

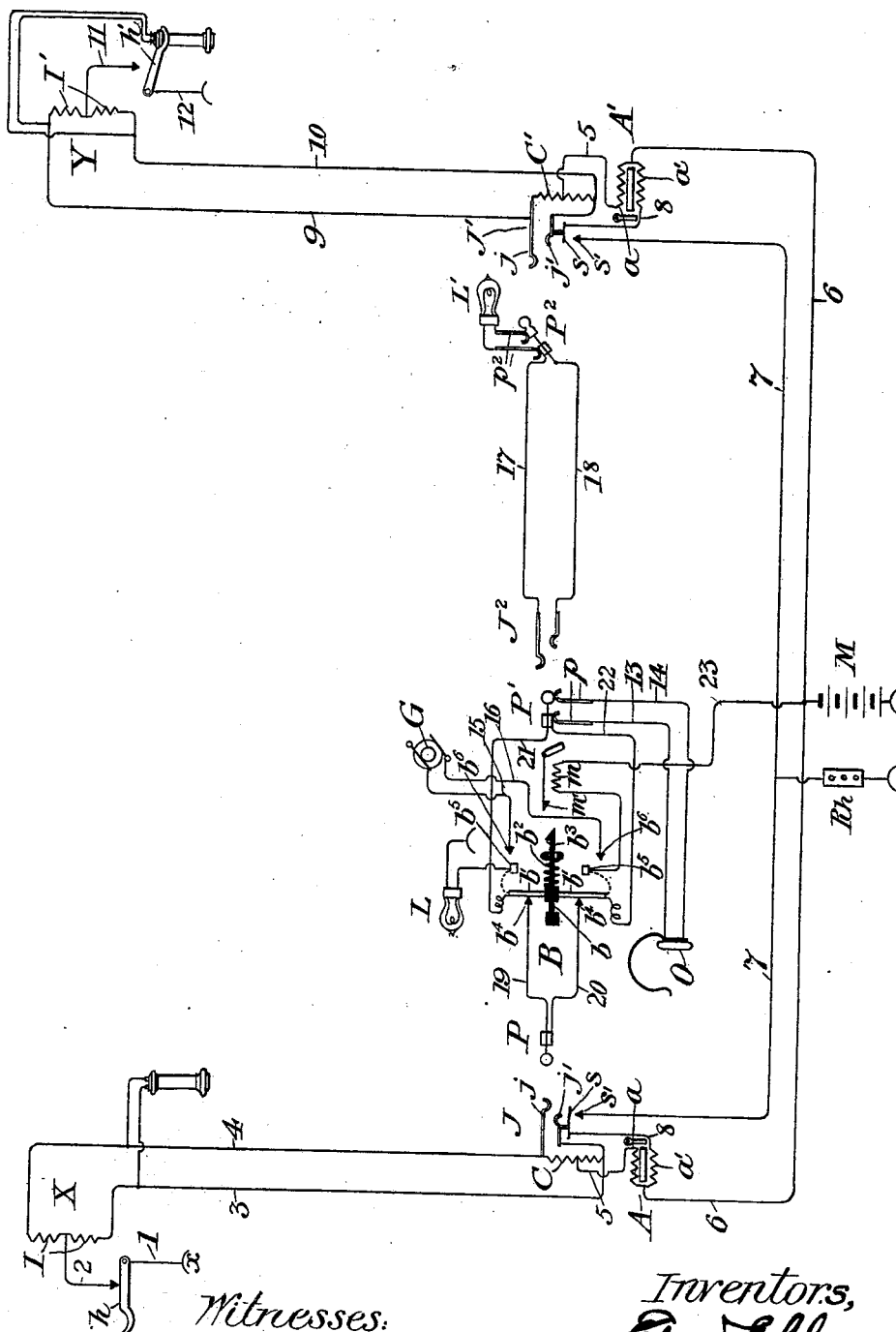
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Patented Apr. 3, 1900.

E. E. CLEMENT & W. D. GHARKY.  
TELEPHONE EXCHANGE SYSTEM.

(Application filed Dec. 24, 1898.)

(No Model.)



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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 646,680, dated April 3, 1900.

