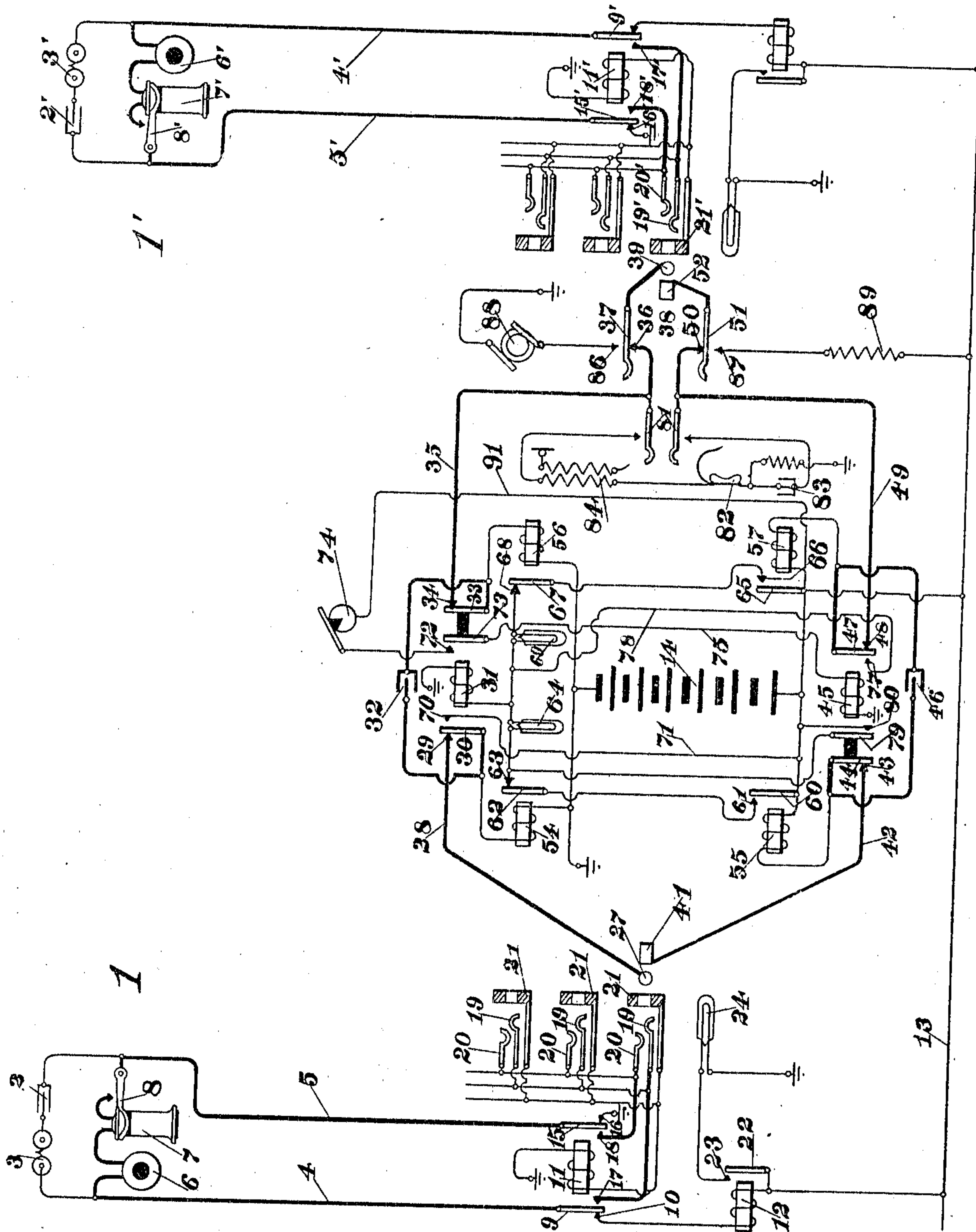


H. P. CLAUSEN.
TELEPHONE SYSTEM.
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1,088,879.

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TELEPHONE SYSTEM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HENRY P. CLAUSEN, a citizen of the United States, and resident of Rochester, county of Monroe, State of New York, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification:

My invention relates to telephone systems of the central energy multiple type.

