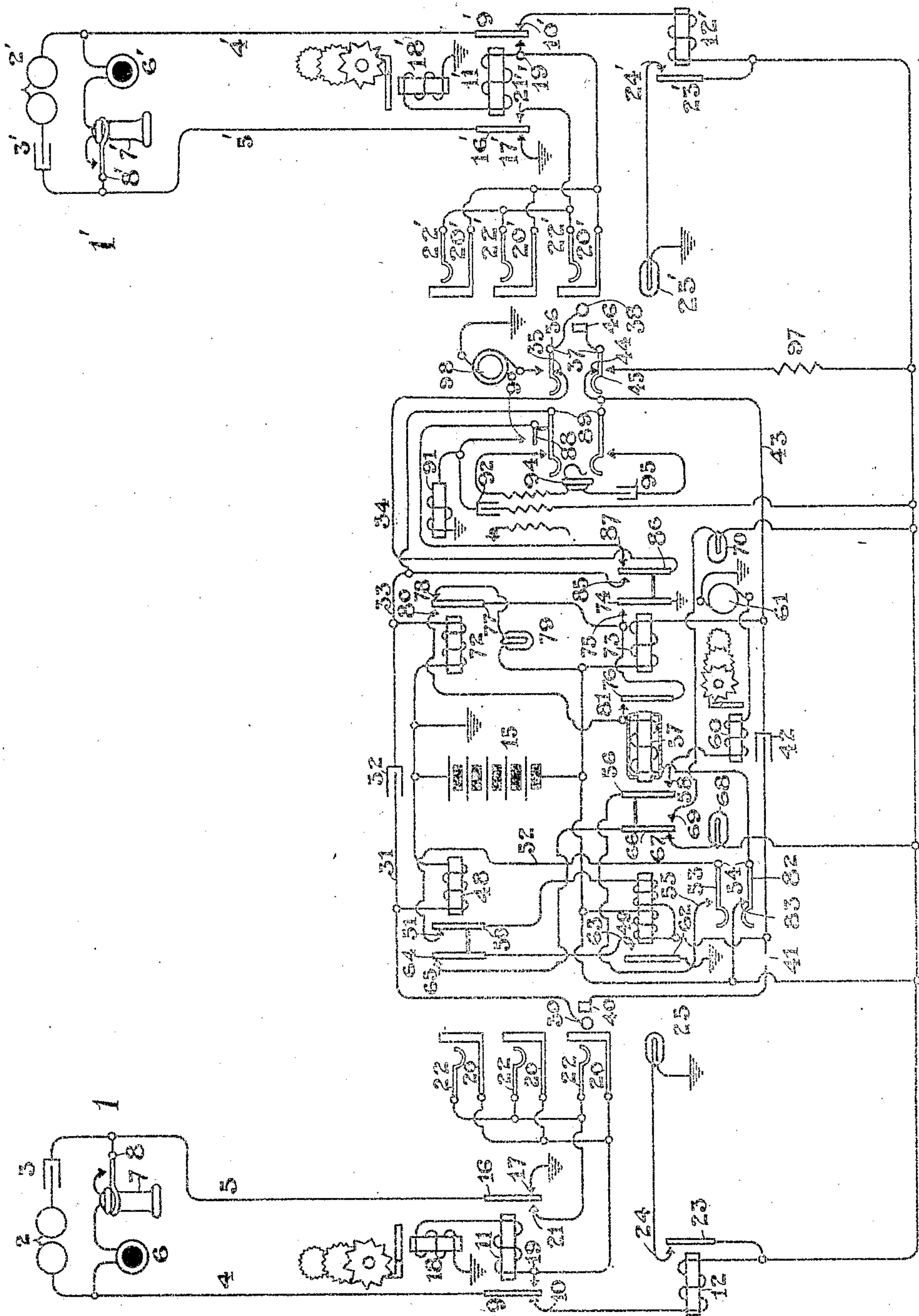


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SERVICE METER SYSTEM.
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SERVICE-METER SYSTEM.

