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M. G. KELLOGG.

MULTIPLE SWITCHBOARD FOR TELEPHONE EXCHANGES.

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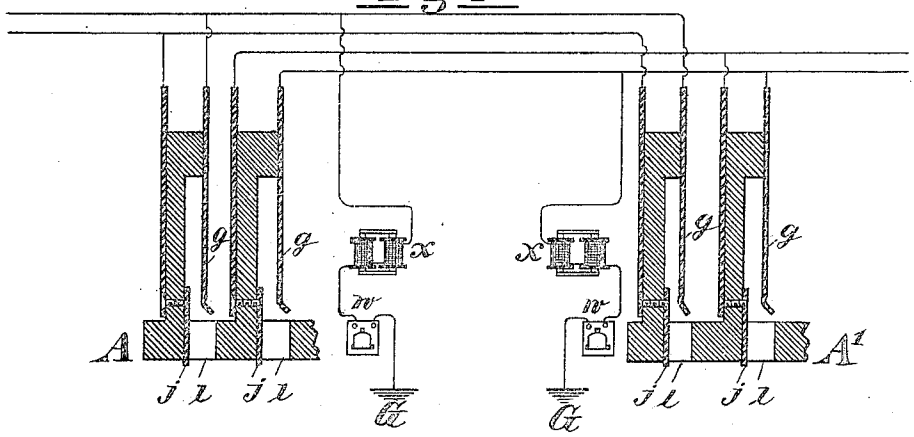
Fig. 1.



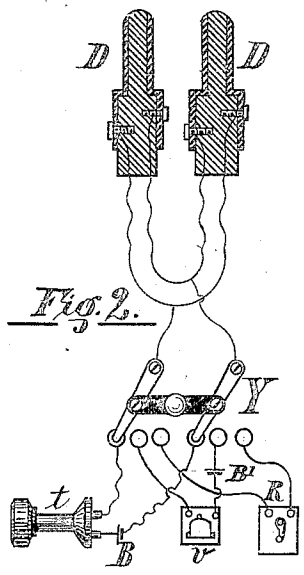


Fig. 2.

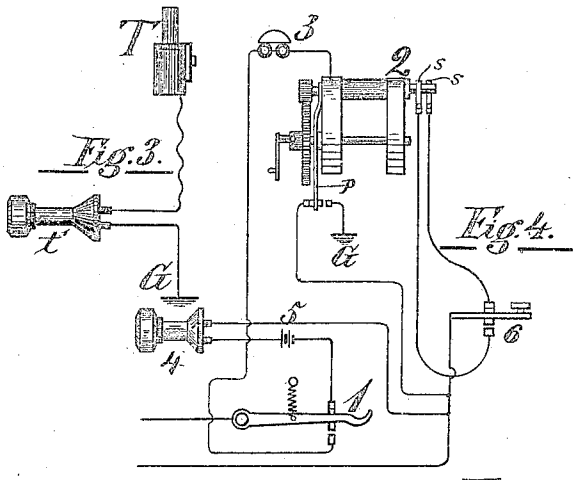


Fig. 3.

Fig. 4.

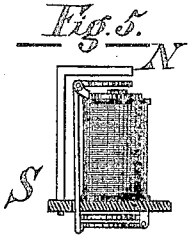


Fig. 5.

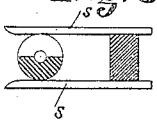


Fig. 6.

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UNITED STATES PATENT OFFICE.

MILO G. KELLOGG, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

MULTIPLE SWITCHBOARD FOR TELEPHONE-EXCHANGES.

No. 821,807. Specification of Letters Patent. Patented May 29, 1906.

Application filed November 30, 1891. Serial No. 413,605.

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, of Chicago, in the county of Cook and State of Illinois, temporarily residing at Geneva, in the Republic of Switzerland, 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 especially to a metallic circuit system or to a system in which part of the lines are metallic-circuit lines, but is not in all respects limited to such a system; and it consists in a system for calling, testing, switching, and clearing out, which I shall describe and claim in detail.

