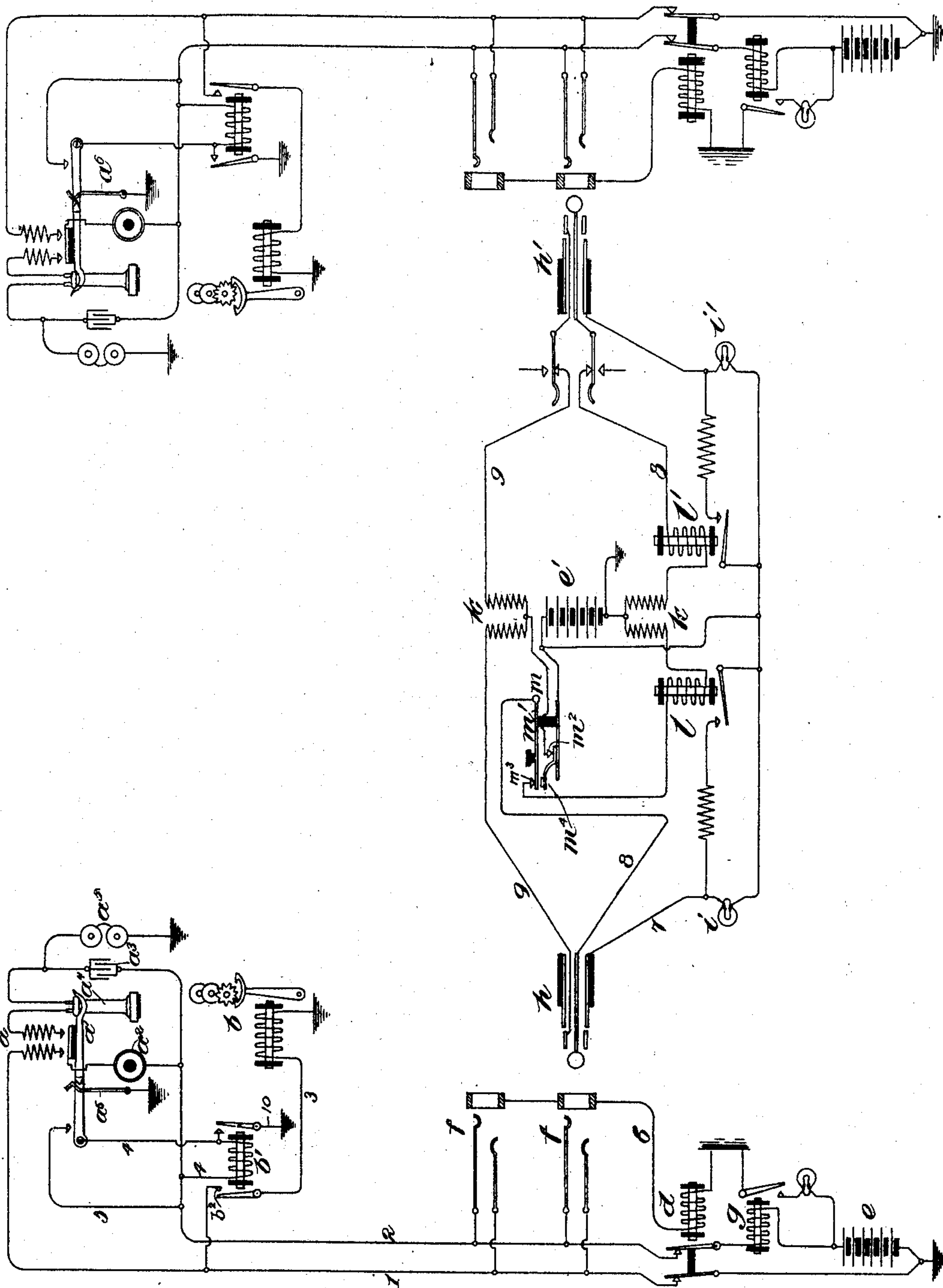


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SERVICE METER FOR TELEPHONE LINES.

