

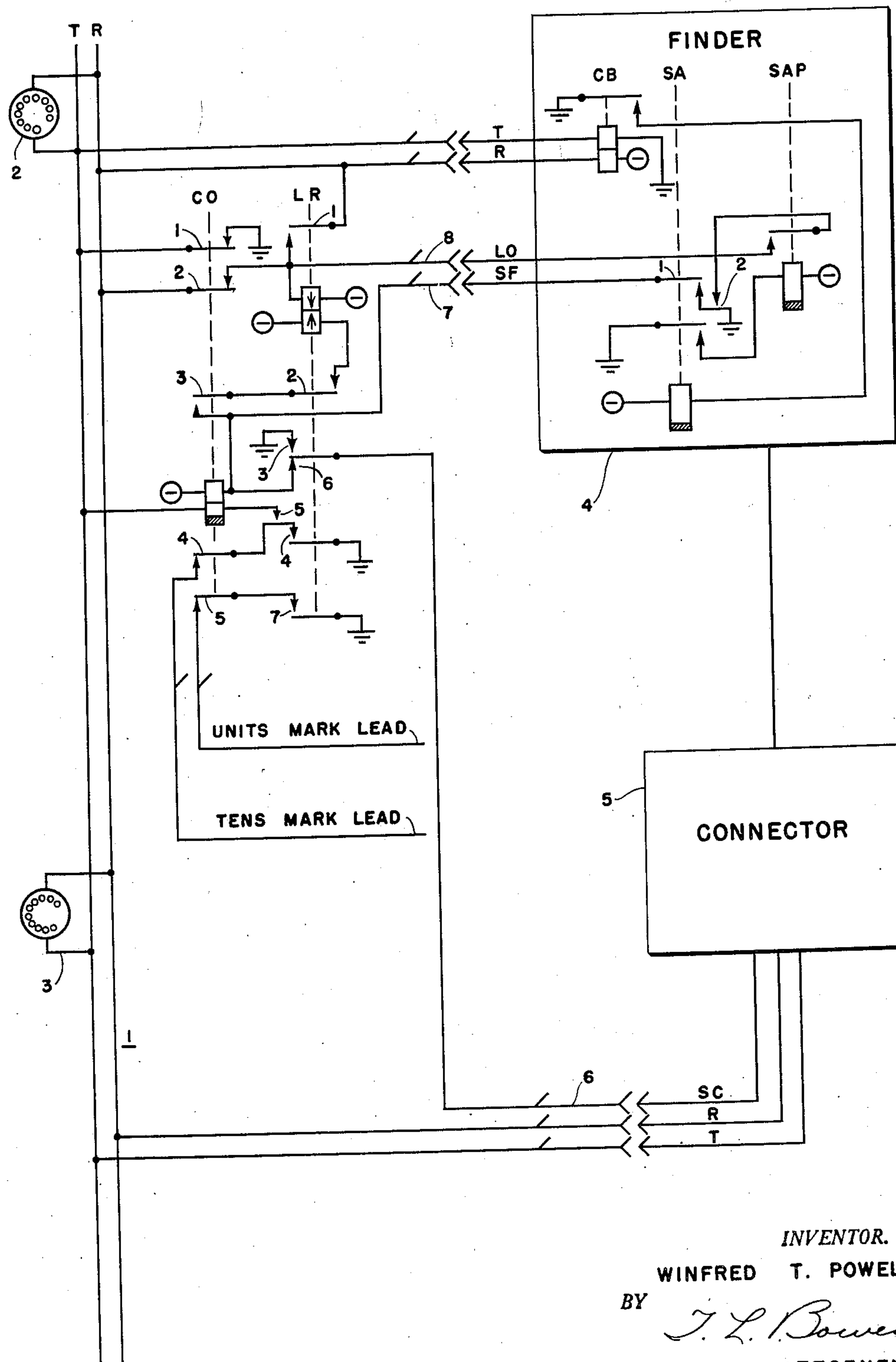
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LINE CIRCUIT FOR AUTOMATIC TELEPHONE SYSTEMS

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LINE CIRCUIT FOR AUTOMATIC TELEPHONE SYSTEMS

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This invention relates to line circuits for automatic telephone systems and more particularly to such circuits comprising only two relays.

It is an object of my invention to provide a new and improved two-relay line circuit for telephone systems.

