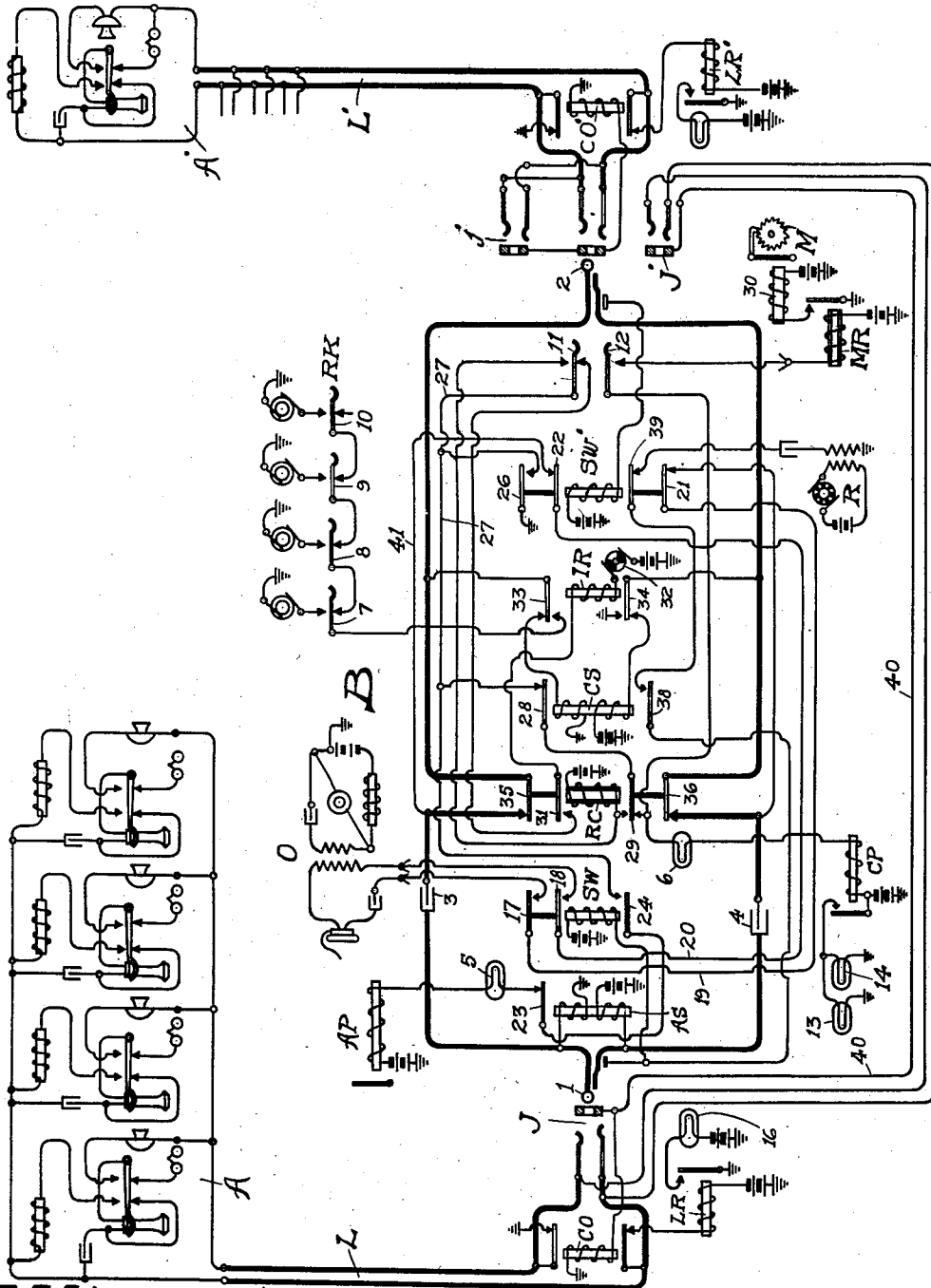


H. D. CURRIER.
TELEPHONE SYSTEM.
APPLICATION FILED FEB. 18, 1916.

1,316,477.