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# UNITED STATES PATENT OFFICE.

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## SERVICE-METER FOR TELEPHONE-LINES.

SPECIFICATION forming part of Letters Patent No. 794,125, dated July 4, 1905.

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*To all whom it may concern:*

Be it known that we, CHARLES E. SCRIBNER and JAMES L. McQUARRIE, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Service-Meters for Telephone-Lines, of which the following is a full, clear, concise, and exact description.

This invention concerns the arrangement and operation of service-meters at substations of telephone-lines designed to register at each station the connections initiated at the station, its object being to so adapt the meter and its circuit connections to the signaling and telephonic appliances of the system as to free the meter from all interference by signaling or telephonic currents in the system.

Various plans have been devised for associating a meter with the apparatus of a telephone-substation to count or register the calls originated at the station or to permit such registration by some change of apparatus made automatically or manually in the central office. It has been usual to make the connection of the service-meter with the line at the substation dependent on the act or on the continuance of the use of the telephone. In such an arrangement calling-currents directed through the substation may traverse the meter or its electrical controlling mechanism if the telephone be taken for use at the moment of calling and may operate the meter, or various other accidental conditions may arise which result in the flow of current through the meter to cause a false record of use.

Our invention herein to be described consists, broadly, in causing the act of replacing the telephone on its switch or clearing out at the termination of connection with another line to bring the service-meter into operative connection with the calling-line at the substation. This condition may most readily be brought about through the agency of a relay at the substation controlling the circuit of the meter, so associated with the line conductors and the circuits through the telephone apparatus at the substation that it becomes excited

at the completion of conversation and the replacement of the substation-telephone on its switch-hook. Independent means under the control of the central-office operator are provided for applying current to the line to operate said meter.

Our invention is described in the attached drawing, which is a diagrammatic illustration of two subscribers' stations with line conductors therefrom to a switchboard in a central office, means for uniting the lines in the switchboard, and an appliance for operating the service-meter of the calling-line.

The line-circuits of the substation apparatus and of the switchboard are substantially those which are usual and well known in the automatic signal-switchboard. Slight modifications of the circuits at the substation and of the plug-circuit at the central office have been made to adapt the system for the electrical actions required to control and operate the meter.

Line conductor 1 leads through a winding of the telephone induction-coil  $a$  to a normally open contact at the telephone-switch  $a'$ , and the other line conductor 2 leads through multiple branches, of which one contains the receiving-telephone  $a^4$ , together with a condenser  $a^3$  and the other winding of the induction-coil  $a$ , and the other of which includes the transmitting-telephone  $a^2$  to terminate in other normally open contacts of the telephone-switch, which become closed together and with the first-mentioned contact while the telephone is in use. A ground branch leads from line conductor 2 between the condenser and the receiving-telephone, which includes the magnet of the polarized call-bell  $a^5$ . Thus a normal circuit which is inductively complete as to alternating currents exists from line conductor 2 through the bell  $a^5$  to earth. When the telephone is taken for use, the line conductors 1 and 2 are united through one winding of induction-coil  $a$  and the transmitter  $a^2$ , while a shunt or multiple path between the same conductors is formed through the receiving-telephone  $a^4$ , the other winding of the induction-coil, and the condenser. This circuit



will be recognized as that which is usual for the substation apparatus of the so-called "common-battery" system.

