E. E. CLEMENT.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED JAN. 28, 1905.

1,027,239. **Patented May 21, 1912.**

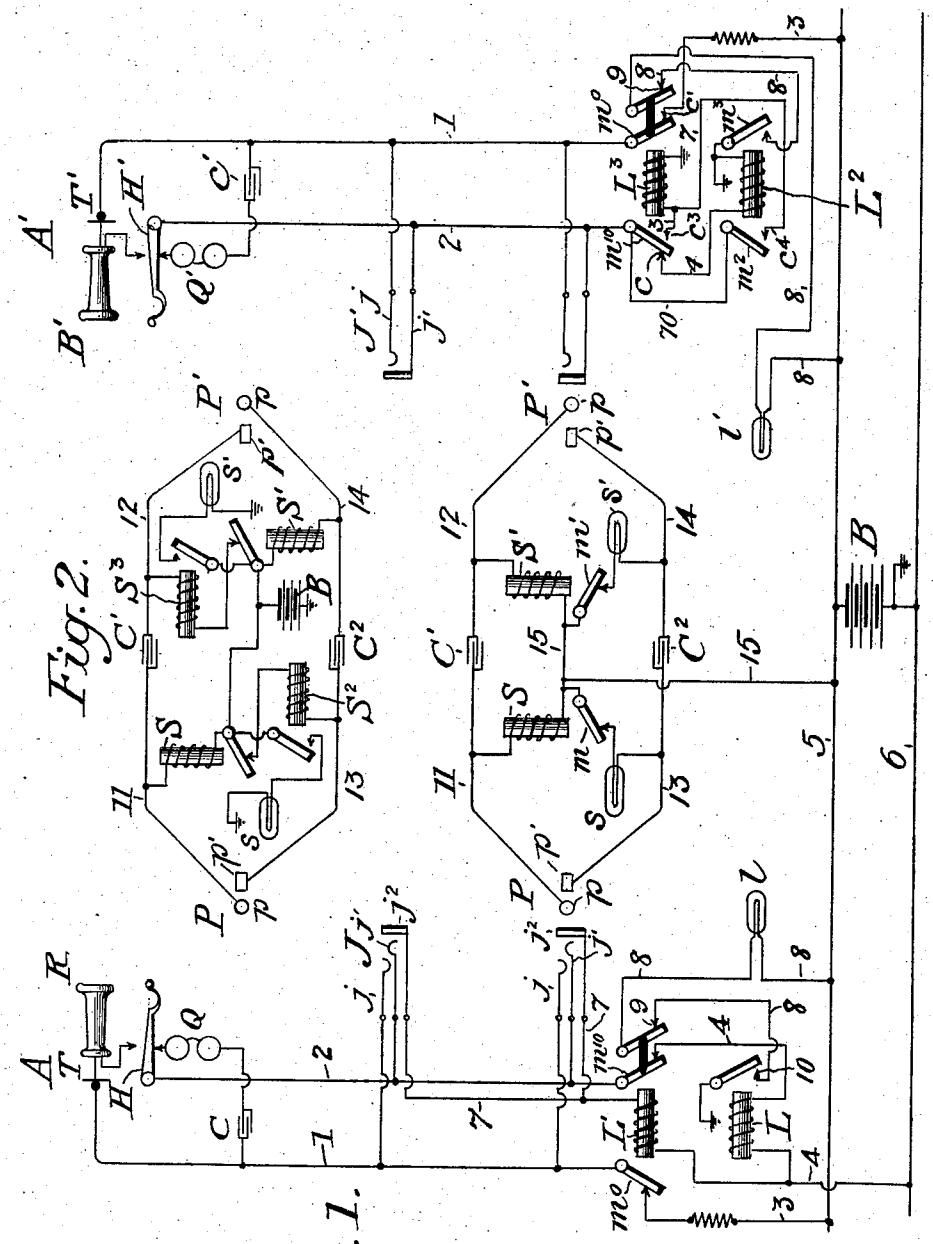

Fig. 1.

Fig. 2.

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TELEPHONE-EXCHANGE SYSTEM.

1,027,239. Specification of Letters Patent. Patented May 21, 1912.

Application filed January 28, 1905. Serial No. 243,114.

To all whom it may concern:

Be it known that I, EDWARD E. CLEMENT, a citizen of the United States, residing at Washington, in the 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 therein to the accompanying drawing.

My invention relates to telephone exchange systems, and has for its object the production of a common battery system, in which either two-wire or three-wire line circuits may be employed, together with two conductor cord-circuits.

A portion of the invention relates to the line circuits specifically, but the cord-circuit may be employed to tie together different line circuits, and may be arranged so as to operate successfully in connection with a number of recognized standard circuits.

