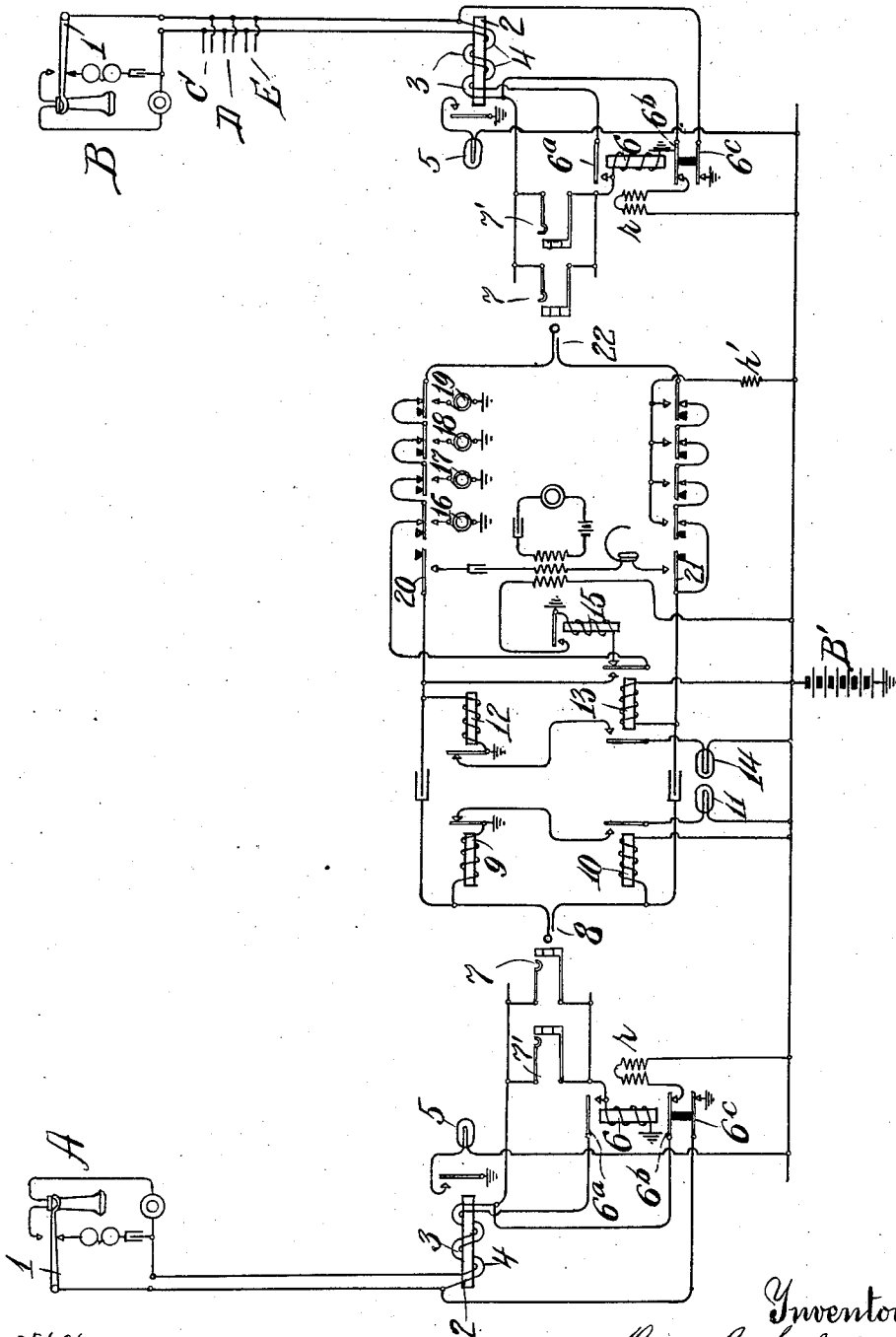


H. G. WEBSTER.
TELEPHONE EXCHANGE SYSTEM.
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Patented Apr. 16, 1912.



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TELEPHONE-EXCHANGE SYSTEM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification.

