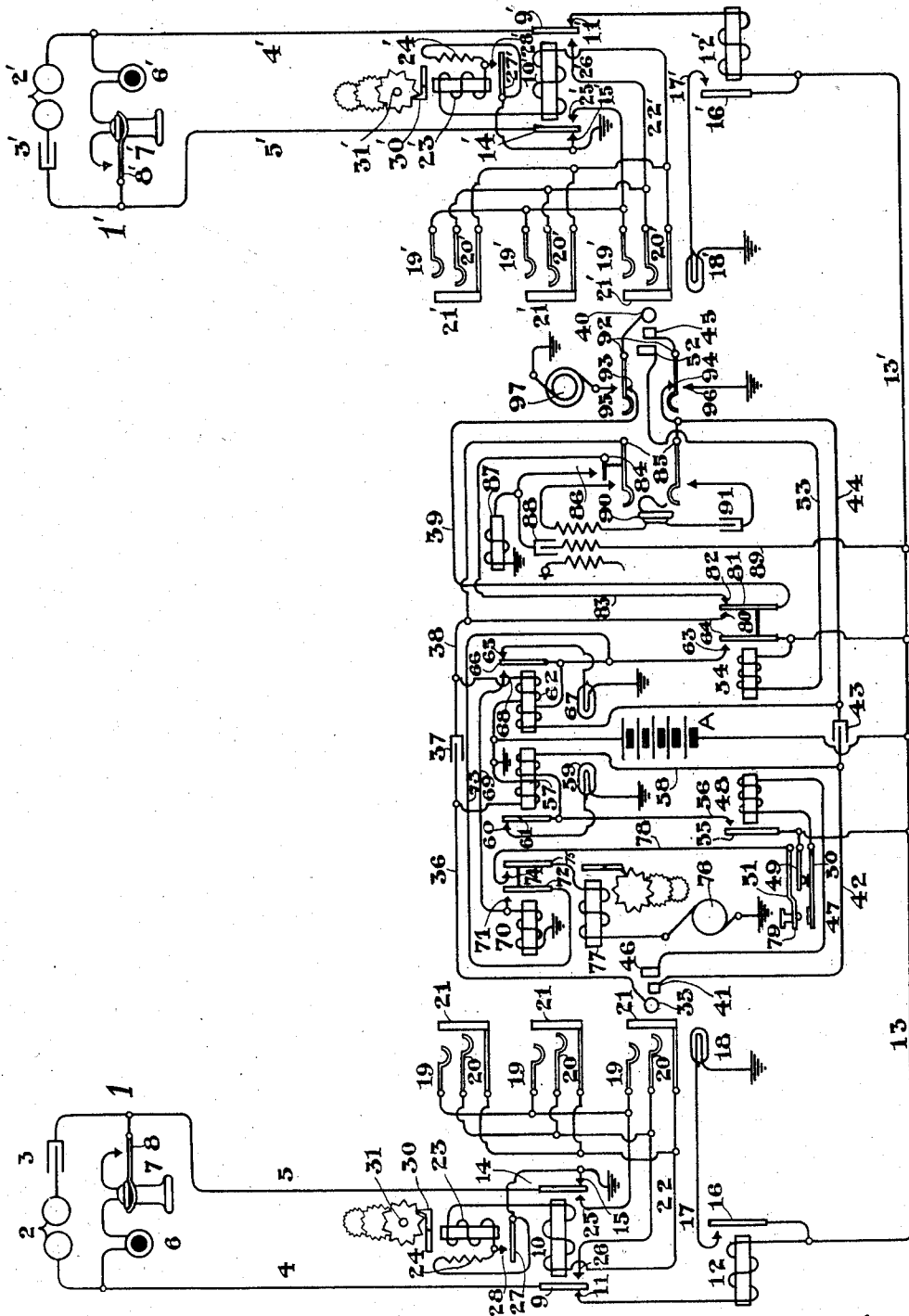


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SERVICE METER SYSTEM.
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SERVICE-METER SYSTEM.

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To all whom it may concern:

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

My invention relates to telephone systems, and particularly to systems of the central energy three-conductor type having service meters at the central office to register calls made by a subscriber in the use of his telephone.

It is the object of my invention to improve systems of this character and to provide a system in which it is impossible to register more than one call against a subscriber for a single connection, and in which it is impossible to register a call against a called subscriber.

My invention is illustrated in the accompanying drawing in which all apparatus is shown in its normal and unactuated condition.