In many cases heretofore, the common battery at central has been connected in a bridge across each cord circuit, and local circuits for lamp or other signals have been controlled by relays responding to the current flow in the battery bridge. In order to keep these local circuits and the relay circuits from becoming confused, numerous expedients have been resorted to, one being to provide joint control by means of two or more relays themselves in different circuits, and another being to locate the local signals in circuits closed through third conductors in the respective cords, the continuity whereof might be controlled by the connective plugs and jacks. In the present case I dispense with the third conductor, provide for a feed through the supervisory relays in the cords to the respective lines they connect, and for a return for the lines to the battery through their respective cut-off relays, the current so passing serving the double purpose of supplying the subscribers' transmitters and of working the signals while the cut-off and supervisory relays serve the double purpose of controlling the signals and of choking out voice currents from the battery connections.

The local circuits of my supervisory lamps, I control as to their normal continuity, by forming them in part of the talking strands of the cord-conductor terminating in the respective plug contacts. When a plug is first inserted, its lamp comes momentarily into circuit with its corresponding cut-off relay, insuring the operation of the latter, but being cut off itself while the lines are in use, thus leaving a clear talking circuit with no bridges of the cord.

My invention is illustrated in the accompanying drawings, wherein—

Figure 1 is a diagram showing two subscribers' lines, one with a three-wire jack circuit, and the other with a two-wire circuit, together with my improved cord-circuits. Fig. 2 shows a modified cord-circuit.

Referring to Fig. 1, A and A′ are subscribers' stations, equipped with apparatus usual in common battery exchange systems. From each station line-wires 1 and 2 lead to central office, terminating in the springs j, j' of the jacks J and J′ of the switchboard. Beyond the jacks each line has extensions. From the jacks J the lines 1 and 2 are extended to the armatures m^{9}, m^{10} of the cut-off relay L′, and on one side to the line or signal relay L; also by the wires 3 and 4 to the battery bus-bars 5 and 6, of main battery B, which is grounded. The line or signal relay L controls the local circuit 8 of the signal lamp l through the front contacts of relay L and back contacts of cut-off relay L′. The cut-off relay L′ is connected by a wire 7 to the ring j^{2} of jack J and by the wire 4 to bus-bar 6 of battery B. From the jacks J′ the line-wires 1 and 2 are extended to the armatures m^{9}, m^{10}, of cut-off relay L^{3}; from the contact c wire 4 goes to the line or signal relay L^{2} and ground; while from contact c' wire 3 goes to the bus-bar 5 of battery B.

The line or signal relay L^{2} controls the local circuit 8 of signal lamp l' through the front contacts of relay L^{2} and back contacts of cut-off relay L^{3}. The windings of cut-off relay L^{3} are connected by the wires 3 and 7 to the contacts c^{3} and c^{4} and through the earth to bus-bar 6 of battery B. The armature m^{10} of cut-off relay L^{3} is connected by the wire 70 to the armature m^{2} of line-relay L^{2}.

The cord-circuit in Fig. 1 consists of the following: An answering plug P, with a tip p and sleeve p' connected respectively with the wires 11 and 13; the calling plug P′ with a tip p and sleeve p' connected respectively with the wires 12 and 14. Condensers C′ and C^{2} are inserted in the wires 11, 12, and 13, 14, respectively, which separate the answering plug P from the calling plug P′,

so as to permit of double supervision. From the tip wires 11 and 12, respectively, the windings of the supervisory relays S and S′ are connected by the wire 15 to bus-bar 5 of battery B. From the sleeve wires 13 and 14, respectively, the supervisory lamps *s*, *s′* are connected by contacts in the relays S, S′, and by the wire 15 to bus-bar 5 of battery B.

In Fig. 2, an arrangement is shown whereby the bridging of one condenser in the cord-circuit by the two supervisory relays, as in Fig. 1, is avoided. The tip *p* of the answering plug P is connected by wire 11 to condenser C′ and then by the wire 12 to the sleeve *p′* of the calling plug P′. The sleeve *p′* of the answering plug P is connected by the wire 13 to condenser C^2 and then by the wire 14 to tip *p* of the calling plug P′. Supervisory relays S, S′ are connected to the wires 11 and 14, respectively. Supervisory lamps *s*, *s′* are controlled by relays S^2 and S^3, themselves connected to the wires 12 and 13, respectively, and controlled by relays S and S′. It will readily be seen that the operation of this circuit will be the same as in Fig. 1, and the bridging of any one of the condensers in the cord-circuit is avoided.

