

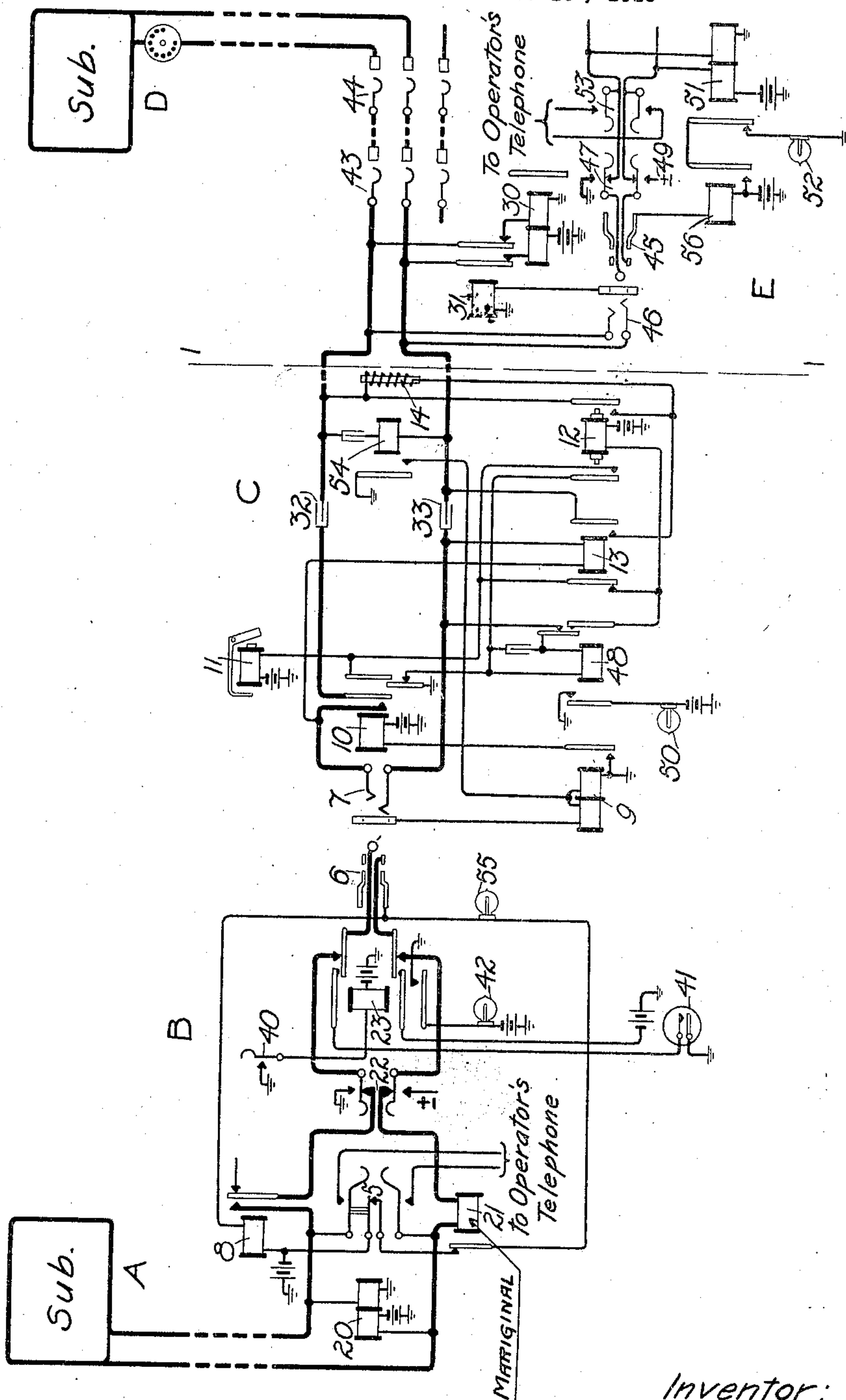
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R. S. BAILEY

TELEPHONE EXCHANGE SYSTEM

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Inventor:
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by *g v for* Atty.

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, RAND S. BAILEY, residing at Montclair, in the county of Essex and State of New Jersey, have invented certain Improvements in Telephone-Exchange Systems, of which the following is a specification.

