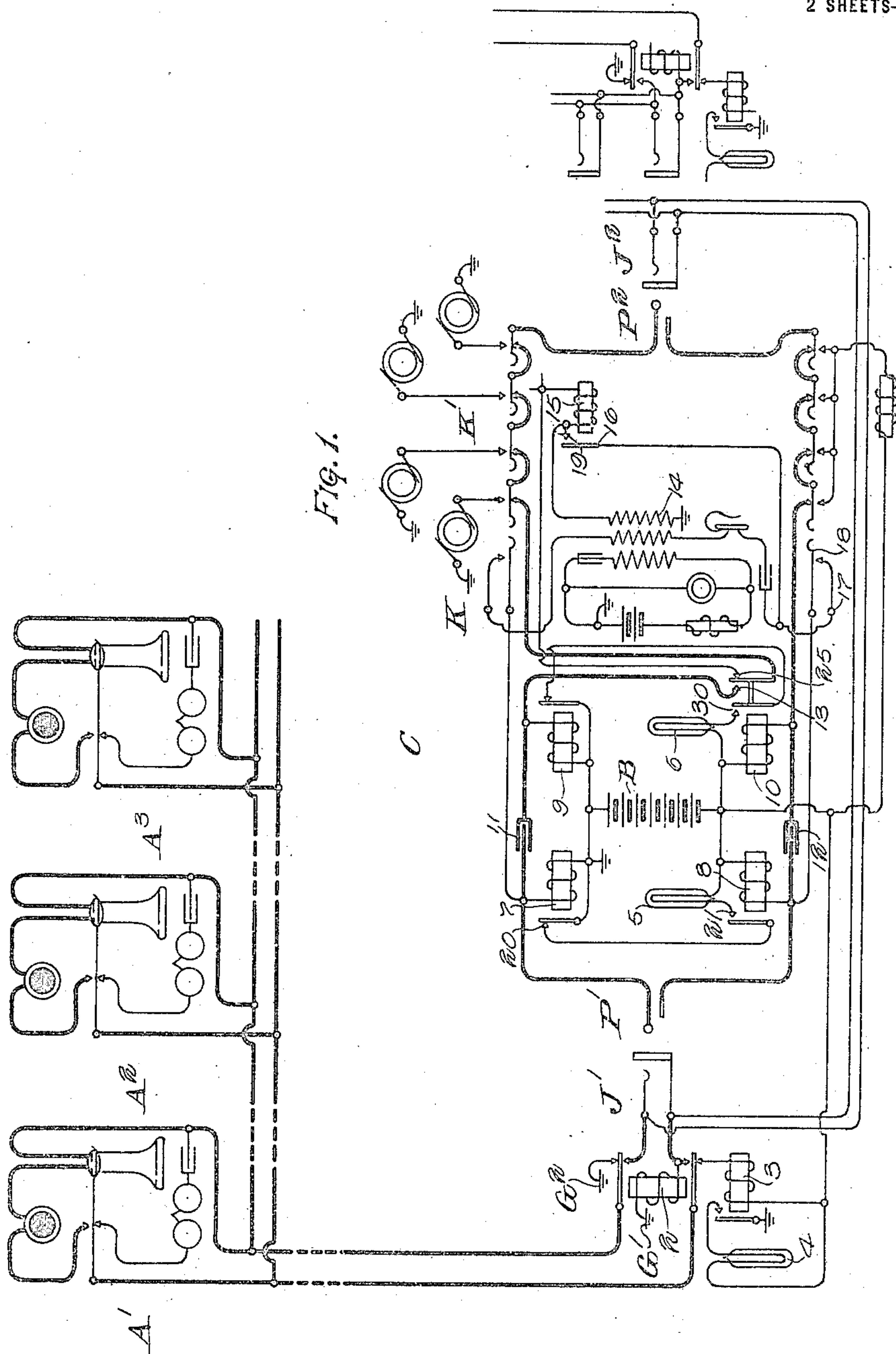


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 APPLICATION FILED MAR. 3, 1913.

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Patented Jan. 8, 1918.
 2 SHEETS—SHEET 1.



