

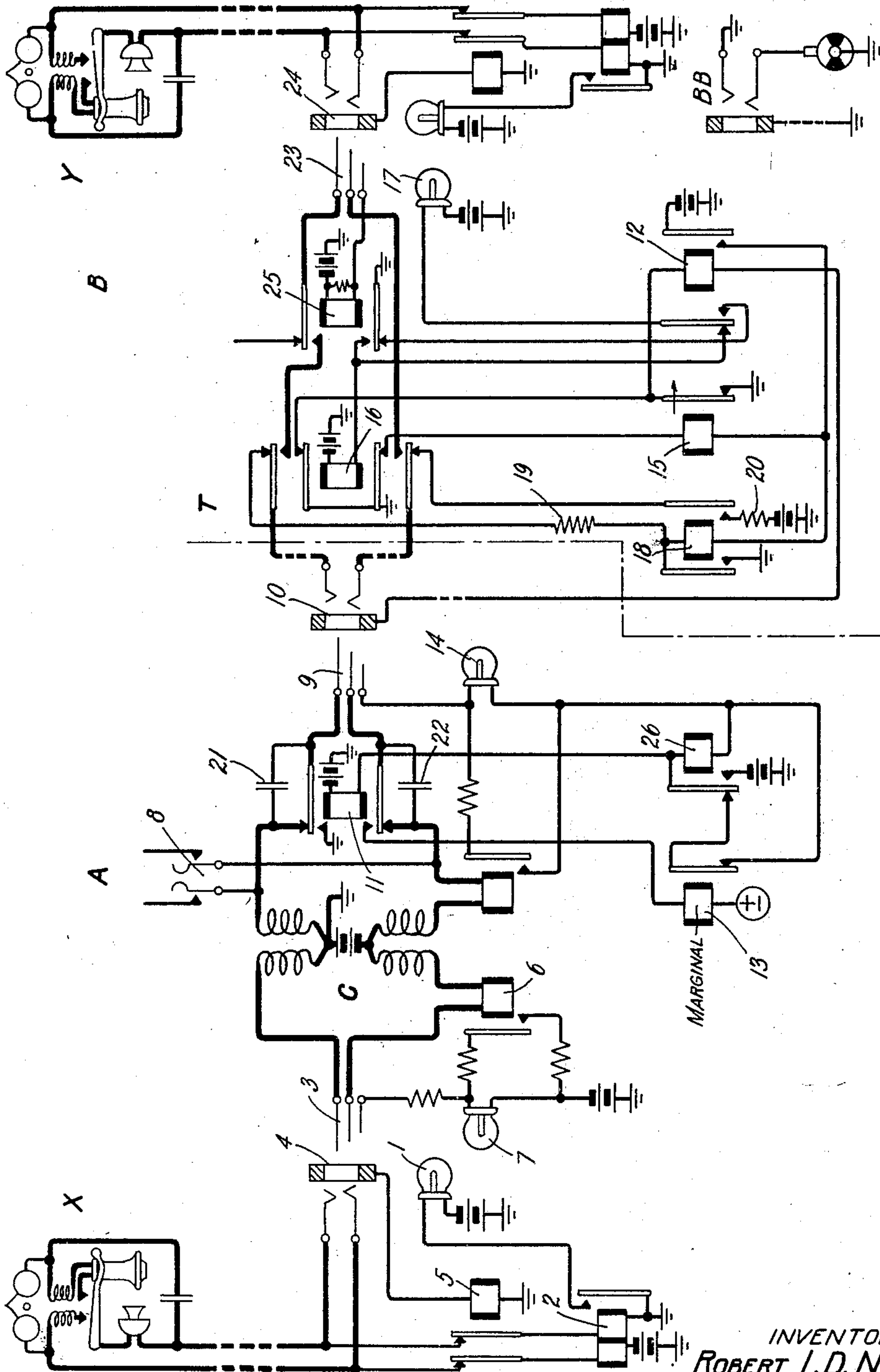
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TELEPHONE TRUNK CIRCUITS

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TELEPHONE TRUNK CIRCUITS

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This invention relates to telephone exchange systems in which telephone lines, terminating at different exchanges, may be interconnected by means of trunk circuits, and more particularly to such systems which employ automatic ringing cord circuits for making connection with the trunk circuit at the A or originating exchange.

In trunking calls from an A to a B switchboard it frequently happens that the called line, which terminates at the B board, is found to be busy and the B operator therefore plugs the incoming end of the trunk into a busy back jack instead of the called line.

