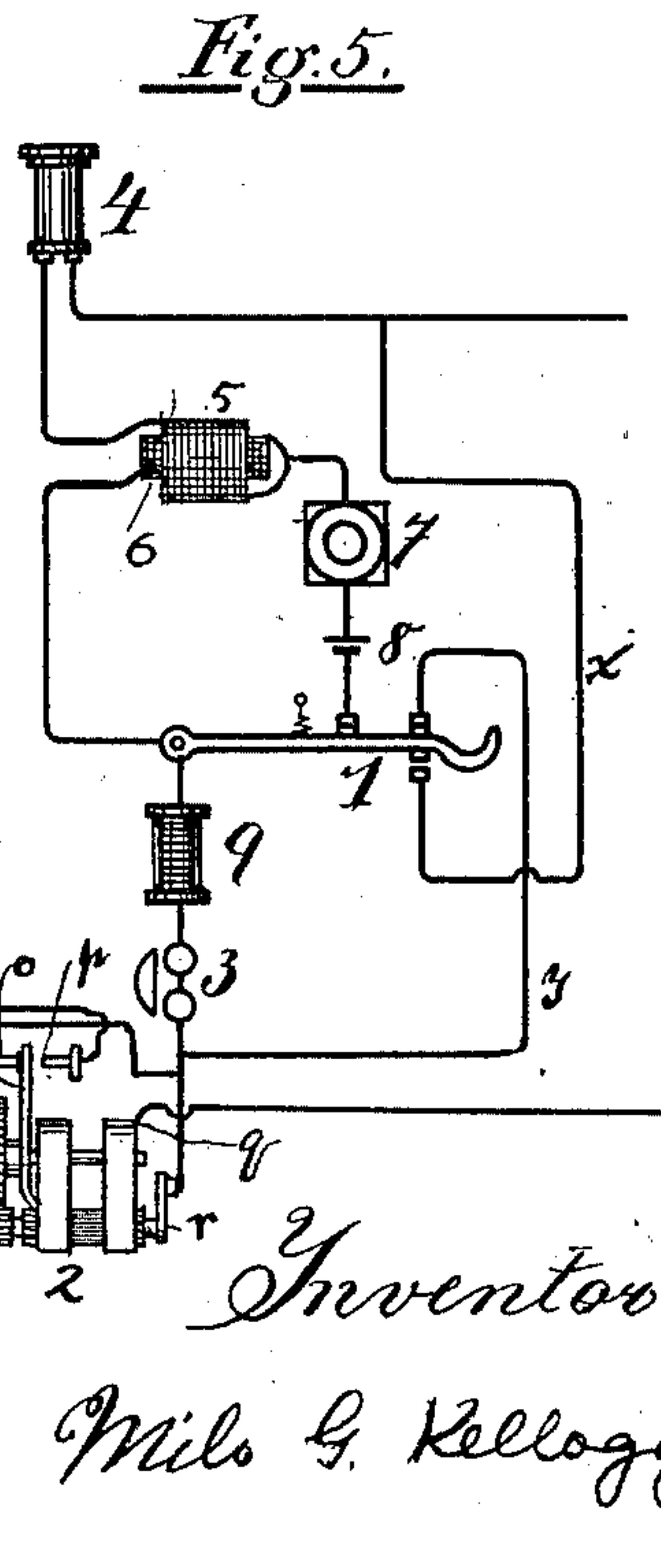