976,184

Specification of Letters Patent.

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To all whom it may concern.

Be it known that I, GUY A. JOY, a citizen of the United States, residing in Chicago, county of Cook, and State of Illinois, have
5 invented certain new and useful Improvements in Service-Meter Systems, of which the following is a specification.

My invention relates to service meter systems for two-wire multiple telephone sys-
10 tems.

The object of my invention is to provide a system which will be simple in its operation but one which can be operated without causing a noise in the calling subscriber's
15 telephone during the time that the telephone is held at the subscriber's ear.

It has been customary in the past to register calls against calling subscribers as soon as the called subscriber answers his call. It
20 is, of course, necessary in a two-wire multiple system to in some way change the current condition in the multiple jacks in order to operate the service meter, and it is the object of my invention to so arrange my sys-
25 tem that this current change in the conductors of the multiple jack cannot occur until after the conversation has been terminated and the calling subscriber has replaced his receiver upon the switch hook. In this
30 way the signal may be given without disturbing the conversation in any way.

My invention is illustrated in the accompanying drawing which shows all of the apparatus in its normal or unactuated condi-
35 tion and which represents a complete system comprising the calling and called telephone lines and the connecting cord circuit.

The subscriber's station No. 1 is illustrated as the calling station and is equipped
40 with the annunciator 2 and condenser 3 in a permanent bridge between the line conductors 4 and 5, and with the transmitter 6 and receiver 7 in a bridge maintained normally open by contacts of the switch hook 8. The
45 line conductor 4 is connected at the central office through contacts 9 and 10 of cut-off relay 11 and the coil of line relay 12 with the live pole of battery 15 and line conductor 5 is connected through contacts 16 and 17 of
50 cut-off relay 11 with earth.

One terminal of the cut-off relay 11 is connected through the coil of the line service meter 18 with ground and the other terminal of the coil of relay 11 is connected with

its normally open contact 19 and with the
55 sleeve contacts 20 of the answering and multiple jacks. The other normally open contact 21 of cut-off relay 11 is connected with the tip contacts 22 of the answering and
60 multiple jacks. Line relay 12 controls the normally open contacts 23 and 24 in the circuit of line lamp 25. The called telephone line is similarly equipped, the corresponding apparatus of this line being designated
65 by like figures the suffix "'".

The cord circuit to connect the lines for conversation is of the so-called two-conductor type. That is, there are two contacts to the answering and two contacts to the
70 calling plugs. The tip strand of the cord circuit extends from the tip 30 of the calling plug through conductor 31, condenser 32, conductors 33 and 34 and the series contacts
75 35 and 36 of the operator's ringing key 37 to the tip contacts 38 of the calling plug. The sleeve strand extends from the sleeve contact 40 of the answering plug through conductor
41, condenser 42, conductor 43 and the series contacts 44 and 45 of the operator's ringing
80 key 37 to the sleeve contact 46 of the calling plug. The answering end of the cord circuit has the supervisory relays 48 and 49, relay 48 having its coil bridged between the
85 tip strand 31 and the ground pole of battery 15, and relay 49 having its main coil bridged between the sleeve strand 41 and the live pole of battery 15. Relay 49 also has an
auxiliary coil which is preferably of lower resistance and connected between the sleeve
90 strand 41 of the cord circuit and contact 50 of relay 48. Contact 50 is normally connected through contact 51 of relay 48 and
conductor 52 with the tip spring 53 of the service meter key 54. The actuation of the
95 service meter key 54 connects the spring 53 with contact 55, that contact being connected with the spring 56 of locking relay 57. The relay 57 which is preferably made
slow acting by means of a copper shell, has the normally open contact 58 adapted
100 to be engaged by the spring 56, this contact being connected through the coil of the position meter 60 with the live pole of the direct current generator 61, the other
pole of this generator being connected with
105 ground. This generator is preferably of a voltage somewhat higher than that of the main battery 15, though by the proper ad-

justment of resistance it may be of the same potential as the battery 15 and may in fact be the battery 15.

