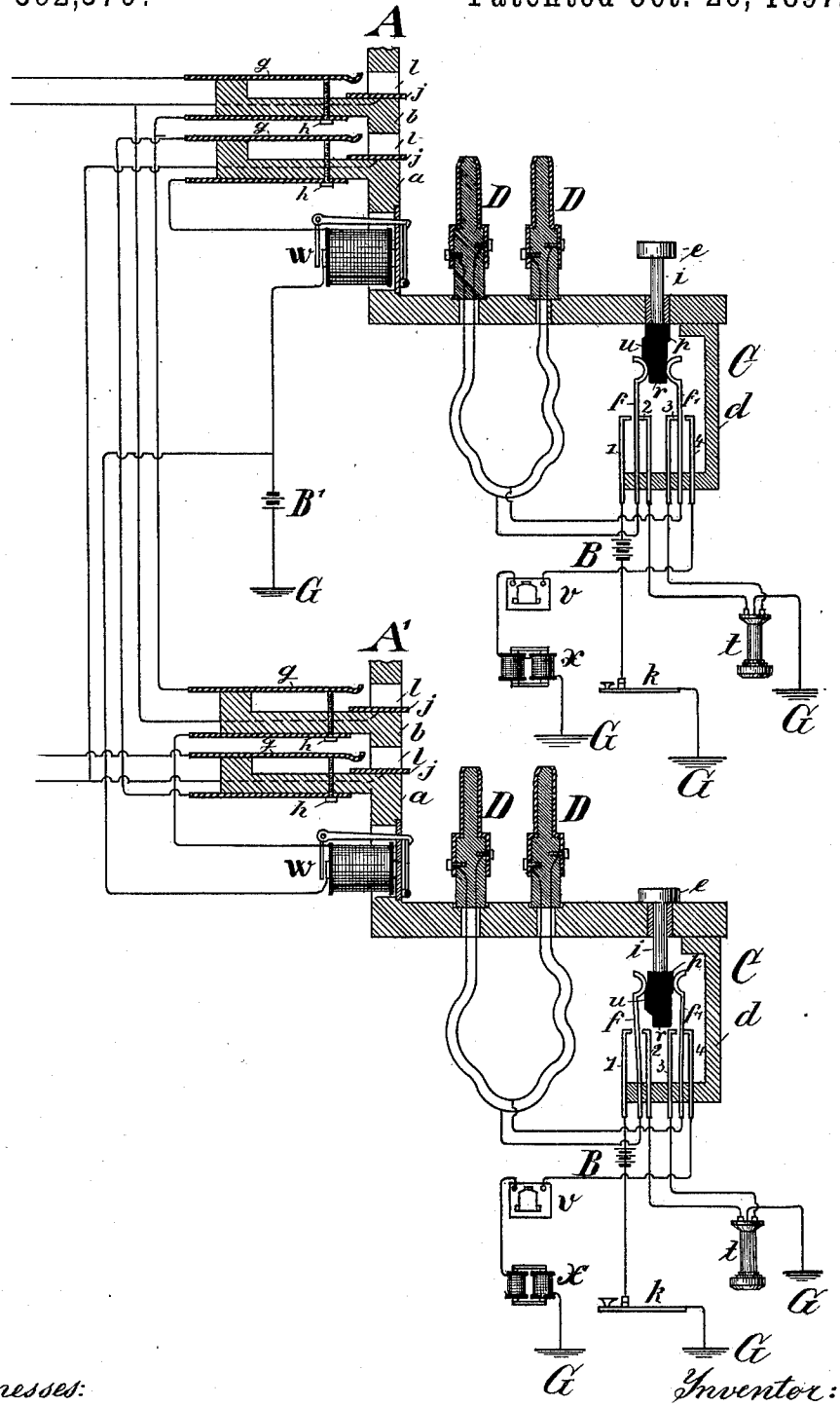
(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,370. Patented Oct. 26, 1897.



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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. 592,370, dated October 26, 1897.

Application filed July 26, 1890. Serial No. 360,079. (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 the lines are connected together for conversation by means of pairs of loop-switch plugs, the two contact-pieces of one plug of a pair being connected to the two contact-pieces of the other plug by means of double flexible conductors. Such a system is called a "double-cord" system.

My invention includes a system of testing and apparatus, circuits, and connections whereby the operator may quickly and with few motions connect her telephone to the circuit of the calling-line, may ascertain by a test whether the line wanted is ready for use, may connect the two lines together, may send a signal-current over the line wanted, may connect her telephone to the circuit to determine whether the subscribers are through conversation, and may disconnect the lines and place the apparatus in readiness for receiving new calls.

