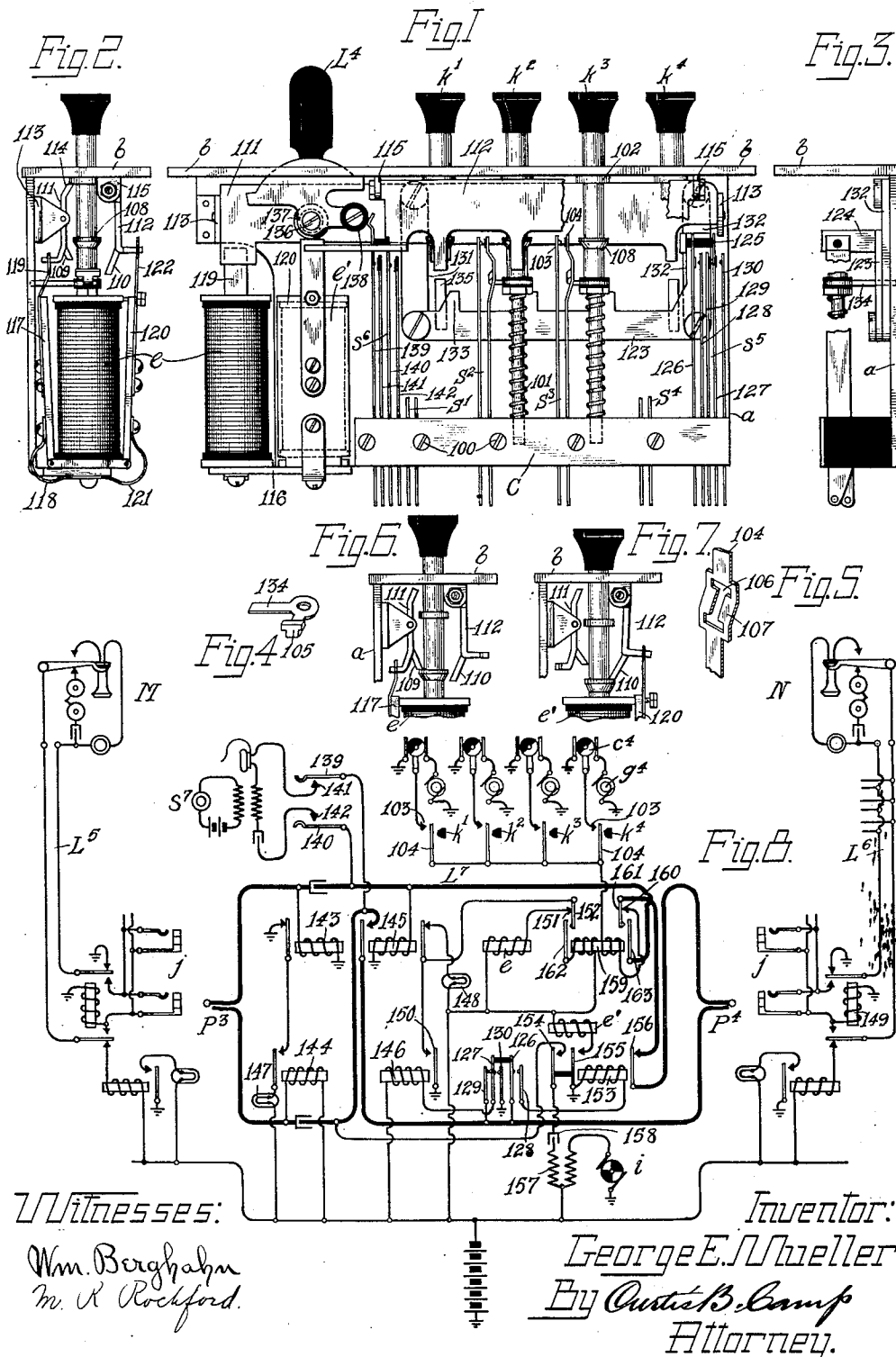


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TELEPHONE KEY.

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-KEY.

1,178,023.

Specification of Letters Patent.

Patented Apr. 4, 1916.

Original application filed March 1, 1907, Serial No. 360,116. Divided and this application filed September 30, 1911. Serial No. 652,070.

*To all whom it may concern:*

Be it known that I, GEORGE E. MUELLER, a citizen of the United States, residing at La Grange, in the county of Cook and State of Illinois, have invented new and useful Improvements in Telephone-Keys, of which the following is a specification.