Relay 49 has the normally open contacts 5 62 and 63, the contact 62 being connected with ground and the contact 63 being connected through the normally closed contacts 64 and 65 of relay 48 and the normally closed contacts 66 and 67 of relay 57 with 10 one terminal of the supervisory signal 68, the other terminal of this signal being connected with the live pole of battery 15. Relay 57 also has the normally open contact 69 adapted to be engaged by the spring 66 15 when the relay is actuated. Contact 69 is connected with one terminal of the register signal 70, the other terminal of that signal being connected with the live pole of battery 15.

20 The calling end of the cord circuit has the supervisory relays 72 and 73, the relay 72 having its coil connected between the tip strand 33 and the ground pole of battery 15, and the relay 73 having its coil connected 25 between the tip strand 43 and the live pole of battery 15. Relay 73 has normally open contacts 74 and 75, contact 74 being connected with earth, and the contact 75 being connected both with the spring contact 76 30 of relay 57 and with the spring contact 77 of relay 72. Spring contact 77 of relay 72 is normally connected through the contact 78 and the calling supervisory signal 79 with the live pole of battery 15. Relay 72 35 also has the normally disconnected contact 80 adapted to be engaged by contact 77 when the relay is actuated, this contact 80 being connected with the normally open contact 81 of relay 57 and with one terminal of the 40 coil of this relay is connected with the lower spring 82 of the service meter key 54 and through the normally closed contact 83 of that key with the live pole of battery 15. Relay 73 also has the normally open con- 45 tacts 85 and 86 maintaining a normal separation between the portions 33 and 34 of the tip talking strand.

The spring 86 of relay 73 is normally connected through contact 87 to the auxiliary 50 contact 88 of the operator's listening key 89. This auxiliary contact is adapted to connect with the contact 90 when the key is actuated, this contact 90 being connected through the impedance coil 91 with earth and also with 55 one terminal of the condenser 92, the other terminal of this condenser being connected through the tertiary winding of the operator's induction coil with the live pole of battery 15. The operator's receiver 94 and 60 the condenser 95 are adapted to be placed in a bridge between the talking strands by the actuation of the listening key 89.

The operation of the system will now be traced as it occurs when the call arises at 65 subscriber's station 1. The receiver 7 being

removed from the switch hook a path for current is completed from the live pole of battery 15 through the coil of line relay 12, contacts 10 and 9 of cut-off relay 11, con- 70 ductor 4, transmitter 6, receiver 7, switch hook 8, line conductor 5 and contacts 16 and 17 of cut-off relay 11 to ground. The current in this path actuates line relay 12 closing its contacts 23 and 24 and displaying the line signal 25. When the operator sees the 75 line signal displayed she inserts her answering plug into the jack designated by the signal and thus completes a circuit from the live pole of the battery 15 through the main coil of relay 49, sleeve contacts 40 and 20 of 80 the plug and jack, the coil of cut-off relay 11 and the coil of the line service meter 18 to ground. The current in this path is sufficient to actuate relays 11 and 49 but is not sufficient for the actuation of the line service 85 meter 18, this meter having considerable mechanical resistance. The actuation of cut-off relay 11 interrupts the circuit of the line relay 12, which now falls back and effaces the line lamp, and connects the line con- 90 ductors 4 and 5 with the contacts 20 and 22 of the jack. The actuation of relay 49 closes its contacts 62 and 63 but does not complete the circuit of the lamp 68 because its circuit is immediately broken at contacts 64 and 65 95 by the actuation of relay 48, the relay 48 being actuated by current from the live pole of battery 15 through the main coil of relay 49, sleeve contacts 40 and 20 of the plug and jack, contacts 19 and 9 of cut-off relay 100 11, line conductor 4, transmitter 6, receiver 7, switch-hook 8, line conductor 5, contacts 16 and 21 of the cut-off relay 11, tip contacts 22 and 30 of the jack and plug and the coil of supervisory relay 48 to ground. The 105 operator now throws her listening key 89 and inquires for the desired number. Finding this to be that of subscriber's line 1' she touches the tip contact of her calling plug to the sleeve contact 20' of one of the multiple 110 jacks of the desired line. If the desired line is busy one of its sleeve contacts will be in connection with the sleeve contact of another cord circuit and, therefore, all of the test contacts will be maintained at a potential 115 higher than that of ground. Current will therefore flow from the test contacts over the tip 38 of the calling plug through contacts 36 and 35 of ringing key 37, conductor 34, contacts 86 and 87 of relay 73, the now 120 closed contacts 88 and 90 of the listening key 89 and through the impedance coil 91 to ground. The current in this path will slightly change the potential of the top terminal of condenser 92 and will cause a partial 125 discharge of that condenser. This discharge causes a disturbance in the tertiary of the operator's induction coil which in turn causes a click in the operator's receiver. If no click is heard however, the operator 130