My invention has to do with means for controlling the operative condition of the line relay of a telephone line, the said relay being normally operable by current over a line and being thereafter rendered unoperated by a second relay also associated with the line.

In accordance with my invention, I provide the line relay with differentially connected windings, one winding being placed in series with each limb of the line. I provide a low resistance path which normally excludes one of the said windings so that when current is caused to flow in the line, the other winding will receive an effective current flow causing the magnetization of the relay core and the operation of its switch contacts. When the second relay referred to is actuated, it includes in circuit the winding which is normally excluded and current will then flow through the two differential windings of the line relay and a neutralizing effect will be produced upon the core thereof which will permit the switch mechanism of the relay to return to its normal position.

In the figure, I have illustrated diagrammatically telephone system circuits embodying my invention including two telephone lines extending from substations to an exchange and a single operator's cord-circuit adapted to be employed in connection with them.

The line extending to substation A is a single party-line, while that extending to substation B is adapted for party-line service, the taps to three other subscribers' stations C, D and E being indicated. The line circuit arrangements of the two lines are alike and a description of that of the line of substation A will suffice for both. A line signal 5 and an answering jack 7 is provided for the line and also multiple jacks 7' of which one only is indicated. For effecting the display of line signal 5, the line relay 2 is provided, being operable responsive to the establishment of a conductive bridge of the line limbs at substation

A which will be effected in the usual manner by the removal of the receiver from hook lever 1. The windings 3—4 of line relay 2 are differential windings whereof the winding 4 is excluded from circuit by a connection extending to ground through the normal contact of armature 6^c of the signal effacing or cut-off relay 6. The winding 3 is normally connected to the tip contacts of the spring-jacks and through the normal contact of armature 6^b and the protective resistance *r* to the active side of battery B. Thus, when the calling subscriber A removes his receiver, a circuit will be completed from battery B through contact 6^b, winding 3, over one line limb, through raised hook-lever 1, returning over the other line limb and through contact 6^c to the return side of battery. At this time the winding 4 is on open circuit at 6^a and has no effect upon the core of relay 2 which is energized by current through the winding 3 to attract its armature and display line signal 5. When the operator inserts answering plug 8 within answering jack 7, relays 10 and 6 will be energized in series through the sleeve plug and jack contact whereon attracted armature 6^c will remove the ground from winding 4 of relay 2 and armature 6^a, engaging its contact, will connect said winding with the active side of battery B from which current will now circulate, branching at armature 6^a through winding 4 over the line limbs of substation A, returning through winding 3 and the tip plug and jack contact to ground through relay 9, the actuation of said relay occurring practically simultaneously with that of relay 10 preventing the display at this time of the supervisory signal 11. Armature 6^b of cut-off relay 6, of course, disconnected the normal battery connection from winding 3. It is apparent that at this time there is equal current flow through the windings of relay 2, the magnetism induced by each winding tending to neutralize that of the other so that the core of the line relay 2 has its magnetism reduced sufficiently to permit the retraction of the relay's armature and the rendering inert of the line signal 5. The windings 3—4 being differential, will present substantially no impedance to the rapidly fluctuating voice currents.

Answering the call, the operator will actu-

ate levers 20, 21, of her listening key, and after ascertaining the number of the called subscriber, will test the called line, assumed to be the line extending to substation B. To do this, the tip of calling plug 22 is touched to the sleeve contact of a spring-jack of the called line. If the said line be busy, the prior connection of a plug to one of its spring-jacks will have altered the potential at the sleeve contacts of the spring-jacks from that of ground, which is normally maintained by the connection extending through cut-off relay 6. Thus, if the line be busy, the said potential will develop into a current circulating through the tip contact of plug 22 over the tip cord strand and through the usual test relay 15 to ground, actuating the said relay which attracts its armature to cause the customary "click" in the operator's head telephone. If the called line be idle, the relay 15 will, of course, remain inert and no signal be received by the operator when testing.