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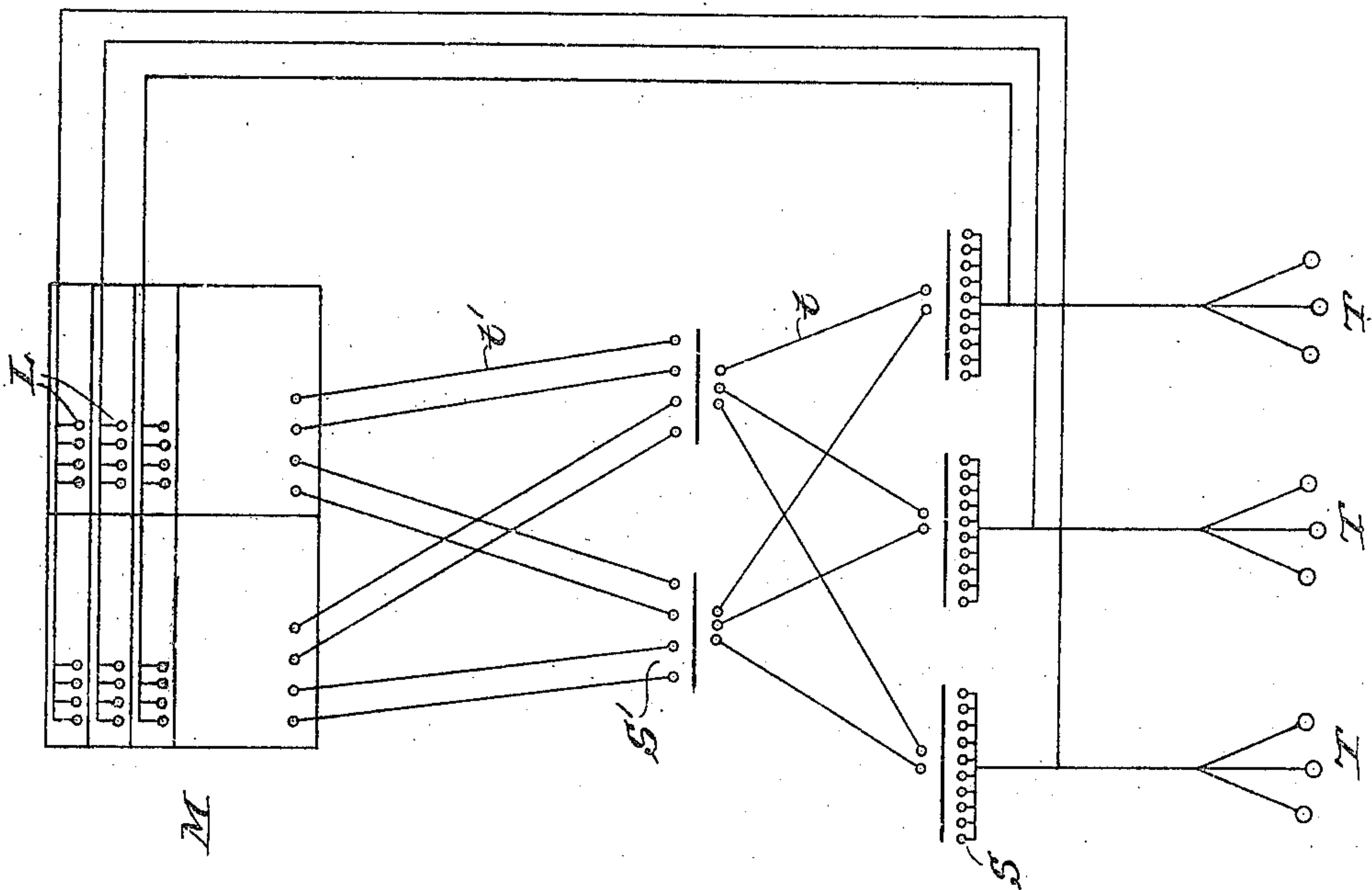


FIG. 2.

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UNITED STATES PATENT OFFICE.

BERNARD D. WILLIS, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TESTING SYSTEM FOR PARTY-LINES.

1,252,979.

Specification of Letters Patent.

Patented Jan. 8, 1918.

Application filed March 3, 1913. Serial No. 751,890.

To all whom it may concern:

Be it known that I, BERNARD D. WILLIS, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Testing Systems for Party-Lines, of which the following is a specification.

My invention relates to improved testing systems for party-lines—that is, to means in a telephone system for enabling an operator to ascertain whether the line which he is testing is the same as the calling line or a different line. In party-line telephone systems in which each line is provided with a plurality of multiple jacks, when a subscriber calls and the operator responds, these multiple jacks are rendered busy, and if a subscriber is calling another subscriber on the same line, the operator will, upon testing one of these multiple jacks, receive the busy signal.