In the accompanying drawing, illustrating my invention, A A' are sectional views of sections of two switchboards to which the same lines connect. Each switchboard has 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 from the point when a switch-plug is inserted into the switch, and has a contact-piece which is insulated from the other parts (except by the circuit connections) and which is connected with a contact-piece of the switch-plug when the plug is inserted. This contact-piece is adapted to have a test plug or device applied to it for testing. The contact-springs are shown at $g\ g$, while $h\ h$ are the contact-points on which the springs normally bear, and $j\ j$ are the contact-pieces of the switches. $l\ l$ are the switch-holes through the fronts of the rubber strips $a\ b$, on which the metal parts of the switches are mounted.

The switch-plugs (marked D D) are loop-plugs adapted to be inserted into the switches, and when a plug is inserted into a switch it separates the points which are normally in contact, and one of its contact-pieces forms connection with the spring g, while the other forms connection with the contact-piece j of the switch.

B' is a test-battery. $w\ w$ are line-annunciators. $x\ x$ are retardation-coils, and G in each case in the drawing is a ground connection.

Two lines and their switches on the several boards and their annunciators are shown in the drawing. The circuits of the lines are as follows and as shown: One side or branch of the line passes successively through the pairs of contact-points of the line-switches, passing in each case to the spring g first and from the last contact-point h through the line-annunciator to the common ground wire or connection of the lines in which is the test-battery and through the battery to ground. The other side or branch of the line is connected to contact-pieces $j\ j$ of the switches of the line.

The line should be grounded at the subscriber's station while the subscriber's telephone is not switched for use and this ground connection open while the line is thus switched. This can be accomplished in the usual way for such a connection by means of contact-points on the telephone-switch. The signal-receiving bell may be placed in this ground-connection circuit.

For each pair of plugs there is an operator's switching device. These devices are marked C C. There is one for each pair of plugs and one is shown at each board. Other pairs of plugs, with their apparatus, may be added and connected to the operator's system of apparatus, substantially as will be described.

$d\ d$ are the rubber supports of the switching device.

$f\ f'$ are a pair of contact-springs of the device.

1, 2, 3, and 4 are contact-points.

i is a movable piece to one end of which is attached the irregularly-shaped rubber piece $p\ u\ r$ and to the other end of which is at-

tached the knob *e*. The piece *i*, with the rubber piece *p u r*, and the knob *e* move as one piece and may be called the "commutator-piece." The springs and points are so constructed, mounted, adjusted, and related to each other that when the commutator-piece is in its upper position, as shown at board A, the two springs *f f'* are in contact with points 2 and 3, respectively. When the piece is moved to its central position, so that the springs rest on *u*, *f* is in contact with 1 and *f'*, is out of contact with 3 and 4. When the piece is moved to its inner position, as shown at A', *f* is in contact with neither of the points and *f'* is in contact with 4.

v v are clearing-out annunciators. There may be one clearing-out annunciator and one retardation-coil for each pair of cords.

B B are calling generators or batteries. *k k* are two-point keys having their points normally in contact, and *t t* are operators' telephones, of which there may be one of each kind for each operator.

The connection of a pair of plugs to its operator's switching device and to the operator's special apparatus is as shown and as follows: The two contact-pieces of one of the plugs are connected to the two contact-pieces of the other plug, respectively, by two flexible-cord circuits. One of these cord-circuits is connected to spring *f*, and the other circuit is connected to opening *f'*. Contacts 2 and 3 are connected together through the telephone. Contact 1 is connected to the ground through the calling generator or battery and the points of the key. Contact 4 is connected through the clearing-out annunciator and the retardation-coil of the pair of cords to the ground. Instead of using a separate retardation-coil the required retardation and resistance in this circuit connection or branch may be obtained in any other well-known way—for instance, by using annunciators of high resistance and retardation, as is well known and understood in the art. The wire which connects the two coils of the telephone is connected with the ground. The commutator-piece of the switching device remains normally in its outer position, as shown at board A. The subscriber's calling generator or battery should be so connected into the circuit that while the generator is being operated it is in a circuit which is grounded at the subscriber's station and between such ground and the normal ground of the line at the central office.