Patented Sept. 16, 1919.



Witnesses:
G. A. Yanochowski.
Bob Brien.

Inventor:
Hiram D. Currier.
By Curtis B. Camp.
Attorney.

UNITED STATES PATENT OFFICE.

HIRAM D. CURRIER, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND
SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

1,316,477.

Specification of Letters Patent.

Patented Sept. 16, 1919.

Original application filed October 1, 1913, Serial No. 792,747. Patent No. 1,249,036, dated December 4, 1917.
Divided and this application filed February 18, 1916. Serial No. 79,020.

To all whom it may concern:

Be it known that I, HIRAM D. CURRIER, a citizen of the United States of America, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates in general to telephone systems and is directed more particularly to certain features having to do with the control of meter circuits, an object of my invention being to provide a simplified arrangement of control circuits of the above character in connection with an operator's link circuit.

This application is a divisional application of my application for telephone systems filed October 1st, 1913, Serial No. 792,747, and issued Dec. 4, 1917, as Patent No. 1,249,036.

One of the features of my invention is the provision of a service meter control circuit in combination with a ringing key and certain supervisory relays.

I have provided a service meter common to each operator's cord circuits and adapted to be operated a single time responsive to the actuation of the ringing key and so controlled that even should the operator actuate the key more than a single time, for a connection, but a single call will be registered thereon. The control circuits for said service meter are also so arranged that, in the regular method of connecting lines, the meter cannot be operated without applying ringing current to the connected line.

For a better understanding of my invention reference is to be had to the accompanying drawing in which two telephone lines L and L¹ are shown, each line being of the party line type and having a plurality of substations A or A¹ connected thereto. Said lines terminate at a central office switchboard in line circuits comprising jacks J and line signal control apparatus preferably a line relay LR, cut-off relay CO.

I have preferably embodied my invention in an operator's cord circuit B having answering and calling plugs 1 and 2, respectively, said plugs being united by the heavily marked tip and sleeve conduc-

tors having interposed condensers 3, 4. An answering supervisory relay AS is associated with the answering end of the cord circuit together with a switching relay SW which assists in the control of the answering supervisory signal 5, and also connects the operator's telephone O to the cord circuit. An answering pilot relay AP is also provided.

In connection with the calling end of the cord circuit, I provide supervisory control relays comprising a calling supervisor relay CS and a so-called switching relay SW¹, which relay SW¹ assists in the control of the calling supervisory signal 6 and disconnects the operator's telephone O from the cord circuit. Automatic ringing control apparatus is also provided including an interrupter relay IR which is adapted to periodically apply ringing current to the called line, and a second ringing control relay RC which acts to disconnect the interrupter relay responsive to the energization of the calling supervisory relay CS, when a response is secured from the called substation. A party line ringing key RK is provided being preferably of the four-party type and having independently operable ringing contacts, 7, 8, 9 and 10 and a set of common contacts 11, 12. The ringing key is also preferably of the so-called indicating type in which when a ringing plunger is fully depressed to its ringing position, one of the ringing contacts is operated as are also the common contacts 11, 12. When the operator relieves the pressure upon the actuated ringing plunger it restores to its middle or indicating position restoring the common contacts 11, 12 to their normal position as illustrated, but maintaining the actuated ringing contacts in their alternate position.

When the operator inserts the calling plug 2 into a jack j, the calling supervisory signal 6 and its associated pilot signals 13, 14 are operated and remain so until the ringing key is actuated at which time the ringing control relay RC operates to efface signals 6, 13, 14. The actuation of the ringing key is also effective to cause the energization of the meter relay MR to register a single con-

nection upon the meter M, and although the operator may repeatedly operate the ringing key, further registrations of the meter apparatus are prevented, until another connection by the cord circuit B is established, or such additional registration cannot occur without calling some party on the line connected with.

In connection with party line systems it is most essential that a so-called revertive busy test be provided so that an operator may know when a subscriber is calling for a substation on his own line. To this end I have provided an improved revertive busy control so arranged that when the operator places the tip of the calling plug 2 upon the sleeve of a busy jack, the calling supervisory relay CS will operate and connect the revertive busy tone R to a contact of the answering plug 1 whereby if the calling plug 2 is touching a jack multiply connected to the jack in which the answering plug 1 is inserted, a characteristic busy tone is transmitted to the operator's telephone.

