No. 820,360. PATENTED MAY 8, 1906.

M. G. KELLOGG.

MULTIPLE SWITCHBOARD FOR TELEPHONE EXCHANGES.

APPLICATION FILED FEB. 13, 1892.

Fig. 1.

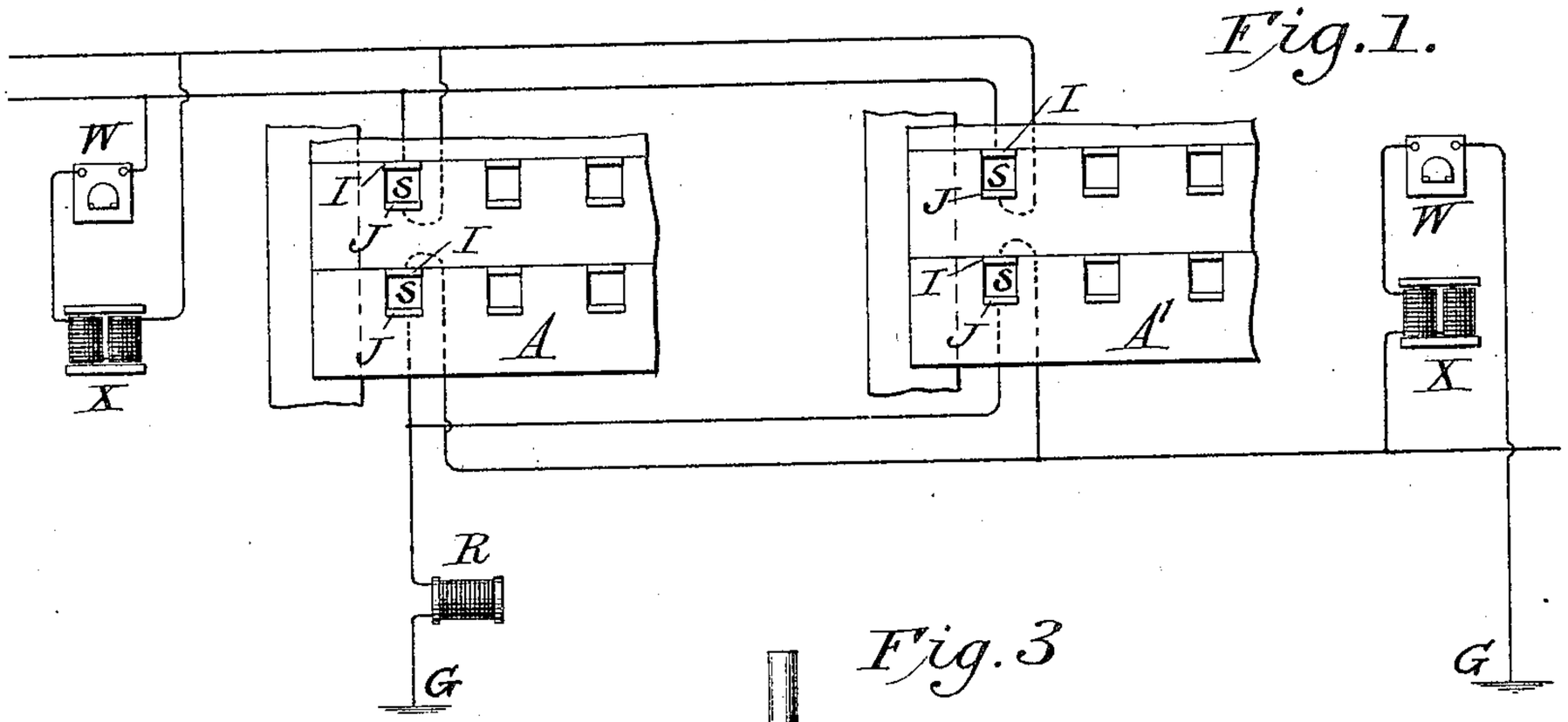


Fig. 2

Fig. 3

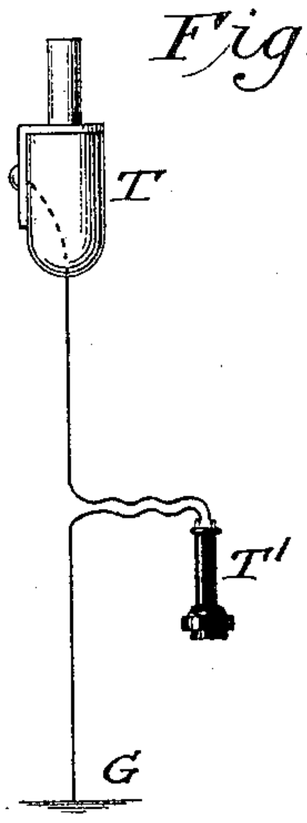


Fig. 4

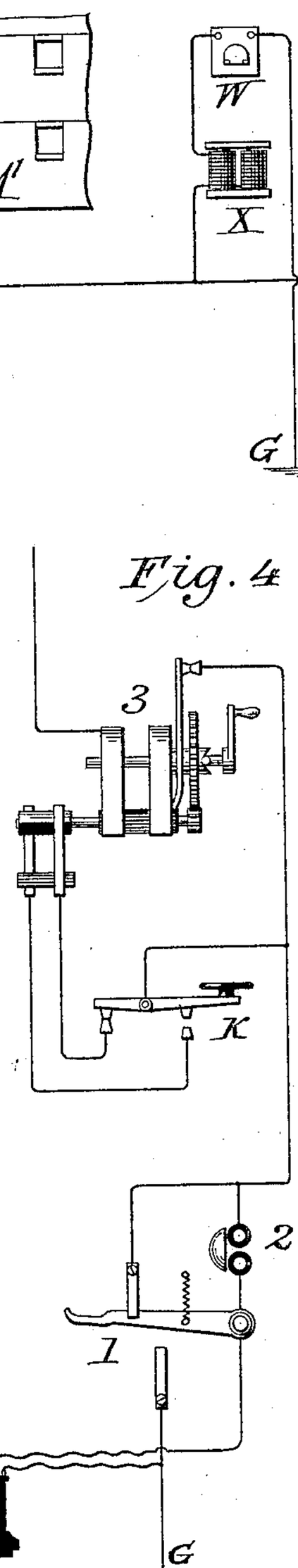
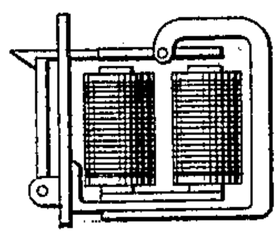


Fig. 5



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MULTIPLE SWITCHBOARD FOR TELEPHONE-EXCHANGES.

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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, 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 part of the lines are ground-circuit lines and part of the lines are metallic-circuit lines. Certain features of it, however, are applicable to exchanges in which all the lines are ground-circuit lines, and certain features of it are applicable to exchanges in which all the lines are metallic-circuit lines.

My invention consists in a system of calling, answering calls, switching, testing, and clearing out signals, which I shall describe and claim in detail.

In the accompanying drawings, illustrating my invention, Figure 1 is a diagram of the central-office main-line apparatus and connections necessary to illustrate my invention. Fig. 2 shows an operator's cord system or apparatus. Fig. 3 shows an operator's test system or apparatus. Fig. 4 shows a subscriber's-station apparatus; and Fig. 5 shows a polarized annunciator, of which I employ one for each line.

In Fig. 1 two multiple switchboards A A′ are shown. As many other multiple boards may be used as is necessary for the size and character of the exchange. Each board has a switch for each line of the exchange. The switches are marked *s s*. Each switch is adapted to receive the loop switch-plugs (shown in Fig. 2 and marked D D) and has two contact-pieces with which, respectively, the two contact-pieces of the plug form contact when the plug is inserted. Each line has an annunciator (marked W) and a retardation-coil, (marked X.) Instead of the annunciator and retardation-coil for each line, as shown, an annunciator of high resistance and high retardation may be employed. Each ground-circuit line has also a resistance-coil of suitable resistance (marked R.) The two contact-pieces of each line-switch are marked I and J. One side of each metallic-circuit line is connected to one of the contact-pieces—say J—of each switch of the line, and the other side of the line is connected to the other contact-pieces of the line—say I. The two sides of the line are connected together at the central office through the annunciator and retardation-coil of the line, (or through the annunciator alone if an annunciator of high resistance and high retardation is used.) Each ground-circuit line is connected to one of the contact-pieces—say I—of each switch of the line and is grounded at the central office through the annunciator and retardation-coil, (or through the annunciator alone if an annunciator of high resistance and high retardation is used.) The other contact-pieces—say J—of the switches of each ground-circuit line are grounded through the resistance-coil R of the line. The line-annunciators are placed at the various boards and where the calls of the lines are to be answered. For reasons which will hereinafter appear the line-annunciators should be polarized annunciators constructed to respond to one polarity of current only, and each should be connected into its circuit, so that the same pole is connected to the contact-pieces I of its switches.

