G. BABCOCK.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED FEB. 17, 1910.

1,186,464.

Patented June 6, 1916.

2 SHEETS—SHEET 1.

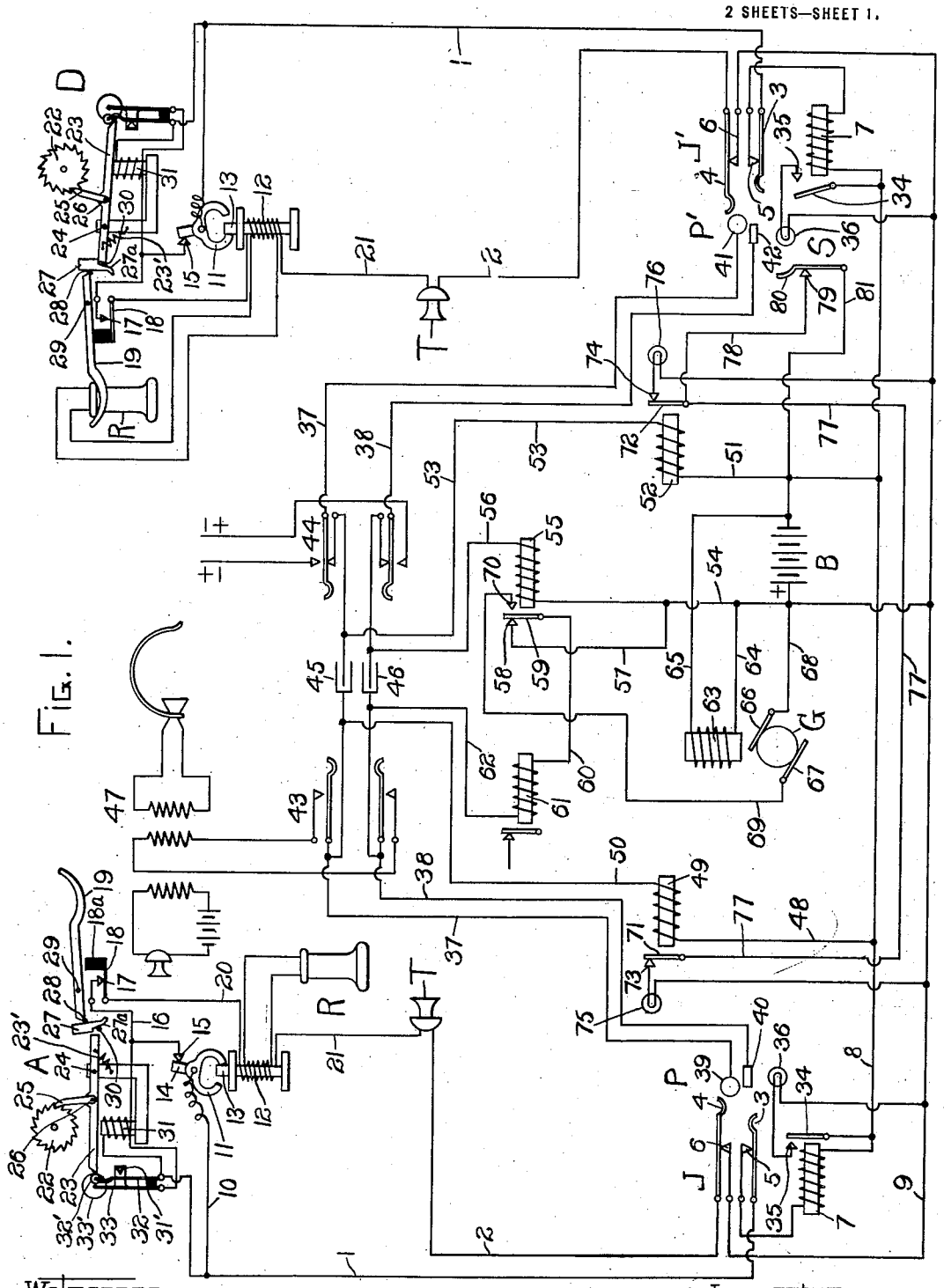

Fig. 1.

