

J. J. O'CONNELL.

SIGNALING APPARATUS FOR TELEPHONE SWITCHBOARDS.

(Application filed Oct. 25, 1899.)

(No Model.)

2 Sheets—Sheet 1.

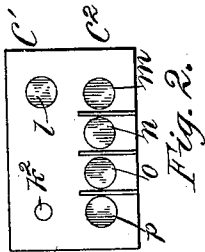


Fig. 2.

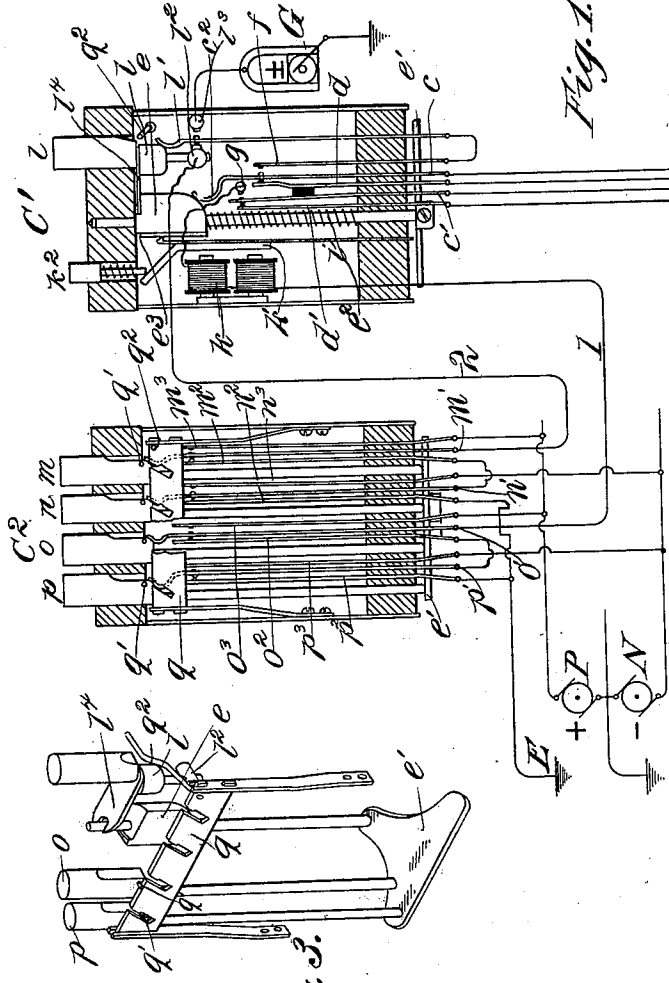


Fig. 1.

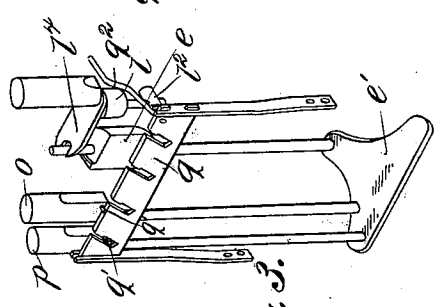
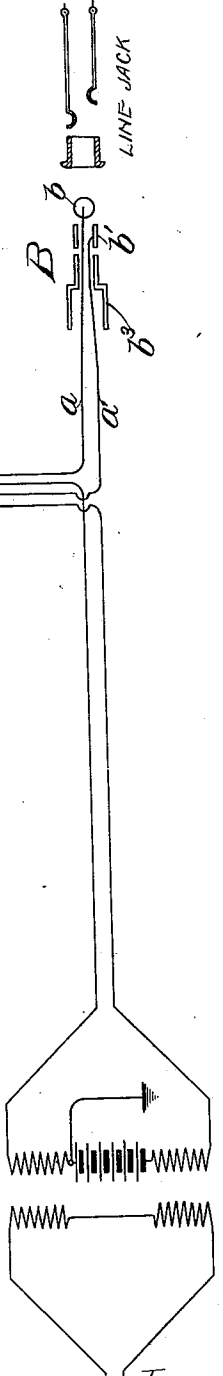


Fig. 3.



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2 Sheets—Sheet 2.