In the operator's cord system, (shown in Fig. 2,) D D are a pair of loop-plugs, each adapted to be inserted into any switch S at its board, and when thus inserted contact-piece M of the plug forms connection with contact-piece I of the switch and contact-piece M′ of the plug forms connection with contact-piece J of the switch. The two contact-pieces M M of the plugs are connected together by a flexible conductor, and the two contact-pieces M′ M′ of the plugs are connected together by another flexible conductor. Y is a looping-in switch having two levers and three pairs of contact-bolts against which, successively, the two levers may be placed in contact. The two levers are connected to the two flexible conductors, respectively, of the pair of plugs. The two bolts of one pair of bolts are connected together through the operator's telephone, (marked F.) The two bolts of another pair are connected together through a clearing-out annunciator, (marked V,) and the two bolts of the last pair are connected together through a calling-generator, (marked B.) The clearing-out annunciator V may be the usual non-polarized

annunciator and will consequently be operated by either polarity of current or by alternating currents, and the subscriber in sending a clearing-out signal will send the opposite current from that used in calling. The calling-generator B of the operator should preferably be constructed so as to send but one polarity of current to the line and should be so connected as not to send the polarity which will operate the line-annunciators. The subscriber's signal-bell will be such as to respond to the current sent by the calling-generator. The flexible conductor connected with the pair of plug-contacts M′ M′ is connected through a retardation-coil for the pair of plugs (marked X) and thence through a test-battery B′ to the ground. Each operator has as many pairs of plugs as she may need for her work. Each pair of plugs has a looping-in switch, a clearing-out annunciator, and a retardation-coil. She has one telephone and one calling-generator, and one test-battery will answer for the exchange.

In the subscriber's test system, (shown in Fig. 3,) T is the test-plug, and T′ is the test-receiving instrument. The plug is adapted to be brought into connection with any contact-piece J at its board and is grounded through the test-receiving instrument.

Each operator has one cord system and one test system, and their various parts are suitably mounted and arranged for the work.

In the diagram of the subscriber's-station apparatus, (shown in Fig. 4,) 1 is the telephone-switch, 2 is the signal-receiving bell, 3 is the calling-generator, 4 is the operator's telephone, and K is a calling-key. The generator is constructed with the usual automatic device whereby it is shunted or switched from the line-circuit while not operated. The insulated contact-piece on the shaft of the armature, to which is connected one end of the armature-wire and which conducts the generated current to the line through the stationary spring-contact (or contacts) provided for it, is a half-circle, the remaining part of the circle being an insulation, as shown. I provide two stationary spring contact-pieces, as shown, each bearing on the diametrically opposite part of the circle of the shaft of which said insulated contact-piece is a part. The key K is provided with two pairs of contact-points, as shown, one pair being normally closed and the other pair normally open, and when the key is depressed the normally open pair of contacts is closed and the normally closed pair is opened. The connection of the keys to the contact-springs of the generator and to the line-circuit is as follows and shown: The spring-lever, which forms one of the contacts of each pair of contact-points, is connected with one side of the main-line circuit. The two other contact-pieces of the pairs of contact-points are connected to the two contact-springs, respectively. As stated above, one end of the armature-wire is connected with half-circle contact-piece on the generator-shaft, on which the springs alternately bear when the generator is being turned. The other end of the armature-wire is connected with the other side of the main-line circuit. The automatic shunt device mentioned before may shunt that part of the circuit containing the armature-wire and the key when the generator is not being turned.

It is well known that when magneto-generators are turned and operated a current of one polarity is generated during one-half of the revolution of the armature and a current of the other polarity is generated during the other half-revolution of the armature. It will be apparent from the description of the subscriber's apparatus which has been given and from the circuits that when the generator is being operated and the key remains in its normal position the armature-wire is in one circuit through one of the contact-springs, and that only, and a current of one polarity only will be sent to the line, and that when the generator is being operated and the key is depressed the armature-wire is in circuit through the other contact-spring, and that only, and a current of the other polarity only will be sent to the line. The subscriber can therefore at will send currents of either polarity to line as he does not or does press the calling-key.

The line-annunciators should preferably be connected into their respective circuits in such a direction as to be operated by the current from the subscriber's generator when it is operated while the calling-key is not depressed.

