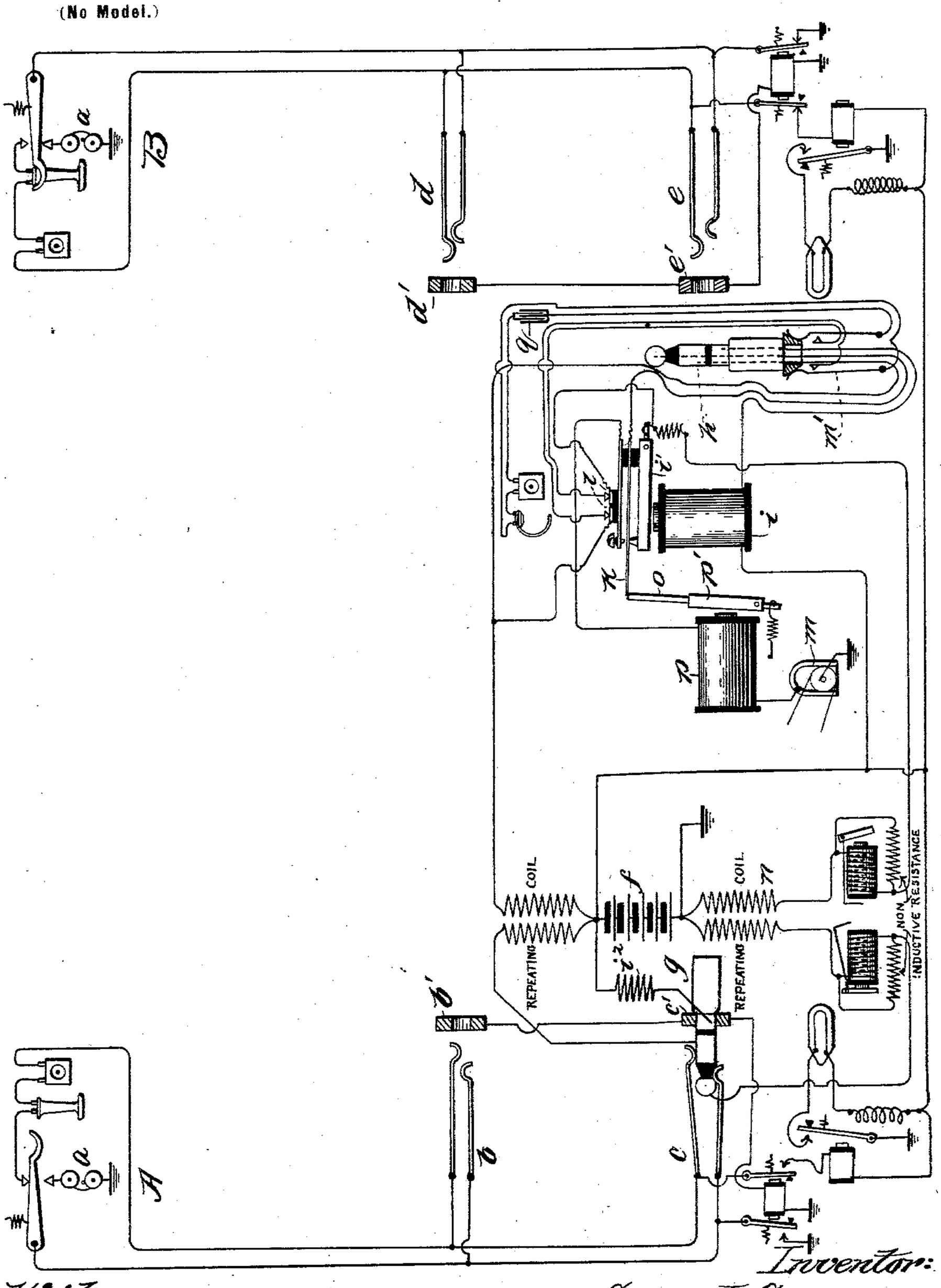
No. 629,957. Patented Aug. 1, 1899.

G. L. CRAGG.

TELEPHONE EXCHANGE SYSTEM.

(Application filed May 16, 1898.)

(No Model.)



Witnesses:
Dugald B. Jackson
A. D. Lawrence

Inventor:
George L. Cragg.
By Barton & Brown
Attorneys.