10 The object of my invention is to provide automatic disconnecting means for the telephone lines whereby subscribers who have been in conversation through a cord circuit may obtain immediate and automatic
15 disconnection from each other by replacing their receivers upon their switch-hooks. In this manner the operator is relieved of the necessity of pulling down a cord connection immediately upon receiving the disconnect
20 signals, thereby equalizing the operator's load and permitting her to take down her cords during times when there are no unanswered calls upon the switchboard.

25 My invention provides for more rapid handling of connections than has been afforded by other manual telephone systems.

Other objects and advantages will be more specifically pointed out in the following description and claims.

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

35 The calling subscriber's station 1 is provided with the condenser 2 and annunciator 3 in a bridge between the line conductors 4 and 5, and with the transmitter 6 and receiver 7 adapted to be bridged between the limbs of the line by the contacts of the
40 switch-hook 8. Line conductor 4 extends to the central office and thence through contacts 9 and 10 of cut-off relay 11, the coil of line relay 12 and conductor 13, to the live pole of battery 14, and line conductor 5 extends to the central office and thence
45 through contacts 15 and 16 of cut-off relay 11, to ground. Cut-off relay 11 has normally open contacts 17 and 18 extending, respectively to the ring contacts 19 and the
50 tip contacts 20 of the answering and multiple jacks. The sleeve or test contacts 21 of these jacks are connected through the coil of cut-off relay 11 with earth. Line relay 12 controls normally open contacts 22
55 and 23 in the circuit of line lamp 24. The

called subscriber's line 1¹ is provided with similar apparatus, similarly connected, the like apparatus and conductors of this line being designated by corresponding figures with the suffix "1".

60 The cord circuit for connecting these lines for conversation comprises tip and sleeve voice current conductors, the tip conductor extending normally from the tip contact 27 of the answering plug, through conductor 65 28, contacts 29 and 30 of relay 31, condenser 32, contacts 33 and 34 of relay 31, conductor 35, and contacts 36 and 37 of the operator's ringing key 38, to the tip contact 39 of the
70 calling plug. The sleeve voice current conductor extends from the sleeve contact 41 of the answering plug, through conductor 42, contacts 43 and 44 of relay 45, condenser 46, contacts 47 and 48 of relay 45, conductor 49 and contacts 50 and 51 of the
75 operator's ringing key 38, to the sleeve contact 52 of the calling plug. This cord circuit is provided with tip and sleeve answering and calling supervisory relays 54, 55, 56 and 57. The coil of relay 54 is connected
80 between the contact 30 of relay 31 and the grounded pole of the central battery 14. The coil of relay 55 is connected between contact 44 of relay 45 and the live pole of battery 14. The relay 56 is connected between
85 the contact 33 of relay 31 and the grounded pole of battery 14, and the relay 57 is connected between the contact 47 of relay 45 and the live pole of battery 14. These four relays are thus connected in bridge of the
90 voice current conductors, said bridge including the battery 14, whereby transmitter energization is furnished to the voice current conductors through the coils of the relays, and whereby the impedance of these
95 coils prevents the short-circuiting of the voice currents through the central battery. Relay 55 controls normally open contacts 60 and 61, and relay 54 controls normally closed contacts 62 and 63 in the circuit of
100 the answering supervisory lamp 64, this circuit including the coil of relay 31. The relay 57 controls normally open contacts 65 and 66, and the relay 56 controls normally closed contacts 67 and 68 in the circuit of
105 the calling supervisory lamp 69, this circuit also including the coil of relay 31. Relay 31 has a normally open contact 70, adapted to connect with the lever 30 upon the actuation of the relay. This contact 70 is con- 110