Having described more in general the apparatus employed in the preferred embodiment of my invention, its operation in the course of establishing a connection will now be described. Assuming that a substation A on line L desires to call, the receiver thereat is removed whereby a circuit for the line relay LR is established over the calling line, causing the energization of said relay and the lighting of line lamp 16. The operator in response to this signal inserts an answering plug 1 into the answering jack J of the calling line whereby a series circuit including the winding of cut-off relay CO and switching relay SW is established through the third contacts of the connected plug and jack. Said relays CO and SW are therefore energized, the energization of CO causing the disconnection of the line relay and effacing the line lamp. Responsive to the energization of relay SW, its alternate contacts 17, 18 are closed connecting the operator's telephone O over conductors 19, 20, and normal contacts 21, 22 in bridge of the talking strands of the cord circuit. Also upon connection of jack J and plug 1, the answering supervisory relay AS is connected in bridge of the calling line L whereby current flows through the winding of said relay and over the calling line, causing the energization of AS.

The operator's telephone having been automatically connected with the link circuit, the operator ascertains the wants of the calling subscriber and finding that a connection is wanted with substation A¹ of the line L¹, the operator proceeds to test the called line in the usual manner, that is by touching the tip of the calling plug 2 to the third or test contact of the called line jack j. Finding the called line is idle she inserts plug 2 into

a jack j thereof. A circuit including switch relay SW¹ and cut-off relay CO¹ is therefore established over the third contacts of the connected plug and jack 2, j respectively whereby said relays are energized. The energization of CO¹ removes the substation control of its line signal while upon energization of SW¹, its normal contacts 21, 22, are interrupted causing the disconnection of the operator's telephone from the link circuit.

It might be well to state at this time that when the called line is busy there is a battery connection to the third contact of its connected jacks so that when the tip of the plug 2 is placed against this third contact in testing, an energizing circuit through the upper winding of relay CS is established, but this is only incidental when a line different than the calling line is being tested, and has no effect upon the usual "click" test circuit here employed.

Referring again to the switching relay SW¹, also responsive to its energization its alternate contact 26 is closed whereby ground is connected to conductor 27, normal contact 28 of relay CS, supervisory signal 6 and the winding of the calling pilot relay CP to battery. Lamp 6 is therefore lighted and relay CP energized to light the pilot signals 13, 14, said signals 6, 13, and 14 remaining lighted until the associated ringing key is operated. It will be apparent that with this arrangement a chief operator or monitor by watching any operator's pilot signals 13 or 14 can tell how the operator is working. The operator's pilot 13 is of course positioned before the operator, and pilot 14 may be positioned before a chief operator or monitor.

The operator now depresses the plunger of the proper ringing key 7, 8, 9 or 10 to its fully depressed position, thereby actuating the associated ringing contacts and the common contacts 11, 12. Responsive to the closing of alternate contact 12, a circuit for the meter relay MR is established from battery through the winding of MR, alternate contact 12, to grounded normal contact 29 whereby said relay MR is energized to cause a single operation of the meter M by its magnet 30. Responsive to the closing of alternate contact 11, which occurs after the closing of alternate contact 12, a circuit for the ringing control relay RC is established, traced from battery through the winding of RC, alternate contact 11 to the grounded conductor 27. Relay RC therefore interrupts its normal contact 29 effacing signals 6, 13, 14 and restoring the meter relay MR. Relay RC also establishes a locking circuit for itself through its alternate contact 29, normal contact 28, to grounded conductor 27 which circuit is maintained until the calling supervisory relay CS is energized by the re-

sponse of the called subscriber. The operator of course releases the actuated ringing key plunger after maintaining it fully actuated for a short period, whereby the common contacts 11, 12 are again restored to normal, but the actuated ringing contact 7, 8, 9, or 10 is maintained closed in its alternate position. It will be apparent that although the operator may actuate the ringing plunger more than once, further operations of the meter relay MR are prevented due to the interruption of its circuit at normal contact 29, of RC.

