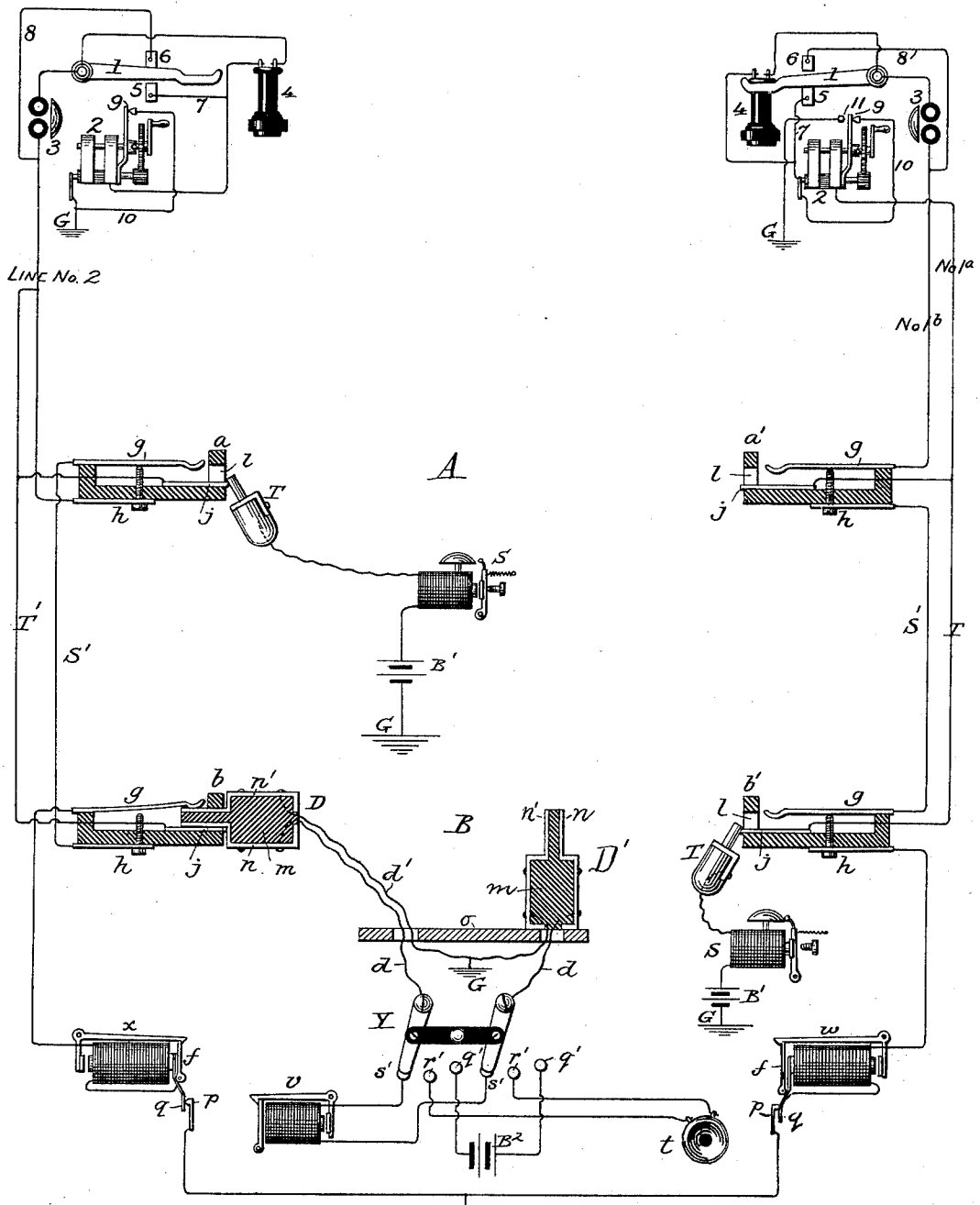
(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,338. Patented Oct. 26, 1897.



Witnesses

C. W. Brooke.

Myron Francis Hill

Inventor.

Milo G. Kellogg.

by his attorneys.

Baldwin, Davidson & Wight.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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. 592,338, dated October 26, 1897.

Application filed December 20, 1889. Serial No. 334,355. (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 telephone-exchange system in which the lines normally unite in a common wire after passing to the switchboards, in which is a rheotome or other apparatus which constantly varies the electrical condition, and in which the lines, while switched for conversation, are disconnected from said common wire, and the apparatus and the test is applied to the circuit of the line before the line passes to the contact-points which make such disconnection. The lines may be single or metallic circuit lines, or both. Such a system is shown in my Patent No. 393,509, dated November 27, 1888.

