R. I. UTTER.

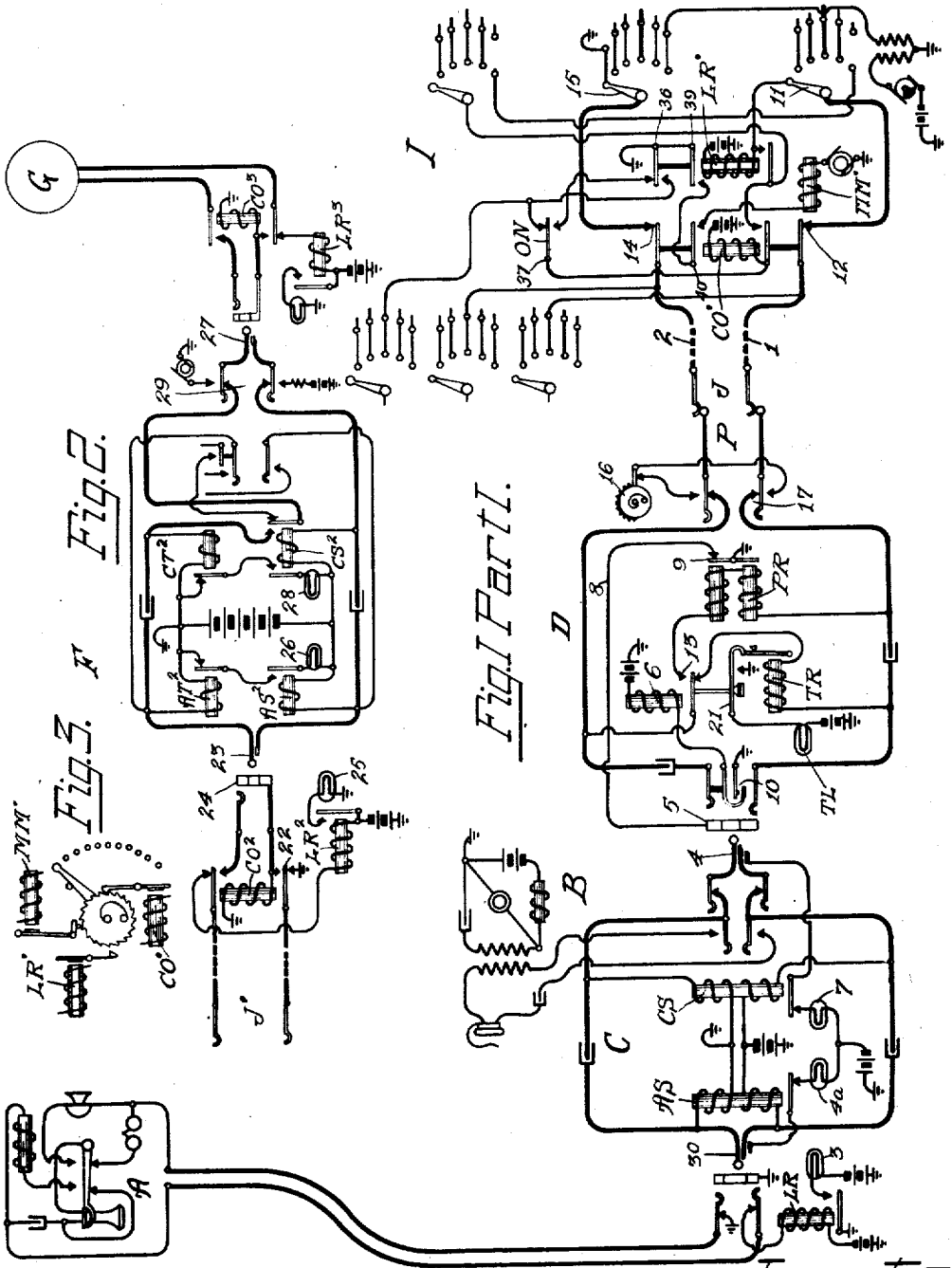
TELEPHONE SYSTEM.

APPLICATION FILED JUNE 18, 1914.

1,283,603.

