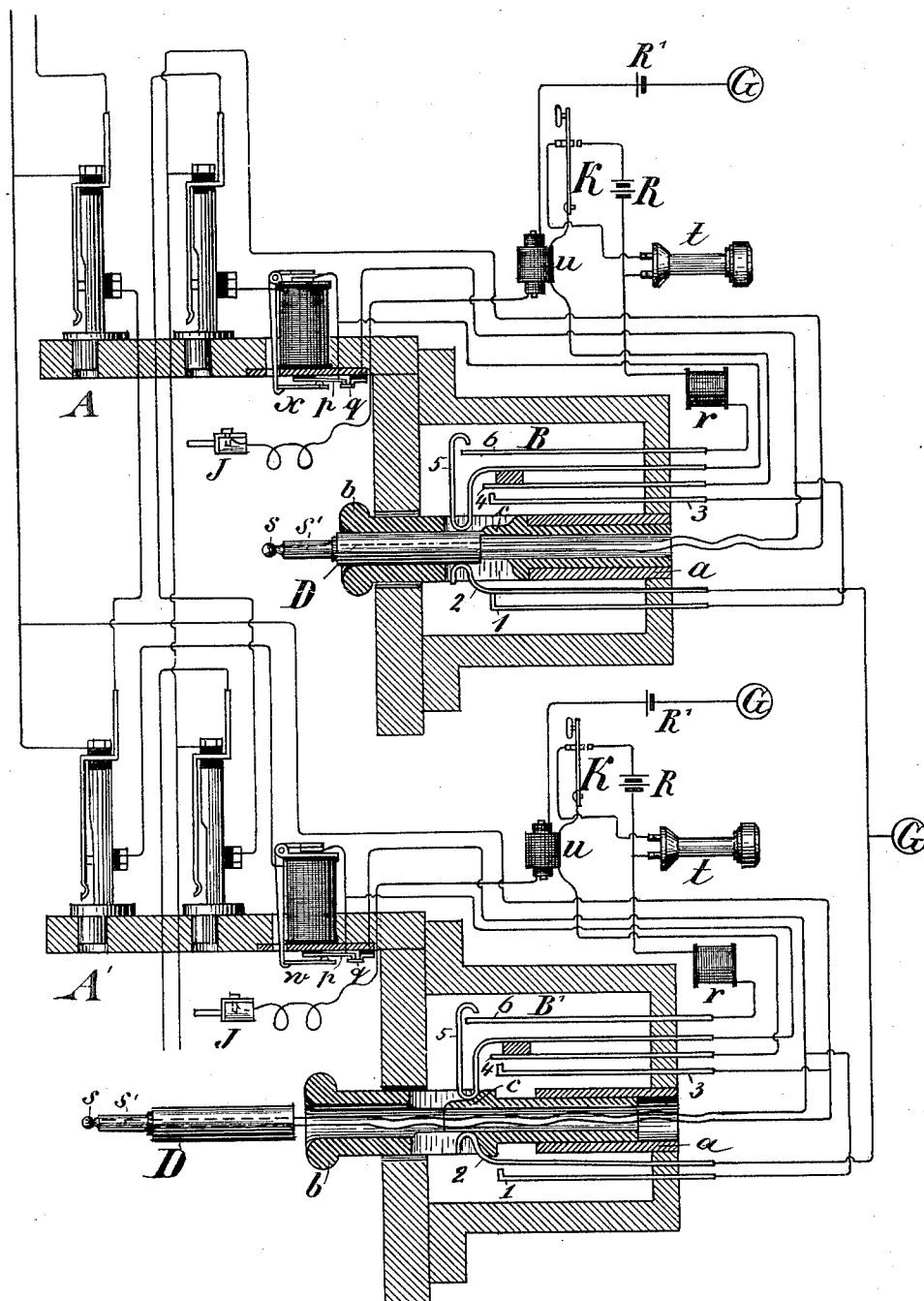


(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,386.

Patented Oct. 26, 1897.



Witnesses:
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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. 592,386, dated October 26, 1897.