The invention consists in an attachment or arrangement of contact-points of the line-annunciators by which, while a line-annunciator indicates a call, its line is automatically disconnected from its normal connection with the common wire, in which is the rheotome. By so doing the line tests "busy" when the annunciator indicates a call, whether the line has been switched for use or not, and the operator will not connect the line with another line when the subscriber has sent in a call and the call has not been answered. A subscriber's line is therefore reserved to himself as soon as he sends his call in and the operation of the exchange system will be more satisfactory to him.

In the drawing accompanying this application are shown the apparatus and circuits with which I preferably use my invention.

In the drawing two subscribers' circuits are shown, one circuit grounded and the other circuit metallic. It is obvious that all the circuits might be grounded or all might be metallic. I prefer, however, to show how my invention may be used in an exchange comprising both kinds of circuits.

I place as many boards in the central office as are found necessary or desirable in order to properly answer the calls and make the necessary connections and disconnections. On each board is a spring-jack or similar switch for each line. Each switch has a contact-spring which normally bears on an insulated contact-point and has a contact-piece insulated from the rest (except by the circuit connections) and is adapted to receive a loop-switch plug and, when a plug is inserted, to disconnect the spring from the contact-point and connect the two contact-pieces of the plug with the spring and with said switch contact-piece, respectively.

In the figure, *g g* represent the springs of the switches, *h h* the contact-points on which the springs normally bear, and *j j* the insulated contact-pieces of the switches. *l l* are the switch-holes. *a b* are the rubber strips on which the contact-pieces are mounted, as shown, and through the fronts of which are the holes *l l*. The insulated contact-pieces *j j* of the switches are so placed that a test-plug or similar device may readily be applied to them. When a switch-plug is inserted into a switch-hole *l*, it separates the pieces *g h* of the switch and one of the contact-pieces of the plug is in contact with the piece *j* and the other piece is in contact with the spring *g*. The switches for the single-circuit lines are marked *a b* and those for the metallic-circuit lines are marked *a′ b′*.

R is a rheotome or mechanical circuit-breaker containing a clockwork-movement actuated by a spring. It contains an oscillating bar fixed to the verge-shaft and standing at right angles to it. A pair of contact-points is connected with the bar or with the shaft in such a way that their contact is alternately made and broken with the oscillations. The pair of contact-points are properly insulated and are connected into the circuit as indicated for the rheotome. Instead of the rheotome shown, any form of mechanical or electrical rheotome, or any apparatus which changes the electrical condition of the line so that the change will be indicated on the test receiving instruments, may be connected into the circuit, as indicated for the rheotome.

w and x are calling-annunciators, one for each of the lines shown.

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, q, is a spring-contact which is pressed by the annunciator-drop when the drop falls away from its corresponding contact-point p. The contact-point p is in contact with the spring when the spring is not actuated by the annunciator-drop.

The annunciator is shown in detail in the drawing. The line runs to a bolt o, mounted on and insulated from the plate o', and from thence is connected with one terminal of the annunciator-coil, the other terminal of which is connected to the plate o'. The contact-spring q is mounted upon and is in electrical connection with the plate o', while the bracket piece or contact p, with which the spring is normally in contact, is insulated from the plate. The ground connection through the battery B is connected with the contact p. When the drop falls, the projection at its bottom comes in contact with the spring q and presses it away from the contact-piece p. Two lines are shown, one a metallic-circuit line, the two sides or branches of which are marked line No. 1^a and line No. 1^b, respectively, and one a single-circuit line grounded at its outer end, marked line No. 2.

The circuit of the single-circuit line is as follows: from the subscriber's ground G through the armature of the generator 2, short-circuited by the conductor 10 and contacts 9, opened while the generator is actuated by a call through the telephone 4, normally or while the telephone is not switched for use, short-circuited by the conductor 7 and contact 5, through the bells 3, short-circuited by the conductor 8 and contact 6 while the telephone is switched for use, line conductor No. 2, test-contacts j at each board, through the line and the pairs of contact-points g h successively of its switches on the several boards, going in each case to the point h first, thence through its line-annunciator to the common wire of the lines in which is the rheotome. This wire is grounded, with the rheotome between the ground connection and the connection of the lines with it. All the contact-pieces j j of a single-circuit line are connected together and to their line between its switches and the subscriber's station.

The two contact-points of the line-annunciator p q are placed in the circuit of its line between the several pairs of contact-points of the line-switches and the point where the line unites with said common wire, in which is the rheotome.

