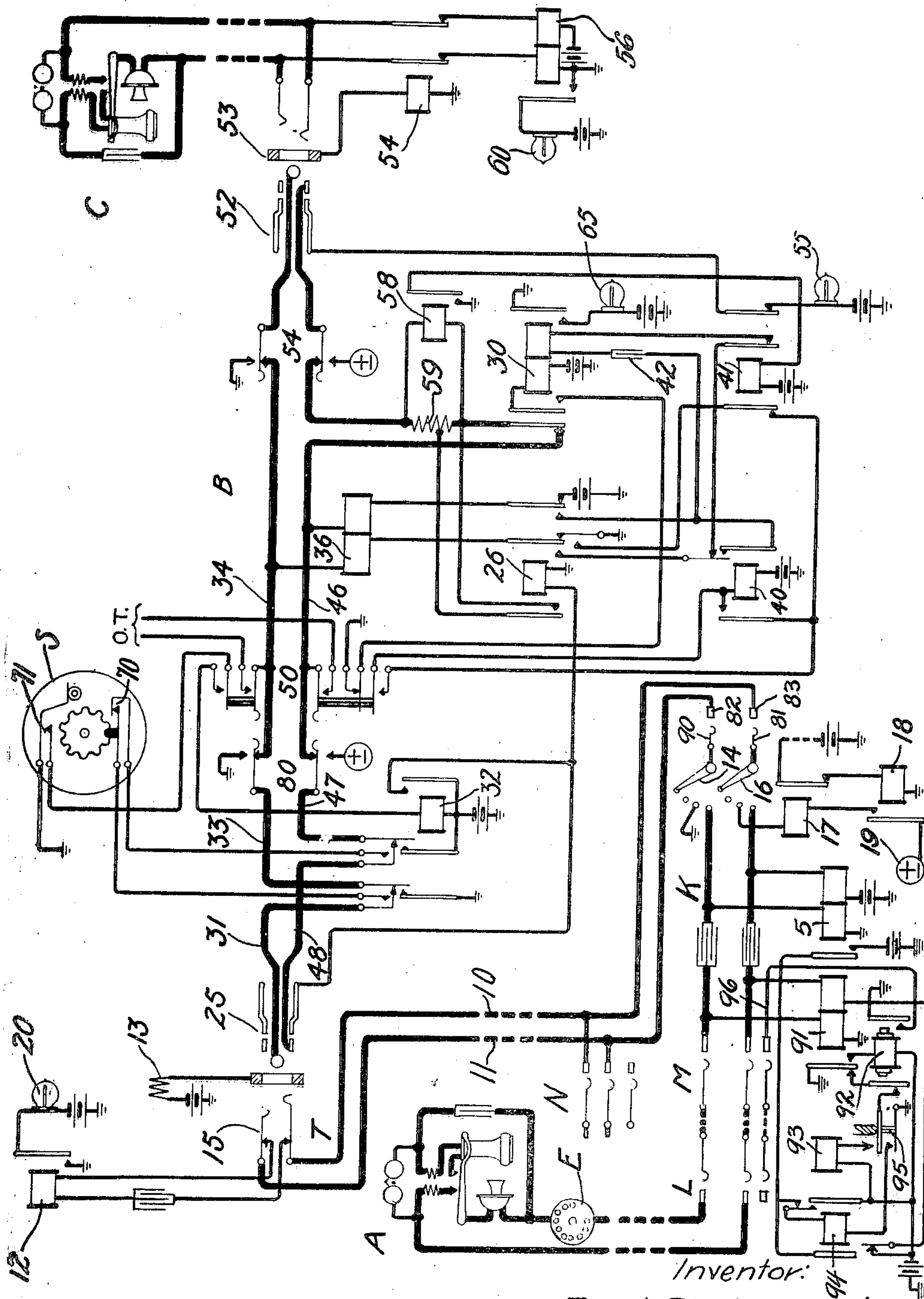


R. S. BAILEY.
TELEPHONE EXCHANGE SYSTEM.
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Inventor:
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by *g. v. toh* Att'y.

