(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,311. Patented Oct. 26, 1897.

Fig. 1a.

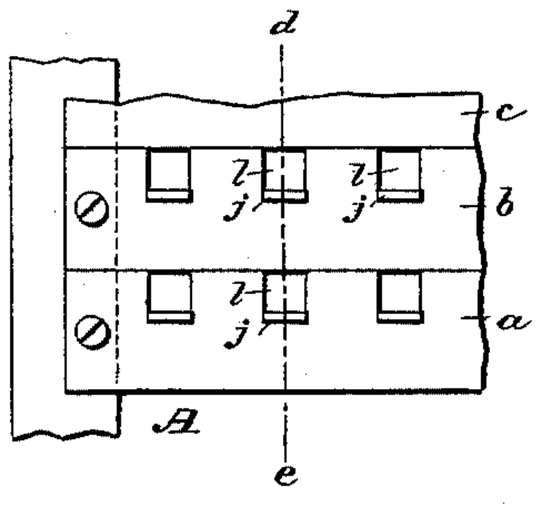


Fig. 1b.

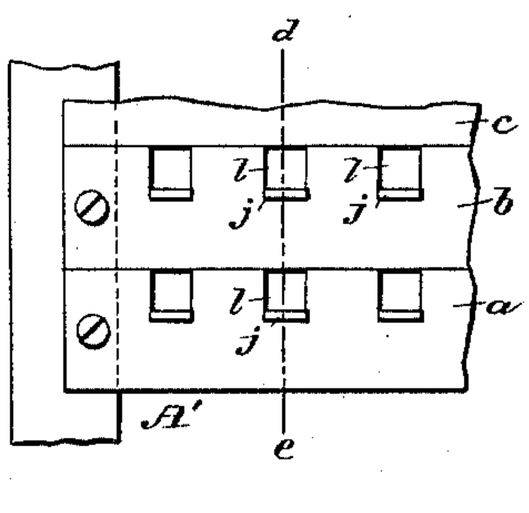


Fig. 2.