The operation of the system is as follows: When the operator at any board observes the annunciator of a line to indicate a call, she places one of the plugs of a pair of her plugs in the switch of the line. By so doing the line is disconnected from its normal ground connection through the test-battery and is included in circuit with the operator's telephone. The connection is from the two contact-pieces of the plug to the springs *f f'* of the switching device and thence to the two sides of the telephone through contacts 2 and 3, respectively. The operator then finds out by conversation what line is wanted. She then tests the line by placing a contact-piece of the other plug on the piece *j* of the switch of the line wanted, and if she hears a click in her telephone she knows that the line is not in use and places the plug in the switch. By so doing the line is disconnected from its connection to ground through its test-battery, and the circuit of the two lines is established, with the circuit bridged or cross-connected by the operator's telephone. The operator then presses the commutator-piece to its central position, and the circuit is grounded through the calling-generator. This connection is made by the contact between *f* and 1. A calling-current will therefore go to the circuit of the line wanted and to ground through its normal ground connection, through its signal-receiving bell, and the bell will ring. The operator then presses the commutator-piece to its lower position, as shown at A', and *f'* is in contact with 4 and the other points of the device are open. The generator is thereby disconnected from the circuit and the circuit is grounded through the clearing-out annunciator and retardation-coil and any clearing-out signal sent by either subscriber from his calling-generator will be indicated on the annunciator.

Should the operator desire to listen to the circuit to determine whether the subscribers are through conversation, she opens the contact-points of the key and while the key is in that position moves the commutator-piece to its outer position, when the circuit is bridged or cross-connected through the telephone. The operation of the key prevents any calling-current from going to the lines to give a false signal that they are wanted.

The operations of answering a call and making a connection are, first, to place a switch-plug in the switch of the calling-line; second, to test the line wanted with the other plug; third, to place the plug in the switch, and, fourth, to press the commutator-piece from its outer to its inner position. The lines are thereby connected together and signaling-current sent to the line wanted, and they are left with their circuit grounded through the clearing-out annunciator and retardation-coil.

To disconnect a connection, the operator merely takes the plugs from the switches and moves the commutator-piece of the switching device to its outer position.

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 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, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, and an operator's telephone temporarily in a bridge across the two sides of the circuit, in combination with an annunciator and retardation-coil in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts of said switching device in said bridge, one pair on each side of said telephone, a pair of normally open contacts of said switching device, one of which contacts of said normally open pair is connected to the other side of said circuit connection containing said generator, the other of which is connected with said metallic circuit, another pair of normally open contacts, one of which contacts of said last-mentioned pair is connected to the other side of said circuit connection containing said annunciator and retardation-coil, and the other of which is connected to said metallic circuit, and a commutator-piece of said switching device, adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, substantially as set forth.

2. In a telephone-exchange system, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, and an operator's telephone temporarily in a bridge across the two sides of the circuit, in combination with an annunciator and retardation-coil in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts in said bridge, one on each side of said telephone, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said generator, and the other of which is connected with said metallic circuit, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said annunciator and retardation-coil, and the other of which is connected to said metallic circuit, a commutator-piece adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, and a key in circuit with said generator having a pair of contacts normally closed but opened at the will of the operator, substantially as set forth.

3. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with an annunciator and retardation-coil in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts of said switching device in said bridge, one pair on each side of said telephone, a pair of normally open contacts of said switching device, one of which contacts of said normally open pair is connected to the other side of said circuit connection containing said generator and the other of which is connected with one of said switch-conductors, another pair of normally open contacts of said switching device, one of which contacts of said last-mentioned pair is connected to the other side of said circuit connection containing said annunciator and retardation-coil and the other of which contacts of said pair is connected to one of said switch-conductors, and a commutator-piece of said switching device, adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, substantially as set forth.

4. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with an annunciator and retardation-coil in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts in said bridge, one on each side of said telephone, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said generator, and the other of which is connected with one of said switch-conductors, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said annunciator and retardation-coil, and the other of which is connected to one of said switch-conductors, a commutator-piece adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, and a key in circuit with said

generator having a pair of contacts normally closed but opened at the will of the operator, substantially as set forth.

5. In a telephone-exchange system, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, and an operator's telephone temporarily in a bridge across the two sides of the circuit, in combination with an annunciator in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts of said switching device in said bridge, one pair on each side of said telephone, a pair of normally open contacts of said switch device, one of which contacts of said normally open pair is connected to the other side of said circuit connection containing said generator and the other of which is connected with said metallic circuit, another pair of normally open contacts of said switching device, one of which contacts of said last-mentioned pair is connected to the other side of said circuit connection containing said annunciator, and the other of which contacts of said last-mentioned pair is connected to said metallic circuit, and a commutator-piece of said switching device adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, substantially as set forth.

