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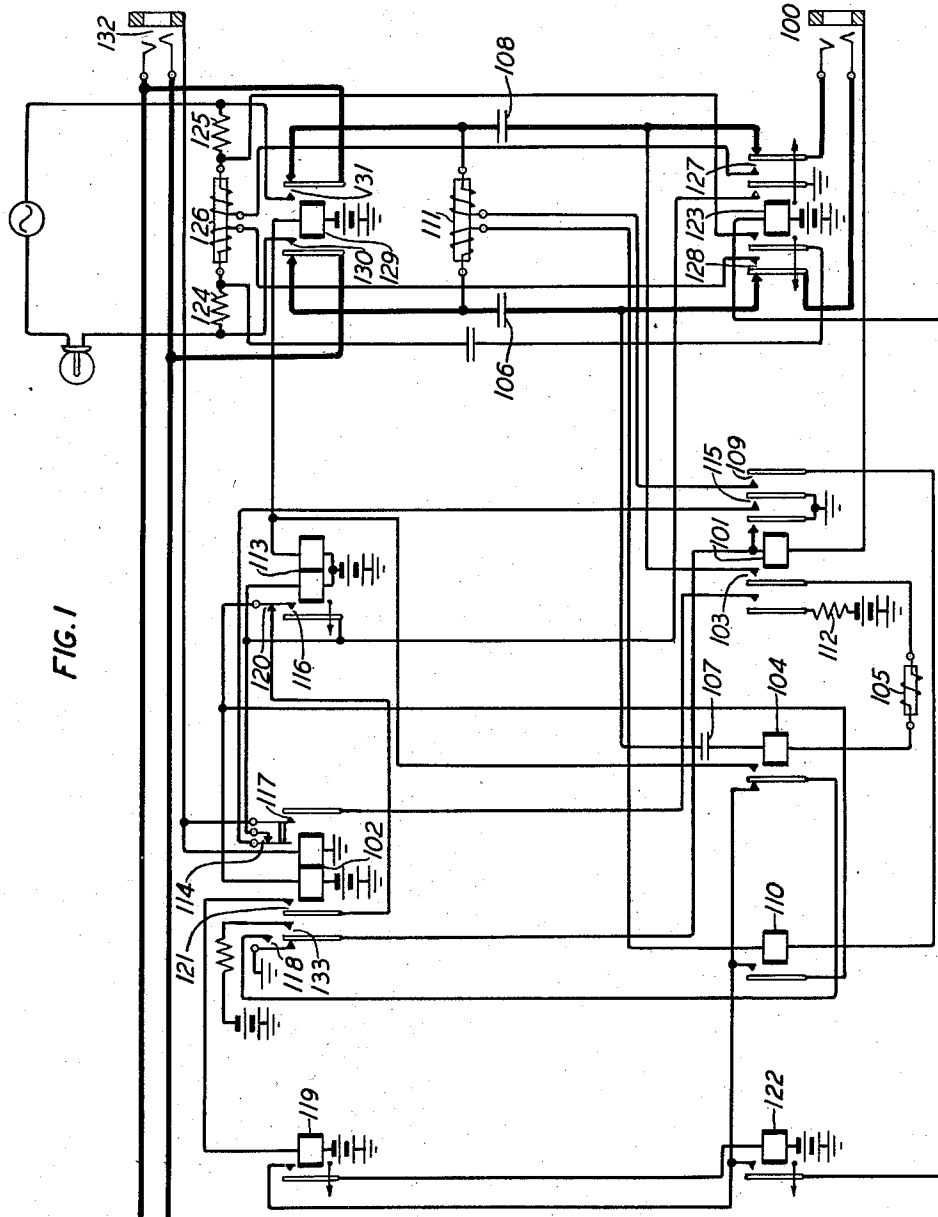
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2,006,483

