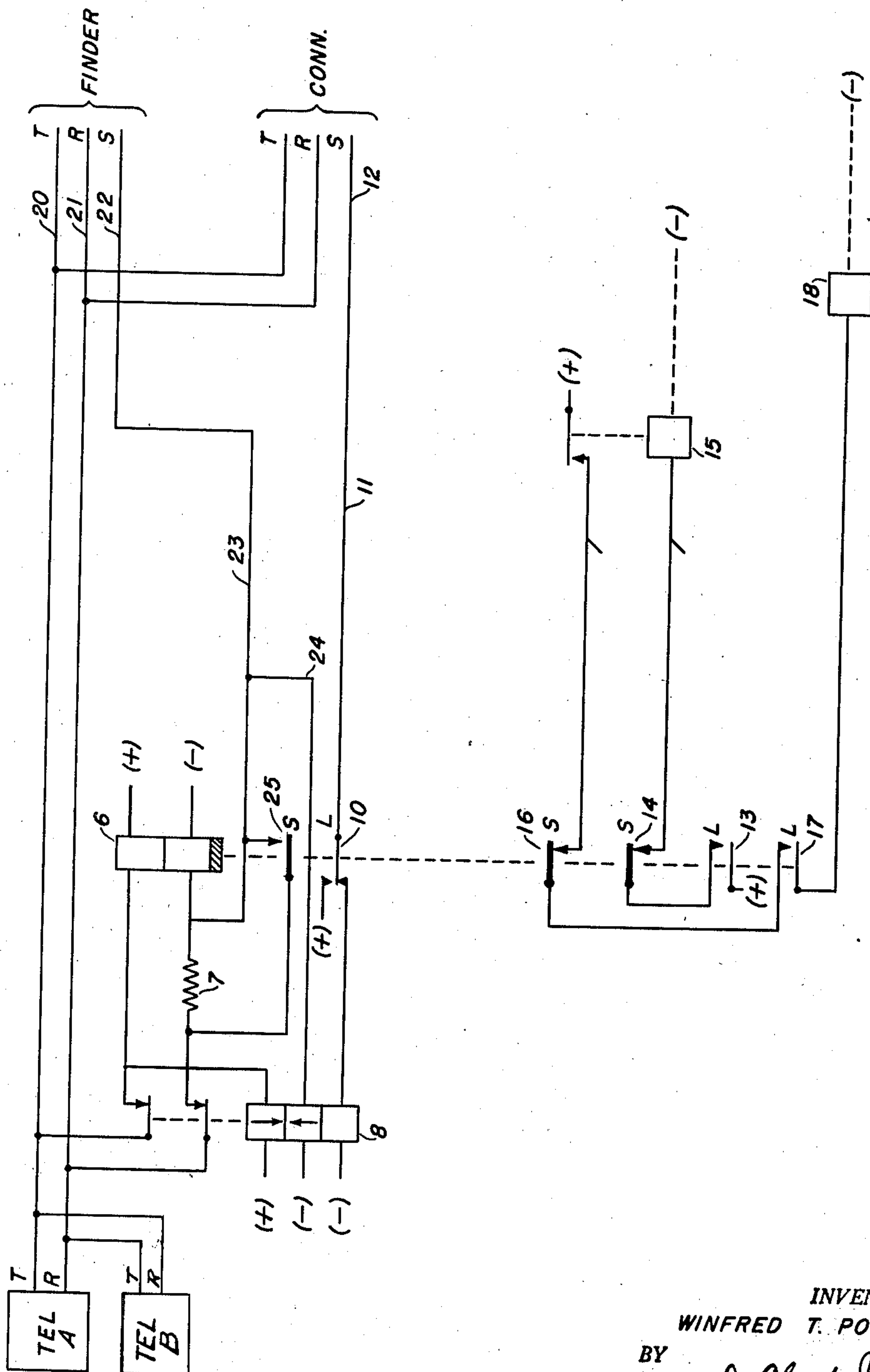


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W. T. POWELL
TELEPHONE LINE CIRCUIT

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INVENTOR.
WINFRED T. POWELL
BY *D. Clyde Jones*
ATTORNEY

UNITED STATES PATENT OFFICE

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TELEPHONE LINE CIRCUIT

Winfred T. Powell, Rochester, N. Y., assignor to
Stromberg-Carlson Company, Rochester, N. Y.,
a corporation of New York

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5 Claims. (Cl. 179—17)

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This invention relates to telephone systems and more particularly to a line circuit for use therein.