Patented Nov. 5, 1918.

2 SHEETS—SHEET 1.



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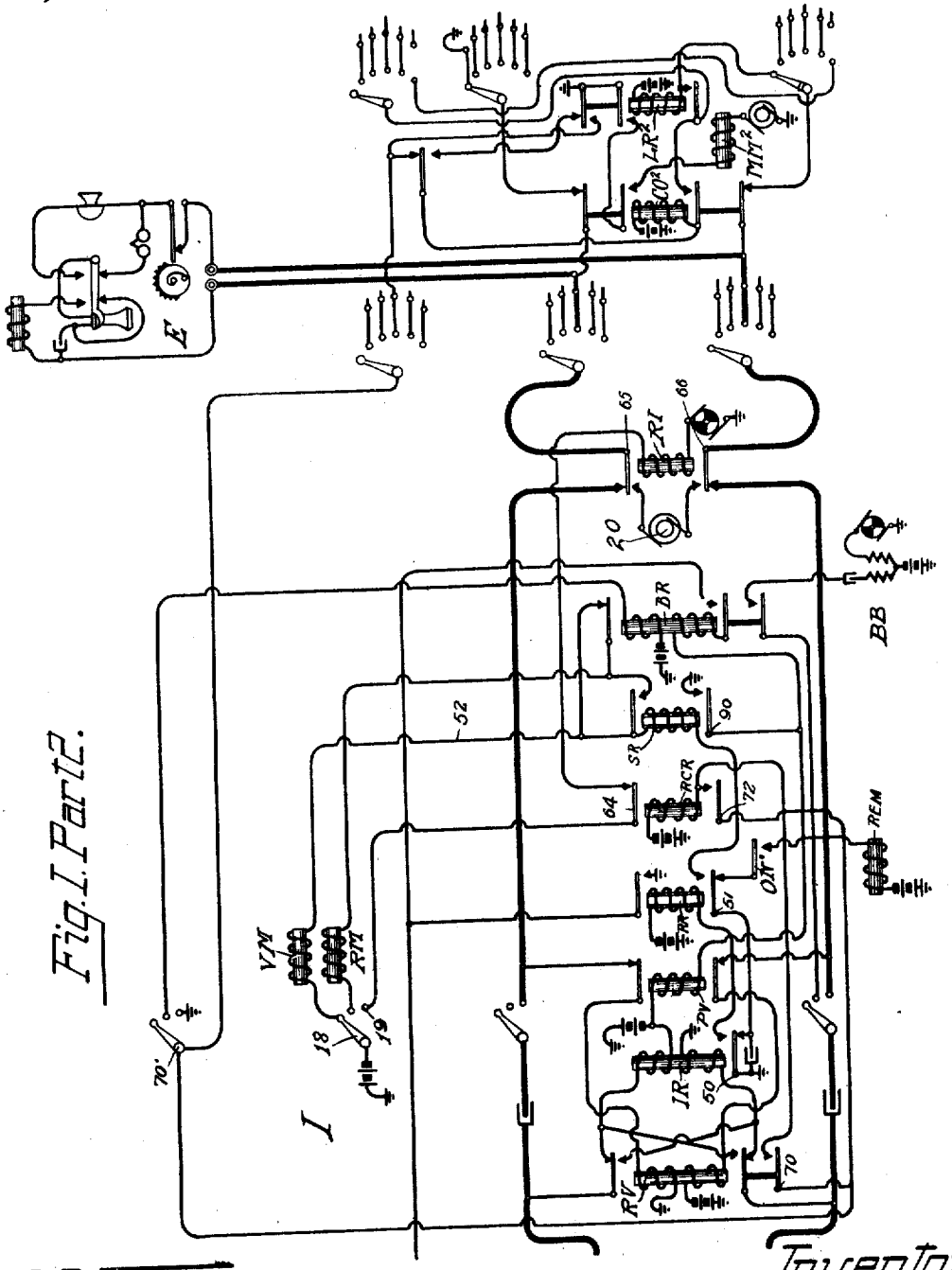

Fig. 1 Part 2.