Witnesses

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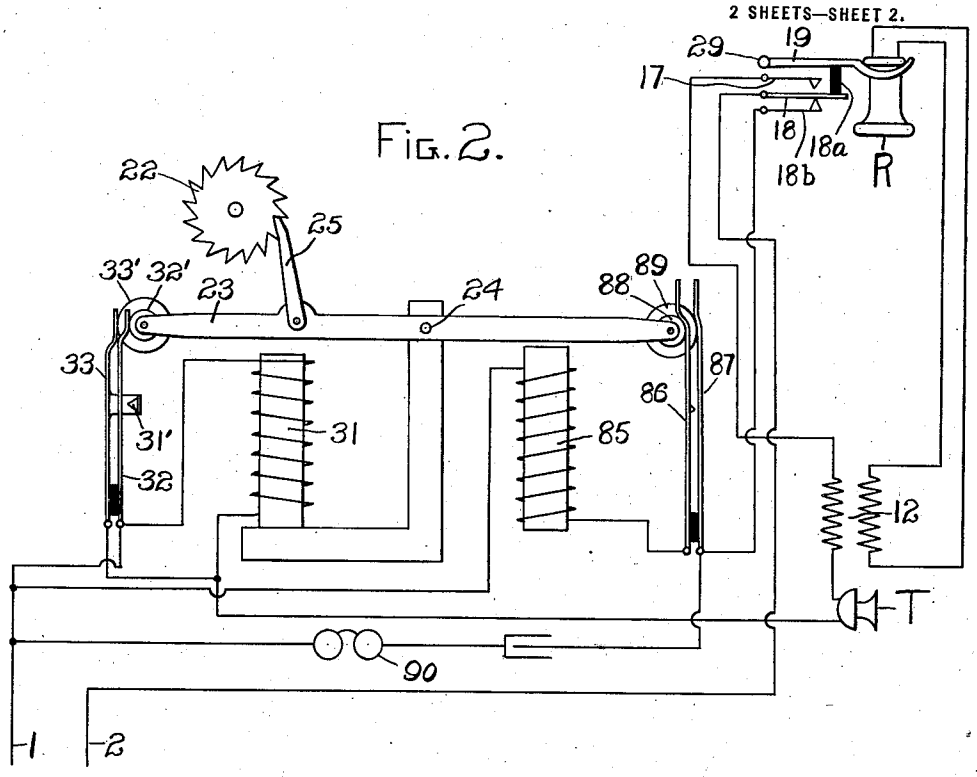

Fig. 2.

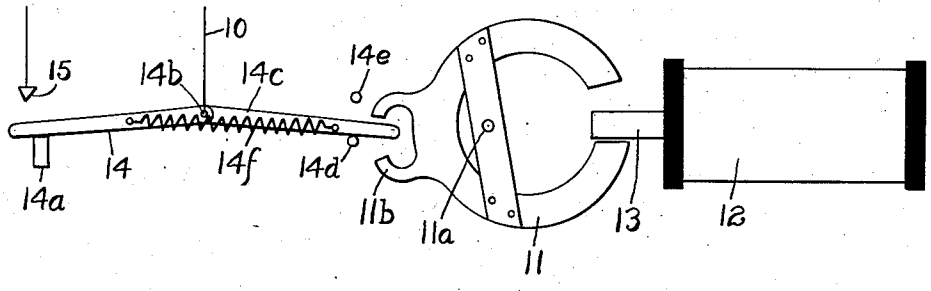

Fig. 3.

Witnesses

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GARRISON BABCOCK, OF ROCHESTER, NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

1,186,464. Specification of Letters Patent. Patented June 6, 1916.

Application filed February 17, 1910. Serial No. 544,429.

To all whom it may concern:

Be it known that I, GARRISON BABCOCK, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to service meters for telephone exchange systems, and has reference particularly to that class of service meters in which the metering mechanism is located at the substations.

It is an object of my invention to provide a meter of the class referred to of such a nature that the meter is under the joint control of the subscriber and of the apparatus located at the exchange which apparatus is controlled by the called subscriber in answering the call.

My invention refers particularly to such a combination of parts that the operation of registering a call initiated at any substation is accomplished by means of the operation at such substation of the mechanism ordinarily used in calling the central exchange. After connection has been made by the operator at the exchange with the calling line and such connection has been extended to the called line, response on the part of the called subscriber causes operation of relay mechanism associated with the cord circuit employed in making the connection in such a manner as to reverse the polarity of the current supplied to the answering end of the cord circuit and in this manner apparatus is actuated at the calling substation which apparatus by its operation serves to reset the register ready for registering another call.

In carrying out my invention I prefer to employ at the substation a polarized relay which is responsive to a reversal in current direction, as a result of which the resetting magnet is actuated when the polarized relay is operated. After having been properly reset to be actuated the meter may be operated either by the mechanical operation of the switch hook or may be electrically operated by a circuit closed by the motion of the switch hook from its talking to its normal position.