In the accompanying drawings, illustrating my invention, Figure 1 is a diagram with sections of two switchboards to which the same lines are connected, with two lines and their central-office apparatus connected with the same. Fig. 2 shows an operator's cord system adapted to be used at any board. Fig. 3 shows an operator's test system adapted to be used at any board. Fig. 4 shows a subscriber's station apparatus for each line. Fig. 5 shows a polarized annunciator which may be used for each line. Fig. 6 is an end view of the generator-shaft at the subscriber's station with two contacts, one bearing on each side of the shaft.

In Fig. 1, A A′ are sectional views of sections of two switchboards. Each board has a switch for each line. Each switch has two contact-pieces insulated from each other (except through the circuit connections) and a switch-hole adapted to receive the switch-plugs at its board. The contact-pieces of the switches are so placed and arranged that when a loop-switch plug (shown in Fig. 2 and marked D D) is inserted into the switch-hole the two contact-pieces of the plug form connection with the two contact-pieces of the switch, respectively. In the drawings one of the contact-pieces of each switch is a spring, (marked *g*,) and the other contact-piece is placed along the switch-hole and is marked *j*. The switch-holes are marked *l l*. The contact-pieces are mounted on rubber strips of the shape substantially as shown, through the fronts of which are the switch-holes. Other forms of switches may be used which have two contact-pieces insulated from each other and adapted to receive loop-switch plugs and form connection between their contact-pieces and the contact-pieces of the plug.

w w are line-annunciators, and *x x* are retardation-coils, one annunciator and one retardation-coil for each line. On account of the calling system which I shall describe it is preferable that the annunciators be polarized annunciators.

One side or branch of each line is connected to one of the contact-pieces of each of the switches of the line—say pieces *g g*—and the other contact-pieces—say *j j*—are connected with the other side or branch of the line. One side or branch of each line—say the side which is connected to the contact-pieces *g g*—is permanently grounded through the annunciator and retardation-coil of the line. The connections shown in Fig. 1 are substantially as described above.

In Fig. 2, D D are a pair of loop-switch plugs, each plug being adapted to be inserted into each switch at its board and when inserted to form connection between its contact-pieces and the contact-pieces of the switch. The two contact-pieces of one plug are connected with the two contact-pieces of the other plug, respectively, by two flexible switch conductors. *t* is the operator's telephone; R, a calling-generator; Y, a looping-in switch; *v*, a clearing-out annunciator; B, a test-battery in a loop with the telephone, and B′ a test-battery in a loop with the clearing-out annunciator. Each pair of plugs has a switch Y, a clearing-out annunciator *v*, and a test-battery B′. One calling-generator will answer for the exchange. The connections are substantially as shown. By means of the looping-in switch Y the operator may at will bridge the circuit of the two flexible conductors with either the loop containing her telephone and its test-battery or the loop containing the clearing-out annunciator and its test-battery or with the calling-generator.

Only one pair of plugs with their special apparatus is shown. Other pairs may be added to the operator's cord system in a way which will be apparent to those skilled in the art.

The clearing-out annunciators should pref-

erably be of comparatively high resistance—say about five hundred ohms—and of a kind which offers considerable retardation to telephone-currents.

In the operator's test system, (shown in Fig. 3,) T is the test-plug, and t' the test-receiving instrument. The test-plug is connected with a flexible conductor and is adapted to be brought for testing into connection with any switch-contact piece j at its board. It is grounded through its test-receiving instrument. Each operator has one cord system and one test system suitably arranged at her board.