knows that the line is idle and she therefore inserts her calling plug completely into the jack of the desired line and throws her ringing key 37. Upon doing this the sleeve spring 45 of the key 37 is connected with battery, and, therefore, current flows over the sleeve contacts 46 and 20' through the coils of the cut-off relay and the service meter to ground. The resistance 97 is made high and the current is not sufficient to actuate the line service meter, but is sufficient to actuate the cut-off relay 11'. When this relay is actuated its contacts 9' and 16' assume their abnormal position and current from the ringing generator 98 flows over the tip contacts 38 and 22' of the plug and jack, contacts 21' and 16' of cut-off relay 11', line conductor 5', condenser 3', annunciator 2', line conductor 4', contacts 9' and 19' of cut-off relay 11', sleeve contacts 20' and 46 of the jack and plug, the lower contacts of the ringing key through the resistance 97 and through the battery 15 to ground. The current from the ringing generator 98 being alternating in form passes through the condenser 3' and sounds the annunciator 2'. The ringing key 37 is now released and a new path for current is completed from the live pole of battery 15 through the coil of supervisory relay 73, the sleeve conductor 43, series contacts 44 and 45 of ringing key 37, sleeve contacts 46 and 20' of the plug and jack and the coils of the cut-off relay 11' and the service meter 18' to ground. Current in this path maintains the actuation of the cut-off relay 11' and actuates the supervisory relay 73. The actuation of the latter relay closes its contacts 74 and 75 which complete a path from the live pole of battery 15 through the supervisory signal 79, contacts 78 and 77 of relay 72 and contacts 75 and 74 of relay 73 to ground. The current in this path displays the supervisory signal 79 and indicates to the operator that the called subscriber has not yet answered his call. The actuation of relay 73 also separates its contacts 86 and 87 disconnecting the testing apparatus from the tip of the calling plug and completing the connection between its contacts 85 and 86, thus closing the normal break between the portions 33 and 34 of the tip talking strand.

When the called subscriber answers his call a new path for current is completed over the path previously described from the live pole of battery 15 to the contact 19' of cut-off relay 11', thence through the spring 9', line conductor 4', transmitter 6', receiver 7', the now closed contacts of the switch hook 8', line conductor 5', contacts 16' and 21' of cut-off relay 11', tip contacts 22' and 38 of the jack and plug, series contacts 36 and 35 of the ringing key 37, conductor 34, contacts 86 and 85 of relay 73, conductor 33 and the coil of relay 72 to ground. The current

