

(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,325.

Patented Oct. 26, 1897.

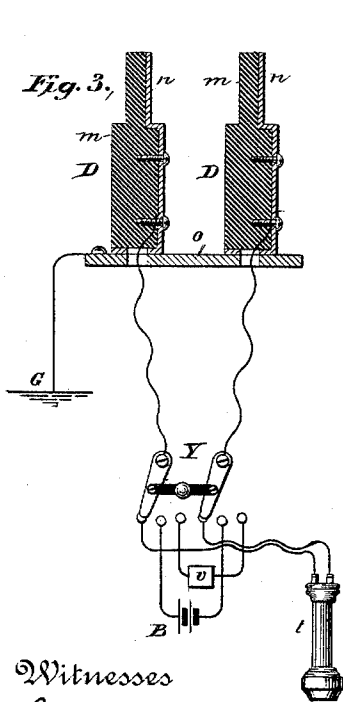
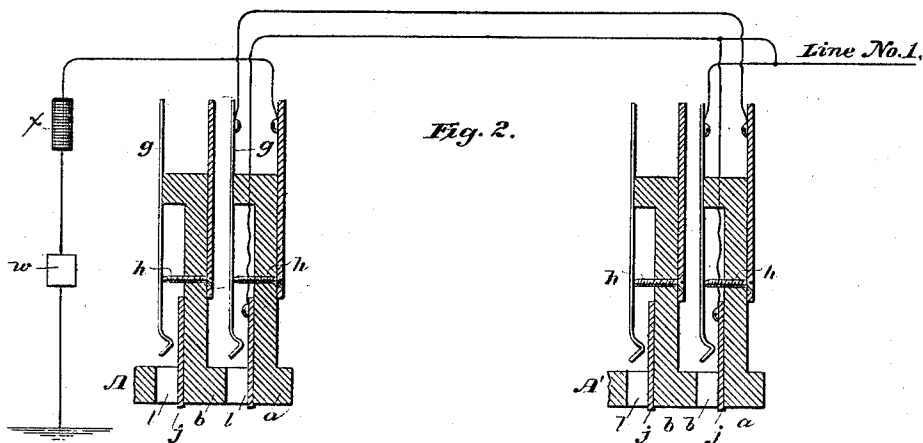
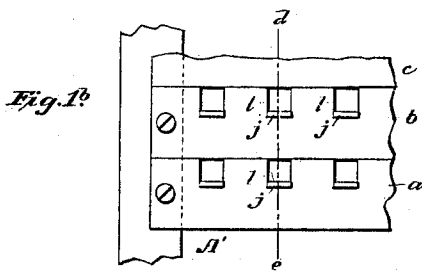
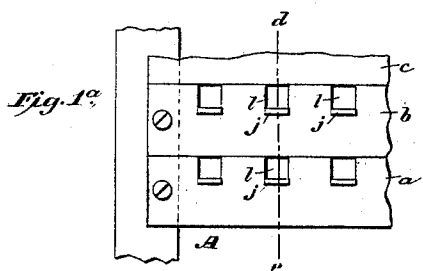


Fig. 5.

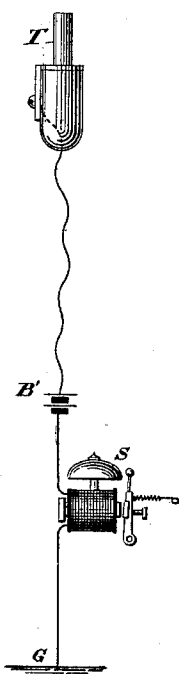
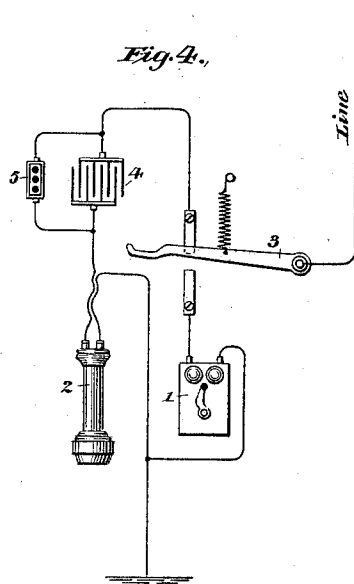


Fig. 4.



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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. 592,325, dated October 26, 1897.

Application filed November 30, 1889. Serial No. 332,114. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, of Chicago, 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 single-circuit telephone-lines; and it consists in a system of testing such lines to determine whether they are in use.

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

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

G represents the 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*.

There are as many boards in the exchange as are necessary for the number of lines. 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 switch-plug and, when a plug is inserted, to disconnect the spring from the contact-point and form connection between the spring and the contact-piece of the plug.