UNITED STATES PATENT OFFICE.

GEORGE L. CRAGG, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 629,957, dated August 1, 1899.

Application filed May 16, 1898. Serial No. 680,759. (No model.)

To all whom it may concern:

Be it known that I, GEORGE L. CRAGG, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Systems, (Case No. 3,) of which the following is a full, clear, concise, and exact description.

My invention relates to telephone-exchange systems, and has for its object to dispense with manually-operated keys which have heretofore been employed in connection with cord-circuits in the manipulation of circuits for effecting telephonic connection between subscribers.

As is well known, the operator in establishing a connection temporarily includes her telephone in circuit with the telephone of the calling subscriber to ascertain the connection desired and then cuts her telephone out of circuit, at the same time including a generator of signaling-current in circuit with the signal or bell at the called-subscriber's station, the generator being removed after the signal has been sent. In the preferred embodiment of my invention I employ a single appliance which is adapted upon the manipulation of the connecting apparatus to unite subscribers for conversation to perform these various operations in their proper order.

Generally speaking, one feature of my invention may be described as consisting in an electromagnetic appliance and suitable switching apparatus operated thereby for effecting the requisite changes in the circuit conditions of the operator's telephone and signaling-generator, the apparatus being such that upon the insertion of the answering-plug within the line-switch or spring-jack of the calling subscriber the operator's telephone may be included in circuit without the manual operation of a key, the connecting-plug being adapted in effecting commmunication between the subscribers to cause the operation of said appliance to open the circuit including the operator's telephone and to include the signaling-generator in circuit with the signal at the called-subscriber's station, said generator being thus (and preferably so) automatically included in circuit with said signal. In addition to this mechanism I preferably employ an additional instrumentality, preferably a second electromagnet, which may be controlled by apparatus at the called-subscriber's station—as, for example, the telephone switch-hook—to effect the removal of the generator when the call is responded to. All of this apparatus for closing and opening the operator's telephone-circuit and for including and removing the generator comprises a single electromagnetic appliance which is so organized and controlled by the switching apparatus employed in connecting subscribers for conversation that all of the various operations of the signaling and telephone switches are accomplished in orderly sequence. I am aware that automatically-operated instrumentalities have heretofore been employed in operating ringing and listening keys or switches; but I am not aware that any one electromagnetic appliance has been heretofore constructed adapted to effect the proper and orderly operations of both a ringing and a listening or operator's telephone-switch, the systems of the prior art requiring a separate appliance for each switch. Moreover, in the devices heretofore employed for effecting the automatic control of operators' listening-keys the arrangement and apparatus were such in the more highly developed systems that an almost constant flow of current was essential in controlling the position of the telephone-switch. By means of my peculiar arrangement I am enabled properly to control the condition of the operator's telephone-switch without the unnecessary waste of electrical energy. Generally speaking, this feature of my invention may be said to consist, in a metallic bridge conductor, of a cord-circuit, a magnet, an armature therefor, an operator's telephone-switch controlled by said armature, and an operator's telephone adapted to be included in said metallic bridge conductor when the armature is unattracted. The connecting-plug upon being manipulated to establish connection between subscribers serves to complete a circuit through said electromagnet, the armature whereof is thereupon attracted and the operator's telephone cut out of circuit with said metallic bridge

conductor. Current is only flowing through said magnet during an established connection. It is considered by many to be the best telephone practice to insert several answering-plugs within the spring-jacks of calling subscribers before establishing a complete connection between subscribers. I therefore provide means for opening the operator's telephone-circuit when the connecting-plug is in its normal idle position which consists, preferably, in a socket-switch, which through the influence of the engaging connecting-plug serves to open circuit through the operator's telephone. The switch that I prefer to employ is a mechanically-actuated one adapted to separate contacts serially included in the telephone-circuit.

I will describe my invention more particularly by reference to the accompanying drawing, which illustrates the preferred embodiment thereof.

The drawing illustrates a well-known type of line-circuits, the connections and instrumentalities at the central office being such as are employed in what are generally termed "relay-switchboards," the particular switchboards herein illustrated being multiple switchboards. As the apparatus associated with the telephone-lines illustrated is well known to those skilled in the art, I deem a detailed description thereof to be unessential.

