

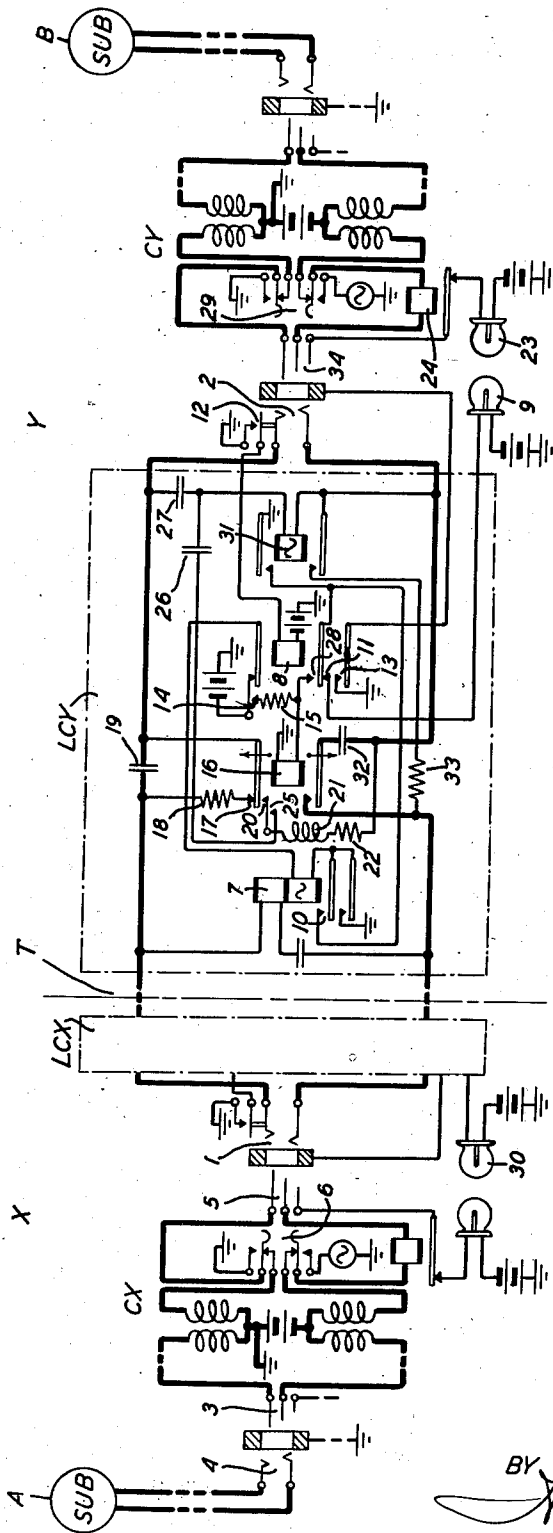
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TIE TRUNK LINE

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TIE TRUNK LINE

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5 Claims. (Cl. 179-43)

This invention relates to telephone systems and more particularly to what are known as tie trunk lines for interconnecting private branch exchange switchboards.

5 The object of the invention is to simplify and improve the efficiency of such trunk lines and particularly the means for signaling and supervision thereover.

10 A feature of the invention resides in means associated with each end of the trunk line for discriminating between ringing current incoming over the line from the distant switchboard and ringing current applied at the near switchboard whereby incoming ringing current is prevented
15 from directly affecting the apparatus of a connected common battery cord circuit by opening one of the trunk line conductors and a direct current bridge across the line is opened to control the cord supervisory signal in the usual manner
20 and whereby outgoing ringing current removes the direct current bridge and closes the line conductor to enable the ringing current to be transmitted over the trunk line to the distant end.

25 Other features not specifically mentioned will be apparent from the following description when read in conjunction with the accompanying drawing which shows a two-way manual ring down tie line in accordance with the invention which terminate at each end in a private branch exchange
30 switchboard.

For purposes of description, it will be assumed that subscribers' stations A and B are connected to and served by private branch exchange switchboards X and Y respectively and that extending
35 between these switchboards is a two-way ring-down tie trunk line in accordance with the present invention which terminates at switchboard X in jack 1 and at switchboard Y in jack 2.

40 Let it be further assumed that subscriber A desiring to communicate with subscriber B has called and then answered by the operator at switchboard X by inserting plug 3 of the cord circuit CX into the calling subscriber's line jack 4. Upon
45 ascertaining that subscriber B is desired, which station is reached via the tie trunk line T and switchboard Y, the operator at switchboard X inserts the calling plug 5 of the cord circuit into the line jack 1 of the tie line and applies ringing current to the line by operating the ringing key 6
50 thereby causing the obvious operation of the ring-up relay 7 at the distant end of the tie line.