In employing the service-meter  $b$  in conjunction with the apparatus at the substation the actuating-magnet of the meter is connected in a local ground branch 3 from line conductor 1, which branch is controlled by the switch-contacts  $b^2$  of a relay  $b'$ . The magnet of this relay is connected in a conductor 4, leading from line conductor 2 to the lever of switch  $a'$  and thence, while the telephone-switch is in transit from one to the other of its normal positions, to a temporary contact  $a^6$  of the switch, which is connected to ground. The same conductor 4 after traversing the magnet-winding of relay  $b'$  is led to a front contact of the relay, which when the armature is attracted is connected to earth through another grounded conductor 10. Thus when the magnet of relay  $b'$  is excited and the relay attracts its armature or closes its two pairs of contact-points it connects the service-meter  $b$  with line conductor 1 and at the same time completes a locking-circuit for itself to earth from line conductor 2, after which its excitement is independent of the passing contact  $a^6$ . However, a short-circuiting conductor 5 is led from line conductor 2 to an upper or alternate contact of the switch-lever of the telephone-switch, which short-circuits the magnet  $b'$  when the telephone-switch is in its raised position and deprives it of current, permitting the armature to fall back. Hence in its upward movement the telephone-switch making momentary contact with the grounded spring  $a^6$  excites relay  $b'$  and causes it to close both circuits which it controls, but immediately thereafter shunts the magnet of the relay and permits it to again open the circuit; but in passing downward the switch similarly closes the circuit through magnet  $b'$ , but does not deenergize the magnet after so closing its circuit. Both ground branches from line conductors 1 and 2 are then closed, the service-meter  $b$  being connected with line conductor 1. In short, assuming a grounded source of current normally connected with the line conductor 2 at the central office, the act of taking the telephone for use leaves the service-meter disconnected; but the act of replacing the telephone at the termination of conversation brings the service-meter into connection with the line conductor 1 in a ground-circuit, wherein it may be controlled by any suitable appliance at the central office to register the use of the line.

In the relay-switchboard line conductors 1 and 2 are led through the switch-contacts of a cut-off relay  $d$  to the poles of a battery  $e$ , which may be common to the different lines of the exchange. The pole of the battery connected with the line conductor 1 is grounded. The line conductors are also led to normally open terminals or spring-jacks  $f$  in the switchboard,

and in the path of one of the conductors a signal-controlling magnet  $g$  is interposed for indicating the subscriber's call. Plugs  $h$  and  $h'$ , with their plug-circuit, are furnished for uniting the lines for conversation. Associated with the spring-jacks and plugs are complementary conductors adapted to form a local circuit, one of these, a wire 6, being associated permanently with each line, including the actuating-magnet of cut-off relay  $d$ , and terminating in contact-thimbles of the spring-jacks, and another portion 7 including a signal-lamp  $i$  and terminating in a corresponding contact-piece of the plug. The conductors 8 and 9, uniting the line-contacts of the plugs  $h$  and  $h'$  and constituting the plug-circuit, are connected with the poles of the common battery  $e'$  through windings of a repeating-coil  $k$ . The conductors of the plug-circuit include the windings of two relays  $l$  and  $l'$ , one in the path of current from the central source through each of the plugs. These relays control, by means of shunts, the currents through the signal-lamps  $i$  and  $i'$ , and thus cause the signals to indicate the flow or cessation of current through the lines with which they are respectively associated. Thus the insertion of plugs  $h$  and  $h'$  into the spring-jacks of two lines to unite said lines for conversation severs the normal connection of the lines with the battery  $e$  and with their respective line-signals and substitutes a new connection with battery  $e'$  through the repeating-coil and supervisory signals, whereby a suitable current is supplied for operating the substation-transmitters and the signals provided to indicate the completion of conversation. For the operation of our invention the supervisory relays  $l$  and  $l'$  should be placed in the conductor 8, which is connected with the grounded pole of battery  $e'$ , one of them being in the path of the returning current from each of the lines united through the plug-circuit.

The appliance herein provided for controlling the service-meter of the station of the calling subscriber consists in a key  $m$ , having two switch-levers with normal resting contacts  $m^2 m^3$ , which are connected, respectively, in the portion of conductor 8 leading to the plug  $h$  and in the branch from the battery  $e'$  to conductor 9. The switch-lever  $m'$  in conductor 8 has also an alternate contact  $m^4$ , which is connected with the free pole of battery  $e'$ , so as to apply battery directly to conductor 8 instead of the normal earth connection. The key is so constructed that in its operation the contact of lever  $m'$  with its normal resting stop is first broken, then contact of the same lever with the battery-terminal is made, and, finally, after a short interval circuit between battery  $e'$  and conductor 9 is interrupted. Any suitable appliance may be substituted for the key  $m$  which is capable of performing substantially the same shifting of the circuits.