The apparatus at subscribers' stations A and B is of well-known type, the signal-bells *a a* being preferably of high resistance, so that upon removal of the telephones from their switches paths of low resistance are afforded for any current passing over the lines. The telephone-line of subscriber A extends in two limbs to the exchange, where it is connected in multiple with two spring-jacks *b c*, located at different sections of the switchboard. The telephone-line of subscriber B extends to the exchange and is connected in multiple with spring-jacks *d* and *e*, located at the same boards with spring-jacks *b* and *c*, respectively. Metallic thimbles *b' c' d' e'* are in this instance shown before the line-springs of the spring-jacks, line-jacks, or line-switches, the thimbles in this particular instance being grounded. The particular type of cord-connecting apparatus that I have herein shown is generally used at the present time in the more highly develope systems. Other cord-connecting apparatus, however, may be employed without departing from the essential features of the invention.

A centralized battery *f* is included between the repeating-coils, this battery supplying the telephones of the connected subscribers with current and also serving to operate several of the instrumentalities of the switching apparatus, as will be understood by reference to the drawing and as will be more fully explained hereinafter. The repeating-coils, as is well known, serve to propagate voice-currents from one branch of the telephonic circuit to the other, clearing-out indicators being connected in circuit with the calling and called subscribers' portions of the united telephonic circuit to indicate the condition of use of said portions of the telephonic circuit in a manner well understood by those skilled in the art.

I in this instance employ, in connection with each cord-circuit, two plugs, one of which constitutes the answering-plug *g* or that plug which is inserted within the calling-subscriber's spring-jack, and the connecting-plug *h* or that plug which is inserted within the called-subscriber's spring-jack, the condition of use of the line-indicating apparatus being changed upon the insertion of these plugs, as is well understood by those skilled in the art. Each of said plugs in this instance comprises three metallic portions—namely, the tip for engaging the short-line springs of the spring-jacks, a sleeve for engaging the long-line springs of the spring-jacks, and a heel or sheath portion adapted for electrical contact with the metallic thimbles or test-rings.

In the preferred embodiment of the invention I employ an electromagnet *i*, constituting a portion of my improved appliance, which is preferably included in a circuit independent of either of the telephone-lines, whereby the operation of said electromagnet by substation apparatus is prevented. A pivotally-mounted armature *i'* is adapted to be actuated by the magnet. A ringing or signaling switch *k* and a telephone-switch *l*, having in this instance two contacts, are preferably both carried by the armature. The back contact of the ringing-switch is connected with the generator *m*, preferably of alternating current, while the normal contact-anvils of the switch *l* are connected with the contact-anvils of the plug-seat or socket-switch *m'*, the springs of said plug-seat or socket-switch being preferably normally mechanically separated from the anvils by the connecting-plug when resting within its socket. The operator at the board where the calling-subscriber's line-signal is located inserts the answering-plug in the spring-jack of said calling subscriber, and, if she is ready to listen to the calling subscriber, lifts the connecting-plug from its seat, whereupon her telephone is thrown into telephonic communication with the calling-subscriber's telephone, the armature being unattracted. After having ascertained the connection desired the operator tests the condition of use of the called-subscriber's line—if the board be a multiple switchboard—by applying the tip of the connecting-plug to the metallic thimble of said spring-jack or line switch. If the line called for is in use, a grounded battery *f* at another board will be connected with said thimble, so that upon the application of the tip of the test-plug current will pass from said grounded battery by way of the tip of the testing-plug through a winding of the repeating-coil to ground. The presence of current in the coil *n* will be manifested by a click in the oper-

ator's telephone. If the called-subscriber's line be not in use, the test rings d' e' will be free of battery connection, so that no sound will be manifested in the operator's telephone, the operator thereupon inserting the connecting-plug in the spring-jack of the subscriber B, assuming that subscriber to be the one with whom A desires connection. I include a condenser q in the operator's telephone-circuit to prevent the passage of battery-current therethrough for the purpose of preventing false tests, which would occur, but for the presence of the condenser, upon the application of the tip of the connecting-plug to a test-thimble of an idle line, the condenser interrupting the direct current that would otherwise flow from the grounded battery f to the grounded test-thimble.

