

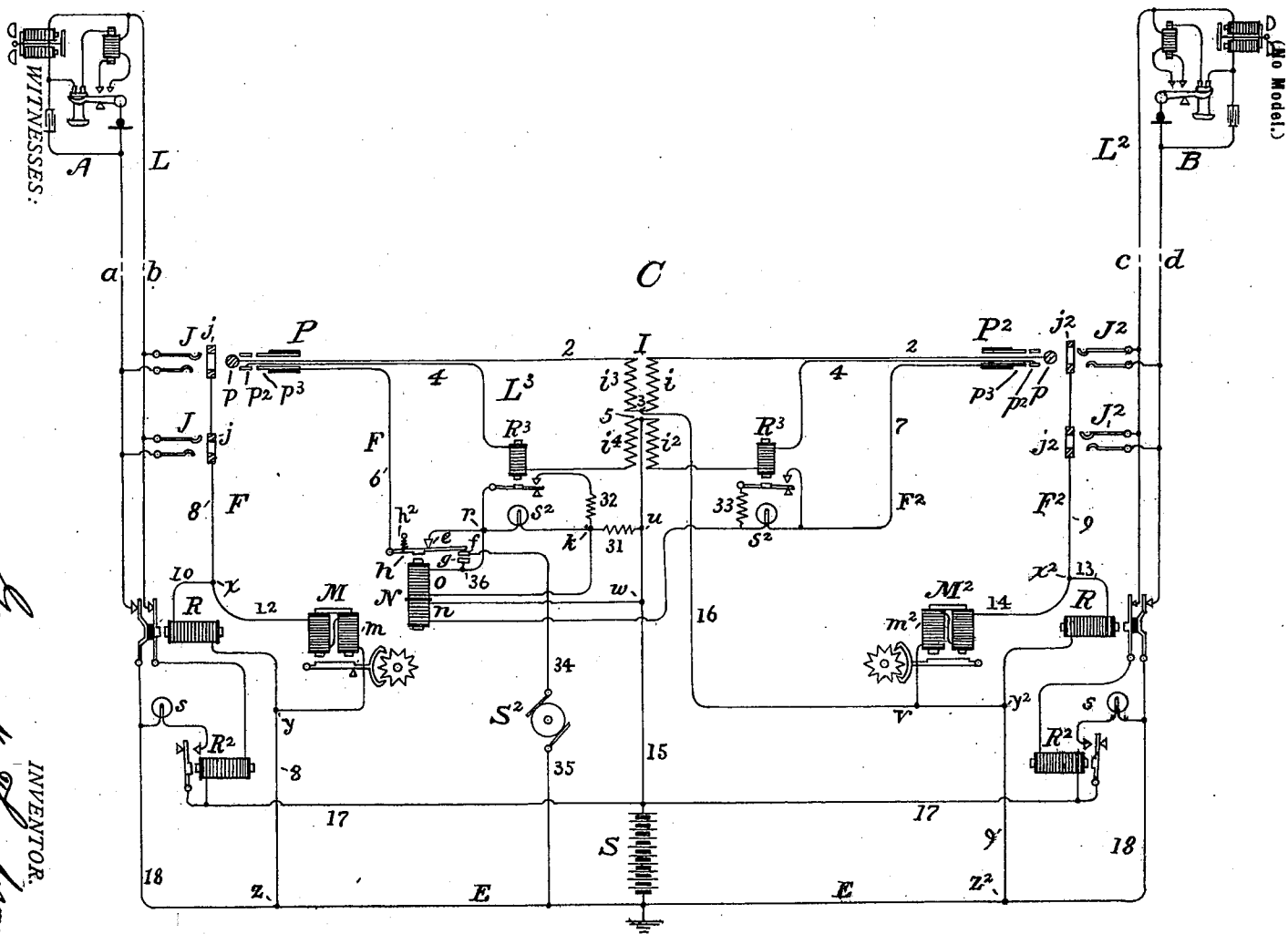
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G. K. THOMPSON.