The present invention relates to telephone keys such as are commonly used by operators in the manipulation of their link-circuit connecting apparatus and has to do more particularly with that type which is used in connecting the operator's telephone set in circuit and applying ringing current to the line for signaling substations and especially for signaling one of a number of substations on the line.

An object of the present invention is to provide a key of the character indicated having certain features of construction including novel catch mechanism for maintaining the various actuating members in their different operating positions, another feature being a novel arrangement of a reciprocating member common to the plungers and adapted to operate a common set of spring-contacts.

The present application is a division of my application for telephone key, Serial Number 360,116, filed March 1st, 1907.

In the form of my invention herein illustrated, it comprises in general a plurality of ringing keys of the plunger type in association with a listening key of the lever type, all mounted compactly upon an elongated frame. Each of the longitudinally movable ringing keys has three operating positions, a normal, a fully depressed, and an intermediate position, locking mechanism being provided for said plungers, and also a reciprocating bar or plate common to the plungers, and adapted for operating a common set of springs each time a key is depressed.

The invention also includes other features and details which, together with the above, will be more fully understood upon reference to the following detailed description taken in connection with the accompanying drawings, and the scope of the invention will be more particularly pointed out in the appended claims.

Figure 1 is a side elevation of the key of

my invention; Fig. 2 is an elevation of the same viewed from the left; Fig. 3 is a similar elevation viewed from the right; Figs. 4 and 5 are details of certain cooperating parts of the key; Figs. 6 and 7 are sectional views illustrating different positions of a ringing key; Fig. 8 is a diagram of circuits illustrating one application of said key.

Throughout these views like characters refer to like parts.

Referring now to the form of the invention illustrated in Figs. 1 to 8 inclusive, it will be seen that a frame-plate *a* has a flange *b* which forms a face-plate through which the listening-key lever *L*<sup>1</sup> and the longitudinally movable ringing-keys *k*<sup>1</sup>—*k*<sup>2</sup>—*k*<sup>3</sup>—*k*<sup>4</sup> extend. These keys extend downwardly through the face-plate in a position to engage sets of contact springs *s*<sup>1</sup>—*s*<sup>2</sup>—*s*<sup>3</sup>—*s*<sup>4</sup>, two of which are broken away, together with other parts of the structure, for clearness. These spring contacts are secured at their lower ends by a suitable insulating member *c* preferably secured by screws to the frame-plate *a* and arranged so as to properly space the springs of each set of contacts in the manner illustrated. The member *c* also supports a set of contacts *s*<sup>5</sup> which are adapted to be operated upon the depression of any of the ringing-keys, and a set *s*<sup>6</sup> of listening-key spring contacts. The member *c* is provided with suitable guiding openings through which the lower ends of the keys *k*<sup>1</sup>—*k*<sup>2</sup>—*k*<sup>3</sup>—*k*<sup>4</sup> are adapted to pass. The guiding ends of these keys are also reduced in diameter and each is provided with a suitable returning spring closely coiled about it and bearing at its opposite ends against the member *c* and a shoulder of the corresponding key. Each of the keys *k*<sup>1</sup>—*k*<sup>2</sup>—*k*<sup>3</sup>—*k*<sup>4</sup> is adapted to occupy three operating positions, namely, a normal, an intermediate or ringing, and a fully depressed or busy position.

In the normal position, the collar forming a catch-engaging-projection on the shank of the key bears against the under face of the flange *b*, and the tips of the spring contacts 103—104 are held out of engagement. Upon the downward movement of the key, the contacts 103—104 remain out of engagement; but upon the return movement of the key, these contacts are brought

into engagement. This is accomplished by means of a T-shaped tongue 105 extending through an I-shaped slot 106 in the spring contact 104 and coöperating with an inclined portion 107 formed by bending said spring contact in the manner illustrated in Figs. 1 and 5. In the normal position, the end of the tongue 105 extends through the upper portion of the slot 106; and upon the downward movement of the key, it is carried over the left face of the inclined portion 107 until it reaches the lower end of the I-shaped slot. During this downward movement, the spring contact 104 is forcibly moved against its spring tension from its normal position; and as soon as the end of the tongue 105 reaches the lower end of the slot, the spring contact 104 returns, under its own tension, to its normal position and thereby moves to the left of the tongue 105. Upon the return movement of the key and the tongue 105, the broad end of the tongue engages the right-hand face of the inclined portion 107 and forces the spring contact 104 to the left into engagement with its associated contact 103. This engagement continues until the key reaches its normal position, at which time the broad end of the tongue 105 again reaches the upper end of the I-shaped slot 106 and the spring contact 104 is free to return, under its spring tension, to its normal position, thereby again bringing the end of the tongue 105 to the left of the spring contact.

