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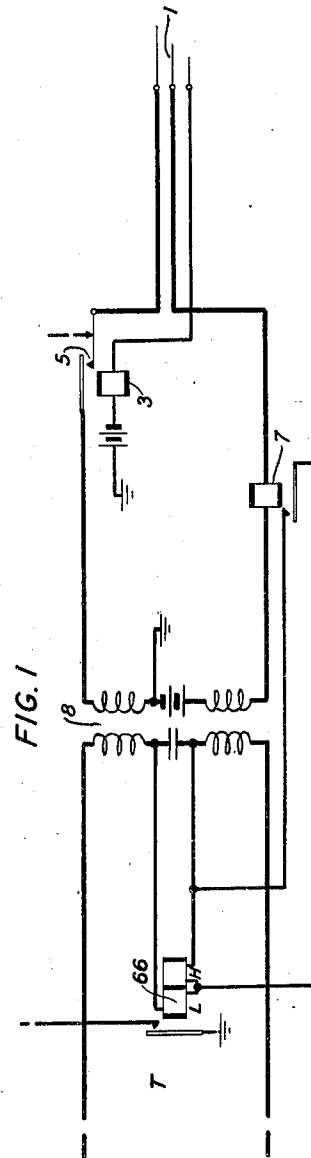
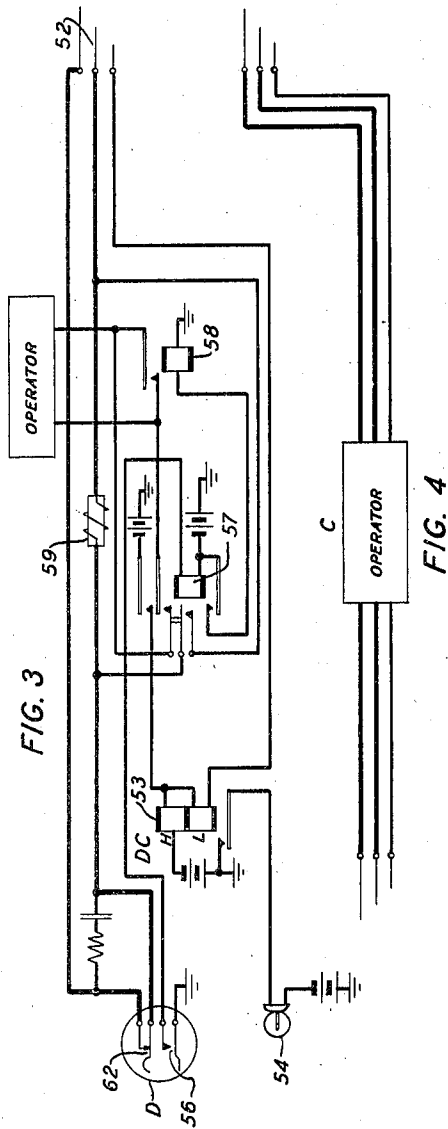
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TELEPHONE TRUNKING SYSTEM