In the subscriber's-station apparatus, (shown in Fig. 4) 1 is the telephone-switch; 2, the calling-generator; 3, the signal-receiving bell; 4, the subscriber's telephone; 5, a station-battery, and 6 a clearing-out key. These parts may be of usual kinds. The calling-generator is, however, modified as follows: The insulated contact-piece on the shaft of the armature, to which is connected one end of the armature-wire and which conducts the generated current to the line through the stationary spring-contact (or contacts) provided for it, is a half-circle, the remaining part of the circle being an insulation, as shown in Fig. 6. I provide two stationary spring contact-pieces, as shown, (marked *s s*,) bearing on the diametrically opposite parts of the circle of the shaft of which said insulated contact-piece is a part. The key 6 is provided with two pairs of contact-points, as shown, one pair being normally closed and the other pair normally open, and when the key-lever is depressed the pair normally closed is opened and the normally open pair is closed. The connections of the key to the contact-springs of the generator and to the line-circuit is as follows and as shown: The spring-lever which forms one of the contact-points of each pair is connected to one side or branch of the line. The two other contacts of the key are connected to the two contact-springs of the generator, respectively. The frame of the generator is connected with that contact-point of the telephone-switch which is in connection with the switch-lever when the telephone is on the switch and the signal-receiving bell is in circuit with the generator. The lever of the switch is connected with the other side or branch of the line. The other contact-point of the switch (that against which the lever comes into contact when the telephone is taken from the switch) is connected to the first-mentioned side of the line through the telephone and station battery. As is usual with this style of generator, (which is well known,) one terminal of the armature-coil is connected to the generator-frame and to the arm through which the generator is grounded when operated. As seen in Fig. 6, the generator is therefore normally shunted, but when operated the shunt is opened and the armature grounded. It is evident from the drawings and the above description that when the telephone is on the switch the generator and bell are in circuit with the line and when the telephone is off the switch the telephone and battery are in circuit with the line.

It is well known that when the usual calling magneto-generator is operated a current of one polarity is generated during half the revolution of the armature and a current of the other polarity is generated during the rest of the revolution. The contact-springs of the generator are so placed that one of them conducts the current of one polarity and the other the current of the other polarity. It will be apparent from the description of the generator and circuit connections which has been given that when the generator is operated with the subscriber's telephone on its switch and the key is not depressed a current of one polarity will be generated in the line and when the key is depressed a current of the other polarity is generated. The subscriber can therefore at will send a current of either polarity.

The automatic device of the generator has a pair of contacts by which the line-circuit is automatically grounded while the generator is being operated. The apparatus should be so connected into the line-circuit that the generator is between this ground connection and the permanent ground connection of the line at the central office.

The polarized annunciators should preferably be so connected into their respective circuits as to be operated by the current from the subscriber's generator when it is operated and the key is not depressed. The polarized annunciator shown in Fig. 5 is substantially a modification of the non-polarized annunciator most generally used for telephone-exchanges and shown and described in detail in the patent of James C. Warner, No. 266,405, and dated October 24, 1882. The modification consists, essentially, in the employment of a permanent magnet (marked N S) attached at one end to the iron plate which forms the pole-piece of the electromagnet of the annunciator and which therefore charges the cores of the electromagnet with one polarity of magnetism. The permanent magnet is bent so that its other end is in close juxtaposition to the armature of the annunciator and charges the armature by induction. It is well known that when a current is sent through a polarized annunciator of the polarity not to operate it there is no attraction whatever between the electromagnet and the armature of the annunciator, and therefore there is no tendency to release the annunciator-drop, so that it may fall and indicate a call. On the other hand, when such a current is passing through the annunciator there is a repulsion between the

electromagnet and its armature, which, in fact, then positively holds down the catch of the annunciator and positively locks or prevents the release of the drop.

The clearing-out annunciators may be non-polarized annunciators.