We have already traced the operation of the



mechanism at the substation in detail. We may now describe this operation as involved in the making and breaking of connection between lines in the switchboard.

5 Taking the telephone from its telephone-switch for use at the substation closes the line-circuit through the telephones at the substation and displays the individual line-signal at the central office. The operator answers the  
10 call by inserting the plug  $h$  in the spring-jack of the calling-line and completes the connection called for by inserting the other plug,  $h'$ , in the spring-jack of the line wanted. The operator sends a call-signal by means of the  
15 usual calling-key, and when the telephone is taken from its switch at the called station the users of the telephones at the stations are able to communicate with each other. When at the termination of conversation the telephones  
20 are replaced on their switches at the stations, both relays  $b'$  become excited, as before traced—that is, the current flows from battery  $e'$ , through conductors 9 of the plug-circuit, to conductors 2 of each of the lines, thence  
25 through magnets  $b'$ , wires 4, and the temporary contacts with springs  $a^6$  to earth. These currents excite relays  $b'$  and cause them to close conductors 3 and to form direct connections of the wires 4 to earth to lock the relays  $b'$ . The interruption of connection between line conductors 1 and 2 deprives relays  
30  $l$  and  $l'$  of current and permits them to break the shunts about the lamps  $i, i'$ , and thus to indicate the replacement of the telephones on their switches in a way to constitute a call for disconnection. The operator who completed the connection before removing the connection between the lines depresses key  $m$ . This key  
35 first applies battery  $e'$  to the line conductor 1 of the calling-line, which is through the agency of the relay  $b'$  directly connected with the service-meter  $b$ , and thus actuates the meter, causing it to register the use of the line. In its subsequent movement the key  $m$  breaks  
40 connection of battery  $e'$  with the conductor 9 of the plug-circuit, and hence with line conductors 2 of the two lines, depriving relays  $b'$  at the two stations of current and permitting their armatures to fall away. The apparatus  
45 at both stations is thus restored to its initial condition, the service-meter at the calling-station alone having registered the connection.

Our invention is defined in the following claims:

55 1. The combination with a telephone-line and a service-meter adapted for electrical operation at the substation thereof said service-meter being normally in an inoperative condition with respect to current flowing over the  
60 line, circuit connections of said service-meter with the line made operative in the replacement of the telephone on its switch, and independent means under the control of the operator for applying current in the circuit of

the meter to actuate the meter after said circuit connections are closed, as described. 65

2. The combination with a telephone-line and a service-meter at the substation thereof said service-meter being normally disconnected from the line, plugs and a plug-circuit for  
70 making connection with the line in the central office, a circuit of the said service-meter closed through the plug-circuit or a portion thereof, a telephone-switch at the substation, a contact  $b^2$  controlling the circuit of the service-meter, means for closing said contact through  
75 the agency of the telephone-switch as the telephone is replaced after use, and means under the control of the operator for applying current in the circuit to operate the meter after  
80 said contact  $b^2$  is closed, as described; whereby the meter may be caused to register the use of the line during connection of the plug with the line and after the replacement of the  
85 telephone on its switch.

3. The combination with a telephone-line and a service-meter at the substation thereof, and a relay controlling a branch from a conductor of the line through the said service-meter, a telephone-switch, a circuit of the relay closed through the agency of the substation telephone-switch as the telephone is replaced after use, independent circuits through  
90 different line conductors for said service-meter and said relay, and means in each of said  
95 circuits for exciting the meter and the relay, respectively, as described.

