(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,332. Patented Oct. 26, 1897.

Fig. 1a,

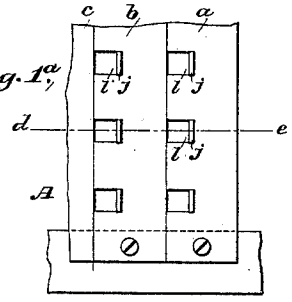


Fig. 1b,

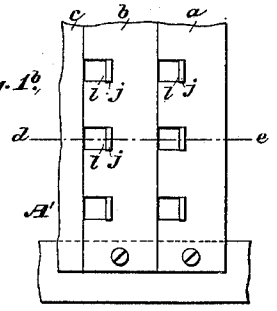


Fig. 2,

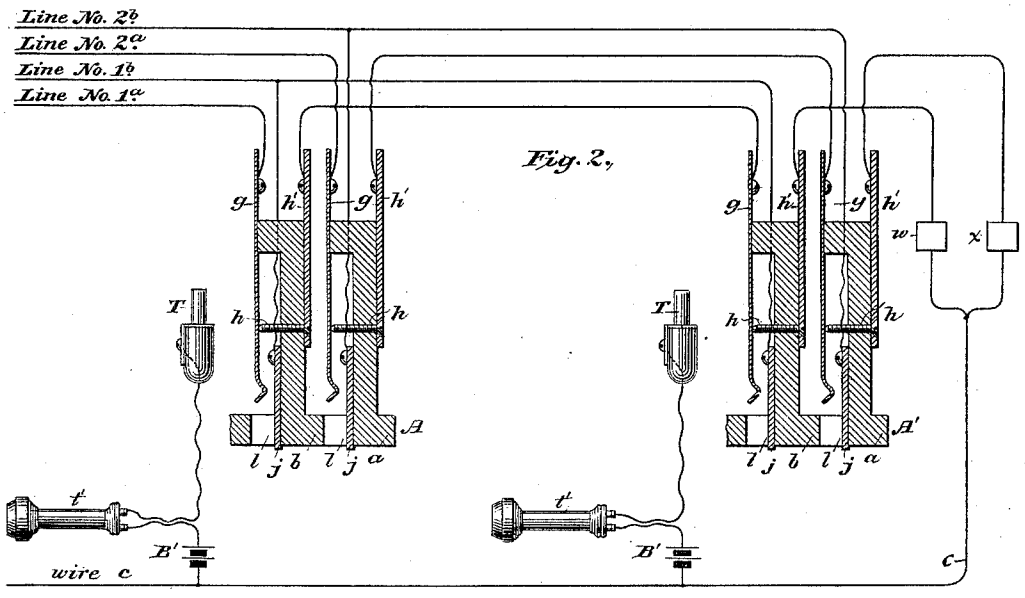


Fig. 3,

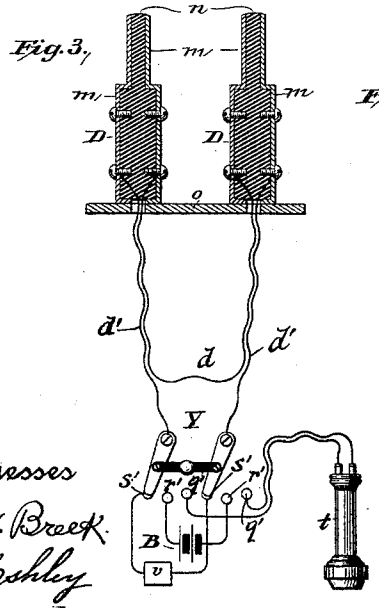
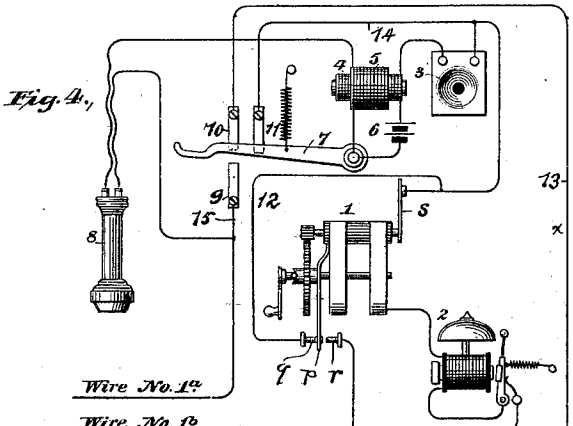


Fig. 4,



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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. 592,332, dated October 26, 1897.