The operation of the system is as follows: When a subscriber wishes a connection, he operates his generator without pressing down his key-lever. A calling-current passes from the ground connection he thereby establishes and one branch of his line and the line-annunciator to the ground at the central office and operates the annunciator. The operator then places one of her switch-plugs in the switch of the line and the levers of the switch Y of the plug being in the position where the telephone bridges across the two contact-pieces of the plug. She finds out by conversation what line is wanted. She then tests the line wanted, as will hereinafter be indicated, and if it tests "free" or unswitched she places the other plug of the pair in its switch. She then moves the switch Y so that the calling-generator is in a bridge connection across the two sides of the circuit established between the two lines and a calling-current will go in split current through the circuit of both lines and ring the bell of the subscriber wanted and also that of the calling subscriber if he has replaced his telephone on its switch. The operator then moves the switch Y so that the clearing-out annunciator, with its battery, is in the bridge connection across the two sides of the circuit. The subscribers are then connected together for conversation and their circuit is grounded through the annunciators and retardation-coils of both lines. This, however, will not interfere with telephone conversation which may be sent over the circuit. It is preferable that the plugs be placed in the switches in such a direction that the annunciators and retardation-coils of both lines are connected to ground on the same side of the metallic circuit established between the lines. To send a clearing-out signal, either subscriber presses on his clearing-out key and at the same time operates his calling-generator. A clearing-out current is therefore sent through his metallic circuit, and the clearing-out annunciator which bridges the circuit and the annunciator will be operated, indicating a clearing-out signal. When the clearing-out signal is given, current will also go to ground through the annunciators of the lines. It will, however, not be of the polarity to operate the annunciators. When the subscriber sends the clearing-out signal, as above described, and part of the current goes through the line-annunciators of the two lines, there is, on account of the polarity of the current and the construction of the annunciators, no attraction whatever between the line-annunciator magnets and their armatures, and consequently there is no tendency or force whatever exerted to release the drop. There is, on the other hand, a repulsion between the two which acts at that time to postively lock and prevent the release of the drop. The drop is therefore positively prevented from being operated when the clearing-out current is sent and is, in fact, locked, so as to be prevented from falling. In other systems of exchange operation in which the line-annunciators of two connected lines are in circuit with the calling-generator operated to send a clearing-out signal there is an attraction between the line-annunciator magnets and their armatures, and consequently there is a tendency to release the drop, which is only prevented from being operated or released from the fact that the current is not strong enough to furnish sufficient attraction to move the armature and release the drop. In such a system the line-drops are prevented from being operated only by a margin of adjustment current or force, which may at times be difficult to obtain and be more or less unreliable, while in my system the line-annunciators are positively prevented from being operated by and the drops are, in fact, electrically locked to the current sent through the annunciators in sending the clearing-out signal, however strong the current may be, and the drops do not depend on not being operated when the clearing-out current is sent by any mere margin of adjustment current or force. This result is obtained by the construction of the line-annunciators. So far as I am aware, this system of clearing-out signals is generically new with me, and I do not limit myself to the specific means of positively preventing the operation of the line-annunciator drop when a current is sent from a subscriber's station to operate the clearing-out annunciator, since, obviously, other ways may be devised of accomplishing such a result by the use of devices operating in well-known ways.

The test system is as follows: When an operator tests a line, she places her test-plug on the contact-piece *j* of the switch of the line. If then the line is switched for use and the circuit is bridged by either a telephone and its battery or the clearing-out annunciator and its battery or the calling-generator, a circuit is established which contains the test-receiving instrument and a source of electricity, and the instrument will sound or respond. This circuit is from the ground to one side of the line, thence through the bridge connection which contains the source of electricity to the other side of the line, and to ground through its ground connection. If the line is not switched for use, but the subscriber has taken down his telephone for use, when the line is tested there is a complete circuit established from the ground through the test-receiving instrument to the line and through the circuit of the line by way of the

subscriber's station and the battery which is then in the circuit at the subscriber's station back to ground at the central office through the line-annunciator, and the instrument will respond or sound. The test-receiving instrument will therefore sound whether the line is switched for use or the subscriber's telephone is switched for use. When neither is switched for use, the instrument will not sound. The test therefore indicates whether or not either the line is switched or the subscriber's telephone is switched for use.

The clearing-out annunciators, as heretofore stated, are preferably of comparatively high resistance and considerable retardation to telephone-currents. They therefore operate as retarding-coils to minimize the effect of the bridge or cross connection through the test-battery between the two sides or branches of the metallic circuit established for conversation between two subscribers.