Application filed August 5, 1890. Serial No. 361,113. (No model.)

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 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 drawing, forming a part of this specification.

My invention relates to a metallic-circuit telephone-exchange system in which there is a cord and a plug attached to the cord for each line, to which the line is normally connected. Said plug rests normally in a switching device, and when it is desired to switch the line with another line for conversation the plug is taken from its normal position and placed in the switch of the line wanted. Such a system is called a "single-cord" system.

My invention consists in a system of testing, and in apparatus, circuits, and connections for each line, whereby the operator may expeditiously and with few operations connect her telephone to the circuit of the line when its call is indicated, may test the line wanted to see whether it is in use, may connect the two lines together, may send signaling-current over the lines, may receive a clearing-out signal, may connect her telephone into the circuit to determine whether the subscribers are through conversation, and may disconnect the lines and place the line apparatus in readiness for receiving a new call. Said organization is more simple and the work required is less than in other systems devised for the same purpose. In said system the lines test "busy" whether they are switched for use at any board or the line-annunciators indicate a call.

In the accompanying drawing, illustrating my invention, A and A' represent sections of two multiple switchboards at the central office of the exchange, to which the same lines connect. On each board is a spring-jack or similar switch for each line. Each switch has a contact-spring which is normally in contact with a contact-point, but is separated and insulated from the point while a plug is inserted

into it, and a contact-piece which is normally insulated from the spring and is connected with the plug while the plug is inserted into the switch. The contact-piece is adapted to have a test-plug applied to it for testing. The spring-jacks shown in the drawing are of well-known construction.

For each line is a compound answering switching device located at the board where the plug and cord of the line is located and where the calls of the line are to be answered. This device is manipulated in part by the switch-plug when in the device and in part by the operator who answers the call. The construction, operation, and manipulation of these switching devices will be hereinafter explained in detail.

Two lines and their switches on the boards, their plugs and cords, their answering-switches, their annunciators, and their plug switching devices are shown in the drawing.

The drawing represents the answering apparatus of one of the lines as located at one of the boards and that of the other line as located at the other board.

B B' represent the two compound answering-switches, and D D the two switch-plugs of the lines to which the double-conductor flexible cords are attached and which are adapted to be placed in any spring-jack switch at the board where they may be located. One plug is shown in its switching device and one plug is shown out of its device.

In the answering-switches B B', *a a* are cylinders, preferably of metal, adapted to receive and guide the movable commutator and plug-supporting piece *b*. This piece may be of rubber, and is of the shape substantially as shown, and may be of other shapes to correspond with variations in the construction, shape, and arrangement of the other parts of the switches B B'. 1, 2, 3, 4, 5, and 6 are contact-pieces insulated from each other. 2, 4, and 5 are spring-pieces. The other pieces may be rigid. Pieces 1 and 2 are mounted parallel to each other and in close juxtaposition, so that contact between them will be made and broken by the operation of the switch-plug, as hereinafter indicated. The pairs of contacts 3 4 and 5 6 are mounted parallel to each other and in close juxtaposition,

so that the contact of each pair is made and broken, as hereinafter described, by the operation of the plug. Spring 4 is connected near its upper end to spring 5 by means of an insulation-piece fastened to both. It therefore moves back and forth as spring 5 moves. Springs 2 and 5 are constructed and adjusted to press toward the center of piece *b* and will press against and be acted upon by the plug, as will be described. The piece *b* has a hole or socket in which the handle of the switch-plug may be placed. It has also two chambers adapted to receive the bent portions of the spring-pieces 2 and 5, as shown, and has a shoulder adapted to rest on the top of *a* when it is moved to its lower position. In the chamber adapted to receive the bent part of spring 5 is a shoulder *c*, on which 5 bears when the piece *b* is moved to its higher position and which causes the contacts to change, as will hereinafter be described.

The pieces *b* are adapted and intended to occupy two positions, the upper position as shown in B' and the lower position as shown in B.

