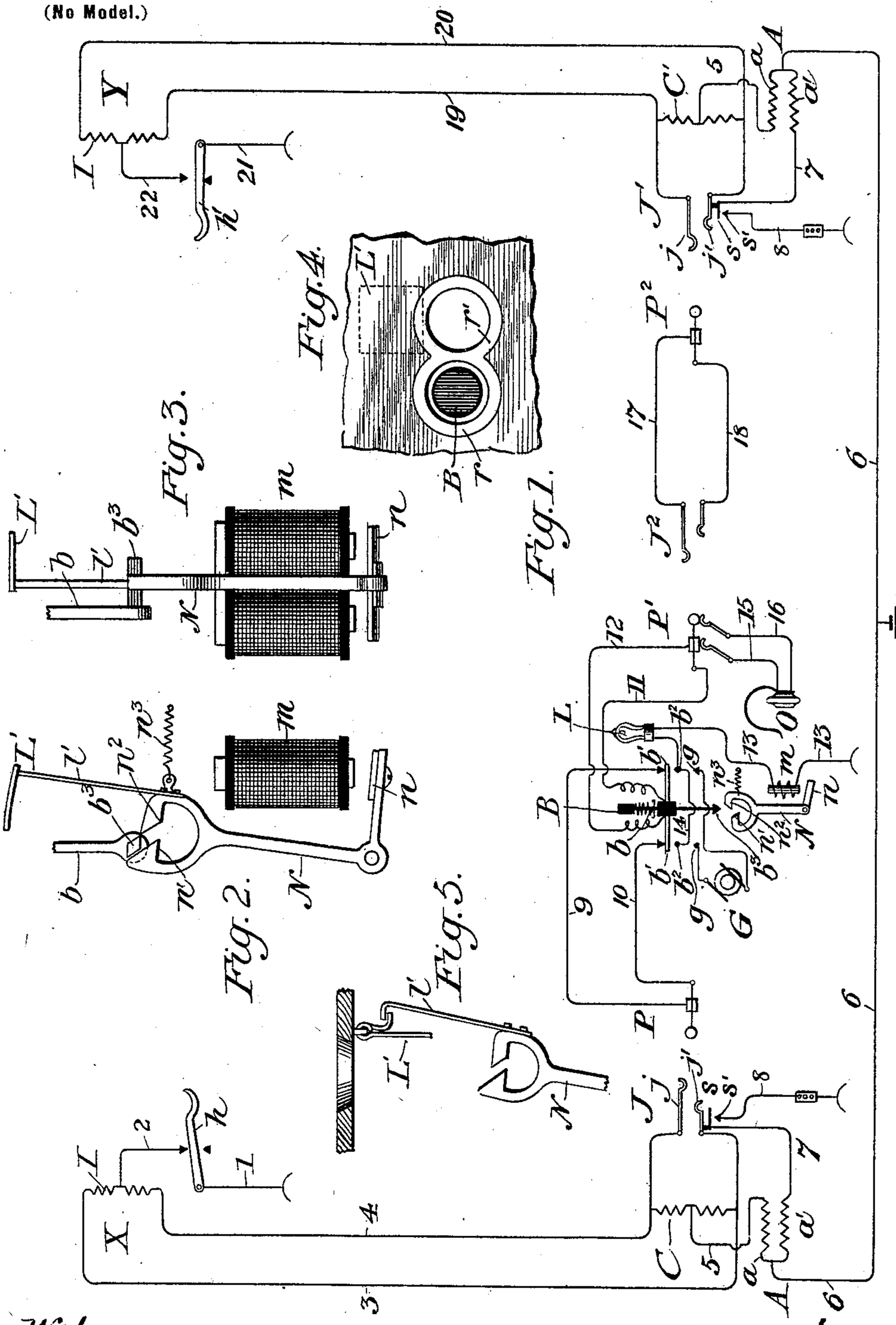
No. 646,679. Patented Apr. 3, 1900.

E. E. CLEMENT.

TELEPHONE EXCHANGE SYSTEM.

(Application filed Dec. 24, 1898.)

(No Model.)



Witnesses:
D. C. Edelin.
J. G. Moore

Inventor:
Edward E. Clement

UNITED STATES PATENT OFFICE.

EDWARD E. CLEMENT, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE SUN ELECTRIC MANUFACTURING COMPANY, OF NEW JERSEY.

TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 646,679, dated April 3, 1900.

Application filed December 24, 1898. Serial No. 700,193. (No model.)

To all whom it may concern:

Be it known that I, EDWARD E. CLEMENT, a citizen of the United States, residing in the city of Washington, District of Columbia, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a specification, reference being had to the accompanying drawings, forming a part of this application.

My invention relates to telephone-exchange systems in which automatic signals for the operators are employed, and particularly to such systems in which the subscribers are served upon different switchboards or board-sections interconnected by trunk-lines.

The invention is in the nature of an improvement on certain matters disclosed in the application of William D. Gharky, Serial No. 683,634, and in the joint applications of myself with said Gharky, Serial Nos. 689,119 and 689,120. In these prior systems it is arranged to sever or disconnect the cord-circuit of an answering or A operator when a connection has been initiated therethrough and to allow it to remain so disconnected until the call has been answered, when it is automatically reconnected. While the cord-circuit remains disconnected, certain signals are adapted to be placed under the control of the operators and subscribers which keep the operator who initiated the connection informed as to the progress of the same.

It is the object of my present invention to simplify and improve said signals and the devices for operating them, and particularly for connecting and disconnecting them. In order to attain this object, I provide for each cord-circuit of the answering or A operators a switch, a signal, and a magnet controlling a detent which is adapted to retain the switch in an operative position, to disconnect the parts of the cord-circuit as long as the advance-line connections are in a certain condition, and which will act to release the switch and reconnect the circuits when the condition changes.

My invention is fully illustrated in the accompanying drawings, in which the same letters refer to the same parts throughout.

Referring to the drawings, Figure 1 is a diagrammatic representation of my system as a whole. Figs. 2 and 3 are side and rear views, respectively, of the detent-escapement and the magnet controlling it. Fig. 4 is a top view, and Fig. 5 is a modification thereof.

Referring to Fig. 1, X and Y are two subscribers' stations. As the apparatus and the circuits thereat are in no wise a part of my invention, and as almost any common battery calling arrangement of the circuits would satisfy the requirement, I have shown only the barest diagram of the station outfit. This is represented at X as a hook-switch *h*, an induction-coil I, tapped from its middle point, and a normally-open ground connection. The transmitter and receiver may be of any desired form. From the station X line-wires 3 4 are taken to the central office, where they terminate in springs *j j'* of a spring-jack J. Outside of this spring-jack a coil C, of proper construction to offer great impedance to high-frequency currents, is bridged. From the middle point of the winding of this coil a wire 5 is led to one winding *a* of an annunciator A, the other winding *a'* of which is connected to a contact-spring *s*, which when a plug is inserted in the jack J is forced by spring *j'* against the anvil *s'*, completing the circuit 7 8 through resistance to ground. Both coils are connected by a common wire 6 to a main battery M and ground.

The arrangement at the station Y is the same as at X, and therefore needs no description, and in fact all the circuits so far referred to are substantially the same as those described in the prior applications referred to.

In the exchange work to which this invention is particularly applicable the operators are all divided into two sets, the answering and the calling, denominated, for convenience, the "A" and the "B" operators. Of these the A operators answer all calls, and if the subscriber wanted in any particular case is immediately at hand finish the connection. If, however, the subscriber wanted has his terminal on another section of the switchboard, the call is transferred, through a trunk-line, to the B operator at the desired board-section. The B operator is instructed by the A operator as to the number wanted and finishes the connection, but does not make the call—*i. e.*, she does not connect the ringing-

generator to line. This duty is performed by the A operator, and it must be apparent that this necessitates the provision of means whereby the A operator may know accurately when the B operator has finally inserted the calling-plug in the wanted jack. Then when the subscriber has answered it is necessary that the A operator should also know that, so that she will not again ring up.

I will describe my improvement in connection with a trunking-call only, because it will be understood that the same steps will be followed in making a plain cord connection.

Each A operator is provided with plugs and cords in pairs. These are designated in Fig. 1 by the letters P and P′ for the plugs and 9 10 and 11 12 for the cord conductors. Normally these last are serially connected, as shown in Fig. 1, through the cross-arms b' b' of the switch B. This switch has a spindle or plunger b, provided at its extremity with a detent or pallet b^3, adapted to coöperate with the escapement-teeth n' n^2 on the armature-lever N, controlled, through the armature n, by a magnet m, to be presently described.