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 a manual private branch exchange system where such a system is employed in connection with automatic or semi-automatic systems.

It is the usual practice in private branch exchange systems of this nature to provide circuit arrangements so that the switches at the automatic exchange are under the control of the operator. In cases of a slow disconnect on the part of the operator, the switching mechanism at the automatic exchange would be tied up.

It is therefore an object of this invention to provide a new and improved cord circuit for use at private branch exchanges arranged for through supervision where connections are established with subscribers of automatic exchanges.

A further object is to provide means for signaling the operator and for preventing the ringing current from passing to the substation of the private branch exchange system in cases of slow disconnect on the part of the operator when the trunk extending to the automatic exchange has been seized by another automatic switch.

A feature of the invention consists in means for placing the automatic switches under the control of the substation of the private branch exchange when a connection exists between said substation and a station at the automatic exchange.

A further feature consists in the provision of an alternating current bridge in the cord circuit in cases of slow disconnect on the part of the operator.

A still further feature provides means in cases of a slow disconnect on the part of the operator for opening up the cord circuit in response to the sending of ringing current from the distant exchange to prevent

said ringing current from signaling the substation connected with the cord.

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

There is shown in the drawing, a telephone line A terminating in an automatic exchange and a line C in a manual or private branch exchange. T represents a trunk line extending from the automatic to the manual exchange terminating at the former exchange in a contact bank with which automatic switching apparatus cooperates and at the latter exchange in a jack in the switchboard. Automatic connecting circuits such as a line finder L, a selector M and a connector K provide means for an automatic subscriber to select a trunk leading to the manual switchboard. A finder N having access to selectors at the automatic exchange is multiplied to the connector terminals. B represents, a cord circuit at the manual exchange for extending connections from the trunk circuit T to a subscriber C of the manual or private branch exchange. S represents a sender used by the operator for selectively operating the switches on outgoing calls to 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.

It will be assumed that the subscriber at substation A of the automatic exchange desires connection with a line C of the private branch exchange. Subscriber A removes the receiver and by means of the impulse sender E, extends his line to a connector switch in the manner well known. Relay 91 thereupon operates over the calling line circuit and energizes the usual slow relay 92 which interposes a break in the circuit of the connector release magnet and grounds the release wire 96 to hold the preceding switches set in the well-known manner. The connector is then set in the well-known manner to pick out an idle P. B. X. trunk. After

a trunk such as T has been tested and found idle, ringing current will be sent over the conductors 10, 11 of the trunk leading to the manual exchange to energize a relay 12 thereat. The circuit therefor is as follows: ground, wiper 14 in its third position, brush 90, terminal conductor 82, tip spring and contact of jack 15, winding of relay 12, contact and ring spring of jack 15, conductor 10, contact 83, brush 81, wiper 16 and its third contact, winding of ringing cutoff relay 17, front contact and armature of relay 18 which is energized in the third position of the side switch wipers, to a source of ringing current 19. Attraction of the armature of relay 12 causes a signal 20 to be displayed indicating to the operator that a call has arrived.

The operator thereupon inserts plug 25 into jack 15 cutting off relay 12 to extinguish lamp 20 and operating relay 26 of the cord circuit B, the circuit therefor being from grounded battery, resistance 13, sleeves of jack 15 and plug 25, winding of relay 26 to ground. Relay 26 attracts its armatures thus placing an alternating current bridge across the talking conductors of the cord circuit B.