TELEPHONE EXCHANGE SYSTEM

Filed May 12, 1933

3 Sheets-Sheet 1



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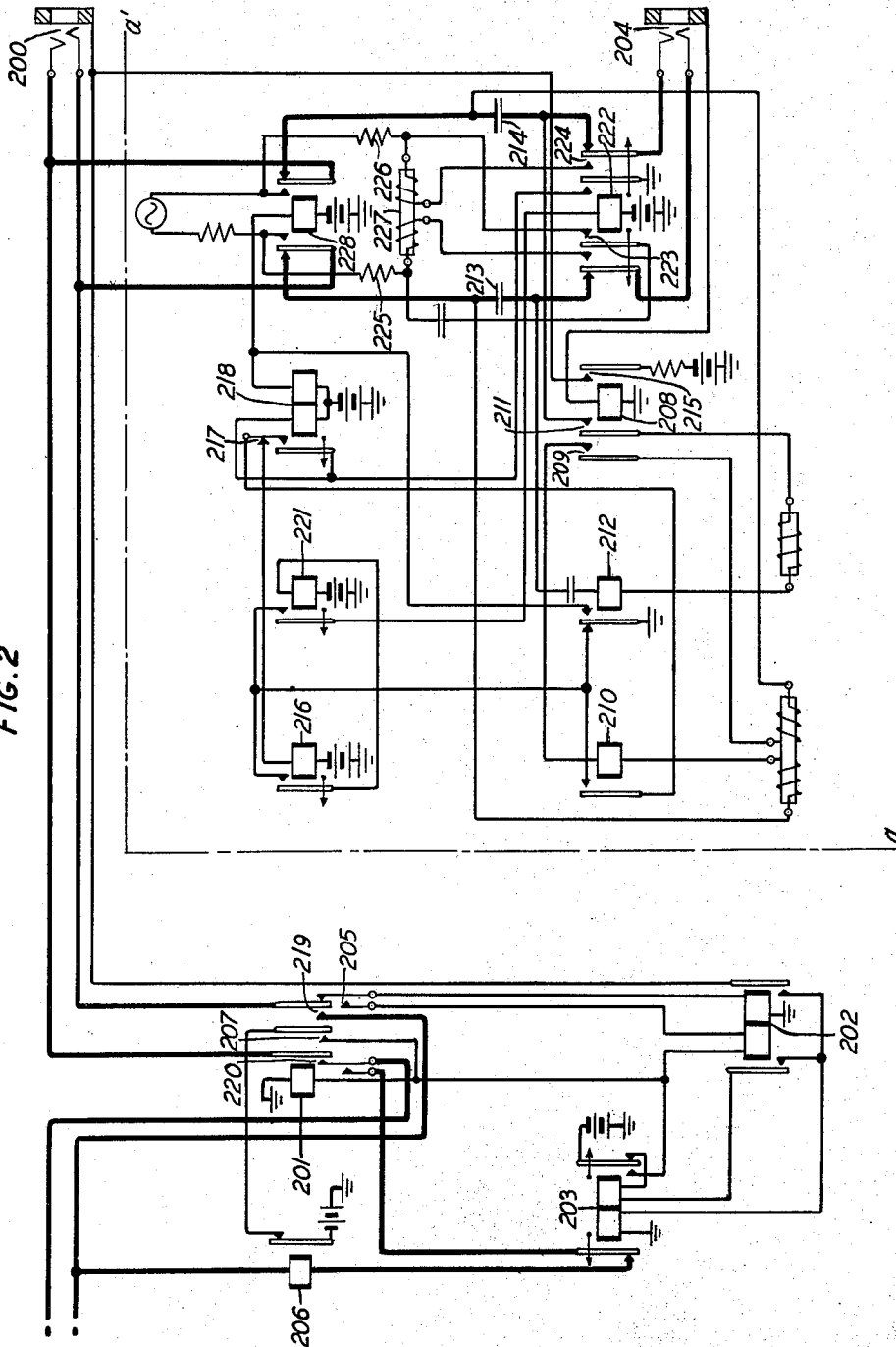
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FIG. 2