The switch-plunger b has three positions. Its first or normal position is, as shown in the drawings, Fig. 1, connecting the cord conductors serially. Its second position connects the conductors 11 12 to the terminals b^2 b^2, which, joined by a wire 14, are connected to the lamp L and the magnet m in series through the wire 13 to ground. At the same time it will be noticed the through-circuit of the cord is broken. The third position of the plunger carries the arms b' b' past the terminals b^2 b^2 and causes them to make contact with the terminals g of the circuit of a calling-generator G.

The plunger b is supposed to be depressed by the A operator after she has connected the calling-plug with a line, either a subscriber's line or a trunk-line. It may be depressed, as shown, by a simple push-button, or it may have a lever or cam. It is so arranged in any case, however, that when depressed the detent passes into engagement with escapement-teeth, and when pressure is removed from the push as the plunger tends to rise under the influence of a suitable spring it catches beneath the tooth n', (shown in Fig. 2 as ready for such service,) being held so normally by a retractile spring n^3. This engagement retains the plunger in its second position, with the cord-circuit broken and the signal L and magnet m connected. When the magnet m is energized, the escapement or armature lever N is thrown suddenly over, and the detent b^3 is immediately caught under the other tooth n^2, and when the magnet becomes again deënergized it is released, as is obvious from the construction.

The calling-plug P′ normally rests in a seat provided with contact-springs, which coöperate with rings on the plug to connect the operator's set O to the circuit. This construction may be replaced, however, by any other which will not interfere with the functions of the switch B. The plug P′ coöperates with a jack J^2 of a trunk-line 17 18, leading to a terminal plug P^2 before a B operator. The advance signals and the instruction-circuit for this operator are not shown, as they are not necessary to an understanding of the invention.

I will now describe the operation of my system, proceeding upon the assumption that the subscriber X has called and desires connection with the subscriber Y.

When the subscriber X removes his receiver from the hook h, a circuit is completed from the main battery through the line-wires and the winding a of annunciator A to ground. The A operator upon perceiving the consequent display of the signal inserts plug P in jack J and receives the number wanted. If the number is of a line on her own board, she completes the connection and rings out at once; but if, as we have assumed, it is on the other board she inserts the plug P′ in the trunk-jack J^2 and depresses plunger b, at the same time informing the B operator over her instruction-circuit what number is desired. She can do no more until the B operator shall have finished the connection. The condition of things is then this: the through-circuit broken, the arms b' b' resting on the contacts b^2 b^2, and the magnet m and lamp L in series with each other connected in an incomplete circuit from ground through wire 13 and conductors 11 12 and the trunk-conductors 17 18 in parallel to plug P^2. The A operator watches the lamp L, and as soon as the B operator has completed the connection by inserting the plug P^2 in jack J′ she sees it glow, the circuit then being closed from main battery M, through wire 6, annunciator-winding a, coil C both ways, jack J′ and plug P^2, trunk and cord conductors, lamp L, magnet m, and by wire 13 to ground. The lamp glows and in addition the magnet m is energized and pulls the armature-lever N over until the pallet b^3 is engaged by the tooth n^2 of the escapement. The annunciator of the called line is not displayed by this current, because at the same time that current flows through the winding a it is admitted to coil a' by reason of the spring s and contact s' being forced together. Upon perceiving the lamp L glowing, the A operator again depresses plunger b to its full extent, thus momentarily disconnecting the signal L and magnet m and connecting the generator G to the forward portion of the cord 11 12, and therefore to the called line. She then withdraws her hand and the lamp again glows. When the subscriber at Y answers the call, he closes the ground-tap 21 22, affording a low-resistance path for current through the line-wires 19 20 from the main battery in shunt of the supervisory-signal circuit. If the generator is of low internal resistance and the current-flow therefore sufficient in volume to affect the lamp and mag-

net even when shunted, suitable means, such as a resistance, must be provided in each line-wire 6 to limit the flow, so as to secure the proper result—that is, to deënergize the magnet m, which is at no time allowed by the resistance of the lamp L to receive more than just enough current to energize it sufficiently to pull over the lever N. The work done is small, being largely that incident to overcoming the friction of the parts and the strength of the spring n^3. As the magnet is deënergized the lever N is drawn over to its normal position by the spring, and the plunger b thus released is retracted, restoring the continuity of the through-circuits and cutting out the lamp L and the magnet m. When the A operator perceives the lamp to cease glowing, she knows that the call has been answered and calls no more.