6. In a telephone-exchange system, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, and an operator's telephone temporarily in a bridge across the two sides of the circuit, in combination with an annunciator in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts in said bridge, one on each side of said telephone, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said generator, and the other of which is connected with said metallic circuit, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said annunciator, and the other of which is connected to said metallic circuit, a commutator-piece adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, and a key in circuit with said generator having a pair of contacts normally closed but opened at the will of the operator, substantially as set forth.

7. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with an annunciator in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts of said switching device in said bridge, one pair on each side of said telephone, a pair of normally open contacts of said switching device, one of the contacts of which normally open pair is connected to the other side of said circuit connection containing said generator and the other of which contacts of said pair is connected with one of said switch-conductors, another pair of normally open contacts of said switching device, one of which contacts of said last-mentioned pair is connected to the other side of said circuit connection containing said annunciator, and the other of which contacts of said last-mentioned pair is connected to one of said switch-conductors, and a commutator-piece of said switching device, adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, substantially as set forth.

8. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with an annunciator in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts in said bridge, one on each side of said telephone, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said generator, and the other of which is connected with one of said switch-conductors, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said annunciator, and the other of which is connected to one of said switch-conductors, a commutator-piece adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being

closed and the other pairs being open, and a key in circuit with said generator having a pair of contacts normally closed but opened at the will of the operator, substantially as set forth.

9. In a telephone-exchange system, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, and an operator's telephone temporarily in a bridge across the two sides of the circuit, in combination with a circuit connection of high resistance and retardation grounded on one side, of which the coils of an annunciator comprise a part, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts of said switching device in said bridge, one pair on each side of said telephone, a pair of normally open contacts of said switching device, one of which contacts of said pair is connected to the other side of said circuit connection containing said generator, and the other of which contacts of said pair is connected with said metallic circuit, another pair of normally open contacts of said switching device, one of which contacts of said last-mentioned pair is connected to the other side of said circuit connection of high resistance and retardation, and the other of which contacts of said last-mentioned pair is connected to said metallic circuit, and a commutator-piece of said switching device, adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, substantially as set forth.

10. In a telephone-exchange system, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, and an operator's telephone temporarily in a bridge across the two sides of the circuit, in combination with a circuit connection of high resistance and retardation grounded on one side, of which the coils of an annunciator comprise a part, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts in said bridge, one on each side of said telephone, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said generator, and the other of which is connected with said metallic circuit, a pair of normally open contacts, one of which is connected to the other side of said circuit connection of high resistance and retardation, and the other of which is connected to said metallic circuit, a commutator-piece adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, and a key in circuit with said generator having a pair of contacts normally closed but opened at the will of the operator, substantially as set forth.

11. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with a circuit connection of high resistance and retardation grounded on one side, of which the coils of an annunciator comprise a part, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts of said switching device in said bridge, one pair on each side of said telephone, a pair of normally open contacts of said switching device, one contact of which is connected to the other side of said circuit connection containing said generator, and the other contact of which is connected with one of said switch-conductors, another pair of normally open contacts of said switching device, one of the contacts of which is connected to the other side of said circuit connection of high resistance and retardation, and the other contact of which is connected to one of said switch-conductors, and a commutator-piece of said switching device adapted to be placed in three positions, in its normal position said contacts being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, substantially as set forth.

12. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with a circuit connection of high resistance and retardation grounded on one side, of which the coils of an annunciator comprise a part, a calling-generator in a circuit connection grounded on one side, a switching device, two normally closed pairs of contacts in said bridge, one on each side of said telephone, a pair of normally open contacts, one of which is connected to the other side of said circuit connection containing said generator, and the other of which is connected with one of said switch-conductors, a pair of normally open contacts, one of which is connected to the other side of said circuit connection of high resistance and retardation, and the other of which is connected to one of said switch-conductors, a commutator-piece adapted to be placed in three positions, in its normal position said contacts

being in their normal condition, in another position said two first-mentioned pairs of contacts being opened and one of the other pairs being closed, and in the other position said third-mentioned pair of contacts being closed and the other pairs being open, and a key in circuit with said generator having a pair of contacts normally closed but opened at the will of the operator, substantially as set forth.

13. In a telephone-exchange system, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, in combination with an annunciator and retardation-coil in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, and a switching device containing a pair of contacts, one contact of which is connected with said metallic circuit and the other contact of which is connected with the other side of said first-mentioned circuit connection, another pair of contacts one contact of which is connected to said metallic circuit and the other contact of which is connected to the other side of said second-mentioned circuit connection, and a commutator-piece adapted to be placed in two positions, in one position said first-mentioned pair of contacts being closed and in the other position said second-mentioned pair of contacts being closed, substantially as set forth.