This invention relates to telephone exchange systems, and more particularly to 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 exchange 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 character by which the operators at a manual exchange may control over the trunk circuit the automatic switches provided at the automatic exchange, for establishing connections between the trunk circuits and the telephone lines.

In accordance with the various features of this invention, the transmission of selecting impulses over the trunk circuit from the manual exchange to the automatic exchange is effected by intermittently interrupting the continuity of a bridge of the talking conductors of the trunk circuit by means of a relay bridged across the talking conductors and controlled by an impulse sending device at the manual exchange, the bridge being established in the first instance by a relay responding to the connection of a link circuit with the trunk circuit.

For a more complete understanding of this invention reference should be had to the following description considered in connection with the accompanying drawing which illustrates one embodiment of the invention.

There is shown in the drawing a telephone line A terminating at a manual exchange, where it may be connected with the link circuit B in any suitable and well known manner. The calling end of the link circuit B may be connected with the trunk circuit C extending from the manual to an automatic exchange, at which are provided the usual selector and connector switches for effecting connection between the trunk circuit and telephone lines, such

as D, terminating at the automatic exchange. At the automatic exchange the trunk circuit is multiplied to jack terminals at a toll switchboard at which is located a link circuit E, by means of which connection may be established with the trunk circuit and signals at the manual exchange controlled from the toll switchboard. The apparatus shown to the left of the dotted line 1—1 is located at the manual exchange, while that shown to the right of the dotted line is located at the automatic exchange. The nature of this invention is such that it is believed 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 the station on telephone line A having 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 connecting 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. Ascertaining that connection is desired with 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. The relays 8 and 9 thereupon operate over a circuit from battery through the winding of relay 8, sleeve contacts of the plug 6 and the jack 7 and both windings of relay 9 to ground. The operation of relay 8 closes a normally open contact in the tip conductor of the link circuit B.

Relay 10 operates upon the energization of relay 9 closing a normally open contact in the tip talking conductor of the trunk circuit C, and operating busy signal 11 associated with the multiple jack. Relay 10 in operating causes the energization of relay 12 over a circuit from battery through the winding of relay 12, left-hand contact of relay 13 and the right-hand alternate contact of relay 10 to ground. Relay 12 in operating closes its right-hand contact, thereby establishing a short circuit for impedance coil 14.

The energization of relay 8 causes the operation of relay 13 over a circuit from battery through the left-hand winding of battery feed coil 20, winding of supervisory re-

lay 21, lower normal contact of ringing key 22, lower normal contact of relay 23, ring contacts of the plug 6 and the jack 7, winding of relay 13, tip contacts of the jack 7 and the plug 6, upper normal contact of relay 23, upper normal contact of ringing key 22, alternate contact of relay 8 and the right-hand winding of battery feed coil 20 to ground. Relay 13 is of high impedance to talking currents and is of such high resistance that supervisory relay 21 does not operate when connected in series therewith. Relay 21 will operate, however, when the plug 6 of the cord circuit B is connected to the jack of a circuit (not shown), which has a low resistance bridge across the talking conductors. Relay 13 in operating establishes a bridge across the talking conductors of the trunk circuit which may be traced from the tip talking conductor through the right-hand contact of relay 12 and the right-hand contact of relay 13 to the ring talking conductor. The operation of relay 13, however, opens the energizing circuit of slow release relay 12 which thereby becomes deenergized and when its armatures are fully released, opens the short circuit about the impedance coil 14 which is thereby included in the bridge previously traced.

Upon the establishment of this bridge across the talking conductors of the trunk circuit, impulse response relay 30 operates over a circuit from battery through the left-hand winding of impulse response relay 30, inner right-hand contact of cut-off relay 31, right-hand contact of relay 13, impedance coil 14, outer right-hand contact of cut-off relay 31 and the right-hand winding of impulse response relay 30 to ground. This impulse response relay 30 controls the usual motor magnets and control mechanism for the selector and connector switches provided at the automatic exchange for effecting connection between trunk circuits and the telephone lines terminating thereat. Condensers 32 and 33 provided in the tip and ring talking conductors of the trunk circuit divide the talking conductors into inner and outer sections and serve to prevent the flow of current from the link circuit B over the trunk circuit to the automatic exchange and also to prevent the flow of current from the automatic exchange to the link circuit when connected with the trunk circuit.