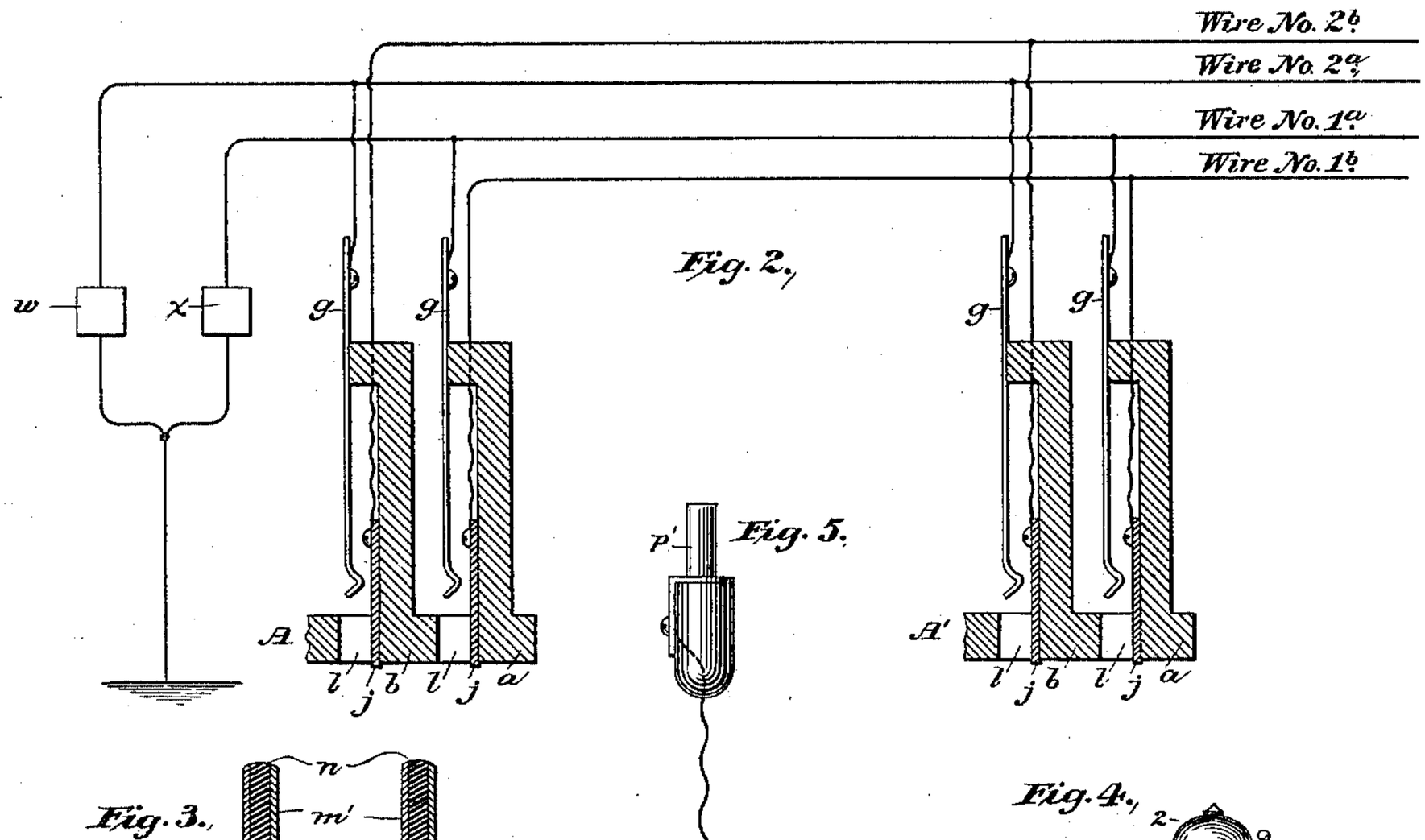


Fig. 5.

Fig. 3.