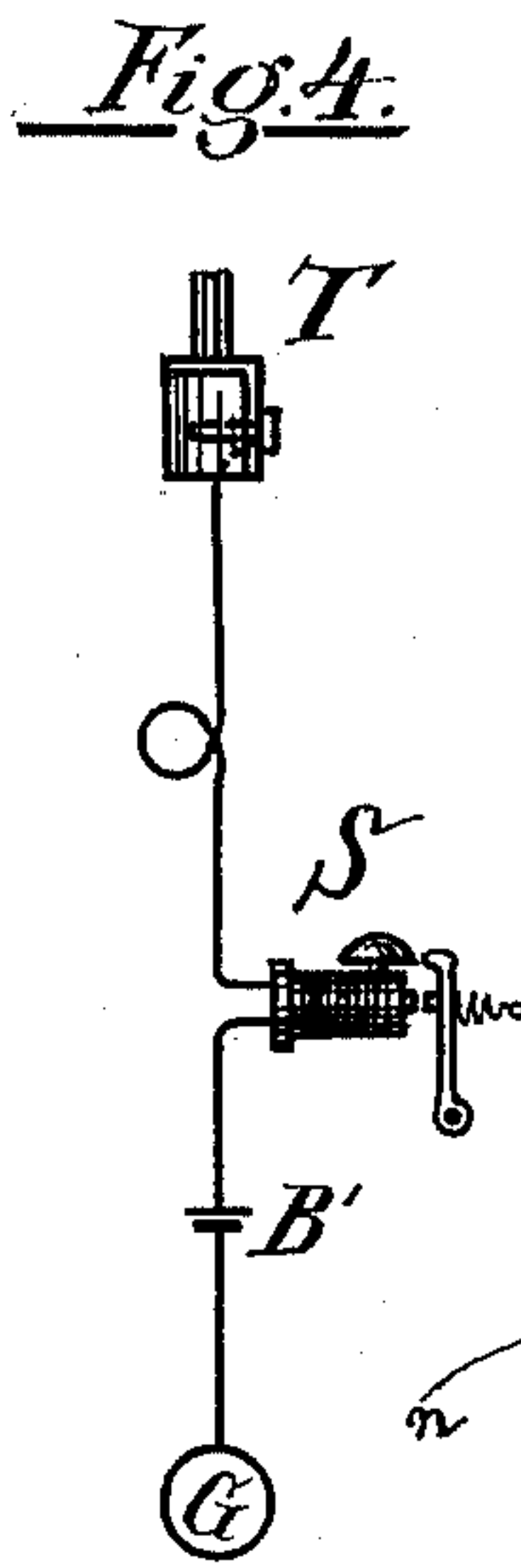
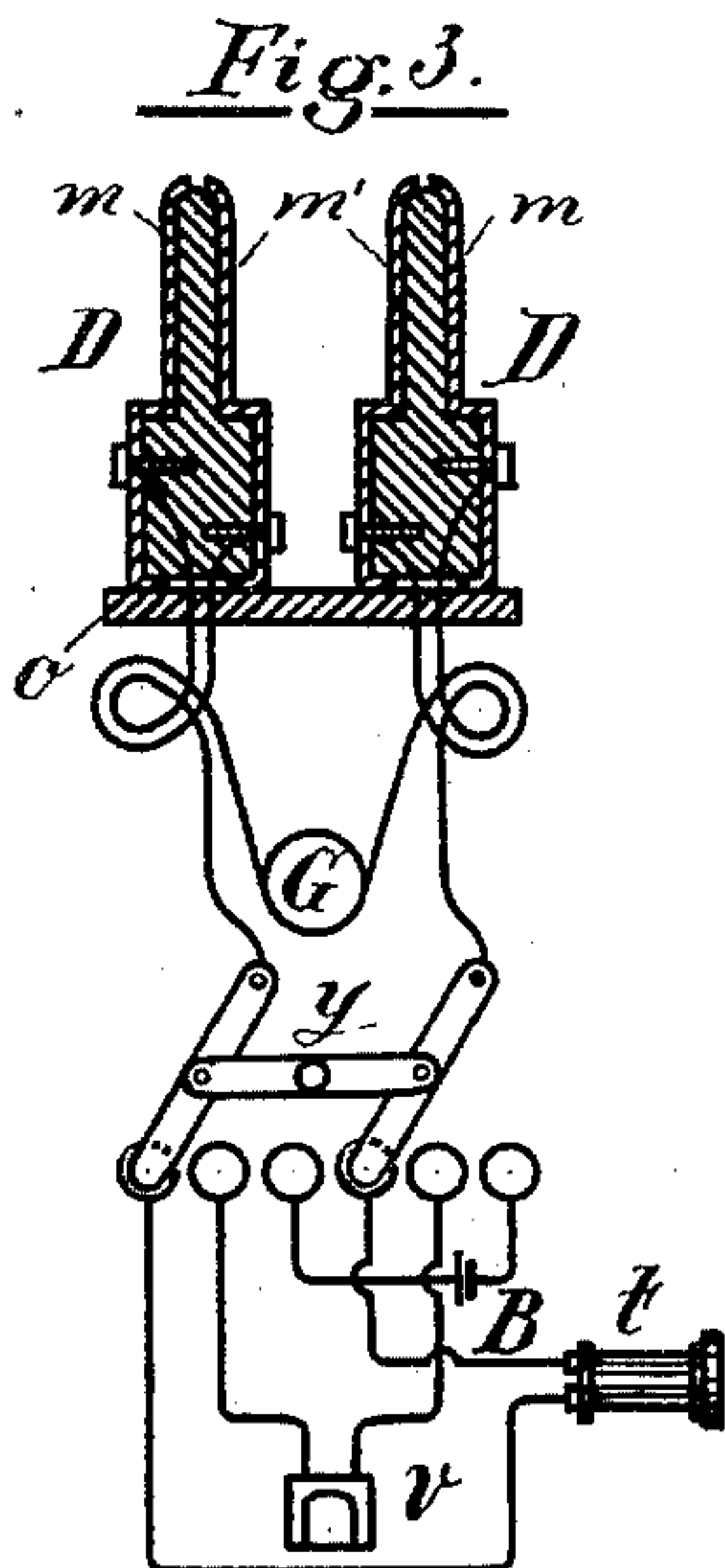
