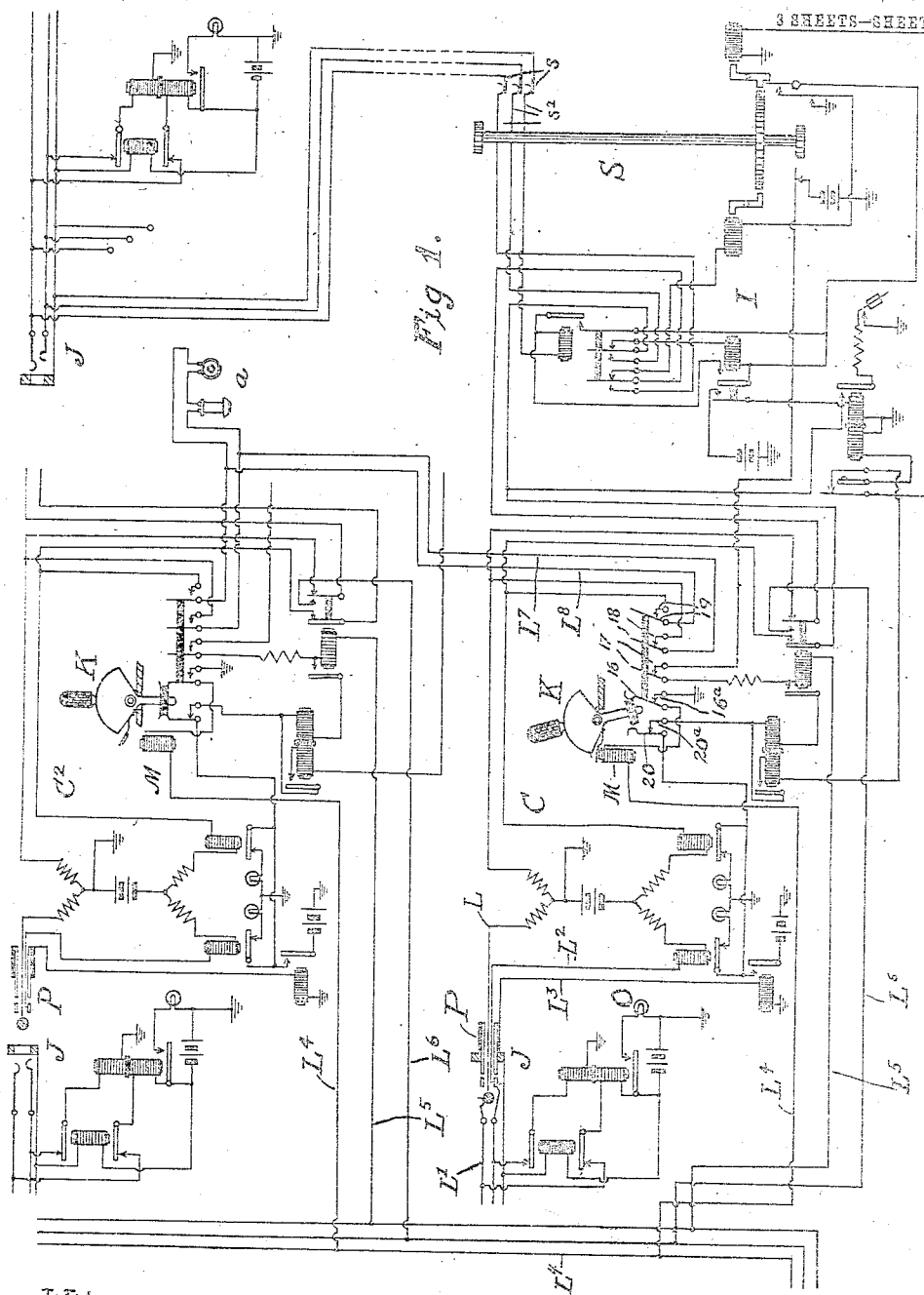


APPLICATION FILED AUG. 26, 1907.

Patented Nov. 23, 1909.