The system might be modified by leaving the subscribers' batteries out of the circuits, and the tests would indicate whether or not the lines were switched for use. It might also be modified by leaving the test-battery out of the bridge connections at the central office, and the tests would then indicate whether or not the subscribers' telephones were switched for use.

Instead of the annunciator *w* and retardation-coil *x* for each line an annunciator may be employed which has high resistance and high retardation to telephone-currents.

I claim as my invention—

1. In a telephone-exchange system, metallic-circuit lines and polarized annunciators, one for each line through which one side or branch of the line is permanently grounded, in combination with switching apparatus to switch any two of said lines into a metallic circuit for conversation which does not include their annunciators, clearing-out annunciators, one in a bridge connection across each metallic circuit thus established, and calling apparatus at each subscriber's station with commutator and switch parts to send at will a current of one polarity in a grounded circuit through the line-annunciator or when the line is switched a current of the other polarity in the metallic circuit through the clearing-out annunciator, substantially as set forth.

2. In a telephone-exchange system, a metallic-circuit line, one side or branch of which is normally grounded at the central office a calling-generator, commutator and switch apparatus at the subscriber's station to at will send a current of either polarity into the line, and switch-contacts to ground the line while the generator is being operated, substantially as set forth.

3. In a telephone-exchange system, a metallic-circuit line, a calling-generator, commutator and switch apparatus at the subscriber's station to at will send a current of either polarity into the line, and switch-contacts automatically operated by the generator to ground the line while the generator is being operated, substantially as set forth.

4. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of one of which are respectively connected to the two contact-pieces of the other by two flexible switch-conductors, in combination with an operator's telephone and a test-battery in a temporary bridge connection across said conductors, substantially as set forth.

5. In a telephone-exchange system, a pair of loop-switch plugs the two contact-pieces of one of which are respectively connected with the two contact-pieces of the other by two flexible switch-conductors, in combination with a loop containing an operator's telephone and a test-battery, another loop containing a clearing-out annunciator and a test-battery, and a looping-in switch with contacts and connections to at will connect either of said loops in a bridge connection across said conductors, substantially as set forth.

6. In a telephone-exchange system, two telephone-lines connected together in metallic circuit for conversation, in combination with an operator's telephone and test-battery in a temporary bridge connection across said circuit, substantially as set forth.

7. In a telephone-exchange system, two telephone-lines connected together in metallic circuit for conversation, in combination with a loop containing an operator's telephone and a test-battery, another loop containing a clearing-out annunciator and a test-battery, and a looping-in switch with contacts and connections to at will connect either of said loops in a bridge connection across said circuit, substantially as set forth.

8. In a telephone-exchange system, multiple switchboards, metallic-circuit lines connected to the boards, and two of said lines connected together in metallic circuit with one side of the circuit grounded, in combination with a loop containing a clearing-out annunciator and test-battery, another loop containing an operator's telephone and test-battery, a looping-in switch with contacts and connections to at will connect either of said loops in a bridge connection across said circuit, and test-receiving instruments, one at each board, each grounded on one side and connected on the other side to a plug or device adapted to be brought, for testing one of said lines, into connection with the other side of said circuit, substantially as set forth.

9. In a telephone-exchange, multiple switchboards, metallic-circuit lines connected to the boards, and two of said lines connected together in metallic circuit with one side of the circuit grounded through a retarding-coil, in combination with a loop containing an operator's telephone and test-battery,

another loop containing a clearing-out annunciator and test-battery, a looping-in switch with contacts and connections to at will connect either of said loops in a bridge connection across said circuit, and test-receiving instruments, one at each board, each grounded on one side and connected on the other side to a plug or device adapted to be brought, for testing one of said lines, into connection with the other side of said circuit, substantially as set forth.

