

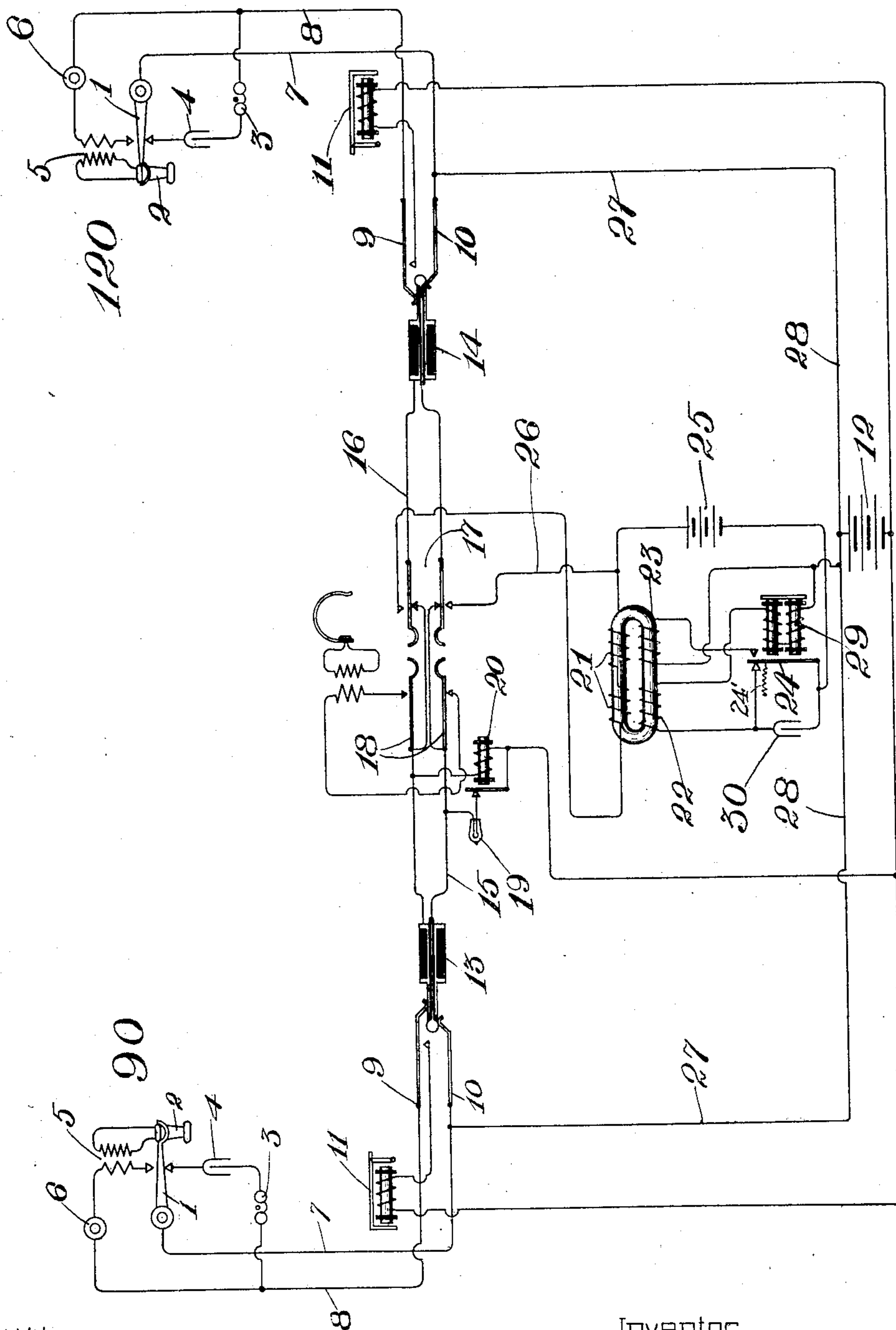
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J. C. F. MALTHAUER.  
TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED JUNE 23, 1902.

NO MODEL.



Witnesses:

Leonard W. Novander.

Lynn A. Williams

Inventor

John C. F. Malthauer

By

Charles A. Brown & Cragg  
Attorneys.

