(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,326. Patented Oct. 26, 1897.

Fig. 1a.

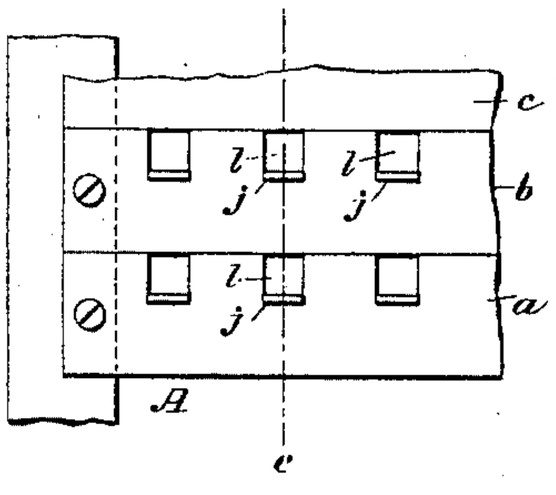


Fig. 1b.

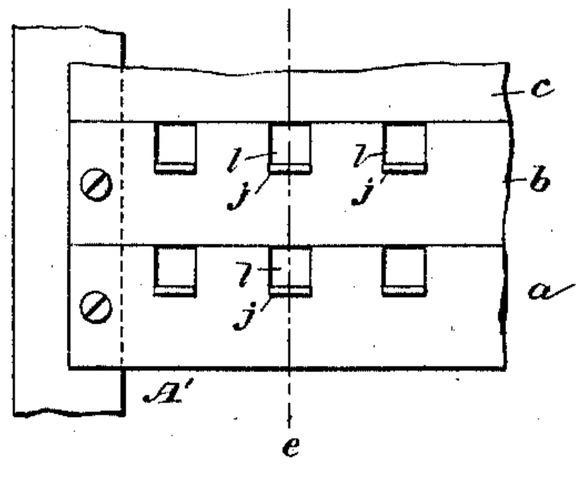


Fig. 2.