in this path actuates relay 72 opening its contacts 77 and 78 and severing the circuit of the calling supervisory signal 79, so that, that signal is now effaced. The actuation of relay 72 also closes the contacts 77 and 80 which complete a path for current from the live pole of battery 15 through contacts 83 and 82 of the service meter key 54, the coil of locking relay 57, contacts 80 and 77 of relay 72 and contacts 75 and 73 of relay 73 to ground. The current in this path actuates relay 57 and closes its contacts 76 and 81 in parallel with the contacts 77 and 80 of relay 72 so that if the relay 72 is again deenergized the circuit of relay 57 will be maintained through its own contacts 76 and 81. The actuation of relay 57 also disconnects the answering supervisory signal 68 from its connection with the spring 66 of relay 57 and substitutes therefor the service meter signal 70, this signal being preferably a signal of a different color to indicate to the operator that the service meter key must be thrown. The actuation of relay 57 also closes the normally open contacts 56 and 58 which complete the circuit between the position meter 60 and the contact 55 of the service meter key 54.

It will now be seen that if the operator actuates her service meter key 54 during the conversation the circuit will be completed from the generator 61 through the position meter 60, contacts 58 and 56 of locking relay 57, contacts 55 and 53 of service meter key 54 to the contact 51 of relay 48, but the circuit will here be interrupted because the relay 48 is actuated during the entire conversation. Therefore, the actuation of the key 54 during conversation will have no effect upon the service meter 18. Neither would the actuation of the key 54 have any effect upon the service meter 18 after the relay 48 had been deenergized by the calling subscriber hanging up his receiver if the called subscriber had not answered his call, because under those conditions the locking relay 57 remains in its normal position, and the circuit for actuating the service meter would be interrupted at contacts 56 and 58 of relay 57. However, when both the calling and the called subscribers hang up their receivers after the termination of their conversation, or if only the calling subscriber hangs up his receiver the service meter signal 70 is displayed. The circuit for displaying this signal is completed from the live pole of battery 15 through the signal 70, contacts 69 and 66 of the now actuated relay 57, contacts 65 and 64 of relay 48, and contacts 63 and 62 of relay 49 to ground.

When the signal 70 is displayed the operator throws her service meter key 54 and thus completes a path from the live pole of the generator 61 through the coil of the position meter 60, contacts 58 and 56 of lock-

ing relay 57, contacts 55 and 53 of service meter key 54, conductor 52, contacts 51 and 50 of relay 48, the auxiliary coil of relay 49, the sleeve conductor 41, sleeve contacts 40 and 20 of the plug and jack, the coil of cut-off relay 11 and the coil of line service meter 18 to ground. The current in this path is preferably from a high voltage source and therefore is sufficient to actuate the service meter 18 which thus registers a call against the calling subscriber. When the service meter key 54 is actuated its contacts 82 and 83 are severed and if the called subscriber has also hung up his receiver the locking circuit of relay 57 will be broken at contacts 81 and 76 of that relay such that one impulse only will be given to the line service meter and such that it is impossible for the operator by a number of actuations of the key 83 to register more than one call against the calling subscriber. The service meter signal 70 is now effaced, its circuit having been interrupted at contacts 66 and 69 of relay 57 when the locking circuit for that relay was interrupted. When that relay resumes its normal position, however, the circuit of the supervisory signal 68 is again completed at contacts 66 and 67 of relay 57 and the signal is continuously displayed until the operator removes her answering plug from the jack at which time the circuit of relay 49 is interrupted and its contacts fall to their normal positions and interrupt the circuit of the signal 68. When the calling plug is removed from the jack the circuit of relay 73 is interrupted and its contacts resume their normal position again interrupting the circuit of supervisory signal 79. The signals are now all effaced at the central office and the system is in condition for completing a second connection.

Many details of the system shown and described could be changed without materially altering the operation and it is to be understood that I do not wish to be too closely limited to the circuit arrangement. Many other features of the system are only conventionally shown and form no part of my invention, and it is to be understood that any well known form of apparatus may be substituted for these without departing from the spirit or scope of my invention.