The circuit of a metallic-circuit line is as follows: One side or branch of the line, say line No. 1^a, as shown, is connected with all the contact-pieces j j of its switches on the boards. The other branch of the line, say line No. 1^b, passes successively through the pairs of contact-points g h of its switches on the several boards, going in each case to the spring first. It then passes through the line-annunciator and thence to the common wire c, in which is the rheotome. The circuit of each line through its annunciator and annunciator contact-points is as follows and as shown: The line passes through the annunciator-magnet and thence to spring q, and normally through the contact between q to the angle-piece p, and thence to the common wire. The metallic circuit is traced from test-contacts j in the spring-jacks b' and a', connected to the line-circuit conductor T', through the line conductor, the subscriber's call-generator 2, short-circuited by the conductor 10 and contacts 9, open during a call, telephone set 4, short-circuited by the conductor 7 and contacts 5, normally or while the telephone is not switched for use, connected with the switch-lever 1, call-bells 3, short-circuited by the conductor 8 and contact 6, while the telephone is switched for use, line conductor S', through contacts g h of each jack in the order cited, annunciator w, contacts p q, opened by the flap of said annunciator while it indicates a call, common wire c and rheotome R, grounded at G. When a test-plug is applied to a test-contact j, thus introducing the test outfit into the circuit just traced, the test receiving instrument S gives a continuous signal in response to the rheotome R. The two contact-points of the line-annunciator p q are placed in the circuit of its line between the several pairs of contact-points of the line-switches and the point where the line unites with said common wire, in which is the rheotome.

At board B is shown an operator's switching outfit, comprising two switch-plugs D and D', each comprising insulating material m, upon which are mounted contacts n and n', adapted to make connection with spring-jack contacts j and g, respectively, when inserted in a spring-jack, and adapted to be crossed by a conducting base-plate o when in their normal position of rest. The contacts n' of the two plugs are connected together by a flexible conductor d', grounded at G when used in a mixed exchange. The contacts n of the two plugs are connected together by a flexible conductor d, in the circuit of which is a looping-in switch Y, adapted to be placed upon pairs of contacts q' q', r' r', or s' s' and thereby loop into the circuit the call-generator B^2, the operator's telephone set t, or the clearing-out annunciator v. The looping-in switch Y normally rests upon the pairs of contacts s' s'. When two grounded lines are connected together, or when two metallic circuits are connected together, the ground connection of the flexible conductor d' plays no material part. When a metallic and a grounded circuit are connected together, a circuit for

conversation is established from the ground over line conductor 2, test-contact *j*, flexible conductor *d*, test-contact *j* of the metallic circuit, over said circuit to the spring-contact *g*, connected to the plug-contact *n'*, grounded at G. The rheotome R is disconnected from these or any two connected circuits, and when either circuit is tested the test receiving instrument, by its failure to give a continuous signal, indicates "busy."

The generator has an automatic device, which is a modification of the automatic device very generally used in telephone-generators. The modification consists, essentially, in the arrangement and number of the contacts. One side or branch of the line—say line No. 1^a, as shown—is connected with the insulated spring of the generator, which is maintained in contact with an insulated end of the armature-coil. The other end of the armature-coil is connected with the metal frame of the generator, as is also the other side or branch of the line, line No. 1^b, and the contact-spring of the automatic device. When the generator is operated, the contact-spring is forced away from the contact-point on which it normally rests, thereby removing the normal shunt of the generator, and into connection with the point which is connected with the ground, thereby grounding the circuit with the armature-coil between such ground connection and the normal ground connection of the line at the central office.

In the operator's test outfit T is the test-plug, connected by a flexible conductor to the test receiving instrument S, and thence through the test-battery B' to the ground. Each operator has a cord outfit and a test system, and they are conveniently mounted and arranged for her work. When a line is tested by placing a test-plug on a contact-piece *j* of the line and the line is not switched at any board and the line-annunciator does not indicate a call, there is a complete circuit from the ground through the test receiving instrument, battery, the circuit of the line, the pairs of switch contact-points of the line, the annunciator contact-points, and the rheotome to the ground, and the test receiving instrument will sound or respond to the vibrations of the rheotome, indicating to the operator that the line is free to be connected to. Should, however, the line be switched at any board, this circuit is open and the instrument will not sound or respond. Should, again, the line-annunciator indicate a call, this circuit is open at the pair of contact-points of the annunciator and the instrument will not sound or respond. When the instrument, on a test being made, does not respond, the operator knows, therefore, that either the line is switched for use or its annunciator indicates a call and she will not then connect it with another line. The test receiving instruments and the battery should be such that when closed to the circuits with the rheotome the instruments will respond to the vibrations of the rheotome.