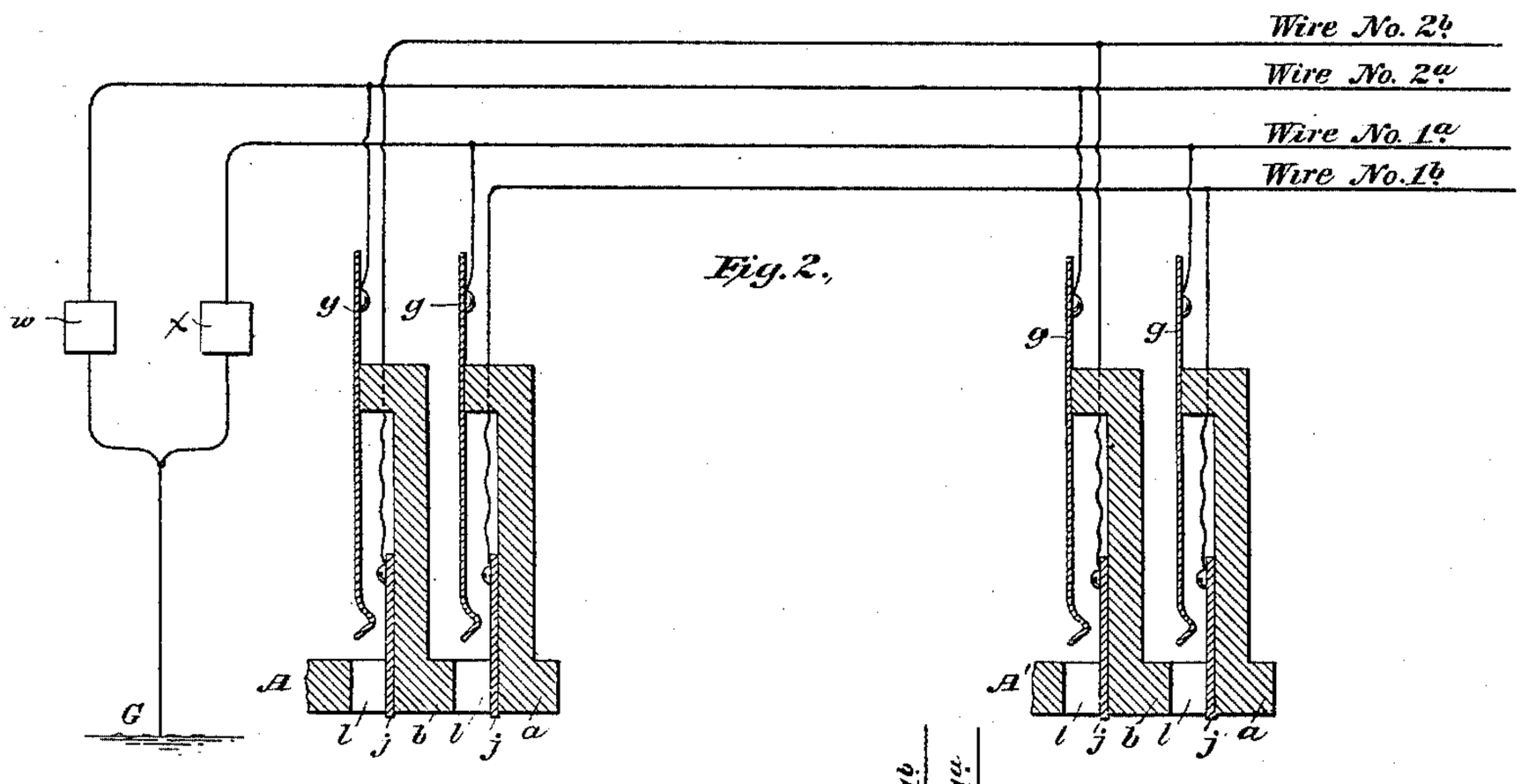


Fig. 3.

