

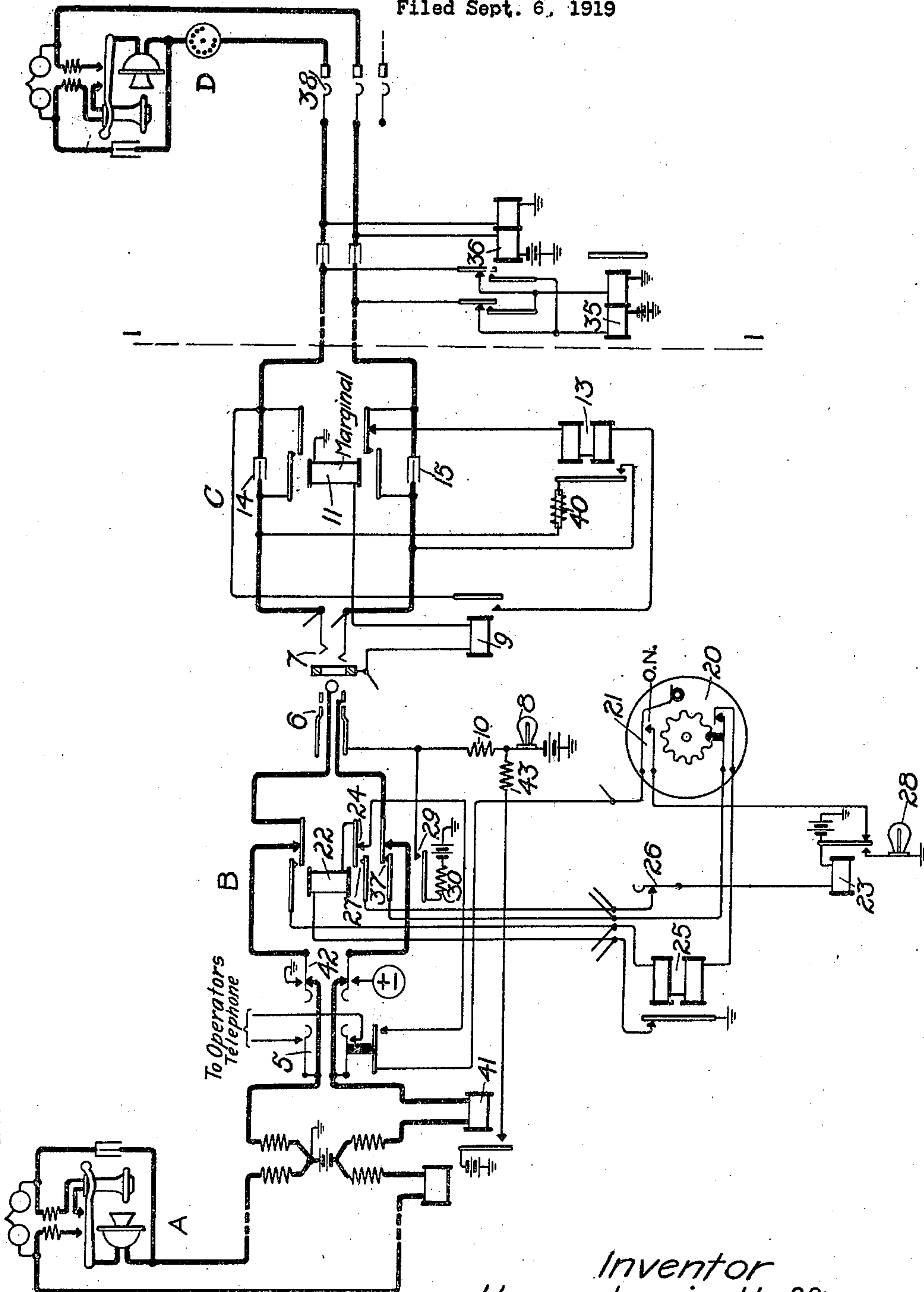
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H. L. HOFFMANN

TELEPHONE EXCHANGE SYSTEM

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

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To all whom it may concern:

Be it known that I, HENRY L. HOFFMANN, residing at St. Louis, in the city of St. Louis and State of Missouri, have invented certain
 5 Improvements in Telephone-Exchange Systems, of which the following is a specification.