The insertion of plug 25 in jack 15 transfers the circuit for ringing current to relay 30 of said bridge over the following path: ground, third contact and wiper 14, brush 90, contact 82, conductor 11, tips of jack 15 and plug 25, conductor 31, left-hand normal contacts of relay 32, conductor 33, upper spring and normal contact of the answering cord ringing key 80, conductor 34, left-hand winding of retardation coil 36, inner right-hand armature and make contact of relay 26, normal contact of relay 40, inner right-hand armature and back contact of relay 41, right-hand winding of ring-up relay 30, condenser 42, front contact and outer right-hand armature of relay 26, right-hand winding of retardation coil 36, conductor 46, contact and lower spring of the answering cord ringing key 80, conductor 47, normal contacts of the left-hand inner armature of relay 32, conductor 48, ring of plug 25, ring of jack 15, conductor 10, brush 83, contact 81, wiper 16 and third contact, winding of relay 17, front contact and armature of relay 18 to source of ringing current 19. Relay 30 locks up under control of key 50. The operator then actuates the listening key 50, thus bridging her head-set across the talking conductors of the cord circuit B. Actuation of the listening key 50 opens the locking circuit for relay 30, and causes energization of relay 40, which interrupts the alternating current bridge in the cord circuit B and substitutes therefor a direct current bridge resulting in the side switch at the connector switch moving from position 3 to 4 in the well-known manner. Relay 40 is

energized over the following path: grounded battery, winding of relay 40, outermost lower contacts of key 50, back contact and left-hand armature of relay 41, and lower make contacts of the right-hand inner armature of relay 26 to ground. Relay 40 is held locked up over its left-hand armature and front contact. The alternating current bridge was interrupted at the normal contacts of relay 40 and the direct current bridge was established at the right-hand armature and alternate contact of relay 40.

The operator having ascertained the number of the desired line, plug 52 is inserted into jack 53 and ringing key 54 is actuated to send ringing current over the line to substation C in the usual manner. Insertion of plug 52 into jack 53 energized relay 54 thus disconnecting line relay 56 from substation C and causing supervisory lamp 55 to light over the following path: grounded battery, lamp 55, right-hand armature and back contact of relay 41, sleeve of plug 52, sleeve of jack 53, winding of relay 54 to ground.

In response to the ringing signal, the subscriber at substation C removes the receiver from the switchhook, whereupon relay 58 of the cord circuit is energized by current from the line relay 5 of the connector circuit at the automatic exchange flowing over the talking conductors of trunk T, cord circuit B and through the loop of substation C. The winding of relay 58 is of low resistance and although there are other paths for the current from the automatic exchange through the winding of retardation coil 36 and the shunt 59, sufficient current flows through relay 58 to energize it. Upon energization, relay 58 through its front contact and armature closes a circuit to energize relay 41 which, upon attracting its armatures, causes the cord supervisory lamp to be extinguished by interrupting the circuit for said lamp at its outer right-hand armature and back contact, and the control of the automatic switching apparatus to be transferred from the cord circuit to the substation C by interrupting the holding circuit for relay 40 at the left-hand armature and back contact of relay 41. Talking current for substation C is supplied from relay 5 of the connector circuit over the talking conductors of the trunk and cord circuit, through the relay 58 and the shunt 59 thereof and thence over the talking conductors of the cord circuit B and the line leading to substation C. The relay 5 in attracting its armature operates relay 94 which locks itself to ground at off-normal switch 95. In attracting its left armature, relay 94 removes the control of the release of the switches from the subscriber at substation A by shifting the battery connected to the right winding of relay 91 to the front contact of relay 5.

At the conclusion of conversation, the sub-

scribers restore the receivers to the switchhooks. The replacement of the receiver at station C releases relay 5 which releases relay 91. Relay 91 releases slow relay 92. The retracted condition of the armatures of these latter relays closes the circuit of release magnet 93 which restores the connector. The retraction of the right armature of slow relay 92 removes ground from the release wire 96 resulting in the release of the preceding switches in the well-known manner. The restoration of the receiver to the switchhook at station C either before or after the subscriber at station A hangs up releases relay 58 since current ceases to flow through this relay. Relay 58 in retracting its armature opens the circuit for relay 41 which in retracting its armatures re-establishes the alternating current bridge across the talking conductors of the cord circuit so that should another call arrive over the trunk circuit T before the operator has withdrawn the plugs, subscriber C will not be signalled due to the energization of relay 30 which responds to ringing current from the distant office and locks up thereby interrupting the continuity of the talking conductors leading to station C. The ringing current is thus prevented from passing through and signaling station C. Relay 41 in releasing also completes a circuit for supervisory signal 55 indicating to the operator that conversation has ceased.