In the type of automatic telephone system disclosed in Powell Patent No. 2,325,877, granted August 3, 1943, it has been necessary in the past to provide for each telephone line, not only a line relay and a cut-off relay but also a so-called lockout relay, whenever the lockout feature was desired.

The main feature of the present invention relates to a simplified telephone line circuit for use in an automatic telephone system of the mentioned type.

Another feature of the invention relates to a telephone line circuit which provides the lockout feature of the system of the patent and yet requires only two relays per line in contrast to three relays per line previously required for service of this kind.

For an understanding of the invention, reference is made to the drawing wherein there is illustrated a single telephone line together with its finder contacts and connector contacts, as well as the relays individual to the line and two of the chain marker relays of a line group for marking this line so that it will be seized.

In the operation of this telephone line circuit, when the subscriber on this line originates a call, the line relay 6, which also performs the functions of a cut-off relay, is energized. This line relay is provided with two sets of armature springs, one set being closed when the relay is energized by weak current and both sets being closed when the relay is energized by strong current. This result may be achieved by providing one armature on the relay responsive to relatively weak currents for actuating the so-called "light" contact springs and by providing a second armature responsive to relatively strong currents for actuating the so-called "strong" contact springs. Alternatively, the line relay, which may be provided with a single armature, is marginal in operation to actuate this armature in two steps, depending on strength of energizing current, to close the so-called "light" and "strong" contact springs. The energizing circuit of the relay 6 extends from the negative pole of battery, lower winding of relay 6, resistor 7, inner back contact and armature of cut-off relay 8 over the ring side of the calling line and through the substation circuits thereof, tip side of the line, uppermost armature and back contact of lock-out relay 8, upper winding of the line relay 6 to the positive pole of battery. The operation of the line relay at this time is effective to close only its light

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armature springs herein indicated by the letter L associated therewith. This operation of the line relay 6 immediately applies positive potential at the front contact and armature 10 of the line relay over conductor 11 to the connector sleeve 12 of this line for making this line busy against seizure by any connector switch. Since the line relay 6 is maintained operated throughout an originating connection, this positive battery is held on the connector sleeve 12 for maintaining this line busy.

It has been previously mentioned that the present line relay circuit is especially applicable to a system utilizing the switching arrangement disclosed in the mentioned Powell patent. In the system of the patent, tens lockout relays and units lockout relays for a group of lines are provided to mark the originating or calling line so that it will be seized by suitable finder switching mechanism.

Also when the line relay 6 is operated in the manner just described, it closes a circuit from the positive pole of battery, light armature spring 13 and contact of the line relay, strong armature spring 14 and back contact of the line relay, which strong spring is not operated by the mentioned operation of the line relay, winding of the tens lockout relay 15, and thence through the armatures and contacts of other tens lockout relays (not shown), to the negative pole of battery. The tens lockout relay 15 is thus operated and at its armature and front contact extends the positive pole of battery through the back contact and strong armature spring 16 of the line relay 6, front contact and light armature spring 17 (now closed), of relay 6, winding of the units lockout relay 18 and through the armatures and contacts in series of other units lockout relays to the negative pole of battery. The tens lockout relay 15 and the units lockout relay 18 mark the calling line (herein illustrated) so that the finder switch mechanism (not shown) extends an idle link (likewise not shown) to the tip, ring and sleeve contacts 20, 21 and 22 of the calling line. As soon as the finder switching mechanism seizes the calling line, positive battery is applied from the link of the mentioned finder through the sleeve contact 22 and sleeve conductor 23 through the lower winding of the line relay 6 to the negative pole of battery. The energization of this lower winding of the relay 6 causes this relay to attract its strong armature springs so that not only the light armature springs previously operated but also the strong armature springs of this relay are now operated. The circuit including

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the sleeve conductor 23 also extends through the conductor 24, middle winding of the differentially wound lockout relay to the negative pole of battery. The lockout relay 8 is operated in this circuit and thereby removes the battery bridge including both windings of the line relay 6 from the calling line. The line relay 6, however, is maintained operated in its circuit, including the sleeve conductor 23, in the manner just described. When the line relay attracts its strong armature springs, it closes its armature spring 25 and front contact which short circuits, the resistor 7, for a purpose to be described. Also when the line relay 6 attracts its strong armature springs, it opens its springs 14 and 16 which interrupt the marking circuits to deenergize the tens lockout relay 15 and the units lockout relay 18.