This invention relates to telephone exchange systems and more particularly to
 10 such systems in which connections between telephone lines terminating at manual and automatic exchanges are established by way of trunk circuits, over which automatic switches are controlled from the manual ex-
 15 change for effecting connections between the trunk circuits and telephone lines at the automatic exchange.

The object of this invention is the production of an improved system of this
 20 character, by which the operators at the manual exchange may control automatic switches provided at the automatic exchanges and in which complete supervision over the connection is given to the operators
 25 at the manual exchange.

In accordance with the various features of this invention, an operator's impulse sending device provided at the manual office and common to the link circuits thereat,
 30 is rendered individual to a link circuit when connected with a trunk circuit extending to the automatic exchange by means responsive to the initial actuation of the impulse sending device. Means provided at the
 35 manual office and controlled over the trunk circuit in turn controls the disconnection of the impulse sending device from the particular engaged link circuit, and further means under the control of the operator is pro-
 40 vided whereby, if the sending device has not been disconnected by the means controlled over the trunk circuit prior to the time that the operator desires to connect the sending device with another link cir-
 45 cuit, the operator may disconnect the sending device from the engaged link circuit. Condensers are provided in the talking conductors of the trunk circuit which normally prevent the flow of direct current
 50 from the manual to the automatic exchange, and which upon the connection of the operator's sending device with the en-

gaged link circuit are short-circuited to provide a direct current path for impulses.

For a more complete understanding of
 55 this invention reference should be had to the following description and to the accompanying drawing which illustrates one embodiment of the invention.

There is shown in the drawing a telephone
 60 line A which terminates at the manual exchange, where it may be connected with a link or cord circuit B in any suitable and well known manner. The calling end of the link circuit B may be connected with a
 65 trunk circuit C extending from the manual to the automatic exchange, at which are provided the usual selector and connector switches for effecting connection between the trunk circuit and telephone lines, such
 70 as D, terminating at the automatic exchange. The apparatus shown to the left of the dotted line 1—1 is located at the manual exchange, and that to the right thereof at the automatic exchange. The nature of
 75 this invention is such that it is believed that a clear understanding thereof will be obtained from a description of the operation of the system shown in the drawing, and it will be so described.

The subscriber at telephone line A hav-
 80 ing initiated a call and the answering end of the link circuit B having been associated therewith in any well known manner, the operator actuates listening key 5, connect-
 85 ing the operator's telephone set in circuit so that the operator may converse with the calling subscriber to ascertain the number of the line with which connection is desired. Assuming that connection is desired with
 90 telephone line D, which terminates at the automatic exchange, the operator inserts calling plug 6 of the link circuit B into jack 7 of the trunk circuit C. Calling supervisory lamp 8 and sleeve relay 9 are there-
 95 upon operated over a circuit from battery, through the lamp 8, resistance 10, sleeve contacts of the plug 6 and the jack 7 and the windings of relays 9 and 11 to ground. Relay 11 is marginal and does not operate
 100 in series with resistance 10 and the winding of relay 9, resistance 10 being comparatively high. The operation of relay 9 bridges polarized relay 13 across the talking con-

ductors of the trunk circuit on the automatic exchange side of condensers 14 and 15 provided in the talking conductors for the purpose of normally preventing the flow of direct current from the manual to the automatic exchange. Polarized relay 13 does not operate at this time for the direction of flow of current through its windings is such as to prevent its operation.

The operator may now actuate an operator's impulse sending device 20 which is common to the link circuits at this operator's position. Upon the initial actuation of the impulse sending device 20, the off-normal contact 21 thereof is closed, causing the operation of sending device connecting relay 22 over a circuit from battery through the normal contact of pilot relay 23, off-normal contact 21, lower contact of listening key 5, contact 24 and winding of relay 22, and the contact of polarized relay 25 to ground.

Relay 22 in operating completes a locking circuit for itself from battery, through the winding of pilot relay 23, contact of the operator's switching key 26, contact 27 and winding of relay 22, and the contact of polarized relay 25 to ground. The operation of relay 22 opens the talking conductors of the link circuit B and bridges the impulse contact of the sending device 20 and polarized relay 25 across the talking conductors of this link circuit connected with the plug 6. The energization of pilot relay 23, resulting from the closure of the locking circuit of relay 22, opens a contact in the original energizing circuit of relay 22 and causes pilot lamp 28 to be lighted, indicating that the sending device 20 has been rendered individual to one of the link circuits and connected therewith. The closure of contact 29 of relay 22 connects resistance 30 in parallel with supervisory lamp 8 and resistance 10, thereby lowering the resistance of the circuit which includes the winding of relay 11, which thereupon operates.