In addition to the collar 102, each key is provided with a collar 108 forming a second catch-engaging-projection having a lower inclined surface. This collar coöperates with the catches 109—110 of the catch-bars 111—112. The bar 111 is pivoted at its opposite ends to the posts 113 extending outwardly from the frame-plate *a* near the under side of the flange *b*. This pivotal connection with the posts 113 is on a line intermediate of the catches 109 at its lower side, and the catches 114 at its upper side. The latter catches coöperate with the collars 102 of the keys to lock them in their normal positions, as illustrated in Fig. 2. The catch-bar 112 on the other hand is pivoted near its upper end to the posts 115 which project downwardly from the flange *b*. The catch-bars 111 and 112 in this case are independently controlled by electromagnets *e—e'*, which are mounted side by side upon a flange 116 extending outwardly from the lower edge of the frame-plate *a*. Each of these electromagnets is provided with an armature pivoted at its lower end and extending upwardly into operative relation with the associated catch-bar. The armature 117 of electromagnet *e* is provided with a restoring spring 118 and an upwardly projecting member 119 which extends through a suitable aperture in a projection of catch-

bar 111. Similarly, the armature 120 of electromagnet *e'* is provided with a restoring spring 121 and with an upwardly projecting member 122 which similarly extends through an aperture in a projection of the catch-bar 112. Thus the attraction of the armature 117, due to the energization of electromagnet *e*, rocks the catch-bar 111 so as to move catches 114 out of engaging position and thereby unlock the ringing-keys *k'—k<sup>2</sup>—k<sup>3</sup>—k<sup>4</sup>*. The key, being thereupon depressed to its lowest position, as illustrated in Fig. 7, will be held in such position provided the electromagnet *e'* is energized, since at such time the appropriate catch 110 of the catch-bar 112 will be in a position to engage the upper face of the collar 108 on the shank of the operated key. Upon the subsequent retraction of armature 120, the key will be free to return to its intermediate position, as illustrated in Fig. 6, provided the armature 117 of electromagnet *e* is attracted at such time. When in this position, the appropriate catch 109 engages the same collar 108. It will be apparent from the arrangement of the catches 109—110, relative to the collar 108, that the depression of any one key will force all the catches out of engaging position and thereby free any key which is at the time in a depressed position. The set of spring contacts *s<sup>a</sup>* is operated by means of a reciprocating bar 123 which carries at one end a projection 124 which is adapted to engage an insulating member 125 to actuate the contact springs 126 and 127, the former to engage contact 128, and the latter to disengage contact 129 and engage contact 130. The reciprocating bar 123 is hung by links 131 and 132, pivotally secured to the frame-plate *a* adjacent to its flange *b*. The reciprocating bar 123 carries a projection 133 corresponding to each ringing-key, which has an inclined edge with which a finger 134, carried by the corresponding key, is adapted to engage to cause the reciprocation of the bar upon the depression of the key. In each case, the finger 134 is guided by a slot 135 in the frame-plate *a*, through which the said finger passes. From this it will be apparent that upon the depression of any one of the ringing-keys *k'—k<sup>2</sup>—k<sup>3</sup>—k<sup>4</sup>*, the reciprocating bar 123 will be operated to actuate the contacts of set *s<sup>a</sup>*.

The listening-key lever *L<sup>4</sup>* is pivoted at 136 to a projection extending from the face of the frame-plate *a* through a suitable opening 137 in the catch-bar 111. The listening-key lever is provided with a suitable projection having an insulated covering 138 which is adapted to actuate the springs 139 and 140 of the set of spring contacts *s<sup>b</sup>* to engage their coöperating springs 141 and 142, respectively. This movement is accomplished by throwing the lever *L<sup>4</sup>* to the right in Fig. 130

1. In this form of the invention, the listening-key is independent in its operation of the ringing-keys  $k'$ — $k^2$ — $k^3$ — $k^4$ .