14. In a telephone-exchange system, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, in combination with an annunciator and retardation-coil in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device containing a pair of contacts, one contact of which is connected with said metallic circuit and the other contact of which is connected with the other side of said first-mentioned circuit connection, another pair of contacts, one contact of which is connected to said metallic circuit and the other contact of which is connected to the other side of said second-mentioned circuit connection, and a commutator-piece adapted to be placed in two positions, in one position said first-mentioned pair of contacts being closed and in the other position said second-mentioned pair of contacts being closed, and a key in circuit with said generator, having a pair of normally closed contacts opened at the will of the operator, substantially as set forth.

15. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with an annunciator and retardation-coil in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, and a switching device containing a pair of contacts, one contact of which is connected with one of said switch-conductors, and the other contact of which is connected with the other side of said first-mentioned circuit connection, another pair of contacts, one contact of which is connected to one of said switch-conductors and the other contact of which is connected to the other side of said second-mentioned circuit connection, and a commutator-piece of said switching device adapted to be placed in two positions, in one position said first-mentioned pair of contacts being closed and in the other position said second-mentioned pair of contacts being closed, substantially as set forth.

16. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with an annunciator and retardation-coil in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, a switching device containing a pair of contacts, one of which is connected with one of said switch-conductors and the other of which is connected with the other side of said first-mentioned circuit connection, a pair of contacts in said switching device, one of which is connected to one of said switch-conductors and the other of which is connected to the other side of said second-mentioned circuit connection, and a commutator-piece adapted to be placed in two positions, in one position said first-mentioned pair of contacts being closed and in the other position said second-mentioned pair of contacts being closed, and a key in circuit with said generator, having a pair of normally closed contacts opened at the will of the operator, substantially as set forth.

17. In a telephone-exchange system, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, in combination with a circuit connection of high resistance and retardation grounded on one side, a calling-generator in a circuit connection grounded on one side, an annunciator whose coils comprise part of said first-mentioned circuit connection of high resistance and retardation, and a switching device containing a pair of contacts, one contact of which is connected with said metallic circuit and the other contact of which is connected with the other side of said first-mentioned or high-resistance and retardation circuit connection, a pair of contacts one contact of which is connected to said metallic circuit and the other contact of which is connected to the other side of said second-mentioned circuit connection, and a commutator-piece adapted to be placed in two positions, in one position said first-mentioned pair of contacts being closed and in the other position said second-mentioned

pair of contacts being closed, substantially as set forth.

18. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with a circuit connection of high resistance and retardation grounded on one side, a calling-generator in a circuit connection grounded on one side, an annunciator whose coils comprise part of said first-mentioned circuit connection of high resistance and retardation, and a switching device containing a pair of contacts one contact of which is connected with one of said switch-conductors and the other contact of which is connected with the other side of said first-mentioned circuit connection, another pair of contacts one contact of which is connected to one of said switch-conductors, and the other contact of which is connected to the other side of said second-mentioned circuit connection, and a commutator-piece adapted to be placed in two positions, in one position said first-mentioned pair of contacts being closed and in the other position said second-mentioned pair of contacts being closed, substantially as set forth.

19. In a telephone-exchange system, two metallic-circuit lines temporarily connected together in a metallic circuit for conversation, in combination with an annunciator in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, and a switching device containing a pair of contacts, one contact of which is connected with said metallic circuit and the other contact of which is connected with the other side of said first-mentioned circuit connection, another pair of contacts one contact of which is connected to said metallic circuit and the other contact of which is connected to the other side of said second-mentioned circuit connection, and a commutator-piece adapted to be placed in two positions, in one position said first-mentioned pair of contacts being closed and in the other position said second-mentioned pair of contacts being closed, substantially as set forth.

20. In a telephone-exchange system, a pair of loop-switch plugs, the two contact-pieces of each of which are respectively connected with the two contact-pieces of the other by flexible switch-conductors, and an operator's telephone temporarily in a bridge across the two conductors, in combination with an annunciator in a circuit connection grounded on one side, a calling-generator in a circuit connection grounded on one side, and a switching device containing a pair of contacts one contact of which is connected with one of said switch-conductors, and the other contact of which is connected with the other side of said first-mentioned circuit connection, a pair of contacts, one contact of which is connected to one of said switch-conductors, and the other contact of which is connected to the other side of said second-mentioned circuit connection, and a commutator-piece adapted to be placed in two positions, in one position said first-mentioned pair of contacts being closed and in the other position said second-mentioned pair of contacts being closed, substantially as set forth.

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

MILO G. KELLOGG.

Witnesses:
EMIL ABENHEIM,
C. STRICH-CHAPELL.