No. 804,861. PATENTED NOV. 21, 1905.

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MULTIPLE SWITCHBOARD FOR TELEPHONE EXCHANGES.

APPLICATION FILED FEB. 13, 1892. RENEWED FEB. 9, 1893.

Fig. 1.

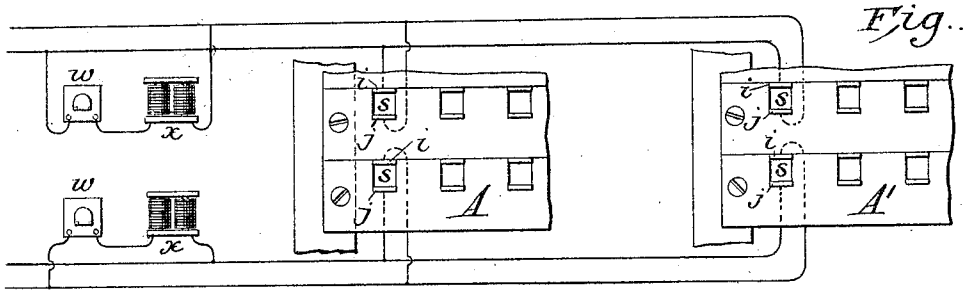


Fig. 2.

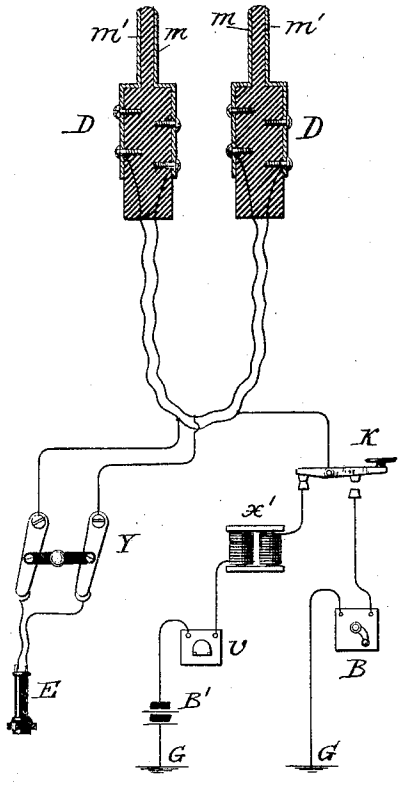


Fig. 3

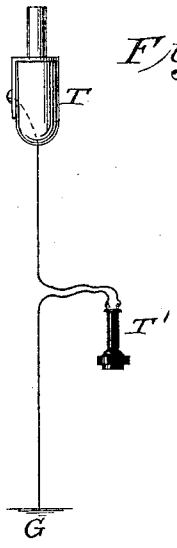
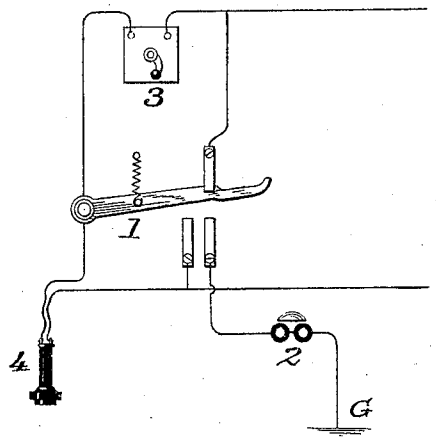


Fig. 4.



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MULTIPLE SWITCHBOARD FOR TELEPHONE-EXCHANGES.

No. 804,861. Specification of Letters Patent. Patented Nov. 21, 1905.

Application filed February 13, 1892. Renewed February 9, 1893. Serial No. 461,686.

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 especially to a telephone-exchange system in which 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, and Fig. 4 shows a subscriber's station apparatus necessary to illustrate my invention.

In Fig. 1 two multiple boards (marked A A′) are shown. As many other multiple boards may be used as are 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.

The two contact-pieces of each line-switch are marked *i* and *j*. One side of each metallic circuit is connected to one of the contact-pieces—say *i*—of each switch of the line, and the other side of the line is connected to the other contact-pieces of the line—say *j*.

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.)

The line-annunciators are placed at the various boards and where the calls of the lines are to be answered.

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 a pair of contact-bolts against which 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 are connected together through the operator's telephone, (marked E.)

K is a calling-key, having a lever and two contact-points, against one of which the lever is normally in contact and against the other of which the lever comes into contact when it is pressed to send a call. In that case it is out of contact with the first-mentioned point.

x′ is a retardation-coil, and *v* is a clearing-out annunciator, of which there is one of each for each pair of plugs.