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CALL REGISTER OR SERVICE METER CIRCUIT FOR SWITCHBOARD APPARATUS.

(Application filed Oct. 8, 1900.)



WITNESSES:

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CALL-REGISTER OR SERVICE-METER CIRCUIT FOR SWITCHBOARD APPARATUS.

SPECIFICATION forming part of Letters Patent No. 664,191, dated December 18, 1900.

Application filed October 8, 1900. Serial No. 32,423. (No model.)

To all whom it may concern:

Be it known that I, GEORGE K. THOMPSON, residing at Malden, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Call-Register or Service-Meter Circuits for Switchboard Apparatus, of which the following is a specification.

This invention concerns call-registers or service-meters to count the calls transmitted over a telephone-exchange line from a substation thereof and to indicate their number or to register a charge for the service rendered to the line in question, and relates in particular to that class of circuit arrangement for such meters wherein the measuring appliance is located at the central-station end of the line and is made operative for the registration of a call whenever the line wanted having been tested and found unoccupied is switched to the line which has called for it.

Heretofore it has been proposed to employ service-meters whose operation depends upon an increase of current produced in the third or local circuit of the switch-cord and its continuation through the cut-off relay of the calling-line by the short-circuiting of a supervisory signal or a special resistance when the call has been responded to by the wanted line or when the switch-plug has been inserted in the switch-socket of such line; but the increase of current thus produced is in any event but small and cannot at all times be confidently relied upon for the performance of the desired operation. Heretofore, also, service-meters with two coacting electromagnets have been provided, the coils of one of the said magnets being connected in the cut-off-relay circuit.

The object of the present invention is to so place the service-register and its actuating-magnet that on the insertion of the second or companion plug (sometimes termed the "calling-plug") of a pair of plugs united by a switch-cord in the switch-socket of the wanted line the said magnet shall be subjected to an operating-current so much stronger than that employed in operating the ordinary signals that the operation of the said register shall in all cases be performed with certainty; also, to forestall the possibility

of making a double or plural charge on occasions when by inadvertence the said companion plug has been placed in the switch-socket of a line other than that which has been called for and has then been withdrawn and subsequently placed in the proper socket. In this invention for the attainment of these objects a service-meter having a single actuating-electromagnet has the exciting-coil of said magnet connected in parallel with the cut-off relay of the substation-circuit which is to have its calls registered, the said actuating-magnet being, however, so constructed or adjusted as to be irresponsive to the normal working current of the local circuit of said cut-off relay and requiring for its operation a current considerably stronger. An electromagnetic circuit-changer is associated with the local-circuit conductor of the answering-plug of the usual switch-cord and operates responsively to the insertion of the companion plug in the switch-socket of a wanted line, the active member of said circuit-changer (which practically is a switch-lever) being arranged to pass between two terminal contact-stops and while in transit to move over and establish operative contact with an intermediate stop or plate forming the terminal of a relatively high potential source of current, which thereby is transiently brought into the local circuit of the service-meter now completed through the local cord conductor and is enabled to transmit through the said local circuit, including in parallel the register and cut-off-relay magnets of the calling-line, a brief but sufficiently-protracted current impulse of the increased strength required for the operation of the service-meter, which thereupon becoming active registers the call. The controlling-electromagnet of the circuit-changer has two exciting-coils. One of these—the "actuating coil"—is the stronger, is connected in the local circuit of the companion or calling plug, and is operative under the normal current of said local circuit. It is by the agency of this coil that the said circuit-changer is operated, as described, to transmit the said stronger current impulse required for the register. The other coil is connected in the corresponding local circuit of the answering-plug, being, in fact, in series