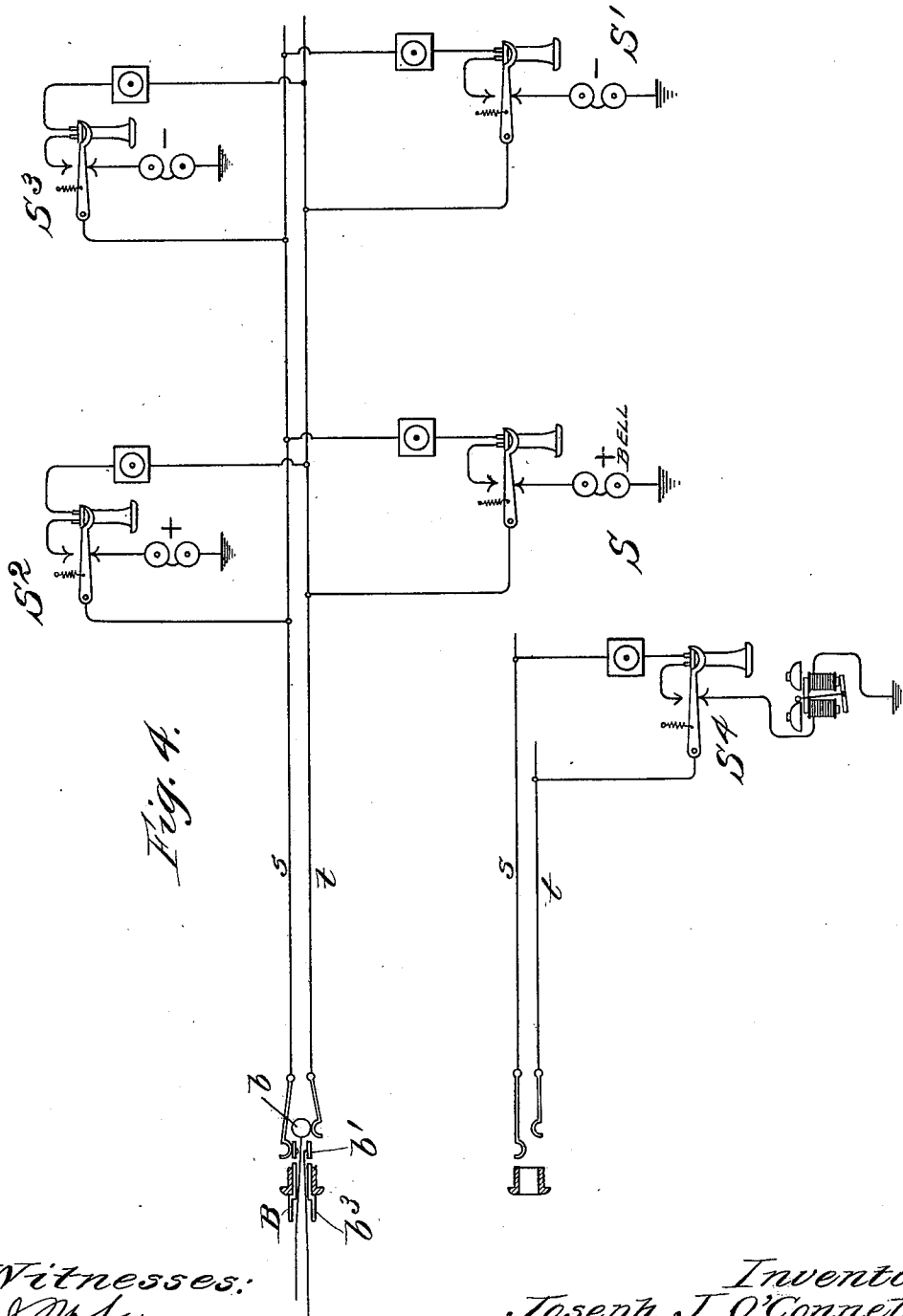


Fig. 4.

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# UNITED STATES PATENT OFFICE.

JOSEPH J. O'CONNELL, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

## SIGNALING APPARATUS FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 652,977, dated July 3, 1900.

Application filed October 25, 1899. Serial No. 734,759. (No model.)