The operation of relay 11 opens the bridge which contains the polarized relay 13 and short-circuits the condensers 14 and 15 to provide a path for the direct current impulses controlled by the sending device 20. Upon the short-circuiting of these condensers impulse responsive relay 35 operates over a circuit from ground through the right-hand winding of impulse responsive relay 35, right-hand normal contact of reversing relay 36, upper alternate contact of relay 11, tip contacts of the jack 7 and the plug 6, upper alternate contact of relay 22, windings of polarized relay 25, impulse contact of the sending device 20, contact 37 of relay 22, ring contacts of the plug 6 and the jack 7, lower alternate contact of relay 11, left-hand normal contact of reversing relay 36, and the left-hand winding of impulse responsive relay 35 to battery.

The opening and closing of the impulse contact of the sending device 20 during the return movement of the sending device to its normal position causes the opening and closing of the last traced circuit of the preceding paragraph, whereby impulse responsive relay 35 follows the impulses transmitted by the sending device 20. This impulse relay 35 controls the usual motor magnets for the connector switch at the automatic exchange, whereby connection is established through the switch 38 with telephone line D. After the selecting impulses have been transmitted the operator may restore the listening key 5 to normal position. The call bell at the station of telephone line D may be actuated in the usual manner, and the subscriber in responding to the operation thereof removes the receiver from the switchhook, causing the energization of reversing relay 36. The energization of this relay 36 reverses the battery connections with the talking conductors of the trunk circuit, whereby polarized relay 25 bridged across the talking conductors of the link circuit B is energized and opens its contact. The opening of this contact interrupts the locking circuit of the relay 22, whereupon this relay 22 and pilot relay 23 connected in series therewith are deenergized and restored to normal. The deenergization of relay 22 disconnects the sending device 20 from the link circuit B and the deenergization of pilot relay 23 opens the circuit of and extinguishes the pilot lamp 28.

The deenergization of relay 22 also disconnects the resistance 30 from parallel relation with the lamp 8 and resistance 10, whereupon marginal relay 11 releases its armatures reconnecting polarized relay 13 in bridge of the talking conductors and opening the short circuits of the condensers 14 and 15. The direction of the flow of current through the windings of polarized relay 13 is now such as to cause the energization of this relay which, in closing its contact, bridges impedance coil 40 across the talking conductors of the trunk circuit on the manual side of the condensers. This impedance coil 40 is of such high impedance that it does not interfere with the talking currents. Upon the connection of this impedance coil 40 across the talking conductors, supervisory relay 41 operates over a circuit from battery through the winding of supervisory relay 41, lower normal contact of ringing key 42, lower normal contact of relay 22, ring contacts of the plug 6 and the jack 7, contact of polarized relay 13, impedance coil 40, tip contacts of the jack 7 and the plug 6, upper normal contact of relay 22, and upper normal contact of ringing key 42 to ground. The energization of supervisory relay 41 connects resistance 43 in parallel with the lamp 8,

thereby causing the lamp to be extinguished, which indicates to the operator that the called subscriber has answered.

Should the operator, prior to the response of the party on telephone line D, have needed to use the impulse sending device 20 in connection with another link circuit, the calling device 20 must first be disconnected from the link circuit B which may be done by actuating key 26. The opening of the contact of this key 26 interrupts the locking circuit of relay 22 so that this relay and pilot relay 23 release in the manner before described, to disconnect the sending device 20 from the link circuit and to extinguish the pilot lamp 28. Marginal relay 11 is also deenergized by the deenergization of relay 22. If after the disconnection of the sending device 20 from the link circuit B in the manner just described, the subscriber D responds by removing the receiver from the switchhook, the energization of reversing relay 36 causes the operation of polarized relay 13. The operation of this relay 13 bridges the impedance coil 40 across the talking conductors of the trunk circuit, whereupon supervisory relay 41 energizes and extinguishes the lamp 8.