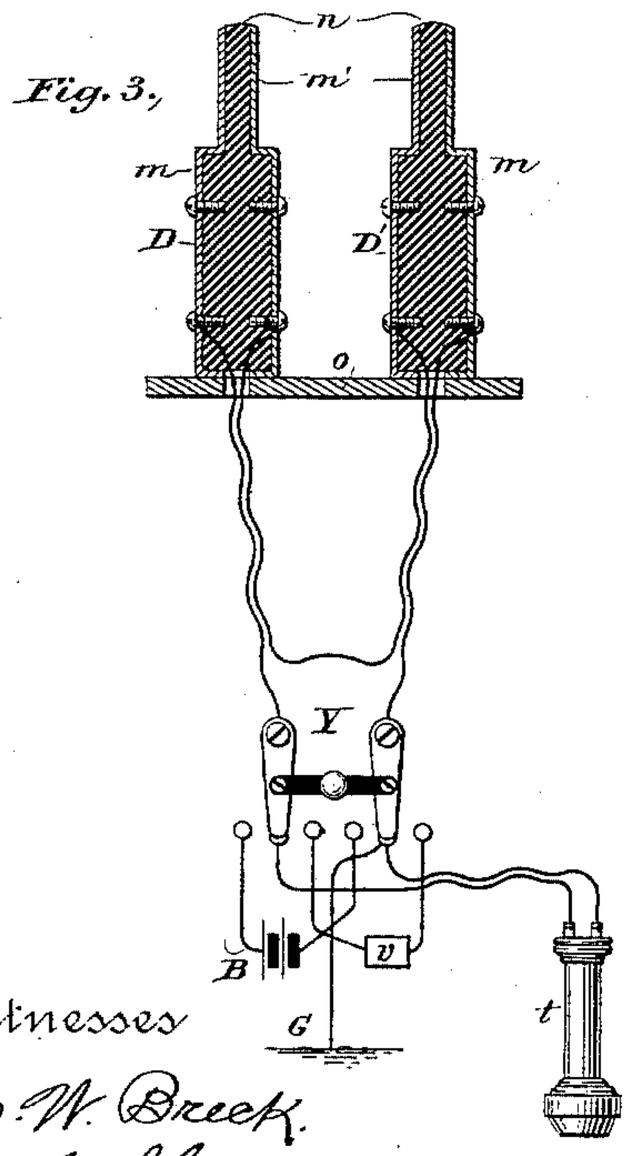
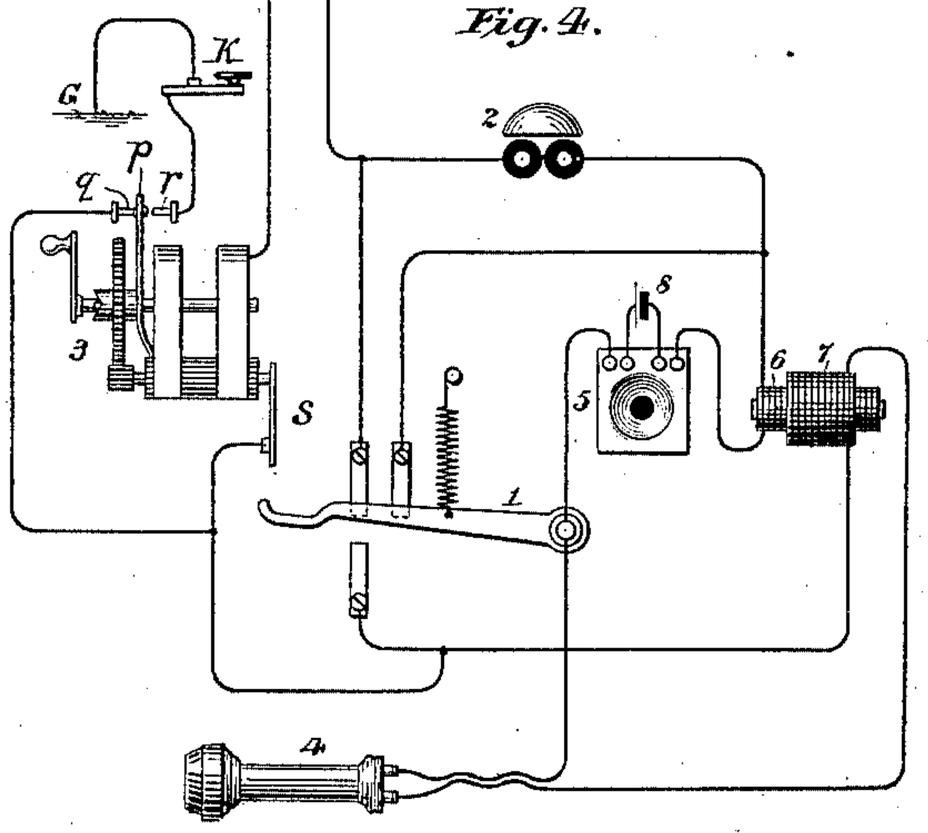


Fig. 4.



Witnesses
Geo. W. Breck.
C. E. Ashley

Inventor
Milo G. Kellogg,
By his Attorneys
Baldwin, Davidson & Wright

UNITED STATES PATENT OFFICE.

MILO G. KELLOGG, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF SAME PLACE.

MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,326, dated October 26, 1897.

Application filed December 11, 1889. Serial No. 333,339. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, of Chicago, Illinois, temporarily residing at Stuttgart, in the Empire of Germany, have invented certain new and useful Improvements in Multiple Switchboards for Telephone-Exchanges, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a telephone-exchange system in which the subscribers' lines are metallic-circuit lines connected to multiple switchboards; and it consists in a system of switching and of testing at any board to determine whether any line is in use.

I place as many switchboards in the central office as are found necessary or desirable in order to properly answer the calls and connect and disconnect the subscribers' lines. On each board I place for each line a spring-jack or other switch having two contact-pieces which are insulated from each other, (except by the circuit connections.) Said switches are each adapted to receive a loop-switch plug, and, when a plug is inserted, to connect the two contact-pieces of the plug with the two contact-pieces of the switch, respectively.