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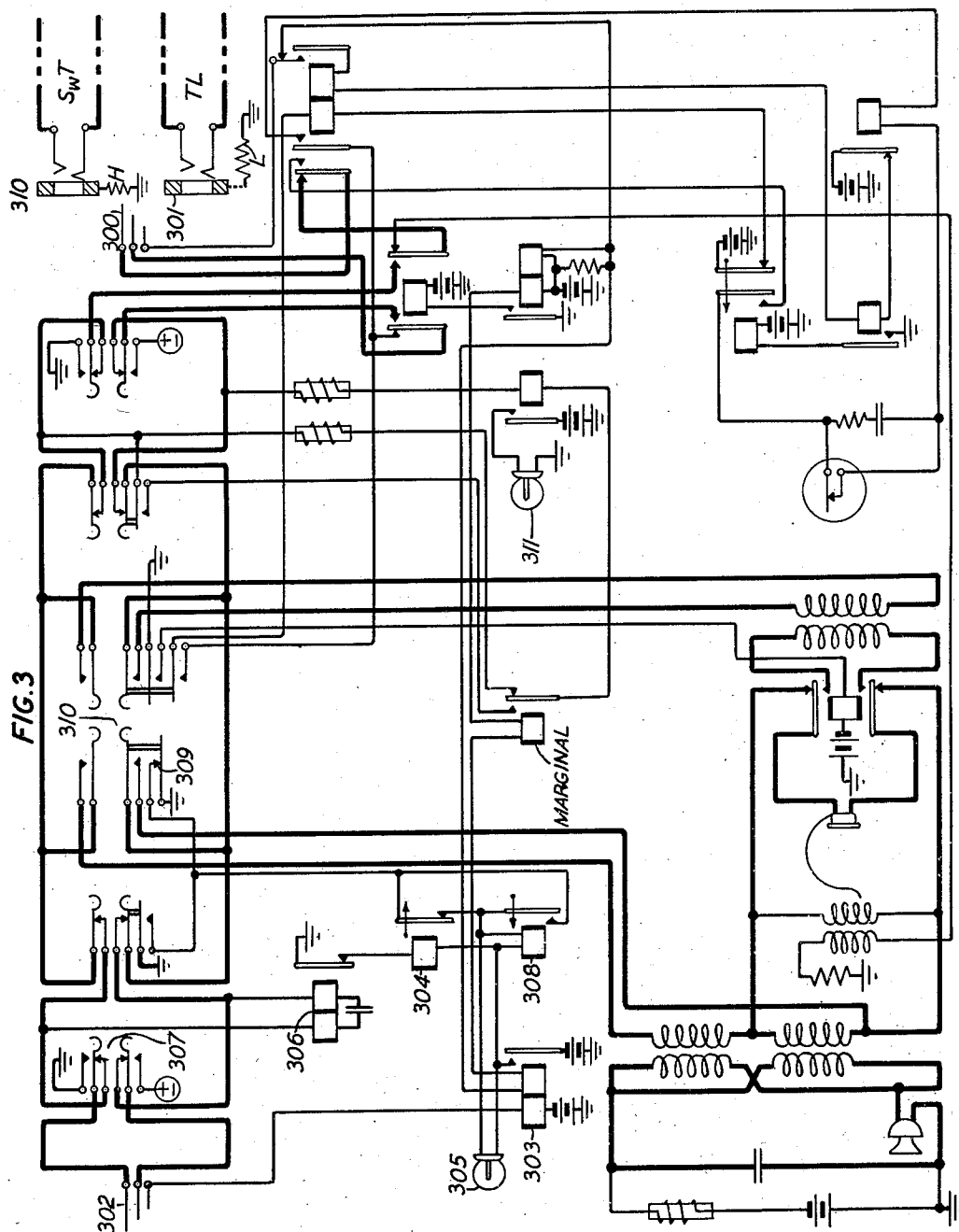
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2,006,483

TELEPHONE EXCHANGE SYSTEM

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Application May 12, 1933, Serial No. 670,714

4 Claims. (Cl. 179—41)

This invention relates to telephone systems and more particularly to trunk circuits terminating at a toll operator's position.

In present day telephone practice trunk circuits both incoming to and outgoing from a toll board are arranged for direct current supervision, whereas the regular cord circuits used at some toll positions are so arranged that but one end can be used with trunk circuits, the other end of such cords being adapted for magneto supervision only, i. e., for use only with magneto toll lines.

It is often desirable that a toll operator be able to complete a connection between two trunk circuits by means of one of her regular cord circuits. This, however, is not possible with present standard toll cords of the type mentioned.