The several drawings illustrating my invention are as follows:

Figure 1 is a diagrammatic drawing showing the telephone system complete with the apparatus at one of the substations in its talking condition while the apparatus at the other substation is shown in its normal or resting condition. Fig. 2 shows a modified form of apparatus that may be used in connection with the meter armature to control the circuit of its magnet and also to hold the armature in its attracted position. Fig. 3 is a detail view of a construction that may be employed in connection with the polarized relay to provide against accidental opening of the contact adapted to be closed by such relay.

Similar numerals refer to similar parts throughout the several views.

In Fig. 1 of the accompanying drawings illustrating my invention, the substation A is connected by line wires 1 and 2 with the exchange, the line circuit there terminating in the tip and sleeve springs 3 and 4 respectively of the line jack J. The springs 3 and 4 normally make contact with the contact springs 5 and 6 respectively. The spring 5 is connected with the winding of the line relay 7, the other terminal of which is connected by wire 8 with the negative pole of the battery B. The spring 6 is connected by wire 9 with the positive pole of battery B.

At the substation the line wire 1 is connected by a wire 10 with the pivotal point of a polarized armature 11 of the combined induction coil and magnet 12, the core 13 of which is extended to attract the polarized ends of the armature 11. The armature 11 carries a spring 14 adapted to engage a contact 15 when the armature is in its normal position. The contact 15 is connected by a wire 16 with a contact 17 adapted to engage a spring 18 when the switch hook 19 is in its raised or calling position. The spring 18 is connected by a wire 20 with the primary winding of the induction coil 12, the other terminal of which is connected by wire 21 with the transmitter T, the other terminal of which is connected directly to the line wire 2. The secondary winding of the induction coil 12 is connected directly with the receiver R, as indicated.

The register mechanism 22 is adapted to

be operated by a lever 23 pivoted at 24 by means of a pawl 25 pivoted at 26 to such lever. The right-hand end of the lever is extended beyond the pivot 24 to be engaged by a pawl 27 pivoted at 28 to the left-hand end of the switch hook 19, which is pivotally supported at 29. The pawl 27 is so conformed that when the switch hook is in its lower or normal position the shoulder formed on the lower end of such pawl rests over the right-hand end of the lever 23, and as the switch hook 19 is raised while being moved from its normal position the spring usually provided to cause this operation, and not shown, depresses the right-hand end of the lever 23, thus raising the pawl 25 to operate the register mechanism 22. The continued motion of the switch hook 19 in an upward direction causes engagement between a cam surface 27ª at its lower end and a fixed stop 30, as a result of which the pawl 27 is moved upon its pivot 28 to cause it to be disengaged from the lever 23, which lever is held in this position by means of the spring 23′ which is of sufficient tension to hold the lever 23 and pawl 25 in their upper position but is not strong enough however, to operate the register mechanism 22. The lever 23 also serves as a polarized armature for the resetting magnet 31 of the registering mechanism, as a result of which when the magnet 31 is properly energized the lever 23 is moved forcibly downward thus resetting the pawl 25 in position to subsequently operate the registering mechanism. This motion of the lever 23 releases the spring 32 which is comparatively stiff and permits it to engage the contact 31′ carried by the contact spring 33.

The springs 32 and 33 carry at their upper ends rollers 32′ and 33′ disposed side by side and opposite the beveled left hand end of the lever 23. The centers of the rollers 32′ and 33′ are so disposed that when the lever 23 is in its upper or actuated position, the centers of such rollers lie practically in a continuation of the lower side of such lever and the tension exerted by the springs 32 and 33 upon the end of the lever 23 does not, therefore tend to throw the lever in one direction or the other. When, however, the lever 23 is attracted to its resetting position, the roller 32′ being smaller than the roller 33′, is entirely disengaged from the left hand end of the lever 23 and thus the spring 32 is permitted to engage the contact 31′ as a result of which the tension of the spring 32 is added to the tension of the spring 33 and the combined effort is exerted upon the left hand end of the lever 23 and upon the beveled surface formed thereon, as a result of which at this time the roller 33′ serves to lock the lever 23 in its reset position and the spring 32 and the contact 31′ are held positively in engagement.

The resetting magnet 31 is connected between the line wire 1 and the wire 16, as indicated, and the contact springs 32 and 33 are connected to the terminals of the resetting magnet, as a result of which when the lever 23 has been moved downward to its resetting position the closure of the contacts 32 and 31′ establishes a short circuit between the terminals of the resetting magnet, and further operation of such magnet is therefore prevented until the lever 23 is again moved upward mechanically by means of the switch hook 19. A further result accomplished by the closure of the contacts 32 and 31′ is that the impedance of the reseting magnet 31 at the calling substation is removed from the line circuit during talking.