When the test of a ground-circuit line is made and the line is not switched for conversation and its annunciator does not indicate a call, there are two branch or derived circuits to ground from the test-contact to which the test-plug is applied, one being over the circuit of the line to the subscriber's station, which is always complete, and therefore makes a closed circuit with the test receiving instrument and battery, and the other through the line-annunciator and rheotome to ground, which is alternately made and broken with the makes and breaks of the rheotome. It is intended that the test receiving instrument shall respond to the makes and breaks of the rheotome when closed to this circuit by the operator on testing. To this end, when a signal-bell or similar test receiving instrument is used the bell and battery will of course be such that when closed to the circuit of the line and the rheotome-contacts are open there is not sufficient current passing through the bell-magnet to attract and move its armature, but when the path or circuit to ground through the rheotome-contacts are closed the current passing through the bell-magnet will be sufficient to attract and move its armature. It is evident that this adjustment may be facilitated by the use of comparatively high resistance in the the line-circuit or at the subscriber s station in manners well known and which do not materially affect the operation of the system in other respects. With the magneto-telephone as the test receiving instrument, which is the form of test receiving instrument generally in use, the test-signal will be given in response to the make and break of the rheotome without reference to the adjustment of the battery and the resistances.

The test outfit at board A is shown testing the condition of line No. 2 and the test receiving instrument is shown as silent. This is due to the test-circuit being open at spring-jack *b* by the insertion of the switch-plug D, which lifts the spring-contact *g* from its anvil-contact *h*, thereby opening the test-circuit. At board B the test outfit is shown testing and responding to the "free" condition of the metallic circuit due to the presence of the rheotome R. When a subscriber sends in a call, the annunciator-contacts *p q* are opened as soon as a call is indicated to prevent a continued induction on neighboring circuits, and they also prevent the continued ringing of the subscriber's bell, thus informing him that his call has been registered at central. The parts should, however, be so related to the line-annunciators that on a test of a line being made it will not operate the annunciators. For this purpose the annunciators may be such as will be operated only when one polarity of current passes through them, and the batteries may be so connected to the circuit

as not to operate the annunciator. A metallic conductor may be substituted for ground. The contacts *p q* may be opened by any kind of call system—the Law system, for example. All such modifications lie within the scope of my invention.

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

1. In a multiple-switchboard exchange, a test signaling device, test-circuits including said device, a test-battery, and call-contacts open while a call is being communicated controlling the condition of each of said test-circuits.

2. In a multiple-switchboard exchange, a rheotome, a number of test-circuits including said rheotome, and annunciator-contacts in each test-circuit, controlling the condition of said test-circuit.

3. In a multiple-switchboard exchange, a rheotome, annunciator-contacts normally closed but open while the annunciator indicates a call, and a test-circuit including said rheotome and contacts.

4. In a multiple-switchboard exchange, a common ground-wire for the lines, a rheotome in said wire, annunciator-contacts in each of said lines normally closed but open while a call is indicated, and test-circuits including said contacts and rheotome.

5. In a multiple-switchboard exchange, a telephone-line, and a test-circuit associated therewith, including a rheotome, a battery, a test receiving instrument adapted to respond thereto, normally open contacts closed for testing, and normally closed call-contacts open while a call is being sent in.

6. In a multiple-switchboard exchange, a telephone-line, a test-circuit associated therewith, including a rheotome, a battery, a test receiving instrument adapted to respond thereto, normally open contacts closed for testing, and two sets of normally closed contacts, one set open while a call is indicated, and the other set open while the telephone-line is switched for use.

7. In a multiple-switchboard exchange, in the order named, a grounded subscriber's circuit, test-contacts, normally closed switch-contacts, open while the line is switched for use, normally closed annunciator-contacts open while a call is being indicated, a rheotome, and a ground connection; in combination with a grounded test outfit adapted to be connected to a test-contact and to respond to said rheotome while said contacts are closed, but not otherwise, and a call-circuit adapted to open said annunciator-contacts.

8. In a multiple-switchboard exchange, in the order named, test-contacts, two limbs of a closed metallic circuit, normally closed spring-jack contacts open while the line is switched for use, normally closed call-contacts opened by call apparatus while a call is being communicated, a rheotome, and a test outfit, adapted to respond thereto while connected to a test-contact, and said normally closed contacts are not open, but not otherwise.