An object of the present invention, therefore, is to permit the operative connection of a magneto cord circuit to a direct current supervision trunk line.

Another object of the invention is to enable a toll operator to connect two direct current supervision trunk circuits by means of a cord circuit one end of which is arranged for magneto supervision only.

A feature of the invention whereby the foregoing objects are attained resides in the provision of an auxiliary circuit including a jack which is associated with the conductors of an outgoing trunk circuit and so arranged that when the magneto or "toll" end of a cord is inserted in the auxiliary jack current supervisory signals transmitted over the trunk from the distant end will be received in the auxiliary circuit, translated into alternating ringing current, and transmitted into the toll cord to control magneto supervisory signal apparatus associated therewith.

A further feature resides in filter means associated with the auxiliary circuit for the purpose of eliminating harmonics in, and decreasing the intensity of, the ringing current whereby annoyance to the operator is reduced in case she is connected to the cord at the time the ringing current is transmitted back into the cord and also to prevent operation of ringing responsive apparatus in a trunk circuit to which the other end of the cord may be connected.

The invention will now be described, reference being had to the accompanying drawings:

Fig. 1 of which shows a toll switching trunk outgoing from a toll operator's position to a distant common battery manual switchboard and arranged with an auxiliary jack and circuit in accordance with the present invention;

Fig. 2 represents a toll switching trunk outgoing

from a toll operator's position to a distant automatic exchange also arranged with an auxiliary jack and circuit in accordance with this invention; and

Fig. 3 represents a standard toll operator's cord circuit, the left-hand end of which is arranged for magneto supervision only and the right-hand end for either magneto or common battery supervision.

For purposes of description, it will first be assumed that the toll operator has received a call for a subscriber in a distant exchange and has obtained a connection with the calling subscriber's line over a toll switching trunk SWT shown at the right of Fig. 3 by inserting the trunk plug 300 of her cord pair into the jack 110 of the trunk. If the call is to be extended over another switching trunk, Fig. 1, to a distant common battery manual switchboard the toll operator may, by the provision of this invention, insert the left-hand or magneto plug 302 of her cord pair directly into the auxiliary jack 100 of the trunk circuit shown on Fig. 1 which trunk extends to the desired manual switchboard, not shown.

When the plug 302 is inserted in jack 100 relays 101 and 302 operate in the following circuit, battery, left winding of sleeve relay 303, sleeve of plug 302 and jack 100, winding of relay 101, ground at the outermost left contact of relay 102. Operation of relay 303 causes relay 304 to operate thereby preventing supervisory lamp 305 from lighting at this time. When relay 101 operated it (a) completes, at its contact 103, a ringing bridge consisting of relay 104, retard coil 105 and condensers 106, 107 and 108 across the tip and ring of the trunk circuit; (b) completes at its contacts 109, a supervisory bridge consisting of relay 110 and windings of retard coil 111 across the trunk; (c) locks to ground at its inner right contacts independent of relay 102; (d) connects battery at its outer left contact through resistance 112 to the right-hand armature of relay 102 for future use in holding relay 102 operated and; (e) operates relay 113 in a circuit which can be traced from battery, left winding of relay 113 and contact 114 of relay 102 to ground at contact 115 of relay 101. Relay 113 in operating operates relay 102 in the following circuit, ground, contact 115 of relay 101, contact 114 of relay 102, armature and contact 116 of relay 113 and left-hand winding of relay 102 to battery. Relay 102 in operating performs the following functions (a) locks up in the following circuit, battery, left-hand contact of relay 101, contacts 117 and right-hand winding of relay 102 to ground and (b) removes at its

contacts 114 the operating ground for relay 113, which relay slowly releases provided relay 110 is not operated.

When relay 101 operated and connected the supervisory bridge, comprising relay 110, across the line, relay 110 momentarily operated due to normal battery potential across the trunk conductors at the distant office, but this potential would, under normal conditions, be removed immediately by the functioning of relays at the distant office. In case, however, relay 110 is still operated when relay 102 operates relay 113 is held operated until relay 110 releases in a circuit which can be traced from battery left-hand winding of relay 113, its contacts 116, contacts of relay 110, normal contacts of ringing bridge relay 104 and contact 118 of relay 102 to ground.