connected through conductor 71 with the live pole of battery 14. Relay 31 also has normally open contacts 72 and 73. Contact 72 extends to the slowly rotating interrupter 74 which is connected to the live pole of battery 14, and contact 73 is connected through conductor 75 and the coil of relay 45 with ground. The relay 45 has the normally open contact 77, adapted to connect with the lever contact 47 upon the actuation of the relay. This contact 77 is connected through conductor 78 with the coil of relay 31. Relay 45 also has normally open contacts 79 and 80, contact 80 being connected with the live pole of battery 14, while contact 79 is connected with the contact 63 of relay 54. This cord circuit is also provided with the usual listening key 81, adapted, upon actuation, to place the operator's receiver 82, condenser 83, and the secondary 84 of the operator's induction coil, in a bridge between the strands of the talking circuit in a manner well known in the art. The operator's ringing key 38 has normally open contacts 86 and 87 extending, respectively, to the ringing generator 88 and through the non-inductive resistance 89, to the live pole of battery 14.

In the operation of this system, the subscriber at sub-station 1 removes his receiver 7 from switch-hook 8, and thus completes a circuit from battery 14, through conductor 13, coil of line relay 12, contacts 10 and 9 of cut-off relay 11, line conductor 4, transmitter 6, receiver 7, contacts of switch-hook 8, line conductor 5, and contacts 15 and 16 of cut-off relay 11, to ground. The current in this path actuates line relay 12, closing its contacts 22 and 23, thus completing the circuit of the line lamp 24 and displaying that lamp to indicate to the operator that a connection is desired upon the line thus designated. The operator, seeing the display of the line lamp, inserts her answering plug into the jack associated with the lamp and thus completes a circuit from the live pole of battery 14, through the coil of supervisory relay 55, contacts 44 and 43 of relay 45, conductor 42, sleeve contacts 41 and 21 of the plug and jack and the coil of cut-off relay 11, to ground. The current in this path actuates relays 11 and 55. The actuation of cut-off relay 11 severs the circuit of the line relay 12, thus effacing the line lamp 24, and connects the limbs 4 and 5 of the telephone line directly with the ring and tip contacts 19 and 20 of the answering jack. A second circuit is thereby completed from the live pole of battery 14, through the coil of relay 55, contacts 44 and 43 of relay 45, conductor 42, sleeve contact 41 and ring contact 19 of the plug and jack, contacts 17 and 9 of cut-off relay 11, line conductor 4, transmitter 6, receiver 7, contacts of switch-hook 8, line conductor 5, contacts