One of the contact-pieces of each switch should be so placed that a test-plug or similar device may be readily applied to it, or so connected to a test-bolt that it can be readily connected with it.

At each subscriber's station is a battery which for purposes of testing should be in the circuit of his line when the line is not in use, but when the line is in use should be so switched as to send no battery-current to the line. This battery may be the same as that which is used with his telephone-transmitter.

Figures 1^a and 1^b of the drawings are front views of sections of two multiple switchboards to which the same lines are connected. Fig. 2 is a diagram of the boards and their circuits and connections necessary to illustrate my invention. Fig. 3 shows an operator's cord system, adapted to be used with the switches. Fig. 4 is a diagram of the subscriber's station apparatus necessary to illustrate my invention.

In the drawings like parts and apparatus are indicated by the same letters and figures of reference.

In Fig. 2, A is a sectional view of the switchboard shown in Fig. 1^a, and A′ is a sectional view of the switchboard shown in Fig. 1^b, each as indicated by the line *d e*. *a b* represent rubber strips of the shape substantially as shown, on which the metal parts of the switches are mounted. These strips may be of a length to receive any convenient number of switch parts. *l l* are square holes through the fronts of and at the edges of the strips, adapted to receive and guide the switch-plugs. The contact-springs *g g* are mounted to the rear of and are parallel to the holes *l l* to which they belong, as shown. *j j* are contact-pieces of the switches, so placed as to make the switch connections hereinafter described and also to be readily connected with a test-plug for purposes of testing. The switch-plugs used are substantially as shown in Fig. 3.

The several parts are so made, shaped, and adjusted that when a switch-plug is inserted into a switch the two contact-pieces of the plug form connection, respectively, with the two contact-pieces of the switch.

w and *x* in Fig. 2 are two line-annunciators in the central office for receiving signals from the subscriber's stations.

From central the conductor 1^b or 2^b, as the case may be, is connected at the subscriber's station (see Fig. 4) in the order named through the generator 3 and the normally closed short circuit 14 therefor in multiple: conductor 13, contact 8, normally in contact with switch-lever 3, said lever, transmitter 5, and transmitter and test-battery 8 in multiple, primary coil 6, bells 2, and wire 1^a or 2^a to central and to ground through the line-annunciator. When the telephone is switched for use—that is, removed from the lever 1—that lever automatically leaves the contact 8 and closes the short circuit around the bells 2 by crossing the contacts 9 and 10. The circuit is then transferred from the contact 8 to the con-

ductor 12, secondary coil 7 of the induction-coil, conductor 11, containing the telephone 4, the switch-lever 1, contact 9, to wire 1^a. At the same time the contact 10 and switch-lever 1 short-circuit or switch the battery 8 from the line-circuit and close the following primary circuit: Contact 10, primary coil 6, battery 8, and transmitter 5 in multiple, lever 1 to contact 10.

When the generator 3 is actuated for a call, the spring *p* is separated from the contact *q*, thereby opening the short circuit, and grounds the frame of the generator through the normally-closed contacts at K. This spring is actuated automatically in the usual manner, though the described circuit it establishes is somewhat different.

In clearing out, the contacts K are opened while the generator is operated, to prevent the call-annunciator from responding. When the contacts are opened, all the current goes over the metallic circuit.

Two lines are shown in Fig. 2, the two branches of one line being marked "wire No. 1^a" and "wire No. 1^b," respectively, and the two branches of the other line being marked "wire No. 2^a" and "wire No. 2^b," respectively.

The connections of the lines are as follows: The wires *b b* are connected to the contact-pieces *j j* of their respective switches on the several boards. The wires *a a* are connected to the contact-springs *g g* of their respective switches on the several boards, and pass from thence through their line-annunciators and to ground.

In the operator's cord system shown in Fig. 3 only one pair of cords, with its plugs, switch, clearing-out annunciator, telephone, and calling battery or generator is shown. Other pairs, with their parts, could be added and connected in a manner which will be apparent to those skilled in the art. One system of pairs of cords is placed at each board for an operator, and the parts are so mounted that the operator can conveniently operate the board.