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TELEPHONE SYSTEM.

1,283,603. Specification of Letters Patent. Patented Nov. 5, 1918.

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To all whom it may concern:

Be it known that I, RICHARD I. UTTER, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and is more particularly designed to provide a universal cord circuit and trunk circuit which may be used interchangeably in connection with telephone systems of the automatic or manual type.

A form in which my invention has been of special benefit, for instance, is in connection with a so-called private branch swichboard for use on boats so that this private branch switchboard can be directly connected with terminating jacks or plugs of the telephone systems at the ports where this boat docks. Under these conditions it is desirable that the trunk circuit leading from the private branch switchboard be susceptible of use with both manual and automatic switchboards.

My invention of course has other uses, but for the sake of illustrating it clearly I will describe it in the form thus used as set forth above in connection with the accompanying drawing illustrating the same diagrammatically in which—

Figure 1 Part I represents diagrammatically my improved private branch exchange system with my improved trunk circuit as connected with an automatic exchange.

Fig. 1 Part II is a continuation of the automatic exchange equipment partially shown in Fig. 1 Part I.

Fig. 2 shows diagrammatically a common battery manual exchange system adapted for connection with my improved trunk circuit, and

Fig. 3 is a view diagrammatically indicating line switch arrangements of an automatic telephone system.

Referring more particularly to Fig. 1 Part I and Fig. 1 Part II, I show a subscriber's substation A as forming part of a so-called private branch exchange system B including the private branch cord circuit C and the private branch trunk circuit D terminating in the plug P. This plug is adapted for association with a jack J leading directly by means of the line circuit 1 and 2 to an automatic exchange I, the continuation of which is to be found in Fig. 1 Part II.

The automatic exchange is shown as extending to an automatic subscriber's station E to which a connection will be traced from the substation A. Assuming that the operator at A has removed his receiver, the line relay LR is energized to light the lamp 3. The operator at the station B thereupon inserts the answering plug of cord circuit C which act energizes the answering supervisory relay AS so that the answering supervisory lamp 4^a is not lighted. Upon ascertaining that a connection is desired to an automatic subscriber, the operator inserts the plug 4 into the jack 5 of the local trunk. The insertion of the plug 4 within the jack 5 operates the relay 6 and also lights the calling supervisory lamp 7 because the calling supervisory relay CS is not energized and the circuit of this lamp is completed through the thimble contact of the jack 5 by way of the conductor 8 to the back contact 9 of the polarized relay PR to ground. The polarized relay under these conditions is not actuated as battery flows through this relay in the particular direction which will not cause its actuation as will be presently explained. Relay 6 however is actuated by the closure of the contacts 10 forming part of the jack 5 as is readily apparent. This operates the line relay LR′ at the automatic exchange, which circuit can be readily traced from the battery through said line relay, wiper 11, contacts 12 of the cut-off relay CO′, sleeve wire of the trunk circuit D, through relay PR, front contact 13 of the relay 6, tip of the trunk, line conductor 2, back contact 14, wiper 15, to ground.

As before stated the relay PR does not operate with the battery current flowing in this direction. Relay LR′ as customary places a ground on the connector contacts to establish the busy condition of this particular line switch. The energization of relay LR^1 closes an energizing circuit for the cut-off relay CO^1 traced from ground at alternate contact 36 of the relay LR^1, through normal contact 37 of off-normal contact ON, and through the winding of cut-off relay CO^1 to battery. The energization of relay CO^1 closes an energizing circuit for motor magnet MM′ traced from

ground at alternate contact 39 of LR^1, alternate contact 40 of CO', motor magnet MM' to the grounded generator. The motor magnet MM' steps the wipers 11 and 15 over the bank contacts connected to the connector switches at the automatic exchange in search of an idle connector switch. The off-normal contact ON assumes its alternate position upon the first step of the individual switch. Relays LR^1 and CO^1 remain energized as long as the line switch is seeking an idle connector switch, but as soon as the wipers engage the bank contacts of an idle connector switch, the circuit of relay CO^1 is opened to deënergize the motor magnet MM' to prevent the wipers from being stepped beyond the selected contacts, the relay LR^1 remaining energized from ground at the private contact of the connector.