I claim:

1. In a telephone system, a service meter for each line at the central office of the system, a cord circuit to connect with said line, and means associated with said cord circuit permitting the actuation of said service meter only after a conversation has been terminated, substantially as described.

2. In a telephone system, the combination with a telephone line, a cord circuit to connect with said line, of a service meter therefor at the central office of the system under

the control of the operator, and means associated with said cord circuit to prevent the actuation of said service meter by the operator during conversation, substantially as described.

3. In a telephone system, the combination with a telephone line, a cord circuit to connect with said line, of a service meter therefor at the central office of the system actuated over a talking strand, and means associated with said cord circuit to prevent the actuation of said service meter by the operator during conversation, substantially as described.

4. In a telephone system, the combination with a telephone line, of a service meter therefor at the central office of the system actuated over a portion of the talking circuit, and means permitting the actuation thereof by the central office operator only after the conversation has been terminated, substantially as described.

5. In a telephone system, the combination with a telephone line, of a service meter adapted to be actuated by a change of potential of one of the talking strands of the line, and means at the central office of the system to prevent the operator from producing the proper change of potential on the line to operate the service meter during conversation whereby the subscribers will not be disturbed by the actuation of the meter, substantially as described.

6. In a telephone system, the combination with a telephone line, of a service meter therefor at the central office of the system, a cord circuit to connect with the line, and a signal for the cord circuit adapted to be displayed when the calling subscriber replaces his receiver upon the hook to indicate to the operator that the service meter has not been actuated, substantially as described.

7. In a telephone system, the combination with a telephone line, of a service meter therefor, a cord circuit to connect with the line, a service meter key associated with the cord circuit, a slow-acting relay, the actuation of said service meter key being adapted to open the circuit of the coil of said slow-acting relay, whereby the relay is deenergized, and to close a circuit through the contacts of said relay and the coil of the service meter, whereby the service meter will receive a single impulse to actuate the same, substantially as described.

8. In a telephone system, the combination with a telephone line, of a service meter therefor, a cord circuit to connect with the line, a relay for the cord circuit having a locking circuit, a key having normally closed contacts in the locking circuit of said relay, said key also having normally open contacts in the circuit of the service meter and the

contacts of said relay, whereby the actuation of said key will give a single impulse of current through the service meter, substantially as described.

5 9. In a telephone system, the combination with a telephone line terminating at the central office in a two-point jack, of a service meter for the line at the central office of the system actuated by current over one of the
10 points of said jack, and means to prevent the operator from disturbing the potential of the limbs of the telephone line by attempting to operate the meter during conversation, substantially as described.

15 10. In a telephone system, the combination with a telephone line terminating at the central office in a two-point jack, of a service meter for the line actuated by current over one of the points of said jack, and
20 means to prevent the actuation of said service meter by the operator during conversation, substantially as described.

25 11. In a telephone system, the combination with a telephone line, of a line service meter therefor, a cord circuit to connect with the line, a position meter for the cord circuit, a source of current associated with the cord circuit, a service meter key, and means
30 whereby the continued actuation of said service meter key will connect the position meter and the line service meter in series

with said source for a short duration of time only, substantially as described.

12. In a telephone system, the combination with a telephone line, of a service meter 35 therefor, a cord circuit to connect with the line, calling and answering supervisory signals for the cord circuit, and an additional signal adapted to be displayed only when the calling subscriber has replaced his receiver upon the hook to indicate that the
40 service meter has not yet been actuated, substantially as described.

13. In a telephone system, the combination with a telephone line, of a service meter 45 therefor, a cord circuit to connect with the line, a service meter key, a locking relay for the cord circuit, the circuit of said locking relay being initially under the control of the called subscriber and thereafter under
50 the control of the operator, and contacts of said service meter key and contacts of said locking relay in the circuit of said service meter, substantially as described.

Signed by me at Chicago, county of Cook, 55 and State of Illinois, in the presence of two witnesses.

GUY A. JOY.

Witnesses:

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