with the cut-off relay, the service-meter, and the normal source of current of said local circuit in both terminal positions of the circuit-changing lever, and while its magnetizing power is too weak with the current furnished in this circuit by the said normal source for the initial operation of the circuit-changer in the movement of its active member between its traverse-limiting contact-stops it develops sufficient power with such current to retain the said circuit-changer in the second terminal position when moved thereto by the more powerful actuating-coil, and it is therefore termed herein the "retaining-coil." Thus the circuit-changer having once been actuated for the registration of a call is prevented by the action of the retaining-coil from returning to its original position, even though the companion plug for any reason be withdrawn from the socket where it has been placed and inserted in another or, indeed, notwithstanding any number of such withdrawals from any number of sockets and subsequent replacements, and since the initial or forward operation of said circuit-changer is requisite for the registration of a call it follows that no additional registration can be made by the same service-meter until the answering switch-cord plug shall also have been withdrawn, and hence that with this apparatus and circuit arrangement there can be no two or more registrations of the same call.

The drawing which accompanies this specification is a conventional diagram showing the several appliances involved in proper circuit arrangement.

L and L² are exchange-circuits extending from substations A and B, respectively, to the central station C, the said substations being both fitted with the standard signal and telephonic apparatus appropriate to the operation of the central-battery system.

It will be assumed that substation A desires to communicate with substation B and has sent or is about to send a call in to the central station signifying such desire. L therefore may be termed the "calling-line" and L² the "called" or "wanted" line. The calling-line L has main conductors *a* and *b*, which branch at the central stations into switch-sockets J, having socket frames or rings *j*. Similarly the called line L² has main conductors *c* *d*, branching at the central station into switch-sockets J², having frame-piece contacts *j*². Both main circuits are fitted with the usual central-station terminal appliances of a cut-off relay R, a line-relay R², and a signal-lamp *s*, controlled by the latter. The frame-piece contacts *j* of line L are united electrically by conductor 8, dividing at *x* into parallel branches 10 and 12, which reunite at *y*, the said conductor 8 after such reunion being continued to a junction at point *z* with a return or earth conductor E. So, also, the frame-piece contacts of line L² are united by a conductor 9, splitting at *x*² into parallel

branches 13 and 14, which coalesce at *y*², the said re-formed conductor 9 continuing to a junction at *z*² with the return or earth conductor E. The cut-off relays R of lines L and L² are connected in the branches 10 and 13 of their respective local conductors 8 and 9.

Call-registers or service-meters M M² are furnished for the lines L L², respectively, and are located at the central station, the said service-meters M M² having their actuating-magnets *m* *m*² respectively connected in branches 12 and 14 of the local conductors 8 and 9 of their several lines. The service-meter of each substation-circuit is therefore connected in parallel with the cut-off relay of the same circuit in branches of the local socket-frame conductors thereof, and when the said conductors are united with others and a source of current to complete any circuit F the cut-off relay and the service-meter of the line concerned may properly be characterized as being in parallel with one another in such circuit. The actuating-electromagnets of the service-meters are, however, so wound or otherwise constructed or adjusted as to require for their operation an electrical current stronger in a marked degree than the normal current employed for the operation of the parallel cut-off relay. Thus when the said normal current is caused to flow in conductor 8, which occurs when a switch-plug is placed in socket J to answer a call, the cut-off relay R will be operated, but the call-register will be wholly irresponsive and will remain quiescent.

L³ is a switch-cord (as many such cords being of course employed as are requisite for the proper conduct of the central-station operations) fitted at one end with the answering switch-plug P and at the other end with the companion or calling plug P², both plugs being formed with tip and sleeve conducting-sections *p* *p*² to engage, respectively, the shorter and longer switch-socket springs or main-circuit contact-pieces and with a stem conducting-section *p*³ to engage the frame-piece *j* or local-circuit contact of the switch-socket. The tip and sleeve conductors of plug P are united with the similar conductors of plug P² by cord conductors 2 and 4, the former containing in series the windings *i* and *i*³ of the repeating-coil I and the latter containing in series the remaining two repeating-coil windings *i*² and *i*¹ and also the two supervisory relays R³, one for each switch-plug, controlling their respective signals *s*² by means of shunts in the usual way.