D D′ represent a pair of plugs in sectional view.

n is the rubber insulation of the plug. *m* is one of the contact-pieces, and *m′* is the other contact-piece. The contact-pieces *m m′* extend to the bottom of the plug, as shown, and are adapted to rest normally, or when the plug is not in use for switching, on the metal strip *o*, which thereby temporarily connects them together. Weights, as is usual, or similar devices may be used to bring the plugs into contact with the strip and form a good connection.

Y is a looping-in switch having three pairs of contact-bolts, on which the operator may at will place the levers of the switch.

v is the clearing-out annunciator of the pair of cords, B is the operator's calling generator or battery, and *t* is her telephone, connected, respectively, to the pairs of bolts *q q*, *r r*, and *s s*. Each of these instruments is placed in a loop, and the two ends of the loop are connected to the two contact-bolts of a pair of contact-bolts of the looping-in switch. The loop in which is the operator's telephone is connected with the ground, as shown.

The cords have two conductors, as shown, and should be long enough so that the operator may connect any plug with any switch at her board.

Each operator needs only one calling-generator and one telephone for her cord system. She should have as many looping-in switches as she has pairs of cords, each of which normally rests upon the contacts *q* of the clearing-out annunciator *v*.

One conductor d^2 of each pair of cords is connected to the contact-piece *m′* of its plug, and these two conductors are connected together. The other conductor *d′* of each pair is connected at one end to the contact-piece *m* of its plug and at the other end is connected to one of the levers of its looping-in switch.

G in each case in the drawings represents a ground connection.

The operation of the system is as follows: When a subscriber desires to call, he turns the crank of his generator and thereby temporarily connects his line with the ground and, sending a calling-current over it, operates his line-annunciator at the central office. He then removes his telephone from its switch, and the operator at the central office places D′ (one of the plugs of a pair of plugs) in the switch of the line where the call is indicated, and, placing the levers of the switch Y corresponding with the pair of plugs used on the contact-bolts connected with her telephone-loop, finds out what line is wanted. When the operator finds out what line is wanted, she places *m* of the other plug D of the pair on the contact-piece *j* of the switch of the line wanted as a test. A complete circuit is thereby established, as follows: From the ground, through the operator's telephone, to contact-piece *m* of the plug used, thence to the line, through the contact-piece *j* of the line-switch, and over the line, and back to the office ground through the other branch of the line.

In Fig. 3 the telephone is grounded on the side to which contact-piece *m* of plug D′ is connected. Hence in order to make the test of a line with the telephone as the test receiving instrument the contact-piece *m* of plug D should be used for testing. It follows that plug D′ should be used to connect with a calling subscriber, so as to leave plug D free to be used for testing. If, then, the subscriber's telephone of the line being tested is off from its switch, (for use,) there will be no current or so little on the test-circuit thereby established that the test receiving instrument (the operator's telephone) will not respond. If, however, the subscriber's telephone is on

its switch, there will be a current over the test-circuit established and the instrument will respond, regardless of whether the line is or is not switched at central. The operator can therefore determine on testing whether or not any line is in use, as indicated.

The test-circuit of an unswitched line is always complete when the test is made and is from the office ground, through the test receiving instrument used, to one side of the line, thence through that side of the line to the subscriber's station, at which station the line is ungrounded and the two sides of the line are closed to each other, thence through the other side of the line to the central office and to ground there through the line-annunciator. When the test-circuit is established, as above described, and the subscriber's telephone is not switched for use, battery-current passes over the circuit which is sufficiently strong to cause the test receiving instrument, which is the operator's telephone, to sound or "click," thus indicating to the operator that the telephone is not switched for use, but, although the full current of the battery then passes through the line-annunciator at the central office, it does not cause the annunciator to indicate a call, although the annunciator-armature is attracted because the battery, being an ordinary transmitter-battery, does not produce a sufficiently strong current to cause the armature to move.