Assuming the number of the called automatic substation is 45, the operator, through the medium of the key 17, connects the calling device 16 with the trunk circuit extending to the automatic exchange, and operates the calling device to send the different series of impulses to select the called for automatic substation E. When the calling device 16 is actuated to send four impulses of current, which we have assumed is the first digit of the called substation's number, the opening and closing of these contacts interrupts the circuit of the impulse relay IR. Upon energization of relay IR, a circuit is closed for the release relay RR, traced from ground through alternate contact 50 of IR and the winding of relay RR to battery. The operator having actuated the calling device to send four impulses, which energize and deënergize the impulse relay IR, the relay operates to transmit four impulses to the vertical magnet VM. Upon the first deënergization of relay IR, an energizing circuit for secondary relay SR is established, traced from ground to the normal contact 50 of relay IR, alternate contact 51 of RR, the winding of relay SR, conductor 52, the winding of vertical magnet VM and the side switch wiper 18 of battery. The relays RR and SR being slow acting are not responsive to the rapid interruptions of relay IR. The vertical magnet being quick acting is responsive to the said impulses, and steps the wipers of the connector to the fourth level of the switch contacts. The relay SR remains energized while the impulses are being sent, and the closure of its alternate contact 90 establishes a circuit for the relay PV, traced from battery through the winding of said relay PV, and the alternate contact of relay SR to ground. After the first set of impulses relay P^V deënergizes having its circuit open at alternate contact 90 of relay SR, and mechanically steps the side switch wipers from first to second position. The side switch wiper 18, upon engaging its second contact point, places the rotary magnet RM in series circuit with relay SR. The operator now actuates the calling device 16 to transmit five impulses, energizing and deënergizing the interrupter relay IR five times. Upon each deënergization of relay IR, relay SR and the rotary magnet RM are connected in series, the circuit being traced from ground at normal contact 50 of IR, through alternate contact 51 of relay RR, secondary relay SR, rotary magnet RM and the side switch wiper 18 to battery. The rotary magnet being quick acting responds to impulses transmitted by the impulse relay IR, and steps the wipers of the connector to the fifth contacts of the fourth level which are the contacts of the called line. The relay PV deenergizes after the last impulse is transmitted of this series, and operates to mechanically step the side switch wipers from second to third position. The wiper 18, upon engaging its contact 19, closes an energizing circuit for the ringing relay RI traced from battery through the side switch wiper 18, normal contact 64 of relay RCR, and through the interrupter relay RI to the interrupter. The relay RI is intermittently energized and deënergized through the medium of the said interrupter and operates to connect the ringing generator 20, through the alternate contacts 65 and 66 of relay RI to intermittently ring the call bell at the called substation E. When the party at substation E removes his receiver from the switch hook in response to the call, reversing relay RV operates. The operation of relay RV reverses the original battery flow through the supervisory relay PR of the cord circuit D, causing the effacement of supervisory lamp 7 of the cord circuit C. The operation of reversing relay RV also closes an energizing circuit for the ring control relay RCR, traced from battery through the winding of said relay RCR, alternate contact 70 of relay RV, through the side switch wiper 70' to ground. The energization of relay RCR opens the circuit for relay RI at its contact 64. The relay RI deenergizes thus cutting off the ringing current when the called subscriber answers. The relay RCR also closes a locking circuit for itself through its alternate contact 72.

After the conversation has been completed, the party at the substation E replaces his receiver upon its switchhook, this act opening the circuit of the reversing relay RV which again restores and causes the reversal of battery in the trunk circuit thus again operating relay PR and causing supervisory lamp 7 of the cord circuit C to glow. The glowing of supervisory lamp 7 notifies the operator that the called subscriber has replaced his receiver upon the switch hook. The party at the substation A, upon replac-

ing his receiver, causes the supervisory relay AS to deënergize and to close the circuit through the supervisory lamp 4ª. The operator noting the glowing of supervisory lamps withdraws the plugs from the subscriber's line and from the trunk circuit E. The withdrawal of the plug 4 from the trunk circuit E permits relay 6 to deënergize and to open the bridge across the trunk conductors of the said trunk circuit D, thus allowing impulse relay IR of the connector switch to deënergize. The relay IR, upon deënergizing, opens the circuit of the release relay RR which in turn upon deënergizing, closes a circuit through the release magnet REM. The release magnet operates to restore the connector switch to normal. The restoration of the connector switch restores the individual switch, due to the removal of ground from the test conductor.