In order that one of the telephone lines terminating at the automatic exchange, when connection therewith is desired, may be selected and the trunk circuit C connected therewith, there is provided an impulse sending device which may be connected with the link circuit B through the operation of relay 23 upon the actuation of key 40. The actuation of key 40 causes the operation of relay 23 which opens the tip and ring con-

ductors of the link circuit B and bridges the operator's sending device 41 across the talking conductors of the link circuit connected with the contacts of the plug 6. The closure of the lower contact of relay 23 lights the sending device pilot lamp 42. The sending device 41 is connected with the talking conductors before the continuity thereof is interrupted so that relay 13 remains energized through the contacts of the sending device. Relay 13 is deenergized upon each opening of the sending device contact. Upon the first such opening of the contact of sending device 41 and deenergization of relay 13, relay 12 operates to establish a short circuit about the impedance coil 14 and the opening of the right-hand contact of relay 13 interrupts the bridge across the talking conductors of the trunk circuit causing the release of the impulse response relay 30. Relay 12 is made slow in releasing so that the short circuit of the impedance coil 14 will be maintained during the short intervals that relay 13 is energized when the sending device is transmitting impulses.

Impulse response relay 30 controls the motor magnets of the selector and connector switches at the automatic exchange. After the sending of the proper number of impulses relay 13 remains energized and relay 12 releases its armatures removing the short circuit of the impedance coil 14. The trunk circuit C is connected with the telephone line D by means of the switches 43 and 44 controlled by the motor magnets and control apparatus associated with the impulse response relay 30. The impedance coil 14 which is of high impedance to talking currents so that it has no appreciable effect thereon is provided for controlling supervisory apparatus as will more fully hereinafter appear. The purpose of short-circuiting this impedance coil 14 is to increase the signaling range and to prevent any disturbances, due to inductive action of this impedance coil were it left in the circuit while transmitting the impulses. After the impulses have been transmitted, the operator may restore the key 40 to its normal position, whereupon relay 23 releases to reestablish the continuity of the talking conductors of the link circuit B and to disconnect the operator's impulse sending device 41 from these conductors.

The station on telephone line D may be signalled in any usual and well known manner and the subscriber in responding to the operation of the usual call bell may remove the receiver from the switchhook, whereby a talking circuit between the two stations on the telephone lines A and D is established. At the conclusion of the conversation the parties may restore the receivers to the switchhooks. The usual disconnect signal may be given to the operator at the

manual exchange by the restoration of the receiver at the station on telephone line A to its switchhook, whereupon the operator may withdraw the plug 6 from the jack 7, causing all apparatus of the link circuit B and the trunk circuit C to be restored to normal position.

Assuming that the toll operator at the automatic exchange desires to establish a connection by way of the trunk circuit C with a telephone line terminating at the manual exchange, a plug 45 of the toll link circuit E is inserted into a jack 46 and ringing key 47 is actuated and then restored to its normal position. The insertion of the plug 45 into the jack 46 causes the operation of relay 56 and cut off relay 31. The operation of relay 56 causes supervisory lamp 52 to be lighted and to remain lighted until the operator at the manual exchange answers as will more fully hereinafter appear. The operation of cut off relay 31 disconnects impulse response relay 30 from the trunk circuit C. During the time that the ringing key 47 is actuated, ringing response relay 48 is energized over a circuit from a source of ringing current 49 through the lower alternate contact of ringing key 47, ring contacts of the plug 45 and the jack 46, condenser 33, normal contact of relay 48 and winding thereof and the normal contact of relay 10 to ground. Ringing response relay 54 also energizes but performs no useful function at this time.

Relay 48 in operating completes a locking circuit for itself from battery through the winding of slow release relay 12, right-hand alternate contact of relay 48 and winding thereof and the normal contact of relay 10 to ground. Relay 48 in operating closes its left-hand contact, thereby causing lamp 50 to be lighted. Relay 12 in closing its right-hand contact establishes the short circuit for impedance coil 14, and in closing its left-hand contact causes busy signal 11 to be operated over a circuit from battery through the winding of the busy signal 11, left-hand contact of relay 12, and the normal contact of relay 10 to ground.

