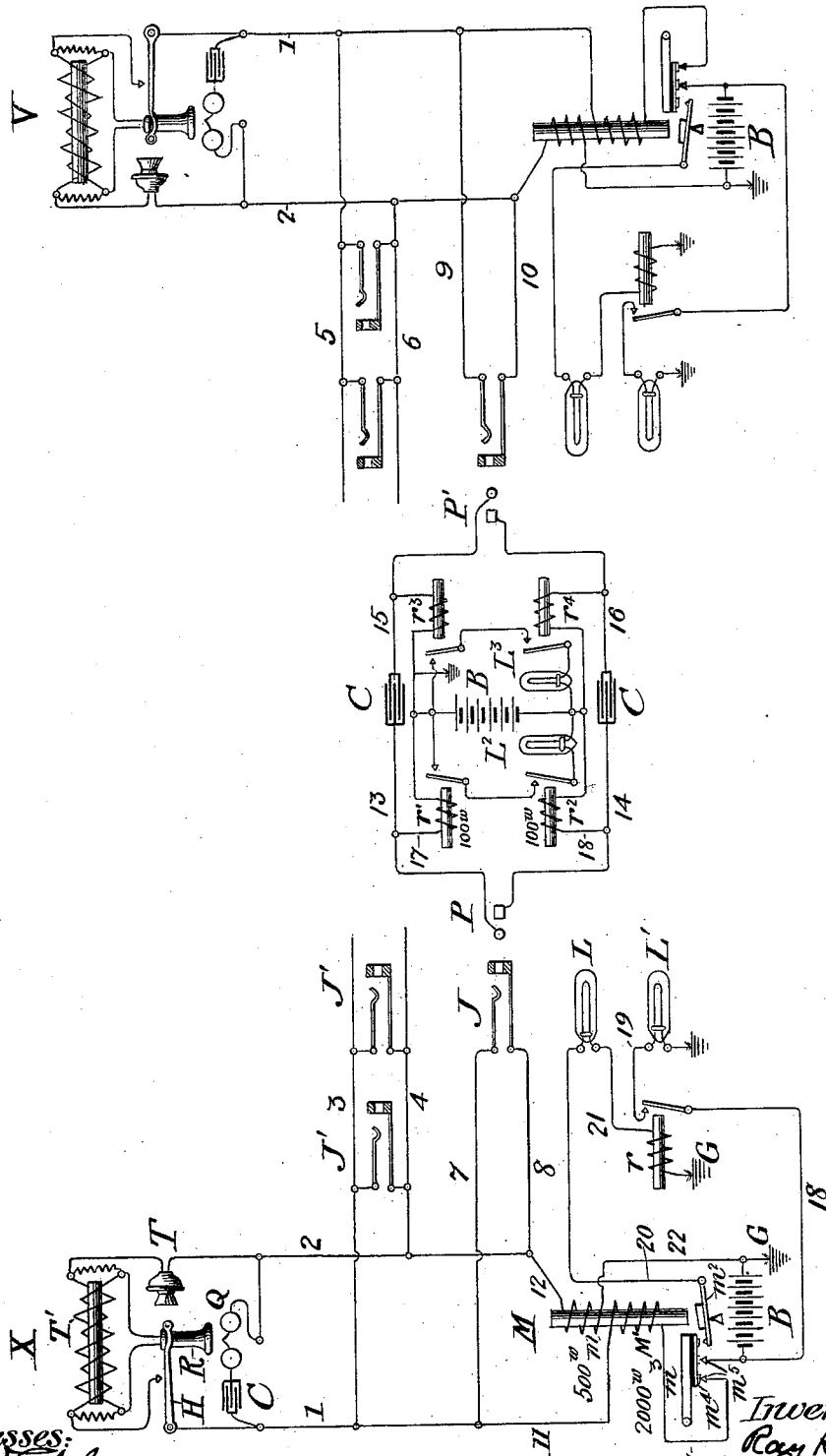


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TELEPHONE EXCHANGE SYSTEM AND APPARATUS,
APPLICATION FILED NOV. 15, 1904.

937,832.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM AND APPARATUS.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, RAY H. MANSON, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone-Exchange Systems and Apparatus, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to telephone exchange systems, and particularly those employing a centralized or common battery for signaling purposes.

It has for its object the simplification and improvement of the signal apparatus, and particularly the line signal and cut off mechanism, as operated in connection with cord circuits or their equivalent.

In most common battery systems heretofore designed a cut-off relay is employed for each line at the central office, which is normally inactive, but becomes active when the operator answers a call and removes the line relay, or its signal device, from operative connection with the line. In such systems each line requires a line relay and a cut-off relay therefor, the former connected to the line and the latter connected in some way to the jack terminals. It has been sought to reduce the number of the jack terminals for the reason that in large exchanges space upon the switchboard is at a high premium, and consequently the jacks must be made small. A multiplicity of contacts, or of connections, is therefore extremely undesirable, not to mention the matter of size of cables and the complication in other parts of the wiring than those immediately connected with the jacks. Two-wire systems have been devised, in which the line and cut-off relays are both operated over portions of the talking circuit; but in all such cases, so far as I know, the complication in wiring and the number of conductors in the signaling circuits has been quite as great as if more than two contacts and connections were employed to each jack.

