a telephone system, a toll board, a trunk extending from said toll board, a calling line, means for extending a connection from said line to said toll board over said trunk, a line relay associated with said trunk, a source of tone current, means for bridging said relay across the conductors of said trunk in series with said source of tone current when said connection is extended, means controlled by the operator at said toll board for increasing the current in the circuit of said relay to cause said relay to operate, means controlled by the operation of said relay for short-circuiting said source of tone current, and means controlled by the operator at said toll board for decreasing current in the circuit of said relay to cause said relay to deenergize and remove the short circuit from said source of tone current.

25. In a telephone system, a toll board, an automatic exchange, a combination toll recording and toll service trunk extending from the toll board to the exchange, an automatic switch controlled by means of a calling device at a calling substation connected thereto and having access to said trunk for extending a toll connection to the toll board, a second switch at said exchange terminating said trunk for extending toll connections to the exchange, a signal at said toll board, and means responsive to the seizure of said trunk either at the toll board or at the exchange for operating said signal.

26. In a telephone system, a toll board, an automatic exchange, a combination toll recording and toll service trunk extending from the toll board to the exchange, an automatic switch controllable by means of a calling device at a calling substation connected thereto and having access to said trunk for extending a connection to the toll board, a second switch at said exchange terminating said trunk for extending toll connections to the exchange, a signal at said toll board, and means responsive to the seizure of said trunk at said exchange for operating said signal.

27. In a telephone system, a toll board, an automatic exchange, a combination toll recording and toll service trunk extending from the toll board to the exchange, an automatic switch at said exchange terminating said trunk for extending toll connections to the ex-

change, a calling line at said automatic exchange, a second automatic switch accessible to said calling line and having access to said trunk under the control of a calling device at said calling line, a signal at said toll board, means responsive to the seizure of said trunk by said automatic switch for operating said signal, a link circuit at said toll board for answering calls on said trunk, and means responsive to the connection of said link circuit to said trunk for answering a call to terminate the operation of said signal.

28. In a telephone system, a toll board, an automatic exchange, a combination toll recording and toll service trunk extending from the toll board to the exchange, an automatic switch at said exchange terminating said trunk for extending a toll connection to the exchange, a calling line, a second automatic switch accessible to said calling line and having access to said trunk under the control of a calling device at said calling line, a link circuit at said toll board, means for connecting said link circuit to said trunk for answering a call extended over said trunk from said calling line, a signal at the toll board, means responsive to the connection of said link circuit to said trunk for answering a call extended from said calling line over said trunk for preparing an operating circuit for said signal, and means responsive to the restoration of the receiver at said calling line for operating said signal over said prepared circuit.

29. In a telephone system, a toll board, an automatic exchange, a combination toll recording and toll service trunk extending from the toll board to the exchange, an automatic switch controllable by means of a calling device at a calling substation connected thereto and having access to said trunk for extending a toll connection to the toll board, a second switch at said exchange terminating said trunk for extending a toll connection to the exchange, a section of said trunk at said toll board, a second section of said trunk at said toll board, and a repeating coil inductively connecting said first section to said second section for completing a talking circuit over said trunk.

30. In a telephone system, a toll board, an automatic exchange, a combination toll recording and toll service trunk extending from the toll board to the exchange, an automatic switch controllable by means of a calling device at a calling substation connected thereto and having access to said trunk for extending a toll connection to the toll board, a second switch at said exchange terminating said trunk for extending toll connections to the exchange, a relay at said exchange, and means responsive to the seizure of said trunk at either the toll board or the exchange for bridging said relay across the conductors of said trunk.

31. In a telephone system, a toll board, an

automatic exchange, a combination toll recording and toll service trunk extending from the toll board to the exchange, an automatic switch controllable by means of a calling device at a calling substation connected thereto and having access to said trunk for extending a toll connection to the toll board, a second switch at said exchange terminating said trunk for extending toll connections to the exchange, a relay at said toll board bridged across the conductors of said trunk, and means controlled by the operator at said trunk board for short-circuiting a part of the winding of said relay to increase the flow of current in the conductors of said trunk.

32. In a telephone system, a two-way trunk line connecting an automatic exchange and a manual exchange, an incoming branch and an outgoing branch at the automatic exchange, a normally connected talking branch and a normally disconnected control branch at the manual exchange, a calling device and means for connecting it to said control branch, and means responsive to the operation of said calling device for connecting said control branch to the trunk line and for disconnecting said talking branch therefrom.

33. In a telephone system, a trunk line terminating in an automatic switch, a first branch normally connected to the trunk line, a second branch normally disconnected from the trunk line, a calling device and means for connecting it to said second branch, connecting means responsive to the movement of said calling device for substituting said second branch for said first branch, said switch being thereafter controlled by said calling device to extend a call, a manually operated key for disabling said connecting means, and means responsive to the answering of the call for disabling said connecting means in case said key has not been operated.

34. In a telephone system, a two-conductor trunk terminating in a manual jack at one end and in an automatic switch at the other end, a calling device and associated plug adapted to cooperate with said jack, a double wound line relay for said switch, an operating circuit for said relay including one winding of the relay and one conductor of the trunk completed responsive to the insertion of said plug into said jack, and a control circuit for said relay including the two windings of the relay and the two conductors of the trunk line in series completed responsive to the off-normal movement of said calling device.

In witness whereof, I hereunto subscribe my name this 16th day of January, A. D. 1928.

VICTOR S. THARP.

In witness whereof, I hereunto subscribe my name this 16th day of January, A. D. 1928.

THOMAS F. CROCKER.