Application filed December 12, 1889. Serial No. 333,535. (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 a telephone-exchange system in which the subscribers' lines are metallic-circuit lines; and it consists in a system of calling, switching, and testing such lines which I shall describe and claim.

I place as many switchboards in the central office as are found necessary or desirable in order to properly answer calls and connect and disconnect the subscribers' lines. On each board I place for each line a spring-jack or similar switch having two contact-pieces which are normally in contact and a third contact-piece insulated from the rest, (except by the circuit connections,) said switch being adapted to receive a switch-plug and when a plug is inserted to disconnect the contact-pieces of the switch which are normally in contact and connect one of them with one contact-piece of the plug, while the other contact-piece of the plug is connected with said third contact-piece of the switch.

The third contact-pieces of the switch mentioned above are so placed and arranged that the operator may at will apply a test-plug or similar device to them.

Figures 1^a and 1^b of the drawings are sections of two multiple switchboards to which the same lines are connected. Fig. 2 is a diagram of the boards and the circuits and connections of one form of my invention. Fig. 3 is an operator's cord system adapted for use with the boards. Fig. 4 is a diagram of one form of a subscriber's-station apparatus which may be used with my invention.

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

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*.

Upon rubber strips *a b*, of the shape substantially as shown, are mounted the metal parts of the switches. These strips should be long enough to receive a convenient number of jack-switches. Through the fronts of and at the edges of the strips are square holes *l l*, adapted to receive and guide the switch-plugs. The contact-springs *g g* are mounted in the rear of and parallel to the switch-holes *l l*, as shown. The contact-anvils *h h*, corresponding to the contact-springs, pass through the rubber strips and are connected to the conducting-strips *h′ h′*. The test-contacts *j j* of the switches are insulated from the other parts except by the circuit connections. Each test-contact is adapted to connect one side of the line to one of the contact-pieces of a loop-plug D when the plug is inserted into a switch, as well as to be a test-contact of the line.

The circuit connections are as follows: test-contacts *j j* at each board, line conductor No. 1^b to the subscriber's station, thence normally or when the telephone is not switched for use through the circuit-breaking bell 2 to the frame of the generator 1, through the normally closed contacts *p q*, short circuit 12, transmitter 3, primary coil 4 of the induction-coil, transmitter-battery 6, switch-lever 7, normally in connection with contact 9, thence by way of shunt 15 around the receiver-circuit to line conductor No. 1^a to the central station, thence in the order named through the normally closed contacts *g* and *h*, a pair at each board, thence through the line-annunciator *w* or *x* to the common ungrounded conductor *c*, thence over the common wire to each subscriber's station to a contact *r*, normally disconnected from the spring-contact *p* of the call-generator thereat. At the central station are test outfits comprising a telephone *t′* and test-battery B′, connected on one side to the common wire *c* and on the other side to a test-plug T, adapted to be connected to a test-contact *j* for testing, and thus establish a test-circuit over the circuit just traced. The presence of the vibrating bell 2 and the test-battery B′ in the circuit causes a buzz in the telephone *t′* and indicates that the line is "free."

When the subscriber's telephone is off the hook 7 and is thus switched for use, the subscriber's circuit is traced from line conductor

No. 1^b, over the short circuit 13, around the calling set, contact 10, switch-lever 7, secondary coil 5, telephone 8 to line conductor No. 1^a. The call-bell 2 is thus switched from the subscriber's circuit, and a testing operator hearing no buzz finds the line "busy."

When the subscriber's telephone is switched for use, his transmitter-circuit is closed as follows: lever 7, battery 6, primary coil 4, transmitter 3, conductor 14, and contact 11 in contact with switch-lever 7.