In Fig. 2, *g g* represent the springs of the different switches, *h h* the contact-points on which the springs normally bear, and *j j* the contact-pieces. *l l* are the switch-holes. *a b* are the rubber strips on which the metal parts are mounted and through the fronts of which are the holes *l l*. These holes are

adapted to receive the switch-plugs shown in Fig. 3 and, when a plug is inserted, to operate the switch, as above described.

The contact-pieces *j j* should be so placed that a test-plug may be readily applied to them. Their function is to form test-pieces for their lines on the different boards, and they may be placed as shown or in other convenient positions on the boards.

The connections of the lines to the switchboards and apparatus are as follows and as shown for line No. 1: The line passes successively through the pairs of contact-points of its switches on the boards, passing in each case to the spring first. It then passes through a line-annunciator and resistance-coil to ground.

w is the annunciator, and *x* is the resistance-coil.

The contact-pieces *j j* of a line are connected to the line, the connection being between the switch contact-points on the one hand and the subscriber's station on the other hand.

Fig. 3 shows an operator's cord system with one pair of cords and their plugs, switch, annunciator, and the operator's telephone and calling battery or generator. The plugs *D D* are constructed substantially as shown, *m m* being the rubber insulation and *n n* the contact-pieces, and they should be inserted into the switches in such a position that the contact-piece of the plug is in connection with the spring and is not in connection with the piece *j* of the switch. *o* is a metal strip on which the bases of the plugs normally rest and which then connects the contact-pieces with the ground. The circuits are as shown. The method of connecting other cords to the system, as well as the method of operating the system in connection with the boards, will be apparent to those skilled in the art.

Each operator has one cord system and as many pairs of cords as she may need, and they are mounted and arranged convenient for her use.

In the subscriber's-station apparatus shown in Fig. 4, 1 is the magneto-bell containing a generator. 2 is the telephone. 3 is the telephone-switch. 4 is a condenser of suitable capacity, and 5 is a resistance-coil of suitable resistance. The contact-points and cir-

cuits are as shown or otherwise arranged so as to perform the operations hereinafter described. The condenser and resistance-coil are in derived or parallel circuit to each other, as shown, and the circuit which contains them is in the circuit of the line and telephone when the telephone is taken from the switch for use and it is switched from the circuit of the line when the telephone is placed on the switch.

In the operator's test system shown in Fig. 5, *T* is the test-plug. *S* is the test receiving instrument, and *B* is the test-battery. *G* is the ground connection. Each operator has a test system and the parts are connected substantially as shown and are conveniently mounted for the operation of the system. The test receiving instrument and battery should be so adjusted to each other and to the circuits that the instrument will sound when the test-plug is applied to a test contact-piece *j* of a line and the subscriber's telephone is on its switch and the circuit to the ground through the pairs of contact-points of the switches is not interrupted by the line being switched at some board, but will not sound when the line is switched at some board or when the additional resistance is introduced into the circuit by the operator's telephone being switched for use. When neither the line nor the telephone is switched and the apparatus connected as described, the circuit through the test receiving instrument and battery to ground will be of less resistance than it will be when either one is switched or both are switched for use. The adjustment is therefore a practical, easy thing to accomplish. The resistances at the stations and at the central office may be of such magnitudes as are found necessary or convenient for the purpose of adjustment. The condenser bridges the resistance at the subscriber's station, so as not to unduly impede the telephone-currents.

The adjustment described above is easy to obtain and depends on the fact that an electromagnet with an armature and a retractile spring acting on the armature may, when closed in circuit with a battery and a certain resistance, cause the armature to move, and when the resistance is considerably increased the strength of current will not be enough to cause the armature to move. The resistances of the circuits may be, for instance, such that the resistances of the telephone-lines, when the subscribers' telephones are on their switches, may be about three hundred ohms each, (not including the resistance through the switches and the annunciators and resistance-coils to the office ground,) and when the subscriber's telephone is switched for use it may be, say, six hundred ohms, and the resistance through the switches to the office ground may be about one hundred and fifty ohms. When a test-plug is then applied to the test-piece *j* of a line and the line is not switched

at any board and the subscriber's telephone is not switched for use, the resistance from the test-plug through the two circuits (one to ground through the subscriber's station and the other to ground through the pairs of switch contact-points) will be, say, one hundred ohms. The test receiving instrument and battery are such that with this resistance the instrument will sound. If the circuit through any pair of switch-points is open (but the line is not connected with any other line) and the subscriber's telephone is not switched, the resistance from *j* to ground will be about three hundred ohms and the instrument will not sound. If when the line is in that condition the telephone is off the switch, the resistance will be six hundred ohms and the instrument will not sound. If two lines are switched together by the insertion of a pair of plugs in their respective switches and the telephones are switched for use, the circuit from the test-plug to the two subscribers' grounds will be three hundred ohms and the instrument will not sound. If the two lines are thus switched together and the telephones are not switched for use, the resistance from the test-plug to the two subscribers' grounds will amount to one hundred and fifty ohms and the instrument will not respond. If a line is not switched and the subscriber's telephone is switched for use and the test-plug is applied to one of its test-pieces *j*, the circuit to the subscriber's ground is practically open to the battery at the condenser, and the resistance from the piece *j* to the office ground being about one hundred and fifty ohms the instrument will not sound. The amount of resistance in the line-circuits and in the ground-circuits may vary from the figures given above and adjustment and operation of the system as indicated still be easy to obtain.