15 and 18 of cut-off relay 11, tip contacts 20 and 27 of the jack and plug, conductor 28, contacts 29 and 30 of relay 31, and the coil of relay 54, to the ground pole of battery 14. The current in this path actuates relays 54 and 55. The actuation of relay 55 closes its contacts 60 and 61 in the circuit of supervisory signal 64, but the actuation of relay 54 immediately opens its contacts 62 and 63 in said circuit and prevents the display of the signal 64. The operator now depresses her listening key 81 and obtains the number of the desired subscriber. Having done so she inserts her calling plug into the jack of the desired line and depresses her ringing key. A circuit is thus completed from the live pole of battery 14, through the non-inductive resistance 89, contacts 87 and 51 of the operator's ringing key 38, sleeve contacts 52 and 21¹ of the plug and jack, and the coil of cut-off relay 11¹, to ground. The current in this path actuates the cut-off relay 11¹ and thus completes a circuit from the ringing generator 88, through the contacts 86 and 37 of the operator's ringing key 38, tip contacts 39 and 20¹ of the plug and jack, contacts 18¹ and 15¹ of cut-off relay 11¹, line conductor 5¹, condenser 2¹, annunciator 3¹, line conductor 4¹, contacts 9¹ and 17¹ of cut-off relay 11¹, ring and sleeve contacts 19¹ and 52 of the jack and plug, contacts 51 and 87 of the operator's ringing key 38, and the non-inductive resistance 89, through the battery 14, to ground, and thus back to the ringing generator 88. The current from this ringing generator, being alternating in character, passes the condenser 2¹ and sounds the annunciator 3¹. Upon the release of the ringing key 38, the circuit is completed from the live pole of battery 14, through the coil of relay 57, contacts 47 and 48 of relay 45, conductor 49, contacts 50 and 51 of the operator's ringing key 38, sleeve contacts 52 and 21¹ of the plug and jack and the coil of cut-off relay 11¹, to ground. The current in this path maintains the actuation of cut-off relay 11¹ and actuates the supervisory relay 57. The actuation of relay 57 closes its contacts 65 and 66 and thus completes a circuit from the live pole of battery 14, through contacts 65 and 66 of relay 57, contacts 67 and 68 of relay 56, supervisory lamp 69 and the coil of relay 31, to ground. The current in this path displays the calling supervisory signal 69, but is not sufficient to actuate the relay 31, this relay being of low resistance compared to the resistance of the lamp 69. Upon the response of the called subscriber, a circuit is completed from the live pole of battery 14, through the coil of supervisory relay 57, contacts 47 and 48 of relay 45, conductor 49, contacts 50 and 51 of ringing key 38, sleeve and ring contacts 52 and 19¹ of the

plug and jack, contacts 17¹ and 9¹ of cut-off relay 11¹, line conductor 4¹, transmitter 6¹, receiver 7¹, contacts of switch-hook 8¹, line conductor 5¹, contacts 15¹ and 18¹ of cut-off relay 11¹, tip contacts 20¹ and 39 of the jack and plug, contacts 37 and 36 of ringing key 38, conductor 35, contacts 34 and 33 of relay 31 and the coil of relay 56, to the ground pole of battery 14. The current in this path assists in the actuation of relay 57 and actuates supervisory relay 56. The actuation of supervisory relay 56 separates its contacts 67 and 68 and thus effaces the supervisory signal 69. The calling and called subscribers are now connected for conversation, the transmitter energy being fed to the calling subscriber's line through the coils of relays 54 and 55, and the transmitter energization current being fed to the called subscriber's line through coils of relays 56 and 57. The voice currents, being alternating in character and of comparatively high frequency, readily pass through the condensers 32 and 46, these condensers simply serving as means for isolating the calling and called subscribers' lines so far as the flow of direct current is concerned.

When the conversation has been terminated and the calling and called subscribers replace their receivers upon their respective switch-hooks, the circuits through relays 54 and 56 are interrupted, permitting the armatures of these relays to return to their normal positions. The closure of contacts 62 and 63 of relay 54 completes the circuit of the answering supervisory signal 64, this circuit including the coil of relay 31. The closure of contacts 67 and 68 of relay 56 completes the circuit of the calling supervisory signal 69, this circuit also including the coil of relay 31. The current through either supervisory signal 69 or 64 alone is insufficient to initially actuate relay 31, but the current through these signals in parallel is sufficient for the actuation of relay 31. That relay is, therefore, actuated at this time, moving all of its contacts to their abnormal positions.

The movement of contacts 30 and 33 of relay 31 severs the connection of the tip cord conductors 38 and 35, thus interrupting the circuit of each tip cord strand of the cord circuit and producing the same effect, so far as the subscribers are concerned, as though the tips of the plugs were removed from the jacks with which they are connected.

The closure of contacts 72 and 73 of relay 31 completes a circuit from the live pole of battery 14, through conductor 91, the conductor portion of interrupter 74, contacts 72 and 73 of relay 31, and the coil of relay 45, to ground. The current in this path actuates relay 45, moving all of its contacts to their abnormal positions. The movement of the lever contacts 44 and 47 of relay 45 sev-

ers the sleeve talking strand of the cord circuit, thus entirely disconnecting the calling and called subscribers.