10. In a telephone-exchange, multiple switchboards, metallic-circuit lines connected to the boards, and two of said lines connected together in metallic circuit with one side of the circuit grounded through the annunciator of one of said lines, in combination with a loop containing an operator's telephone and test-battery, another loop containing a clearing-out annunciator and test-battery, a looping-in switch with contacts and connections to at will connect either of said loops in a bridge connection across said circuit, and test-receiving instruments, one at each board, each grounded on one side and connected on the other side to a plug or device adapted to be brought for testing said lines into connection with the other side of said circuit, substantially as set forth.

11. In a telephone-exchange system, a pair of loop-switch plugs the two contact-pieces of one of which are respectively connected with the two contact-pieces of the other by two flexible switch-conductors, in combination with a loop containing an operator's telephone and a test-battery, another loop containing a clearing-out annunciator and a test-battery, another loop containing a calling-generator, and a looping-in switch with contact and connections to at will connect either of said loops in a bridge connection across said conductors, substantially as set forth.

12. In a telephone-exchange system, two telephone-lines connected together in metallic circuit for conversation, in combination with a loop containing an operator's telephone and a test-battery, another loop containing a clearing-out annunciator and a test-battery, another loop containing a calling-generator, and a looping-in switch with contacts and connections to at will connect either of said loops in a bridge connection across such circuit, substantially as set forth.

13. In a telephone-exchange system, multiple switchboards, metallic-circuit lines connected to the boards, and two of said lines connected together in metallic circuit with one side of the circuit grounded, in combination with a loop containing an operator's telephone and test-battery, another loop containing a clearing-out annunciator and test-battery, another loop containing a calling-generator, a looping-in switch with contacts and connections to at will connect either of said loops in a bridge connection across said circuit, and test-receiving instruments, one at each board, each grounded on one side and connected on the other side to a plug or device adapted to be brought, for testing one of said lines, into connection with the other side of said circuit, substantially as set forth.

14. In a telephone-exchange system, multiple switchboards, a metallic-circuit telephone-line grounded on one side at the central office and temporarily switched in a metallic circuit for conversation, in combination with a test-battery in a bridge connection across the two sides of the line, a battery at the subscriber's station in the circuit of the line while the subscriber's telephone is switched for use and only then, and test-receiving instruments, one at each board, grounded on one side and connected on its other side to a plug or device adapted to be brought for testing into connection with the line on its other side, substantially as set forth.

15. In a telephone-exchange system, multiple switchboards, a metallic-circuit telephone-line grounded on one side at the central office and temporarily switched in a metallic circuit for conversation, in combination with a test-battery and a retarding-coil in a bridge connection across the two sides of the line, a battery at the subscriber's station in the circuit of the line while the subscriber's telephone is switched for use and only then, and test-receiving instruments, one at each board, grounded on one side and connected on its other side to a plug or device adapted to be brought for testing into connection with the line on its other side, substantially as set forth.

16. In a telephone-exchange system, multiple switchboards, a metallic-circuit telephone-line grounded on one side at the central office through a retarding-coil and temporarily switched in a metallic circuit for conversation, in combination with a test-battery in a bridge connection across the two sides of the line, a battery at the subscriber's station in the circuit of the line while the subscriber's telephone is switched for use and only then, and test-receiving instruments, one at each board, grounded on one side and connected on its other side to a plug or device adapted to be brought for testing into connection with the line on its other side, substantially as set forth.

17. In a telephone-exchange system, two telephone-lines temporarily connected together into a complete circuit for conversation, in combination with a calling-generator at one of the subscriber's stations of the two lines, operated to send a current of one polarity only to give the primary or calling signals of the line and to send a current of the other polarity only to give a clearing-out signal when the lines are thus connected, and a special clearing-out annunciator and the line-

annunciators of the two lines which are then or when the clearing-out signal is sent in closed circuit with said calling-generator, said clearing-out annunciator responding or indicating and said line-annunciators being in circuit with their generators when operated and polarized and connected in polarity so as not to respond to the current thus sent from the generator for the clearing-out signal, but to respond to the current sent for the primary calling-signal.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:
ANNA P. KELLOGG,
LEROY D. KELLOGG.