Assuming that the subscriber at the substation E is busy and the operator has operated the calling device to send the last set of impulses which are five in number to select the called line, a ground will be encountered by the test or private wiper of the connector switch, this ground will establish an energizing circuit for the busy relay BR, traced from battery through the upper winding of said relay, side switch wiper 70^1 in second position, and through the said test wiper to the grounded private bank contact. The busy relay BR, upon energizing, closes a locking circuit for itself independent of the ground at the private bank contact. The last set of impulses five in number having been transmitted and the busy line encountered by the connector wipers, and due to the relay SR being slow-acting it remains energized thus preventing the private relay PV from releasing until another circuit is established in series with the lower winding of busy relay BR. The relay PV in remaining energized when the connector engages the busy contact transmits a busy signal from the busy machine BB to the calling subscriber's line. The subscriber at A receiving the busy signal replaces his receiver and opens the circuit of the supervisory relay AS as hereinbefore described. The relay RV of the connector switch not operating does not reverse the battery to the supervisory relay PR of the trunk circuit D Therefore, the supervisory signal 7 remains glowing. The operator noting the glowing of the supervisory signals, removes the plugs from the line jacks of the calling subscriber's line and from the trunk jack thus permitting the apparatus to return to normal in the manner hereinbefore described.

When the automatic subscriber desires to converse with a subscriber of the exchange B, for instance, the subscriber A, then the automatic subscriber initiates a call in the usual manner to reach the trunk circuit D which is associated with the automatic exchange through the usual connector contacts. As soon as the automatic subscriber has reached the trunk circuit D the ringing generator of the automatic exchange sends ringing current over the conductors 1 and 2, thereby sending alternating current through the trunk relay TR. This actuates the said trunk relay, whereupon a circuit is closed through the trunk lamp TL as readily apparent. This trunk relay TR is in the nature of a trip relay and the circuit through the trunk lamp TL remains closed on account of the peculiar construction of the trip spring 21. Now as soon as the operator connects the cord circuit C with the jack 5, circuit is closed through the relay 6, to thereby release the connection of spring 21, thereby extinguishing the lamp TL and permitting the armature of the relay TR to restore. Similarly the relay PR is actuated to prevent the answering supervisory lamp 7 from being actuated. The call is then completed to the subscriber's station A and the restoration is similar as before explained when the call is made in the reverse order.

Now assuming that a connection is desired through the common battery exchange F which terminates in a jack J', then under these conditions the plug P would be inserted in the jack J' in readiness for such service. Assuming now that the subscriber at the station A initiates a call, similarly as explained in connection with the automatic switchboard, the plug 4 is inserted into the jack 5 which then leads by means of the trunk circuit to the jack J'. It will be understood that the relay CS of the cord circuit C acts as the calling supervisory relay whenever a connection is made between two local subscribers such as the subscriber A. The insertion of the plug 4 of course again operates the relay 6 and bridges the relay PR across the line. Relay LR^2 is thereupon energized, the circuit extending of course by way of the contacts 13, through the relay PR and back to the ground at 22. Relay PR however does not operate. As soon as the operator at the exchange F answers by inserting the plug 23 into the jack 24, the battery current is reversed at the same time that the relay LR^2 is eliminated from the circuit, thereby actuating the relay PR and extinguishing the calling supervisory lamp 7. Relay LR^2 is of course eliminated by the relay CO^2, whereby the line lamp 25 is of course also extinguished. In the usual manner relays AS^2 and AT^2 are actuated, thereby preventing the lighting of the answering supervisory lamp 26. The exchange operator at the station F thereupon ascertains the connection desired and inserts the calling plug 27 into the jack of the desired line which may be the substation G. This substation G is of the ordi-