When the toll operator receives the call passing signal "zip tone" or is otherwise apprised of the fact that the distant operator is ready to receive the call she passes the number of the desired subscriber's line.

Subscriber's line connected

When the distant operator inserts the plug end of the trunk into the called subscriber's line battery and ground are reconnected to the trunk conductors in a well known manner and cause relay 110 to operate. Relay 113 now being released and relay 102 operated an operating circuit is therefore completed to cause a momentary spurt or impulse of ringing current to be connected to the toll cord as follows: Operation of relay 110 closes at its contacts the following circuit to operate slow-releasing chain relay 119. Ground, contact 118 of relay 102, normal contacts of relay 104, contacts of relay 110, contact 129 of relay 113, contact 121 of relay 102 and winding of relay 119 to battery. Relay 119 in operating completes an energizing circuit to operate a second chain relay, 122 which can be traced from ground, contact 118 of relay 102, normal contacts of relay 104, contacts of relay 119, and the winding of relay 122 to battery. Relay 122 thereupon closes its contacts to operate relay 123, the circuit for which can be traced from ground, contact 118 of relay 102, normal contacts of relay 104, contacts of relay 122 and winding of relay 123 to battery.

Relay 123 in operating connects ringing current at its contacts 127 and 128 to the tip and ring of the toll cord through the filter arrangement comprising resistances 124 and 125 and impedance coil 126 which reduces its intensity. This causes relay 306 in the cord circuit to operate thereby releasing relay 304 which connects ground at its back contact to complete a circuit to light supervisory lamp 305 as a ready-to-ring signal. Relay 308 also operates in an obvious circuit and locks up to ground at contact 309 of talk key 310 if this key is in its normal position at the time. Operation of relay 308 also provides a locking circuit for lamp 305 which will remain lighted until the operator extinguishes it by operating her talk key 310. If, however, the talk key in the toll cord should be in an operated position at this time when the distant subscriber's line is connected, the lamp 305 will not light and relay 308 will not operate as ground is disconnected at contacts 309 of key 310.

Operation of relay 123 also reoperates relay 113 in an obvious circuit which; (a) locks up in a circuit which can be traced from battery, its left-hand winding, contacts 116, contacts of relays 110 and 104 and contact 118 of relay 102 to ground;

and (b) releases relays 119 and 122 in turn. When relay 122 releases it opens the previously described operating circuit for relay 123 which slowly releases to disconnect the ringing current from the toll cord. Relays 119 and 122 also have a slow-release characteristic and therefore release of 123 is delayed sufficiently to permit the proper functioning of relay 306 in the toll cord to light the supervisory lamp 305 as previously described.

The reduced intensity of the ringing current transmitted to the toll cord minimizes annoyance to the operator if she happens to have her telephone set connected to the cord at that time and prevents operation of any ringing-responsive relays that may be connected across the trunk circuit to which the other end of the toll cord may be connected at this time.

Ringing the called subscriber

When the toll operator rings the called subscriber at the distant office by operating ringing key 307, the ringing current thus applied over the tip and ring conductors of plug 302 and jack 100 causes relay 104, bridged across the outer contacts of relay 123, to operate which (a) opens its left-hand contact thereby removing ground from the armature of relay 110 and the springs of relays 122 and 119 and deenergizes the left-hand winding of relay 113 and (b) operates relay 129 and energizes the right-hand winding of relay 113 to hold this relay operated during the ringing interval. Relay 129 operated connects, at its contacts 130 and 131, ringing current to the trunk it being observed that the auxiliary jack 100 and cord circuit are at this time disconnected at the outer contacts of relay 129.

When the ringing key 307 is released, relay 104 releases which in turn releases relay 129 which disconnects ringing current from the trunk. The right-hand winding of relay 113 is also deenergized but this relay does not release as the release of relay 104 reestablishes the previously traced holding circuit through its left-hand winding.