In the system here shown the substation 1 is illustrated as the calling station and is equipped 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 the contacts of the switch hook 8. Line conductor 4 terminates at the central office in the spring 9 of cut-off relay 10, this spring being normally connected through contact 11 and the coil of line relay 12 and conductor 13 with the live pole of battery A. The line conductor 5 is connected with the spring 14 of cut-off relay 10 and thence through contact 15 with earth. The line relay 12 controls the normally open contacts 16 and 17 in the circuit of the line lamp 18. The answering and multiple jacks have the tip, ring and sleeve contacts 19, 20 and 21. The sleeve contact 21 is connected through conductor 22, the coil of cut-off relay 10, coil of line service meter 23 and non-inductive resistance 24 with earth. Contacts 19 and 20 are connected respectively with the inside contacts 25 and 26 of cut-off relay 10. The service meter 23 has the normally open contacts 27 and 28 adapted when closed to complete a shunt about the non-inductive resistance 24. This meter also has the actuating armature 30 for moving the registering mechanism 31, though it is to

be understood that armatures 27 and 30 may be one and the same.

The called line 1' is similarly equipped with apparatus of the same character as that of the calling line, the corresponding apparatus being designated by like figures with the suffix "'".

The cord circuit for connecting the calling and called lines for conversation has three principal strands to connect respectively with the tip, ring and sleeve conductors of the answering and multiple jacks. The tip strand extends from the tip 35 of the answering plug through conductor 36, condenser 37, conductors 38 and 39 to the tip 40 of the calling plug. The ring strand extends from the ring contact 41 through conductor 42, condenser 43, conductor 44 to the ring contact 45 of the calling plug. The sleeve contact 46 of the answering plug is connected through conductor 47, the coil of relay 48, and the normally closed contacts 49 and 50 of the operator's meter key 51 to the live pole of battery A. The sleeve contact 52 of the calling plug is connected through conductor 53 and the coil of relay 54 with the live pole of battery A. Supervisory relay 48 has the normally open contacts 55 and 56 adapted when closed to complete the circuit of the main battery A through one of the coils of supervisory relay 57, over conductor 58 to the ring talking strand of the cord circuit. Relay 57 has its other coil connected between the ground pole of battery A and the tip talking conductor of the cord circuit. Contacts 55 and 56 of relay 48 are also adapted when closed to complete the circuit of supervisory signal 59, which circuit is adapted to be broken by contacts 60 and 61 of relay 57.

The calling end of the cord circuit is similarly equipped with relay 62 which has two coils inductively connected, one between the ground pole of battery A and the tip conductor of the cord circuit, and the other between the sleeve conductor of the cord circuit and the contact 63 of supervisory relay 54, this contact being adapted to be connected with battery through the contact 64 when the relay 54 is actuated. Relay 62 has the normally closed contacts 65 and 66 in the circuit of the supervisory signal 67 and in addition has the normally open contact 68 which is connected through conductor 69 with the coil of the locking relay 70. This

locking relay has the normally open contact 71 connected with the conductor 69 and adapted to be connected through contact 72 and conductor 73 with the contact 63 of supervisory relay 54. The locking relay 70 also has the normally open contacts 74 and 75 which are adapted when closed to complete the circuit from the direct current generator 76 through the position meter 77 and conductor 78 to the contact spring 79 of the service meter key 51.

Supervisory relay 54 has the normally open contacts 80 and 81 maintaining the normal separation between the portions 38 and 39 of the tip talking conductor. The spring 81 is in normal contact with the point 82 which is connected through conductor 83 with the auxiliary contact 84 of the operator's listening key 85. This contact 84 is adapted upon the actuation of the listening key to connect with the point 86 which is connected with one terminal of the impedance coil 87 and with one terminal of the condenser 88. The other terminal of impedance coil 87 is connected with earth, and the other terminal of the condenser 88 is connected through the tertiary winding of the operator's induction coil and conductor 89 with the live pole of battery A. The secondary of the operator's induction coil, the operator's receiver 90 and the condenser 91 are adapted to be placed in a bridge between the talking strands of the cord circuit by the actuation of the listening key 85.

The operator's ringing key 92 has tip and ring springs connected with the tip and ring contacts of the calling plug, these springs being normally connected with the talking strands of the cord circuit through contacts 93 and 94, and being adapted to be connected through contacts 95 and 96 with the ringing generator 97 and earth when the ringing key is actuated.