When the switch-plug is in its socket in its piece *b*, the piece occupies its lower position and the handle of the plug presses on the springs 2 and 5, so that spring 2 is in contact with piece 1 and spring 5 is out of contact with piece 6, while spring 4 (which is attached to, but insulated from, 5) is kept out of contact with piece 3. When the switch-plug is withdrawn by the operator from the socket, the springs 2 and 5 will be released from the pressure of the plug-handle and (the movable piece being still in its inner position) contact between 2 and 1 is broken and that between 3 and 4 and that between 5 and 6 are established. When the plug is removed and the operator manipulates the piece *b* and places it in its outer position, the contact between 1 and 2 still remains broken, and the shoulder *c* in the chamber of the piece presses spring 5 out of contact with piece 6 and spring 5 at the same time carries spring 4 out of contact with piece 3. When, therefore, the plug is in the socket and the piece *b* is in its lower position, 1 and 2 are in contact with each other and the other contacts of the device are out of contact. When the plug is out of the socket and piece *b* is still in its lower position, 1 and 2 are out of contact and the other pairs 3 4 and 5 6 are in contact, respectively, and when the plug is out of the socket and the piece *b* is raised to its outer position all of the three pairs are out of contact.

The switch-plugs D D are of a usual construction of loop-switch plugs adapted to be used with the spring-jack switches shown. The outsides of the handles have a rubber insulation. Each plug has two contact-pieces insulated from each other, one, *s*, at the end of the plug and the other, *s'*, along the plug cylinder-tip. When a plug is inserted into any of the switches, the piece *s* presses against

the spring of the switch and forces the spring away from the contact-point and forms connection with the spring, and the other piece, *s'*, of the plug forms connection with the metal frame or socket of the switch.

tt are operators' telephones; *J J*, operators' test-plugs; *R R*, operators' calling-generators; *r r*, resistance-coils; *u u*, induction-coils; *K K*, calling-keys, and *R' R'* test-batteries. Each operator will have one of each said parts, and they will be connected to each other and to her answering-switches, substantially as shown and as will be described.

w and *x* are calling-annunciators, one for each line shown, and *G G* are ground connections.

Each annunciator has a pair of contact-points normally (or when the annunciator does not indicate a call) in contact with each other, but which are separated by the annunciator while it indicates a call. The two contact-points of a pair are marked *p* and *q*, respectively. One of them, *p*, is a spring-contact which is pressed by the annunciator-drop, when the drop falls, away from its corresponding contact-point *q*. The contact-point *q* is represented as an angle-piece which passes over the spring *p* and is in contact with the spring when the spring is not actuated by the annunciator-drop.

The connections are substantially as follows: One side or branch of each line passes normally successively through the pairs of contact-points normally in contact of its switches on the several boards, passing in each case to the spring first. It then passes through its line-annunciator and the pair of contact-points of the annunciator and is then connected by one of the insulated conductors of the switch-cord to the contact-piece *s* of the switch-plug of the line. The other branch of the line is connected to all the other or insulated contact-pieces of the switches of the line and is connected to the contact-piece *s'* of the plug through the other conductor of the cord. The first-mentioned side or branch of the line is also connected after it passes through the annunciator contact-points to contact-piece 1 and before it passes through the annunciator contact-points to piece 5, and the other side or branch of the line is also connected to contact-piece 3. One side of the operator's telephone is connected through the resistance-coil to contact-piece 6. The other side of the telephone is also connected to the upper contact-point of the operator's calling-key, and the lower contact-point of the key is connected through the calling-generator to the circuit-wire which connects her telephone and resistance-coil. The contact-spring 2 is connected to the ground. The secondary of the induction-coil is placed in circuit with the telephone between said contact-pieces 4 and 6. Contact-piece 4 is connected to the lever of the calling-key. Each line is connected to switches, compound answering-switch, cord and plug, and annunciator, substantially as

described. Each compound answering-switch is connected to the operator's special apparatus and also to the ground, substantially as described.