The switch hook 19 is so disposed relatively to the contacts 17 and 18 that when in its depressed position which is its normal position under the weight of the receiver R, it engages a block of insulation 18ª carried by the spring 18, and thus separates the contacts 17 and 18 and interrupts the circuit through the primary winding of the induction coil 12, which primary winding is also effective in energizing the core 13 to cause operation of the armature 11. The primary winding referred to is so wound that current in one direction, which, in the embodiment herein shown, is assumed to be in a direction entering the winding from the wire 21, will attract the armature 11 in a manner to close and maintain such armature in its normal position to close the contacts 14 and 15, which closure establishes a shunt or short circuit through the wires 10 and 16 between the terminals of the resetting magnet 31.

Assuming that the receiver R has been removed from the switch hook 19, as shown at the substation A, the register 22 is actuated and the contacts 17 and 18 are closed, and thus in a manner well known in the art, the line relay 7 is energized by the pulling up of its armature 34 against the contact 35, and a circuit is closed between the wires 8 and 9 through the line lamp 36 to signal the operator at the exchange that a connection is desired. The current in the line at this time flows through the transmitter T, the primary winding of the induction coil 12 and through wires 16 and 10, and by the motion of the switch hook 19 to its raised position the lever 23 and pawl 25 have been moved to a position to operate the register mechanism 22. This condition continues until the direction of current flow through the instrumentalities referred to is reversed, at which time the opposite pole of the armature 11 is attracted, as a result of which the line current now flows through the resetting magnet 31 as well as through the other instrumentalities described. This results in the attraction of the lever 23 and the resetting of the registering mechanism 22. When

the lever 23 reaches its lower position it closes the contacts 32 and 31′, thus short-circuiting the resetting magnet 31, and the lever remains in this position, as a result of the action of the spring 32 and 33 and the roller 33′ described above. The reversal of current flow in the line circuit is accomplished as follows:

The cord circuit herein shown consists of two strands 37, 38, extending from the tip and sleeve 39, 40 of the answering plug P to the tip and sleeve 41 and 42 of the calling plug P′, respectively. The strands 37 and 38 have connected in them the listening key 43 and the ringing key 44, and these strands are interrupted conductively, although continuous inductively by the condensers 45, 46, in a manner well known in the art. An operator's set 47 is provided in the usual manner, such set being connected with the listening key 43.

The battery B has its negative terminal connected by the wires 8 and 48 with one terminal of the winding of the tip supervisory relay 49, the other terminal of which is connected by wire 50 with the answering end of the strand 37. The same terminal of the battery B is also connected by wire 51 with one terminal of the winding of the tip supervisory relay 52, the other terminal of which is connected with the calling end of the strand 37 by wire 53. The positive pole of the battery B is connected by wire 54 with one terminal of the winding of the sleeve supervisory relay 55, the other terminal of which is connected by wire 56 with the calling end of the strand 38. The same pole of the battery B is also connected by wires 54 and 57 with the back contact 58 of the armature 59 of the relay 55.

The armature 59 is connected by wire 60 with one terminal of the winding of the sleeve supervisory relay 61, the other terminal of which is connected by the wire 62 with the answering end of the sleeve strand 38. A generator G is provided, and has its field winding 63 connected by wires 64 and 65 directly with the terminals of the battery B. The positive and negative brushes 66 and 67 of the generator are connected respectively by wires 68 and 69 with the positive pole of the battery B, and the front contact 70 of the armature 59.

The armatures 71 and 72 of the supervisory relays 49 and 52 are normally in engagement with their back contacts 73 and 74, which are connected with the supervisory lamps 75 and 76 respectively, the other terminals of these lamps being connected together by the wire 9 to the positive pole of the battery B. The armatures 71 and 72 are connected together by the wire 77, and are also connected by the wire 78 with the spring contact 79 of the plug seat switch S, the other member 80 of which is connected by wire 81 with the negative pole of the battery B.