In the operation of my invention the calling subscriber removes his receiver 7 from the switch hook 8, and thereby completes a circuit from the like pole or battery A through conductor 13, the coil of line relay 12, contacts 11 and 9 of cut-off relay 10, line conductor 4, transmitter 6, receiver 7, the now closed contacts of the switch hook 8, line conductor 5 and contacts 14 and 15 of cut-off relay 10 to earth. The current in this path actuates line relay 12 closing its contacts 16 and 17 and completing the circuit of the line signal 18. This signal being thus displayed, the operator inserts her answering plug into the answering jack of the line so designated and causes the tip, ring and sleeve contacts 35, 41 and 46 of her answering plug to register with the corresponding contacts 19, 20 and 21 of the answering jack. This completes a circuit from the live pole of battery A through contacts 49 and 50 of the service meter key 51, the

coil of relay 48, conductor 47, sleeve contacts 46 and 21 of the plug and jack, conductor 22, the coil of cut-off relay 10, the coil of the line service meter 23 and non-inductive resistance 24 to earth. The battery A being of the customary voltage of substantially 24 volts, furnishes sufficient current for the actuation of relays 48 and 10, but does not furnish sufficient current for the actuation of the line service meter 23, this meter being adjusted with its armature at a considerable distance from the core and having considerable mechanical resistance on account of the mechanism required to be moved. The actuation of cut-off relay 10 interrupts the circuit of the line relay 12 at contacts 9 and 11 of the cut-off relay and thereby allows relay 12 to fall back and sever the circuit of the line signal 18. The actuation of relay 10 also disconnects its contact 14 from ground and connects it with the contact 25 which extends to the tip contact 19 of the jack. The actuation of relay 48 completes the circuit from the live pole of battery A through contacts 55 and 56, one of the coils of relay 57, conductor 58, the ring conductor 42 of the cord circuit, ring contacts 41 and 20 of the plug and jack, contacts 26 and 9 of the cut-off relay 10, line conductor 4, transmitter 6, receiver 7, switch hook 8, line conductor 5, contacts 14 and 25 of the cut-off relay 10, tip contacts 19 and 35 of the jack and plug, tip conductor 36 and the other coil of supervisory relay 57 to the ground pole of battery A. Current in this path actuates the relay 57 and operates its contacts 60 and 61, thus preventing the display of the supervisory signal 59 which would otherwise have been displayed by current through the contacts 60 and 61.

The operator now receives the desired number and raising her calling plug, touches it to the sleeve or test contact of the jack of the desired line. If the desired line is busy the sleeve contact of one of its multiple jacks will be connected with the sleeve contact of another cord circuit and will therefore be at a potential higher than that of ground. Current will therefore flow from the sleeve 21' through the tip 40, contact 93 of the ringing key 92, conductor 39, contacts 81 and 82 of the sleeve supervisory relay 54, conductor 83, the now closed contacts 84 and 86 of the operator's listening key 85 and through the impedance coil 87 to earth. This will slightly lower the potential of one terminal of the condenser 88 and cause that condenser to be partially discharged, thus producing an inductive kick in the secondary of the operator's induction coil and therefore in the operator's receiver which is connected in series therewith. However, if no kick is received the operator will insert her calling plug into the jack of the desired line and will release her listening key 85 and

actuate her ringing key 92. The insertion of the plug into the desired line completes a circuit from the live pole of battery A through the coil of supervisory relay 54, conductor 53, sleeve contacts 52 and 21' of the plug and jack, conductor 22', the coil of cut-off relay 10', the winding of the line service meter 23' and the non-inductive resistance 24' to earth. The current in this path actuates relays 54 and 10' but is not sufficient to actuate the service meter 23'. The actuation of relay 10' moves its contacts 9' and 14' into connection with the points 26' and 25' respectively, and the actuation of relay 54 closes its contacts 63 and 64 which complete the circuit of the supervisory signal 67 through the contacts 65 and 66 of the supervisory relay 62. The actuation of relay 54 also completes the continuity of the tip strand of the cord circuit between the portions 38 and 39 by closing contacts 80 and 81 and by the separation of contacts 81 and 82 disconnects the testing apparatus from the tip of the calling plug. The ringing key 92 now being thrown, current from the generator 97 passes through contact 95 over the tip contacts 40 and 19' of the plug and jack, contacts 25' and 14' of cut-off relay 10', line conductor 5', condenser 3', annunciator 2', line conductor 4', contacts 9' and 26' of cut-off relay 10', contacts 20' and 45 of the jack and plug and contact 96 of the ringing key to ground. Current from this generator being alternating passes through the condenser 3' and actuates the annunciator 2'.