- 5 The operator's test-battery and the primary of the induction-coil are connected into a circuit which is grounded at one end and connected at its other end through a flexible conductor to the tip of her test-plug.
- 10 The two branches of the subscriber's line will be normally on closed circuit to each other at the subscriber's station, and may be preferably normally open to the ground there, but closed to the ground by the subscriber
- 15 while he is sending in a call, with his generator-armature in the circuit between the ground then established and the normal ground connection of the line at the central office. The calling-key K is a usual form of
- 20 three-point key. The lever normally rests on the upper point, as shown, but when it is depressed by the operator its connection with the upper point is broken and it comes into contact with the lower point.
- 25 The operation of the system may be described as follows: When the plug of a line is on its normal position in the socket of its compound answering-switch and the line is not switched at any board of the exchange
- 30 and its annunciator does not indicate a call, the line is grounded at the central office. When the line is switched at any board by the insertion of a switch-plug into its switch or its plug is withdrawn from its normal position for insertion into any switch or its annunciator indicates a call, the ground connection is interrupted. In one case the interruption is at the pair of contact-points 1 2,
- 40 in another case at the pair of contact-points of the switch used, and in the third case at the pair of contact-points of the annunciator. When the plug of a line is withdrawn from its normal position in its compound switch, the two sides or branches of the line are
- 45 brought into a closed circuit, with the operator's telephone in the circuit. This connection is automatically made by the closing of the two pairs of contacts 3 4 and 5 6, respectively. Such circuit is from contact-spring
- 50 5 (which is connected to one side of the line) to contact-piece 6, and thence through the resistance-coil *r*, the operator's telephone *t*, the upper contact-point of the key K, and the key-lever to contact-piece 4, and thence to
- 55 contact-piece 3, which is connected to the other side of the line. The operator then by conversation finds out what line is wanted. She then tests the line wanted, as will be hereinafter described, and if she finds the
- 60 line "free" she will place the switch-plug in the switch of said line at her board. When she has done this, the two lines are disconnected from their normal connection with the ground, are connected together in a metallic circuit, and their circuit is bridged or
- 65 cross-connected at the central office by the circuit which contains the resistance-coil, the

telephone, the secondary of the induction-coil, and the key. The operator then presses on the key, thereby disconnecting the lever 70 from the upper contact and connecting it with the lower contact-point, and a circuit in the bridge or cross connection is established, which contains the calling-generator and does not contain the operator's telephone. 75 A calling-current is thereby directed in split current to both lines and the bell of the line wanted will be rung and the calling subscriber notified by the operation on his telephone or calling-bell that the connection is 80 made and the subscriber wanted is rung up. The operator then pulls the movable piece *b* to its upper or outer position and the cross or bridge connection of the metallic circuit is interrupted by the opening of the pairs of 85 contact-points 3 4 and 5 6.

When the operator desires to listen into the circuit to hear whether the subscribers are through conversation, she presses the movable piece *b* to its lower position and the cross 90 or bridge connection is again established and enough telephone-current, if the line is in use, will pass through her telephone, so that she can hear the conversation. When the operator desires to clear out the connection, 95 she takes the switch-plug from the switch and places it in its normal position in the socket and presses the piece *b* to its lower or inner position. The apparatus is then ready to receive and answer a new call on the line by 100 the mere act of withdrawing the plug and making the other operations I have described.

The special use and function of the resistance-coil *r* is to prevent an undue amount of 105 telephone-current from being diverted to the operator's telephone when she listens into a circuit, to the detriment of the conversation which is passing over the main circuit, and this resistance may be made great or small, as 110 is found most desirable for the general conduct of the business.