When the line herein illustrated is called, positive battery applied to the connector terminal 12 is extended through the conductor 11, armature spring 10 and back contact of the line relay 6, lowermost winding of the lockout relay to the negative pole of battery. The lockout relay is operated in this circuit and removes the battery bridge from the called line.

When a connection to or from the line of the character just described is released, both the line relay 6 and the lockout relay 8 release and thereby restore the line circuit to its normal condition.

In the case of a revertive call, as, for example, when station TEL A desires to call station TEL B (see drawing) on the party line, or vice versa, when the calling or the called party answers following the temporary closure of the calling switch-hook following the extension of the call, positive battery is removed from the finder conductor 23 (in the manner shown in the mentioned patent) which effects the release of the lockout relay 8 but since the line relay 6 is slightly slow acting, this latter relay does not release. The line relay is now maintained energized through both of its windings in series, back contacts and armatures of the lockout relay 8 and the two sides of the line in series. In this instance, the resistor 7 is short circuited and the lower winding of the relay 6 being connected in the mentioned circuit through the front contact and the strong armature spring 25 of this relay. This circuit also serves to supply talking battery to this line during the revertive call. Since both the light and strong armature springs are actuated at this time, the line is held busy at the connector sleeve 12 and the circuit to the marking relays 15 and 18 is opened at the strong armature springs 14 and 16. During the holding of the line relay 6, in the case of the revertive call, the two upper windings of the lockout relay 8 are connected directly in multiple with the windings of the line relay 6. However, the two upper windings of the lockout relay are differentially connected so that this relay does not operate at this time.

It should also be pointed out that two upper windings of the lockout relay 8 are also connected in parallel with the two windings of the line relay 6 during the initiation of a call. In this case also the lockout relay is not operated because of its differential connection.

What I claim is:

1. In an automatic telephone system, a telephone line, a finder sleeve conductor and a connector sleeve conductor associated with said line, a line relay having two windings and also primary and secondary sets of contact springs operated thereby, the primary sets of contact springs being

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operated in response to relatively weak current through a winding of said relay and the secondary sets of contact springs being operated in response to relatively strong current through a winding of said relay, a second relay having two sets of normally closed contacts, said line relay on the initiation of a call on said line having its two windings connected in a series circuit including both sides of said line and said normally closed contacts, said series circuit having sufficient resistance therein to limit the current through said line relay whereby only the primary contact springs thereof are operated, controlling means including operated primary contact springs and non-operated secondary contact springs for effecting the extension of said telephone line responsive to the operation of the line relay on the initiation of a call, a circuit independent of said resistance completed for said line relay responsive to the extension of said line whereby both primary and secondary contact springs are operated by said line relay, a circuit completed over said finder sleeve conductor for operating said second relay also in response to the extension of said telephone line, and an operating circuit completed for the second relay through the connector sleeve conductor responsive to the extension of a call to said telephone line, whereby the normally closed contacts of the second relay are operated to disconnect the line relay from said line.

2. In an automatic telephone system, a telephone line, a finder sleeve conductor and a connector sleeve conductor associated with said line, a line relay having two windings and also primary and secondary sets of contact springs operated thereby, the primary sets of contact springs being operated in response to relatively weak current through a winding of said relay and the secondary sets of contact springs being operated in response to relatively strong current through a winding of said relay, a second relay having at least two windings and two sets of normally closed contact springs, said line relay on the initiation of a call on said line having its two windings connected in a series circuit including both sides of said line and said normally closed contacts, a resistor connected in said series circuit to limit the current through said line relay whereby only the primary contact springs thereof are operated, means controlled through said primary and said secondary sets of contacts for effecting the extension of said telephone line responsive to the operation of the line relay on the initiation of a call, a circuit independent of said resistor completed for said line relay responsive to the extension of said line whereby both primary and secondary contact springs are operated by said line relay, a circuit completed through the finder sleeve conductor and one winding of the second relay for operating the same also in response to the extension of said telephone line, and a circuit completed through the connector sleeve conductor and another winding of the second relay for operating the same responsive to the extension of a call to said telephone line, whereby the normally closed contacts of the second relay are operated to disconnect the line relay from said line.