As a result of the circuit connections above described, when the operator answers a call received by the flashing of the lamp 36 and inserts the answering plug P into the jack J, the line relay 7 is deënergized by the separation of the jack springs 3 and 4 from the contacts 5 and 6 respectively, and current is now supplied from the battery B through the supervisory windings 61 and 49 to the line wires 1 and 2 in the same direction as it was previously supplied through the springs 5 and 6, as a result of which no actuation of the armature 11 occurs, since the core 13 is magnetized in the same direction. This condition continues until the called subscriber, after having been properly connected by the insertion of the calling plug P′ in the jack J′, and operation of the signaling mechanism, not shown, at the called substation, responds by removing his receiver from his switch hook. The signaling mechanism at the substation is not shown here in detail since it forms no part of this invention. When the called subscriber removes his receiver from the switch hook he closes a circuit through the substation apparatus, thus causing the energization of the relay 55. This results in pulling up the armature 59 and interrupting the circuit from the positive pole of the battery B through wires 57 and 60 to the winding of the supervisory relay 61, and closing a path between the negative brush of the generator G through wire 69, contact 70, armature 59, and wire 60 to the same terminal of the relay 61. The potential developed by the generator G should be approximately twice the potential of the battery B, and as a result current is caused to flow through the battery B in opposition to its voltage, and the resultant voltage impressed upon the strands 37 and 38 is of about the same value as the voltage of the battery B but in a reverse direction. The generator G is especially constructed so as to supply direct noiseless current to the substation circuit which is adapted for talking purposes, and by its flow through the primary winding of the induction coil 12 it reverses the polarity of the core 13, thus rotating the armature 11 around to the left upon its pivot 11^a and separating the contacts 14 and 15, and, since the contacts 32 and 31′ are open and the contacts 17 and 18 are closed, the resetting magnet 31 is energized, thus setting the register 22, at the close of which operation the contacts 32 and 31′ are closed to prevent accidental operation of the magnet 31.

Since the contacts 14 and 15 are normally in contact and are so held by the direction of current sent through the primary winding of the induction coil at the called sta-

tion, it follows that although the meter mechanism at the called substation has been actuated by the removal of the receiver there located, and that therefore the corresponding contacts 32 and 31′ are separated, the associated resetting winding is still inoperative as a result of the shunt closed by such contacts 14 and 15 as a result of which the impedance of the resetting magnet at the called station is removed from the line circuit during a conversation.

From the circuits above described it will be noticed that the supervisory lamps 75 and 76 are lighted when the apparatus at the corresponding substations is returned to its normal position by hanging the receivers upon the hooks and that flow of current through the supervisory lamps 75 and 76 is interrupted by the opening of the plug seat switch S when the calling plug P′ is returned to its normal position.

The lever 23 at the substation A is polarized in order that if the contacts 14 and 15 become accidentally separated the resetting magnet 31 may not be actuated by an initial flow of current therethrough before the contacts 14 and 15 are closed by the energization of the core 13. The polarization of the lever 23 is in such a direction that it will only respond to a current flow through the resetting magnet 31 in the same direction that current flow through the primary winding of the induction coil 12 will cause an operation of the armature 11 to separate the contacts 14 and 15. This provides that actuation of the resetting magnet 31 can only take place when current has been properly applied to the line circuit to reverse the direction of energization of the core 13 whether the contacts 14 and 15 are closed or not.

From the above it will appear that if the called subscriber does not respond, although the registering mechanism at the calling substation has been actuated, the calling subscriber is not improperly charged because when he makes the next call, it will effect no actuation of the registering mechanism, inasmuch as it was not reset during the preceding calling operation. In other words, by my system, although a call may be registered, when the called party is not available, still the charged call is in effect credited since no advance of the registering mechanism is made for the next call which may be responded to by the called subscriber.

The arrangement of the meter operating mechanism at the substation D is identical with that shown and described for the substation A, the only difference being that in connection with the substation D the lever 23 is shown in its lower position and the switch hook 19 is shown in its normal position supporting the receiver R.

In Fig. 2 a modified form of substation apparatus adapted to operate the registering mechanism is shown which differs from that shown in Fig. 1 in that an operating magnet 85 is provided for actuating the registering mechanism in place of mechanically actuating the register by means of the switch hook 19. The winding of the magnet 85 is connected between the line conductor 1 and the spring 18^b adapted to be engaged by the spring 18 when the hook switch is in its normal position. Switch springs 86 and 87 are included in this path for the purpose of interrupting the circuit of the magnet 85 when the lever 23 is moved downward at its right hand end by the energization of the magnet to advance the registering mechanism 22. The springs 86 and 87 which are in contact when the lever 23 is in its set position, are so conformed at their upper ends as to engage rollers 88 and 89 carried by the right hand end of the lever 23. When the lever is in its set position the spring 86 engages the roller 88 but the engagement between the springs 86 and 87 serves to lift the spring 87 from engagement with the roller 89. When, however, the lever 23 is moved downward at its right hand end the roller 89 comes into engagement with the spring 87 while the roller 88 is moved from engagement with the spring 86 thus allowing the spring 86 to spring away to the left from engagement with the spring 87 and open the circuit through the energizing winding of the magnet 85. The conformation of the upper end of the spring 87 serves at this time to retain the lever 23 in the position to which it has been moved by the magnet 85. In this modified form of apparatus the springs 32 and 33 are conformed at their upper ends to engage the rollers 32′ and 33′ which are carried by the left hand end of the lever 23. The coöperation of the springs 32 and 33 and the rollers 32′ and 33′ is similar to that already shown and described in connection with Fig. 1, the spring 33 serving, when the lever 23 is moved downward at its left hand end, to lock the lever in such position until it is positively operated by means of the magnet 85. In this modification the transmitter and primary winding of the induction coil 12 are included between the winding 31 and the spring 17 of the hook switch instead of being included between the line conductor 2 and the spring 18 as shown in Fig. 1. A ringer 90 may be connected between the line conductor 1 and spring 87 if desired, a condenser being interposed to prevent the flow of steady current in a manner well known in the art.