The operation of the system is as follows: When a subscriber desires to make a call, he operates his generator without pressing his key K. A calling-current is thereby sent to the line which operates the line-annunciator. The operator then places one of the switch-plugs into the switch-terminal of the line and places her switch so that her telephone is in circuit with the levers of the switch. The telephone therefore bridges or cross-connects the two cord conductors which connect with the contact pieces of the plug and is therefore in circuit with the line, and the operator may receive the order of the subscriber. If the subscriber's line is a metallic-circuit line, the telephone is bridged across the two sides or branches of the line and the line-annunciator with its retardation-coil is also bridged across in another circuit connection. On account of the high resistance and retardation of this latter bridge-circuit very little of the telephone-current passes through it and the strength of the current through the telephone is not materially reduced. If the subscriber's

line is a ground-circuit line, the telephone is in a circuit of the line to ground through the resistance-coil R and the operator will receive the order of the subscriber. The line-annunciator and the retardation-coil are in another connection or circuit from the line to ground; but on account of the high resistance and retardation of this circuit very little of the telephone-current passes through it and the strength of the current through the telephone is not materially reduced. When the operator finds out by conversation what line is wanted, she tests the line, (as will hereinafter be indicated,) and if she finds it is not in use she places the other plug of the pair in the switch of the line. The two lines are then connected together into a complete circuit. The operator then moves the levers of the switch Y so that the calling-generator S is in circuit with them, and a calling-current goes to the two lines. She then moves the levers of the switch Y so that the clearing-out annunciator V is in circuit with them, and the lines are then connected together for conversation with the two subscribers and ready to receive any clearing-out signal which may be sent by either of them. If the two lines thus connected together are metallic-circuit lines, they are connected together into a complete metallic circuit, and this circuit is bridged or cross-connected at the central office by the two circuit connections of high retardation and resistance which contain the annunciators of the lines and is also bridged or cross-connected by the clearing-out annunciator V of the pair of plugs. On account of the high retardation and resistance of the bridges which contain the line-annunciators very little of the telephone-currents which pass through the metallic circuit will be diverted through them. For the same reason most of the clearing-out currents when sent will pass through the clearing-out annunciator V. If the two lines connected together for conversation are ground-circuit lines, they are switched into a ground-circuit and this circuit has a third leg to ground through the clearing-out annunciator and thence in parallel circuit through the resistance-coils R R of the two lines. The circuit has also a third leg to ground through the connection of each line to ground through its annunciator. As these connections to ground through the line-annunciators are of high resistance and retardation, very little of the telephone-current passing through the circuit of the lines will be diverted through said circuit connections. If the two lines connected together for conversation are one a metallic-circuit and the other a ground-circuit line their circuit is from, say, the ground at the subscriber's office of the ground-circuit line through his line to one side or branch of the metallic-circuit line, thence through the circuit of the metallic-circuit line to ground through the resistance-coil R of the ground-circuit line. The circuit is bridged or cross-connected at the central office by the connection of the metallic-circuit line which contains its annunciator and retardation-coil and by the clearing-out annunciator and is grounded by the connection which contains the annunciator and retardation-coil of the ground-circuit line. When either subscriber desires to send a clearing-out signal, he operates his clearing-generator and at the same time depresses his key K. A current is thereby sent over his line which has the opposite polarity from that which operates his line-annunciator. It will therefore not operate either his annunciator or that of the other line connected with it. Part of the current will, however, pass through the clearing-out annunciator, which is non-polarized and operated by the polarity of current which he sends. The clearing-out signal will therefore be indicated to the operator who made the connection. Any operator on desiring to test any line to determine whether it is in use places her test-plug T on the contact-piece J at the board of the line. If the line is not then switched for conversation, she gets no indication in the test-receiving instrument. If, however, it is switched for conversation at any board, her test-receiving instrument is in a complete circuit with the test-battery B′ and she gets an indication which shows that the line is in use. This complete circuit is from, say, the ground through the test-battery B′ to the contact-piece M′ of the plug with which the line is switched, thence to the contact-piece J of the switch at which the line is tested, and thence to ground through the test-receiving instrument.

The use of the resistance-coils R R is that the test-receiving instrument shall not be short-circuited when the test of the ground-circuit line is made. With the other systems of testing—as, for instance, where the test-circuit does not go to ground—these resistance-coils would not be required.

It is evident that the connection of the ground-circuit lines each connected to its switch-contacts I I and to ground through its line-annunciator and retardation-coil and with its switch-contacts J J connected to ground as shown and described is the equivalent of the connection of the line to its switch-contacts I I with the contacts J J connected to the ground and the contacts I I connected to the contacts J J through the line-annunciator and retardation-coil, in that in either case the contacts I I are connected to the contacts J J through the annunciator and retardation-coil of the line and the line is grounded through its annunciator and retardation-coil.