Filed July 26, 1941

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

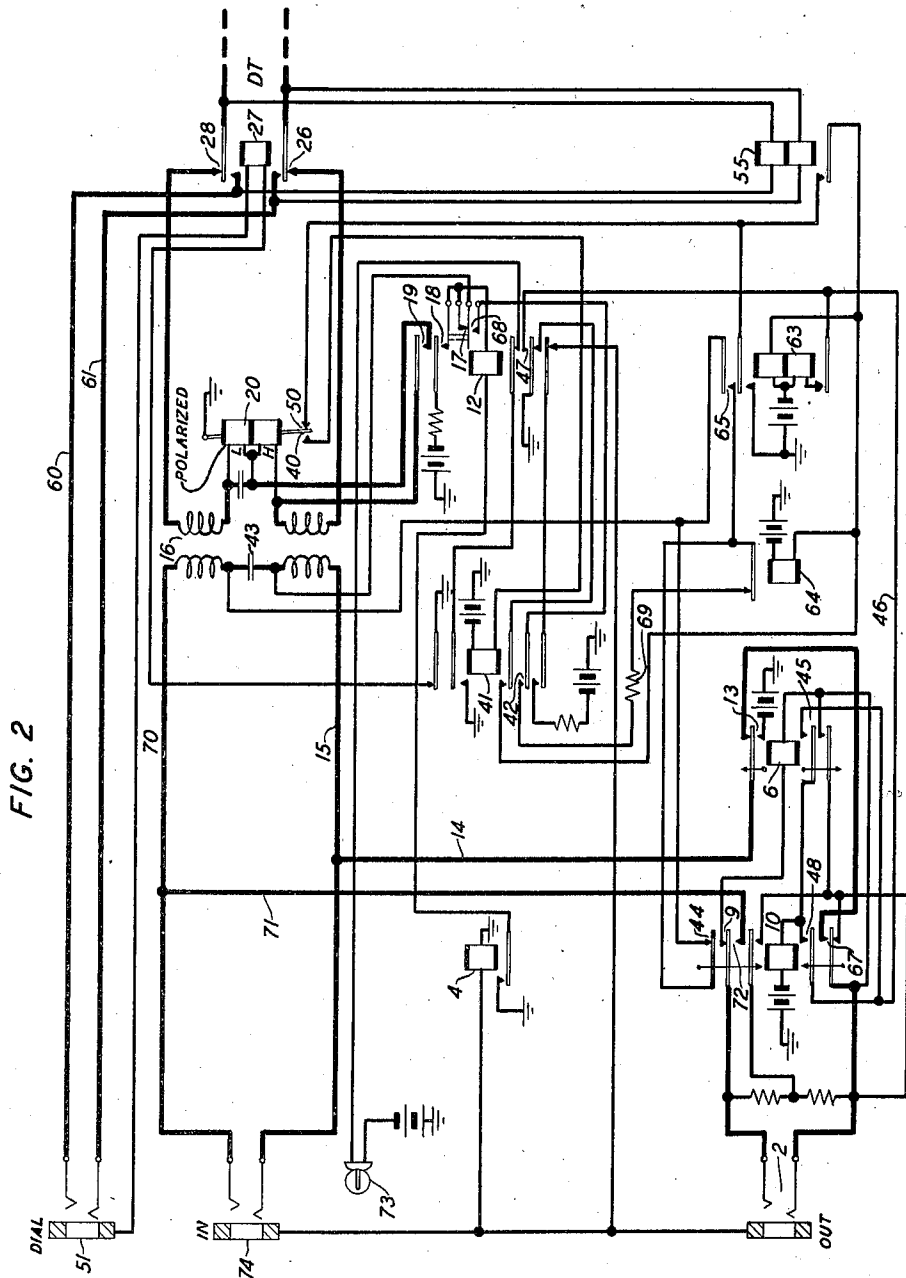


FIG. 2

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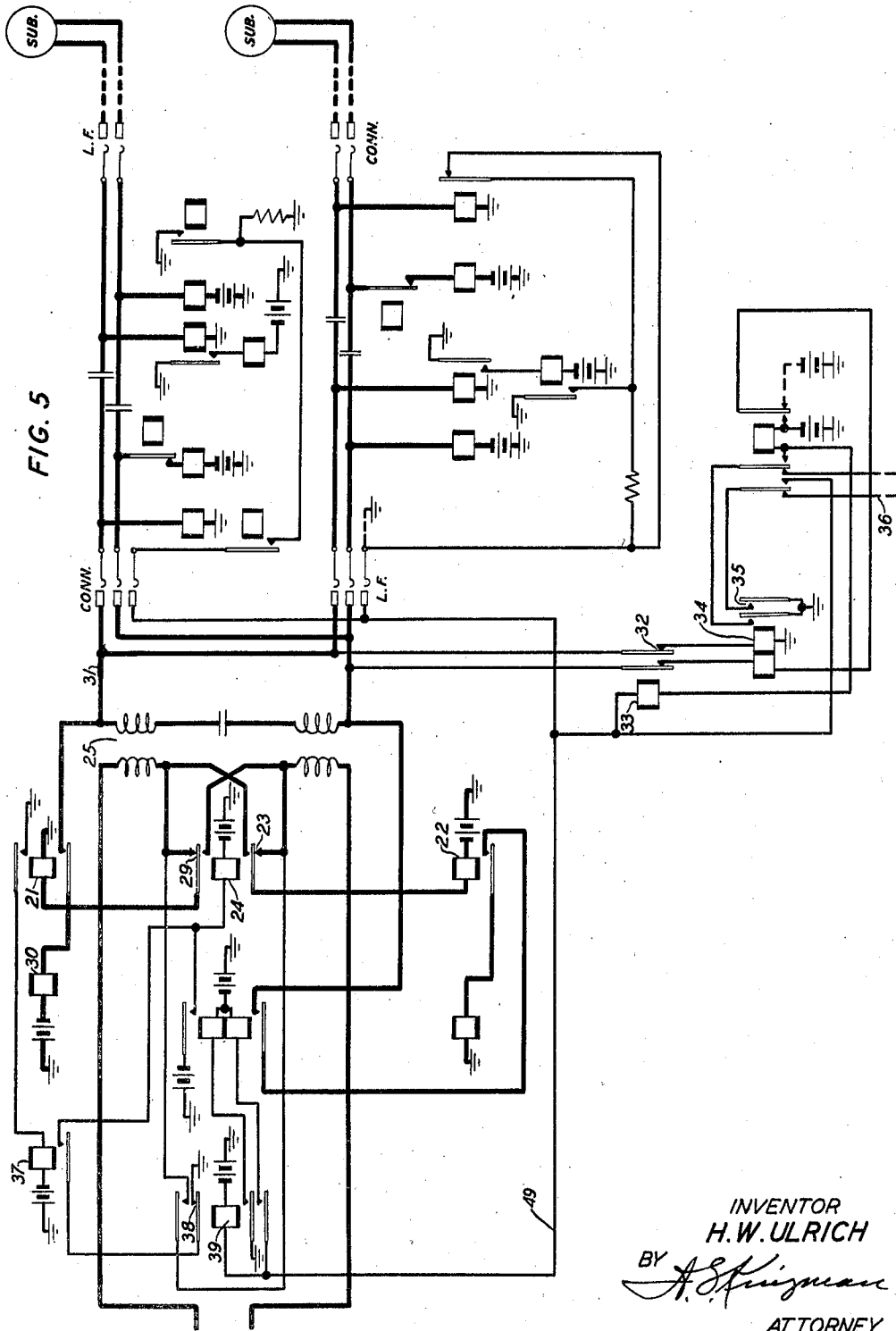
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TELEPHONE TRUNKING SYSTEM

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3 Sheets-Sheet 3



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# UNITED STATES PATENT OFFICE

2,302,587

## TELEPHONE TRUNKING SYSTEM

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8 Claims. (Cl. 179-27)

This invention relates to telephone exchange systems and more particularly to arrangements at an operator's position intermediate an incoming trunk from a calling exchange and an outgoing trunk terminating at an automatic central office, at which operator's position, subsequent to connection of the incoming trunk to the outgoing trunk, the intermediate operator associates an impulse device with the outgoing trunk to control the extension of the trunk through the automatic office to a called subscriber.

A feature of the invention resides in a trunk extending from a so-called master office to a link type community dial exchange which dial exchange is arranged to reverse the normal polarity of the trunk battery thereat immediately upon seizure of the trunk at the master office by an incoming trunk from a distant calling exchange and to maintain this condition until an idle link is available and connects itself to the trunk whereupon the polarity of the battery is restored to its normal condition which restoration of normal battery polarity is effective, in case a dial cord is associated with the trunk, to light a lamp before the operator as a signal to commence dialing and to prevent such reversals from transmitting supervisory signals back over the incoming trunk until the dial cord has been disconnected whereupon a subsequent reversal caused by the called subscriber removing his receiver from the hook will transmit a signal to the calling exchange in the usual manner.

The invention will be understood from the following description when read in connection with the accompanying drawings which represent an arrangement of circuits embodying the invention.

Referring to the drawings,

Fig. 1 represents the incoming end of the trunk circuit from a distant calling exchange terminating at a so-called master office operator's position;

Fig. 2 represents the master office end of a trunk circuit extending to a "community dial" automatic exchange;

Fig. 3 represents a dial cord for association with a community dial trunk to control automatic switching equipment thereover;

Fig. 4 represents a conventional operator's cord circuit for answering and completing calls incoming to the master office from a community dial office; and

Fig. 5 represents the circuit arrangement of the community dial office.