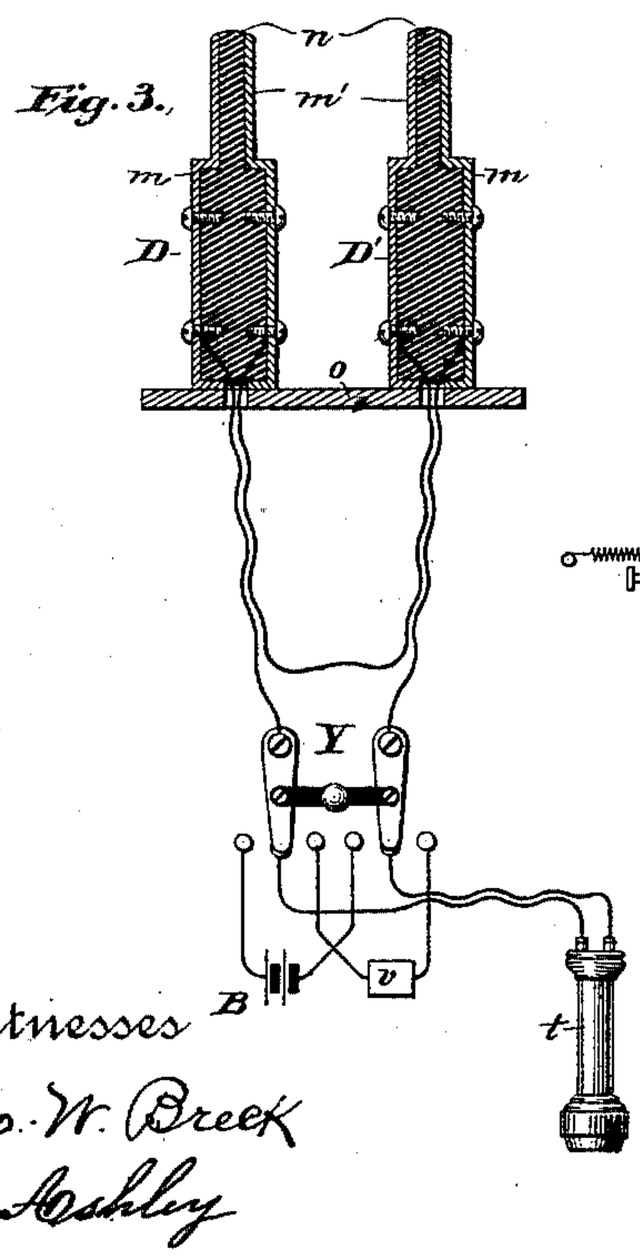
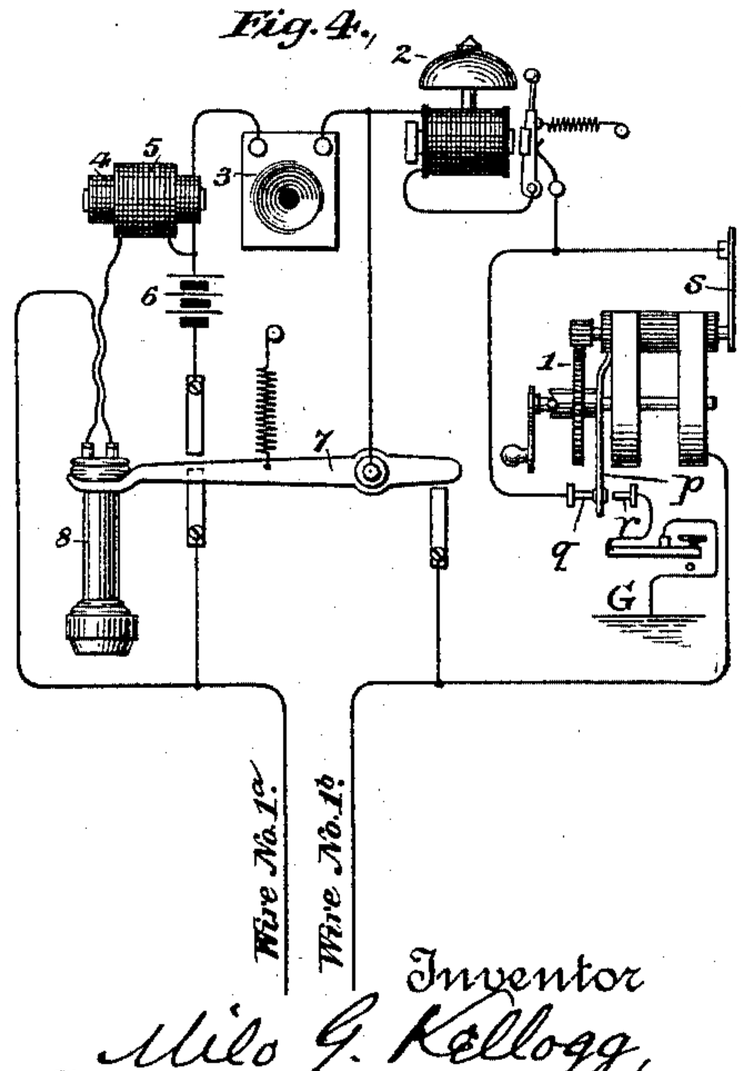


Fig. 4.



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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. 592,311, dated October 26, 1897.

Application filed November 29, 1889. Serial No. 332,013. (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 with the two contact-pieces of the plug, 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.

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 switchboards. Fig. 4 is a diagram of the subscriber's-station apparatus necessary to illustrate my invention. Fig. 5 shows an operator's test outfit.

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 switchboards shown in Fig. 1^a, and A′ is a sectional view of the switchboard shown in Fig. 1^b, the section being taken on the line *d e*. Upon the rubber strips *a b* of the form substantially as shown are mounted the contacts *g* and *j*. These strips may be long enough to hold a convenient number of jacks.