S is a general source or generator of current, such as a battery, arranged to supply current for the operation of the line-relays R² and signals *s* when the telephone-receivers at the substations are removed from their hooks to close the main circuits conductively, and thereby send a call, and also to supply an operating-current for the cut-off relays and supervisory signals and for the transmitters of the substation-telephones when the lines are

switched. For the former purpose the conductors 17 and 18, attached to the two lever-contacts of the cut-off relay, extend, respectively, to the active battery-pole through the line-relay and to the return-conductor E thereof, a branch leading through the contacts of said line-relay and the signal s . To provide for the substation-transmitter supply, one pole of said battery S is united by the conductor 15 to a point 5 on the main cord-strand 4 between the repeating-coil helices z^2 and z^4 , a return-conductor 16 leading from a similarly-placed point 3 on the main cord-strand 2 to the other pole by way of the points v and y^2 , conductor 9, and the general return E.

S^2 is an alternative or auxiliary current generator of high potential or electromotive force adapted under certain operative conditions, presently to be described, to transmit through the local conductor 8 of the calling-line and the call-register magnet contained therein a current considerably stronger than that normally furnished by the battery S and strong enough to operate the said call-register magnet. The source S^2 is shown as a straight-current magneto-generator, but may of course be of any desired type.

N is a circuit-changing device actuated by an electromagnet having two independent exciting-coils n and o and comprising an armature, a bar attached thereto and practically constituting a switch-lever h , and three contact points or surfaces e , f , and g , with which the said lever may connect. The lever h is the movable member or element of the circuit-changer N, and the points or plates e , f , and g are the fixed members thereof. The points e and g , besides being contact-points, are stops limiting the range of traverse of the lever h , which normally is held in contact with the back stop e , but which when attracted by the actuating-magnet separates from the said stop e and moves into contact with the front stop g . While in transit between the said stops, the end of the lever, formed in a well-known manner to facilitate the operation, brushes over the middle contact or plate f , which forms a terminal of the special source S^2 , forming a transient and speedily-dissolved connection therewith. The coils n and o are of diverse magnetizing power. With a normal current flowing from the source S of strength proper for the operation in its regular local circuit of the cut-off relay of any line the actuating-coil n , placed in the circuit, would develop a sufficient magnetic strength to operate the circuit-changer, moving the switch-lever thereof from one limit-stop e to the other, g ; but with the same current or a current of like strength passing through the coil o alone sufficient attractive power would not be developed in the magnet, and the circuit-changer would remain quiescent. The retaining-coil o is, however, so proportioned that when such normal current is caused to circulate in it after the magnet-armature has been attracted and the switch-

lever brought to its forward position by the superior magnetizing power of the actuating-coil n sufficient power is developed to retain the armature and the switch-lever attached thereto in the said forward position, even though the circuit of the coil n should be opened and the attractive power of said coil n be thus caused to disappear. When no current is passing through either of the coils, the switch-lever is held in contact with the back stop e by the counter-spring h^2 , which, moreover, retracts the said lever when, having been attracted into its forward position, neither coil continues to exercise magnetizing power on the common magnet-core. The answering-plug P has a local-circuit conductor 6, normally connecting the local or sleeve conducting-surface p^3 of said plug with the battery S through the circuit-changer lever h , its back contact e , point r , the lamp-signal s^2 , and its controlling-shunt in parallel, points k and u , and conductor 15, suitable resistances 31 and 32 being included in the local circuit proper and the lamp-controlling shunt to insure, as usual, the proper strength of normal current. The retaining-coil o of the circuit-changer-actuating magnet is also associated with this local-circuit conductor 6 and is in a third branch 36 thereof in parallel with the shunted lamp leading from the point k to the point r . The plug P^2 also has a local-circuit conductor 7, extending from the local conducting-surface p^3 of said plug through the associated signal s^2 and its shunt to point w on the battery-conductor 15. The signal-shunt in this case also may be provided with a resistance 33 to bring its current down to proper strength. The actuating-coil n of the circuit-changer is placed in the circuit of this conductor. When the plug P is inserted in the socket J in response to a call, the line of conduction just described completes the local circuit F of the source S through the cut-off relay, which then operates in the ordinary way; but the call-register M, though in a branch of the circuit F parallel to the cut-off relay, is not operated, because the normal current is not strong enough for the excitation of its magnet; nor is the circuit-changer operated, because though its retaining-coil o is in a branch of the circuit it does not with the current flowing develop the requisite magnetizing power. Having received the call, the plug P^2 is placed in a socket J² of the desired line L². The local circuit F² of this plug is now completed through the local conductor 9, including in its parallel branches the register and cut-off relay of line L². Current from the battery S flows in the said local circuit by way of conductor 15, point w , conductor 7, including the actuating-coil n of the circuit-changer N and the signal s^2 and its shunt, plug-conductor p^3 , socket-frame j^2 , conductor 9, and its parallel branches 13 and 14, separating at x^2 and reuniting at y^2 , their contained appliances and point z^2 to return-conductor E and the other pole of the battery.