Following is a description of the operation of the circuits of the invention.

Let it first be assumed that a call is originated at a distant exchange, not shown, over the trunk line T of Fig. 1 for a subscriber A reached through the community dial exchange (Fig. 5).

Connection to the trunk T at the distant calling exchange causes the master office operator's telephone set (not shown) to be connected thereto in the usual manner. When the operator is connected and learns that a subscriber A in the community dial exchange of Fig. 5 is wanted, she inserts plug 1 of the trunk in the out jack 2 of the community dial trunk whereupon relay 3 in the incoming trunk and sleeve relay 4 of the community dial trunk operate. Operation of relay 3 closes its contact 5 thereby completing a circuit to operate relay 6 of the community dial trunk, when the tip and ring contacts of the plugs are both in engagement with the respective tip and ring springs of jack 2. This circuit can be traced from battery, lower right winding of repeating coil 8, winding of relay 7, ring contacts of the plug and jack, winding of relay 6, contacts 9 of relay 10, tip contacts of the jack and plug, contacts 5 of relay 3, upper right winding of coil 8 to ground. Relay 6 operates in this circuit and in conjunction with relay 4 causes operation of relay 12 in the following circuit, battery, contacts 13 of relay 6, conductors 14 and 15, lower left winding of repeating coil 16, contacts 17 and winding of relay 12 to ground at contacts of sleeve relay 4. Operation of relay 12 in this circuit closes a locking circuit for itself at its contacts 18 under control of the sleeve relay 4 and at its contact 19 short-circuits the lower (high resistance) winding of polarized relay 20, thereby causing operation of line relays 21 and 22 at the dial office (Fig. 5). The circuit for relays 21 and 22 can be traced from battery, winding of relay 22, contacts 23 of relay 24, lower left winding of repeating coil 25, ring conductor of trunk DT, contacts 26 of relay 27, lower right winding of coil 16, contacts 19 of relay 12, upper (low resistance) winding of relay 20, upper right winding of coil 16, contacts 28 of relay 27, tip conductor of the trunk DT, upper left winding of coil 25, contacts 29 of relay 24, and winding of relay 21 to ground.

Operation of relay 21 closes its lower contact, thereby connecting battery through inductance 30 to the tip conductor 31 to ground over contacts 32 of cut-off relay 33 and the right-hand winding of line relay 34 which relay operates in this circuit and closes its contact 35 to connect

ground to start lead 36 to cause a line finder to hunt for the calling trunk. Operation of relay 21 also operates relay 37 which in turn closes an obvious circuit to operate reversing relay 24 from ground at contacts 38 of relay 39. Operation of relay 24 reverses the direction of the current flowing in polar relay 20 at the master office (Fig. 2) which relay then moves its grounded armatures to close contacts 40 thereby operating relay 41 to close, at its contacts 42, one break in the supervisory bridge across the condenser 43 at the mid-point of the left side of repeating coil 16 which circuit is, however, now open at contacts 44 of relay 10, which relay operated in response to operation of relay 12 following operation of relay 6. The circuit for relay 10 can be traced from battery, winding of relay 10, contacts 45 of relay 6, and conductor 46 to ground at contacts 47 of relay 12. Relay 10 in operating locks over its contacts 48 to ground on conductor 46. Relay 10 in operating also opens its contacts 9 to release relay 6 thereby completing at contacts 13 a connection between the incoming trunk T and the left side of the repeating coil 16.

When a line finder at the dial office finds the calling line it connects ground, over the sleeve terminal of the finder bank, to sleeve conductor 49 thereby operating relay 39 which opens its contact 38 to release relay 24 thereby restoring the original polarity of the trunk battery which causes the armature of polar relay 20 to move into engagement with contact 50 and to open its contacts 40 thereby releasing relay 41 which reconnects ground at its uppermost contacts to prepare relay 27 for operation under control of the dial cord DC (Fig. 3) which is adapted to be connected to the dial jack 51.