# UNITED STATES PATENT OFFICE.

JOHN C. FRED MALTHAUER, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

## TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 743,532, dated November 10, 1903.

Application filed June 23, 1902. Serial No. 112,935. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN C. FRED MALTHAUER, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to telephone-exchange systems, and has for its object the provision of improved means whereby a source of direct current may be employed in operating alternating-current signal-bells at substations, and by means of my invention I am enabled to dispense with power-generators for creating alternating current, thus rendering the invention particularly adapted for service in connection with small exchanges.

In practicing my invention I employ a secondary circuit that is preferably in conductive relation with the called subscriber's telephone-line, desirably placed in such connection by means of a cord connecting apparatus and two primary circuits, each containing a primary coil and adapted when in circuit to alternatively induce in the secondary circuit positive and negative currents, which currents are manifested upon the line of the called subscriber in much the same manner as simple single-phase alternating currents. There is preferably employed in association with these two primary circuits a single battery adapted to be alternatively associated with one or the other of the circuits, preferably through the agency of the armature of an electromagnet, which electromagnet is desirably included in a local circuit that also includes the armature, the armature being adapted to alternately make and break circuit through the electromagnet when a subscriber is being called. The circuit including the electromagnet is preferably closed by means of ringing-key mechanism such as is commonly employed in telephone-exchange apparatus, so that the armature of this electromagnet is caused to vibrate during the

time the ringing-key is actuated to call a subscriber, whereby positive and negative impulses are alternately manifested in the secondary circuit by means of the two primary windings to effect the propagation of alternating signaling-current.

I will explain my invention more fully by reference to the accompanying drawing, illustrating diagrammatically a telephone-exchange system equipped with the apparatus of my invention.

I have shown at each of the substations and 120 a suitable form of apparatus comprising a gravity switch-hook 1, a telephone-receiver 2, and a call bell 3, included in bridge of the telephone-line when the telephone is upon the switch-hook by the engagement of the said switch-hook with its lower contact, there being preferably included in this bell bridge a condenser 4, the primary and secondary windings of an induction-coil 5, and a transmitter 6, included in circuit with the primary coil.

The system illustrated is a metallic-circuit telephone system, though I do not wish to be limited to such a system in all applications of my invention.

The sides of the telephone-line extend in two metallic limbs 7 and 8 to springs 9 and 10 of a spring-jack in case of single cords, which jacks may be multiplied, as is obvious, if the invention is to be applied to multiple boards. There is, as is common practice, associated with each telephone-line at the exchange a line-indicator 11, having a permanent connection with one terminal of the common battery 12, the other terminal of the line-indicator being in the form of a back contact in normal engagement with the line-spring 9. The line-signal obviously will operate when a calling subscriber removes his telephone from its switch-hook and may be cut out of circuit when the operator in responding inserts an answering-plug, as the plug 13, in the calling subscriber's jack. Correspondingly the connecting-plug 14, inserted within the called subscriber's jack, may cut out the line-indicator of the called subscriber to prevent it from being operated when the



said called subscriber responds. The answering and connecting plugs 13 and 14 illustrated are each provided with a sleeve and tip, the tips being connected by means of a tip-strand 15, while the sleeves are connected by means of a sleeve-strand 16. The tip and sleeve strands each include a spring of a ringing-key 17, which when normal—that is, when a subscriber is not being called—engages a normal contact to complete the continuity of the cord-circuit, this cord-circuit being broken to engage the springs of this ringing-key with other alternate contacts that constitute the terminals of a conductor, including the secondary of the signaling appliance, as will be hereinafter set forth. The listening-key has its springs 18 permanently connected with the strands of the cord-circuit adapted to be moved to include the operator's telephone outfit when the answering-plug is in the jack of a calling subscriber. The clearing-out signal 19 may be controlled in any suitable way and be of any suitable form, the particular signal illustrated being a small incandescent lamp controlled by means of the armature of an electromagnet 20, which electromagnet is energized when a subscriber in connection with the cord-circuit has his telephone off its hook, thereby to prevent the operation of the clearing-out signal, such clearing-out signal being operated when both subscribers have restored their receivers to place. The circuit of the lamp includes the battery 12 and will be readily apparent to those skilled in the art.