*To all whom it may concern:*

Be it known that I, JOSEPH J. O'CONNELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Signaling Apparatus for Telephone-Switchboards, (Case No. 3,) of which the following is a full, clear, concise, and exact description.

My invention relates to signaling apparatus for telephone-switchboards, and is more particularly applicable to ringing-keys for selectively signaling the different stations of party telephone-lines.

Heretofore it has been usual to provide in connection with each pair of plugs at the central office which are to be used in effecting connection with party telephone-lines a number of ringing-keys corresponding to the number of stations on the party telephone-line—that is, one key for each station—each key being equipped with a full set of contacts for opening the cord-circuit and connecting with the severed ends thereof a source of current of the desired character to operate any particular one of the substation signaling instruments. My invention is an improvement upon this system of signaling; and it consists, generally speaking, in a master-key equipped with a full set of contacts for opening the cord-circuit and effecting the various incidental circuit changes therein and auxiliary keys adapted merely to connect a source of current of the desired character with certain switch-terminals of the master-key. Each one of the auxiliary keys is mechanically connected with the master-key, so that whichever of the auxiliary keys may be operated it will simultaneously cause the operation of the master-key. Interlocking mechanism is also preferably provided, whereby after one of the auxiliary keys has been depressed the other keys are automatically locked to prevent their operation until the depressed key has been released. To illustrate, consider a switchboard where some ordinary individual circuit-lines and some party-lines having, say, four substations on each line terminate, each line having a spring-jack or connection socket on the switchboard into which a plug may be inserted to make connection with the

line. Here the master-key is connected with the cord-circuit of the plug and five auxiliary keys are associated with the master-key, four of said auxiliary keys being adapted for effecting the desired circuit changes to signal the corresponding four substations of the party telephone-line with which the plug may be connected, and the fifth key being adapted merely to connect an ordinary generator of calling current suitable for operating the usual signal-bell of an ordinary telephone-substation having an individual line. I also preferably provide means whereby any key after having once been depressed will be automatically maintained in that position until released by electromagnetic mechanism responsive to the changes ordinarily effected by the response of the called subscriber and the removal of his telephone from its switch-hook or until manually tripped by the operator, as when the called subscriber fails to answer.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 indicates my improved ringing or signaling key applied to the connecting-plug at the receiving end of a telephone trunk-line, the circuits and associated apparatus being illustrated diagrammatically with the aid of conventional symbols. Although the two halves of the ringing set are in practice mounted together, in this figure they are shown separately for clearness in illustrating the circuit connections. Fig. 2 is a plan view of the ringing set as it appears to the switchboard operator. Fig. 3 is a skeleton view illustrating the interconnection of the two halves of the ringing set—that is, the connection of the auxiliary keys with the master-key and the interlocking mechanism; and Fig. 4 illustrates two telephone-lines extending from substations and terminating in spring-jacks at a central-office switchboard, one of the lines being a party-line with four substations and the other an ordinary individual line connected with but a single substation.

Similar letters and numerals of reference are used to designate the same parts wherever they are shown.

As a matter of common knowledge among

telephone-engineers, trunk-lines ordinarily terminate at their receiving end in a switch-plug, and it is usual for the receiving operator merely to make connections with such  
 5 plugs at the order of the answering operator, who is located at the other end of the trunk-line. The ordinary circuits and the operation of such a trunk-line are widely known in the art, and I have therefore shown in the  
 10 drawings only the apparatus at the receiving end—that is, the apparatus directly associated with the plug—and only that which is directly involved in my invention, since, for example, to illustrate the operator's tele-  
 15 phone set or the supervisory indicating apparatus would needlessly complicate the diagram.