It is obvious that an operator's telephonic circuit insufficient for purposes of conversation may be employed for the purpose of testing, and I therefore do not wish to be limited to the particular arrangement herein shown in the adaptation of my invention for the purpose of testing.

Upon the insertion of the connecting-plug in the spring-jack of the called subscriber current is directed from the grounded battery f through the magnet i and metallic thimble e' to the ground connection of said thimble or test-ring. To prevent the battery from being partially shunted, I provide a resistance i^2, which serves to balance the resistance of the magnet i. Said magnet thus being included in circuit with the battery f is energized and attracts the armature i', serving thereby to open the operator's telephone-circuit and at the same time to bring the ringing-switch k, which in this instance is in the form of a strip-spring, in engagement with its alternate contact-anvil forming the terminal of generator m, this engagement of the switch and anvil being effected by the stop o, disposed within the path of said switch. It is preferable, especially where generators of alternating current or current of other character likely to interfere with the propagation of voice-currents are employed, to remove the generator from circuit with the signal at the called-subscriber's station when said subscriber responds. To this end means are employed controlled by the called subscriber for effecting the removal of said generator. In the present instance for the purpose of effecting the removal of the generator the stop o is carried by a pivotally-mounted armature p'. A magnet p is included in circuit with the generator m, the resistance of the signal-bell a being such that said magnet is not energized sufficiently to attract the armature p' when the generator-current is passing through the bell a. Upon the removal of the telephone in response to the signal a path of low resistance is closed at the subscriber's station, the magnet p thereupon being sufficiently energized to attract the armature p', whereby the stop o is withdrawn from the path of the switch k, which by reason of its resiliency breaks contact with its alternate generator contact-anvil, the tip-strand of the connecting-plug being at the same time completed. The said path of low resistance in this particular instance includes both limbs of the telephone-line of called subscriber B, the tip and sleeve of the connecting-plug h, the short and long line springs of the called-subscriber's spring-jack engaging said tip and sleeve, the grounded calling-generator connected with the tip of the connecting-plug, and the battery f, with its ground and connection with the sleeve of said plug. This circuit of low resistance is established, as has been said, upon the removal of the telephone at the called-subscriber's station, the bell of high resistance at said station being cut out of circuit with the generator. The circuit of low resistance exists but for a moment, the magnet p being immediately sufficiently energized upon the establishment of said low-resistance circuit to withdraw the armature p' to remove the generator from connection with the cord-circuit and called-subscriber's telephone-line. The magnets i and p, together with the coöperating apparatus, form a single electromagnetic appliance for automatically effecting the proper operation of the telephone and ringing switches.

In some of the claims I use the words "metallic bridge conductor" in the sense of a bridge conductor metallically connected with the cord-circuit.

While I have shown the ringing and listening switches both mounted upon a single armature controlled by a single electromagnet, I do not wish to be limited to this precise arrangement, as modifications may readily be made without departing from the spirit of the invention.

Having, however, thus particularly described one telephone-exchange system embodying the features of my invention, I claim as new, and desire to secure by Letters Patent, the following:

1. In an operator's generator and telephone switching apparatus for telephone-exchanges, the combination with a single electromagnetic appliance, of suitable operator's generator and telephone circuit connections, and switching mechanism operated by said electromagnetic appliance for operatively changing the conditions of the operator's telephone-circuit and for connecting the generator with and disconnecting it from a subscriber's line, substantially as described.

2. In an operator's generator and telephone switching apparatus for telephone-exchanges, the combination with a single electromagnetic appliance, of a signal-circuit, an operator's telephone-circuit, and switching mechanism operatively associated with said electromagnetic appliance for changing the condition of the operator's telephone-circuit and serving

to include the signaling-generator in and disconnect it from the signal-circuit, substantially as described.

3. In an operator's generator and telephone switching apparatus for telephone-exchanges, the combination with a suitable circuit connection and a signaling-switch for connecting a signal-generator with and disconnecting it from a signal-circuit conductor, of an operator's telephone-switch and a single electromagnetic appliance for effecting the operation of said signaling and telephone switches, substantially as described.