Application filed December 24, 1898. Serial No. 700,194. (No model.)

*To all whom it may concern:*

Be it known that we, EDWARD E. CLEMENT, residing in Washington, District of Columbia, and WILLIAM D. GHARKY, residing at Philadelphia, Pennsylvania, citizens of the United States, have invented an Improvement in Telephone-Exchange Systems, (No. 6,) of which the following is a specification.

Our invention relates to telephone-exchange systems wherein subscribers' lines converge to a common point or common points and are there adapted to be connected with each other, as required, by means of fixed and movable terminals upon a switch board or boards. It has particular reference to systems of this general character wherein the connection of some or all of the subscribers' lines in pairs, as desired, is accomplished by means of trunk-lines—that is, divided central systems.

The object of our invention is to improve and simplify the apparatus required for such systems, and in particular to improve and simplify the apparatus and operation of our prior systems described in applications now pending, Serial Nos. 689,119 and 689,120.

The subscribers' circuits and their signaling and terminal apparatus at the central office are substantially the same in the present case as in the prior systems; but the connecting cord-circuits are different and the supervisory signals are arranged in an improved manner. In the present system means in the cord-circuit under the control of an answering operator breaks the connection between the answering and the calling plug and at the same time connects a restoring device and a supervisory signal to the calling-plug ends. When the answering operator makes connection with a trunk-line, a signal is energized to call the attention of the proper calling operator, and when the latter completes the connection with the desired line the answering operator's supervisory signal apprises her thereof. When the called subscriber answers, she is further apprised of the fact, and, moreover, the through circuits are automatically completed.

Other features of improvement exist, which

will be pointed out in the description and 50 claims.

Our invention is fully illustrated in the accompanying drawing, wherein the same letters and numerals designate the same parts throughout, and the figure is a diagrammatic 55 representation of the circuits and apparatus of our system.

Referring to the drawing, X is a subscriber's station provided with the usual transmitter-receiver, call-receiving device, and 60 switch. As there is nothing unusual in these parts, we have designated them in a general manner only. I indicates the secondary coil of the induction-coil. *h* is the switch-hook. The other parts are related to these in the 65 common way. Y is a second station having the same apparatus, illustrated as an induction-coil I' and a switch-hook *h'*, with a receiver thereon, the call presumably not having been given or answered. Ground connections 1 2 and 11 12 are provided at the subscriber's stations to be completed when the hooks *h* and *h'* rise for signaling. From the substations line-wires 3 4 and 9 10 proceed to the central station, where they terminate, respectively, in jacks J and J', each with contact-springs *j* and *j'* and extra contacts *s* and *s'*, operatively connected to springs *j'*. Bridged across the lines outside of the jacks are impedance-coils C and C', from the middle points of whose windings wires 5 are led to coils *a* of the annunciators A and A', respectively, the circuit further proceeding in each case by wire 6 to main battery M and ground. We have indicated the ground 85 throughout the present case by a short curved line—for example, as at *x*, station X. Each line-annunciator is provided with a second differential and balancing winding, which is designated by the letter *a'*. It is connected 90 on one side to the wire 6 and on the other by wire 8 to contact *s*, and when the plug P is inserted in jack J by contact *s'*, wire 7 to resistance R/*h* and to ground. The resistance R/*h* is inserted in order that the current passing through the coils *a'* may be reduced to approximately the amount that is taken by coils *a*. In some cases it may be necessary to sub-

stitute individual resistances in the several lines for this common resistance—*i. e.*, where the line resistances vary widely.

The operator's connecting-circuits include the plugs P and P' and conductors—in practice flexible cords—19 20 21 22. The plugs are of any good design, this not being material to our invention. The plug P', however, is preferably provided with extra rings to make connection to the terminals *p* of the operator's circuit 13 14, as fully set out in our prior applications.