The trunk-line has two limbs  $a$   $a'$ , which are connected through the flexible cord-circuit with the tip  $b$  and sleeve  $b'$ , respectively,  
 20 of the plug B. The third contact piece or shank  $b^3$  of the plug may be connected with certain supervisory apparatus, whose operation is now well understood. The tip-strand  
 25  $a$  and sleeve-strand  $a'$  of the trunk-line plug-circuit terminate in contact-springs  $c$   $c'$ , respectively, of the master-key, which is located on the side  $C'$  of the key set C. Normally these springs  $c$   $c'$  rest in contact with  
 30 springs  $d$   $d'$ , which form the terminals of the incoming end of the trunk-line from the distant answering-board, so that normally the circuit of the limb  $a$  of the trunk-line is completed through springs  $c$   $d$  and the limb  $a'$   
 35 of the trunk-line is completed through springs  $c'$   $d'$ . The springs  $c'$  and  $d'$  are mechanically connected together by a block of insulating material. The spring  $c$  is provided with a curved extension  $e^2$ , which is adapted to be  
 40 engaged by the plunger  $e$  of the master-key. When the plunger is depressed, that spring will be moved to the right and the contact which normally exists between the springs  $c$   
 45 and  $d$  and the springs  $c'$  and  $d'$ , respectively, will be broken. When the parts are in their alternative positions—that is, when the plunger  $e$  is depressed—the spring  $c$  is forced into  
 50 engagement with a spring  $f$  and spring  $c'$  is forced into engagement with a contact stud or post  $g$ . A spring-detent  $i$ , which carries the  
 55 armature  $k'$  of the releasing-electromagnet  $k$ , is adapted to engage a projecting portion  $e^3$  of the plunger when the latter is depressed, and thus to hold the plunger down until released. The release of the plunger may be  
 60 accomplished in two ways—*i. e.*, by the energization of magnet  $k$ , causing the same to attract its armature and move the spring-detent to the left, or by manually depressing  
 65 the release-plunger  $k^2$ , which engages with the beveled extension of the armature  $k'$  and forces the same to one side, thus tripping the plunger and allowing it to snap back into its normal position under the influence of the  
 70 coiled spring  $e^2$ . A manually-operated plunger  $l$  is associated with the side  $C'$  of the ring-  
 75 ing set and engages with a switch-spring  $l^1$ ,

which normally rests in contact with the stud  $l^2$ , but which when the plunger  $l$  is depressed is forced into engagement with another stud  
 70  $l^3$  and breaks its other contact. The stud  $l^3$  is connected with a grounded source of alternating signaling-current. Switch-springs  $l'$  and  $f$  are electrically connected together. The plunger  $l$  is provided with an extending  
 75 arm  $l^4$ , which is adapted to engage with the plunger  $e$  when depressed, so that the depression of key  $l$  will always automatically cause the depression of the plunger  $e$  of the master-key. It will be evident at a glance,  
 80 however, that the depression of the master-key may be effected quite independently of the key  $l$ , although, as stated, the depression of the key  $l$  always actuates the master-key. Referring now to the other half  $C^2$  of the  
 85 switch set C, (illustrated in the left-hand portion of Fig. 1,) four keys or plungers  $m$   $n$   $o$   $p$  are provided, each mechanically connected with the master-key, so that each plunger when depressed will automatically cause the  
 90 depression of the plunger  $e$  of the master-key. This is effected by means of a plate  $e'$ , mounted upon the lower end of the plunger  $e$ , which plate is so disposed that it will be engaged by the lower ends of the plungers of the keys  
 95  $m$   $n$   $o$   $p$ . It is obvious, of course, that the plunger  $e$  may, however, be depressed independently of either of the last-mentioned keys, as by the key  $l$ . The spring  $e^2$ , encircling the plunger  $e$ , tends to maintain the  
 100 same normally in an elevated position, as has previously been intimated, so that after the master-key has been depressed by any one of the auxiliary keys it will when released automatically return itself and such auxiliary  
 105 key to the initial position. Switch-springs  $m'$   $n'$   $o'$   $p'$  are associated with the plungers  $m$   $n$   $o$   $p$ , respectively. These switch-springs normally rest in engagement with contact-springs  $m^2$   $n^2$   $o^2$   $p^2$ , respectively, and are  
 110 adapted when forced to one side by the depression of their plungers to break such engagement and come in contact with contact-springs  $m^3$   $n^3$   $o^3$   $p^3$ , respectively.