4. In a telephone-exchange system, the combination with two telephone-lines extending from subscribers' stations to an exchange, of a cord-circuit for forming a continuation of one of said telephone-lines, a connecting-plug adapted to connect said cord-circuit and telephone-line with the remaining telephone-line, a signal at the subscriber's station of the latter line, a generator, a signaling-switch for connecting the generator with and disconnecting it from said signal, an operator's telephone-switch for connecting the operator's telephone with said plug and disconnecting it therefrom, and a single electromagnetic appliance for operating said signaling and telephone switches, substantially as described.

5. In a telephone-exchange system, the combination with two telephone-lines extending from subscribers' stations to an exchange, of a cord-circuit for forming a continuation of one of said telephone-lines, a connecting-plug adapted to connect said cord-circuit and telephone-line with the remaining telephone-line, a signal at the subscriber's station of the latter line, a generator, a signaling-switch for connecting the generator with and disconnecting it from said signal, an operator's telephone, a telephone-switch for connecting the operator's telephone with the cord-circuit to complete a telephonic circuit between the operator and the subscriber at the station of the first aforesaid telephone-line, said telephone-switch serving to break said telephonic circuit when in an alternative position, and a single electromagnetic appliance for operating said signal and telephone switches, substantially as described.

6. In a telephone-exchange system, the combination with two telephone-lines extending from subscribers' stations to an exchange, of a cord-circuit for forming a continuation of one of said telephone-lines, a connecting-plug for connecting the second telephone-line with the cord-circuit and the aforesaid telephone-line, a signal at the subscriber's station of the second telephone-line, a generator, a signaling-switch for connecting the generator with and disconnecting it from said signal, an operator's telephone, a telephone-switch for connecting the operator's telephone with the cord-circuit to complete a telephonic circuit between the operator and the subscriber at the station of the first aforesaid telephone-line, said telephone-switch serving to break said telephonic circuit when in an alternative position, a single electromagnetic appliance for operating said signal and telephone switches, and means controlled by said connecting-plug for operating said electromagnetic appliance, substantially as described.

7. In a telephone-exchange system, the combination with two telephone-lines extending from subscribers' stations to an exchange, of a cord-circuit for forming a continuation of one of said telephone-lines, a connecting-plug for connecting the second telephone-line with the cord-circuit and the aforesaid telephone-line, a signal at the subscriber's station of the second telephone-line, a generator, a signaling-switch for connecting the generator with and disconnecting it from said signal, an operator's telephone, a telephone-switch for connecting the operator's telephone with the cord-circuit to complete a telephonic circuit between the operator and the subscriber at the station of the first aforesaid telephone-line, said telephone-switch serving to break said telephonic circuit when in an alternative position, a single electromagnetic appliance for operating said signal and telephone switches, a connecting or spring-jack switch for the second telephone-line, in which the connecting-plug is inserted upon establishing connection between the two telephone-lines, means operated by said plug and connecting-switch for operating said electromagnetic appliance to open the operator's telephone-circuit, said electromagnetic appliance in the latter condition of use serving to include the generator in circuit with the signal at the station of the aforesaid second telephone-line, and means operated by the subscriber at said second station for further actuating said electromagnetic appliance to remove the generator from circuit with said signal, substantially as described.

8. In a telephone-exchange system, the combination with two telephone-lines extending from subscribers' stations to an exchange, of a cord-circuit for forming a continuation of one of said telephone-lines, a connecting-plug for connecting the second telephone-line with the cord-circuit and the aforesaid telephone-line, a signal at the subscriber's station of the second telephone-line, a generator, a signaling-switch for connecting the generator with and disconnecting it from said signal, an operator's telephone, a telephone-switch for connecting the operator's telephone with the cord-circuit to complete a telephonic circuit between the operator and the subscriber at the station of the first aforesaid telephone-line, said telephone-switch serving to break said telephonic circuit when in an alternative position, a single electromagnetic appliance for operating said signal and telephone-switches, a connecting or spring-jack switch for the second telephone-line, in which the connecting-plug is inserted upon establishing connection between the two telephone-lines, means operated by said plug and connecting-

switch for operating said electromagnetic appliance to open the operator's telephone-circuit, said electromagnetic appliance in the latter condition of use serving to include the generator in circuit with the signal at the station of the aforesaid second telephone-line, means operated by the subscriber at said second station for further actuating said electromagnetic appliance to remove the generator from circuit with said signal, and a socket-switch adapted through the agency of the connecting-plug which engages the same when not in use to open the operator's telephone-circuit, substantially as described.