Responsive to the closing of alternate contact 31 of RC, and upon the closing of normal contact 11 of the ringing key, a circuit for the interrupter relay IR is established traced from battery through interrupter 32, the winding of IR, alternate contact 31, normal contact 11, to grounded conductor 27. Relay IR is therefore periodically energized operating its contacts 33, 34 each closure of the alternate contacts 33, 34, connecting ringing current from the proper ringing generator in bridge of the called line to ring the call bell of the substation A¹. Upon each closure of normal contacts 33, 34, of relay IR, the calling supervisory relay CS is connected in bridge of the called line but due to the condenser at substation A¹, no path for the flow of direct current over CS exists as long as the receiver remains upon the switch-hook. During the ringing period normal contacts 35, 36, of relay RC are interrupted so that the ringing current does not affect the calling line.

In response to the operation of the call bell at substation A¹, the subscriber thereat removes his receiver whereby a path for direct current is established over the calling line L¹ and including the windings of calling supervisory relay CS. Said relay therefore energizes interrupting its normal contact 28 and thereby interrupting the locking circuit for the ringing control relay RC, causing its deenergization. Alternate contact 31 of RC is therefore interrupted, interrupting the circuit for relay IR and preventing any further application of ringing current. Lines L and L¹ are now connected for conversation.

After the subscribers have finished conversation they replace their receivers upon their respective switch-hooks whereby the circuits for supervisory relays AS and CS are interrupted causing the restoration of said relays. Responsive to the closing of normal contact 23 of AS, a circuit for the answering supervisory signal 5 is established through alternate contact 24 of SW to the grounded conductor 27. Responsive to the closing of normal contact 28 of CS, ground is again connected to normal contact 29 of RC whereby signals 6, 13, and 14 are again lighted, and remain lighted

until the calling plug 2 is withdrawn from the jack, thus affording to the chief operator or monitor before whom lamp 14 is positioned, a check upon the period of disconnection.

Should the operator now attempt to cause another, or improper actuation of the meter relay MR by again actuating the ringing key RK before withdrawing lug 2, the result will be that ringing current will again be applied to the connected line as before described. It will be apparent from the above that it is impossible for the operator to register connections on the meter without calling some substation.

The operator observing the lighting of signals 5, 6, referred to, is aware that disconnection is desired and therefore withdraws plugs 1, 2 from the connected jacks. At the answering end of the cord circuit this results in the restoration of relays CO and SW, and at the calling end of the cord this results in the restoration of relays SW¹ and CO¹. Signal 5 is therefore effaced due to the interruption of alternate contact 24 of SW, and the signals 6, 13, 14 are effaced due to the interruption of alternate contact 26 of SW¹ and the removal of ground from conductor 27. The apparatus used in establishing the connecting being again at normal, is available for use in establishing other connections.

Now as to the operation of so-called reverting busy test, assuming that an answering plug 1 has been inserted into a jack J in response to a call over line L and whereby relays AS and SW have operated as before, and that the calling substation is to be connected with another substation on the same line. Therefore, the operator, unaware that the calling and called substations are on the same line will place the tip of the associated calling plug 2 against the third or test contact of a multiple jack J¹. This test contact of course is connected to battery through the test contact of J, third contact of plug 1 and the winding of SW. Therefore when the operator places plug 2 against the jacks J¹, a circuit is established for relay CS from battery at said test contact of J¹, the tip of plug 2, tip calling conductor, normal contact 33 and the upper winding of CS to ground. Relay CS therefore closes its alternate contact 38 connecting the characteristic reverting tone from apparatus R through normal contact 39, alternate contact 38, third contacts of plug 1 and jack J, conductor 40, test contact of jack J¹, tip of plug 2, calling tip conductor, normal contact 35, conductor 41, normal contact 22, alternate contact 18, receiver of operator's telephone O, alternate contact 17, conductor 19, normal contacts 21, 36, 34, and the lower winding of CS to battery and ground. The operator by this characteristic tone knows that

the wanted substation is on the same line with the calling substation and therefore asks the calling subscriber to replace his receiver upon its switch-hook for a moment or two while the called substation is being rung.