When the desired subscriber answers his call and removes his receiver 7' from the switch hook 8', the ringing key having now been released, a circuit is completed from the live pole of battery A through contacts 64 and 63 of supervisory relay 54, one of the coils of supervisory relay 62, ring conductor 44, ring contacts 45 and 20' of the plug and jack, contacts 26' and 9' of cut-off relay 10', line conductor 4', transmitter 6', receiver 7', switch hook 8', line conductor 5', contacts 14' and 25' of cut-off relay 10', contacts 19' and 40 of the jack and plug, contact 93 of the operator's ringing key, conductor 39, the now closed contacts 81 and 80 of relay 54, conductor 38 and the other coil of relay 62 to the ground pole of battery A. The current in this path actuates relay 62, separating its contacts 65 and 66 and opening the circuit of the supervisory signal 67. The actuation of this relay also closes the contacts 66 and 68 completing a circuit from the live pole of battery A through contacts 64 and 63 of the supervisory relay 54, contacts 66 and 68 of supervisory relay 62, conductors 69 and the coil of locking relay 70 to ground. This actuates the relay 70 and connects its contacts 71 and 72, contact 72 being connected through conductor 73 to the contact 63 of

supervisory relay 54 in such manner that the contacts 71 and 72 are placed in a shunt about contacts 66 and 68 and the relay 70 is maintained actuated independent of the condition of relay 62. The actuation of relay 70 which occurs simultaneously with the response of the called subscriber completes the circuit from the direct current generator 76, which has a potential somewhat higher than battery A and in practice may be substantially 50 volts, through the coil of the position meter 77 and conductor 78 to the spring 79 of the service meter key 51. The operator now seeing that the subscribers are in satisfactory conversation depresses the service meter key 51 and completes the connection between its contacts 79 and 50 and immediately thereafter interrupts the connection between its contacts 50 and 49. Connecting contacts 79 and 50 complete the circuit from the generator 76 through the coil of relay 48, over conductor 47, sleeve contacts 46 and 21 of the plug and jack, coil of cut-off relay 10, the coil of the line service meter 23 and the non-inductive resistance 24 to earth. The current in this path furnished from the generator is sufficient to overcome the resistance of the service meter and to actuate that meter and register a call against the calling subscriber. The actuation of the meter completes its contacts 27 and 28 such that the non-inductive resistance 24 is shunted out of the circuit. The current for actuating the line service meter also passes through the position meter 77 and actuates that meter, thus registering one complete connection against the operator. Upon the release of the key 51 the battery circuit is again completed when the contacts 49 and 50 of the key 51 are again connected together. The service meter 23 now being actuated and the non-inductive resistance shunted, the current from the battery A is sufficient to hold the armature of the service meter in its actuated position, it requiring much less magnetism to maintain the armature held up than to initially actuate it, and furthermore, the current being considerably increased by the decrease in the resistance of the path caused by the shunting of the non-inductive resistance 24.

It will be seen that the operator will not be able to register a call against the calling subscriber until after the desired subscriber has answered his call because the contacts 74 and 75 of relay 70 maintain the interruption of the service meter circuit until the supervisory relay 62 has been actuated to complete the circuit of the relay 70, which controls the contacts 74 and 75. It will further be seen that even though the conversation is very short and the called subscriber hangs up his receiver before the operator has had time to press the service meter key 51 the relay 70 will not fall back

to its normal position and the operator may register the call even after the conversation has been entirely terminated.

When the subscribers have finished their conversation and hang up their receivers they interrupt the circuits of relays 57 and 62 allowing those relays to fall back to again complete the circuits of signals 59 and 67. The display of these signals indicates to the operator that the conversation has been completed and she removes her answering and calling plugs from their connection with the jacks of the calling and called lines and thereby severs the circuits of relays 48 and 54 and of relays 10 and 10', thus allowing all of the apparatus to resume its normal condition.

It is to be understood that this invention particularly relates to the circuits and combinations with respect to the service meters, and that it is entirely possible to adapt the principle here shown and described to many other forms of cord and line circuits, and therefore that I do not wish to be limited too closely to the particular arrangement here shown, many features of which may be changed without departing from the spirit or scope of my invention.

I claim:

1. In a telephone system, the combination with a telephone line, of a cut-off relay for the line, a service meter for the line having its coil connected in series with the cut-off relay, an auxiliary resistance for said cut-off relay normally in series with the coil thereof but adapted to be shunted by the actuation of the service meter, a cord circuit to connect with the line, a pair of sources associated with the cord circuit, one of said sources being normally connected with the coil of the service meter when the cord is connected with the line but of insufficient voltage to actuate the meter, and the other of said sources being adapted to be connected temporarily with the coil of the service meter and being of a potential high enough to actuate the service meter, substantially as described.