nary common battery type having the line relay LR^3 and cut off relay CO^3 at its terminus at the exchange F. The usual tests are made of course and if the called for line is not busy, the subscriber at the substation G may respond. The relays CS^2 and CT^2 control the calling supervisory lamp 28 in the usual manner, relay CT^2 not operating until the subscriber at the station G has answered. When the conversation is completed the calling subscriber restores his receiver, thereby permitting the relay AS to restore its armature to light the lamp 4^a. The restoration of the receiver by the called subscriber restores relay CT^2 to actuate the lamp 28. The operator at the exchange B thereupon restores the cord circuit C by withdrawing its plugs, thereby breaking the circuit for the relay AT^2 which had been hitherto completed by way of the relay PR, thereby actuating the answering supervisory lamp 26. The main exchange operator thereupon takes down the connection, both supervisory lamps 26 and 28 having been lighted. Should the call originate at the station G it is answered in the usual way and the operator at the station F inserts the calling plug in the trunk jack 24. Relays CS^2 and CO^2 operate in the usual manner to light the lamp 28 and to cut off the line relay LR^2. The operator thereupon actuates the ringing key 29 so that ringing current is transmitted over the trunk circuit which flows through the relay TR, thereupon lighting the lamp TL. The operator at the station B thereupon inserts the plug 30 into the jack 5 and calls the substation A in the usual way. Insertion of the plug into the jack 5 of course again actuates the relay 6 to restore the lamp TL.

When the conversation is completed this is again indicated to the operator at the station B who thereupon withdraws the cord circuit C, whereupon the operator at the station F withdraws her cord circuit so that everything is restored to normal.

From what has been described the nature of my invention will be clear in that I am enabled to effect connection by means of the trunk circuit herein disclosed for a private branch exchange switchboard either to an automatic switchboard or to a manual switchboard, which particular form shown herein is of course for illustrative purposes. Having however thus disclosed one form which my invention may take, what I claim as new and desire to secure by Letters Patent is:

1. In a telephone system, a cord circuit, a two-conductor universal trunk circuit having a jack at one extremity for connection to said cord circuit, a supervisory circuit extending from said cord circuit to said trunk circuit through said jack, said supervisory circuit being separate from the talking conductors of the said trunk circuit, a polarized relay for controlling said supervisory circuit, and means for reversing the flow of current through said relay.

2. A universal trunk circuit comprising two conductors having a jack at one extremity, a cord circuit for connection to said trunk circuit, a supervisory circuit extending through said jack and adapted to be associated with said cord circuit, a polarized relay for controlling said circuit, a relay for controlling the circuit of said polarized relay, contacts provided in said jack and controlled by a connected cord circuit to control said relay, and subscriber controlled means for operating said polarized relay thereby causing said relay to open said supervisory circuit.

3. A universal trunk circuit comprising two conductors having a jack at one extremity, a cord circuit for connection thereto, a supervisory circuit adapted for association with said cord circuit, a polarized relay for directly controlling a set of contacts in said circuit, and an automatic calling device adapted to be associated with said conductors.

4. A universal trunk circuit comprising two conductors having a jack at one extremity, a cord circuit for connection thereto, a supervisory circuit adapted for association with said cord circuit, a polarized relay for directly controlling said circuit, a relay for directly controlling the circuit of said polarized relay, contacts provided in said jack and controlled by said cord circuit to directly control said relay, and an automatic calling device adapted to be associated with said conductors.

5. A universal trunk circuit comprising two conductors having a jack at one extremity, a cord circuit for connection thereto, a supervisory circuit adapted for association with said cord circuit, a polarized relay for controlling said circuit, a relay for controlling the circuit of said polarized relay, contacts provided in said jack and controlled by said cord circuit to control said relay, a trip relay associated with said conductors, means to prevent the passage therethrough of direct current, and a signal for said trunk circuit controlled by said trip relay.