In manual and semi-automatic systems it is not advisable to burden an operator with the duty of knowing at the time a call is initiated whether or not the called for subscriber is on the same line as the calling subscriber. It thus becomes necessary to provide some special means by which an operator will obtain a distinctive signal when she tests a multiple jack of the calling line.

An object of my invention is to provide such a distinctive busy signal, and it contemplates the employment of a normally inoperative testing mechanism which becomes operative when and only when a jack of the calling line is tested.

My invention is useful both in connection with manual systems in which the entire connection between the calling and called subscribers is controlled manually, or in a semi-automatic system in which the operator controls but part of the operations of setting up the connection, the rest of the operations being performed automatically.

My invention will be more readily understood by reference to the accompanying drawings, in which—

Figure 1 represents diagrammatically a poly-station subscriber line to which are connected the substations A' , A^2 and A^3 and the operator's cord circuit C.

Fig. 2 represents diagrammatically the arrangement of a semi-automatic system.

The subscriber's line circuit is of a well known type and is equipped at the central office with the usual answering jack J' , one or more multiple jacks J^2 , a cut-off relay 2, line relay 3 and line lamp 4. The multiple jack J^2 is shown in the proximity of the calling plug of the cord C, so as to indicate more clearly certain circuits which will be traced hereinafter. The cord circuit C is a well known type of cord circuit, comprising the usual answering and calling plugs P' and P^2 , supervisory lamps 5 and 6, relays 7, 8, 9 and 10. Two condensers 11 and 12 are included in the tip and sleeve strands, respectively, of the cord. The tip strand is normally open at the contact 13 of the relay 10. The keys K and K' are the usual answering and ringing keys. One terminal of the tertiary or testing winding 14 of the operator's induction coil is connected to the grounded terminal of the battery, while the other terminal of said winding is connected through a back contact 25 of the relay 10 with the tip of the calling plug P^2 . A high resistance relay 15 is inserted in the connection between the tertiary winding 14 and the contact 25. The relay 15 is provided with an armature 16 which is connected to the spring 17 of the listening key K, whereby when said key is operated a connection is extended from said armature through the contact 17—18 to the sleeve of the answering plug. When the relay 15 is energized, its armature 16 engages a contact point 19 which is connected to the terminal of the winding of the relay 15 nearest the tertiary winding 14. The relay 15 may be common to all the cord circuits on one operator's position.

The operation of the system shown is as follows: Upon the removal of the receiver at one of the substations preparatory to making a call, the circuit of the line relay 3 at the central office is closed through the transmitter and receiver at the telephone. The relay 3, upon energizing, closes the circuit of the line lamp 4 to signal the operator in the usual manner. In answer to the signal displayed by the lamp 4 the operator inserts the answering plug P' into the answering jack J' , operates the key K to bridge the receiver circuit across the calling end of the cord and inquires the number of the subscriber desired. Upon the insertion of the plug into

the jack a circuit is closed from ground G' through the cut-off relay 2, sleeve conductors of the jack J' and plug P' and the relay 8 to the non-grounded terminal of the battery B. The relay 2, upon energizing, disconnects the ground G^2 and line relay 3 from the calling line and establishes the connection between the calling line and its jack terminals, and therefore with the cord C by way of the jack J' and the plug P' . The relay 7 in the cord circuit thereupon receives current from the battery B through the calling telephone and the relay 8. The relay 7, upon energizing, opens the contact 20 in the circuit of the lamp 5 at practically the same instant that the contact 21 in the same circuit is closed by the relay 8. After ascertaining the number of the subscriber with whom connection is desired, and before restoring the listening key K to its normal position, the operator determines whether or not the line of the called for subscriber is busy or idle by touching the tip of the calling plug P^2 to the sleeve of the multiple jack of said line. It will be seen that the tip of the plug P^2 is at the ground potential, as are also the sleeves of the jacks of the subscribers' lines when in the normal or idle condition. Therefore, if the tip of the plug P^2 is touched to the jack of an idle line, no flow of current is set up in the tertiary winding 14 and the operator hears nothing. When a line is busy, however, the potential of the sleeves of its jacks is raised above the ground potential, since they will then be connected to the non-grounded terminal of the battery through the relay 8 or the relay 10, depending upon whether the line is a calling or a called one of some cord circuit. Thus it will be seen that when the tip of the plug P^2 is touched to the sleeve of a jack of a busy line, current will flow from said sleeve through the tip of the plug, contact 25, relay 15 and the winding 14 to ground, whereby a momentary click will be produced in the operator's receiver. The relay 15 is energized by the current which flows through it while testing, but if the line being tested is not the same line with which the calling plug of the same cord is connected, this operation of the relay is functionless and without effect.