The operator at the manual exchange upon observing the lighted condition of the lamp 50, may insert the plug 6 of the link circuit B into the jack 7 of the trunk circuit C, whereupon relays 8 and 9 operate in the manner hereinbefore described. Relay 10 operates upon the actuation of relay 9 and in opening its normal contact interrupts the locking circuit of relay 48 which thereupon releases extinguishing the lamp 50. The closure of the right-hand alternate contact of relay 10 before the opening of the normal contact thereof, maintains the busy signal 11 in operated condition. Relay 13 also operates upon the energization of relay 8 and in so doing establishes a bridge across

the talking conductors of the outer section of the trunk circuit, thereby causing the energization of supervisory relay 51 over a circuit from battery through the left-hand winding of supervisory relay 51, lower normal contact of ringing key 47, ring contacts of the plug 45 and the jack 46, right-hand contact of relay 13, impedance coil 14 (relay 12 having released upon the energization of relay 13), tip contacts of the jack 46 and the plug 45, upper normal contact of ringing key 47, right-hand winding of supervisory relay 51 to ground. Supervisory relay 51 in opening its contact extinguishes supervisory lamp 52 which indicates to the toll operator that the operator at the manual office has answered. The toll operator may thereupon actuate listening key 53 to connect the telephone set with the talking conductors and the operator at the manual exchange may, after inserting the plug 6 into the jack 7, actuate listening key 5. The operators may thereupon converse, and the operator at the manual exchange may complete in any well known manner, the connection with the desired line, after the necessary instructions have been given to the operator at the manual exchange by the toll operator. The respective listening keys may be then restored to normal position.

Should the toll operator, for any reason after such connection as described in the preceding paragraph has been established desire to communicate with the operator at the manual exchange, this may be done by first signaling the operator at the manual exchange. This signaling is effected by momentarily and repeatedly actuating the ringing key 47. During each actuation of the ringing key, ringing response relay 54 is energized and establishes a short circuit for the high resistance right-hand winding of relay 9, thereby reducing the resistance in circuit with supervisory lamp 55 to such an extent that the lamp is lighted over a circuit from battery through the normal contact of listening key 5, contact of supervisory relay 21, lamp 55, sleeve contacts of the plug 6 and the jack 7, left-hand winding of relay 9 and the contact of relay 54 to ground. This lighting of the lamp each time relay 54 is energized, results in the intermittent lighting or what may be termed the "flashing" of the supervisory lamp. The operator at the manual exchange upon observing this flashing condition of the supervisory lamp, is informed thereby that the toll operator is recalling. After repeatedly actuating the ringing key 47 the toll operator may leave the key in its normal position and actuate listening key 53 to connect the telephone set with the talking conductors. The operator at the manual exchange, upon observing the flashing of the supervisory lamp 55, may actuate listening key 5 to connect

the telephone set to the circuit so that the operators may converse.

What is claimed is:

1. In a telephone exchange system, in combination, a two-way trunk circuit comprising a pair of talking conductors terminating in a jack, inductive means connected in and electrically dividing the talking conductors into inner and outer sections, signaling current responsive means connected to the trunk circuit, an impulse response relay, an impulse sending device, means including a link circuit terminating in a plug for connecting the impulse sending device with the trunk circuit, a relay bridged across the inner section and intermittently energized under control of the sending device, and circuit connections controlled by the bridged relay for intermittently bridging the outer section to control the impulse response relay and for short circuiting said signaling current responsive means.

2. In a telephone exchange system, in combination, a two-way trunk circuit comprising a pair of talking conductors, inductive means connected in and electrically dividing the talking conductors into inner and outer sections, signaling current responsive means connected to the trunk circuit, an impulse response relay, an impulse sending device, means including an operator's link circuit for connecting the impulse sending device with the trunk circuit, a relay bridged across the inner section and intermittently energized under control of the sending device, circuit connections controlled by the bridged relay for intermittently bridging the outer section to control the impulse response relay, an impedance device normally included in the bridge of the outer section, and means controlled by the bridged relay and effective during the intermittent operation thereof for eliminating the impedance device from the bridge and for short circuiting said signaling current responsive means.