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 readily connect with a test-plug for purposes of testing. The switch-plugs 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 at the central office for receiving signals from the subscribers' stations.

Two lines are represented 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 line-circuits may be traced from the test-contacts *j* in the jack at each board, line conductor No. 1^b to the subscriber's station, thence normally, or while the telephone is not switched for use, to the frame of the generator, normally-closed contacts *p* and *q*, short circuit 14, around the armature of said generator, circuit-breaking bell 2, conductor 15, switch-lever 7, contact 9, normally in electrical connection therewith, short circuit 13, around the receiver-circuit, line conducter No. 1^a to central spring-contacts *g* at each board, the annunciator *x* to ground at G. The connections of all the subscribers' circuits are substantially the same.

While the subscriber's telephone is off the switch-lever, and is thereby switched for use, the subscriber's circuit is traced as follows: line conductor No. 1^b, short circuit 12 around the calling set, contact 10, now connected to

the switch-lever 7, conductor 15, transmitter 3, primary coil 4, also from switch-lever 7, battery 6, connected thereto through contact 11, secondary coil 5 of the induction-coil, the telephone-receiver 8, to line conductor No. 1^a. The closing of the contact 11 with the switch-lever 7 closes the transmitter-circuit containing the battery 6, the primary coil 4, transmitter 3, and the conductor 15.

When the call-generator is operated, the usual automatic device well-known to telephone-engineers forces the spring-contact p away from the contact q, thereby opening the short circuit 14, and brings it into connection with the grounded contact r and normally-closed contacts 16 and 17. Since the metallic circuit is open at central, the current will be thrown over the line conductor No. 1^a and ground. When clearing out, the metallic circuit is no longer open at central and the generator-current is thrown over this circuit, thereby operating the clearing-out annunciator. To prevent the operation of the calling-annunciator while clearing out, the subscriber manually opens the contacts 16 and 17. Thus it will be seen the subscriber's generator is between line conductor No. 1^a and ground. While clearing out, the calling-generator is in the metallic circuit alone, between the two line conductors. While the generator is operated, the telephone must be on its switch.

The existence of the short circuits 12, 13, and 14 around the telephone set, the calling set, and the generator switches those elements out of the line-circuit. It is obvious that they might be placed on open circuit instead. Various other obvious modifications might be used.

The signal-bell 2 is the ordinary vibrating bell or automatic circuit-breaker and has a resistance suitable to the circuit.

Each operator at the central station is provided with a test outfit like that shown in Fig. 5, comprising a test-battery B′ and test receiving instrument t', grounded on one side at G and on the other side connected to a test-plug p', adapted to be applied to a test-contact j for testing.

The battery B′, the test receiving instrument t', and the subscriber's vibrating bell 2 are so related that when in circuit with each other the battery causes the bell 2 to ring and the test receiving instrument t' to give a corresponding signal. When the call-bell 2 is short-circuited by the conductor 12 when the telephone is switched for use, the test receiving instrument t' will no longer give an indication corresponding to the automatic circuit-breaker 2, thus indicating that the line is "busy." Thus the test depends entirely upon the condition of the subscriber's outfit, the test receiving instrument giving a continuous signal while the line is "free," but giving a single tap when the line is "busy."

When the line tests "free," the ringing bell at the subscriber's station may call the subscriber, informing him that he is wanted at the telephone; but preferably this call is preliminary and short, and the call-generator B is used for the purpose of calling.

The system as constructed has another peculiar advantage which will be described later.