9. In a telephone-exchange system, the combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug adapted to unite said cord-circuit and telephone-line with the second telephone-line, an electromagnet having an armature, a switch controlled by the armature connected with a metallic bridge conductor of the cord-circuit, an operator's telephone which is adapted to be connected in said bridge conductor by said switch, through the agency of said armature when unattracted, a circuit for said electromagnet, and means for closing said circuit controlled by the connecting-plug and the line-switch or spring-jack engaging the same, whereby the armature is attracted and said telephone bridge conductor is broken by the switch controlled by the armature, substantially as described.

10. In a telephone-exchange system, the combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug adapted to unite said cord-circuit and telephone-line with the second telephone-line, an electromagnet having an armature, a switch controlled by the armature connected with a metallic bridge conductor of the cord-circuit, an operator's telephone which is adapted to be connected in said bridge conductor by said switch, through the agency of the armature when unattracted, a circuit for said electromagnet, means for closing said circuit controlled by the connecting-plug and the line-switch or spring-jack engaging the same, whereby the armature is attracted and circuit through said bridge conductor and telephone is broken, and a socket-switch adapted through the agency of the connecting-plug normally engaging the same to effect an opening in said telephone bridge conductor, substantially as described.

11. In a telephone-exchange system, the combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug adapted to unite said cord-circuit and telephone-line with the second telephone-line, an electromagnet having an armature, a switch controlled by the armature connected with a metallic bridge conductor of the cord-circuit, an operator's telephone which is adapted to be connected in said bridge conductor by said switch, through the agency of the armature when unattracted, a circuit for said electromagnet, means for closing said circuit controlled by the connecting-plug, whereby the armature is attracted and circuit through said bridge conductor and telephone is broken, and a mechanically-actuatable socket-switch adapted to open and close another portion of said metallic telephone bridge conductor independently of the switch controlled by the armature, said switch being adapted through the agency of the connecting-plug to open said bridge conductor, the opening or openings in said bridge conductor at said socket-switch being closed thereby when relieved of the mechanical influence of the connecting-plug, substantially as described.

12. In a telephone-exchange system, the combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug adapted to unite said cord-circuit and telephone-line with the second telephone-line, an electromagnet having an armature, a switch controlled by the armature connected with a metallic bridge conductor of the cord-circuit, an operator's telephone which is adapted to be connected in said bridge conductor by said switch through the agency of the armature when unattracted, a mechanically-actuatable socket-switch adapted to open and close another portion of said metallic telephone bridge conductor independently of the switch controlled by the armature, said switch being adapted through the agency of the connecting-plug to open said bridge conductor, the opening or openings in said bridge conductor at said socket-switch being closed thereby when relieved of the mechanical influence of the connecting-plug, and a line or spring-jack switch for the said second telephone-line in which the connecting-plug is inserted in establishing connection between the two lines, the circuit including said electromagnet being adapted to be closed by said plug and line-switch, whereby the operator's telephone is cut out of circuit upon establishing connection between the two telephone-lines, substantially as described.

13. In a telephone-exchange system, the combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug adapted to unite said cord-circuit and telephone-line with the second telephone-line, an electromagnet having an armature, a switch controlled by the armature connected with a metallic bridge conductor of the cord-circuit, an operator's telephone which is adapted to be connected in said bridge conductor by said switch, through the agency of the armature when unattracted, a mechanically-actuatable socket-switch adapted to open and close another portion of said metallic telephone bridge conductor independently of the switch controlled by the armature, said switch being

adapted through the agency of the connecting-plug to open said bridge conductor, the opening or openings in said bridge conductor at said socket-switch being closed thereby when relieved of the mechanical influence of the connecting-plug, a line or spring-jack switch for the said second telephone-line in which the connecting-plug is inserted in establishing connection between the two lines, the circuit including said electromagnet being adapted to be closed by said plug and line-switch, whereby the operator's telephone is cut out of circuit upon establishing connection between the two telephone-lines, a signal at the subscriber's station of the said second telephone-line, a signaling-generator, and a ringing-switch controlled by said electromagnet, adapted to effect the inclusion of said generator with said signal upon the establishment of connection between the two telephone-lines, substantially as described.