Referring now more particularly to the specific features of the system disclosed involving my invention, the secondary 21 of the two transformers is preferably subdivided into two coils, each being more directly in inductive relation with a corresponding primary coil. The primary coils 22 23 are preferably wound upon the same magnetic core that supports the secondary winding 21, so that the magnetic flux due to either primary will be manifested in both coils of the secondary by reason of this common core, which is preferably looped to form a closed magnetic circuit, as illustrated. The primary coil 22 is included in a local circuit that contains the normal or back contact of an armature 24, the said armature 24, a battery 25, which may or may not be distinct from the common battery, as preferred, the conductor 26, common to the primary and secondary circuits, the tip-strand 15, the line-spring 10, conductor 27, and conductor 28. The primary 23 includes in its circuit the alternate or front contact of the armature 24, the said armature 24, the battery 25, conductor 26, tip-strand 15, line-spring 10, conductors 27 and 28. The closure of both these circuits of course depends upon the connection of the leg 26 with the contiguous spring of the ringing-key 17. There is preferably included in one of the primary circuits, as in the circuit

with the primary winding 22, the winding of the electromagnet 29, associated with the armature 24. It will be apparent that the battery 25 is alternately included in circuit with and excluded from the circuit containing the electromagnet 29, the continuity of the energizing-circuit for this electromagnet depending upon the engagement of the armature with its normal contact. When this circuit is established, the electromagnet is immediately energized to bring its armature into engagement with the alternate contact, whereupon the armature is forced to return into engagement with its normal contact through the agency of a spring 24'. Primaries 22 and 23 are so wound with respect to each other that the winding 22, for example, will produce current in the secondary 21 in a negative direction, while the winding 23 will produce current in the secondary 21 in the positive direction, or vice versa. In this manner an alternating current manifested in the secondary is propagated over the line of the called subscriber to operate his signal-bell, which may be of the usual polarized type ordinarily employed in conjunction with power-driven alternating-current generators. I am thus enabled to provide the substation apparatus with the usual type of signaling appliance without the necessity of equipping the exchange with power-driven alternating-current generators, while at the same time securing as effective results in the signaling operations.

Any desired ratio of transformation between the primary and secondary windings may be employed that will prove effective in a given system. I have found in practice that a ratio of transformation of one for the primary to ten for an individual secondary coil of the secondary winding 21 has proved very effective.

I have found in practice that a source of direct current impressing seven volts upon each primary circuit is sufficient, though this may be modified as occasion may require.

I have indicated a condenser 30 in shunt of the armature and its normal contact to reduce the sparking between the armature and its normal contact.

I do not wish to be limited to the precise embodiment of my invention herein shown, as departures therefrom may readily be made without departing from the spirit; but,

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, a secondary circuit, a ringing-key included in the cord-circuit for closing the secondary circuit and associating the same with the called subscriber's line, two primary windings rela-



tively wound so that each may produce current in the secondary circuit in a direction opposed to the other to produce alternating currents, said primary windings being included in separate circuits having a strand of the cord-circuit for a common conductor; a source of direct current, and means whereby the said source of direct current may be alternately included in said circuits each containing one of the said primary windings, substantially as described.

2. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, a secondary circuit, a ringing-key included in the cord-circuit for closing the secondary circuit and associating the same with the called subscriber's line, two primary windings relatively wound so that each may produce current in the secondary circuit in a direction opposed to the other to produce alternating currents, said primary windings being included in separate circuits having a strand of the cord-circuit for a common conductor; a source of direct current, and a switch whereby the said source of direct current may be alternately included in said circuits each containing one of the said primary windings, substantially as described.

3. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, a secondary circuit, a ringing-key included in the cord-circuit for closing the secondary circuit and associating the same with the called subscriber's line, two primary windings relatively wound so that each may produce current in the secondary circuit in a direction opposed to the other to produce alternating currents, said primary windings being included in separate circuits having a strand of the cord-circuit for a common conductor; a source of direct current, a switch whereby the said source of direct current may be alternately included in said circuits each containing one of the said primary windings, and an electromagnet for operating the said switch, substantially as described.

4. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, a secondary circuit, a ringing-key included in the cord-circuit for closing the secondary circuit and associating the same with the called subscriber's line, two primary windings relatively wound so that each may produce current in the secondary circuit in a direction opposed to the other to produce alternating currents, said primary windings being included in separate circuits having a strand of the

cord-circuit for a common conductor; a source of direct current, a switch whereby the said source of direct current may be alternately included in said circuits each containing one of the said primary windings, and an electromagnet for operating the said switch, the said switch also controlling the circuit through the electromagnet, and being operated thereby to open circuit through the electromagnet, whereupon the said switch is permitted to reverse its position to again close circuit through the electromagnet, the switch being thereby caused to alternately close and open the circuits including the primaries, substantially as described.

5. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of cord connecting apparatus at the exchange for signaling the called subscriber, a secondary circuit, a ringing-key included in the cord-circuit for closing the secondary circuit and associating the same with the called subscriber's line, two primary windings relatively wound so that each may produce current in the secondary circuit in a direction opposed to the other to produce alternating currents, said primary windings being included in separate circuits having a strand of the cord-circuit for a common conductor, a source of direct current, and means whereby the said source of direct current may be alternately included in said circuits each containing one of the said primary windings, substantially as described.

6. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of cord connecting apparatus at the exchange for signaling the called subscriber, a secondary circuit, a ringing-key included in the cord-circuit for closing the secondary circuit and associating the same with the called subscriber's line, two primary windings relatively wound so that each may produce current in the secondary circuit in a direction opposed to the other to produce alternating currents, said primary windings being included in separate circuits having a strand of the cord-circuit for a common conductor; a source of direct current, and a switch whereby the said source of direct current may be alternately included in said circuits each containing one of the said primary windings, substantially as described.

7. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of cord connecting apparatus at the exchange for signaling the called subscriber, a secondary circuit, a ringing-key included in the cord-circuit for closing the secondary circuit and associating the same with the called subscriber's line, two primary windings relatively wound so that each may produce current in the secondary circuit in a direction op-



posed to the other to produce alternating currents, said primary windings being included in separate circuits having a strand of the cord-circuit for a common conductor; a  
 5 source of direct current, a switch whereby the said source of direct current may be alternately included in said circuits each containing one of the said primary windings, and an electromagnet for operating the said  
 10 switch, substantially as described.

8. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of  
 15 cord connecting apparatus at the exchange for signaling the called subscriber, a secondary circuit, a ringing-key included in the cord-circuit for closing the secondary circuit and associating the same with the called subscriber's line, two primary windings relatively wound  
 20 so that each may produce current in the secondary circuit in a direction opposed to the other to produce alternating currents, said primary windings being included in separate circuits having a strand of the cord-circuit  
 25 for a common conductor; a source of direct current, a switch whereby the said source of direct current may be alternately included in said circuits each containing one of the said primary windings, and an electromagnet  
 30 for operating the said switch, the said switch also controlling the circuit through the electromagnet and being operated thereby to open circuit through the electromagnet, whereupon the said switch is permitted to reverse  
 35 its position to again close circuit through the electromagnet, the switch being thereby caused to alternately close and open the circuits including the primaries, substantially as described.

40 9. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of cord connecting apparatus at the exchange for uniting subscribers for conversation, a  
 45 secondary circuit adapted for association with a called subscriber's line, two primary windings relatively wound so that each may produce current in the secondary circuit in a direction opposed to the other to produce alternating  
 50 nating currents, said primary windings being included in separate circuits having a

strand of the cord-circuit for a common conductor, a source of direct current, and means whereby the said source of direct current may be alternately included in said circuits each  
 55 containing one of the said primary windings, substantially as described.

10. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of  
 60 cord connecting apparatus at the exchange for uniting subscribers for conversation, a secondary circuit adapted for association with a called subscriber's line, two primary windings relatively wound so that each may  
 65 produce current in the secondary circuit in a direction opposed to the other to produce alternating currents, said primary windings being included in separate circuits having a strand of the cord-circuit for a common con-  
 70 ductor, a source of direct current, means whereby the said source of direct current may be alternately included in said circuits each containing one of the said primary windings, and a ringing-key for the cord-circuit controlling the operation of the said means, sub-  
 75 stantially as described.

11. In a telephone-exchange system, the combination with telephone-lines extending from subscribers' stations to an exchange, of  
 80 cord connecting apparatus at the exchange for uniting subscribers for conversation, a secondary circuit adapted for association with a called subscriber's line, two primary windings relatively wound so that each may pro-  
 85 duce current in the secondary circuit in a direction opposed to the other to produce alternating currents, a source of direct current, an electromagnetic switching appliance whereby current from said source may  
 90 be directed to alternately flow through circuits each including one of said primary windings, and a ringing-key for closing circuit through the said electromagnetic switching appliance, substantially as described.  
 95

In witness whereof I hereunto subscribe my name this 21st day of May, A. D. 1902.

JOHN C. FRED MALTHAUER.

Witnesses:

FLORENCE WICKLIN,  
 GEORGE L. CRAGG.