The operation of my system is as follows: The parts are normally in the position shown in the drawing. Supposing subscriber A calls central, he closes the line-circuit 1 and 2 and current flows from the main battery B through the winding of line-relay L, which attracts its armature and closes the circuit 8, which causes the lamp *l* to glow. The operator seeing the signal inserts the answering plug P into the jack J and asks in the regular way for the number wanted. Upon the insertion of the plug P the sleeve *p′* connects the spring *j′* with the ring j^2 of the jack J, which places the cut-off relay L′ and supervisory relay S in series with one another with battery in parallel with the line relay L. The cut-off relay L′ thereupon attracts its armatures m^9, m^{10}, which disconnect the line-relay L and extinguish the line lamp *l*. The supervisory relay S also attracts its armature and cuts off the supervisory lamp *s*. Battery current is then supplied to the subscriber through the tip by the supervisory relay S and through the sleeve by the cut-off relay L′. The operator finding that subscriber A′ is wanted, inserts the calling plug P′ in the jack J′ and rings in the ordinary manner. The insertion of the plug P′ into the jack J′ causes battery current to flow through the supervisory lamp *s′* through the windings of the line relay L^2 to ground. The armatures m^2, m^3 are then attracted. Armature m^2 connects the cut-off relay through the contact c^4 of the line-relay L^2 and by the wire 7. The cut-off relay L^3 then attracts its armature and cuts off the line relay L^2 and is kept locked by battery current flowing through the supervisory lamp *s′* through the contact c^3 and the armature m^{10}. The cut-off relay L^3 is wound so that enough current is passed to allow the lamp *s′* to glow. Battery current is then supplied to subscriber A′ through the tip by the supervisory relay S′ and through the sleeve by the cut-off relay L^3. When the subscriber A′ answers he closes the line-circuit 1 and 2 which causes battery current to flow through the supervisory relay and attracts its armature and extinguishes the lamp *s′*. When the subscribers A, A′ hang up their telephones at the end of the conversation, the armatures of the supervisory relays S and S′ fall back and cause their respective lamps *s*, *s′* to glow. The operator upon seeing these signals withdraws the plugs from the line jacks J, J′, and the apparatus assumes its normal position and condition. By way of reversing these conditions, suppose subscriber A′ calls for subscriber A. In calling, the line-circuit is closed and current flows from main battery B by the back contacts of the cut-off relay L^3 through the winding of line relay L^2, which attracts its armatures m^2 and m^3. The attraction of the armatures closes circuit 8 and causes the line lamp *l′* to glow and at the same time completes the circuit of the cut-off relay L^3 through the contact c^4. This cut-off relay is sluggish in its action and the amount of current derived from the subscriber's line with the line relay L^2 in parallel will not attract its armatures. The operator perceiving the line signal inserts the answering plug P into the line jack J′. This insertion causes an extra amount of current to flow over the sleeve from the supervisory lamp *s* through the cut-off relay L^3 which then attracts its armatures m^9, m^{10} and cuts off the line-relay L^2 and extinguishes the line lamp *l′*. Battery current is supplied to subscriber as in the first operation over the tip from the supervisory relay S and over the sleeve from the cut-off relay L^3. As subscriber A is wanted the operator inserts the calling plug P′ into the jack J. This insertion causes current to pass through the supervisory lamp *s′*, through the winding of cut-off relay L′, which then attracts its armatures and cuts off the line relay L. This cut-off relay is wound so that it passes enough current to make the supervisory lamp *s′* glow. Battery current is supplied to subscriber A as in the first operation; through the tip supervisory relay S′ and through the sleeve by the cut-off relay L′. The subscriber A upon answering causes current to flow through the supervisory relay S′, which attracts its armature and extinguishes supervisory lamp *s′*. At the end of the conversation the operator getting the disconnect signals when the subscribers hang up their

telephones, withdraws the plugs and the apparatus is restored to its normal position.

Referring to Fig. 2, I show a modification of the cord circuit in which a relay S^2 or S^3 is substituted for the lamp in the cord circuit bridge, the lamp itself being in a separate branch to ground closed when the relay S^2 or S^3 is energized. Since the supervisory relay S or S′ is simultaneously energized however, the lamp is always open circuited when the cord is in use and conversation is proceeding.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

In a telephone exchange system, line circuits, a line relay and a cut-off relay for each line, each line terminating on a pair of contacts in its cut-off relay, one of which is normally connected through a coöperating contact with one side of main battery, and the other through a corresponding coöperating contact with the windings of the line relay and thence to the other side of battery, a signal lamp having its circuit extended from one side of battery through normally closed contacts on the cut-off relay and normally open contacts on the associated line relay to the other side of battery, a jack for each line having three contacts, one connected to each side of line direct and the third to the cut-off relay and thence to one side of battery, a link circuit for interconnecting the lines having terminal plugs each provided with tip and sleeve contacts, the latter of sufficient length to bridge together the contacts connected to one side of line and to the cut-off relay respectively, a supervisory relay in the link having its circuit extended from one side of battery to the tip conductor, a lamp controlling relay having its circuit extending from battery through normally closed contacts in the supervisory relay to the sleeve conductor, and a supervisory signal lamp having its circuit extended from the battery through normally open contacts in the controlling relay to the other side of the battery, whereby when a subscriber calls, current will flow in his line through the line relay only, and when a plug is inserted, current will flow to the line through the cut-off relay only on one side and through the supervisory relay in the link on the other, the line relay, the line signal lamp, the controlling relay in the link, and the supervisory lamp in the link being all disconnected and deprived of current during conversation.

In testimony whereof I have affixed my signature in presence of two witnesses.

EDWARD E. CLEMENT.

Witnesses:

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MELVILLE D. CHURCH.