Referring now to the diagram of Fig. 8, which illustrates two subscribers' lines  $L^5$ — $L^6$  extending from substations M and N to a central office provided with a suitable link-circuit  $L^7$  for uniting the lines for conversation, it will be seen that the line circuits are of a well known type and that the link-circuit is of the four-relay type, including supervisory relays 143—144 associated with the answering end of the link-circuit, and similar supervisory relays 145—146 associated with the calling end of said circuit, the relays 143—144 controlling supervisory lamp 147, and relays 145—146 controlling supervisory lamp 148. Assuming that a party at substation M has removed his receiver, the operator will respond by inserting the answering plug  $P^3$  into a jack  $j$  of the line  $L^5$ , and will place her operator's set  $s^7$  in circuit by depressing her listening-key lever  $L^4$  to close contacts 139—141 and 140—142. Having learned the desired substation to be, for example, substation N on line  $L^6$ , she will insert the calling plug  $P^4$  into a jack  $j$  of the line  $L^6$  and depress a ringing-key  $k'$ ,  $k^2$ ,  $k^3$  or  $k^4$  to cause the operation of the call signal at substation N. The insertion of the plug into the jack will complete a circuit from the live pole of battery  $b$  through the winding of sleeve supervisory relay 146, closed contacts 127—129, plug and jack sleeve contacts and the winding of cut-off relay 149 to ground. The closing of this circuit will energize the sleeve supervisory relay 146 and the cut-off relay 149—the former to close its contact 150 to cause the illumination of lamp 148, and the latter to interrupt the normal line connection and extend the line limbs to the tip and sleeve contacts of the jacks. As soon as contact 150 is closed, a circuit will also be completed through the winding of electromagnet  $e$  by which catch-bar 111 is controlled. This circuit extends from the live pole of the battery  $b$  through the winding of said electromagnet, closed contacts 151—152 and closed contact 150 to ground. The resulting energization of electromagnet  $e$  rocks the catch-bar 111 so as to unlock the ringing-keys  $k'$ — $k^2$ — $k^3$ — $k^4$ . Until this occurs, the operator cannot depress the proper ringing key. Assuming that the operator depresses key  $k^4$  to actuate the call signal at substation N, it will be seen that the ringing circuit will not be completed upon the full depression of the key, since the contacts 103—104 of such key are not closed by this movement; but on the other hand, the spring contact of the set  $s^5$  will be operated by the movement of reciprocating bar 123 to break contact 127—129 and close contact 127—130, and at the same time to close contact 126—128. If the line  $L^6$  is

busy at this time, a potential above that of ground will exist at the sleeve contact of the jacks  $j$  and, upon the closing of contact 126—128, current will flow from the sleeve contact of the jack over the sleeve side of the link-circuit, through contact 126—128 and the winding of relay 153 to ground, thereby energizing said relay to close its contacts 154—155 and to open its contact 156. The opening of the latter contact interrupts a possible connection for ringing current to the tip contact of the plug  $P^4$ . The closing of contact 154 sends a "busy" signal over the line to the calling party. This signal may be transmitted through the agency of an interrupter  $i$  and an induction coil 157, the interrupter being included in a primary circuit with the primary winding of the induction coil and with the battery  $b$ ; and the secondary circuit including a secondary winding of said induction coil, condenser 158, closed contact 154, the sleeve side of the circuit through substation M, and back over the tip side of the circuit to ground through the various ground connections with the tip strand of the link-circuit  $L^7$ . The closing of contact 155 of relay 153 completes a circuit to ground through the winding of electromagnet  $e'$  which controls catch-bar 112. The attraction of armature 120, resulting from the energization of electromagnet  $e'$ , brings the catches 110 into engaging position, and the key  $k^4$  is thereby held in its fully depressed position. Upon learning the busy condition of the line, as before, the operator will take down the connection, whereupon the electromagnets  $e$  and  $e'$  will be de-energized; and through the action of the returning spring 101, the key  $k^4$  will be restored to its normal position.