If the trunk T is selected before disconnection takes place, relay 30 will be energized thereby completing a circuit for signal 65. This signal serves to indicate to the operator that another call has arrived from the automatic exchange. The operator thereupon removes plug 52 from jack 53, actuates listening key 50 and then proceeds as with any incoming call.

In the foregoing, a description has been given of the operation of cord circuit B for completing an incoming call from an automatic exchange. A brief description of the operation and use of the cord circuit for completing an outgoing call will now be given.

In response to the removal of the receiver from the switchhook at station C, line relay 56 and in turn line signal 60 operate. The operator in answering inserts plug 52 into jack 53 whereupon relay 54 operates thereby cutting off line relay 56 and extinguishing line signal 60. Supervisory relay 58 operates over a circuit including ground, back contact and inner right-hand armature of relay 26, left-hand winding of retardation coil 36, upper normal contacts of ringing key 54, tips of plugs 52 and jack 53, the substation loop, rings of jack 53 and plug 52, lower normal contacts of ringing key 54, winding of relay 58 and shunt 59 thereof in parallel, outer left-hand arma-

ture and back contact of relay 30, right-hand winding of retardation coil 36, outer right-hand armature and back contact of relay 26 and grounded battery. Relay 58 in operating completes a circuit at its right-hand armature and front contact for relay 41. The operator then actuates listening key 50 and upon being informed by the calling subscriber that station A at the automatic exchange is desired, inserts plug 25 into jack 15. Relay 26 then operates over the path previously traced. Relay 26 in attracting its righthand armatures disconnects battery and ground from the talking conductors and current from the first selector at the automatic exchange is substituted therefor over finder N which maintains relays 58 and 41 operated. The operator then actuates impulse sender S to transmit impulses over the trunk T to the automatic exchange to set the selector switches and the connector thereat in accordance with the number desired in the well known manner.

Impulse sender S is provided with a set of contacts 70 which are actuated a number of times in accordance with the digit dialed to set the switches and with a set of contacts 71 which are closed when the dial is in an off-normal position. The contacts 71 are closed upon the initial movement of the dial and remain closed during the entire movement and until the dial returns to normal. When sender S is actuated, contacts 71 are closed thereby completing a circuit for relay 32, said circuit including the uppermost contacts of key 50. Relay 32 in operating disconnects the calling from the answering end of the cord circuit and connects battery and ground to the talking conductors of the answering end. After the last series of impulses have been sent, relay 32 in deenergizing renders the cord circuit continuous. Key 50 is then restored to normal, whereupon talking current is fed to station C from the connector at the automatic office in the well-known manner.

Upon completion of conversation, subscriber C in restoring the receiver to the switchhook opens the loop leading to the automatic exchange whereupon supervisory relay 58 deenergizes and the switches at the automatic exchange are released in the usual manner. Relay 58 in retracting its armature opens the circuit for relay 41 whereupon ring-up relay 30 is bridged across the talking conductors. Supervisory lamp 55 lights indicating to the operator that the conversation has ceased. The operator then removes the plugs from their associated jacks and all relays are released.

If trunk circuit T is now selected before the operator has disconnected, relay 30 will again operate and lock up and signal 65 will light, thus indicating to the operator

as before mentioned that a call exists on trunk T whereupon plug 52 will be removed and listening key operated to inquire from the calling subscriber the number desired.

5 What is claimed is:

1. In a telephone system, a calling line and a called line, means including automatic switches, a trunk line and a cord circuit for interconnecting said lines, a bridge across said cord circuit effective until the response of the called subscriber for preventing said switches from releasing, and means controlled over the called line for opening said bridge.