When a line is switched for conversation at the central office, the test-circuit is also always complete when the test is made and is from the office ground, through the test receiving instrument used, to one side of the combined circuit, thence in derived or parallel circuits to each of the two subscribers' stations, at each of which stations the circuit is ungrounded and the two sides of the line are closed to each other, thence to the central office through the other side of each line, and thence to ground at the central office.

When the test-circuit is established, as above described, and one only of said subscribers' telephones is not switched for use, current passes through the test receiving instrument from such subscriber's transmitter-battery and is sufficiently strong to cause the test receiving instrument to sound or click. If both of the subscribers' telephones are then not switched for use, current from the transmitter-batteries at both stations will pass through the test instrument and cause it to sound or click. The transmitter-batteries being connected into their respective circuits in the same direction as to polarity, they do not oppose each other in the test receiving instrument and the current from them, although sufficient to cause the operator's telephone to click, will not in any case be sufficiently strong to cause either line-annunciator to indicate a call.

When the two lines are thus switched at one of the multiple boards, and owing to the negligence of the subscribers the clearing-out annunciator is not operated, but one or both of the telephones are upon their switches and the lines are thus "tied up," an operator testing either line at another board will find it free and will connect it with a third line. This third line and the loop-circuits connected thereto form a bridge across the tied-up circuit, and when the call-generator is looped into the third circuit it is thereby bridged into the tied-up circuit and will operate the clearing-out indicator at the board where they are tied up at the same time that it operates the bells of the called subscribers. Both subscribers may respond, but as the operator at the board where they were tied up sees the clearing-out indicator she disconnects the lines, leaving only the desired subscriber connected to the third line at the other board. Thus the business of exchanges is expedited, and the subscribers, preferring generally to be called up uselessly rather than be reported "busy" when they are "free," are given better service.

If the test indicates that the line is not in use, the operator will place the plug D in the switch of the line. The two lines are thereby connected together into one metallic circuit. By moving the levers of the looping-in switch belonging to the pair of plugs used the operator may send a signaling-current over the circuit from her calling-generator. Again, by moving the levers of the switch she may switch a clearing-out annunciator into the circuit, and again, by moving them she may switch her telephone into the circuit to determine by listening whether the subscribers are through conversation.

It will be observed that in this system of switching and testing the office ground of a line is not removed when a line is switched with another line. This does not interfere with the working of the telephone system, as it is well known that one ground on a metallic telephone-circuit does not interfere with its operation.

It will be observed that although the line-annunciators are not cut off from their lines when the lines are switched for conversation they are not, however, included in the metallic circuit of the two lines switched, but that a special clearing-out annunciator may be placed in their circuit.

By this system of switching and testing only two contact-pieces are required for each switch and only two leading-in wires to the same instead of three or more contact-pieces and leading-in wires for each switch, as is required in other metallic-circuit and multiple-switchboard systems.

If the switch-plug D is used for testing, as is described, the ground connection on the pair of cords should be placed so that the telephone is between it and the contact-piece *m*

of the plug. The other plug could be used for testing by reversing the ground connection to the other side of the telephone.

The central-office operator in this system may switch her telephone into the circuit and by listening ascertain when the subscribers have finished conversation, or clearing-out signals may be sent by either subscriber as follows: A normally-closed key K may be placed in the ground-line running from contact *r*, and when the subscriber operates his generator he opens this key, so that the current from the generator only passes through the metallic circuit, and there will then be no danger of operating the line-annunciator.

I claim as my invention and desire to secure by Letters Patent—

1. In a multiple-switchboard exchange, telephone-lines, switching apparatus therefor adapted to switch said lines for use at the central office, a test-circuit for each line adapted to be closed for testing into a complete circuit whether the line is or is not switched for use at the central office or at the subscriber's station, a test signaling device for said test-circuit, a test outfit at the central office adapted to respond thereto, and a switch controlled by a subscriber when he switches his telephone for use to alter said response.

2. In a multiple-switchboard exchange, telephone-lines, switching apparatus for switching said lines together for conversation, a test-circuit for each line adapted to be completely established for testing whether or not the line is switched for use at the central office or at the subscriber's station, a test-battery and a test receiving instrument for said test-circuit coöperating on testing to produce two responses, and a switch controlled by a subscriber to select either response according to whether he switches his telephone into or out of circuit.