When a plug is inserted into a switch of a line which is being tested at another board, this line is disconnected from the common wire *c* to which all the testing outfits are connected and the testing operator will hear no buzz in her telephone *t'*, regardless of whether the subscriber's telephone is or is not switched for use.

It is obvious that one battery B', if placed in the common wire *c* between all the test outfits and all the central-office line-circuit connections, would do the work of the various test-batteries B' when connected as shown.

The subscriber's call-bell 2 is an ordinary vibrating or automatic circuit-breaking bell, and its resistance and those of the test-batteries and the test receiving instruments are so adjusted to each other that when they are on closed circuit with each other the bell will ring and the test receiving instrument will indicate the buzz of the bell. The ringing of the bell also answers for a call of the subscriber. The subscriber's call-generator 1 is in circuit between the spring *s* and the frame and spring *p*. The spring *p*, as already described, is normally in connection with the contact *q* and conductor 12, which short-circuits the armature.

When the generator is operated by any of the usual automatic devices well known to the electrical engineer, it causes the spring-contact *p* to leave the contact *q*, thus opening the short circuit, and to close one side of the generator to the contact *r* and to the common conductor *c*. It will be seen that the generator is thus connected between the two line conductors Nos. 1^a and 1^b and between the line conductor No. 1^a and the common ungrounded wire *c*. As the metallic circuit is normally open at central, all of the current will be sent over line conductor No. 1^a through the contacts *g h*, the annunciator *w* or *x*, and the common conductor *c*, thus operating the annunciator for a call. When the annunciator is disconnected from the line-circuit by the insertion of a switch-plug D into the line-jack, all of the current will be sent over the metallic circuit and any extensions thereto and operate any clearing-out annunciator that may be present in the metallic circuit.

In Fig. 3 are shown two plugs, each composed of insulating material *n*, upon which are mounted contacts *m* and *m'*. The contacts *m* of the two plugs are connected together by a flexible conductor *d*. The two contacts *m'* 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'*, *s' s'* and thereby switch into the circuit the operator's telephone *t*, a call-generator B, or a clearing-out annunciator *v*. When a switch-plug D is inserted into a spring-jack, the contacts *m* make connection with the contacts *j* and the contacts *m'* make connection with the spring-contacts *g*, or vice versa. When one plug is inserted into the jack of a calling-line, the circuit of the operator's outfit is completed to the contacts *m* and *m'* of the other plug, which are crossed by the conducting base-plate *o* while that plug rests in its normal position. It is obvious that the call-generator B is unnecessary in this system. The looping-in switch Y normally rests upon the contacts *s' s'*.

When the subscriber's telephone is off its switch, the circuit-breaking bell is out of the direct or active circuit of the line. To eliminate an element from a circuit, it must be short-circuited, shunted, or placed on open circuit, or its function must somehow be omitted. All such modifications lie within the scope of my invention and are intended to be covered by the word "switched."

The operation of the system is as follows: When a subscriber desires to call, he turns the crank of his generator and thereby temporarily connects his line with the common wire *c*, and sending a calling current over the circuit operates his line-annunciator at the central office. He then removes his telephone from the switch, and the operator at the central office places one of a pair of plugs in the switch of the line where the call is indicated, and, placing the levers of the switch Y corresponding with the pair of plugs used on the contact-bolts connected with her telephone-loop, finds out what line is wanted. She then places the test-plug on the contact-piece *j* of the switch of the line wanted, as a test. If the line is not switched for use, there will be a complete circuit established, in which are the operator's test receiving instrument and battery and the subscriber's-station apparatus, and if the subscriber's telephone is on the switch his signal-bell will ring and the operator's test receiving instrument will respond. This circuit is from the common wire *c* through test-battery B', instrument *t'*, and test-plug T to the test-contact of the line-test, thence over the line to subscriber's station, through the vibrating bell 2, shunt around the generator, transmitter, and telephone-switch to the other side of the line, thence through the switch-contacts at the central office to the common wire *c*. If, on the other hand, when the test is made the line is switched at the central office, there will be no complete circuit established in which is the battery, the test receiving instrument, and the signal-bell, and the bell will not ring and the test receiving instrument will not respond. When the test is made and the subscriber's telephone is off