15 2. In a telephone exchange system, a calling line and a called line, means including automatic switches, a trunk line and a cord circuit for interconnecting said lines, an alternating and a direct current bridge for said cord circuit, operator controlled means for removing said alternating current bridge and substituting therefor the direct current bridge, and means under the control of the called line for removing said direct current bridge.

25 3. In a telephone exchange system, a calling line, a called line, means including automatic switches and a cord circuit for interconnecting said lines, manual means in said cord circuit for placing a holding bridge across the cord circuit until the called subscriber answers, automatic means for removing said bridge when said called line answers, and means for substituting a bridge at the called station.

35 4. In a telephone system, a calling line, a called line, a cord circuit, means including automatic switches for interconnecting said lines over said cord circuit, a key in said cord circuit, a relay actuated in response to the actuation of said key, adapted to place a holding bridge across the cord circuit, a second relay in said cord circuit actuated in response to the answering of the called subscriber for disabling said holding bridge, and means for substituting a holding bridge at the called station.

45 5. In a telephone system, two subscribers' lines, a cord circuit, means including automatic switching apparatus for establishing a connection between said lines over said circuit, and for impressing alternating current on said cord circuit, means controlled over one of said lines for releasing the automatic switching apparatus and for immediately causing an alternating current bridge to be connected across the talking conductors of the cord circuit, and means controlled by said bridge for preventing alternating current from operating the bell at the called station.

60 6. In a telephone system, two subscribers' lines, a cord circuit, means including automatic switches for establishing a connection between said lines over said cord circuit,

and for impressing alternating current on said cord circuit, means controlled over the subscribers' lines for releasing the automatic switches, a source of current associated with said automatic switches for supplying talking current for said lines, a relay associated with said cord circuit actuated by said source of current, an alternating current bridge normally disconnected from said cord circuit means controlled by said relay for connecting said alternating current bridge to said cord circuit, and means controlled by said bridge for preventing alternating current from operating the bell of the called station.

7. In a telephone exchange system, an automatic exchange, a manual exchange, two subscribers' lines, one terminating at each of said exchanges, a cord circuit at said manual exchange, means including automatic switches for establishing a connection between said lines over said cord circuit, means controlled over the subscribers' lines for releasing said switches, a source of ringing current at said automatic exchange, a relay associated with said cord circuit responsive to the ringing current adapted upon actuation to interrupt the continuity of the talking conductors leading to one of said lines, a locking circuit for said relay and means for opening said locking circuit.

8. In a telephone exchange system, a calling and a called line, a cord circuit, means including automatic switches for connecting said lines over said cord circuit, including a pair of talking conductors, means for signaling said called line, a holding bridge in said cord circuit effective until the subscriber of said called line answers, means for disabling said holding bridge upon the response of the subscriber of the called line, means for connecting an alternating current bridge across the talking conductors of said cord circuit upon restoration of the receiver to the switchhook at the station of the called subscriber, and means controlled by the replacement of the receiver at the subscribers' stations for releasing said switches.

9. In a telephone exchange system, two subscribers' lines, a station for each line, a trunk circuit, a cord circuit, means including automatic switches for establishing a connection between said lines over said trunk and said cord circuits, signaling responsive means associated with said cord circuit normally disconnected therefrom and means for releasing said switches and connecting said signal responsive means to said cord circuit when one of said subscribers restores the receiver to the switchhook.

10. In a telephone exchange system, in combination, a trunk circuit including automatic switches extending from a first to a second office, a telephone line terminating at the second office, a cord circuit thereat for

connecting the trunk circuit with the telephone line, means controlled over said line for releasing said automatic switches, a relay in the cord circuit responsive to alternating current, said relay being disconnected from said cord circuit when the receiver of the telephone line is removed from the switchhook, and means for bridging said relay across the talking conductors of said cord circuit when the receiver is restored to the switchhook.