3. In a multiple-switchboard exchange, telephone-lines, switch apparatus for switching said lines for use, a test-circuit for each line adapted to be completely established when testing whether or not the line is switched for use at the central office or at the subscriber's station, a test-battery in said test-circuit while the subscriber's telephone is not switched for use but not otherwise, and a test receiving instrument at each operator's board adapted to detect the presence or the absence of said battery.

4. In a multiple-switchboard exchange, telephone-lines, switch apparatus for switching said lines for use at each board, a metallic test-circuit for each line adapted to be completely established for testing whether or not the line is switched for use at the central office, a test signaling device for said test-circuit, a test outfit at each board at central coöperating therewith to give either of two different responses, and a switch controlled by a subscriber when he switches his telephone into or out of use to select the proper response.

5. In a multiple-switchboard exchange, telephone-lines, switch apparatus at each board for switching said lines for use, a metallic test-circuit for each line adapted to be completely established for testing whether or not the line is switched for use at central, comprising in the order named, test-contacts, a line conductor, a normally-ungrounded subscriber's outfit including a subscriber's test-battery normally in the circuit, a return metallic conductor to central, test receiving instruments in multiple, one at each board, and a plug or device for each test receiving instrument adapted to be applied to a test-contact for testing.

6. In a multiple-switchboard exchange, metallic-circuit telephone-lines, double-conductor switching apparatus at central for switching said lines for use, a metallic test-circuit completely established whenever the test is made, comprising in the order named, switchboard test-contacts, a line conductor, a normally-ungrounded subscriber's outfit including a subscriber's test-battery normally in said metallic circuit, including also a switch for switching said battery out of the metallic circuit while the telephone is switched for use, a return metallic conductor to central, test receiving instruments in multiple, one at each operator's board, and a plug or device for each test receiving instrument adapted to be applied to a test-contact for testing, to determine the presence or absence of said battery.

7. In a multiple-switchboard exchange, metallic-circuit telephone-lines, double-conductor switching apparatus for switching said lines for use, a metallic test-circuit completely established for testing whenever a test is made comprising in the order named, switchboard test-contacts, a line conductor, a normally-ungrounded subscriber's outfit including a subscriber's test-battery normally in said metallic circuit, a shunt for switching said battery out of the line-circuit, and a switch with contacts closing said shunt while the telephone is switched for use, a return metallic conductor to central, switchboard-contacts connected to said conductor, test receiving instruments connected in multiple, one for each operator, and a plug or device for each test receiving instrument adapted to be applied to a test-contact for testing.

8. In a multiple-switchboard exchange, metallic circuits, switch apparatus for switching said metallic circuits for use at any board, each circuit comprising continuously in the order named, test-contacts, one at each of two or more boards, a line conductor, a normally-ungrounded subscriber's outfit including a subscriber's test-battery normally in its circuit but switched therefrom while the subscriber's telephone is switched for use, and including a call-generator and normally open

ground connection closed during a call, a return metallic conductor to central, switch-contacts at each of said boards, and a ground connection containing a call-annunciator; in combination with test receiving instruments at each of said boards connected on one side to said ground connection and on the other adapted to be connected to said test-contacts for testing.

9. In a multiple-switchboard exchange, metallic-circuit lines, switching apparatus for connecting said lines, each circuit comprising, in the order named, test-contacts, one at each board, a line conductor, a normally-ungrounded subscriber's outfit including a subscriber's test-battery normally in the circuit, a switch for switching said battery out of circuit while the telephone is in use, a normally short-circuited call-generator normally in said circuit, a ground connection closed to said generator while actuated for a call, contacts for opening said short circuit while the generator is actuated, a return metallic conductor to central, and a ground connection containing an annunciator; in combination with a test receiving instrument grounded on one side and on the other adapted to be connected to a test-contact for testing.