At the time the operator connects trunk plug 1 to jack 2, or subsequent thereto, she also inserts plug 52 of the dial cord DC into dial jack 51 and if a line finder at the dial office has already attached itself to the trunk, thereby restoring the trunk battery to its normal polarity to cause relay 41 to release, relay 53 will operate in a circuit from battery, high resistance upper and low resistance bottom winding of relay 53 in series, sleeve contacts of the plug and jack, winding of relay 27 to ground at the uppermost contacts of relay 41. Operation of relay 53 causes pilot lamp 54 to become lighted as a signal to the operator that a line finder is attached to the trunk at the dial office and that the equipment thereat is in readiness to receive dial pulses. Relay 27 does not operate at this time due to the combined resistance of the upper and lower windings of relay 53 and consequently relay 55 operates in parallel with polar relay 20 from battery on the tip and ring of trunk DT supplied at the dial office, the circuit for which can be traced from the tip conductor of trunk DT, upper winding of relay 55, conductor 60, tip of the dial jack 51, and plug 52, normally closed pulsing contacts 62 of the dial D, impedance 59, ring contacts of plug 52 and jack 51, conductor 61 and lower winding of relay 55 to the ring conductor of the trunk to the dial office. Operation of relay 55 closes its contacts thereby operating relays 63 and 64 from ground at contacts 50 of relay 20. Relay 63 locks over its lower contacts to ground at contacts 47 of relay 12 and at its contact 65 short-circuits the open contacts 44 of relay 10.

In case there are no links available at the dial office, i. e., the line finders are all busy, relay 24 of the dial office will remain operated to hold

the trunk battery reversed, thereby holding relay 41 operated and when the dial cord is connected, relay 53 will not operate and lamp 54 will remain dark.

Assuming, however, that a link at the dial office is available and has attached itself to the trunk and the dial cord is plugged into jack 51, the operator is notified by the lighting of pilot lamp 54 that she can start dialing. When the operator moves the dial off normal, for the first series of pulses, the off-normal contacts 56 are closed thereby operating relay 57 which in turn operates relay 58. Relay 57 in operating short-circuits the upper high resistance winding of relay 53 thereby reducing the resistance of the sleeve circuit including relay 27 which relay then operates to disconnect the repeating coil 16 and relay 20 from the dial trunk, to short-circuit relay 55, and to connect conductors 60 and 61 to the trunk leading to the dial office. The pulsing circuit is now complete from the dial through to the distant dial office. Relay 55 now being released, relay 64 releases thereby reclosing its contacts whereby the supervisory bridge is now only open at contacts 42 of relay 41. Each time the dial returns to normal, relay 27 releases whereupon relay 55 operates to again operate relay 64 which introduces another break in the supervisory bridge. At the conclusion of the dialing operation, the operator removes the plug of the dial cord from jack 51 whereupon relay 55 releases in turn releasing relay 64 thus placing the supervisory bridge under the exclusive control of relay 41. When the called subscriber answers, the battery at the dial office is again reversed in the usual manner, polar relay 20 at the master office again moves its armature to open contacts 50 and close contacts 40, thereby operating relay 41 which closes its contacts 42 thereby completing, for the first time, the circuit of the supervisory bridge across the mid-point of the left side of repeating coil 16 whereupon a circuit is closed to operate relay 7 in the calling trunk T (Fig. 1) which can be traced from battery, lower right winding of repeating coil 8, winding of relay 7, ring contacts of plug 1 and jack 2, contact 67 of relay 10, upper back contact of relay 6, conductors 14 and 15, lower left winding of repeating coil 16, contacts 68 of relay 12, contacts 42 of relay 41, resistance 69, upper contacts of relay 64, contacts 65 of relay 63, upper left winding of coil 16, conductors 70 and 71, contacts 72 of relay 10, tip contacts of jack 2 and plug 1, contacts 5 of relay 3, upper right winding of coil 8, to ground.

Operation of relay 7 short-circuits the right-hand high resistance winding of the line relay 66 thereby causing a supervisory signal at the distant calling exchange to be extinguished, in a well-known manner, to indicate to the operator thereat that the called subscriber has answered.