At the conclusion of the conversation, the subscribers restore their receivers to the switchhooks. The restoration of the receiver to the switchhook at the station on telephone line D causes the deenergization of reversing relay 36, whereupon the connection of battery with the talking conductors of the trunk circuit is reversed causing the release of signal-control polarized relay 13. Impedance coil 40 is removed from bridged relation with the talking conductors and supervisory relay 41 deenergizes, permitting the lighting of the supervisory lamp 8 which now serves as a disconnect signal to the operator at the manual office. The operator may thereupon disconnect the plug 6 from the jack 7, whereupon all operated apparatus associated with the calling end of the link circuit B and with the trunk circuit C is released and restores to normal position.

What is claimed is:

1. In a telephone exchange system, in combination, a trunk circuit, an operator's link circuit connected therewith, a called line, an impulse sending device, means local to the link circuit responsive to the actuation of the impulse sending device for connecting it with the link circuit, and means controlled over the trunk circuit by the called line for disconnecting the impulse sending device from the link circuit.

2. In a telephone exchange system, in combination, a trunk circuit, a link circuit connected therewith, an impulse sending device, a relay energized in response to the actuation of the sending device for connect-

ing it with the link circuit, a locking circuit for the relay established upon the energization thereof for rendering its continued energization independent of the impulse sending device, and means controlled over the trunk circuit for automatically opening said locking circuit.

3. In a telephone exchange system, in combination, a trunk circuit, a link circuit connected therewith, an impulse sending device, a relay individual to the link circuit responsive to the actuation of the impulse sending device for connecting the device with the link circuit, and a relay in the link circuit controlled over the trunk circuit for disconnecting the impulse sending device from the link circuit.

4. In a telephone exchange system in combination, a trunk circuit, a link circuit connected therewith, an impulse sending device, a relay energized in response to the actuation of the sending device for connecting it with the link circuit, a telephone line, and a polarized relay controlled over the trunk circuit and by the telephone line for disconnecting the impulse sending device from the link circuit.

5. In a telephone exchange system, in combination, a trunk circuit terminating in a jack, an operator's link circuit terminating in a plug connected therewith, an impulse sending device, means responsive to the actuation of the impulse sending device for connecting it with the link circuit, and a signal-control relay controlled over the trunk circuit for disconnecting the sending device from the link circuit.

6. In a telephone exchange system, in combination, a trunk circuit, a link circuit connected therewith, an impulse sending device, a relay energized in response to an actuation of the impulse sending device for connecting it with the link circuit, a telephone line, a signal-control relay controlled over the trunk circuit and by the telephone line for disconnecting the impulse sending device from the link circuit, and a supervisory signal in the link circuit operating in response to the energization of the signal-control relay.

7. In a telephone exchange system, in combination, a trunk circuit, a link circuit connected therewith, an impulse sending device, a relay energized in response to an actuation of the impulse sending device for connecting it with the link circuit, a pilot relay, a sending device pilot lamp controlled thereby, and a locking circuit for the first-mentioned relay established upon the energization thereof and including the winding of the pilot relay.

8. In a telephone exchange system, in combination, a trunk circuit terminating in a jack, an operator's link circuit terminating in a plug connected therewith, an impulse

sending device, a relay individual to the link circuit responsive to the actuation of the impulse sending device for connecting it with the link circuit, and operator-controlled means for disconnecting the sending device from the link circuit.

9. In a telephone exchange system, in combination, a trunk circuit, a link circuit connected therewith, an impulse sending device, a relay energized in response to an actuation of the impulse sending device for connecting it with the link circuit, a locking circuit for the relay established upon the energization thereof for rendering the continued energization of the relay independent of the sending device, and subscriber and operator-controlled means for opening the locking circuit to disconnect the sending device from the link circuit.

10. In a telephone exchange system, in combination, a called line, a trunk circuit, a plurality of link circuits, an impulse sending device common to the link circuits, means dependent upon the connection of one of the link circuits with the trunk circuit, and upon an actuation of the impulse sending device for rendering the sending device individual to the engaged link circuit, and means controlled by the called line over the trunk circuit for disconnecting the impulse sending device from the link circuit.

11. In a telephone exchange system, in combination, a trunk circuit comprising a talking conductor, a condenser in the talking conductor, a link circuit connected with the trunk circuit, an impulse sending device, means responsive to an actuation of the impulse sending device for connecting it with the link circuit and for establishing a direct current path around the condenser, and an impulse relay controlled by the impulse sending device over a circuit including the direct current path around the condenser.