In cases where the A switchboard is equipped with machine ringing cords having ring back condensers, ringing is automatically started as soon as the cord circuit is plugged into the trunk and an audible ringing signal goes back to the calling subscriber, thus indicating that ringing is going on. With trunk circuits as in use at present if the B operator finds the called line busy and connects the inward end of the trunk to a busy back jack instead of to the line called, the subscriber has in the meantime received a false signal and, upon later receiving the busy back tone, is likely to be confused and doubt if the wanted line is really busy for the reason that he first heard the ringing tone.

An object of the invention is to eliminate the possibility, under certain conditions, of giving the calling subscriber a false indication of the progress of his call.

More specifically, the object is to prevent giving a calling subscriber a premature audible ringing signal when the subscriber's line is connected to the outgoing end of the trunk circuit by means of an automatic ringing cord circuit before the incoming end of the trunk circuit is connected to the called line.

A feature of the invention, whereby the foregoing object is attained, resides in the provision of means at the inward end of a trunk circuit whereby if the trunk is seized at its outward end by an automatic ringing cord circuit before the inward end of the trunk is connected to the called subscriber's line the ringing current in the cord circuit will be immediately disconnected and held

in this condition until the inward end of the trunk circuit is connected to the called line, at which time the ringing current will be reconnected to signal the called subscriber. The invention will be understood from the following description when read in connection with the accompanying drawing, which represents two subscribers' stations terminating at different exchanges and connected by means of a machine ringing cord circuit and an interoffice trunk circuit.

In the drawing the cord circuit C at exchange A is what is known as a machine or automatic ringing cord circuit, i. e. one that is arranged to automatically apply ringing current to a called line in response to its calling plug being inserted in the line jack and is further arranged to transmit an audible ring-back signal to the calling subscriber when ringing starts, this well known feature being accomplished by shunting the normal contacts of the ringing relay with condensers of suitable capacity such as condensers 21 and 22.

A call from subscriber X to subscriber Y will now be traced.

When the receiver at station X is removed from its hook, lamp 1 is lighted in response to the usual operation of line relay 2. When the operator in control of cord circuit C inserts the answering plug 3 in jack 4 of the calling line, cut-off relay 5 operates to restore the line relay 2 and extinguish the lamp 1. Supervisory relay 6 also operates, due to the fact that the calling subscriber's receiver is off the hook, and thereby prevents the supervisory lamp 7 from lighting at this time. Since these circuits are well known and not a part of the invention, they are only shown schematically for the purpose of giving a more comprehensive idea of the invention to be later described.

The operator either before plugging into the calling line or immediately thereafter operates the listening key 8, thereby connecting her telephone set, not shown, to the cord circuit. Upon ascertaining the number of the called subscriber, whose line terminates at a distant switchboard B reached over the trunk line T, the A operator communicates

with the B operator in some manner, such as over a called circuit not shown, and gives the number of the desired subscriber, whereupon the B operator assigns a trunk circuit which we will assume is circuit T. The A operator then inserts the calling plug 9 of the cord circuit C in jack 10 of the trunk, thereby operating relay 11 in the cord circuit and relay 12 in the inward end of the trunk at switchboard B. This circuit can be traced from battery, winding of relay 11, normal contacts of relay 26, normal contacts of tripping relay 13, supervisory lamp 14, sleeve conductors of the cord and trunk circuit and winding of relay 12 to ground at the normal contacts of relays 15 and 16. Relay 11 in operating connects ringing current to the trunk circuit at its inner contacts but is immediately deenergized by the operation of tripping relay 13, an operating path for which is prepared when relay 12 operates, which operation will now be described.

Relay 12 closes obvious circuits to light guard lamp 17 and operate relay 15. Relay 15 thereupon disconnects one of the holding grounds from relay 12, which, however, is not released at this time to release relay 12 due to the normal condition of relay 16.

Relay 12 in operating also connects battery to the winding of relay 18, thereby completing a circuit for its operation, which can be traced from ground, upper alternate contacts of relay 11, tip conductors of the cord and trunk uppermost normal contacts of relay 16, resistance 19, and winding of relay 18 to battery at contacts of relay 12.

The function of relay 18 is to hold battery disconnected from the ring of the trunk until the tip of the plug has passed over the ring spring of the jack, thereby preventing an annoying click in the operator's receiver due to a surge of current in the upper right hand winding of the repeating coil at the moment the tip of the plug engages the ring spring of the jack.

When relay 18 operates in response to the operation of relay 12, it locks itself under control of relay 12 and also connects a battery bridge, including resistances 19 and 20 across the talking conductors of the trunk, thereby causing the tripping relay 13 in the cord to operate.

Relay 13 opens its contacts and removes the short-circuit around relay 26, which relay thereupon operates in series with relays 11 and 12. As soon as relay 26 operates it locks up under control of relay 16 and short-circuits relay 11, which relay releases and disconnects the ringing current from the trunk.