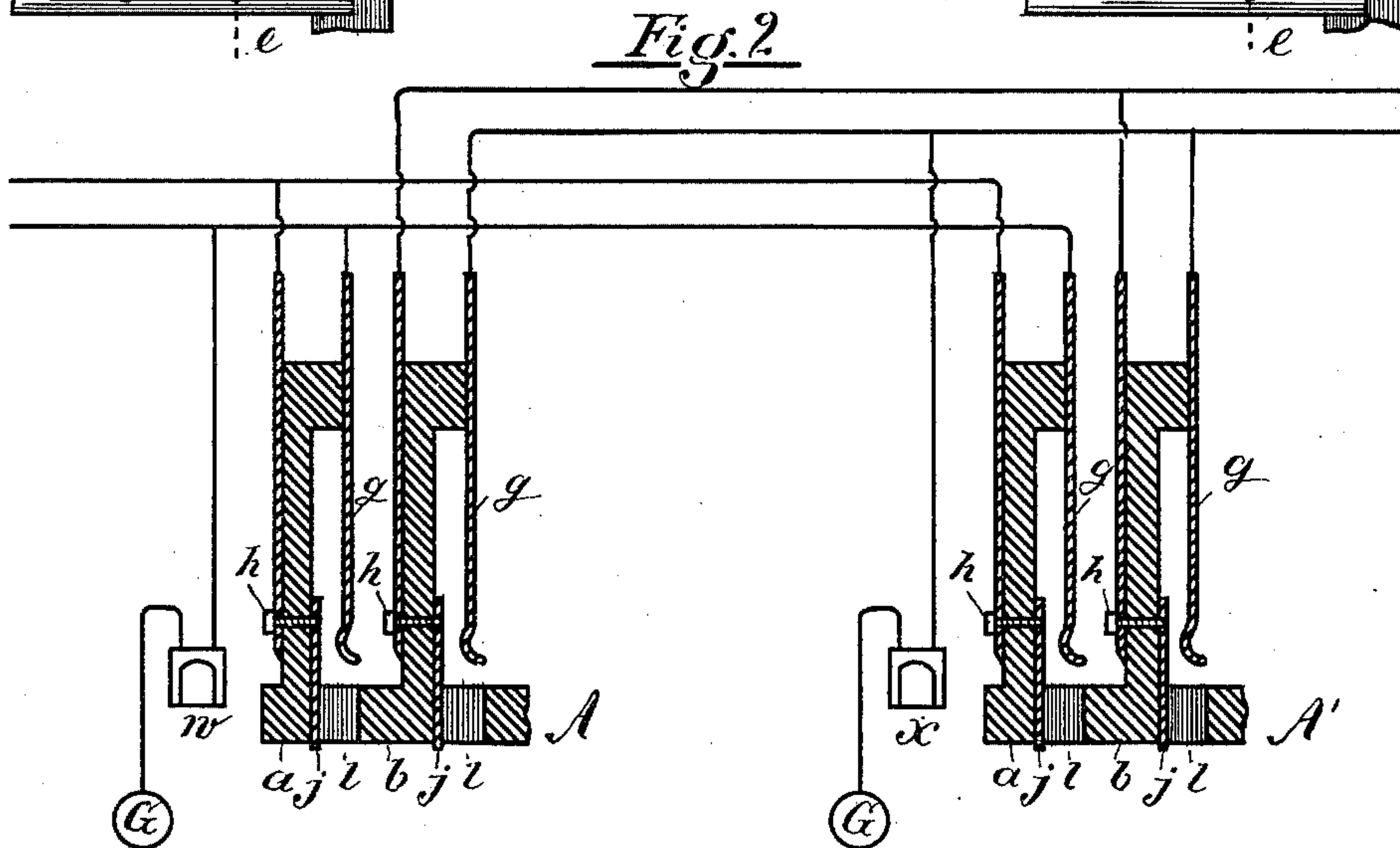