Suppose, however, that the subscriber called for is on the same line as the calling subscriber—that is, assume that the subscriber at the substation A' is calling the subscriber at the substation A^2 . In this case the answering plug P' is inserted into the jack J' and the multiple jack J^2 or some other multiple jack of the same line is tested with the tip of the plug P^2 . Now it will be seen that the potential of the sleeve of the jack J^2 is raised as soon as the plug P' is inserted into the jack J' , and consequently the operator will, upon testing the jack J^2 , hear a click in the same manner as when

some other busy line is tested, as described above. Thus, unless some means are provided to give the operator some additional notification, she will think the line called for is busy and the subscriber will be denied the connection. The relay 15, in this case, is the means for giving this additional notification. When the tip of the plug P^2 is touched to the sleeve of the jack J^2 , the circuit is closed through the coil 14 and the relay 15, as explained above. Since the sleeve of the jack J^2 is now in electrical connection with the sleeve of the plug P' , the relay 15, upon energizing, short circuits itself. This short circuit may be traced from one terminal of the relay through the contact point 19, armature 16, springs 17 and 18 (which are closed at this time), sleeve of the plug P' and jack J' , sleeve of the jack J^2 , tip of the plug P^2 and contact 25 back to the other terminal of the relay 15. The relay 15 immediately deenergizes upon the closure of this short circuit and opens it again at the armature 16. Thus the relay operates as a buzzer as long as the tip of the plug P^2 touches the sleeve of the jack J^2 . This buzzing of the relay 15 causes the current in the testing winding 14 of the operator's induction coil to fluctuate, whereby the operator hears a buzzing sound. Since the short circuit which causes the relay 15 to buzz can be closed only when the sleeve of the jack being tested is connected with the sleeve of the calling plug of the cord to which the testing plug belongs, it will be evident that this buzzing sound is an indication to the operator that the subscriber called for is on the same line as the calling subscriber. She may then request the calling subscriber to hang up his receiver, inserts the plug P^2 into the jack J^2 and operates the proper lever of the key K' to ring the subscriber called for. Upon the insertion of the plug P^2 into the jack J^2 , the relay 10 is energized in circuit with the cut-off relay of the line and disconnects the winding 14 from the plug and closes the contact 13 in the tip strand of the talking circuit. After the called subscriber has answered and the calling subscriber has again removed his receiver, the substations are both provided with talking current through the relays 7 and 8 and 9 and 10.

When both subscribers hang up their receivers upon the completion of the conversation, the relays 7 and 9 deenergize and close the circuits of the lamps 5 and 6, since the relays 8 and 10 both remain energized through the cut-off relay, and therefore maintain the contacts 21 and 30, respectively, closed. Upon the removal of the plugs from the jacks, the relays 8 and 10 deenergize and open the circuits of the lamps.

When two different lines are connected the operation of the relays 7 and 9 is as above explained, except that the relay 7 is con-

trolled by the calling subscriber alone and the relay 9 is controlled by the called subscriber alone, as is well known in the art.

It is to be understood that my invention is not limited to use in a manual telephone system, but may be employed in a semi-automatic telephone system as well. For instance, it may be used in a system in which the answering end of the cord, instead of being connected with the calling line through the medium of a plug and jack, is connected with said line through the medium of one or more automatic trunk-selecting switches. Such systems are well known in the art (see, for example, British patent to S. G. S. Dicker No. 15,133 of 1911), and it is not thought necessary to describe the same in detail herein. In Fig. 2, however, I have shown a diagrammatic representation of such a system. In this figure there is shown a plurality of groups of subscribers' telephones T, each of which is provided at the central office with an individual trunking switch S and the usual multiple jack L on a manual switchboard M. The switches S have access to trunk lines *t* which lead to secondary switches S', which latter in turn have access to trunks *t'* that lead to the manual switchboard, where they may terminate either in jacks like the subscriber's line in an ordinary manual system, or in plugs with which connection may be made directly with the subscribers' multiple jacks.

Other changes and modifications will readily suggest themselves, as, for example, it is of course understood that I do not wish to limit myself to the form of cord circuit shown, as many other types of cord circuit may be employed.