It is well known that when a current is sent through a polarized annunciator of the polarity not to operate it there is no attraction whatever between the electromagnet and the armature of the annunciator, and therefore there is no tendency to release the annunciator-drop, so that it may fall and indicate a call. On the other hand, when such a current is passing through the annunciator there is a repulsion between the electromagnet and its armature, which, in fact, then positively holds down the catch of the annunciator and positively locks or prevents the release of the drop. When the subscriber sends the clearing-out signal, as above described, and part of the current goes through the line-annunciators of the two lines, there is, on account of the polarity of the current and the construction of the annunciators, no attraction whatever between the line-annunciator magnets and their armatures, and consequently these is no tendency or force whatever exerted to release the drop. There is, on the other hand, a repulsion between the two which acts at that time to positively lock and prevent the release of the drop. The drop is therefore positively prevented from being operated when the current is sent for the clearing-out signal and is, in fact, locked, so as to be prevented from falling. In other systems of exchange operation in which the line-annunciators of two connected lines are in circuit with the calling-generator operated to send a clearing-out signal there is an attraction between the line-annunciator magnets and their armatures, and consequently there is a tendency to release the drop, which is only prevented from being operated by the fact that the current is not strong enough to furnish sufficient attraction to move the armature and release the drop. In such a system the line-drops are prevented from being operated only by a margin of adjustment current or force, which may at times be difficult to obtain and be more or less unreliable, while in my system the line-annunciators are positively prevented from being operated by, and the drops are, in fact, electrically locked by, the current sent through the annunciators in sending the clearing-out signal, however strong the current may be, and the drops do not depend on being operated, when the current is sent for the clearing-out signal, by any mere margin of adjustment current or force. In like manner when the operator sends a calling-current through the subscriber's line and part of the same passes through his line-annunciator the line-annunciator is by the polarity of the current and its own construction positively prevented from being operated or is practically locked to the calling-current, whatever may be strength of the current, and the preventing of the line-drop from being operated does not depend on the current not being sufficient to attract and move the armature of the annunciator. So far as I am aware, this system of clearing-out signals is generically new with me, and I do not limit myself to the specific means of positively preventing the operation of the line-annunciator drop when a current is sent from a subscriber's station to operate the clearing-out annunciator or from the central office to ring the subscriber's bell, since, obviously, other ways may be devised of accomplishing such a result by the use of devices operating in well-known ways.

I claim as my invention—

1. In a telephone-exchange system, two metallic-circuit lines, each permanently closed at the central office through the helices of a polarized call-annunciator and the two lines temporarily switched together for conversation into a single metallic circuit with the annunciators connected so as to respond to the same polarity of current, in combination with a clearing-out annunciator in a bridge or cross connection to said metallic circuit and responding to a current of the other polarity, calling and commutator apparatus at each subscriber's station to send at will calling-currents of either polarity, and an operator's cord system including plugs and a calling-generator adapted to send to line a current of such polarity only as not to operate the line-annunciators, substantially as set forth.

2. In a telephone-exchange system, two telephone-lines, each permanently closed at the central office through the helices of a polarized call-annunciator and the two lines temporarily switched together for conversation into a single circuit with the annunciators connected so as to respond to the same polarity of current, in combination with a clearing-out annunciator in a bridge or cross connection to said circuit and responding to a current of the other polarity, calling and commutator apparatus at each subscriber's station to send at will calling-currents of either polarity, and an operator's cord system including plugs and a calling-generator adapted to send to line a current of such polarity only as not to operate the line-annunciators, substantially as set forth.

3. The combination of two telephone-lines, a switchboard having a switch for each line with two contacts to which contacts the two sides of each line-circuit are respectively permanently connected, a polarized line-annunciator and retardation-coil permanently connected between the two sides of each line-circuit, a generator at each subscriber's station from which, at the will of the subscriber, either a calling-current of one polarity only to operate the subscriber's line-annunciator or a clearing-out current of opposite polarity only may be sent, an operator's cord system

including switching-plugs and a clearing-out annunciator adapted to be operated by said clearing-out current, and an operator's calling-generator adapted to send into a line a current of one polarity only and of such polarity as to not operate the line-annunciator of said line.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:
FRANK S. OBER,
EDWARD C. DAVIDSON.