When the conversation is finished and the called subscriber restores his receiver to the hook the battery at the dial office is restored to normal polarity and relay 20 moves its armature to open contacts 40 thereby releasing relay 41 which opens at its contacts 42 the circuit, previously traced, for operating relay 7 in the calling trunk T. Release of relay 41 removes the short circuit around the right-hand winding of relay 66 which thereby increases the resistance of the bridge across the trunk T and causes the supervisory signal at the calling exchange to be displayed. When the operator at the calling exchange disconnects from the trunk, a disconnect signal (not

shown) at the master office is displayed as an indication that plug 1 may be removed from jack 2. When this is done all relays restore and the circuit returns to normal.

Calls from the dial exchange over dial office trunk DT cause the trunk circuit at the master office to function in a well-known manner to light the line lamp 73 which call is answered in the usual manner by connecting the cord circuit C (Fig. 4) to the inward jack 74.

What is claimed is:

1. In a telephone system, a calling exchange, an automatic exchange having incoming trunk finder switches thereat, an intermediate dialing operator's position, a trunk between the calling exchange and the operator's position and a trunk between the operator's position and the automatic exchange, a dial at the operator's position, a signal device associated with said dial, switching means for connecting the calling exchange trunk to the automatic exchange trunk, means independent of said switching means for connecting said dial to said automatic exchange trunk, said automatic exchange being arranged to reverse the polarity of the battery connected to the incoming trunk when it is connected to the calling trunk at the operator's position, to restore the normal polarity of the battery when a trunk finder switch is connected thereto, and to again reverse the battery supply polarity when the called subscriber answers, means at the operator's position responsive to said second reversal to actuate said signal device when the dial is connected to the automatic exchange trunk as an indication to the operator that the automatic exchange is conditioned to receive dial pulses, means for transmitting supervisory signals over said calling exchange trunk responsive to a reversed polarity of the automatic exchange trunk battery and other means to prevent transmission of supervisory signals over said calling exchange trunk until said dial has been connected to and disconnected from said automatic exchange trunk.

2. In a telephone system, a calling exchange, an automatic exchange having incoming trunk finder switches thereat, an intermediate operator's position, a trunk between the calling exchange and the operator's position, a trunk between the operator's position and the automatic exchange, a dial at the operator's position, a signal device associated with said dial, switching means for connecting the calling exchange trunk to the automatic exchange trunk, means independent of said switching means for connecting said dial to said automatic exchange trunk, said automatic exchange being arranged to reverse the normal polarity of the battery connected to the incoming trunk when the calling exchange trunk is connected thereto at the operator's position and to restore the normal polarity of the battery when a finder switch is connected thereto, means at the operator's position jointly responsive to the connection of said dial to the automatic exchange trunk and the restoration to normal polarity of said exchange battery to actuate said signal device as an indication to the operator that the automatic exchange is conditioned to receive dial pulses, means for transmitting supervisory signals over said calling exchange trunk responsive to a reversal from normal of the automatic exchange battery, and other means to prevent transmission of said supervisory signals over said calling trunk until

said dial has been disconnected from said automatic exchange trunk.

3. In a telephone exchange system, an operator's position, a calling trunk incoming to said position, trunks between said position and said automatic exchange, switching means at said position for connecting said calling trunk to any one of said trunks to the automatic exchange, finder switches at said automatic exchange fewer in number than said trunks terminating thereat, said automatic exchange being arranged to reverse the normal polarity of the battery supply thereat to any one of said trunks responsive to connection of said calling trunk thereto at the operator's position, and to restore said battery supply polarity to normal when a finder switch attaches itself to the trunk, a dial and an associated signal device at said position, means for connecting said dial and associated signal device to any one of said trunks to the automatic exchange, means at said position jointly responsive to connection of said dial and signal device to any one of said trunks to the automatic exchange which is connected to said calling trunk and to a restoration of the normal battery polarity thereto, to actuate said signal device, and means in each automatic exchange trunk at said position for controlling the transmission of supervisory signals over a connected calling trunk responsive to battery reversal from normal thereover, and means for preventing transmission of such supervisory signals until said dial has been connected and disconnected from the automatic exchange trunk.