B′ is a test-battery, and B is a calling-generator, of which there may be one of each for the exchange.

The lever of the calling-key is connected to one of the conductors which connects its pair of plugs—say that one connected to the contact-pieces *m′ m′* of the plugs. The contact-point against which the lever is normally in contact is connected through the retardation-coil *x′* and the clearing-out annunciator *v* of the pair of plugs, and thence through the test-battery B′ to the ground. The other contact-point of the key is connected through the calling-generator 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, and 4 is the operator's telephone.

The contacts and connections of the subscriber's station are substantially as shown. They may, however, be different and still perform the operations and obtain the results substantially as required for the operation of the system. When the subscriber's telephone is on its switch, the calling-generator is in the metallic circuit of the line, and said circuit is grounded through the signal-bell, and the telephone is out of the circuit. When the telephone is removed from the switch, it is in the metallic circuit of the line, and the calling-generator is out of the circuit, and the ground connection through the signal-bell is removed.

The circuits show the telephone and generator as being removed from the metallic circuit in the operation of the system as above described by their being short-circuited or shunted. Instead of this they might be switched from the circuit in the common and well-known manner.

The plugs may be inserted into the line-switches at the central office in such a direction that the contacts *m′* form connection with the contacts *j* of the switches. In that case it is preferable that the branch of the line which passes from the switch-lever through the subscriber's generator be that one which is connected direct to the contacts *j j* of the line-switches. The reason for this will hereinafter be indicated.

The annunciators, both the line-annunciators marked *w w* and the clearing-out annunciators marked *v v*, are non-polarized annunciators constructed to operate on a balance of strength of current, substantially as will be indicated. Each line-annunciator is of such sensitiveness that it will be operated when the subscriber's calling-generator is opened while the line is not switched at the central office, and consequently all of the current from the generator passes through it, but is not sensitive enough to be operated while the line is switched for conversation, and part of the current from the generator is diverted or passes through the annunciator of the other line and part through the clearing-out annunciator of the pair of plugs with which the connection is made. The clearing-out annunciators are, however, of such sensitiveness that when only part of the current of a calling-generator, as will be indicated hereinafter, passes through them they will be operated.

The operation of the system is as follows: When a subscriber desires to make a call, he operates his generator. A calling-current is thereby generated, all of which passes through and 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 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 metallic circuit. The operator then moves the levers of the switch Y, so that the telephone is out of circuit with them. She then presses on the calling-key K, connected with the pair of plugs used, and a calling-current passes from ground through the calling-generator B, thence to that side or branch of the line wanted, which is connected to the contacts *j j* of the line-switches and through it to ground at the subscriber's station through his signal-bell. Part of the calling-current will pass through the other branch of the line, passing through the two line-annunciators and their retardation-coil circuits; but on account of the great resistance and retardation of these circuits the greater portion of the current will pass through the first-mentioned branch of the line and not enough current will pass through the line-annunciators to operate them. If the calling subscriber has kept his telephone from its switch while the operator is sending the calling-current, none of the currents will pass through his signal-bell, and therefore it will not be rung. When the operator releases the calling-key K, the two subscribers' lines are connected together for conversation into one complete metallic cir-