14. In a telephone-exchange system, the combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug adapted to unite said cord-circuit and telephone-line with the second telephone-line, an electromagnet having an armature, a switch controlled by the armature connected with a metallic bridge conductor of the cord-circuit, an operator's telephone which is adapted to be connected in said bridge conductor by said switch, through the agency of the armature when unattracted, a mechanically-actuatable socket-switch adapted to open and close another portion of said metallic telephone bridge conductor independently of the switch controlled by the armature, said switch being adapted through the agency of the connecting-plug to open said bridge conductor, the opening or openings in said bridge conductor at said socket-switch being closed thereby when relieved of the mechanical influence of the connecting-plug, a line or spring-jack switch for the said second telephone-line in which the connecting-plug is inserted in establishing connection between the two lines, the circuit including said electromagnet being adapted to be closed by said plug and line-switch, whereby the operator's telephone is cut out of circuit upon establishing connection between the two telephone-lines, a signal at the subscriber's station of the said second telephone-line, a signaling-generator, a ringing-switch actuated by the magnet when energized upon completion of connection between two telephone-lines to include said generator in circuit with said signal, a telephone-switch at said station, and means controlled thereby for effecting the removal of said generator, substantially as described.

15. In a telephone-exchange system, the combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug adapted to unite said cord-circuit and telephone-line with the second telephone-line, an electromagnet having an armature, a switch controlled by the armature connected with a metallic bridge conductor of the cord-circuit, an operator's telephone which is adapted to be connected in said bridge conductor by said switch, through the agency of the armature when unattracted, a mechanically-actuatable socket-switch adapted to open and close another portion of said metallic telephone bridge conductor independently of the switch controlled by the armature, said switch being adapted through the agency of the connecting-plug to open said bridge conductor, the opening or openings in said bridge conductor at said socket-switch being closed thereby when relieved of the mechanical influence of the connecting-plug, a line or spring-jack switch for the said second telephone-line in which the connecting-plug is inserted in establishing connection between the two lines, the circuit including said electromagnet being adapted to be closed by said plug and line switch, whereby the operator's telephone is cut out of circuit upon establishing connection between the two telephone-lines, a signal at the subscriber's station of the said second telephone-line, a signaling-generator, a ringing-switch actuated by the magnet when energized upon completion of connection between two telephone-lines to include said generator in circuit with said signal, a telephone-switch at said station, a second electromagnet through which current from said generator is directed, and a path of low resistance for the current passing from said generator through said second electromagnet, closed by the said switch at the second subscriber's station upon the removal of the telephone-receiver therefrom, effectively to energize said second electromagnet, which is thereupon adapted to effect the removal of the generator, substantially as described.

16. The combination with two telephone-lines, of a cord-circuit for forming the continuation of one of said lines, a connecting-plug for uniting said cord-circuit and telephone-line with the second telephone-line, a line or spring-jack switch for the second telephone-line in which said connecting-plug is inserted upon establishing connection between said telephone-lines, a signal at the subscriber's station of the second telephone-line, a signaling-generator, a ringing-switch for including said generator in circuit with said signal and removing it from said circuit, an operator's telephone, a telephone-switch for including said telephone in telephonic circuit with the telephone at the subscriber's station of the first telephone-line and removing it therefrom, a single electromagnetic appliance for operating said switches adapted to be operated through the agency of the connecting-plug and its engaging line-switch to open circuit through the operator's telephone and to include the signaling-generator in circuit with the signal at the second subscriber's station, and a telephone-switch at the latter

station and a suitable circuit controlled thereby serving upon the removal of the telephone from said switch to operate said appliance to effect the removal of said generator, substantially as described.