Inserted in the cord-circuit is a switching device B, having an actuating-spindle *b*, which may terminate in a push button head, as illustrated, or may be operated through the agency of a lever or otherwise. This switching device is shown in its normal position, with the cord-circuits 19 21 and 20 22 connected. It has two other positions—the first when the spindle is partly depressed and the second when it is depressed as far as it will go. The spindle carries cross-arms *b'*, of conducting material, insulated from each other and connected to the forward cord-sections 21 22. The intermediate contacts *b<sup>5</sup> b<sup>6</sup>* are connected, respectively, to a signal L and ground and to a magnet-winding *m* and by wire 23 to main battery and ground. The lowest contacts *b<sup>6</sup>* are connected to the two sides 15 16 of the circuit of a generator G of alternating current.

On the end or at any other convenient portion of the spindle *b* a hook or detent *b<sup>3</sup>* is provided, which is adapted to engage with a corresponding hook or detent *m'* of the armature of magnet *m*. The position of the parts is so regulated that when the spindle is depressed the detents will engage, and when the spindle is released the cross-arms *b' b'* will remain on the contacts *b<sup>5</sup>* until the magnet *m* is energized, when a spring *b<sup>2</sup>* will restore the switch to its normal position.

17 18 are the sides of a trunk-line terminating at an answering-section of switch-board in a spring-jack J<sup>2</sup> and at a calling-section in a plug P<sup>2</sup>. The plug P<sup>2</sup> is provided with extra rings connected to its sleeve and tip, respectively, and substantially as described in our prior cases referred to, which when the plug is in its seat make contact with springs *p<sup>2</sup> p<sup>2</sup>*, forming the terminals of a circuit containing a signal, shown as a lamp L'.

The operation of our system as thus described is as follows: Suppose subscriber X desires connection with subscriber Y. He removes his receiver from the hook *h*, which thereupon rises and completes the signaling-circuit from ground through wire 1, hook *h*, wire 2, the two halves of the induction-coil I in parallel, the two line-wires 3 4 in parallel, the two halves of the coil C in parallel, wire 5, coil *a*, wire 6, battery M, and to ground. Current from the battery M immediately flows to line, and the coil *a* energizes the annunciator-magnet A, which apprises the op-

erator at that section of X's call. She responds by inserting the plug P in the jack J. The first effect of this is to cause spring *s* to close on contact *s'*, whereupon the second coil *a'* of the line-annunciator will receive current through the circuit traced from ground to main battery M, wire 6, winding *a'*, wire 8, contacts *s* and *s'*, wire 7, to resistance R*h*, and to ground. This neutralizes the effect of the winding *a* on the magnet A and causes the line-signal to be forthwith retired. As the listening set O of the operator is connected to the jack J, as soon as she inserts the plug by reason of the connection between springs *p p* and plug P' she can immediately ask for the required number. Having ascertained this, if it is upon her own board she inserts plug P' in the proper jack and depresses the spindle *b* into calling position; but as we have assumed that X wants Y and as Y is on another board-section the operator inserts the plug P' in the jack J<sup>2</sup> of the proper trunk-line to reach the board upon which Y's terminal is located. As soon as the plug is in the jack J<sup>2</sup> she depresses the spindle *b* and lets it stand as it is—that is, with the detent holding it in the intermediate position. The first effect of this is to break the cord-circuit completely in two. The second is to connect the signal L and the magnet *m* to the forward plug, a complete circuit being formed, as follows: from ground to battery M, wire 23, magnet *m*, contact *b<sup>5</sup>*, cross-arm *b'*, cord conductor 22, plug P', trunk-wire 18, plug P<sup>2</sup>, spring *p<sup>2</sup>*, signal L', spring *p<sup>2</sup>* and plug P<sup>2</sup>, trunk-wire 17, plug P', cord conductor 21, cross-arm *b'*, contact *b<sup>5</sup>*, and signal L to ground. Current from battery M, flowing through this circuit, causes the display of both signals L and L', but does not energize the magnet *m*, because its resistance is so low or its number of turns so few that the current it gets with the lamps in series with it is insufficient. The operator at the second board perceiving the signal L' talks or receives instructions from the answering operator over a separate instruction-circuit (not necessary to be here shown) and having ascertained the number desired picks up the plug P<sup>2</sup> and inserts it in the jack of the subscriber Y. As soon as she picks the plug up from its seat the circuit of the signals L and L' is obviously broken and the first or answering operator sees her lamp go out, thus having indicated to her that the connection is about to be completed. If, on the other hand, the other operator neglects the call, the first girl is apprised of the fact by her lamp L staying bright for too long a period and can further instruct the recalcitrant operator. As soon as the plug is inserted in the desired jack J' the circuit through the parts L and *m* is again completed, the current passing through coil C'. This flow of current can either again energize signal L, but not magnet *m*, or it can be regulated by suitably raising the resistance of the coil C', so that once the lamp L has gone out it remains dark. We do not