10. In a multiple-switchboard exchange, telephone-lines adapted to be connected together and to be "tied up" with their telephones not switched for use, a clearing-out signal for said "tied-up" condition, a test receiving instrument at another board adapted to indicate the switched or unswitched condition of the subscribers' telephones, and a source of electricity for operating said signal, adapted to be connected to said clearing-out signal at said other board.

11. In a multiple-switchboard exchange, telephone-lines adapted to be connected together, and to be "tied up" with their subscribers' telephones not switched for use, a test-circuit, a test receiving instrument at another board adapted to indicate that said telephones are not in use when said lines are "tied up," a clearing-out signal for said "tied-up" condition, means for operating said signal from said other board, and an additional telephone-line adapted to be connected to one of said "tied-up" lines.

12. In a multiple-switchboard exchange, two telephone-lines adapted to be connected together at a first board, a clearing-out signal for said lines at said board, a test-circuit for one or more of said lines, a test receiving instrument at a second board adapted to cooperate with said test-circuit and give a "free" signal for either of said lines while the subscribers' outfits thereof are not in use, a third telephone-line adapted to be connected to either of said lines at said second board, and a call adapted to be sent out to the subscriber's outfit of one of said two connected lines, and adapted at the same time to operate said clearing-out signal.

13. In a multiple-switchboard exchange, two "tied-up" metallic circuits switched together at central, a test receiving instrument in a normally open bridge adapted to be closed for the purpose of testing, and subscribers' transmitter and test batteries, one in each metallic circuit, normally, or when the telephones are not switched for use, in the main line in opposition to each other and thereby adapted to assist each other in causing a "free" test signal, a clearing-out indicator in said established circuit, and a call-generator adapted to actuate said clearing-out indicator, thereby calling the desired subscriber, and giving a signal for the "tied-up" lines to be disconnected.

14. In a multiple-switchboard exchange, two "tied-up" lines switched together at central, a test receiving instrument in a normally open bridge adapted to be closed for the purpose of testing, and subscribers' transmitter and test batteries, one in each circuit while the telephone is not switched for use, with like poles connected to like sides of the circuit, and a call-generator at another board from that at which the lines are "tied up," adapted to be connected to said circuit and to call said subscribers.

15. In a multiple-switchboard exchange, two "tied-up" lines switched together at a board, a normally open test-circuit adapted to be closed at another board and give a "free" signal while the lines are thus connected, a clearing-out indicator in said established circuit at said first board, subscribers' calling devices; and a central call-generator at said other board adapted to operate the clearing-out indicator and the subscribers' call devices, and thereby call the subscriber, and give a signal for the disconnection of said "tied-up" lines at said first board.

16. In a multiple-switchboard exchange, two "tied-up" lines switched together at a board, a ground connection for one side of said established circuit, combined transmitter and test batteries, one in each subscriber's outfit, in the established circuit while the telephones are not switched for use, with like poles connected to like sides of the circuit, a test receiving instrument at a second board grounded on one side and on the other side adapted to be connected to the ungrounded side of an established circuit; subscribers' calling devices in said circuit while the telephones are not switched for use, a clearing-out annunciator in said circuit, and a central calling-generator at said second board adapted to be looped into said circuit to operate the calling devices and the clearing-out indicator, whereby the desired subscriber's line may be tested, found "free," be connected to and called up at the second board, and the "tied-up" lines disconnected at the first board.

17. In a multiple-switchboard exchange, two "tied-up" lines forming an established

metallic circuit for communication, a double-conductor loop at one of the multiple boards, connected to said lines, a clearing-out indicator in said loop, a ground connection for one side of said established metallic circuit while thus connected, test-contacts connected to the other side of said circuit, one at each board, a grounded test receiving instrument at a second one of the multiple boards, adapted to be connected to the test-contact at said board for testing, a calling-generator at said board adapted to be bridged into the established circuit, call bells or devices in said circuit at each subscriber's station, said bells and said clearing-out indicator being operated by said call generator when thus bridged.

MILO G. KELLOGG.

Witnesses:
FRANCES D. KELLOGG,
MARGARETHA RIEHL.