3. In an automatic telephone system, a telephone line, a line relay having two windings and also primary and secondary sets of contact springs operated thereby, the primary sets of contact springs being operated in response to relatively weak current through a winding of said

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relay and the secondary sets of contact springs being operated in response to relatively strong current through a winding of said relay, a second relay having two sets of normally closed contact springs, said line relay on the initiation of a call on said line having its two windings connected in a series circuit including both sides of said line and said normally closed contacts, a resistor connected in said series circuit to limit the current through said line relay whereby only the primary contact springs thereof are operated, means including a tens lockout relay and a units lockout relay for effecting the extension of said telephone line responsive to the initiation of a call thereon, each of said lockout relays being operated through a primary set of contact springs and through a secondary set of contact springs, a circuit independent of said resistor completed for said line relay responsive to the extension of said line whereby both primary and secondary contact springs are operated by said line relay, a circuit completed for operating said second relay also in response to the extension of said telephone line, whereby the normally closed contacts of the second relay are operated to disconnect the line relay from said line.

4. In an automatic telephone system, a telephone line, a slow releasing line relay having two windings and also primary and secondary sets of contact springs operated thereby, the primary sets of contact springs being operated in response to relatively weak current through a winding of said relay and the secondary sets of contact springs being operated in response to relatively strong current through a winding of said relay, a second relay having a pair of differentially connected windings and two sets of normally closed contacts, said line relay on the initiation of a call on said line having its two windings connected in a series circuit including said sides of said line and said normally closed contacts, a resistor connected in said series circuit to limit the current through said line relay whereby only the primary contact springs thereof are operated, switching means controlled by primary and secondary contact springs of said line relay for effecting the extension of said telephone line responsive to the initiation of a call thereon, a circuit independent of said resistor completed for said line relay responsive to the extension of said line whereby both primary and secondary contact springs are operated by said line relay to stop the operation of the switching means, a circuit completed through one of the pairs of windings for operating said second relay also in response to the extension of said telephone line, whereby the normally closed contacts of the second relay are op-

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erated to disconnect the line relay from said line, said last mentioned circuit being interrupted on the completion of a revertive call on said line for releasing the second relay whereby said line relay is reconnected to said line, and means responsive to the release of said second relay for energizing the differentially connected windings thereof.

5. In an automatic telephone system, a telephone line, a finder sleeve conductor and a connector sleeve conductor associated with said line, a slow releasing line relay having two windings and also primary and secondary sets of contact springs operated thereby, the primary sets of contact springs being operated in response to relatively weak current through a winding of said relay and the secondary sets of contact springs being operated in response to relatively strong current through a winding of said relay, a second relay having a pair of differentially connected windings and a third winding as well as two sets of normally closed contact springs, said line relay on the initiation of a call on said line having its two windings connected in a series circuit including said sides of said line and said normally closed contacts, a resistor connected in said series circuit to limit the current through said line relay whereby only the primary contact springs thereof are operated, means including a tens lockout relay and a units lockout relay for effecting the extension of said telephone line responsive to the initiation of a call thereon, each of said lockout relays being operated through a primary set of contact springs and through a secondary set of contact springs, a circuit independent of said resistor completed for said line relay responsive to the extension of said line whereby both primary and secondary contact springs are operated by said line relay, means including an operated secondary set of contact springs for short circuiting said resistor, a circuit completed through the finder sleeve conductor and through one of said pairs of windings for operating said second relay also in response to the extension of said telephone line, and a circuit completed through the connector sleeve conductor and the third winding of the second relay for operating the same responsive to the extension of a call to said telephone line, whereby the normally closed contacts of the second relay are operated to disconnect the line relay from said line, the circuit through the finder sleeve conductor being interrupted on the completion of a revertive call on said line for releasing the second relay whereby said line relay is reconnected to said line, and means responsive to the release of said second relay for energizing the differentially connected windings thereof.

WINFRED T. POWELL.