In Fig. 3 there is shown a means for preventing breaking of the contact between the contact member 14 and the contact 15 except when the polarized armature 11 is prop-

erly actuated to effect such result. In this modification the levers 14 and 14^c are pivoted together and pivotally supported at 14^b. A spring 14^f is secured at its ends to the two levers mentioned and stop pins 14^d and 14^e are provided to limit the motion of the lever 14^c. A yoke 11^b carried by the polarized armature 11 is so disposed as to engage the right hand end of the lever 14^c. Suitable clearance may be provided, however, so that the polarized armature 11 may have considerable more motion than is imparted to the right hand end of the lever 14^c. The lever 14 is arranged so that in one position it rests against a stop 14^a and in its other position it rests against the contact 15. The contact 15 and the stops 14^a, 14^d and 14^e are so disposed relatively to the pivot 14^b that when the lever 14^c is moved from one stop 14^d to the other stop 14^e, or vice versa, the spring 14^f passes the pivotal point 14^b and serves to forcibly move the other lever 14 from its previous position to its alternate position as the case may be. Thus the lever 14 is held positively in either of its positions by means of the spring 14^f and any vibration of the armature 11 will not result in throwing the lever 14 either from its stop 14^a into engagement with the contact 15 or away from the contact when it ought to be in engagement therewith.

While I have shown my invention in the particular embodiments herein described, I do not, however, limit myself to this construction, but desire to claim any equivalent that may suggest itself to those skilled in the art.

What I claim is:

1. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, means at the exchange for setting and shunting such meter by reversing the direction of current flow through the associated line upon a subscriber's answering a call, and means for actuating the meter.

2. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, means at the exchange for setting and shunting such meter by reversing the direction of current flow through the associated line by response of the called subscriber upon a subscriber's answering a call, and means for actuating the meter.

3. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter adapted to be actuated by mechanical operation located at one of such substations, means at the exchange for setting and shunting such meter by reversing the direction of current flow through the associated line upon a subscriber's answering a call, and means for actuating the meter.

4. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a self-shunting meter, means for automatically operating it upon the act of taking for use of the talking apparatus at the substation, and means at the exchange for setting such meter by reversing the direction of current flow through the associated line without interruption of use of the talking apparatus.

5. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter adapted to be mechanically operated by the switch hook in calling, means at the exchange for setting such meter by reversing the direction of current flow through the associated line and operating connection between the meter and switch hook.

6. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a call register meter at one of such substations, two sources of current connected in opposition, means for connecting one of such sources to a line in response to a call, and means for connecting the second source through the first source to reverse the direction of current flow in the line to set the meter and means for operating the latter for registering a call.

7. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, two sources of currents connected in opposition, means for connecting one of such sources to a line in response to a call to supply signaling and talking current to the line without operating the meter controlling mechanism, and means operated by the response of the called subscriber for connecting the second source through the first source to reverse the direction of current flow in the line to set the meter and means for operating the latter for registering a call.

8. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations means for operating it, a source of current at the exchange for supplying signaling current to the lines, a resetting magnet for the meter, a controlling magnet connected to the line circuit and adapted by its operation to cause the energization of the resetting magnet, application of signaling current to a calling line traversing the controlling magnet in an inoperative direction, and means for reversing the direction of current

flow through the line and the controlling magnet to cause its operation, such operation of the controlling magnet serving to cause current from the line to energize the resetting magnet of the meter.

9. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, a source of current at the exchange for supplying signaling current to the lines, a resetting magnet for the meter adapted to be operated by current flowing over the line circuit, a polarized relay connected with the line circuit and adapted to be actuated by current flow through the line in but one direction, a shunt circuit normally closed around the terminals of the resetting magnet by such relay, means for supplying signaling current to such line in response to a call in an inoperative direction relatively to such relay, a second source of current of higher potential than the first source, and means for connecting such second source to the line circuit through and in opposition to the first source to operate such relay, the operation of such relay serving to open the shunt circuit and cause actuation of the resetting magnet and means for operating the meter to register a call.

10. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, a source of current at the exchange for supplying signaling current to the lines, a resetting magnet for the meter adapted to be operated by current flowing over the line circuit, a polarized relay connected with the line circuit and adapted to be actuated by current flow through the line in but one direction, a shunt circuit normally closed around the terminals of the resetting magnet by such relay, means for supplying signaling current to such line in response to a call in an inoperative direction relatively to such relay, a second source of current of higher potential than the first source, and means automatically operated by the response of the called subscriber for connecting such second source to the line circuit through and in opposition to such first source to operate such relay, the operation of such relay serving to open the shunt circuit and cause the actuation of the resetting magnet and means for operating the meter to register a call.

11. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, a source of current at the exchange for supplying current to such line in an inoperative direction relatively to the meter, a second source of current of higher potential than the first source, and means for connecting such second source to the line through and in opposition to such first source to reset the meter and means for operating the meter to register a call.

12. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, a source of current at the exchange for supplying signaling current to the lines, a resetting magnet for the meter adapted to be operated by current flowing over the line circuit, a polarized relay connected with the line circuit and adapted to be actuated by current flow through the line in but one direction, a shunt circuit normally closed around the terminals of the resetting magnet by such relay, mechanism associated with the switch hook at the substation to actuate the meter, such switch hook serving when in its normal position to interrupt the circuit through such relay, means for supplying signaling current to such line in response to a call in an inoperative direction relatively to such relay, and means for reversing the direction of current flow in the line to operate such relay, the operation of such relay serving to open the shunt circuit and cause actuation of the resetting magnet.

13. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, a source of current at the exchange for supplying signaling current to the lines, a resetting magnet for the meter adapted to be operated by current flowing over the line circuit, a polarized relay connected with the line circuit and adapted to be actuated by current flow through the line in but one direction, a shunt circuit normally closed around the terminals of the resetting magnet by such relay, mechanism associated with the switch hook at the substation to actuate the meter, such switch hook serving when in its normal position to interrupt the circuit through such relay, means for supplying signaling current to such line in response to a call in an inoperative direction relatively to such relay, a second source of current of higher potential than the first source, and means for connecting such second source to the line circuit through and in opposition to the first source to operate such relay, the operation of such relay serving to open the shunt circuit and cause actuation of the resetting magnet.

14. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, a source of current at the exchange for supplying signaling current to the lines, a resetting magnet for the meter adapted to be operated by current flowing over the line cir-

cuit, a polarized relay connected with the line circuit and adapted to be actuated by current flow through the line in but one direction, a shunt circuit normally closed around the terminals of the resetting magnet by such relay, means for supplying signaling current to such line in response to a call in an inoperative direction relatively to such relay, means for reversing the direction of current flow in the line to operate such relay, the operation of such relay serving to open the shunt circuit and cause actuation of the resetting magnet, a second shunt circuit about the terminals of the resetting magnet adapted to be closed by the resetting of the meter and an operating connection between the meter and switch hook of the subscriber's substation apparatus.

15. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, a source of current at the exchange for supplying signaling current to the lines, a resetting magnet for the meter adapted to be operated by current flowing over the line circuit, a polarized relay connected with the line circuit and adapted to be actuated by current flow through the line in but one direction, a shunt circuit normally closed around the terminals of the resetting magnet by such relay, mechanism associated with the switch hook at the substation to actuate the meter, such switch hook serving when in its normal position to interrupt the circuit through such relay, means for supplying signaling current to such line in response to a call in an inoperative direction relatively to such relay, a second source of current of higher potential than the first source, means for connecting such second source to the line circuit through and in opposition to the first source to operate such relay, the operation of such relay serving to open the shunt circuit and cause actuation of the resetting magnet and a second shunt circuit about the terminals of the resetting magnet adapted to be closed by the resetting of the meter.

16. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, a battery at the exchange adapted to send signaling current through a line when in calling condition, such current also traversing the meter controlling mechanism without effecting its operation, switching mechanism at the exchange for supplying talking current to the calling line through the meter controlling mechanism without operating the same, and a relay at the exchange operated by the response of a called subscriber, the operation of a such relay serving to supply current through the switching means in a reverse direction to the line to cause the resetting of the meter and means for operating the meter to record a call.

17. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, a meter at one of such substations, a source of current at the exchange for supplying signaling current to the lines, a resetting magnet for the meter adapted to be operated by current flowing over the line circuit, a polarized relay connected with the line circuit and adapted to be actuated by current flow through the line in but one direction, a shunt circuit normally closed around the terminals of the resetting magnet by such relay, mechanism associated with the switch hook at the substation to actuate the meter, such switch hook serving when in its normal position to interrupt the circuit through such relay, means for supplying signaling current to such line in response to a call in an inoperative direction relatively to such relay, a second source of current of higher potential than the first source, a second relay at the exchange operated by response of the called subscriber, the operation of such second relay serving to connect such second source to the line circuit through and in opposition to the first source to operate the polarized relay, the operation of such polarized relay serving to open the shunt circuit and cause actuation of the resetting magnet, and a second shunt circuit about the terminals of the resetting magnet adapted to be closed by the resetting of the meter.

18. In a telephone system, a self-shunting substation meter having a member movable in one direction for operating it, means for actuating said member in said direction upon use of the substation apparatus to initiate a call and means for electrically resetting said member in the opposite direction.

19. In a telephone system, a central exchange, a self-shunting substation meter comprising registering mechanism and a member movable in one direction for operating it upon use of the substation apparatus to initiate a call and means for moving said member in the opposite direction operated electrically from the exchange.

20. In a telephone system, a central exchange, a substation meter comprising registering mechanism and a member movable in one direction, for operating it upon use of the substation apparatus in calling the exchange, a line circuit extending from the substation to the exchange and means operated by a reversal of current in said circuit resulting from the response of the called subscriber for moving said operating member in the opposite direction.

21. In a telephone system, a substation meter comprising the combination of registering mechanism, a line circuit extending

from the substation to an exchange, a resetting magnet for the meter, and a controlling magnet, such controlling magnet adapted to be operated by a reversal of current therethrough resulting from the response of the called subscriber and means for operating the meter.

22. In a telephone system, a substation meter comprising the combination of registering mechanism, a resetting magnet for the meter, and a controlling magnet, such resetting magnet normally rendered inoperative by the controlling magnet and placed in condition to operate by operation of the controlling magnet and means for operating the meter.

23. In a telephone system, a substation meter comprising the combination of registering mechanism, a resetting magnet for said mechanism, a circuit therefor and a second magnet controlling the energization of the resetting magnet, such resetting magnet circuit being normally inoperative and adapted to be placed in operative condition by the conjoint operation of the controlling magnet and the movement of the substation switch hook to its calling position.

24. In a telephone system, a substation meter comprising the combination of registering mechanism, a resetting magnet for the meter, and a controlling magnet, such resetting magnet normally rendered inoperative by the controlling magnet and the substation switch hook, and placed in condition to operate by motion of the switch hook to a calling position and by operation of the controlling magnet and means for operating the meter.

25. In a telephone system, a substation meter comprising the combination of registering mechanism, a resetting magnet for the meter, and a controlling magnet, such resetting magnet normally inoperative and adapted to be placed in operative condition by motion of the substation switch hook to its calling position, motion of the switch hook serving to actuate the meter.

26. In a telephone system, a substation meter comprising the combination of registering mechanism, a resetting magnet for the meter, and a controlling magnet, such resetting magnet normally rendered inoperative by the controlling magnet and the substation switch hook and placed in condition to operate by motion of the switch hook to a calling position and by operation of the controlling magnet, motion of the switch hook serving to actuate the meter.

27. In a meter adapted for use at a telephone substation, the combination of registering mechanism, an electromagnet for setting the register, and means controlled by the setting operation for closing a shunt between the terminals of the resetting magnet.

28. In a meter adapted for use at a telephone substation, the combination of registering mechanism, an electromagnet for resetting the registering mechanism, and switch springs controlled by the resetting magnet and adapted to close a shunt between the terminals of such magnet when the same is operated.

29. In a meter adapted for use at a telephone substation, the combination of registering mechanism, an electromagnet for resetting the registering mechanism, and switch springs controlled by the resetting magnet and adapted to close a shunt between the terminals, of such magnet when the same is operated, such switch springs adapted to retain the registering mechanism in its reset position.

30. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, meters associated with the telephone lines at the substations, a resetting magnet associated with each meter and adapted to be operated by current in the line circuit, and means for removing the impedance of the resetting magnet at the calling and called substations from the line during a conversation.

31. In a telephone exchange system, the combination of a main exchange, telephone lines extending from substations to such exchange, meters associated with the telephone lines at the substations, a magnet associated with each meter for resetting the same, a polarized relay for controlling the operation of each resetting magnet, operation of the polarized relay at the calling substation serving to actuate the resetting magnet and close a shunt circuit between its terminals, and the polarized relay at the called station serving by remaining in its normal position during a conversation to remove from the line circuit the impedance of the associated resetting magnet.

In witness whereof, I hereunto subscribe my name this 10th day of February, A. D. 1910.

GARRISON BABCOCK.

Witnesses:
ALBERT C. BELL,
ROBERT F. BRACKE.