The cut-off relay operates and the register does not operate, for the reasons already stated in reference to the calling-line. The circuit-changer, however, is operated because the local circuit F^2 thus formed includes its actuating-coil n , and because the said coil, under the normal current of said circuit, develops sufficient magnet power to cause the movement of the lever h from its contact-point e to contact-point g . In making such movement the local circuit F of the calling-plug P is broken for an instant as the lever separates from contact-stop e , but is again closed when the said lever reaches the contact-stop g . The said lever in passing from one stop to the other brushes over the intermediate contact f , which, by means of conductor 34, is in direct connection with one pole of the high-potential source, (the other pole thereof being connected with the return-conductor E by the conductor 35,) and the circuit of the said source S^2 is thus for a brief period of time closed by way of the circuit-changer lever h , through local circuit F , including the actuating-magnet m of the service-meter. The current from S^2 flowing in the circuit thus formed is of sufficient strength to fully excite the said magnet, and the said meter is operated and registers the call. The transfer of the circuit-changer lever to its front contact g has brought the armature to which said lever is attached much closer to the magnet-pole than it is normally, so that the retaining-coil o in local circuit F , restored by contact between said lever and contact g and receiving the normal current of the battery S , can retain the said armature and lever in their forward position, though not able to bring them to it. Hence the said circuit-changer does not move back to its original position, even though the coil n may have its circuit broken by the withdrawal of the companion plug P^2 . It occasionally happens that the said plug has been placed in the wrong socket inadvertently. When this is done, it must of course be withdrawn and then placed in the socket of the proper line. This, were it not for the retaining-coil, would result in another transient contact with the terminal f of the generator S^2 and a second charge for the same call; but as the circuit-changing lever h having been once moved is held by the influence of the retaining-coil until the circuit of that coil is also broken by the withdrawal of the answering-plug P such an additional registration is prevented. Obviously should B be the call-initiating substation the answering-plug P would again be the one employed in answering the call, but would be placed in the socket J^2 of the line L^2 . In that case the service-meter M^2 would be the one operated.

The features claimed as being characteristic of my present invention are the following:

1. In the switchboard apparatus of a telephone-exchange central station, the combination with two local circuits associated respectively with a calling and a called-for tele-

phone-line, and containing each the cut-off relay of such line, and a source of current appropriate for the operation of said relay; of a service-meter for said calling-line operated by an electromagnet in the local circuit of said calling-line, but irresponsive to the normal current thereof; an auxiliary source organized to develop in the said calling-line local circuit a stronger current, adapted for the operation of said service-meter; and an electromagnetic circuit-changing device comprising a switch-lever in the said calling-line local circuit controlling the connection of said circuit with both sources of current, and adapted when operated to change said circuit transiently from the normal to the auxiliary source, and an operating-magnet therefor having its actuating-coil in the local circuit of the called-for line; substantially as set forth.