M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

Patented Oct. 26, 1897.



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^r
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Milo G. Kellogg

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. 592,355, dated October 26, 1897.

Application filed January 8, 1890. Serial No. 336,260. (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 drawings, forming a part of this specification.

My invention relates to telephone-exchange systems in which the lines are metallic-circuit lines; and it consists in a system of switching, calling, and testing with such lines, which I shall describe and claim.

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 and a contact-piece insulated from the spring except by the circuit connections and is adapted to receive a loop-switch plug and, when a plug is inserted, to connect the two contact-pieces of the plug with said spring and said contact-pieces, respectively.

In the accompanying drawings, illustrating my invention, Figures 1^a and 1^b represent sections of two multiple switchboards of the exchange to which the same lines are connected. Fig. 2 shows a diagram of the boards with the line connections and apparatus necessary to illustrate my invention. Fig. 3 shows an operator's cord system to be used with the boards. Fig. 4 shows an operator's test system. Fig. 5 shows a subscriber's-station apparatus.

In the drawings like parts and apparatus are indicated by the same letters and figures of reference.

G in each case represents a ground connection.

In Fig. 2, A is a sectional view of the switchboard shown in Fig. 1^a, and A' is a sectional view of the switchboard shown in Fig. 1^b, each as indicated by the line *d e*.

In Fig. 2, *g g* represent the springs of the switches, 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.

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

The circuit of a line is as follows and as shown: One side or branch of the line is connected with all the contact-pieces *j j* of its switches on the boards. The other branch of the line is connected with all the contact-springs *g g* of its switches on the different boards and through the line-annunciator to the ground.

In the operator's cord system shown in Fig. 3, *D D* are the loop-switch plugs. *m m'* are the two contact-pieces of each plug. These contact-pieces pass to the bottom of the plug-handles, as shown, and are adapted to rest normally (or when not in use) on the metal plate *o*, which then connects the two contact-pieces of the plug together. *Y* is a looping-in switch for the pair of cords shown. *v* is the clearing-out annunciator for the pair of cords. *t* is the operator's telephone, and *B* is her calling generator or battery. The circuits are substantially as shown.

Only one pair of plugs and cords with their apparatus is shown. Other pairs, as required, may be added to the system in a way which will be apparent to those skilled in the art.