Although it has taken some little time to describe the various operations leading up to disconnection of the ringing current in response to plugging into the trunk, the elapsed time involved is only momentary and there-

fore no appreciable audible ringing signal is passed back to the calling subscriber by way of the condensers 21 and 22.

Ringing is now disconnected and ringing relay 11 held short-circuited and released under control of relay 16 pending connection to the called line.

When the B operator inserts plug 23 in jack 24 of the called line trunk sleeve relay 25 operates, which extinguishes the guard and disconnect lamp 17, transfers the tip of the cord from the busy test lead to the contacts of relay 16 and also operates relay 16.

Relay 16 disconnects the battery bridge from the trunk and connects the talking conductors of the trunk through to the A operator's cord.

When relay 16 operates it opens its inner upper contacts, thereby removing the holding ground from the winding of relay 12, whereupon relays 12 and 26 release. Relay 16 also opens its inner lower contacts, thus opening the circuit for relay 15. Relay 15 is slow to release and therefore, before it closes its back contacts relay 26 in the cord will have time to release.

When relay 26 releases it removes the short-circuit around relay 11 and short-circuits itself.

When relay 15 finally releases it reconnects ground at its back contacts to relay 12 and thence over the sleeve circuit to cause the reoperation of ringing relay 11, which again connects ringing current to the trunk which, this time, is not disconnected until the called subscriber answers to cause the tripping relay 13 to operate in the usual manner. The call from this point progresses in the usual way.

In case the B operator plugs the trunk into the called line before the A operator plugs into the outgoing end of the trunk, relay 25 operates as usual, which in turn operates relay 16 to disconnect the previously mentioned battery bridge including relay 18, thus preventing the preliminary tripping of ringing when the A operator plugs in as before described.

Under this latter condition relay 15 does not operate due to operation of relay 16 and therefore the momentary opening of the trunk sleeve is prevented.

It is evident from the foregoing that when the B operator plugs up before the A operator the automatic ringing equipment functions in the usual manner and is not tripped until the called subscriber answers.

In the latter case the guard and disconnect lamp 17 is lighted as a guard signal when the B operator plugs in and is extinguished, when the A operator makes connection with the trunk.

From the foregoing it is evident that the calling subscriber does not receive an audible signal, which would indicate to him that the

called party is being rung, if the trunk is seized by the A operator before the B operator completes the connection either to the called line or to a busy-back jack circuit such as BB in case the called line is busy.

Another case is where there is a misunderstanding between the A and B operators and the A operator plugs into a different trunk from the one assigned by the B operator. Under this condition also the false ringing indication should be and is prevented by the circuit of this invention.

What is claimed is:

1. In a telephone system, a link circuit, a trunk circuit having outward and inward ends, connecting means at the inward end of said trunk circuit, means in said link circuit automatically actuated in response to its connection to the outward end of said trunk circuit for applying ringing current thereto, and means in said trunk circuit responsive to said connection for immediately causing the disconnection of said ringing current and for thereafter reconnecting said ringing current under control of said connecting means at the inward end.

2. In a telephone system, a trunk circuit having outward and inward ends, a link circuit adapted to be connected with the outward end of said link circuit, means at said link circuit automatically actuated in response to its connection to the outward end of said trunk circuit for applying ringing current thereto, and means in said trunk circuit responsive to said connection for immediately causing the disconnection of said ringing current and connecting means at the inward end of said trunk circuit for causing the said ringing current to be reconnected.

3. In a telephone system, a cord circuit arranged for automatically applying ringing current when connected to outgoing lines of certain character, another outgoing line adapted to be seized by said cord circuit, means in said other line for preventing more than a momentary application of said ringing current thereto, and means for causing the reapplication of said ringing current to said line in response to a changed electrical condition at the inward end of said other line.

4. In a telephone system, a first operator's position, a second operator's position, lines outgoing from said second position, a trunk line interconnecting said positions, a cord circuit at said first position arranged to automatically apply ringing current to said trunk when connection is made thereto, and means for immediately disconnecting and thereafter preventing said ringing current from being applied to said trunk line until said trunk line is connected to one of said lines at the second position.

5. In a telephone system, an operator's position, a trunk line outgoing therefrom, a machine ringing link circuit at said position connected to said trunk line, means for disconnecting said machine ringing in response to connection of said link circuit with said trunk line and means for reconnecting said machine ringing to said trunk line under control of connecting means at its inward end.

6. In a telephone system, a link circuit, a trunk circuit, signaling means in said link circuit automatically actuated upon connection of the link circuit to a line of the trunk circuit, and means in said trunk circuit for disabling said automatic signaling means when the link is connected to the trunk and thereafter reactivating it in response to the actuation of connecting means at the distant end of said trunk circuit.

In witness whereof, I hereunto subscribe my name this 28th day of May, 1928.

ROBERT I. D. NICOLL.