In Fig. 3 are shown two connecting-plugs D and D′, each composed of insulating material n, upon which are mounted two contacts m and m'. The two contacts m' are connected together by a flexible conductor d'. The two contacts m are connected together by a flexible conductor d, in the circuit of which is a looping-in switch Y, adapted to be placed upon pairs of contacts q' q', r' r', or s' s', and thereby loop into the circuit a clearing-out annunciator v, an operator's telephone set t, or a calling-generator B. Normally the switch Y rests upon contacts q' q'. The plugs normally rest upon a base-plate o, their two contacts being crossed thereby, so that when one plug is inserted into the switch of a calling subscriber the operator's outfit is on closed circuit through the contacts of the other plug crossed by the plate. The weight usually used with the flexible conductors d d' insures a good electrical connection between the contacts m m' and the conducting-plate o. When a plug is inserted into a switch, its contacts make connection with the jack-contacts g and j. The plugs may with some test systems be inserted either way, but preferably the plug-contacts m should be connected to the jack-contacts g and the plug-contacts m' connected to the jack-contacts j.

When two lines are connected together and the subscribers hang up their telephones and no clearing-out signal is sent in, the lines are said to be "tied up."

If the telephones of both subscribers are upon their levers and an operator at another board tests either of the connected lines, the operator's test outfit will be in circuit with the vibrating bells of both subscribers in parallel and the line tested will indicate "free." The testing operator then connects the tested line to a calling-line, with the result that the calling-line forms a bridge across the two tied-up lines, and when the operator loops her call-generator into this bridge for calling not only do the subscribers' bells ring, but the clearing-out annunciator is operated at the board where the two lines are tied up, and the operator thereat seeing the disconnection-signal disconnects the tied-up lines. Thus when lines are left in this condition it is dissolved when either line is wanted. Both connected lines would test free and be connected to and their tied-up connection be dissolved if they both were wanted at the same time.

The clearing-out annunciator of two connected lines in use by both subscribers is not operated by the test-battery, because the test-circuit established resolves itself into the well-known Wheatstone bridge, being traced from the ground through the test outfit to a test-contact, thence in multiple over the two

line conductors No. 1^b and No. 2^b, connected together through a flexible conductor d', and through the resistances of the subscribers' telephone sets, which are substantially the same in both lines, thence back to central to contacts g, connected together by a flexible conductor d, forming the "bridge," containing a clearing-out annunciator, thence from each contact g through a call-annunciator, both annunciators having an equal resistance, thence to ground. The clearing-out annunciator is thus in a Wheatstone bridge and is not operated by the test-battery B' of the test outfit.

If one and only one of the subscribers' telephones of two connected lines is upon its switch, this balance is destroyed, for a vibrating bell 2 contains a resistance much smaller than that of the subscriber's telephone set, and the clearing-out annunciator will be operated by a test-battery, so that when two lines are tied up at a board because no clearing-out signal is sent, and one telephone is on and the other off its hook, a testing operator, although finding the line busy, will operate the clearing-out annunciator, so that the tied-up condition is dissolved.

By constructing the subscribers' call and telephone sets of equal resistance the clearing-out annunciator will not operate when either of two connected lines is tested and one telephone is on and the other telephone is off the hook. Thus this feature may be omitted whenever desired without altering the system in other respects.

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 the line, operates his line-annunciator at the central office. He then removes his telephone from its switch, and the operator at the central office places one of a pair of plugs in the switch of the line where the call is indicated, and, placing the lever of the switch Y corresponding with the pair of plugs used on the contact-bolts connected with her telephone-loop, finds out what is wanted. She then places her test-plug on the contact-piece j of the switch of the line wanted as a test. If the test indicates that the line is not in use, the operator places the other plug of the pair used into the switch of the line, thus connecting them together. Then by moving the levers of the looping-in switch she loops a calling-battery into the circuit and calls the subscriber. Then she loops the clearing-out annunciator into the circuit. By moving the switch she may again loop in the calling-battery or loop in her telephone set to determine by listening whether two connected subscribers are through conversation.

The line-annunciators are polarized annunciators, constructed to be operated by only one polarity of current, and they and the operators' test-batteries should be so connected into their respective circuits that the annunciators will not respond when a test is made to their lines.