An interlocking mechanism is provided in  
 115 connection with the auxiliary keys whereby the actuation of one of them locks the others against movement. This interlocking mechanism consists of a horizontally-movable bar  
 120  $q$ , having four diagonal slots therein, said slots being adapted to be engaged by four pins  $q'$   $q'$ , mounted one upon each of the four  
 125 keys  $m$   $n$   $o$   $p$ . The openings of the slots normally register with the pins  $q'$ ; but when any one of the four plungers is depressed the bar  $q$  is moved laterally in an obvious manner  
 130 by the engagement of the pin  $q'$  of such plunger with its slot until the other slots no longer register with the pins of the other plungers. This construction will be understood more  
 135 readily by an inspection of Fig. 3. It will be noticed also that an arm  $q^2$  extends from the movable bar  $q$  over to the other half  $C'$  of the key set in position to be engaged by the plun-

ger  $l$  when the same is depressed, so that the depression of this plunger will in the same manner prevent the operation of either of the keys  $m n o p$ .

5 The contact-springs  $m^3 o^3$  are each electrically connected through a source of positive pulsating current  $P$  to ground at  $E$ . Similarly springs  $n^3 p^3$  are each electrically connected through a source of negative pulsating current  $N$  to the ground. Contact-springs  $n^2$  and  $p^2$  are each connected to ground. The contact-spring  $o^2$  and the switch-spring  $p'$  are connected together. The switch-spring  $o'$  is connected by a conductor 1 through the coils

10 of the releasing-magnet  $k$  to the contact-stud  $g$  and the switch-spring  $m'$  is connected by a conductor 2 with the contact stud or post  $l^2$ .

Bearing in mind the construction of the apparatus and arrangement of circuits above set forth, their operation will be easily understood by following out the steps taken in connecting the trunk-line with a given subscriber's line and signaling the subscriber wanted. First, however, it may be well to review briefly the connections and adjustment of signal-bells on a party telephone-line having four substations, such as that illustrated in Fig. 4. The party telephone-line shown in Fig. 4 has two limbs  $t s$  extending to the switchboard and terminating in the line-springs  $t' s'$ , which are adapted to make electrical connection with the tip and sleeve contacts, respectively, of a switch-plug that may be inserted in the jack. Each of the four substations  $S S' S^2 S^3$  on the party-line has a signal-bell adapted to respond to pulsating current of a given sign and connected between a limb of the line and ground through the ordinary telephone switch-hook. Thus the bell at station  $S$  responds to grounded positive pulsating current impressed on the limb  $t$  of the line, and the bell at station  $S'$  responds to grounded negative pulsating current on the same limb. Similarly the bells at substations  $S^2$  and  $S^3$  respond to grounded positive and negative pulsating current, respectively, on the limb  $s$  of the telephone-line. When the subscriber at any substation removes his telephone-receiver from its hook, this operation will disconnect the signal-bell from the line and will bridge the telephone instruments across the limbs  $t s$ . It should be remembered that the signal-bells present much greater resistance to the passage of current than the telephone instruments, so that when the telephone at any substation is removed from its hook the limbs of the telephone-line are connected together through a path of low resistance. The other telephone-line (illustrated in Fig. 4) similarly has two limbs  $t s$ ; but only one substation  $S^4$  is connected on this line. The signal-bell is of the ordinary polarized type, responding to alternating currents, and is connected by way of the switch-hook from the limb  $t$  of the line to ground. Let us now assume that the receiving operator is requested to connect the trunk-line with the line of,