The resistance-coil *x* and the annunciator *w* for each line furnish resistance by which the desired adjustment and operation are obtained. The required resistance between the test-pieces and the office ground might all be included in the resistance-coil or all included in the annunciator, or might be included in other forms of resistance and might be of small amount.

If one plug of a pair of plugs is in the switch of the line when the line is tested and the other plug rests on the ground-plate *o* and the subscriber's telephone is off from its switch, enough current will not pass through the test-bell to operate it on account of the circuit to ground at the plate *o* through the operator's telephone *t*. This resistance may be made three hundred ohms or considerably greater and obtain the best results for conversation between the operator and the subscribers. The operator will therefore know when she makes a test of the line, the apparatus and circuits being adjusted as described, and her test instrument sounds that neither the line nor the subscriber's telephone is

switched for use and that the line is "free," and when the instrument does not sound she knows that either the line is switched or the operator's telephone is switched for use. In some systems of testing the lines test "busy" when they are switched at the central office, and in other systems they test "busy" when the subscriber's telephone is switched for use. In this system they test "busy" whether they are switched at the central office or whether the operator's telephone is switched for use and will not become tied up. The system combines the advantages and obviates the disadvantages of both the other general systems of testing.

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

1. A test-circuit for a subscriber's line, from the office ground through a test receiving instrument and battery to a test-plug, thence when the line is tested to a line-contact connected with the line between the subscriber's station and the pair of contact-points of his switch at the central office, thence in one direction to the office ground through said pair of contact-points normally in contact but open while the line is switched by the switch which controls them and a resistance, and in the other direction to the ground through the subscriber's-station apparatus, in combination with a resistance-coil and a condenser at the subscriber's station in derived circuit and a switch with contact-points to switch said instruments in derived circuit into the circuit while the subscriber's telephone is switched for use and out of the circuit while the telephone is not thus switched, substantially as set forth.

2. In a multiple-switchboard system, a test-circuit for a subscriber's line, from the office ground through a test receiving instrument and battery to a test-plug at any one of the boards separate from the other contacts and separately connected to the line, thence when the test is applied to a line-contact at the board where the test is made, thence in one direction to the office ground through all of contact-points of the line, one pair on each board and each pair normally closed but open while the line is switched at their board and through a resistance, and in the other direction to the ground through the subscriber's-station apparatus, in combination with a resistance-coil and a condenser at the subscriber's station in derived circuit and a switch with contact-points to switch said instruments in derived circuit into the circuit while the subscriber's telephone is switched for use and out of the circuit while the telephone is not thus switched, substantially as set forth.

3. In a telephone-exchange system, a subscriber's line grounded at its outer end and having in its circuit in derived circuit a resistance-coil and a condenser while the subscriber's telephone is switched for use but not otherwise and at the central office a switch

with a pair of contact-points normally in contact but open while the line is switched by the switch which controls them, and a test contact-piece insulated from the rest, (except by the circuit connections,) said line passing through said pair of contact-points and thence to ground through a resistance and said contact-piece being connected to the line between the switch contact-points and the subscriber's station, in combination with a test wire or circuit containing a test receiving instrument and battery grounded at one end and connected at its other end to a test plug or device adapted to be brought for testing into connection with said test contact-piece, said instrument being so adjusted to the battery and circuits that it will sound when on the test being made neither the line nor said telephone is switched for use, but not otherwise, substantially as set forth.

4. In a telephone-exchange system, a subscriber's line grounded at its outer end and having in its circuit in derived circuit a resistance-coil and condenser while his telephone is switched for use but not otherwise, and at the central office a series of pairs of switch contact-points, one pair on each of several switchboards, each pair normally closed but open while the line is switched for use at their board, and a test contact-piece insulated from the rest, (except by the circuit connections,) said line passing, successively, through said pairs of contact-points and a resistance to ground, and said test contact-piece being connected to the line between the subscriber's station on the one hand and the contact-points and resistance on the other hand, in combination with a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought for testing into connection with said test contact-piece, said instrument being so adjusted to the battery and circuits that it will sound when on a test being made neither the line nor said telephone is switched for use but not otherwise, substantially as set forth.