What I claim as my invention is:—

1. In a telephone system, a plurality of subscribers' lines, an answering jack and a plurality of multiple jacks for each line, means including a cord circuit for establishing a connection between two of said lines, means in said cord for testing a busy line, a testing mechanism, and means for operating said testing mechanism when a jack of the calling line is tested to give the operator an audible busy signal of one character, and to give the operator an audible signal of another character when a jack of a line other than the calling line is tested, said testing mechanism comprising a relay circuit interrupter the interruptions of which produce the pulsations of one of said busy signals.

2. In a telephone system, a plurality of subscribers' lines provided with multiple jacks, means including an operator's cord circuit for establishing a connection between two of said lines, means for placing a guarding potential upon said multiple jack when the line with which they are associ-

ated is busy, and means comprising a circuit interrupter relay in said cord for giving said operator a busy signal when a busy line is tested, said means being operative to give the operator an audible busy signal of one character when a line other than the calling line is tested and of different character when the calling line is tested.

3. In a telephone system, an operator's cord circuit provided with a calling plug, a testing conductor normally connected with said plug, a relay in said testing conductor, a test tone generator associated with said conductor, and means for rapidly energizing and deenergizing said relay to operate said test tone generator only when the calling line is tested.

4. In a telephone system, a plurality of subscribers' lines provided with multiple jacks, an operator's cord circuit provided with a plug for testing said jacks, means for giving the operator a signal when a busy jack is tested, said means including a testing conductor, a test tone generator associated therewith and a relay in said conductor, and means for rapidly energizing and deenergizing said relay to operate said test tone generator only when the calling line is tested to give the operator an audible busy signal.

5. In a telephone system, a plurality of subscribers' lines provided with multiple jacks, an operator's cord circuit provided with a plug for testing said jacks, means for giving the operator a signal when a busy jack is tested, said means including a testing conductor, a test tone generator associated therewith and a relay in said conductor, and means for rapidly energizing and deenergizing said relay to operate said test tone generator only when certain of said jacks are tested to give the operator an audible signal of one character and for energizing said relay but a single time when other of said jacks are tested to give the operator an audible signal of another character.

6. In a telephone system, a plurality of subscribers' lines provided with multiple jacks, means including a cord circuit for establishing a connection between two of said lines, said cord comprising an answering plug and a calling plug, means controlled by said calling plug for testing said jacks, said means including a testing conductor and a relay in said conductor, means for connecting said relay to said answering plug when a multiple jack of the calling line is tested and means controlled by said relay for producing one audible signal when a line other than the calling line is tested and a different audible signal when the calling line is tested.

7. In a telephone system, a plurality of subscribers' lines provided with multiple

jacks, means including an operator's cord circuit for establishing a connection between two of said lines, said cord comprising an answering plug and a calling plug, an operator's set provided with an induction coil, a testing conductor normally connected to the tip of said calling plug and provided with a tertiary winding associated with said induction coil, a relay in said testing conductor adapted to be energized a single time when a busy line other than the calling line is tested, and means for short circuiting said relay when a multiple jack of the calling line is tested.

8. In a telephone system, a plurality of subscribers' lines provided with multiple jacks, means including an operator's cord circuit for establishing a connection between two of said lines, said cord comprising an answering plug and a calling plug, an operator's set provided with an induction coil, a testing conductor normally connected to the tip of said calling plug and provided with a tertiary winding associated with said induction coil, a relay in said testing conductor, means for energizing said relay when a busy jack is tested, and means for connecting one terminal of said relay to the sleeve of the answering jack when a multi-

ple jack of the calling line is tested to thereby short circuit said relay.

9. In a telephone system, a plurality of subscribers' lines provided with multiple jacks, means including an operator's cord circuit for establishing a connection between two of said lines, said cord comprising an answering plug and a calling plug, an operator's set provided with an induction coil, a testing conductor normally connected to the tip of said calling plug and provided with a tertiary winding associated with said induction coil, a relay in said testing conductor, means for energizing said relay a single time when a busy line other than the calling line is tested, and means controlled by said relay for short-circuiting itself when a multiple jack of the calling line is tested, whereby a varying potential is produced in said tertiary winding to thereby produce a distinctive test tone.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 21st day of February, 1913.

BERNARD D. WILLIS.

Witnesses:

ARTHUR J. RAY,
ALEX. E. WALKER.

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