say, the substation  $S$  of Fig. 4. After making the usual test the plug  $B$  is inserted in the spring-jack of the party-line on which station  $S$  is located and the auxiliary key  $m$  is depressed. This automatically causes the operation of the master-key, and the switch-spring  $c$  engages the contact  $f$  and spring  $c'$  engages contact-stud  $g$ . This, in effect, severs the trunk-line and connects the tip and sleeve of the plug with the contact-studs  $l^2$  and  $g$ , respectively. The contact-spring  $m'$  of the key  $m$  having been brought into engagement with the contact  $m^3$ , it will be seen that positive pulsating current will be afforded a path from generator  $P$  by way of contact-springs  $m' m^3$  and conductor 2 to the stud  $l^2$ , and thence by way of the tip-strand  $a$  of the cord-circuit to the tip of the plug and out over the limb  $t$  of the party-line to ground through the signal-bells at substations  $S$  and  $S^2$ . The bell at substation  $S$  will ring, responding to the positive current; but the bell at station  $S'$  will remain inactive, since it is affected only by pulsating current of negative sign. It will be evident, therefore, that by depressing key  $n$  instead of key  $m$  the substation  $S'$  may be signaled, sending negative pulsating current from generator  $N$  to the tip of the plug and out over the limb  $t$  of the line by way of the springs  $n'$  and  $n^3$ ,  $m^2$  and  $m'$ , (key  $m$  being of course normal,) and conductor 2, as before. When this is done, the bell of substation  $S$  will remain silent and that of station  $S'$  will ring. The bells of stations  $S^2$  and  $S^3$  of course are not operated, since the current is sent over the limb  $t$ , and they are connected with the limb  $t'$ . Stations  $S^2$  and  $S^3$  then can be signaled only by positive and negative pulsating current, respectively, sent out over the limb  $s$  of the line, and it will be seen that such current may be sent out by depressing the key  $o$  or the key  $p$ , according to the station desired to be signaled. Thus when key  $o$  is depressed positive pulsating current from generator  $P$  flows by way of contacts  $o^3 o'$ , conductor 1, coils of magnet  $k$  to the stud  $g$ , and thence to limbs of the line through spring  $c'$  and sleeve-strand  $a'$  of the plug. Similarly when key  $p$  is depressed negative pulsating current flows from generator  $N$ , contacts  $p' p^3$  and  $o^2 o'$ , over conductor 1, and, as previously traced, to the limb  $s$  of the line. While current may thus flow through the coil of magnet  $k$ , it will not be sufficient at this time to cause the armature to be attracted because of the high resistance of the signal-bells. When, however, the called subscriber responds, the low-resistance bridge then put across the limbs of the line will permit current to flow out over one limb and back over the other, according to the key depressed, to ground  $E$  at the central office, current thus always traversing the coils of magnet  $k$  going or coming and causing the armature  $k'$  to be attracted. This trips or releases the detent  $i$  from the shoulder  $e^3$  of the master-key plunger and permits the parts to spring back

to their normal position, cutting off the ringing-current and uniting again the strands of the plug-circuit through springs  $c\bar{d}$  and  $c'd'$ .

If the station of the called subscriber is located on an individual line, such as illustrated in Fig. 4, it will be evident that this station can be signaled by depressing the key  $l$ , which connects the limb  $t$  of the line with the grounded generator  $G$  of alternating current, by way of stud  $l^3$ , spring  $l'$ , spring  $f$ , spring  $c$ , (the master-key being simultaneously operated,) tip-strand  $a$  of the plug, and out over the limb  $\bar{t}$ , whence it flows through the signal-bell of subscriber  $S^4$  to ground. When the subscriber here responds, the alternating current will be afforded a low-resistance path back over the limb  $s$  of the line, sleeve-strand  $a'$  of the plug, spring  $c'$ , stud  $g$ , conductor 1, through the coils of magnet  $k$ , and to ground at  $E$  by way of springs  $o'$   $o^2$  and  $p'$   $p^2$ , tripping the master-plunger, as before described, and removing the ringing-current from the line. It will be evident, then, that an operator equipped with the signaling apparatus of my invention can with the same plug selectively signal any station on a party-line or can signal a station having an individual line by depressing an appropriate one of the keys  $m$ ,  $n$ ,  $o$ ,  $p$ , and  $l$ . The source of signaling-current will ordinarily remain connected with the called-subscriber's line until he responds, since the keys are maintained depressed by the detent  $i$ . If, however, the called subscriber does not respond within a reasonable time, the key may be manually released by depressing plunger  $k^2$ .

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A party-line ringing appliance for telephone-switchboards comprising a master-key having switch-contacts operated thereby for changing the cord-circuit connections, auxiliary keys having subsidiary switch-contacts operated thereby, each of said auxiliary keys being adapted when actuated to operate the master-key as well as its particular subsidiary switch-contacts, suitable sources of signaling-current being connected with the said subsidiary contacts, and interlocking mechanism, brought into play by the depression of either of the auxiliary keys, for preventing the depression of any other auxiliary key, substantially as set forth.

2. In a signaling apparatus for telephone-switchboards, the combination with a plug for making connection with a telephone-line spring-jack, of a cord-circuit whereof said plug is the terminal, a master-key for connecting a strand of the cord-circuit with a contact associated with the said master-key, sources of signaling-current, auxiliary switch-keys adapted to connect a source of signaling-current with the said contact, and means, operated by the actuation of either of the

auxiliary keys, for actuating the master-key, substantially as described.