2. In a telephone central-station switching apparatus, the combination of switch-sockets of a calling and a called-for telephone-line respectively; a switch-cord with a calling switch-plug at one end and a companion switch-plug at the other adapted to cooperate with the said switch-sockets respectively, the said switch-cord comprising main-line conductors extending between the said plugs for the interconnection of said calling and called-for lines, and a local-circuit conductor for each plug; a normally incomplete local circuit associated with each line and adapted to be completed through the switch-socket of such line, the plug cooperating therewith, and the local conductor associated with said plug, and to include the cut-off relay of said line, and a source of current to operate said relay; with a service-meter or call-register having its operating-magnet in a branch of the local circuit completed by said calling-plug in parallel with the cut-off relay, but irresponsive to the normal relay-operating current of said local circuit; an auxiliary source of current of relatively high electromotive force associated with the local-circuit conductor of the calling-plug but normally disconnected therefrom; a circuit-changing switch at the junction of the said local conductor and the terminals of both sources, the same being organized when operated to transiently transfer said conductor from said first-mentioned source to the said more powerful auxiliary source; and an electromagnet to operate said circuit-changing switch, having its actuating-coil in the local circuit completed by the companion switch-plug; whereby the call-register of the local circuit associated with the calling-plug may be operated by the completion of the local circuit associated with the companion plug; substantially as described.

3. In a telephone central-station switchboard apparatus, two telephone-lines or substation main circuits; two incomplete local switchboard-circuits associated with said lines respectively and each including when completed the cut-off relay of its own tele-

phone-line and a source supplying a normal current for the operation thereof; switch devices comprising main conductors for the interconnection of said telephone-lines, and independent local-circuit conductors adapted to complete the said local circuits respectively; combined with a call-register for the calling-telephone line operated by an electromagnet in the local circuit of said calling-line but irresponsive to the normal current thereof; a relatively high potential alternative source also associated with said local circuit but normally disconnected therefrom; a circuit-changer for said local circuit determining the connection therewith of the said normal and alternative sources, adapted to transiently substitute the latter for the former for the operation of said call-register, and having a double-wound controlling-electromagnet, one winding being an actuating-coil in the local circuit of the called-for line, responsive to the completion of said circuit, and the other a retaining-coil in the previously-closed local circuit of said calling-line to prevent the said circuit-changer from being again operated during the pendency of the same call, as described.

4. In a telephone-exchange-switchboard apparatus, the combination of switch-sockets representing respectively two telephone-lines one of which has called for the other; a switch-cord with a calling-plug at one end and a companion plug at the other adapted for insertion in the said switch-sockets respectively, the said switch-cord comprising main-line conductors extending between the said plugs for the union of said telephone-lines, and a local-circuit conductor for each plug; a normally incomplete local circuit associated with each line and adapted to be completed through the

switch-socket thereof, the plug therefor, and the local conductor of said plug, and to include the cut-off relay of said lines, a service-meter with an operating-electromagnet in the local circuit completed by the calling-plug, and in parallel with the cut-off relay thereof; an electrical generator normally furnishing in said local circuit a current strong enough to operate the said relay but not the said meter; an alternative generator of higher potential associated with the calling-plug local conductor but normally disconnected therefrom and furnishing current appropriate for the operation of said meter; a circuit-changing switch at a junction of the said calling-plug local conductor and terminals of both generators, the same being organized when operated to transiently transfer the said conductor from said first-mentioned generator to the said more powerful generator; and an electromagnet to operate said circuit-changing switch having an actuating-coil in the local circuit completed by the companion switch-plug, and a retaining-coil in the local circuit of the calling-plug; whereby the call-register of the local circuit associated with the calling-plug is enabled to operate by the completion of the local circuit associated with the companion plug, and is prevented from again operating during the pendency of the same call; substantially as herein set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 5th day of October, 1900.

GEORGE K. THOMPSON.

Witnesses:

GEO. WILLIS PIERCE,
JOSEPH A. GATELY.