At this point it may be mentioned that the tie line circuit apparatus within the broken line box
55 LCY is located at the switchboard or private branch exchange Y, and that identical apparatus

and circuits are associated with the tie line at the switchboard X as indicated by the broken line box LCX.

Relay 7 in operating closes a locking circuit for itself from ground at its lower contacts, through its lower winding to battery at the upper contacts of relay 8. Operation of relay 7 also closes a circuit to light the line lamp 9 which can be traced from ground, contact 10 of relay 7, contacts 11 of relay 8 and lamp 9 to battery.
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The operator at the private branch exchange Y upon noting the lighted lamp 9 inserts plug 34 of her cord circuit CY into jack 2 thereby closing the auxiliary contacts 12 of the jack to operate relay 8 which, in operating, opens its uppermost contacts thereby breaking the locking circuit for relay 7 and opening the circuit for lamp 9 at contacts 11.
15

Relay 8, in operating, also connects ground, at its contacts 13, to the sleeve of the jack 2, and to all other jack sleeves which may be multiplied thereto, whereupon the cord supervisory lamp 23 is lighted in the usual manner. When relay 8 operated it also closed at its contacts 14 a circuit through resistance 15 to operate relay 16.
20 25

The operation of relay 16 opens, at its contact 17, the normally closed shunt, including the resistance 18, around the tip condenser 19, closes, at its lower contacts, the ring side of the line and at its contact 20 connects a bridge, comprising an inductance 21 and a pure resistance 22, across the line conductors to operate the cord supervisory relay 24 in the answering cord, which relay opens its contacts and extinguishes the supervisory lamp 23. Operation of relay 16 also closes its contact 25 which connects condenser 26 on multiple with condenser 27, the purpose of which will later appear.
30 35

The extension of the call to subscriber B will be effected by the other end of cord CY in the usual manner.
40

When the conversation between the connected stations is terminated the operators at each switchboard are appraised of this fact in the usual manner and break the connection by removing the respective cord circuit plugs from the subscriber's line and tie line whereupon the tie line circuit is restored to normal. In case, however, the operator at switchboard X, for example, should desire to recall the operator at switchboard Y before that operator has removed the plug 34 from jack 2, she may do so in the usual manner by ringing on the line whereupon relay 7 operates as before but does not lock up due to the fact that its locking circuit is open
45 50 55

at contacts of relay 8 which is now operated. Neither is line lamp 9 lighted due to the open contacts 11 of relay 8. However, when relay 7 operates a circuit from ground is completed including contacts 10 of relay 7 and contacts 28 of relay 8 to short-circuit relay 16 which releases and opens the bridge 21, 22 across the tie line. Release of relay 16 also opens the ring side of the line at its lower contacts thereby preventing the incoming ringing current from falsely operating the cord supervisory relay 24 which was released when the bridge 21, 22 was opened thus lighting the cord supervisory lamp 23 as a recall signal.

As before mentioned, the tie line T is a two-way circuit, that is to say, it is arranged to operate in either direction and consequently each end is equipped with the same apparatus and circuit connections although for the sake of brevity apparatus has only been shown at the Y switchboard end of the line, similar apparatus and circuits at the other or X switchboard end being indicated by the dotted line box LCX.

Due to the fact that certain other relay operations take place at the end of the line at which a call is initiated, an outgoing or originating call from the private branch exchange Y will now be described.

To initiate an outgoing call from the switchboard Y the operator may insert either end of the cord circuit CY in the jack 2. If we assume that plug 34 is used the operator plugs in and rings by operating the ringing key 29 which lights line lamp 30 at the switchboard X in the manner previously described for lighting the lamp 9 on a call in the opposite direction.

When the operator plugs in the auxiliary jack contacts 12 are closed thereby operating relay 8 which in turn operates relay 16. Relay 16, as before described, opens its contact 17 thereby removing the shunt around condenser 19, opens the ring side of the line, connects the bridge 21, 22 across the tip and ring of the line at its contacts 20 and at contacts 25 connects condenser 26 in parallel with condenser 27 which latter condenser is in series with ringing relay 31 across the line.