2. In a telephone system, the combination with a telephone line, of a service meter therefor connected with one of the jack contacts for the line, said service meter having an actuating coil and an auxiliary coil normally in series and contacts adapted to complete a shunt around the auxiliary coil when the meter is actuated, a cord circuit to connect with the line having a pair of sources associated therewith, one of said sources being connected with the coil of the line service meter when the cord is connected with the line but being of insufficient electro-motive force to actuate the service meter, the other source being adapted to be momentarily connected with the coil of the service meter and being of sufficient electro-motive

force to actuate it, the first source being of sufficient electro-motive force to maintain the actuation of the service meter after the second source is disconnected therefrom, substantially as described.

3. In a telephone system, the combination with a telephone line, of a service meter associated therewith and having its coils connected with one of the jack contacts of the line, an actuating coil and a resistance coil for said service meter normally connected in series, and contacts of the service meter adapted to shunt said resistance coil when the service meter is actuated, a cord circuit adapted to be connected with the line, means to direct a current through the coil of said meter insufficient for its actuation when the cord is connected with the line, and means to direct an increased current through the coil of said service meter sufficient for its actuation when it is desired to register a call, the current insufficient for the actuation of the service meter being sufficient to maintain the actuation thereof after the stronger current is removed, substantially as described.

4. In a telephone system, the combination with a telephone line, of a cut-off relay and the coil of a service meter therefor connected in series, an auxiliary coil for the service meter normally in series therewith, means to shunt said auxiliary coil when the service meter is actuated, a cord circuit to connect with the line, a pair of sources associated therewith, one of said sources being connected through the cut-off relay and the coils of the service meter when the cord is connected with the line but furnishing insufficient current for the actuation of the service meter, means to connect the other of said sources through the coils of the cut-off relay and the service meter without interrupting the circuit therethrough, said source furnishing sufficient current for the actuation of the service meter, the former source furnishing sufficient current to maintain the actuation of the service meter after the latter source has been removed, substantially as described.

5. In a telephone system, the combination with a telephone line having a service meter and a cut-off relay connected in series and with the sleeve contact of the line jack, a cord circuit to connect therewith having a source of current normally connected with the sleeve contact of the plug, a key having series contacts in the circuit of said source, a second source adapted to be connected with the sleeve of the plug by the actuation of said key, the first source being disconnected by the actuation of said key and means to reconnect the first source with the sleeve of the plug before the second source is disconnected therefrom, when the key is released, substantially as described.

6. In a telephone system, the combination

with a telephone line having a service meter and a cut-off relay connected in series and with the sleeve contact of the line jack, a cord circuit to connect therewith having a source of current normally connected with the sleeve contact of the plug, a key having normally-made contacts in the circuit of said source, a second source of current having normally-open contacts in the circuit of said second source and the sleeve contact of the plug, said latter contacts being adapted to be closed before the former contacts are opened in the actuation of the key, whereby the circuit through the service meter will not be interrupted by the actuation of the key, substantially as described.

7. In a telephone system, the combination with a telephone line, of a service meter therefor, a cut-off relay for the line having its coil connected between the service meter and one of the contacts of the line jack, a cord circuit to connect with the line having a contact to register with the said contact of the line jack, a source of current, a relay connected between said source and said contact of the cord circuit, a key having normally closed contacts in the circuit of said relay between the coil of said relay and said source, a second source, said key having normally-open contacts between the coil of said relay and said second source, the actuation of said key being adapted to close its open contact before opening its closed con-

tacts, whereby the circuit of said relay will not be interrupted in the actuation of said key, substantially as described.

8. In a telephone system, the combination with a telephone line, of a cut-off relay therefor, a service meter having an actuating coil and a resistance coil connected in series in the circuit of said cut-off relay, a cord circuit for connecting with the line, means to send current from said cord circuit through the cut-off relay and the coils of the service meter, of sufficient strength to actuate the cut-off relay but of insufficient strength to actuate the service meter, means to send a second current from the cord circuit through the coil of the cut-off relay and the coils of the service meter of sufficient strength to maintain the actuation of the cut-off relay and to actuate the service meter, and means thereafter to remove said resistance coil from the circuit of said cut-off relay and said service meter, whereby the former current will be increased to an amount sufficient to maintain the actuation of the service meter, substantially as described.

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

ALFRED H. WEISS.

Witnesses:

CLIFFORD C. BRADBURY,
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