17. The combination with two telephone-lines, of a cord-circuit for forming the continuation of one of said lines, a connecting-plug for uniting said cord-circuit and telephone-line with the second telephone-line, a line or spring-jack switch for the second telephone-line, in which said connecting-plug is inserted upon establishing connection between said telephone-lines, a signal at the subscriber's station of the second telephone-line, a signaling-generator, a ringing-switch for including said generator in circuit with said signal and removing it from said circuit, an operator's telephone, a telephone-switch for including said telephone in telephonic circuit with the telephone at the subscriber's station of the first telephone-line and removing it therefrom, a single electromagnetic appliance for operating said switches, adapted to be operated through the agency of the connecting-plug and its engaging line-switch to open circuit through the operator's telephone and to include the signaling-generator in circuit with the signal at the second subscriber's station, and a telephone-switch at the latter station and a suitable circuit controlled thereby serving, upon the removal of the telephone from said switch, to operate said appliance to effect the removal of said generator, substantially as described.

18. The combination with two telephone-lines, of a cord-circuit for forming the continuation of one of said lines, a connecting-plug for uniting said cord-circuit and telephone-line with the second telephone-line, a line or spring-jack switch for the second telephone-line, in which said connecting-plug is inserted upon establishing connection between said telephone-lines, a signal at the subscriber's station of the second telephone-line, a signaling-generator, a ringing-switch for including said generator in circuit with said signal and removing it from said circuit, an operator's telephone, a telephone-switch for including said telephone in telephonic circuit with the telephone at the subscriber's station of the first telephone-line and removing it therefrom, a single electromagnetic appliance for operating said switches, a circuit independent of the telephone circuit or circuits between the subscribers which includes a portion of said appliance adapted to be closed by the connecting-plug and the line-switch in which it is inserted to operate said appliance to open circuit through the operator's telephone, the said appliance and the ringing-switch, including the signaling-generator in circuit with the signal at the second subscriber's station, and a telephone-switch at the latter station, a suitable circuit controlled thereby jointly with said telephone-switch serving, upon the removal of the telephone from said switch, to operate said appliance to actuate said ringing-switch in position to effect the removal of said generator, said appliance including means for preventing the reoperation of said ringing-switch to operate said signal during the established connection, substantially as described.

19. The combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug for uniting said cord-circuit and telephone-line with the second telephone-line, a line or spring-jack switch for the second telephone-line with which said connecting-plug is engaged upon establishing connection between said telephone-lines, a signal at the subscriber's station of the second telephone-line, a signaling-generator, a ringing-switch for including said generator in circuit with said signal and disconnecting it therefrom, an operator's telephone, a telephone-switch for connecting said telephone with the aforesaid plug, a single electromagnetic appliance for operating said switches adapted to be operated through the agency of the connecting-plug and the engaging spring-jack or line-switch to disconnect the operator's telephone from the said plug and to include the signaling-generator in circuit with the signal at the second subscriber's station, and a telephone-switch at the latter station and a suitable circuit controlled thereby, serving, upon the removal of the telephone from said switch, to operate said appliance to effect the disconnection of said generator, substantially as described.

20. In a telephone-exchange system, the combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug adapted to unite said cord-circuit and telephone-line with the second telephone-line, an electromagnet having an armature, a switch controlled by the armature connected with a metallic bridge conductor of the cord-circuit, an operator's telephone which is adapted to be connected in said bridge conductor by said switch, through the agency of said armature when unattracted, a circuit for said electromagnet, and means for governing said circuit controlled by the connecting-plug, whereby the armature is attracted and said telephone bridge conductor is broken by the switch controlled by the armature, substantially as described.

21. In a telephone-exchange system, the combination with two telephone-lines, of a cord-circuit for forming a continuation of one of said lines, a connecting-plug adapted to unite said cord-circuit and telephone-line with the second telephone-line, an electromagnet having an armature, a switch controlled by the armature connected with a metallic bridge conductor of the cord-circuit, an operator's telephone which is adapted to

be connected in said bridge conductor by said switch, through the agency of the armature when unattracted, a circuit for said electro-magnet, means for governing said circuit controlled by the connecting-plug, whereby the armature is attracted and circuit through said bridge conductor and telephone is broken, and a socket-switch adapted through the agency of the connecting-plug normally engaging the same to effect an opening in said telephone bridge conductor, substantially as described.

In witness whereof I hereunto subscribe my name this 14th day of May, A. D. 1898.

GEORGE L. CRAGG.

Witnesses:
D. W. C. TANNER,
ALBERT LYNN LAWRENCE.