In accordance with my invention there is provided a two-relay line circuit including a differentially wound two-coil line relay and a two-winding slow-releasing cut-off relay. On originating calls, the line relay operates through one of its windings to cause a finding operation. Upon seizure of the calling line by the line finder, the cut-off relay is operated through one of its windings. Operation of the cut-off relay is employed to energize the other line relay winding to de-energize the line relay. On incoming calls, the cut-off relay is operated, the line relay remaining de-energized. On revertive calls, the relays operate as in outgoing calls except that when the link is released, lock-out is achieved by maintaining the cut-off relay operated and re-operating the line relay through its operating winding.

Further objects and advantages of my invention will be apparent from the following description and accompanying drawing which describe and illustrate, respectively, the preferred form of my invention.

In the drawing there is illustrated a party line comprising, for example, subscribers' stations 2 and 3, line relay LR, cut-off relay CO and switching apparatus such as means for finding a calling line represented by the rectangle 4 and means represented by rectangle 5 for connecting a calling station located at another location (not shown) to the line 1.

As is evident from an inspection of the drawing, the complete line circuit includes only two relays, identified as a line relay and a cut-off relay. These two relays perform not only the normal functions assigned to such relays, but also lockout functions.

Outgoing call

If it be assumed that an individual wishes to make a call from a station connected to line 1 and has removed the receiver to close the hook switch contacts at that location, the tip and ring conductors T and R, respectively, of line 1, are bridged to complete a circuit for operating line relay LR, the circuit extending from ground, through contact 1 of relay CO, lead T, the subscriber's substation, lead R, contact 2 of relay CO, and the upper or operating winding of relay LR to battery. Line relay LR has two windings, differentially arranged. One, illustrated as the upper, is used to operate the relay. The other, shown as the lower, is utilized to release the relay, the two

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windings being connected in field opposing relationship.

The energization of relay LR grounds the units marking lead through contact 7 of relay LR and contact 5 of relay CO and grounds the tens marking lead through contact 4 of relay LR and contact 4 of relay CO. Operation of the line relay LR also grounds sleeve lead 6 between the line circuit and connector 5 at contact 3 of relay LR, thereby immediately making the line busy to incoming calls. Closure of contact 1 of relay LR completes a locking connection for its upper winding over ring lead R, subscriber's loop, tip lead T and contact 1 of relay CO to ground, such locking circuit being of no useful purpose at this time.

The finding operation is carried out to seize the calling line by any suitable means known to the art. A complete finder is not shown, but for the purposes of this description, certain relays are shown and it is believed sufficient to note that, upon seizure of the calling line after the finding operation is complete, a calling relay CB is energized by extension of the tip and ring leads, T and R, respectively. Energization of relay CB causes energization of delay relay SA and operation of relay SA energizes a repeating relay SAP, over obvious circuits.

Energization of relay SA also grounds sleeve lead 7 extending between line and finder through contact 1 of relay SA. Ground on sleeve lead 7 energizes cut-off relay CO through its upper winding. Closure of contact 3 of relay CO energizes the lower or release winding of relay LR over a circuit including grounded sleeve lead 7, contact 3 of relay CO, contact 2 of relay LR and winding of relay LR to battery. Relay LR releases. Operation of relay CO opens the marking leads. Cut-off relay CO remains operated because of the presence of sleeve ground on one terminal of its upper winding and battery on its other terminal. Grounded sleeve lead 7 is connected to lead 6 through contact 6 of relay LR, following release of relay LR, to prevent seizure of line 1 by any connector.

Following termination of the call, loss of ground on sleeve lead 7 de-energizes cut-off relay CO, and line 1 is ready for the next call.

Incoming call

On incoming calls, operation of connector 5 grounds sleeve lead 6 to energize cut-off relay CO. Energization of relay CO opens the operating circuit for line relay LR at contacts 1 and 2 so that operation of the line relay and the finding means is prevented.

Revertive call

When a revertive call is made, the sequence described in connection with outgoing calls takes place until the busy signal is received.

Relay SA is maintained energized during the

revertive call busy test and ringing period by suitable means, not shown, such as disclosed in my U. S. Patent 2,315,378, issued March 30, 1943 and assigned to the same assignee as the present invention. Accordingly, relay CO remains operated.