Called subscriber answers

When the called subscriber removes his receiver from the hook, battery and ground are removed from the trunk conductor in a well-known manner and the bridged relay 110 releases which opens the holding circuit of relay 113 which in turn releases. The circuit is now in condition to respond to a disconnect signal from the distant office.

Called subscriber disconnects

When the called subscriber hangs up relay 110 again operates which causes the successive operation of relays 119, 122 and 123 which again connects an impulse of reduced intensity ringing current to the toll cord which operates relay 306 and causes relay 304 to release which lights lamp 305 and operates relay 308 which locks up to hold lamp 305 lighted under control of the talk key 310.

Relay 123 in operating also operates relay 113 which causes the successive release of relays 119, 122 and 123 which latter relay disconnects the ringing current from the cord and releases relay 306 thereby permitting relay 304 to again operate.

When the toll operator notes the lighted supervisory lamp 305 she operates her talk key 310 thereby releasing relay 308 and extinguishing

lamp 305. She will then challenge in the usual manner and if she receives no response will remove plug 302 from jack 100 whereupon the circuit will restore to normal.

Connection of trunk end of toll cord to trunk

Should the toll operator have occasion to connect the trunk end of her cord circuit to the trunk shown in Fig. 1, she would insert plug 309 in the regular jack 132 of the trunk. These circuits under this condition would function in the usual well-known manner, the only feature of interest being that when plug 300 is inserted in jack 132 relay 102 operates to close its contact 132 thereby substituting battery for ground through relay 101 to the sleeve of auxiliary jack 100 which makes the auxiliary jack busy and prevents it being seized during the period the regular jack 130 is in use.

Call to an automatic exchange

It will next be assumed that the toll operator has received a call for a subscriber reached over a trunk line, shown in Fig. 2, which extends to a distant automatic exchange and that she has secured a connection to the calling subscriber's line by inserting the trunk plug 300 of her cord circuit into jack 310 of a toll switching trunk SWT.

The next operation in completing this connection is to set up a connection to the called subscriber's line by means of dial impulses and as only the trunk end of her cord circuit is equipped for this service, and is now in use, she will insert the trunk plug of another pair, corresponding to plug 300, into the regular outgoing trunk jack 200 of the trunk and dial in the usual manner as described in the patent to Stokely 1,653,789, patented December 27, 1927, it being understood that the cord circuit shown in Fig. 3 of this application is identical with the cord circuit shown in Fig. 1 of the above noted patent and the circuit and apparatus shown above and to the left of the broken line *aa'* of Fig. 2 of this application is identical with the outward end of the trunk circuit shown to the left of the broken line in Fig. 2 of the patent referred to which represents a standard out-dialing trunk to an automatic exchange.

As this dialing operation forms no part of the present invention and is described in detail beginning in line 88 on page 2 of the Stokely patent referred to, no further description will be given here.

Called subscriber's line reached

After the called subscriber's line has been seized by the final selector, which will be indicated by the lighting of the supervisory lamp of the cord used for dialing, which lamp corresponds to lamp 311 of Fig. 3, the operator inserts plug 302 of the pair to be used in completing the connection into the auxiliary jack 204 and removes the plug from jack 200.

When the plug 302 is inserted in jack 204 relays 208, 303 and 304 operate in an obvious circuit. Relay 304 operated prevents lamp 305 from lighting at this time. Relay 208 in operating connects at its contact 209 a supervisory bridge consisting of relay 210 across the trunk, connects, at its contacts 211, a ringing bridge comprising relay 212 across the tip and ring conductors on the auxiliary jack side of the condensers 213 and 214 and at its contact 215 connects battery to the sleeve of the regular jack 200 thereby making it busy. As the called subscriber has not been

rung his receiver is still on the hook and battery and ground are present on the trunk conductors from the distant office thus causing relay 210 to operate immediately. Operation of relay 210 causes relay 216 to operate in a circuit extending from ground, back contact of relay 212, contacts of relay 210, contact 217 of relay 218 and windings of relay 216 to battery. Relay 216 operates relay 221 in an obvious circuit. Relay 221 in operating causes relay 222 to operate, which relay connects, at its contacts 223 and 224, ringing current through the filter, comprising resistances 225 and 226 and impedance coil 227, to the toll cord to operate relay 306 which releases relay 304 thereby connecting ground at its back contact to light supervisory lamp 305 as a ready-to-ring signal. Relay 308 also operates and locks up to the listening key 310 thereby maintaining the lamp 305 lighted until the listening key is actuated.