The subscribers' generators may give currents of alternate polarity (as they are more generally constructed) which will operate the line-annuciators, or they may be constructed so as to give currents of only one polarity, and in the latter case should be so connected into their respective lines as to operate their polarized line-annunciators.

It will be observed that in this system of switching and testing the office ground of a line is not removed where 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 also be observed that although the line-annunciators are not cut off from their lines when the lines are switched for conversation they are substantially switched from the metallic circuit by the conductor d, containing the clearing-out annunciator, which acts as a shunt around the two annunciators, so that enough of the clearing-out current is shunted from the line-annunciators to prevent their operation. The circuit of a clearing-out current may be traced from one pole s of the subscriber's generator, line conductor No. 1^a, to central, to contact g of the switch, where the line is connected, through the annunciator to the common ground connection, thence through the annunciator of the other connected line to the contact g of the jack, where the line is connected, these annunciators being short-circuited or shunted by the conductor d, containing the clearing-out annunciator, connected to the two contact-springs g g of the two lines, thence over the line conductors Nos. 2^a and 2^b to contact j of the latter line, conductor d', contact j of the former line, line conductor No. 1^b, back to the other pole of the subscriber's generator.

Although the ground has been shown as forming part of the call and test circuits, it is obvious that a metallic conductor might be substituted therefor. To effect this, a connection to a common wire would be substituted for each ground connection.

It is to be noted that at any time a subscriber while connected to another for conversation can call the attention of an operator by ringing his call-generator without opening contacts 16 and 17, thus operating the call-annunciator. The metallic circuit, containing two subscribers' circuits, their resistances, and the clearing-out annunciator, is shunted by the call-circuit containing the call-annunciator. An operator can thus be signaled by the calling subscriber and can loop her apparatus into the connected circuit for calling or conversation, and either subscriber may when his circuit is thus tied up secure another connection, with the result that the tied-up condition will be dissolved.

Some features of the test system are used

only in exchanges where all of the line-circuits have approximately the same resistance.

By this system of switching and testing only two contact-pieces are required for each line-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 in other metallic-circuit multiple-switchboard systems.

In sending clearing-out signals the subscriber manipulates the normally closed key in the ground connection of his generator to open the circuit and then operates the generator. There is then no circuit through the line-annunciators and they will not be operated, but the clearing-out annunciator in the circuit of the lines will be operated. The contacts *g* and the test instrument being permanently connected to ground are therefore permanently connected with each other.

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

1. In a multiple-switchboard exchange, a test-circuit containing a circuit-interrupter at the subscriber's station switched from so as not to be a part of said circuit while the telephone is switched for use, but not otherwise, a polarized call-annunciator in said test-circuit so connected as not to be operated thereby, and a call-circuit associated with said annunciator.

2. In a multiple-switchboard exchange, a metallic test-circuit, comprising a test signaling device at the subscriber's station automatically operated by the battery, a test receiving instrument adapted to respond thereto, a battery, a subscriber's-telephone switch controlling said response, a call-circuit, a conductor common to said call and test circuits, and a polarized call-annunciator in said conductor, so connected as not to respond to said test-battery.

3. In a multiple-switchboard exchange, metallic circuits, each comprising in the order named test-contacts, one at each board, a line conductor, a test signaling device at the subscriber's station, a return-line conductor, a test receiving instrument and battery adapted to respond to said test signaling device, and a test plug or device adapted to be connected to a test-contact for testing; in combination with a subscriber's switch to prevent said response while the telephone is switched for use but not otherwise.

4. In a multiple-switchboard exchange, a metallic circuit, closed at subscriber's station, normally open at central, one limb connected through a call-annunciator to ground, an operator's grounded test outfit adapted to be connected to the other limb for testing, an interrupter in said metallic circuit at the subscriber's station coöperating with said test outfit to give a "free" signal, and a subscriber's switch and connections preventing said signal while his telephone is switched for use, but not otherwise.