its switch, the vibrating bell is short-circuited through the wire 13 to the contact 10, as before mentioned. This short circuit switches the bell from the line-circuit. The operator can therefore tell by testing whether or not either a line is switched or the subscriber's telephone is off the switch. If she finds the line free, she places the other plug in the switch of the line. The two lines are thus connected into a metallic circuit and their normal connection with the common wire is removed. The operator may now, by moving the levers of the looping-in switch, connect her calling-generator into the circuit. Again, she may by moving the levers of the switch connect a clearing-out annunciator into the circuit; and again, she may by moving the levers of the switch loop her telephone and listen to determine whether the subscribers are through conversation.

By this system of calling, switching, and testing the test receiving instruments are not grounded, but are open to the ground at the central office, and an accidental ground on the line tested between the subscriber's station and the line-annunciator would not give on testing a false signal that the line was free when it was switched at the central office, as would be the case were the test receiving instrument connected with the ground. It is well known that such accidental grounds are liable to occur in metallic circuits, and in the system described above such a ground would not affect the testing or other operation of the system.

The line-annunciators may be polarized annunciators constructed to be operated by only one polarity of current, and they and the operator's test-batteries should be so connected into the circuits that the annunciators will not respond when a test is made to their lines.

The subscribers' generators may give currents of alternate polarity, (as they are generally constructed,) and they will operate the line-annunciators, or they may be constructed so as to give currents in only one direction, and in the latter case should be so connected into their respective lines as to operate their polarized line-annunciators.

In some systems of multiple-switchboard testing the test merely indicates whether or not a line is switched at some board, and a line may test "free" when a subscriber has sent in his call and taken down his telephone for use and may then be connected to another line to his annoyance and confusion. In other systems the test merely indicates whether or not the subscriber's telephone is switched for use, and a line may test "free" and be connected to another line when the subscriber has placed his telephone on its switch, but the line is not yet disconnected or "cleared out" from another connection. In this case three lines will be connected together, to the annoyance and confusion of the subscribers and of the operators, who generally have no ready means of finding out where the cross connection or "tying up" occurs. The test in this system being as heretofore pointed out, neither of these sources of trouble is present and the service will be more satisfactory to the subscribers and to the operators.

It is obvious that the subscribers' generators, their switch-circuits, the call-annunciators, and the extensions of the ungrounded conductor *c* to the subscribers' stations may be omitted and any other method of calling used, as the Law system, for example. All such modifications lie within the scope of my invention.

Although I prefer to use my system with the ungrounded common conductor *c* on account of the advantages described, I do not want to limit the use of my entire invention to this feature, for it is obvious that many of its features may be used to advantage in a grounded system.

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

1. In a multiple-switchboard exchange, a test-circuit containing an intermittent test signaling device at the subscriber's station, a battery, a test outfit responding thereto, "test-contacts," one at each board, electrically connected together whenever a test is made, and containing also normally closed switchboard-contacts opened by the switching of the line for use to prevent said response.

2. In a multiple-switchboard exchange, a telephone-circuit, a test-circuit associated therewith containing a circuit-breaking call device at the subscriber's station, a test receiving instrument and battery adapted to respond thereto, test-contacts, one at each board, electrically connected together whenever a test is made, and containing also normally closed switchboard-contacts opened by the switching of the lines for use to prevent said response.

3. In a multiple-switchboard exchange, a test-circuit, containing a test signaling device at the subscriber's station, a test receiving instrument and battery adapted to respond thereto, a subscriber's switch controlling said response, test-contacts, one at each board, electrically connected together whenever a test is made, and containing also normally closed switchboard-contacts open while the line is switched for use to prevent said response.

4. In a multiple-switchboard exchange, a telephone-circuit, a test-circuit associated therewith, a battery, a test signaling device normally in said test-circuit at the subscriber's station but switched therefrom while the telephone is switched for use, test-contacts, one at each board, electrically connected together whenever a test is made, and normally closed switchboard-contacts at the central office open while the line is switched for use to prevent said response.