Assuming the line to be idle, the operator inserts plug 22 within the multiple jack tested, whereon relay 13 of the cord-circuit and cut-off relay 6 will be operated in series in the usual manner, the energization of relay 13 cutting off the test relay 15 and rendering the tip cord strand continuous. The left-hand armature of relay 13 effects the display of the calling supervisory signal 14 in the usual manner. The energization of relay 6 alters the connections of the windings of the line relay 2 in a manner similar to that described in connection with that of the line of A when the answering plug was connected to said line, armature 6^a connecting that line limb in circuit with winding 4 to the sleeve of the spring jacks.

I have illustrated a number of ringing generators 16, 17, 18, 19, which may be of different frequencies to selectively ring tuned bells at different substations in the well known manner. The operator now actuates the levers of her ringing key associated with the generator supplying current to ring the bell of substation B, the cut-off relay 6 of the called line being maintained energized, during the ringing, by current through resistance r' and the actuated sleeve strand ringing key lever.

The operator disconnects ringing current and when the called subscriber answers, a circuit is completed extending from ground through supervisory relay 12, attracted right armature of relay 13, tip plug and jack contact, through winding 3, through raised hook lever 1 at substation B, returning through winding 4, armature 6^a, sleeve plug and jack contact and relay 13 to battery B. Relay 12 is thus operated to attract its armature and end the display of supervisory signal 14. The two subscribers are now in conversation and the replacing of their receivers

at the conclusion thereof will deenergize the relays 9 and 12, whereby the two supervisory signals 11 and 14 will be simultaneously displayed, giving the disconnect signal, and upon the operator withdrawing plugs 8 and 22, the line circuit and cord-circuit apparatus will be in its normal condition.

My invention is not limited to the precise structures herein shown and described.

Various modifications may be made of the structures illustrated without departing from the scope of the invention. For instance, the armature, 6^a, may, if desired, be omitted and the winding 4 be permanently connected to the sleeve contacts of the spring-jacks, although I have preferred to illustrate the sleeve contacts of the spring-jacks as entirely insulated from the conductors of the telephone line.

I claim as my invention:

1. A telephone exchange system comprising a telephone line extending from a substation to the exchange by two conductors only, a common source of current for said system, a signal controlling relay having differential windings, the said relay being operable by current from said source over said conductors in series, means normally rendering one of said windings inoperative, and means for rendering both of said windings operative whereby the differential effect is produced.

2. A telephone exchange system comprising a telephone line extending from a substation to the exchange by two conductors only, a common source of power, a signal controlling relay having differential windings, means controlled at the substation for causing a flow of current from said source over said conductors in series and through one of said windings to actuate said relay, apparatus for connection with said line and means operative responsive to said connection to cause a current flow from said source in the other winding to render the differentiability of said windings effective.

3. The combination with a telephone line, of a signal, a line relay for controlling said signal having differential windings, multiple jacks for said line, a cut-off relay for said line, means rendering one of said windings normally inoperable, and switch mechanism of said cut-off relay for rendering said winding operative.

4. A telephone exchange system comprising a telephone line extending from a substation to the exchange by two conductors only, a common source of power at the exchange, a signal controlling relay having differential windings, means rendering one of said windings normally inoperative whereby said magnet is operable by current from said source over said line conductors in series, a line-circuit at the exchange for

connecting with said line, mechanism effective on connection made to render said normally inoperative winding effective and means operative responsive to said connection whereby differentiability is produced by current from said source.

5 5. A telephone system including a telephone line, a source of current, an electromagnet for said line having differential
10 windings, one in each line limb, a low resistance branch from one line limb extending from a point between the substation and a winding to said source, whereby said magnet is operable by current controlled at the
15 substation, a relay associated with said magnet, and means for controlling said relay to open said branch.

6. A telephone system including a tele-

phone line, a line signal therefor, a line relay for displaying said signal, connected
20 with said line and having differential windings, one in each line limb, a branch extending from one line limb at a point between the substation and a winding, whereby the other winding is operable responsive to
25 current controlled at the substation to display said signal, a second relay for said line, mechanism for connecting with said line, and means for operating said second relay on connection made to open said branch.

In witness whereof, I hereunto subscribed my name this 10th day of December, 1907.

HARRY G. WEBSTER.

Witnesses:

CAROLYN WEBER,
G. E. MUELLER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."