3. In a signaling apparatus for telephone-switchboards, the combination with a conductor  $a$  adapted to be connected with a telephone-line, of a master-key and switch-contacts actuated thereby for breaking the continuity of said conductor and connecting the severed end thereof, which leads to the plug, with a contact  $f$ ; a source of signaling-current  $G$ , an auxiliary switch-key  $l$  adapted to connect said source of signaling-current with the contact  $f$ ; a mechanical connection between the master-key and the auxiliary key, whereby the auxiliary key is adapted when actuated to operate simultaneously the master-key, and other auxiliary keys for connecting other sources of current with the contact  $f$ , substantially as set forth.

4. In a signaling apparatus for telephone-switchboards, the combination with a connecting-plug having two contact-surfaces for making electrical connection with the two limbs of a telephone-line, of a cord-circuit having two strands, of which the said contact-surfaces are terminals, a master-key adapted to break the continuity of the said strands and to connect the severed terminals thereof, which lead to the plug, with contact-pieces  $f\bar{g}$  of the master-key, sources of current of different characters, and auxiliary keys each adapted when actuated to operate the master-key and to connect one of the sources of current with one or the other of the said contact-pieces  $f\bar{g}$ , substantially as set forth.

5. In a signaling apparatus for telephone-switchboards, the combination with a plug for making connection between a switch-cord conductor and the spring-jack of a telephone-line, of a master-key adapted when actuated to connect the cord conductor with a contact-piece of the key, sources of current of differing character, and auxiliary keys each adapted when actuated to operate the master-key and to connect one of the sources of current with the said contact-piece, substantially as described.

6. The combination with a plug for making connection with a telephone-line spring-jack, of a cord conductor of which the plug is a terminal, a master-key for effecting changes in the cord-circuit, subsidiary circuits connected with the master-key, and a series of auxiliary keys, each adapted when actuated to operate the master-key and to effect changes in said subsidiary circuits, substantially as described.

7. The combination with a telephone-line having a plurality of substations connected therewith, of signal-receiving instruments, one for each substation, each adapted to respond to current of a peculiar or distinctive character, sources of current, a number of switch-keys corresponding to the number of substations, each key when actuated being

adapted to connect with the telephone-line a source of current of suitable character to actuate a corresponding signal-receiving instrument of the telephone-line, means, controlled by the flow of current in the telephone-line for holding either of said keys in its depressed or operative position when such key is once actuated, a switch at each substation for controlling the flow of current in the line, whereby the release of a depressed key is effected by the operation of said switch, and locking mechanism brought into play during the actuation of either of said keys, for preventing the actuation of the other keys, substantially as described.

8. In a central-office apparatus for telephone-switchboards, the combination with a plug and a cord conductor *a'* having a terminal contact *b'* on the plug, of a master-key adapted to change the circuit of the cord conductor and connect the same with a contact *g*, a conductor 1 extending from the contact *g*, sources of current P N and switch-keys *o p* each adapted when actuated to operate the master-key and to complete the circuit of conductor 1 to ground or other return conductor through one or the other of said sources of current, substantially as and for the purposes set forth.

9. The combination with a telephone-line and a plurality of substations connected on the line, each of said substations having a signal-receiving instrument and a switch for controlling the flow of current in the line, of a conductor *a* at the central office adapted to be connected with the telephone-line, a master-key having a contact *g* associated therewith and being adapted when actuated to break the electrical continuity of the conductor *a'* and connect the end thereof with said contact *g*, a conductor 1 extending from the contact *g* to the earth, a plurality of sources of signaling-current of different characters corresponding to the signaling instruments of the substations, a plurality of auxiliary keys adapted each to connect one of said sources of signaling-current in circuit with the said conductor 1, and an electromagnet controlling the said keys when depressed, the said magnet being included in the conductor 1, whereby a key may be maintained depressed until the switch at one of said substations is operated, substantially as set forth.