5. In a multiple-switchboard exchange, a telephone-circuit, a test-circuit associated therewith containing a circuit-interrupter

normally in circuit at the subscriber's station, a subscriber's switch and connections for switching said interrupter from the circuit while the telephone is switched for use, test-contacts, one at each board, electrically connected together whenever a test is made, a pair of normally closed switchboard-contacts at the central office, a switch-plug opening said contacts while the line is switched for use, and a test outfit adapted to respond to said interrupter while neither the line at the central office nor the telephone at the subscriber's station is switched for use, but not otherwise.

6. In a multiple-switchboard exchange, in the order named, test-contacts, one at each of two or more boards, a line conductor, a subscriber's test signaling device at the subscriber's station, a return line conductor, normally closed contacts at each board, open while the line is switched for use, test outfits, one at each board, adapted to respond to said test signaling device; in combination with a subscriber's switch to switch said test signaling device from the circuit, and a plug or device adapted to open said normally closed contacts at a board.

7. In a multiple-switchboard exchange, in the order named, test-contacts, one at each board, a metallic telephone-circuit containing a circuit-breaking device at the subscriber's station, switched therefrom while the telephone is switched for use, normally closed contacts, a pair at each board, test receiving instruments and batteries in multiple branches, one at each board, test-plugs, one for each branch, adapted to be connected to a test-contact for testing; in combination with a switch-plug adapted to open a pair of normally closed contacts.

8. In a multiple-switchboard exchange, in the order named, test-plugs, one at each board, test outfits connected thereto, a common conductor, pairs of normally closed contacts at each board for several metallic circuits in multiple, line conductors, subscriber's-station outfits including circuit-breaking bells adapted to coöperate with said outfits, return line conductors, and test-contacts at each board; in combination with subscriber's-telephone switches to switch said bells from the circuit, and switch-plugs adapted to be connected to said circuits and thereby open pairs of normally closed contacts in said circuits.

9. In a multiple-switchboard exchange, a test-circuit containing a test signaling device at the subscriber's station, a test outfit responding thereto, test-contacts, one at each board, electrically connected together whenever a test is made, and normally closed switchboard-contacts opened to prevent said response, a call-circuit, a common conductor to said call and test circuits containing a call-annunciator constructed so as not to be operated by said test outfit.

10. In a multiple-switchboard exchange, a telephone-circuit, a test-circuit associated therewith containing a circuit-breaking call device at the subscriber's station, a test receiving instrument and battery adapted to respond thereto, test-contacts, one at each board, electrically connected together whenever a test is made, and normally closed switchboard-contacts opened to prevent said response, a call-annunciator in said test-circuit adapted not to be operated thereby, and a call-circuit and apparatus for operating said annunciator.

11. In a multiple-switchboard exchange, a test-circuit, containing a test signaling device at the subscriber's station, a test receiving instrument adapted to respond thereto, a subscriber's switch controlling said response, test-contacts, one at each board, electrically connected together, and normally closed switchboard-contacts open while the line is switched for use to prevent said response, a call-annunciater in said test-circuit adapted not to be operated thereby, and a call-circuit and apparatus for operating said annunciator.

12. In a multiple-switchboard exchange, a telephone-circuit, a test-circuit associated therewith containing a circuit-interrupter normally in its circuit at the subscriber's station, a subscriber's switch and connections for switching said interrupter from the circuit while the telephone is switched for use, test-contacts, one at each board, electrically connected together whenever a test is made, a pair of normally closed switchboard-contacts, a switch-plug opening said contacts while the line is switched for use, and a test outfit adapted to respond to said interrupter while neither the line nor the telephone is switched for use but not otherwise, a call-annunciator in said test-circuit adapted not to be operated thereby, and a call-circuit and apparatus for operating said annunciator.

13. In a multiple-switchboard exchange, in the order named, a test-contact at each of two or more boards, a line conductor, a test signaling device at the subscriber's station, a return line conductor, normally closed contacts at each board, open while the line is switched for use, a call-annunciator, test outfits in multiple branches, one at each board, adapted to respond to said test signaling device and not to operate said annunciator, and a branch conductor reaching to the subscriber's station, normally open thereat but closed through the call-generator while it is operated for a call; in combination with a subscriber's switch to switch said test signaling device from the circuit, and a plug or device adapted to open said normally closed contacts at, a board.