It now becomes necessary to provide means for maintaining the display of supervisory signals 64 and 69 until the operator removes the plug connections from the jacks, and thereafter to return the apparatus to its normal condition and efface the supervisory signals 64 and 69. The actuation of relay 57 is now maintained through a circuit which may be traced from the live pole of battery 14, through the coil of relay 57, contacts 47 and 77 of relay 45, conductor 78, and the coil of relay 31, to ground. This maintains the actuation of relay 57, holds its contacts 65 and 66 in their closed condition, and maintains the circuit of the supervisory signal 69. The circuit of supervisory signal 64 may now be traced from the live pole of battery 14, through contacts 80 and 79 of relay 45, the signal 64, and the coil of relay 31, to ground. For purposes which will be hereinafter described, the relay 54 is now maintained actuated by current furnished through conductor 71, contacts 70 and 30 of relay 31, and the coil of supervisory relay 54, to ground.

As the interrupter 74 proceeds in its rotation the circuit completed thereby is broken, for example, once in three seconds, the period of interruption being very short, say, .1 of a second. During this interruption the circuit of relay 45 is broken. That relay, therefore, momentarily resumes its normal position. If the calling plug has not already been removed from the jack into which it had been inserted, the circuit through relay 57 will be reestablished through contacts 47 and 48 of relay 45 and the coil of cut-off relay 11¹ of the line with which the calling plug is connected. Relay 57 will, therefore, remain in its operated condition and the circuit through supervisory lamp 69 and the coil of relay 31 will not be interrupted. The current will be interrupted through the lamp 64 at contacts 80 and 79 of relay 45, but, since it requires less current to maintain the actuation of relay 31 than to initially operate it, relay 31 will remain in its actuated condition. When the calling plug has been removed from the jack, however, and the interrupter 74 has rotated to its open position, the circuit of relay 45 is interrupted and that relay resumes its normal position as before, but at this time the circuit of relay 57 is interrupted since there is no path through contacts 47 and 48 and the sleeve of the plug over which current flows to maintain the actuation of relay 57. Relay 57, therefore, falls back to its normal position and interrupts the circuit through the supervisory signal 69 and the coil of relay 31. Relay 31 consequently falls back to its normal position, breaking the circuit be-

tween contacts 72 and 73 of relay 31 so that when the interrupter 74 again closes its circuit the relay 45 will not be again energized. This occurs even while the answering plug is still inserted into the jack of the calling line, the relay 54 being maintained actuated as before described so that, even if the relay 55 is reactivated, due to its circuit being completed through the cut-off relay of the calling line, no current will flow through the supervisory signal 64 and thence through the coil of relay 31, to prevent that relay from falling back to its normal position, while the relay 45 is in its normal position.

If, during the time that the answering and calling plugs are still connected with the jacks, either or both subscribers wish other connections, it is simply necessary for them to remove their receivers from their hooks in the usual way, whereupon the line lamps of the respective subscribers are displayed in the same manner as was formerly described in connection with the calling line 1.

It will be understood that the line lamp of the called line 1² may be, and usually is, located in a different switchboard section from that at which the calling plug is connected with a multiple jack of the line, and, therefore, a re-call upon the called line will be taken care of by another operator in the usual way without her even knowing that a plug is connected with one of the multiple jacks of this line. However, if a re-call occurs upon the calling telephone line, before a plug has been removed from the jack, the line lamp signal will be displayed in proximity with the plug which is inserted in the answering jack of this line. It is then necessary for the operator to remove the calling plug from the line with which it was formerly connected before a second connection can be made for this calling telephone line.