4. The combination with a telephone-line and a plug and plug-circuit connected with the line at the central office, of a service-meter at the substation and a relay controlling the circuit of said meter, the circuit of said relay being controlled by the telephone-switch to be closed when the telephone is replaced on  
100 its switch, and actuating-circuits for said meter and said relay formed in part of conductors of said plug-circuit, and means in the conductors of the plug-circuit for applying currents to said meter and relay, respectively, to  
105 cause the actuation of the meter, whereby the meter may be operated during connection of the plug-circuit with the line but after the replacement of the telephone on its switch, as described. 110

5. The combination with a switch-lever, as  
115 a telephone-switch, a relay and a source of current connected therewith, a momentary contact  $a^6$  of said switch-lever which it touches in passing to one or the other of its extreme  
120 positions, and a circuit of said relay formed thereby, a locking-circuit of the relay closed by the relay when excited independent of said momentary contact, and a contact of said switch at one of its extreme positions adapted  
125 when closed to said switch-lever to short-circuit the magnet of said relay; whereby the relay is excited and remains excited when the switch-lever is thrown in one direction, but



is short-circuited when the lever is thrown in the opposite direction, as described.

6. The combination with a telephone-line having a telephone-switch and a service-meter at the station thereof, of a circuit of the line closed momentarily in the replacement of the telephone on its switch, a relay included in said circuit adapted to form a direct connection of said relay with the line when the relay is excited, and circuit connections of the meter with a conductor of the line controlled by said relay; means for applying current in the line to actuate the service-meter when so connected with the line by the relay, and other means for depriving the relay of current to restore it to its initial condition, whereby the service-meter becomes connected with the line only after the termination of the use of the line and may then be operated to record such use, as described.

7. The combination with a telephone-line, a circuit of the line closed momentarily in the passing of the telephone-switch to its normal position of rest when the telephone is not in use, a relay-magnet in said circuit and a connection of the relay with the line controlled by the relay when excited independent of said passing contact, a service-meter at the substation of the line, and a circuit of the meter with a conductor of the line closed by said relay when excited; a plug and plug-circuit for making connection with the line, a switch in the plug-circuit for applying current in the line adapted to actuate the meter when so connected with the line, and another switch adapted to deprive said relay of current to restore the normal connections of the relay and meter, as described.

8. The combination with a telephone-line and a service-meter at the substation thereof, of a telephone-switch and an electromagnetic switch, said telephone-switch being adapted to close a connection of the line with the electromagnet of said electromagnetic switch when the telephone-switch is out of its position of rest, and means for directing current through the magnet to excite it when such circuit is closed, a locking device for maintaining the position of said electromagnetic switch after the initial excitement of the mag-

net independent of the circuit therethrough controlled by the telephone-switch, and electrical means for rendering said locking device inactive, a circuit connection of the service-meter with the line controlled by said electromagnetic switch, and electrical means for operating the service-meter in said circuit when closed, whereby said electromagnetic switch is operated to place the service-meter under electric control from the central office when the telephone is off the switch, and such control is maintained after the telephone is placed on its switch, as described.

9. The combination with a telephone-line and a service-meter at the substation thereof, plugs and a plug-circuit for making connection with the line at the central office, a circuit of the said service-meter closed through a portion of said plug-circuit, a telephone-switch at the substation, a contact  $b^2$  controlling the circuit of the service-meter, a relay adapted to close said contact a circuit for said relay independent of said contact closed by said switch when the telephone is replaced thereon after use, and means for applying current in said circuit to actuate the meter; whereby the meter is made responsive to actuating-currents upon the replacement of the telephone on its hook after use.

10. The combination with a telephone-line, of a service-meter at the station thereof, said service-meter being normally inoperative with respect to currents flowing over the line, a telephone switch-hook, mechanism controlled in the movement thereof adapted to bring said service-meter into operative connection with the line, and means made operative by the hook while in its up position adapted to counteract said controlling mechanism; whereby said service-meter is brought into operative connection with the line only when the telephone is replaced on the hook.

In witness whereof we hereunto subscribe our names this 29th day of May, A. D. 1900.

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