When the operator actuates ringing key 29 alternating current is applied to the tip and ring of the line which causes relay 31 to operate. It may be mentioned at this time that condenser 27 is of too low capacity by itself to pass sufficient current to operate relay 31 in multiple with the inductance and resistance bridge 21, 22 but the combined capacity of condensers 26 and 27 in parallel enables relay 31 to attract its armatures. When relay 31 closes its upper contacts it short-circuits relay 16 which circuit can be traced from ground, upper contacts of relay 31, contacts 28 of relay 8, now operated, to one terminal of the winding of relay 16, the other terminal of which is permanently grounded. This causes relay 16 to release which recloses, at its contacts 17, the shunt circuit around condenser 19 thereby passing insufficient ringing current over the line to operate the ringing relay at the distant end. Release of relay 16 also opens its contacts 20 and 25 which open the bridge 21, 22 and disconnect the condenser 26 from condenser 27. Sufficient current is now passed by condenser 27 alone due to the disconnection of the bridge 21, 22 to hold relay 31 operated during the ringing interval. Closure of the lower contacts of relay 31 shunts the ring condenser 32 and the now open lower contacts of relay 16, by resistance 33, thereby

permitting the ringing current to pass over the line to the distant exchange.

A subsidiary feature of the foregoing invention resides in so choosing the values of the inductance 21 and resistance 22 that the bridge thus formed will have a high impedance to voice frequency currents and a sufficiently low direct current resistance to operate the cord supervisory relay, such as 24, connected to the tie line, while at the same time limiting the inductive surge through the inductance, when a plug such as 34 is removed from the line jack, to such a value as not to operate the ringing relays, such as 7, connected across the two ends of the line.

What is claimed is:

1. In a telephone system, a two-way trunk line, an operator's position terminating one end thereof, a link circuit and an associated source of alternating ringing current at said position and adapted to be connected to said trunk line, means for connecting said source to said trunk line by way of said link circuit, a direct current bridge circuit at said position adapted to be connected across the trunk line, an alternating current bridge circuit including a first condenser connected across the line at said position, a second condenser adapted to be connected in multiple with said first condenser, means responsive to the connection of said link circuit to said trunk line to connect said direct current bridge circuit across said trunk line and connect said second condenser in multiple with the first condenser, and a relay in said alternating bridge circuit responsive to connection of said current source to said trunk line by way of said link circuit to disconnect said direct current bridge and said second condenser during the interval said current source is connected.

2. In a two-way ring-down trunk line having one conductor normally open at one end, means responsive to the establishment of a connection with the line at said one end for closing said open conductor, introducing a condenser in the other line conductor and connecting a direct current bridge across the line on the switchboard side of said condenser and said point of closure, and discriminating means responsive to the application of ringing current at the distant end of the line for reopening said line conductor, shunting said condenser and removing said bridge and responsive to application of ringing current at the near end of the line for shunting said condenser and removing said bridge only.

3. In a telephone system, near and distant switching stations, a relay at each station, line conductors extending between said stations, one of said conductors being normally opened at contacts of each relay, a condenser in each end of the other line conductor, a direct current shunt around each condenser including normally closed contact of its respective station relay, a link circuit at each station adapted to be connected to said line conductors, a source of alternating ringing current associated with each link and means for connecting said sources to their respective ends of the line, a direct current bridge including inductive and non-inductive resistances adapted to be connected across the line at the near end by the station relay thereat, an alternating current bridge of relatively low capacity connected across the near end of the line, a circuit of predetermined capacity adapted to be connected in multiple with a portion of said alternating current bridge by the respective station relay to increase the capacity of said bridge, means responsive to

the connection of the link circuit with the near end of the line to operate the station relay thereat, thereby closing the normally opened line conductor thereat, opening the respective line condenser shunt, connecting the direct current bridge across the line and increasing the capacity of the alternating current bridge by connecting said multiple circuit therewith, said alternating current bridge including a relay thereafter responsive to the connection of said ringing source to the near end of the line to release said first relay and shunt the contacts thereof normally opening said line conductor when said relay is released.

4. In a telephone system, a two-way ring-down trunk line adapted to be connected to a common battery cord circuit at one end, signal apparatus connected to said line at each end thereof, a direct current bridge circuit adapted to be connected across said one end of the line responsive to connection of said cord circuit with said line thereat said bridge circuit serially including an inductance, and a pure resistance, said inductance and said resistance having such values and so proportioned with respect to each other as to possess a high impedance to speech frequency, to

have a sufficiently low direct current resistance to operate the cord supervisory relay connected to the line and to limit the inductive surge through said inductance when said cord circuit is disconnected from the line to a value ineffective to falsely operate the signal apparatus connected to the line.

5. In a telephone system, a trunk line, a cord circuit adapted to be connected to one end of said line, a source of alternating ringing current associated with said cord circuit and adapted to be connected therein to said line, an alternating current bridge circuit serially including a condenser and a relay connected across said line at said one end, a second condenser adapted to be connected in multiple with said first condenser to increase the capacity of said bridge and means operated in response to connection of said circuit with said line to connect said second condenser in multiple with the first condenser, said relay in series with the multiple capacity being responsive to connection of said source to the line to release said means and thereby reducing the capacity of the bridge.

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