5. In a telephone-exchange system, a subscriber's line grounded at its outer end and at his station a resistance-coil and condenser and a switch with contact-points to switch them into the circuit in derived circuit while the subscriber's telephone is switched for use but not otherwise, and at the central office a pair of contact-points normally in contact, but open while the line is switched at the switch which controls them, and a test contact-piece insulated from the rest, (except by the circuit connections,) said line passing through said pair of contact-points and a resistance to ground, and said contact-piece being connected to its circuit between the subscriber's station and the contact-points and resistance, in combination with a test wire or circuit containing a test receiving instrument and

battery, grounded on one side and connected on its other side to a test plug or device adapted to be brought for testing into connection with said contact-piece, said instrument being so adjusted to the battery and circuits that it will sound when on a test being made neither the line nor said telephone is switched for use but not otherwise, substantially as set forth.

6. In a multiple-switchboard telephone-exchange system, a subscriber's line grounded at its outer end and having in its circuit a resistance-coil and condenser in derived circuit while his telephone is switched for use but not otherwise, in combination with a test contact-piece at each board at the central office separate from the other contacts and separately connected to the line, a resistance in the circuit between the connection of the line with said contact-piece and the normal ground of the line, switch contact-points which disconnect the line from the office ground while it is switched for use, and a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought for testing into connection with said contact-piece, said instrument, battery, and the circuits being so constructed and related that the instrument will sound when on the test being made neither the line nor said telephone is switched for use but not otherwise, substantially as set forth.

7. In a telephone-exchange system, a telephone-line grounded at its outer end and at the subscriber's station, a resistance-coil and condenser in the circuit of the line in derived circuit while his telephone is switched for use but not otherwise in the circuit, in combination at the central office with a series of pairs of switch contact-points, one on each of several switchboards, each pair normally in contact but open while the line is switched at their board, said line passing successively through said pairs of contact-points and thence to ground, a test contact-piece at each board separate from the other contacts and separately connected to the line, a resistance in the circuit between said connection of the contact-piece and the office ground, and a test receiving instrument and battery in a test wire or circuit grounded at one end and connected at the other end to a test plug or device adapted to be brought for testing into connection with said contact-piece, said instrument, battery, and circuits being so constructed and related that the instrument will sound when on the test being made neither the line nor said telephone is switched for use but not otherwise, substantially as set forth.

8. In a telephone-exchange system, multiple switchboards, a telephone-line connected to the same and grounded at its outer end, and at the subscriber's station a resistance-

coil and condenser and a switch with contact-points to switch them into the circuit of the line in derived circuit while the subscriber's telephone is switched for use but not otherwise, in combination with a series of switches for the line, one switch on each of several boards, each switch having a pair of contact-points normally in contact but open while the line is switched at their board, said line passing, successively, through said pairs of contact-points and to ground, test contact-pieces, one on each board and each connected to the line between the subscriber's station and its switch contact-points, a resistance in the circuit between the connection of the line with said contact-pieces and its office ground, and test wires or circuits one for each board, each containing a test receiving instrument and having a battery in its circuit between its ground connection and a test-plug at its other end adapted to be brought for testing into connection with the contact-piece at its board, said instrument being so adjusted to the battery and circuit that it will sound when on a test being made neither the line nor said telephone is switched for use, but not otherwise, substantially as set forth.

9. In a telephone-exchange system, a subscriber's line grounded at its outer end and having in its circuit in derived circuit a resistance-coil and a condenser while the subscriber's telephone is switched for use but not otherwise and at the central office a switch with a pair of contact-points normally in contact but open while the line is switched by the switch which controls them, and a test contact-piece insulated from the rest, (except by the circuit connections,) said line passing through said pair of contact-points and thence to ground, and said contact-piece being connected to the line between the switch contact-points and the subscriber's station, in combination with a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought for testing into connection with said test contact-piece, said instrument being so adjusted to the battery and circuits that it will sound when on the test being made neither the line nor said telephone is switched for use but not otherwise, substantially as set forth.

10. In a telephone-exchange system, a telephone-line grounded at its outer end and at the subscriber's station a resistance-coil and condenser in the circuit of the line in derived circuit while his telephone is switched for use but not otherwise in the circuit, in combination at the central office with a series of pairs of switch contact-points, one on each of several switchboards, each pair normally in contact but open while the line is switched at their board, said line passing successively through said pairs of contact-points and thence to ground, a test contact-piece at each

board separate from the other contacts and
separately connected to the line, and a test
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5 wire or circuit grounded at one end and con-
nected at the other end to a test plug or de-
vice adapted to be brought for testing into
connection with said contact-piece, said in-
strument, battery, and circuits be so con-
10 structed and related that the instrument will
sound when on the test being made neither

the line nor said telephone is switched for
use but not otherwise, substantially as set
forth.

In witness whereof I hereunto subscribe my
name this 18th day of October, 1889.

MILO G. KELLOGG.

Witnesses:

FRANCES D. KELLOGG,
MARGARETHA RIEHL.