14. In a multiple-switchboard exchange, in the order named, test-contacts, one at each board, a metallic telephone-circuit containing a circuit-breaking call device at the subscriber's station, switched therefrom while his telephone is switched for use, and a call-generator, normally closed contacts, a pair

at each board, a call-annunciator, test receiving instruments and batteries in multiple branches, one at each board, test-plugs, one for each branch adapted to be connected to a test-contact for testing; in combination with a normally open conductor closed while the generator is operated completing a call-circuit, and a switch-plug adapted to open a pair of normally closed circuits.

15. In a multiple-switchboard exchange, in the order named, test-plugs, one at each board, test outfits connected thereto, a common conductor, line-annunciators in multiple, one for each of several metallic circuits, pairs of normally closed contacts at each board, line conductors, subscriber's-station outfits including call-generators, and circuit-breaking bells adapted to coöperate with said outfits, return line conductors, and test-contacts at each board; in combination with normally open branches from said common conductor to the subscribers' generators while calling, subscribers' telephone switches to prevent the coöperation of the test outfits and bells, and switch-plugs adapted to open pairs of said normally closed contacts.

16. In a multiple-switchboard exchange, ungrounded call, test, and telephone circuits, a line conductor common to each of said circuits, a second line conductor common to said test and telephone circuits, and an ungrounded conductor common to said call and test circuits, and a test signaling device in said test-circuit controlled by a switch in said telephone-circuit, and normally closed switchboard-contacts in said test-circuit open while the telephone is switched for use.

17. In a multiple-switchboard exchange, a three-conductor system comprising a metallic telephone-circuit, ungrounded call and test circuits associated therewith at the subscriber's station test signaling device in said test-circuit, and an operator's test outfit in said test-circuit adapted to respond thereto.

18. In a multiple-switchboard exchange, a metallic telephone-circuit including a subscriber's test signaling device, one limb normally connected through a call-annunciator to an ungrounded conductor normally disconnected from the subscriber's circuit, but connected thereto while calling, a test outfit connected on one side to said ungrounded conductor, and on the other adapted to be connected to the other limb for testing, and a call-generator in circuit with said annunciator while calling.

19. In a multiple-switchboard exchange, in the order named, test-contacts, one at each of two or more boards, a line conductor, a subscriber's outfit including normally a test signaling device, switched therefrom while the telephone is switched for use, and a call-generator, a return line conductor, normally closed switchboard-contacts, a pair at each board, open while the line is switched for use, a call-annunciator, an ungrounded common conductor, two sets of branches in multiple, one set including test outfits and the other set comprising extensions to subscribers' stations, each extension being normally open to the subscriber's circuit, and closed through the call-generator while actuated for a call.

20. In a multiple-switchboard exchange, a telephone-circuit, a combined test and signaling circuit associated therewith, containing a combined test signaling and signal-receiving device at the subscriber's station, a test receiving instrument and battery adapted to actuate said device, and to cause said instrument to respond thereto, test-contacts, one at each board, electrically connected together whenever a test is made, and normally closed switchboard-contacts opened while in use to prevent said response.

21. In a multiple-switchboard exchange, a test and signaling circuit, containing a test signaling and a signal-receiving device at the subscriber's station, a battery operating said device when in closed circuit therewith, a test outfit responding thereto, test-contacts, one at each board, electrically united whenever a test is made, and normally closed switchboard-contacts opened while in use to prevent said response.

22. In a multiple-switchboard exchange, a test and signaling circuit containing a test signaling and a signal-receiving device at the subscriber's station, a test receiving outfit adapted to operate said device and respond thereto, a subscriber's switch controlling said response, test-contacts one at each board, electrically united whenever a test is made and normally closed switchboard-contacts opened while the line is switched for use to prevent said response.

In witness whereof I hereunto subscribe my name this 4th day of November, 1889.

MILO G. KELLOGG.

Witnesses:
FRANCES D. KELLOGG,
ELISE HÖLZER.