In the subscriber's test system shown in Fig. 4, *T* is the test-plug, connected with a flexible cord and adapted to be brought for testing into connection with any contact-piece *j* at its board. *S* is the test receiving instrument, and *B'* is a test-battery. The parts are connected together and to the ground substantially as shown.

Each operator has a cord system and a test system, and they are conveniently placed and mounted for her work.

In the subscriber's-station apparatus shown in Fig. 5, 1 is the telephone-switch. 2 is the calling-generator. 3 is the signal-receiving bell. 4 is the subscriber's telephone. 5 is the secondary, and 6 is the primary, of the induction-coil. 7 is the transmitter. 8 is the transmitter-battery. 9 is a resistance-

coil of suitable resistance to operate as hereinafter described. These parts may be of usual forms of apparatus and are connected as shown or in other ways so as to perform practically the operations required and the operations hereinafter described. The generator, however, is modified, and is as shown. When it is not in operation, the subscriber's line is open to the ground at his station and is on closed circuit, the two sides of the line being closed at the contacts $n o$. While it is being operated the spring n passes out of contact with o and into contact with p , and the line is automatically connected with the ground, with the armature-coil between said connection and the connection of the line to the ground at the central office.

In the normal condition the armature of the generator is shunted thus: One side of the line is connected with the generator-frame at q , and spring n is connected with the frame and with one terminal of the armature-coil. The other terminal of the armature is connected with a contact on the shaft upon which the finger r bears, the finger being connected with the other side of the line through the bell and resistance when the telephone is on its switch.

When a subscriber operates his generator to send in a call, his line is automatically connected to the ground, with his armature-coil between the connection and the central office ground connection of the line, and the line-annunciator will be operated, indicating his call.

The connections of the subscriber's-station apparatus and switch are such that when the subscriber's telephone is on its switch the signal-receiving bell and the resistance-coil are in the circuit of the line, and the telephone and the secondary of the induction-coil are shunted by a wire X of small resistance, so as to be practically out of the circuit. When the telephone is off the switch, the telephone and the secondary of the induction-coil are in the circuit and the signal-bell and resistance-coil are practically out of the circuit, being shunted by wire y . The resistance of the telephone and secondary of the induction-coil combined aggregate in well-constructed apparatus about four hundred ohms and the resistance of the signal-bell amounts to about one hundred ohms. The resistance of the resistance-coil is made such that when the telephone is in its normal position on its switch the resistance of the line is much greater than is the resistance in the circuit when the telephone is off its switch for use. I utilize this difference in resistance in the operation of the test system, as will hereinafter appear.

When an operator receives a call, she places one of a pair of her switch-plugs in the switch of the line, the contact-piece m' being in connection with the spring g , and there is a complete circuit of the line established through the two branches of the line, the two contact-pieces of the plug used, the pairs of the con-

ductors of the cords, the two contact-pieces of the other plug of the pair, and the metal piece which then connects them together, and the operator can by moving the switch Y connect her telephone with the circuit and find out what line is wanted. When on testing the line wanted she finds it to be free, she places the other plug of the pair into its switch, with the contact-piece m' in contact with the spring, and the two lines are connected together into one circuit. The circuit is as follows: from the ground through the cord connected to the contact-piece m' of one of the plugs to the line belonging to the switch in which the plug is placed, thence through the circuit of the line, and the conductors connected with the contact-pieces m of the plugs to the other line and through the line to the contact-piece m' of the plug inserted into its switch, and thence to the ground through the conducting-cord. When two lines are connected together, the operator may by operating the switch Y of the pair of cords used connect at will either her telephone, her calling-generator, or the clearing-out annunciator into the circuit.

It will be seen that when a switch-plug is placed into the switch of a line, as described, one branch of the line is grounded at the central office by two circuits, one being through the line-annunciator and the other through the conducting-cord of the plug used. The latter circuit is of much smaller resistance, and the annunciator is thereby shunted by a circuit of so small resistance that any signal-current sent over the line will not operate it.