limit ourselves to either mode of operation in this particular. One thing, however, is absolutely essential—that the resistance of *C* must be high enough to prevent sufficient current to pass for the energization of magnet *m*. When the subscriber *Y* answers the call, a low-resistance path is closed for the current from *M* through wire 23, magnet *m*, contact *b*<sup>5</sup>, cross-arm *b'*, conductor 22, trunk-wire 17, line-wire 9, induction-coil *I'*, wire 11, hook *h'*, and wire 12 to ground. The current in this circuit immediately energizes the magnet *m*, and it attracts its armature, releasing the detent *b*<sup>5</sup> and permitting the spindle *b* to assume the position shown in the drawing, thus reuniting the cord-circuit and completing the connection of the subscribers. After the first operator becomes aware, by the extinguishment of her lamp *L*, that the plug *P*<sup>2</sup> has been lifted and inserted in the jack *J'* she sends calling-current to line by depressing the spindle to the limit of its movement, which brings the cross-arms into contact with the terminals of the generator-circuit. She knows when the subscriber has answered for the reason that the spindle *b* remains in its intermediate position until such answer has taken place and afterward assumes the normal position. The lamp or signal *L* and the lever or button of the spindle therefore serve to keep the first or answering operator fully cognizant of the status of affairs. She can therefore be charged without injustice with the duties of calling, as well as answering calls. This makes the apparatus at the second or calling operator's table very simple and consolidates both apparatus and duties.

It must be obvious that the apparatus here described as in the cord-circuit could be used in a system very different from that with which it is here shown, and we reserve the right to vary this use, and we consider that we may change many of the details and some of the connections described without departing from the spirit of the invention.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a telephone-exchange system, a switch-board, subscribers' lines terminating thereon, operators' connecting-circuits adapted to connect any of said lines for conversation, and signals for said circuits, together with means for interrupting each of said operators' circuits when a connection is initiated there-through and connecting a source of current and a signal, respectively, to the portions of said circuit leading to the called line, substantially as described.

2. In a telephone-exchange system, a switch-board, a series of subscribers' lines having terminals thereon, operators' normally-continuous cord-circuits for connecting said lines as desired, a device in each cord-circuit for severing it into two portions, an answering and a calling portion, when a connection has been initiated, a signal and a restoring device adapt-

ed to be connected to the called line, and means whereby the called subscriber, in responding to the call, causes a change in the signal and simultaneously restores the continuity of the circuit, substantially as described.

3. In a telephone-exchange system, a switch-board, subscribers' lines terminating thereon, operators' normally-continuous connecting-circuits therefor, means for severing each connecting-circuit into an answering and a calling portion when a connection is initiated there-through, a signal device for each circuit, and means controlled by the called subscriber in answering the call to produce a change in said signal and also to restore the continuity of the through-circuit, substantially as described.

4. In a telephone-exchange system, a switch-board, subscribers' lines terminating thereon, connecting cord-circuits therefor, a ringing-key and a signal for each circuit and a generator of calling-current for all the circuits, each ringing-key constructed and arranged when operated, first, to sever the said circuit, second, to connect the generator with the forward or calling portion thereof, and third to disconnect said generator and connect the proper signal, substantially as described.

5. In a telephone-exchange system, a central office, subscribers' lines having terminals therein, connecting cord-circuits therefor, a switch for each circuit adapted when operated to sever the circuit, a signal associated with, and a detent and restoring device for, each switch, constructed and arranged to be placed thereby under the control of the called line, and calling-generator terminals so associated with the switch that the signal and restoring device are disconnected while the generator is connected, substantially as described.