The operator now inserts the calling plug 2 into a multiple jack J¹ whereby the switching relay SW¹ is operated in a manner as before described. The operator then depresses the proper ringing plunger whereby ringing current is applied to the called line to ring the bell of the wanted substation in a manner as before described. The application of ringing current is continued until a path for direct current is established over the line L either by the removal of the receiver of the calling or called substations whereby both of the relays AS and CS are energized by current over the line L, the energization of CS causing the disconnection of ringing current in a manner as already described.

When the subscribers have finished their conversation and upon the replacing of both receivers upon their switch-hooks, relays AS and CS deenergize resulting in the operation of the signals for disconnection in a manner as before described followed by the withdrawal of the connecting plugs and the restoration of the apparatus to normal.

Having described my invention, what I claim as new and desire to secure by United States Letters Patent, is:

1. A telephone system comprising telephone lines, an operator's link circuit having a calling end for connecting to called ones of said lines, a ringing key and means controlled thereby for applying ringing current to a connected called line, a meter device common to said lines and responsive to the actuation of said ringing key for registering connections, and a single-wound relay responsive to an actuation of said ringing key, said relay controlling the circuit of said meter device.

2. A telephone system comprising telephone lines, an operator's link circuit for connecting calling and called lines, a ringing key and means controlled thereby for applying ringing current to the called line, a meter device common to said lines and responsive to an actuation of said ringing key for registering said connection, and a relay responsive to the actuation of said ringing key to interrupt the strands of said link circuit and to interrupt the circuit of said meter device.

3. A telephone system comprising telephone lines, an operator's link circuit for connecting calling to called lines, a ringing key and means controlled thereby for applying ringing current to a connected called line, a meter device for said link circuit and adapted to be associated with any of said lines, said meter device being responsive to actuation of said ringing key for registering

a connection, and means to prevent further actuation of said ringing key during said connection from actuating said meter device, said means including a pair of relays.

4. A telephone system comprising telephone lines, operator's link circuits for connecting calling to called lines, a ringing key for each of said link circuits, means controlled thereby when actuated for applying ringing current to a connected called line, and a common meter device responsive to such actuation of any of said keys for registering each connection to a called line, and a subscriber-controlled relay for each of said link circuits for preventing a reactivation of said meter device.

5. A telephone system including a calling line and a called line, an operator's link circuit for connecting said calling and called telephone lines in conversational circuit, a switching relay associated with said link circuit for controlling circuits thereof, a ringing key for applying ringing current to the connected called line, and a meter control relay responsive to actuations of said switching relay and said ringing key.

6. A telephone system comprising telephone lines, an operator's link circuit having a calling end for connecting to a called one of said lines, a switching relay associated with said link responsive to the connection of said link circuit to one of said lines, a ringing key and means controlled thereby for applying ringing current to the called line, and a meter control magnet responsive to an actuation of said switching relay and said ringing key.

7. A telephone system comprising telephone lines, an operator's cord circuit for connecting calling and called lines, a supervisory control relay associated with the said cord circuit responsive to the connection of said link circuit to one of said lines, a ringing key associated with said cord circuit, and a meter control magnet controlled by the operations of said ringing key and said supervisory control relay.

8. A telephone system comprising telephone lines, an operator's link circuit for connecting calling to called lines, a relay associated with said link circuit, a ringing key and means controlled thereby for applying ringing current to a connected called line, a meter control magnet common to said lines and responsive to the actuations of said relay and said ringing key, and means to prevent further actuations of said meter control magnet if said ringing key be operated during connection.

9. A telephone system including a calling line and a called line, an operator's link circuit for connecting said calling and called lines, a switching relay associated with said link circuit for controlling the circuits thereof, a ringing key for applying ringing cur-

rent to the connected called line, a meter control relay responsive to an actuation of said switching relay and aid ringing key, and means to prevent a second actuation of said meter control relay during the said connection.