5. In a multiple-switchboard exchange, in the order named, test-contacts, one at each board, a line conductor, a normally closed subscriber's circuit containing normally a circuit-interrupter at his station, said interrupter being switched therefrom while the telephone is switched for use, a return metallic line conductor, switch-contacts, one at each board, and a test outfit at each board including a test receiving instrument and battery adapted to be connected to a test-contact for testing.

6. In a multiple-switchboard exchange, in the order named, test-contacts, a metallic line conductor, a subscriber's station outfit containing a test signaling device, a metallic return-line conductor, jack-contacts, a polarized annunciator, and a connection to a test plug or device containing a test-battery so connected as not to operate said annunciator, and a test receiving instrument adapted to respond to said test signaling device; in combination with a switch in said subscriber's outfit preventing said response while the telephone is switched for use.

7. In a multiple-switchboard exchange, metallic circuits each comprising, in the order named, a test-contact at each of two or more boards, a line conductor, a subscriber's outfit containing an interrupter normally in its circuit, but switched therefrom while the telephone is switched for use, and a generator grounded while calling but not while clearing out, a return-line conductor, a polarized annunciator, and a ground connection; in combination with a grounded test outfit at each board adapted to be connected to a test contact and to respond to said interrupter, and double-cord connecting apparatus adapted to connect two of said metallic circuits together, with a clearing-out annunciator shunting the call-annunciators of said metallic circuits.

8. In a multiple-switchboard exchange, in the order named, test-contacts, one at each board, a metallic line conductor, a subscriber's circuit containing normally a circuit-interrupter at his station, said interrupter being switched therefrom while the telephone is switched for use, a return-line conductor, switch-contacts permanently connected thereto, one at each board, a polarized call-annunciator, and a connection to test outfits in multiple branches, one outfit at each board including a test receiving instrument adapted to respond to said interrupter while testing and the subscriber's telephone is not switched for use but not otherwise; in combination with a test-battery, in said test-circuit, so connected as not to operate said call-annunciator, and a call-circuit and generator for operating said call-annunciator.

9. In a multiple-switchboard exchange, two telephone-circuits connected together for conversation through a clearing-out annunciator, and a test-circuit associated therewith containing said annunciator in the bridge of a Wheatstone bridge.

10. In a multiple-switchboard exchange, two metallic circuits the two limbs of one

connected to the two limbs of the other, one limb of each circuit being connected through a resistance to a test outfit and battery in a normally open bridge closed while testing, a clearing-out annunciator in a separate circuit connecting said limbs, and a circuit of substantially no resistance connecting the other limbs of said metallic circuits.

11. In a multiple-switchboard exchange, two circuits of substantially equal resistance connected together at a board into a combined circuit for conversation, a clearing-out annunciator in one side of said combined circuit, a normally open bridge closed for testing, containing a test-battery, connected at one end through call-annunciators of substantially equal resistances to the said combined circuit on either side of said clearing-out annunciator, whereby on testing said clearing-out annunciator will not be operated.

12. In a multiple-switchboard exchange, two "tied-up" metallic circuits of substantially different resistance, one with its telephone switched for use, and the other with its telephone not switched for use, a clearing-out annunciator in one limb of said "tied-up" circuit, a bridge containing a test-battery, normally open at one end but closed for testing, connected at the other end through substantially equal resistances to both sides of said clearing-out annunciator whereby on testing, said clearing-out annunciator will be operated and the "tied-up" condition dissolved.

13. In a multiple-switchboard exchange, two "tied-up" metallic circuits, a switch for each circuit at each board containing two contacts, one connected to each limb, connecting apparatus at each board to connect the two contacts of one circuit with the two contacts of another circuit, a clearing-out annunciator in said connecting apparatus, a test-circuit for said connected circuits, and a test outfit responding "free" while testing, said connected circuits, when their telephones are not switched for use, and an operator's call-generator adapted to be connected to said circuit to operate said clearing-out annunciator.

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