It is the object of my present invention particularly to reduce the wiring and connections to the simplest form, and to this end I have devised a relay which combines within itself the operative parts, and performs thereby all the functions, of both the line and cut-off relays referred to.

Other objects of my invention will appear from the detailed description which follows.

The invention is fully illustrated in the accompanying drawing, wherein the figure is a diagram of a telephone system, showing two subscribers' lines and the central station connective apparatus therefor.

In the diagram, X and V are two subscribers' stations, each connected to the central office by line wires 1 and 2, and each provided with the usual sub-station apparatus, comprising the transmitter T, the receiver R, the balancing coil T', and the signal receiving bridge containing a condenser C, and the ringer Q. As long as the receiver is on the hook H, and the latter is down, the circuit is open through the talking set, and as direct current cannot pass the condenser, the line is open so far as the line signals are concerned.

At the central station the line wires 1 and 2 are carried by multiple connections 3 and 4 to the multiple jacks J', and by branches 7, 8 to the answering jacks J, one for each line. These are the designating numerals for the line from station X. For the line from station V, I have employed the numerals 5, 6 and 9, 10 for the branches, merely as a matter of convenience in tracing circuits, the arrangement being precisely the same for all the lines. It will be observed that only two wires are used throughout, all connections being in parallel, and the jacks, whether answering or multiple, having only two contacts each.

Connected to the line wires by branches 11, 12, are the relay M and the main battery B. The relay has two windings m , m' , the former say of 500 ohms resistance, and the latter say, of 2,000 ohms resistance. The 500 ohm coil is connected by branch 12 to the number 2, or sleeve side of line, while the 2,000 ohm winding is connected by branch 11 to the number 1 or tip side of line. Both windings are then connected by wires 22 and 17, respectively, to the battery B, which is grounded on one side at G, and is thus connected between the windings to line.

The relay M is provided with an armature m^2 , carrying or controlling a terminal contact which, when the armature is attracted, touches a contact on the insulated plate m^4 carried upon a heavy pivoted block m^3 . The closing together of these contacts com-

pletes a local circuit from the battery through wires 20 and 21 to the line lamp L, thence to the pilot relay r , and through the ground back to battery. The pilot relay controls a pilot lamp L' in the extension circuit 18, 19.

It is to be understood that for merely closing a lamp circuit 20, 21, the armature m^2 is not attracted with sufficient force to lift the block m^3 off the contacts m^5 upon which it normally rests, the strip m^4 thus serving not merely to complete the battery circuit through the armature to the lamp L, but also to complete the branch 11, 17, including the winding m' of the relay.

For interconnecting the subscribers' lines, I have shown a cord circuit with terminal plugs P, P', adapted to cooperate with the jacks J, J'. The cord conductors 13, 15 and 14, 16 are divided by condensers C, and the main battery B is bridged across both sides of the cord through the supervisory relay r' , r^2 , and r^3 , r^4 . Each of these relays is wound to a resistance of approximately 100 ohms, and each pair controls the circuit at one of the supervisory lamps. Thus, when a plug is inserted in the jack, as P into J, the sleeve side of the circuit is closed from ground to ground through the branch 12 and the relay r^2 , this being a purely local circuit, and the relay r^2 then closing its contacts, and leaving them closed as long as the plug is in the jack. The relay r' on the other hand is on the dry side of battery, and is controlled over the line through the tip wire 7. It therefore controls the lamp on its back stroke. The result of the joint action of these relays is that the lamp is never lighted except when a connected subscriber has hung up his telephone. The lamp L³ is controlled by relays r^3 , r^4 in the same manner.

The operation of the system thus described is as follows: The 2,000 ohm winding of relay M is to line, and is made so that it will pull up the armature m^2 and light the line lamp L when a good ground exists on the tip side of the line, but, as stated, this movement will not be of sufficient strength to lift the block m^3 from the contact m^5 . When a subscriber calls therefore, the magnet M is energized by current flowing from the main battery B out over the line and back through the 2,000 ohm winding m' , attracts the armature m^2 , and closes the lamp circuit. The operator receiving the signal inserts the answering plug P into the answering jack J, and inquires the number wanted. As soon as the plug is inserted, battery current flows through the 100 ohm sleeve relay r^2 , through the 500 ohm winding m in sufficient quantity to energize the magnet strongly, so that it attracts its armature m^2 with sufficient force to lift the heavy block m^3 . As soon as this block is lifted,

however, and the plate m^4 has left the contacts m^5 , the 2,000 ohm winding m' is cut off from the line, and the circuit 20, 21 of the lamp signal L is opened, and the lamp is extinguished. This condition continues throughout the connection, but as soon as the plugs are removed from the jacks in clearing out, the armature m^2 falls and the parts are again in position to receive calls over the line.