9. In a telephone-exchange system, a common ground-wire to which the lines are normally connected, containing a rheotome, in combination with an annunciator normally in the circuit of the line, a pair of contact-points operated by the annunciator to disconnect the line from said common ground-wire while the annunciator indicates a call, a pair of switch contact-points which disconnect said line from said common ground-wire, while the line is switched by a switch which controls them, a test receiving instrument grounded on one side (but not through the rheotome) and connected on its other side to a test plug or device adapted to be brought for testing into connection with the line, and battery in the test-circuit thereby established, substantially as set forth.

10. In a telephone-exchange system, a common wire containing a rheotome to which the lines are normally connected on one side of the rheotome, in combination with an annunciator normally in the circuit of a line, a pair of contact-points operated by the annunciator which disconnect the line from said common wire while the annunciator indicates a call, a pair of switch contact-points which disconnect said line from said common wire while the line is switched by a switch which controls them, a test receiving instrument connected on one side to the common wire on the other side of said rheotome and connected on its other side to a test plug or device adapted to be brought for testing into connection with said wire whether the wire is connected to the rheotome or not, and battery in the test-circuit thereby established, substantially as set forth.

11. In a telephone-exchange system, a common wire containing a rheotome, to which the lines are normally connected on one side of the rheotome, in combination with an annunciator normally in the circuit of a line, a pair of contact-points operated by the annunciator which disconnect said line from said common wire while the annunciator indicates a call, a pair of switch contact-points which disconnect said line from said common wire while the line is switched at a switch which controls them, and a test wire or circuit containing a test receiving instrument and battery, connected at one end to said common wire on the other side of the rheotome and connected at its other end to a test plug or device adapted to be brought for testing into connection with the line whether the line is connected to the rheotome or not, substantially as set forth.

12. In a telephone-exchange system, a common ground-wire, containing a rheotome, to which the lines are normally connected, in combination with a subscriber's line, a series of pairs of contact-points for the line, one pair on each of several boards each pair normally in contact but open while the line is

switched at their board, said line passing normally, successively, through said pairs of contact-pieces and being thence connected to said common wire, an annunciator normally in the circuit of the line, a pair of contact-points operated by the annunciator which break the connection of the line with said common wire while the annunciator indicates a call, and a test wire or circuit, containing a test receiving instrument and battery, grounded at one end, but not through the rheotome, and connected at its other end to a test plug or device adapted to be brought for testing into connection with the line whether the line is connected to the rheotome or not, substantially as set forth.

13. In a telephone-exchange system, multiple switchboards, a telephone-line, a rheotome connected on one side to the ground and on its other side normally connected to the line, switching devices at each board to disconnect the line from its normal connection with the rheotome and switch it with any other line for conversation, an annunciator normally in the circuit of the line, and a pair of contact-points operated by the annunciator which disconnect the line from its normal connection with the rheotome when the annunciator indicates a call, in combination with test receiving instruments, one at each board each grounded on one side (but not through the rheotome) and connected on its other side to a test plug or device adapted to be brought for testing into connection with the line whether the line is connected with the rheotome or not, and battery in the test-circuit thereby established, substantially as set forth.

14. In a telephone-exchange system, a metallic-circuit line, one of whose sides or branches normally passes successively through pairs of contact-points, one pair on each of several boards, each pair normally closed but open while the line is switched at their board, and thence to one side of a circuit connection common to the lines, in combination with an annunciator normally in the circuit of that branch of the line, a pair of contact-points controlled by the annunciator which disconnect the line from said common circuit connection while the annunciator indicates a call, a test receiving instrument connected on one side to the said common circuit connection and on its other side to a test plug or device adapted to be brought for testing into connection with the other side or branch of the line, and a battery and rheotome in the test-circuit thereby established, substantially as set forth.

15. In a telephone-exchange system, multiple switchboards, a telephone-line, a rheotome normally connected on one side to the line, switching devices at each board to disconnect the line from its normal connection with the rheotome and switch it with another line for conversation, an annunciator normally in the circuit of the line, and a pair of contact-points operated by the annunciator which disconnect the line from its normal connection with the rheotome while the annunciator indicates a call, in combination with test receiving instruments, one at each board, each instrument connected on one side to the other side of the rheotome and on its other side to a test plug or device adapted to be brought for testing into connection with the line whether the line is connected with the rheotome or not, and battery in the test-circuit thereby established, substantially as set forth.

In witness whereof I hereunto subscribe my name this 29th day of November, 1889.

MILO G. KELLOGG.

Witnesses:

EMIL ABENHEIM,

MARGARETHA RIEHL.