Relay 222 in operating also operates relay 218 through its left-hand winding which then locks up under control of relay 210 to ground at the normal contacts of relay 212. Relay 218 in operating opens the previously described operating circuit for relay 216 which now releases. Thereupon relay 221 releases which in turn opens the circuit of relay 222 which slowly releases and disconnects the ringing current from the cord.

It will be noted that the ringing current applied to the cord by the operation of relay 222 is reduced in intensity by the filters 225, 226 and 227 in the same manner and for the same purpose as previously described in connection with the trunk of Fig. 1.

Relays 216 and 221 are also slow-releasing so that relay 222 is held operated for an interval sufficient to cause the proper functioning of relays 306, 304 and 308 in the toll cord.

Ringling the called subscriber

The toll operator upon noting the lighted lamp 305 actuates listening key 310 to extinguish it and operates ringing key 307 thereby transmitting ringing current to the trunk to operate relay 212 which, as previously mentioned, was bridged across the tip and ring conductors by the operation of relay 208. Relay 212 in operating energizes the right-hand winding of relay 218 to hold this relay operated during the ringing interval and operates relay 220 which connects ringing current directly to the trunk conductors which causes the called subscriber's bell to be rung. When the called subscriber answers, battery and ground is removed from the trunk conductor and relay 210 releases thereby releasing relay 218.

Called subscriber hangs up

When the called subscriber hangs up battery and ground are again connected to the trunk at the distant exchange and relay 210 again operates thereby operating relays 216, 221 and 222 in turn, which latter relay again connects reduced ringing current to the toll cord to relight supervisory lamp 305 as a disconnect signal. Relay 222 re-operates relay 218 which locks up and releases relays 216 and 221 which latter relay releases relay 222.

When the toll operator operates her listening key the lamp 305 is extinguished and upon challenging on the line and finding the conversation completed, she removes plug 302 from jack 204, whereupon relay 208 releases which restores the circuit to normal.

What is claimed is:

1. In a telephone system, a trunk circuit providing a direct current path between its terminals, one end terminating in a jack circuit adapted for operable connection with a common battery cord circuit, a magneto cord circuit, and an auxiliary jack circuit also associated with said one end of the trunk circuit and including means for operably connecting said magneto cord to said trunk circuit.
2. In a telephone system, a trunk line adapted to transmit direct current supervisory signals from its inward to its outward end, cord circuits arranged for magneto supervision and including supervisory signal apparatus, an auxiliary circuit including a connecting terminal associated with said line and so arranged that said cord circuit can be connected to said trunk line, and means in said auxiliary circuit adapted to receive and translate said direct current supervisory signals into alternating current signals and transmit them over said connecting terminal to a connected one of said magneto cord circuits to operate the supervisory signal apparatus associated therewith.
3. In a telephone system, an operator's position, an outgoing direct current supervision trunk line appearing thereat, magneto supervision cord circuits at said position, an auxiliary circuit asso-

ciated with the trunk conductors and including an auxiliary jack whereby one of said cord circuits can be connected to said trunk over said auxiliary circuit, and means in said circuit for translating direct current supervisory signals, received over said trunk, into alternating ringing current signals and for transmitting them over said auxiliary circuit jack to a connected one of said magneto cord circuits to control the supervisory apparatus therein.

4. In a telephone system, an operator's position, an outgoing direct current supervision trunk line appearing thereat, magneto supervision cord circuits at said position, an auxiliary circuit associated with the outgoing trunk conductors and including an auxiliary jack whereby one of said cord circuits can be connected to said trunk over said circuit, a source of alternating ringing current, means in said auxiliary circuit responsive to direct current signals incoming over said trunk to connect said ringing current source over said jack to a connected one of said cord circuits, and a filter circuit adapted to be completed in response to receipt of said direct current signals for reducing the intensity of and suppressing the harmonics in said ringing current transmitted to said cord circuit.

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