Although I have described my system throughout as including the lamp L, it is not necessary that such a lamp or, indeed, any signal additional to the armature of the magnet m should be provided. In Figs. 2 to 5, inclusive, I have shown forms of a mechanical signal to be actuated or carried directly by the armature of the magnet. Referring to Fig. 2, N is the armature-lever, carrying the escapement-teeth n' n^2. Upon the side of the tooth n^2 I mount an upwardly-extending arm l', carrying at its upper extremity a target L'. This target extends to one side, instead of centrally over the arm, as shown in Fig. 3, and on the switchboard-table I provide a double ring r r', through one half of which the push-button B of the plunger-switch protrudes, while beneath the other half and visible through its orifice the target L' is adapted to move. Inasmuch as the lamp L serves no other end than to indicate the position of the armature N, and consequently the condition of the circuit, obviously the movement of said armature itself, being thus made visible through the target L', is a much better indication. In Fig. 5 I have shown the target L' as hinged to the under side of the switchboard-table, while the arm l' is adapted to push it up into view when the armature is attracted. In any case when the subscriber answers and the armature falls back the target disappears, its appearance and disappearance thus corresponding perfectly to the lighting and going out of the lamp L. This mechanical signal will preferably be used except in special cases in practice; but throughout the foregoing description the lamp was included, because it rendered the matter more susceptible of elucidation. I do not wish to be understood as confining myself, however, either to a lamp or mechanical signal.

I am aware that this invention can be used with other systems than the one shown, and changes can be made without affecting the identity of the invention. Consequently I do not limit myself to the specific embodiment thereof shown and described; but

What I claim, and desire to secure by Letters Patent, is—

1. In a telephone-exchange system, a central office, subscribers' lines terminating therein, connective circuits therefor, a supervisory signal and a switch for each connective circuit, the latter adapted to be actuated manually to connect the former to its connective circuit and to be restored by a sequence of changes in the circuit, means for producing one such change when the connective circuit is joined to a subscriber's line, and means under the control of the subscriber to effect the further necessary change or changes, substantially as described.

2. In a telephone-exchange system, a central office, subscribers' lines terminating therein, connective circuits therefor, a supervisory signal and a continuity-switch for each connective circuit, the latter adapted to be actuated by an operator to sever the connective circuit and connect the supervisory signal to a severed portion thereof, and to be restored by a sequence of changes in the circuit, means for producing one or more such changes by the act of connecting the circuit to a subscriber's line, and means under the control of the subscriber to effect the further necessary change or changes, substantially as described.

3. In a telephone-exchange system a central station and subscribers' lines terminating therein, connective circuits therefor, continuity-switches and supervisory signals for the connective circuits, said switches adapted to be actuated by the operators to sever the circuits and connect the signals to the severed portions, and to be restored by a sequence of current changes in the circuits, a source of current connected to the lines, and means whereby the current from said source is shifted through the connective circuits and through the lines successively when connections are completed and when the calls are answered, substantially as described.

4. In a telephone-exchange system a central office, subscribers' lines terminating therein, connective circuits therefor, a switch for each connective circuit, a two-stop magnetically-controlled detent for the switch, and a supervisory signal, all so arranged that when the switch is actuated by an operator it connects the signal and the magnet of the detent to the connective circuit; a source of current connected to the lines, and means whereby the act of the operator in making connection with any line and the act of the subscriber in answering successively shift the current through the connective circuit and the line to cause the detent to release the switch, substantially as described.

5. In a telephone-exchange system a central office, subscribers' lines terminating therein, connective circuits therefor, a switch for each connective circuit, a two-stop magnetically-controlled detent for the switch, a signal-target in position to be actuated by said detent in its movement; the whole so arranged that

when the switch is actuated by an operator it connects the magnet of the detent to the connective circuit; a series of current connected to the lines and means whereby the act of the operator in making connections with any line and the subsequent act of the subscriber in answering successively shift the current through the connective circuit and the line to operate the detent and display its signal, substantially as described.

In testimony whereof I have hereunto set my hand this 21st day of December, 1898.

EDWARD E. CLEMENT.

Witnesses:

CLAYTON MCELROY,

CHAS. W. CHURCHMAN.