When an operator receives a call on a line assigned to her, she places one of the switch-plugs of a pair in the switch of the line and, moving the levers of the looping-in switch, connects her telephone into the circuit and finds out what line is wanted. She then tests the line wanted, and if she finds it is not busy she places the other plug of the pair in its switch. She then moves the levers of the switch so that the calling-generator is in the circuit and a signal-current is sent over the circuit. The calling-generator should be of such strength that it will operate the subscriber's signal-bell through the resistance of the two lines, including the resistance-coil in circuit, while the subscriber's telephone is not switched for use. The calling-generators generally used by operators are of such strength as to accomplish this. When the operator has sent a calling-current to the circuit, she moves the levers of the switch so that the subscribers are connected together with the clearing-out annunciator of the pair of cords in the circuit.

The operator's test receiving instrument and battery should be so constructed and related that when they are closed to the contact-piece j of the switch of any line and the line is not switched and the subscriber's telephone is not switched for use the instrument will not sound, the resistance of the circuit

being so great that the amount of current passing through the instrument will not operate it, and that when the subscriber's telephone is switched for use and the resistance of the circuit is thereby diminished, as heretofore described, the instrument will sound, and that when the line is connected with another line and the resistance of the test-circuits is reduced by the two channels afforded to the current by the two lines which form a multiple or parallel circuit for the test-circuit the instrument will sound. This construction and relation between the test receiving instrument and battery can be readily obtained. It depends on the fact that an electromagnet may be readily constructed so as to operate when a battery and a certain resistance is in circuit with it and not to operate when the resistance is considerably greater. This operation can be made to depend on the style of the magnet, the number of convolutions of its coil, the size of the battery, and the adjustment of the retractile spring.

When an operator desires to test any line to determine whether it is free to be switched to, she places her test-plug on the contact-piece of the line at her board. If the line is not switched for use at any board and the subscriber's telephone is not switched for use, there is a circuit from the ground through her test receiving instrument and battery and through the circuit of the line back to the ground at the central office, and the resistance-coil at the subscriber's station being in the circuit the test receiving instrument will not sound, indicating to the operator that the line is free to be connected to. If, however, the subscriber's telephone is switched for use, the resistance of the circuit is so much reduced that the instrument will sound on making the test, or if the line is connected with another line the instrument will sound even though the subscriber may not have his telephone switched for use, because the two lines are in multiple or parallel circuit in the test-circuit established and the resistance is so low that the instrument will be operated. The test therefore shows that a line is busy, whether it is switched for use or the subscriber's telephone is switched for use.

It will be observed that when two subscribers' lines are switched together in metallic circuit, as described, the circuit is grounded at the central office. This will not affect the conversation so long as the circuit is not grounded at some point, so that one subscriber's station is between the two grounds.

In this system only two contact-points are required for each line at each switch.

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

1. In a telephone-exchange system, a metallic-circuit telephone-line normally open at one end at the central office and permanently grounded at its other end at the central office and normally grounded there only in combi-

nation with apparatus and a switching device controlled by the subscriber's telephone and greater resistance thereby switched into the circuit of the line at the subscriber's station when his telephone is not switched for use than when it is switched for use and a test wire or circuit containing a test receiving instrument and battery grounded at one end and connected on its other side to a test plug or device adapted, at the will of the operator, to be brought into connection with the normally open end of the line, said test receiving instrument and battery being so related that the instrument will not sound when the test is applied to the line and the line is not switched for use with another line and the subscriber's telephone is not switched for use, but will sound when the test is applied and either the line or the telephone is switched for use, substantially as set forth.

2. In a telephone-exchange system, two or more multiple switchboards at the central office, and metallic-circuit lines connected to them, each line being normally open at one end and connected to each board and at its other end permanently grounded and connected to each board, and normally grounded there only, in combination with apparatus and a switching device controlled by the subscriber's telephone and greater resistance thereby switched into the circuit of the line at the subscriber's station when his telephone is not switched for use than when it is switched for use and a test wire or circuit containing a test receiving instrument and battery grounded at one end, and connected on its other side to a test plug or device adapted, at the will of the operator, to be brought into connection with the normally open end of any line, said test receiving instrument and battery being so related that the instrument will not sound when the test is applied to any line and the line is not switched for use with another line and the subscriber's telephone is not switched for use but will sound when the test is applied and either the line or the telephone is switched for use, substantially as set forth.