3. In a telephone exchange system, in combination, a two-way trunk circuit comprising a pair of talking conductors, inductive means connected in and electrically dividing the talking conductors into inner and outer sections, signaling current responsive means connected to the trunk circuit, an impulse response relay, an impulse sending device, means including an operator's link circuit for connecting the impulse sending device with the trunk circuit, a relay bridged across the inner section and intermittently energized under control of the sending device, circuit connections controlled by the bridged relay for intermittently bridging the outer section to control the impulse response relay, an impedance device normally included in the bridge, and a slow release relay energized during the intermittent operation

of the bridged relay for removing the impedance device from the bridge and for short circuiting the signaling current responsive means.

4. In a telephone exchange system, in combination, a two-way trunk circuit comprising a pair of talking conductors, inductive means connected in and electrically dividing the talking conductors into inner and outer sections, an operator's link circuit, a relay bridged across the inner section and energized in response to the connection of the link circuit with the trunk circuit, a normally open bridge including an impedance device for the outer section completed by the energization of the bridged relay, signaling current responsive means connected to the trunk circuit, an impulse sending device connected with the link circuit and causing during its operation the intermittent deenergization of the bridged relay, an impulse response relay controlled by the intermittent opening of the bridge of the outer section in response to the intermittent deenergization of the bridged relay, and a slow release relay energized upon the first deenergization of the bridged relay for eliminating the impedance device from the bridge of the outer section during the intermittent energization of the bridged relay and for short circuiting the signaling current responsive means.

5. In a telephone exchange system, a two-way trunk circuit comprising a pair of talking conductors, means for inductively dividing the talking conductors into inner and outer sections, signaling current responsive means connected to the outer section of said trunk circuit, an operator's link circuit having a pair of talking conductors, means responsive to the connection of the link circuit with the trunk circuit for establishing a bridge across the outer section of the trunk circuit, an impulse sender, a key for said link circuit, means responsive to the actuation of said key for rendering the talking conductors of said link circuit discontinuous and for connecting said sender in serial relationship with the talking conductors of the inner section of said trunk circuit, and means associated with the inner section of said trunk circuit responsive to the actuation of said sender for intermittently interrupting the bridge across the outer section of said trunk circuit and for eliminating said signaling current responsive means from the trunk circuit.

6. In a telephone exchange system, a two-way trunk circuit comprising a pair of talking conductors, said talking conductors being normally discontinuous, means for inductively dividing the talking conductors into inner and outer sections, signaling current responsive means connected to the inner section of the trunk circuit, an operator's link circuit comprising a pair of talking

conductors, a relay for the trunk circuit energized in response to the connection of the link circuit with the trunk circuit for closing the normally discontinuous talking conductors of the trunk circuit and for disconnecting said signaling current responsive means from the trunk circuit, a second relay bridged across the inner section of said trunk circuit energized in response to the connection of the link circuit with the trunk circuit, a key in said link circuit, an impulse sending device, means responsive to the actuation of said key for rendering the talking conductors of said link circuit discontinuous and for connecting said sender in serial relationship with said bridged relay, and a bridge across the outer section of said trunk circuit controlled by said second relay and said sender.

7. In a telephone system, a two-way trunk circuit comprising a pair of talking conductors and a third conductor, means for inductively dividing the talking conductors

of the trunk circuit into inner and outer sections, a busy signal and signaling current responsive means associated with the inner section of said trunk circuit, an operator's cord circuit, a source of current in said cord circuit, a relay bridged across the inner section of said trunk circuit energized by said source of current in response to the connection of said cord circuit to said trunk circuit, a relay in the third conductor of said trunk circuit actuated in response to the connection of the cord circuit to the trunk circuit for energizing said busy signal and for disconnecting said signaling current responsive means, and circuit connections controlled by the bridged relay for intermittently bridging the outer section of said trunk circuit.

In testimony whereof, I have signed my name to this specification this 20th day of September 1919.

RAND S. BAILEY.