In case the called line is idle at the time the plug  $P^4$  is inserted into its jack, there will be no current flow through relay 153, and consequently electromagnet  $e'$  will not be energized and catch-bar 112 will not be actuated to hold the key in its fully depressed position. At this time, however, the catches 109 of catch-bar 111 will be in their engaging position, and the key  $k^4$  will not be free to return to its normal position, but will stop at its intermediate or "ringing" position. Upon this return movement, as was previously pointed out, the associated contacts 103—104 of key  $k^4$  are brought into engagement, with the result of an intermittent application of ringing current from the generator  $g^4$  through the interrupter  $c^4$  and one winding of relay 159 and closed contacts 160—161 to the tip contact of the plug  $P^4$  and thence over the line  $L^6$  and to ground through the cut-off relay 149. The flow of ringing current over this circuit will be of such a character as not to cause the relay 159 to attract its contents; but as soon as the called-for party responds and there-

by completes a path for battery current through the substation, current will flow, as soon as the interrupter  $c^4$  establishes connection between contact 103 of key  $k^4$  and ground, from the live pole of battery  $b$ , through the winding of supervisory relay 146, contact 127—129, plug and jack sleeve contacts to the winding of cut-off relay 149; thence by one path through the winding of said relay to ground, and by another over the line through the substation and back through the plug and jack tip contacts, closed contact 156, closed contact 161—160, the right-hand winding of relay 159, contact 104—103 through the interrupter  $c^4$  to ground. The completion of this circuit will energize relay 159 to close contacts 162—152, followed by the opening of contacts 151—152; and the closing of contact 161—163, followed by the opening of contacts 160—161. The opening of contact 151—152 breaks the circuit of electromagnet  $e$  and thereby releases key  $k^4$  from its ringing position and allows it to return to normal. The engagement of contacts 152—162 completes a locking circuit for the relay 159 extending from the live pole of battery  $b$  through the left-hand winding of said relay, closed contacts 152—162 and closed contact 150 to ground. The opening of contact 160—161 interrupts the connection to the ringing keys, and the closing of contact 161—163 completes the talking strand at this point. Thus it will be seen that in the operation of the system, the ringing-key can not be depressed until the calling plug has been inserted into the jack. Then, when depressed, if the line is busy, it is retained in its fully depressed position and a busy signal is transmitted to the calling party. However, if the line is not busy, the key is allowed to return to its intermediate or ringing position and it remains in this position until the called-for party responds, whereupon it is freed and allowed to return to its normal position. With the parties connected, the supervisory lamps 147—148 remain dark, by reason of the energization of tip supervisory relays 143—145; but at the close of conversation, the restorations of the receivers to their hooks at the substations interrupts the flow of current to these supervisory relays; and upon the return of their contacts to normal, the said lamps are lighted as a signal to the operator to take down the connection.

It should be understood that the specific key construction may be modified considerably without departing from the spirit and scope of my invention, that in the practice of the same the electromagnets by which the latch mechanism is operated, might be variously connected in existing or novel circuit arrangements, and that various spring combinations may be used. The ac-

companying circuit diagram is intended to be merely typical and to illustrate completely an application of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A party line telephone ringing-key comprising an elongated supporting frame, a row of sets of spring contacts carried thereby, a plurality of longitudinally movable actuating keys extending through the face plate of said frame and each having a plurality of operating positions, catch engaging projections on each of said keys, an electromagnetically controlled elongated catch-bar pivotally secured adjacent to said face-plate and laterally movable toward and from said keys, catches on said bar for engaging the cooperating projections on each of said keys to hold said keys in their different operating positions, and a common contact directly mechanically controlled by said keys.

2. A party line telephone ringing-key comprising an elongated supporting frame, a row of sets of spring contacts carried thereby, a plurality of longitudinally movable actuating keys extending through the face-plate of said frame and each having a plurality of operating positions, catch engaging projections on each of said keys, an elongated catch-bar pivotally secured adjacent to said face-plate and laterally movable toward and from said keys, catches on said bar for engaging cooperating projections on each of said keys to hold said keys in their different operating positions, electromagnetically actuated armature mechanism located adjacent to one end of said frame and operatively connected to said catch-bar, and a common contact directly controlled by the operations of said actuating keys.

3. A telephone key comprising a set of spring contacts, a reciprocating actuating key therefor, a catch-bar movable transversely of said key, a plurality of catch-projections on said bar cooperating with said key whereby said key may be held in a plurality of operating positions, electromagnetic means for actuating said catch-bar, and independently controlled means for holding said key in its fully depressed position.

4. In a party line telephone ringing key, the combination with a plurality of spring-retracted plungers, each having an intermediate and a fully-depressed position, contacts individual to each plunger and arranged to be operated thereby when the plunger is operated, a spring-retracted locking plate common to said plungers for holding a plunger locked down when depressed to its intermediate position, a contact common to said plunger rods, and a movable plate operable by each of said rods in its ringing fully depressed position for closing

said common contact, said movable plate permitting the retraction of the plunger rod to its intermediate position when the plunger pressure is removed from the plunger rod.