3. In a telephone-exchange system, metallic-circuit lines, multiple switchboards for the same and switches, one switch on each board for each line, each switch having two contact-points, one of which is permanently connected to one side of the line and is permanently connected with the ground and the other of which is connected to the other side of the line, in combination with apparatus and a switching device at each subscriber's station controlled by the subscriber's telephone and greater resistance thereby switched into the circuit of his line while his telephone is not switched for use than is the resistance while the telephone is switched for use, test receiving instruments, one at each board, each instrument grounded on one side and connected on its other side to a test plug or device adapted at the will of the operator, to

be brought for testing into connection with any of said second-mentioned contact-points of the switches at its board, and battery in the test-circuit established on testing, each
 5 test receiving instrument and battery being so related that the instrument will not sound when the test is applied to any line and the line is not switched for use with another line and the subscriber's telephone is not switched
 10 for use, but will sound when the test is applied and either the line or the telephone is switched for use, substantially as set forth.

4. In a telephone-exchange system, a metallic-circuit telephone-line normally open
 15 at one end at the central office and permanently grounded at its other end at the central office and normally grounded there only, in combination with apparatus and a switching device controlled by the subscriber's
 20 telephone and greater resistance thereby switched into the circuit of the line at the subscriber's station when his telephone is not switched for use than when it is switched for use, a test wire or circuit containing a test
 25 receiving instrument grounded at one end and connected on its other side to a test plug or device adapted, at the will of the operator, to be brought into connection with the normally open end of the line, and battery in
 30 the test-circuit established on testing, said test receiving instrument and battery being so related that the instrument will not sound when the test is applied to the line and the line is not switched for use with another line
 35 and the subscriber's telephone is not switched for use, but will sound when the test is applied and either the line or the telephone is switched for use, substantially as set forth.

5. In a telephone-exchange system, a metallic-circuit telephone-line normally open
 40 at one end at the central office and grounded at its other end at the central office when the line is switched for conversation and normally grounded there only, in combination with
 45 apparatus and a switching device controlled by the subscriber's telephone and greater resistance thereby switched into the circuit of the line at the subscriber's station when his

telephone is not switched for use than when it is switched for use, and a test wire or circuit containing a test receiving instrument
 50 and battery grounded at one end and connected on its other side to a test plug or device adapted, at the will of the operator, to be brought into connection with the normally
 55 open end of the line, said test receiving instrument and battery being so related that the instrument will not sound when the test is applied to the line and the line is not switched for use with another line and the subscriber's
 60 telephone is not switched for use, but will sound when the test is applied and either the line or the telephone is switched for use, substantially as set forth.

6. In a telephone-exchange system, a metallic-circuit telephone-line normally open at
 65 one end at the central office and grounded at its other end at the central office and normally grounded there only, in combination with apparatus and a switching device controlled by
 70 the subscriber's telephone and greater resistance thereby switched into the circuit of the line at the subscriber's station when his telephone is not switched for use than when it is switched for use, a test wire or circuit containing
 75 a test receiving instrument grounded at one end and connected on its other side to a test plug or device adapted, at the will of the operator, to be brought into connection with the normally open end of the line and battery
 80 in the test-circuit established on testing, said test receiving instrument and battery being so related that the instrument will not sound when the test is applied to the line and the line is not switched for use with another line
 85 and the subscriber's telephone is not switched for use, but will sound when the test is applied and either the line or the telephone is switched for use, substantially as set forth.

In witness whereof I hereunto subscribe my
 90 name this 20th day of December, 1889.

MILO G. KELLOGG.

Witnesses:

EMIL ABENHEIM,
 MARGARETHA RIEHL.