10. A telephone system comprising telephone lines, an operator's link circuit having a calling end for connecting to a called one of said lines, a switching relay associated with said link circuit, a ringing key for applying ringing current to the called line, a slow acting meter control magnet responsive to an actuation of said switching relay and said ringing key, and means to prevent a second actuation of said meter control magnet during the said connection.

11. A telephone system comprising telephone lines, an operator's link circuit for connecting calling and called lines, a switching relay and a supervisory relay associated with said link circuit, a ringing control key for applying ringing current to a called line, a meter control magnet, and a circuit for said meter control magnet controlled by said switching relay, said supervisory relay and said ringing key.

12. A telephone system comprising telephone lines, an operator's link circuit having a calling end for connecting to said lines, a ringing key provided with means for supplying ringing current to a connected line, and a single wound slow acting meter control magnet common to said lines and responsive to an actuation of said ringing key.

13. A telephone system comprising telephone lines, operator's link circuits for connecting calling and called lines, ringing keys provided with means for applying ringing current to called lines, a meter control magnet common to said link circuits and operated responsive to actuations of said ringing keys, and a subscriber-controlled relay for each of said link circuits for preventing re-actuations of said meter-control magnet.

14. A telephone system comprising telephone lines, an operator's link circuit for connecting together a calling line and a called line, a ringing key provided with means for applying ringing current to the connected called line, a meter control magnet, a circuit for said magnet provided with a pair of normally open contacts and with a pair of normally closed contacts, both said normally open contacts and said normally closed contacts being individual to said link circuit, means responsive to the actuation of said ringing key to close the normally open contacts and to open the normally closed contacts whereby an impulse of current is transmitted to operate the said meter magnet, and a third set of contacts included in the circuit of said magnet and controlled by other means.

15. A telephone system comprising a call-

ing line and a called line, an operator's link circuit for connecting the calling to the called line, a ringing key and means for actuating said ringing key to apply ringing current to the called line, a meter control magnet, a circuit for said magnet provided with a set of normally open contacts and a set of normally closed contacts, an auxiliary relay adapted to interrupt the strands of said link circuit, and means controlled by the actuation of said ringing key to close said normally open contacts and to operate said auxiliary relay to open the said normally closed set of contacts whereby said meter magnet is operated.

16. A telephone system comprising a calling line and a called line, an operator's link circuit for connecting the calling to the called line, a ringing key, means for actuating said ringing key to apply ringing current to the called line, a meter control magnet, a circuit for said magnet provided with a set of normally open contacts and a set of normally closed contacts, an auxiliary single-wound relay, means responsive to the actuation of said ringing key to close said normally open contacts thereby closing the said circuit and to operate said auxiliary relay to open the said normally closed set of contacts thereby opening said circuit whereby said meter magnet receives an impulse of operating current.

17. A telephone system including subscribers' telephone lines, operators' link circuits for interconnecting said lines, a ringing key for each of said link circuits, a meter device common to said link circuits responsive to the actuation of any one of said ringing keys, and subscriber-controlled means for preventing the reactivation of said meter device.

18. A telephone system including subscribers' telephone lines, a group of link circuits for interconnecting said telephone lines, a ringing key for each of said link circuits for signaling called subscribers, a meter device common to said link circuits actuable by any one of said ringing keys, and reactivation-preventing means controlled by subscribers and by the said ringing keys.

19. A telephone system including subscribers' telephone lines, link circuits for interconnecting said lines, a ringing key for each of said link circuits, a meter device common to said link circuits, means for actuating said meter device, said means being operable only when one of said link circuits is connected to a called subscriber's line and its ringing key is operated, said last means including a relay energized in response to the connection of a link circuit to a subscriber's line.

20. A telephone system including subscribers' telephone lines, operators' link circuits for interconnecting said lines, ringing

mechanism for each of said link circuits, a
meter device common to said link circuits
responsive to an actuation of said ringing
mechanism, and means individual to a link
5 circuit for preventing a re-operation of the
meter device by a second actuation of said
ringing mechanism.

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

HIRAM D. CURRIER.

Witnesses:

GEORGE A. YANOCKOWSKI,
B. O'BRIEN.