It will be observed that while I employ a portion of the talking circuit for the control of the line and supervisory signals, in reality the cut-off circuit (which is also the controlling circuit of the supervisory relay r^2) is a purely local circuit, the sleeve side of line being used merely for convenience as a common return for signaling and talking.

It should perhaps go without saying that the weight m^3 is not an indispensable feature of the invention. I have shown a relay M with its magnet vertical, and its armature restored by gravity for two reasons, first, because it is convenient for illustration, and second, because a weight is more dependable than a spring. I wish it understood, however, that I may substitute a spring and may change the position of the relay without departing from the spirit of my invention. Many other changes may be made in matters of detail, both of apparatus and the circuits without departing from this spirit, and all such changes I consider as within the scope and purview of my invention.

The windings of the relay M are shown differential in action so as to reduce the magnetic pull on the armature m^3 , so that it will not be sufficient to lift the heavy weight m^4 . In other words, this increases the margin between the action of the line signal portion of the relay and the cut-off portion. By arranging the resistances and number of turns in the windings m and m' so as to get this same margin of operation, it is possible to make other arrangements of the windings. The principle of the relay, however, is to operate the line signal armature through the line resistance and the high winding of the relay and to operate the cut-off portions of the relay through the low resistance path of the local exchange line circuit and the low windings of the relay, and I do not wish to be limited therefore to any specific manner of winding.

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

1. In a telephone exchange system, a sub-station and a central station and a metallic line circuit interconnecting them, a source of current and means at the sub-station to determine the flow therefrom over the line, a signal magnet for the line having a low resistance winding and a high resistance winding, interposed in opposite sides of the line,

normally closed cut-off contacts controlling the line connection through the windings, normally open contacts controlling a local signal circuit, an armature for the magnet adapted to close said normally open contacts and thereafter to open said normally closed contacts, connection terminals for the line, and means controlled in the use of said terminals to close a local circuit through the low resistance winding of the magnet, whereby the current flowing serially through the magnet windings when the sub-station is calling will cause the attraction of the armature to close the signal circuit contacts only, and when connection is made with the line the armature will further move to open the normally closed contacts to break the line connection through the magnet, substantially as described.

2. In a telephone exchange system, the combined signal and cut-off magnet having line and local windings, a set of cut-off contacts for the line windings normally maintained closed by a body acting under pressure, local circuit signal contacts jointly controlled by the armature and said body, means to direct current through said line winding to cause the attraction of the armature against the said body to close the local signal circuit, and further means to direct current through the local winding to cause the armature to move said body and to thereby open the line winding connections, substantially as described.

3. In a telephone exchange system, a metallic line circuit and the combined signal and cut-off magnet therefor having line and local windings, together with cut-off contacts in the line winding branch normally maintained closed by a weighted lever, and an armature adapted to move two steps, the first step to close against said lever or a contact thereon and thereby to complete a signal circuit, the second step to lift the lever and separate the cut-off contacts, said steps being produced respectively by current in the line and cut-off windings, substantially as described.

4. In a telephone exchange system, the combined signal and cut-off magnet having two windings, one in each line limb, local signal contacts controlled by said magnet, means to direct current through said windings to cause the energization of said magnet to close the local signal circuit through said contacts, and further means to direct current through one of said windings to open said local signal circuit.

5. In a telephone exchange system, a metallic line circuit and the combined signal and cut-off magnet therefor having line and

local windings, together with cut-off contacts in the line winding branch normally maintained closed, and an armature adapted to move two steps, the first step to close a contact thereon and thereby to complete a signal circuit, the second step operating through the contact thus closed to separate the cut-off contacts, said steps being produced respectively by current in the line and cut-off windings.

6. In a telephone exchange system, a metallic line circuit and the combined signal and cut-off magnet therefor having line and local windings and an armature adapted to move two steps, the first step to close a contact thereon and thereby to complete a signal circuit, the second step operating mechanically through the contact thus closed to open the line winding circuit, said steps being produced respectively by current in the line and cut-off windings.

7. In a telephone exchange system, the combined signal and cut-off magnet having line and local windings, one in each line limb, local signal contacts controlled by said magnet, means to direct current through said line and local windings to cause the energization of said magnet to close the local signal circuit through said contacts, and further means to direct current through the local winding to open the line winding circuit.

8. In a telephone exchange system, a metallic line circuit and the combined signal and cut-off magnet therefor having line and local windings, together with cut-off contacts in the line winding branch normally maintained closed, and an armature adapted to move two steps, the first step to close a contact thereon and thereby to complete a signal circuit, the second step operating mechanically through the contact thus closed to open the signal circuit.

9. In a telephone exchange system, a metallic line circuit and the combined signal and cut-off magnet therefor having line and local windings, together with cut-off contacts in the line winding branch normally maintained closed, and an armature adapted to move two steps, the first step to close a contact thereon and thereby to complete a signal circuit, the second step operating mechanically through the contact thus closed to mechanically open the signal circuit.

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

RAY H. MANSON.

Witnesses:

WM. W. DEAN,
A. D. T. LIBBY.