cuit, which is grounded at the central office through the retardation-coil and clearing-out annunciator of the pair of plugs used and the battery B′. This complete metallic circuit is bridged or cross-connected by two bridges of high resistance and retardation which contain the line-annunciators and retardation-coils of the two lines. On account of the high resistance and retardation of such bridges very little of the telephone-currents which pass through the metallic circuit will be diverted through them. When the subscribers are through conversation, they replace their telephones on the switches and one of them operates his generator to send a clearing-out signal to the central office. A signal-current is thereby generated. Part of it passes through his metallic circuit to the central office and divides through the two bridge connections which contain the line-annunciators and retardation-coils and the metallic circuit of the other line. Part of the current passes through a ground-circuit which includes at his station his signal-bell and at the central office the clearing-out annunciator. As heretofore indicated, the annunciators are of such construction and sensitiveness that in the circuits, as indicated, the current which passes through the line-annunciators will not operate them, and the current which passes through the clearing-out annunciator will operate it. This construction and degree of sensitiveness can be easily arranged and provided for by those skilled in the art and may be made to depend partly on the amount of resistance and retardation of the various circuits and apparatus. For instance, the bridge connections which contain the line-annunciators and retardation-coils may be of very high resistance and retardation. Good construction for the operation of the system, outside of any requirements for the clearing-out signal system, would advise this. Such a construction would prevent deviation of telephone-currents through such connections while conversation is going on and would not prevent the successful operation of the annunciators when the calling-signals are sent in, as in that case all of the calling-current on the line passes through the coils of the line-annunciator. On the other hand, the ground connection to the metallic circuit which contains the clearing-out annunciator may be of much less resistance and retardation, as such a connection does not cause a deviation of telephone-currents from the main metallic circuit. With such constructions of resistances and retardation the greater portion of any current generated in sending a clearing-out signal may be made to pass through the clearing-out annunciator. The clearing-out annunciator may also be constructed so as to be more sensitive to the same strength of current than the line-annunciators are. It is therefore apparent that it is a mere detail of mechanical and electrical arrangement to obtain the result I have indicated, which is to obtain such a degree of sensitiveness in the calling and clearing-out annunciators that when the subscriber's generator is being operated while the line is not switched at the central office (and consequently all the current generated passes through the line-annunciator) the annunciator will be operated; but when a subscriber's generator is being operated while the line is switched for conversation and part of the current then generated passes through the line-annunciator and part passes through other channel or channels—as, for instance, through the annunciator of the other line or a clearing-out annunciator, or both—the line-annunciator will not be sensitive enough to be operated by the part of the calling-current which passes through it; also, that the clearing-out annunciator in such a case or when a part only of the current generated when a clearing-out signal is sent passes through it shall be sensitive enough to be operated by such portion of the current as passes through it. This system of calling and clearing-out signals I call "working on a margin," the margin being such that the line-annunciator will operate when a calling-current is sent while the line is not switched and all the subscriber's calling-current passes through it, but will not operate when a calling-current is generated while the line is switched and part of the current passes through other channel or channels, one of which is a clearing-out annunciator, and the clearing-out annunciator will be operated when a part only of the generated current passes through it.

It is evident that other systems of circuits and apparatus may be devised in which the calling or line annunciators and clearing-out annunciators are worked on a margin, substantially as indicated above, and I do not limit myself to the particular arrangement of circuits and apparatus herein described to obtain this result substantially as indicated.

One advantage of my system is that telephone-exchanges may be operated with calling or line annunciators and clearing-out annunciators which do not require the operation of spring-jack switches with contact-points opening and closing to disconnect or connect the line-annunciators from the lines as the lines are switched or not switched, and at the same time the subscriber may perform exactly the same movements and operations when he sends a clearing-out signal as he does when he sends a calling-signal.

The operation of the test system is as follows: 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 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 with which the line is tested, and thence to ground through the test-receiving instrument.

It is evident that when two subscribers whose lines are connected together for conversation are through conversation and place their telephones on their switches a ground-circuit is established through the test-battery B′ and the clearing-out annunciator through which their circuit is grounded. This circuit is from ground through the battery B′ and the clearing-out annunciator to the line-circuit and thence to ground at both subscribers' stations. Battery-current will therefore pass through the clearing-out annunciator, which will cause an attraction between its core and armature and reinforce any clearing-out currents which are generated by either subscriber and pass through the annunciator.

My system of operation of calling and clearing-out signals on a margin, such as I have heretofore described, is not, however, dependent on the clearing-out current being reinforced by current from the test-battery and is applicable to systems of exchange where other test systems are employed and where the test-battery cannot reinforce the clearing-out signal sent by the subscriber. My invention is not, therefore, limited to any system in which the test-battery may reinforce the clearing-out current.

I claim as my invention—

1. In a telephone-exchange system, two metallic-circuit lines and two line-annunciators, one for each line, through which the line is closed at the central office, said lines being temporarily switched together for conversation into a single metallic circuit, in combination with a clearing-out annunciator and a battery in a circuit connection from said metallic circuit to ground, a calling-generator at each subscriber's station in the metallic circuit of his line whenever the generator is being operated to send either a calling or clearing-out signal and a normally closed ground connection at each subscriber's station to the metallic circuit of his line, substantially as set forth.

2. In a telephone-exchange system, two metallic-circuit lines and two line-annunciators, one for each line, through which the line is closed at the central office, said lines being temporarily switched together for conversation into a single metallic circuit, in combination with a clearing-out annunciator and a battery in a circuit connection from said metallic circuit to ground, a calling-generator at each subscriber's station in the metallic circuit of his line whenever the generator is being operated to send either a calling or a clearing-out signal, and a ground connection at each subscriber's station to the metallic circuit of his line when the generator is operated.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

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