The operation of the test system is as follows: When the operator tests any line, she places the tip of the test-plug on the metal 115 socket or frame of the switch of the line tested, (to the contact-piece connected to the normally open end of the line.) If, then, the line tested is not switched and its annunciator does not indicate a call, a complete circuit 120 will be established, in which is the primary of the induction-coil and test-battery. The circuit is from ground at the central office through the contact-points 1 2 of the switching device of the line, thence through the 125 line-annunciator and its contacts *p q*, thence successively through the normally closed contacts of the line-switches, thence through the circuit of the line by way of the subscriber's station to the socket or frame of the switch 130 on which the test-plug is applied, thence to the contact-piece of the test-plug, and thence to the ground through the primary of the induction-coil and test-battery R'. An induc-

tion-current will therefore be generated in the closed circuit which contains the operator's telephone and she will hear a "click" in the telephone and know that the line is "free." This closed circuit is through the operator's telephone and the circuit of the calling-line and is completed in the manner and through the connections heretofore traced when the operator removes the plug of the calling-line from its switching device. When the line is switched at any board or its annunciator indicates a call, the test-circuit is interrupted and the operator, not hearing the click, will know that the line is in use.

By the system and mechanism as above described for single-cord metallic-circuit systems the organization has fewer parts and is more simple than in other systems which have been devised for similar use and the operations required of the operator in answering a subscriber and making a desired connection are reduced to a minimum. These operations are merely to take the plug from its normal position, test the line wanted, place the switch-plug in the switch of the line wanted, press on the calling-key, and raise the movable piece of the calling subscriber's answering-switch.

The test does not depend alone on the fact that the line is switched or not. The line also tests "busy" when the annunciator indicates a call. As a result a subscriber's line is reserved to himself from the time he sends in his call and before the operator has had time to answer the call. The service of the exchange is thereby more satisfactory and there is less liability of annoyance and confusion, both to the subscriber and operator, than would be were the line liable to be switched and connected with another line after the subscriber had sent in a call and before the call was answered.

I use the terms "bridge" and "cross-connect" in connection with a complete metallic circuit to describe a connection between one side or branch of the circuit and its other side or branch, and an instrument in a bridge or cross-connecting circuit to a metallic circuit is not in the direct circuit, but is in a circuit connection across the two sides or branches of the circuit.

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

1. In a telephone-exchange system, a metallic-circuit line one side or branch of which is normally grounded at the central office and contains in its circuit an annunciator with contact-points by which the circuit is opened while the annunciator indicates a call, in combination with a test wire or circuit at the central office containing a test-battery and the primary of an induction-coil, and grounded at one end and connected at its other end to a plug or device adapted to be brought for testing into connection with the line, and a test receiving instrument and the secondary of the induction-coil on closed circuit to each

other when the test is made, 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 and contains in its circuit an annunciator with contact-points by which the circuit is open while the annunciator indicates a call, in combination with a test wire or circuit at the central office, containing the primary of an induction-coil and grounded at one end and connected at its other end to a test plug or device adapted to be brought into connection with the line, a test-battery in the circuit thereby established, and a test receiving instrument and the secondary of the induction-coil in closed circuit to each other while the test is being made, substantially as set forth.

3. In a telephone-exchange system, a metallic-circuit line one side or branch of which is normally grounded at the central office and contains an annunciator in its circuit with contact-points by which the circuit is open while the annunciator indicates a call, in combination with switching apparatus by which such ground connection is broken while the line is switched for conversation, a test wire or circuit at the central office grounded at one end and connected at its other end to a plug or device adapted to be brought for testing into connection with the line, a test-battery and the primary of an induction-coil in the test-circuit thereby established, and a test receiving instrument and the secondary of the induction-coil in closed circuit to each other when the test is made, substantially as set forth.

4. In a telephone-exchange system, a metallic-circuit line one side or branch of which is normally grounded at the central office but is disconnected from the ground while the line is switched for conversation and contains an annunciator with contact-points by which the circuit is open while the annunciator indicates a call, in combination with a test wire or circuit at the central office, containing the primary of an induction-coil and grounded at one end and connected at its other end to a plug or device adapted to be brought for testing into connection with the line, a test-battery in the circuit thereby established, and a test receiving instrument and the secondary of the induction-coil in closed circuit to each other while the test is being made, substantially as set forth.