6. A universal trunk circuit comprising two conductors having a jack at one extremity, a cord circuit for connection thereto, a supervisory circuit adapted for association with said cord circuit, a polarized relay for controlling said circuit, a relay for controlling the circuit of said polarized relay, contacts provided in said jack and controlled by said cord circuit to control said relay, a trip relay associated with said conductors, means to prevent the passage therethrough of di-

rect current, a signal controlled by said trip relay, and means controlled by said second aforesaid relay to restore said trip relay.

7. A universal trunk circuit comprising two conductors having a jack at one extremity, a cord circuit for connection thereto, a trip relay associated with said conductors, means to prevent the passage therethrough of direct current, a signal under the control of said trip relay, auxiliary contacts provided in said jack controllable by said cord circuit, and means controlled by said contacts to restore said trip relay.

8. In a telephone system, a calling and called subscriber's line, a link circuit and a trunk circuit for completing connections between said lines, a supervisory circuit for said link circuit separate from the talking circuit, a relay for said trunk circuit for opening and closing said supervisory circuit, and subscriber controlled means for reversing the flow of current through said relay to operate the same.

9. A telephone system comprising a calling and a called subscriber's line, a link circuit provided with a manual terminal and a trunk circuit provided with a manual terminal for extending a connection from said calling to said called line, a supervisory circuit including a contact of the terminals of said link and trunk circuits, a polarized relay for opening and closing said supervisory circuit, and subscriber controlled means for reversing the flow of current through said relay.

10. A telephone system comprising telephone lines, a link circuit provided with a supervisory device, a trunk circuit, a polarized relay bridged across said trunk circuit, means including said link and trunk circuits for completing connections between said lines, a supervisory circuit for said supervisory device controlled by said polarized relay, said supervisory circuit extending through a third conductor of said link and trunk circuits and through a contact of said polarized relay, and a relay for reversing the current flow in said trunk to cause said polarized relay to effect said supervisory circuit.

11. A telephone system including manual and automatic subscribers' lines, a universal trunk circuit for inter-connecting said lines, a manual trunk circuit, an automatic trunk circuit, switching means for connecting said universal trunk circuit to either of said other trunk circuits, and means for completing connections from said last trunk circuits to called ones of said subscribers' lines.

12. The combination of a private branch exchange and a main exchange, link circuits for connecting lines at said private branch exchange, a trunk circuit, automatic equipment and manual equipment located at the main exchange, switching means for connecting said trunk circuit to either said manual or automatic equipment, and means for extending a connection from one of said private branch lines through said link circuit and trunk circuit to either an automatic or a manual subscriber's line at the main exchange.

13. A telephone system including a link circuit provided with a supervisory signal, a trunk circuit, a circuit for said supervisory signal including a conductor of said link and trunk circuits independent of the talking conductors, and a relay responsive to a reversed flow of current in said trunk circuit to close said supervisory circuit.

14. A telephone system including a two-way trunk circuit, automatic equipment and manual equipment, switching means for connecting said trunk circuit to either said manual or said automatic equipment whereby a connection may be extended to an automatic or a manual called line, other automatic equipment for connecting through said automatic equipment to said trunk circuit, other manual equipment for connecting through said manual equipment to said trunk circuit, and a signal for said trunk circuit responsive to such connections to said trunk circuit.

15. A telephone system including a private branch exchange, an automatic exchange, a manual exchange, a trunk circuit located at said private branch exchange, means for connecting said trunk circuit to either said manual exchange or said automatic exchange, and apparatus for extending calls in either direction over said trunk circuit to said other exchanges.

16. A telephone system including a private branch exchange, an automatic exchange, a manual exchange, a trunk circuit for said private branch exchange, equipment at said manual exchange and at said automatic exchange, means for temporarily connecting said trunk circuit to either said manual equipment or said automatic equipment, and operator-controlled means for extending connection from said private branch exchange to a subscriber located at either of said exchanges, depending upon which exchange said trunk circuit has been associated with.

Signed by me at Chicago, county of Cook and State of Illinois, in the presence of two witnesses.

RICHARD I. UTTER.

Witnesses:
GEORGE E. MUELLER,
M. R. ROCKFORD.