11. In a telephone exchange system, an automatic telephone exchange, a manual telephone exchange, means including a trunk circuit or extending a call from said automatic to said manual exchange, a cord circuit for connecting said trunk circuit to a called subscriber at said manual exchange, a ringing relay in said cord circuit actuated in response to the sending of ringing current over said trunk circuit, a key in said cord circuit adapted upon actuation to disconnect said ringing relay and establish a holding bridge in said cord circuit, and means in said cord circuit adapted to remove said holding bridge upon the response of the called subscriber, said means being arranged to again connect said ringing relay to said cord circuit upon restoration of the receiver to the switchhook.

12. In a manual telephone exchange, a trunk circuit incoming from an automatic exchange including automatic switches, terminating in a jack, a cord circuit for extending a connection from said automatic exchange to a called substation in said manual exchange, a holding bridge in said cord circuit effective until said called substation answers, a substitute bridge at the called station closed upon the removal of the receiver thereat for controlling the release of said automatic switches, and an alternating current bridge in said cord circuit effective when said called substation has restored the receiver to the switchhook.

13. A telephone exchange system comprising a manual telephone exchange, a switchboard, telephone lines terminating therein, a trunk circuit extending from said switchboard to an automatic exchange and including automatic switches thereat, a ringing relay in said cord circuit normally disconnected therefrom adapted to open up the talking conductors of the calling end of said cord circuit upon energization, manual and automatically controlled means for connecting said relay to said cord circuit, and means controlled by the subscriber for releasing said switches.

14. In a telephone exchange system, a trunk circuit extending from an automatic to a manual exchange and including automatic switches, a calling subscriber's line at said automatic exchange, a called subscriber's line at said manual exchange, a cord circuit

at said manual exchange for connecting said calling with said called line, a holding bridge in said cord circuit effective upon the response of the operator to the call from the called subscriber, a relay in said cord circuit actuated in response to the removal of the receiver from the switchhook on the called subscriber's line for disabling said holding bridge, means for substituting a holding bridge at the called station, and means controlled by the opening of the bridge for releasing said automatic switches.

15. In a telephone system, an automatic office, a manual office, a cord circuit thereat, called lines terminating in jacks at said manual office, a trunk extending from said automatic office to said manual office and terminating in a jack thereat, a calling station having a dial for setting the switches at the automatic office to pick out said trunk, a signal operated upon the selection of said trunk, a bridge across said cord circuit, a manual switch controlled by the operator for causing the closure of said bridge, means operated thereby for transferring the control of the release of said automatic switches to said bridge, means controlled by the called party for closing another bridge at the called line to hold said switches set and for opening said first bridge, and means controlled by the called party for opening said latter bridge to release said automatic switches.

16. In a telephone system, an automatic office, a manual office, a cord circuit thereat, called lines terminating in jacks at said manual office, a trunk extending from said automatic office to said manual office and terminating in a jack thereat, a calling station having a dial for setting the switches at the automatic office to pick out said trunk, a signal associated with said trunk jack, means at said automatic office for impressing alternating current on said trunk to operate said signal, an alternating current bridge adapted to be closed across said cord circuit upon the insertion of the answering plug, a direct current bridge, a key in said cord circuit for placing the same across said cord circuit, means operated thereby for disconnecting said ringing current, and a relay operated by the response of the called party for opening said direct current bridge and substituting a bridge at the called station to control the release of said automatic switches.

17. In a telephone system, a talking connection including a calling automatic substation, a trunk including automatic switches, a cord circuit and a called manual station, means for impressing alternating current on the cord circuit from the automatic office, a bridge at the called station for controlling the release of said switches, and an alternating current bridge at said cord circuit including a relay adapted to

interpose a break in a talking conductor of the cord circuit when operated, means for opening the bridge at the called station and releasing said switches and placing said alternating current bridge across the cord circuit, means controlled from the automatic substation for selecting the said trunk and impressing alternating current on said cord circuit to operate said relay, and a signal in said cord circuit controlled by said relay. 10

In testimony whereof, I have signed my name to this specification this 5th day of January, 1920.

RAND S. BAILEY.