5. In a telephone-exchange system, a metallic-circuit line one side or branch of which is normally grounded at the central office but is disconnected from the ground while the line is switched for conversation and contains an annunciator with contacts by which the circuit is open while the annunciator indicates a call and the other side or branch of which is normally open at the central office, in combination with a test wire or connection at the central office, containing the primary of an induction-coil and grounded at one end and

connected at its other end to a plug or device adapted to be brought for testing into connection with the normally open side or branch of the line, a test-battery in the circuit thereby established, and a test receiving instrument and the secondary of the induction-coil on closed circuit to each other while the test is being made, substantially as set forth.

6. In a telephone-exchange system, a metallic-circuit line one side or branch of which is normally connected at the central office to a test wire or circuit which contains the primary of an induction-coil and a test-battery and is disconnected from such test wire or circuit while the line is switched for conversation and contains in its circuit an annunciator with contacts by which the circuit is open while the annunciator indicates a call, in combination with a plug or device connected to the other side of such test wire or circuit and adapted to be brought into connection with the line, and a test receiving instrument and secondary of the induction-coil on closed circuit to each other while the test is being made, substantially as set forth.

7. In a telephone-exchange system, a metallic-circuit line one side or branch of which is normally connected to one side of a test wire or circuit and is disconnected from such test wire or circuit while the line is switched for conversation and has in its circuit an annunciator with contacts by which the circuit is open while the annunciator indicates a call, in combination with a test plug or device adapted to be brought for testing into connection with the line, a test-battery and the primary of an induction-coil in the test-circuit thereby established, and a test receiving instrument and the primary of the induction-coil on closed circuit to each other while the test is made, substantially as set forth.

8. In a telephone-exchange system, a metallic-circuit line one side or branch of which is normally closed to one side of a test wire or circuit and contains an annunciator with contact-points by which the circuit is open while the annunciator indicates a call and the other side or branch of which is normally open at the central office to said test wire or circuit, in combination with a plug or device connected to the other side of said test wire or circuit and adapted to be brought for testing into connection with such normally open side or branch of the line, a test-battery and the primary of an induction-coil in the test-circuit thereby established, and a test receiving instrument and the secondary of the induction-coil in closed circuit to each other when the test is made, substantially as set forth.

9. In a telephone-exchange system, a metallic-circuit line one side or branch of which is normally closed to one side of a test wire or

circuit which contains the primary of an induction-coil, said side or branch of the line containing an annunciator with contacts by which the circuit is open while the annunciator indicates a call, and the other side or branch of the line being normally open to the test-wire, in combination with switching apparatus by which such normal connection between the line and the test-wire is broken while the line is switched for conversation, a plug or device adapted to be brought into connection with the normally open side or branch of the line, a test-battery and the primary of an induction-coil in the circuit thereby established, and a test receiving instrument and the secondary of the induction-coil in closed circuit to each other when the test is made, substantially as set forth.

10. In a telephone-exchange system, a metallic-circuit line and an operator's telephone and the secondary of an induction-coil temporarily in closed circuit with the line, in combination with another metallic-circuit line one side or branch of which is normally grounded at the central office but is disconnected from the ground while the line is switched for conversation and has an annunciator in its circuit with contacts by which the circuit is open while the annunciator indicates a call, a test wire or circuit containing the primary of the induction-coil and grounded at one end and connected at the other end to a plug or device adapted to be brought into connection with the line, and a test-battery in the circuit thereby established, substantially as set forth.

11. In a telephone-exchange system, a metallic-circuit line and an operator's telephone and the secondary of an induction-coil temporarily in closed circuit with the line, in combination with another metallic-circuit line one side or branch of which is normally connected with one side of a test wire or connection but disconnected from the same while the line is switched for conversation, said line having an annunciator in its circuit with contacts and connections by which the circuit is open while the annunciator indicates a call, a plug or device connected to the other side of the test wire or connection and adapted to be brought into connection with the other side or branch of the line, and a battery and the primary of the induction-coil in the circuit thereby established, substantially as set forth.

In witness whereof I hereunto subscribe my name this 23d day of June, 1890.

MILO G. KELLOGG.

Witnesses:

EMIL ABENHEIM,
ABBOTT L. MILLS.