The busy test for this system is made in the usual way, though it will be seen that during the period of interruption at the interrupter 74, which has been assumed to be .1 of one second in every three seconds, a false busy test may be given to the operators. This is eliminated by instructing the operators to secure at least three clicks for each busy test. This will insure sufficient lapse of time for the interrupter 74 to have passed over its period of break, so that whenever an operator secures three busy test clicks she will know that a busy test is caused by an actual busy line and not by a line made falsely busy by the failure of the operator to remove her plug from its jack after the termination of the conversation. With this system, either a calling or a called subscriber will be able to secure a new connection in much shorter time than with a system of the usual multiple type, and, aside from this, the operator will be instructed to

attend to her line calls before attending to her disconnect signals, whereby the service will be improved and the traffic per operator largely increased.

While I have shown and described my invention in combination with line and cord circuits of a specific character, well known in the art, it is to be understood that it may be applied to other line and cord circuits, all such modifications being entirely within the scope of my invention.

I claim—

1. In a telephone system, the combination with a pair of telephone lines, of an operator's cord circuit for connecting said lines for conversation, a source of current associated with the cord circuit for supplying transmitter current to said lines, a pair of switches in each strand of said cord circuit, a pair of relays, one controlling the switches of one strand and the other controlling the switches of the other strand, and magnetic means under the control of the subscribers for closing the circuits of said relays at the termination of a conversation whereby the lines will be automatically disconnected each from the other.

2. In a telephone system, the combination with a pair of telephone lines, of a cord circuit for interconnecting said lines, a condenser in each strand of said cord circuit, a pair of normally closed contacts in each strand of said cord circuit, one on each side of said condensers, a pair of relays each controlling a pair of contacts in one strand of said cord circuit; means for operating said relays to sever the strands of the talking circuit, said means being initially operated when both line circuits are opened at the subscribers' stations.

3. In a telephone system, the combination with a cord circuit, of tip and sleeve talking strands therefor, relays for interrupting said talking strands at the termination of a conversation whereby the immediate interruption of the circuit by the operator is unnecessary, and means to return said relays to their normal condition by the interruption of one of the talking strands when the operator finally removes the connection.

4. In a telephone system, the combination with a two wire cord circuit, of a pair of supervisory signals therefor, a pair of relays controlling contacts in the talking strands of said cord circuit, said relays being adapted to be actuated upon the display of both of said supervisory signals to sever the talking strands of the cord circuit, and means to interrupt the circuit of said relays by the removal of the plugs of the cord circuit from their connections.

5. In a telephone system, the combination with a cord circuit, of a pair of telephone lines with which said cord is connected, a pair of supervisory signals for the cord cir-

5 cuit, a relay controlling contacts in the sleeve strand of said cord circuit and adapted to be actuated to sever said contacts upon the simultaneous display of said supervisory signals, interrupter means in the circuit of said relay whereby the relay will periodically return to its normal position, a pair of contacts in the circuit of said relay, said contacts being controlled over a circuit including the sleeve strand of said cord circuit and the sleeve of the jack with which said cord is connected during the open period of said interrupter.

10 6. In a telephone system, the combination with a pair of telephone lines, of a cord circuit for connecting said lines for conversation, a pair of relays having contacts adapted to sever the strands of said cord circuit at the termination of a conversation and before the cord circuit has been disconnected from said lines, and a circuit periodically completed over a strand of said cord circuit for automatically testing the connecting terminal of said cord circuit, and means for inter-

rupting the circuits of said relays when such automatic test indicates that the cord circuit has been disconnected from said lines. 25.

7. In a telephone system, the combination with a pair of telephone lines, of a cord circuit for connecting said lines for conversation, means for automatically interrupting the strands of said cord circuit at the termination of a conversation, a circuit periodically completed over the strand of said cord circuit and a jack of one of said lines for maintaining the actuation of said interrupting means, whereby the strands of the cord circuit will be re-completed when the connection between the cord and a line is finally interrupted. 30 35 40

Signed by me at Rochester, county of Monroe, and State of New York, in the presence of two witnesses.

HENRY P. CLAUSEN.

Witnesses:

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."