4. In a telephone system, an operator's position, an automatic exchange, trunks therebetween, a calling trunk terminating at said position and adapted to be connected to any one of said trunks to the automatic exchange, finder switches at said automatic exchange fewer in number than said trunks, said automatic exchange being arranged to reverse the normal polarity of the battery supplied to any one of said trunks when it is connected, at said position, to said calling trunk, and when a finder switch is brought into engagement therewith to restore said battery supply polarity to normal, a dial and an associated signal device at said position, means for connecting said dial to any one of said trunks and means responsive to the restoration to normal polarity of the trunk battery for actuating said signal device.

5. In a telephone system, a first exchange, an operator's position, an automatic exchange, a first trunk extending between said first exchange and said position, a second trunk between said position and said automatic exchange, switching means at said position for connecting said first and second trunks, an impulse device at said position and means independent of said switching means for connecting said device to the second trunk, means for reversing the normal polarity of the battery supplied to said second trunk at the automatic exchange responsive to the interconnection of the first and second trunks and for restoring said battery polarity to normal when said automatic exchange is ready to receive control impulses, means at said position for transmitting a signal over said first trunk responsive to a battery reversal received over said second trunk, and means for preventing transmission of said signals over said first trunk until said impulse device has been connected and disconnected from said second trunk.

6. In a telephone system, an automatic ex-

change having trunks incoming thereto, trunk finder switches thereat fewer in number than said incoming trunk, said automatic exchange being arranged to reverse the normal polarity of the battery supplied to any trunk when seized at the outward end, a calling exchange, an intermediate operator's position, a trunk between said calling exchange and the operator's position, outgoing terminals at said automatic exchange trunks at said position, switching means at said position for connecting said calling exchange trunk to the outgoing terminals of one of said trunks to the automatic exchange, a supervisory bridge in the automatic trunk at the position adapted when closed to control a supervisory device at the calling exchange over the respective trunk, polarized means in the automatic exchange trunk at the position responsive to a reversal from normal polarity of the trunk battery at the automatic exchange for partially closing the respective bridge, an operator's dial, means independent of said switching means for connecting said dial to the automatic exchange trunk, and means for completing closure of said bridge when said trunk battery is reversed, said means being responsive to the connection and subsequent disconnection of said dial from said automatic trunk.

7. In a telephone system, first and second exchanges, a first trunk for extending calls from said first to said second exchange, an automatic exchange, a second trunk between said second exchange and the automatic exchange, switching means at the second exchange for connecting said first to said second trunk line, an impulse device at said second exchange and means independent of said switching means for connecting said device to the second trunk, supervisory means at said first exchange, a supervisory bridge circuit in said second trunk at the second exchange for controlling said supervisory means, said automatic exchange being arranged to transmit current of one polarity over said second trunk until the switches thereat are ready to receive control impulses, to reverse the polarity of

said current when said switches are in readiness to receive impulses, and to again reverse the current when the called subscriber answers, means at said second exchange controlled by the polarity of current transmitted from said automatic exchange for controlling said supervisory bridge, means responsive to the connection of said first trunk to said second trunk for disabling said supervisory bridge, and other means responsive to the connection and subsequent disconnection of said dial for enabling said bridge for closure in response to reversals of battery polarity over said second trunk.

8. In a telephone system, first and second operators' positions, a first trunk line for extending a call from the first to the second position and terminating at said second position in a cord and plug, an automatic exchange, a second trunk line terminating in a jack at the second position for extending the first trunk line from the second operator's position to the automatic exchange, a dial jack at the second position associated with said second trunk line, an operator's dial cord including a dial at the second position adapted to be connected to said dial jack for controlling the extension of said second trunk through said automatic exchange, a supervisory bridge circuit at said second position associated with said second trunk adapted when closed to control a supervisory device at the first operator's position, said automatic exchange being so arranged that when said first and second trunks are connected, the polarity of the battery connected to the trunk at the automatic exchange will be in such a direction as to tend to close said bridge until a finder link is connected to the second trunk at which time the battery polarity will be reversed to tend to open said bridge, other means responsive to connection of said first of said second trunks for disabling said bridge and still other means responsive to the connection and subsequent disconnection of said dial to said second trunk to condition said bridge for closure under control of said trunk battery.

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