12. In a telephone exchange system, in combination, a trunk circuit comprising a talking conductor, a condenser in the talking conductor, a link circuit connected with the trunk circuit, an impulse sending device, a relay energized in response to an actuation of the impulse sending device for connecting it with the link circuit, a second relay operating in response to the energization of the first relay for establishing a direct current path around the condenser, and an impulse relay controlled by the impulse sending device over a circuit including the direct current path around the condenser.

13. In a telephone exchange system, in combination, a trunk circuit comprising a pair of talking conductors, a condenser connected in one of the talking conductors, a signal-control relay bridged across the talking conductors, a link circuit connected with the trunk circuit, an impulse sending device, means responsive to an actuation of

the impulse sending device for connecting it with the link circuit and for short-circuiting the condenser and opening the bridge including the signal-control relay.

14. In a telephone exchange system, a trunk circuit, automatic switches accessible thereto, a called line, an operator's cord circuit connected with said trunk circuit, an impulse sending device having a forward and backward movement, a relay in the cord circuit responsive to the initial forward movement of the impulse sending device for connecting said device with the cord circuit, means controlled by the backward movement of said device to set said switches, and means controlled by the operator and the called line for disconnecting said device from said cord circuit.

15. In a telephone exchange system, a trunk circuit, a plurality of cord circuits, an impulse sending device common to the cord circuits, means responsive to the connection of one of the cord circuits with the trunk circuit and the initial actuation of the impulse sending device for connecting said device to the engaged cord circuit, and a polarized relay common to the cord circuits controlled over the trunk circuit for disconnecting said device from said cord circuit.

16. In a telephone exchange system, a trunk circuit, a plurality of cord circuits, an impulse sending device common to the cord circuits, a relay for each of said cord circuits, a circuit local to the cord circuit completed upon the initial actuation of said device for said relay to connect said device to said cord circuit, and a second relay common to said cord circuits controlled over the trunk circuits for disconnecting said device from said cord circuit.

17. In a telephone exchange system, a trunk circuit comprising a pair of talking conductors, a condenser in each of the talking conductors, a cord circuit connected with the trunk circuit, an impulse sender, means for connecting the sender to the cord circuit, a relay in the trunk circuit operating in response to the actuation of said connecting means for establishing a direct current path around each of the condensers, and means controlled by the operator for removing the direct current path around the condensers.

18. In a telephone exchange system, an inductively continuous trunk circuit, a cord circuit connected thereto, an impulse sender associated with the cord circuit, and operator controlled means for connecting the sender to the cord circuit and for rendering the trunk circuit conductively continuous.

19. In a telephone exchange system, an inductively continuous trunk circuit, a cord circuit connected thereto, an impulse sender, means for connecting the sender to the cord

circuit and for rendering said trunk circuit conductively continuous, an impulse relay, and an impulse sending circuit, including two conductors of said trunk circuits in series and said sender, for controlling said relay.

20. In a telephone exchange system, a trunk circuit comprising a pair of talking conductors, a source of current connected thereto, a cord circuit connected to said trunk circuit, a source of current connected to said cord circuit, condensers in said trunk circuit for separating said sources, an impulse sender on one side of said condensers and an impulse relay on the other side of said condensers, and a switch associated with said cord circuit for connecting said sender to said trunk circuit and for short-circuiting said condensers to place said relay under control of said sender.

21. In a telephone exchange system, a trunk circuit comprising a pair of talking conductors, an impulse relay connected to one end of said trunk circuit, a cord circuit connected to the other end of said trunk circuit, condensers in said trunk circuit, an impulse relay, an impulse sender associated with said cord circuit, and means controlled by the operator for connecting said sender

to said cord circuit and for short-circuiting said condensers to connect said sender in series relationship with said relay.

22. In a telephone exchange system, a trunk circuit comprising a pair of talking conductors, a condenser in each of the talking conductors, a cord circuit connected with the trunk circuit, an impulse sender, means for connecting the sender to the cord circuit, means in the trunk circuit operating in response to the actuation of said sender connecting means for establishing a direct current path around each of the condensers, and an impulse relay controlled by the sender over a circuit including the direct current path around the condensers.

23. In a telephone exchange system, a calling station, a trunk circuit comprising a pair of talking conductors for extending a connection therefrom, a condenser in each of said conductors, a relay, contacts thereon for establishing a by-path around said condensers, and manual controlling means at the calling station for actuating said relay.

In testimony whereof, I have signed my name to this specification this 28th day of July, 1919.

HENRY L. HOFFMANN.