6. In a telephone-exchange system, a central office, subscribers' lines having terminals therein, and each provided with a high-resistance cross or bridge, operators' cord-circuits, a switch for each cord-circuit constructed and arranged when operated to break its continuity and then to be held, a signal and a restoring-magnet for each switch, of such relative resistances that when placed in series with the line-bridge the signal will operate but the restoring-magnet will not, and means controlled by a called subscriber to close a low-resistance path to line to permit the restoring-magnet to release the switch and restore the continuity of the circuit, substantially as described.

7. In a telephone-exchange system, subscribers' lines, connecting cord-circuits therefor provided with continuity switches and signals, each switch provided with a detent to hold it when actuated, and a magnet controlling the same, the whole so arranged that the actuation of the switch connects the detent-magnet, the signal, and a suitable source of current in series with each other and a called line, and means controlled by the called sub-

scriber in answering the call to shunt the signal with a path of lower resistance, whereby the magnet is energized and the continuity of the cord-circuit restored, substantially as described.

8. In a telephone-exchange system, a switchboard, subscribers' lines having terminals thereon, and operators' cord-circuits, each provided with a switch, a detent therefor, and a signal, so arranged that the signal may be connected through the switch to a called line, and the called subscriber in answering will release the switch, substantially as described.

9. In a telephone-exchange system, divided switchboards at the same or different central stations, subscribers' lines terminating thereon and connecting cord-circuits therefor, trunk-lines interconnecting the switchboard-sections, each provided at one end with a spring-jack and at the other with a plug and a signal; a switch, a detent, and a releasing-magnet therefor, together with a supervisory signal, for each cord-circuit, and means controlled by a called subscriber to energize said releasing-magnet, whereby an answering operator may transfer a call over a trunk-line, and by the act signal the trunk operator, the trunk operator may by the act of completing the connection signal the answering operator, and the called subscriber in answering the call, may also signal the answering operator and at the same time restore the switch and signal mechanism to a normal position, substantially as described.

10. In a telephone-exchange system, divided switchboards, subscribers' lines terminating thereon, connecting cord-circuits therefor, and trunk-lines interconnecting the boards, each trunk-line having at its advance end a signal connected only when the line is not in use, and each cord-circuit having a switch, a detent and releasing device therefor, and a supervisory signal, all so arranged that when a transfer connection through a trunk-line is made the signals are brought into circuit with each other, and when the connection is completed the trunk-signal is removed, and the switch and supervisory signal are placed under control of the called subscriber, substantially as described.

11. In a telephone-exchange system, divided

switchboards located at the same or different points, subscribers' lines terminating thereon, connecting cord-circuits therefor, and trunk-lines interconnecting the boards; a supervisory signal and a switch together with a detent and releasing-magnet therefor, for each cord-circuit, and an advance signal normally connected to the forward end of the trunk-line, the connections being such that when the cord-switch is operated the supervisory signal, the advance signal and the releasing-magnet with a suitable source of current, are placed in series to allow the display of the signals without the energization of the magnet, means in each subscriber's line to maintain this condition after the completion of the connection and further means under control of the subscriber to permit the magnet to operate, substantially as described.

12. In a telephone-exchange system, a switchboard having an answering and a calling section, subscriber's-line terminals upon or within reach of each section, cord-circuits therefor, and a trunk-line interconnecting the sections, a switch in each cord-circuit normally maintaining the continuity thereof but adapted to sever the same when actuated and provided with a detent and releasing-magnet, a signal and a battery connection adapted to be completed to a severed portion of the circuit by the switch, an advance signal for the trunk-line energized by said battery when thus connected, and means under the control of a subscriber to energize the releasing-magnet when a call is answered, substantially as described.

13. In a telephone-exchange system, a central office, subscribers' lines terminating therein, connecting circuits therefor, means for severing the same when connections are initiated therethrough, and signals adapted to be thereby connected to the said severed circuits, substantially as described.

In testimony whereof we have hereunto set our hands in the presence of two witnesses.

EDWARD E. CLEMENT.  
WM. D. GHARKY.

Witnesses:

MORTIMER A. JONES,  
WALTER J. MULLANEY.