When the calling party hangs up upon hearing the busy signal there is caused the de-energization of relay CB in any well known manner. After a time delay, relay SA releases to open the upper sleeve lead 7, which de-energizes cut-off relay CO. Relay CO is slow to release, however, and before release takes place, a new energizing circuit is completed at make-before-break contact 2 of relay SA, through contacts of relay SAP, and lockout lead 8 to re-operate line relay LR. Re-operation of relay LR completes a circuit for energizing relays LR and CO in series, the circuit extending from ground at contacts 4 and 5 of relay LR, lower winding of relay CO, tip lead, subscriber's substation, ring lead, contact 1 of relay LR and upper winding of relay LR to battery. Talking current is thus furnished through the above mentioned windings in series.

Relay SAP was de-energized by the release of relay SA, but being slow to release, held its contacts closed long enough to establish lockout. When relay SAP finally releases, the lockout lead 8 is opened and the finder is disconnected from the calling line.

When the call is terminated, the replacing of the receivers at both substations on line 1 opens the line circuit for effecting the release of relays LR and CO and the consequent restoring of the line circuit to normal.

What I claim is:

1. In a telephone system having a plurality of lines, each line comprising a line circuit having only two relays, namely, a line relay and a cutoff relay; one of said lines having a plurality of substations; means for extending a call from or to any of said line circuits; means responsive to the presence of an outgoing call on a given line for causing operation of said line relay; switching apparatus; means controlled when said line relay is operated and said cutoff relay is unoperated for marking one of said lines as a calling line to said switching apparatus; means responsive to the seizure of said calling line by said switching apparatus when a call is thereon for causing operation of said cutoff relay; means responsive to the operation of said cutoff relay for causing the return of said line relay to its unoperated position; and means responsive to a reverting call condition on said one line for energizing in series the line relay and the cutoff relay associated with said one line in order to lock out said one line and to supply talking current to the substations involved when a connection is established therebetween.

2. In a telephone system, a line circuit for use by a subscriber, a line relay individual to said subscriber's line circuit and having two differentially wound windings, means utilizing one of said windings for operating said line relay over said line circuit responsive to the removal of a receiver thereon to indicate a calling condition on the line, switching means responsive to said calling condition to extend a connection from said calling line circuit, a two-winding cut-off relay, means utilizing one winding of said cut-off relay for operating said cut-off relay over the extended connection, switching means responsive to operation of said cut-off relay for energizing the other winding of said line relay, whereby said line relay

is de-energized to remove the calling condition from said line circuit.

3. In a telephone system, a line circuit for use by a subscriber, a line relay individual to said subscriber's line circuit and having two differentially wound windings, means utilizing one of said windings for operating said line relay over said line circuit responsive to the removal of a receiver thereon to indicate a calling condition on the line, switching means responsive to said calling condition to extend a connection from said calling line circuit, a two-winding cut-off relay, means utilizing one winding of said cut-off relay for operating said cut-off relay over the extended connection, switching means responsive to operation of said cut-off relay for energizing the other winding of said line relay, whereby said line relay is de-energized to remove the calling condition from said line circuit, and circuit means utilizing said one winding of said line relay and effective on reverting call service for reoperating said line relay, circuit means for de-energizing said one winding of said cut-off relay, and circuit means including said one of said windings of said line relay and the other of said windings of said cut-off relay in series for maintaining operated both of said relays for supplying talking current to substations when a connection is established therebetween.

4. In a telephone system, a line circuit for use by a subscriber, a line relay individual to said subscriber's line circuit and having two differentially wound operating windings, means utilizing one of said windings for operating said line relay over said line circuit responsive to the removal of a receiver thereon to indicate a calling condition on the line, switching means responsive to said calling condition to extend a connection from said calling line circuit, a two-winding cut-off relay, means utilizing one winding of said cut-off relay for operating said cut-off relay over the extended connection, switching means responsive to operation of said cut-off relay for energizing the other winding of said line relay, whereby said line relay is de-energized to remove the calling condition from said line circuit, and circuit means utilizing said one winding of said line relay effective on reverting call service for reoperating said line relay, circuit means for de-energizing said one winding of said cut-off relay, and circuit means including said one of said windings of said line relay and the other of said windings of said cut-off relay in series for maintaining operated both of said relays for supplying talking current to substations for marking the line as a busy line when a connection is established therebetween.

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