5 5. The combination with a plurality of spring retracted plunger rods, each provided with a contact operating plunger, of contacts individual to each plunger and arranged to be operated thereby, a plate co-operating with said plunger rods for locking said plunger rods, a contact common to said plunger rods, and a second movable plate coöperative with said plungers and adapted to open and close said common contact when any plunger is depressed.

6. The combination with a plurality of spring retracted plunger rods, each provided with a contact operating plunger, of contacts individual to each plunger and arranged to be operated thereby, a plate co-operating with said plungers for locking said plunger rods, a contact common to said plunger rods, and a second plate movable by said plungers to open and close said common contact.

7. A telephone key comprising a set of spring contacts, a reciprocating actuating key therefor, a catch-bar movable transversely to said key, catch projections on said bar for coöperating with said key whereby the said key may be held in a plurality of operating positions, an auxiliary contact controlled by an endwise movable plate, and means controlled by said key for moving said plate to open and close said auxiliary contact.

8. The combination with a plurality of spring retracted plunger rods, each provided with a contact operating plunger, of contacts individual to each plunger and adapted to be operated thereby, a pivoted plate coöperating with said plunger rods for holding said plunger rods in different operating positions, and a second movable plate controlled by said plungers for opening and closing a common contact.

9. The combination with a plurality of spring retracted plunger rods, each provided with a contact operating plunger, of contacts individual to each plunger and adapted to be operated thereby, a member coöperating with said plungers for holding said plungers in different operating positions, a contact common to said plunger rods, and a second plate movable by any of said plungers to open and close said common contact.

10. A telephone ringing key comprising a supporting frame, suitable contacts carried thereby, spring returned actuating members for controlling said contacts, a plate member provided with catches for holding said actuating members in their different operating positions, a common contact supported by said frame, and a second plate member

controlled by said actuating members for opening and closing the said common contact.

11. A telephone key comprising a supporting frame, a plurality of spring returned actuating members supported by said supporting frame, electromagnetically controlled means for locking said plungers in normal position, electromagnetically controlled means for locking said plungers in their fully depressed position, and means for operating said first electromagnetic means to unlock said plungers and for operating said second electromagnetic means for locking said plungers.

12. A telephone key comprising a supporting frame, suitable contacts carried thereby, a spring returned actuating member for said contacts having a plurality of operating positions, an electromagnetically operated catch for holding said key in one of its positions, a second electromagnetically independently operated catch for holding said key in another of its operating positions, and an auxiliary contact controlled by the said spring returned member.

13. A telephone key comprising a supporting frame, suitable contacts carried thereby, a spring returned actuating member for said contacts having a normal and a fully depressed operating position, an electromagnetically controlled member for locking said spring returned member in its normal position, and a second electromagnetically independently controlled member for locking said spring returned member in its fully depressed position.

14. A telephone key comprising a suitable frame, suitable contacts carried thereby, spring returned actuating members for said contacts having three operating positions, an electromagnetically controlled catch member for locking said actuating members in one of their operating positions, and a second electromagnetically independently controlled catch member for holding the said actuating members in another of their operating positions.

15. A party line telephone ringing key comprising an elongated supporting frame, a row of sets of contacts carried by said supporting frame, a plurality of actuating members for said sets of contacts mounted in said frame and each having a plurality of operating positions, a catch member for holding said actuating members in their different operating positions, a common contact, and a movable plate member controlled by said actuating members for opening and closing said common contact.

16. A party line telephone key comprising a supporting frame, a row of sets of contacts carried thereby, a plurality of actuating members for said sets of contacts mounted in said frame in a row, each having a plu-

15 rality of operating positions, an electromagnetically controlled catch member for holding said actuating members in their different operating positions, an auxiliary contact supported by said frame, and an auxiliary plate controllable by said actuating members for opening and closing said auxiliary contact.

10 17. A party-line telephone ringing key comprising a supporting frame, a row of sets of contacts carried thereby, a plurality of actuating members for said key mounted in said frame, each having a plurality of operating positions, a catch member for holding the said actuating members in their dif-

ferent operating positions, an auxiliary common contact supported by said frame and lying in a plane substantially parallel to the plane of said first contacts, and a movable member directly controlled by said actuating members for opening and closing said auxiliary common contact. 20

Signed at Chicago, county of Cook, and State of Illinois, in the presence of two witnesses.

GEORGE E. MUELLER.

Witnesses:

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