10. The combination with a telephone-line, having two limbs and having a plurality of substations connected therewith, each of said substations having a switch adapted to control the flow of current across the two limbs, and a signal-bell responsive to current of a distinctive character, of a plug, a cord-circuit therefor having two strands terminating in corresponding contact-surfaces of the plug and adapted thus to form extensions of the two limbs of the line, respectively, a master-key adapted to break the continuity of the conductors and connect the severed terminals thereof with conductors 1 2, means for

maintaining the master-key depressed, a magnet included in circuit with conductor 1 adapted when energized to release the master-key, a plurality of sources of signaling-current for operating the signal-bells at the several substations, auxiliary keys each adapted to connect one of said sources of signaling-current with one or the other of said conductors 1 2 and so with one or the other of the limbs of the telephone-line, and switch-contacts closed in one or more of the idle auxiliary keys, connecting that conductor of the pair 1 2 over which such current was not sent out, with a return-path for the current, whereby the flow of current may be controlled by the switch at the called station, substantially as described.

11. A party-line ringing appliance for telephone-switchboards comprising a master-key and switch-contacts operated thereby for changing the cord-circuit connections, auxiliary keys each adapted when actuated to operate the master-key, said auxiliary keys having subsidiary switch-contacts operated thereby to connect suitable sources of ringing-current with the master-key, an electromagnet *k* controlling the keys when depressed, and means for energizing said magnet, substantially as set forth.

12. The combination with a telephone-line having a plurality of substations connected on the line, each of said substations having a signal-bell connected on the line and a switch for controlling the flow of current in the line, of a signaling appliance at the central office comprising a master-key and auxiliary keys, each of said auxiliary keys having contacts connected with the contacts of the master-key and being adapted when actuated to operate the master-key, the switch-contacts of the master-key being adapted to control the circuit of the telephone-line, sources of ringing-current connected with the contacts of the auxiliary keys, whereby any station on the line may be signaled by actuating a corresponding auxiliary key, and an electromagnet, controlled by the flow of current in the line, for controlling the keys, whereby a key may be maintained depressed until the switch at one of the stations on the telephone-line is actuated to control the flow of current in the line, substantially as set forth.

13. A signaling appliance for telephone-switchboards comprising a master-key and auxiliary keys, each of said auxiliary keys having contacts connected with contacts of the master-key and being adapted when actuated to operate the master-key, the said master-key having switch-contacts for changing the cord-circuit connections, and sources of ringing-current connected with the contacts of the auxiliary keys, substantially as and for the purpose set forth.

14. A signaling appliance for telephone-switchboards comprising a master-key and auxiliary keys, each of said auxiliary keys

having contacts connected with contacts of the master-key and being adapted when actuated to operate the master-key, the said master-key having switch-contacts for changing the cord-circuit connections, sources of ringing-current connected with the contacts of the auxiliary keys, locking mechanism brought into play during the actuation of one of said auxiliary keys, for preventing the actuation of another key, and an electromagnet for controlling the release of the keys when they are depressed, said electromagnet being controlled by the flow of ringing-current, substantially as set forth.

15 15. A ringing appliance for telephone-switchboards comprising a master-key and auxiliary keys associated therewith, said master-key having a plunger *e* adapted to be depressed and having a spring *e*<sup>2</sup> tending to restore the plunger to its elevated position, a plate *e*' carried by the plunger of the master-key and adapted to be engaged by the auxiliary keys, whereby either of said auxiliary keys will, when depressed, depress the plunger of the master-key, and whereby the mas-

ter-key when restored by the spring, will restore the auxiliary keys, an electromagnet controlling the release of the keys, and means for energizing the electromagnet, substantially as and for the purpose set forth. 30

16. A ringing appliance for telephone-switchboards comprising a master-key and auxiliary keys associated therewith, each of said auxiliary keys being adapted when actuated to operate the master-key, switch-contacts operated by the master-key for altering the cord-circuit connections, switch-contacts operated by the auxiliary keys and connected with the master-key, a source of alternating current *G* connected with one of the auxiliary keys, and sources of positive and negative pulsating current *P*, *N*, respectively, connected with others of the auxiliary keys, substantially as and for the purpose set forth. 35 40

In witness whereof I hereunto subscribe my name this 20th day of July, A. D. 1899. 45

JOSEPH J. O'CONNELL.

Witnesses:

DE WITT C. TANNER,  
GEORGE P. BARTON.