3 SHEETS—SHEET 1



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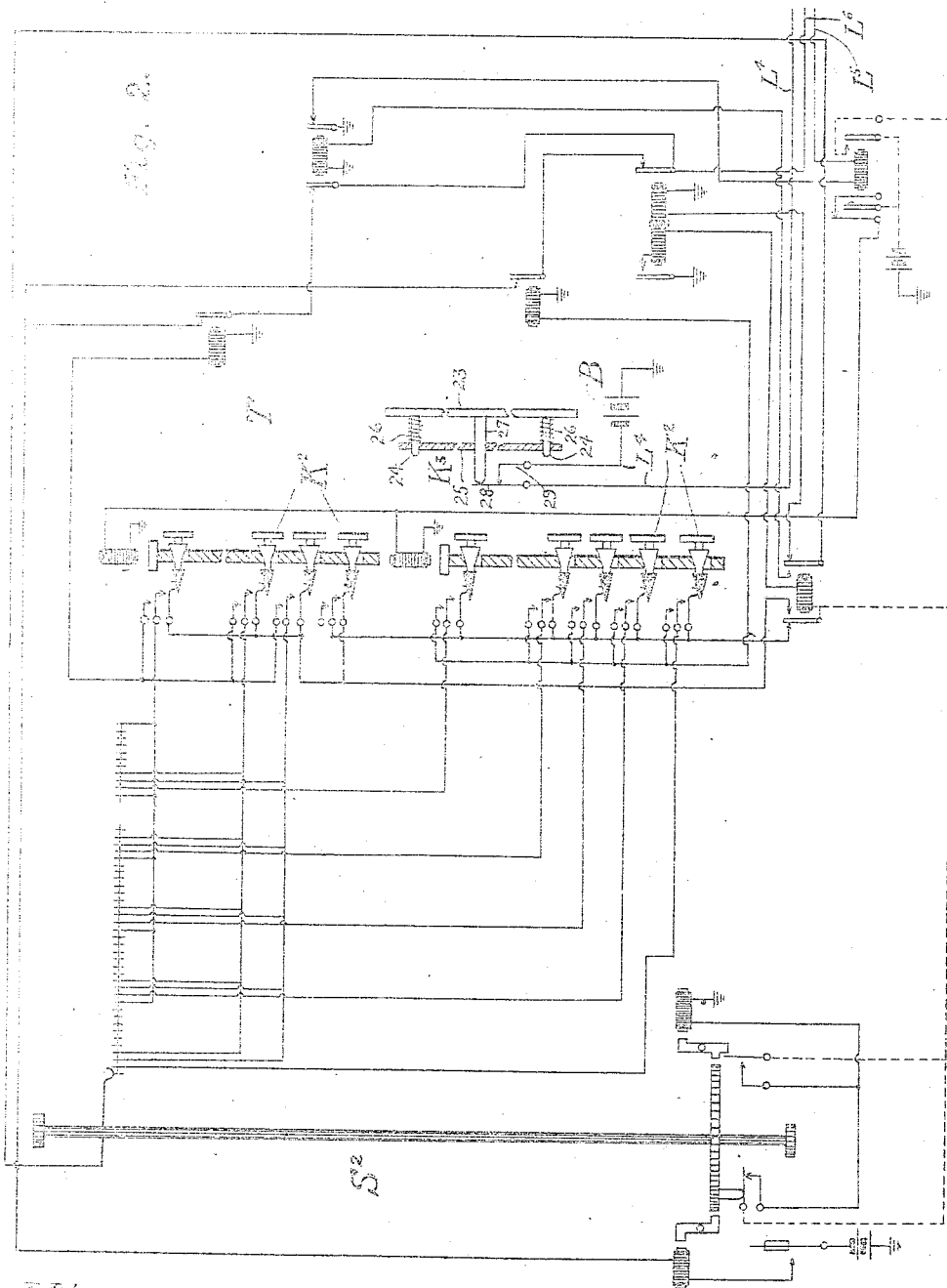
TELEPHONE KEY AND MEANS FOR ACTUATING THE SAME.

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Patented Nov. 23, 1909.

3 SHEETS—SHEET 2.

940,678.



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 TELEPHONE KEY AND MEANS FOR ACTUATING THE SAME.
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 3 SHEETS—SHEET 3.

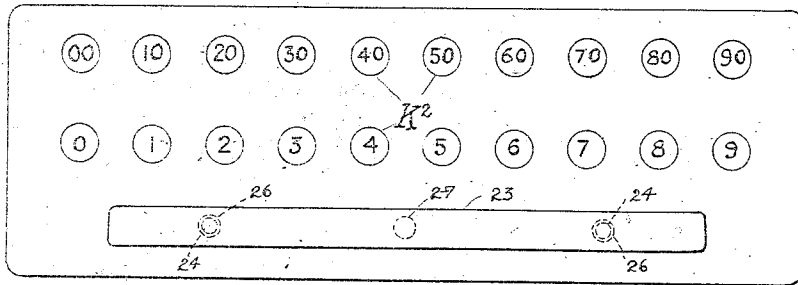


Fig. 3.

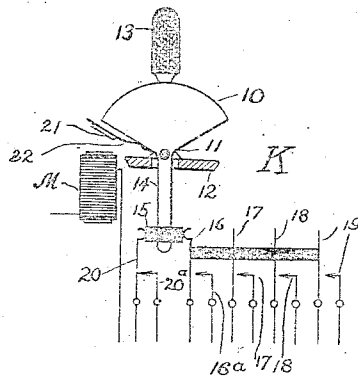


Fig. 4.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-KEY AND MEANS FOR ACTUATING THE SAME.

940,673.

Specification of Letters Patent.

Patented Nov. 23, 1909.

Application filed August 26, 1907. Serial No. 390,204.

To all whom it may concern:

Be it known that I, WILLIAM CHRISTENSEN, residing at Belmont, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone-Keys and Means for Actuating the Same, of which the following is a specification.

This invention relates to means for actuating keys included in the connecting or cord circuits used by operators for switching telephone lines, it being directed particularly to the release of listening keys contained in circuits constituting a portion of a system in which both manual and mechanical switching operations are performed. In exchanges of this character each operator is provided with a suitable number of cord circuits, say twenty-five, one extremity of each cord having a connecting plug by means of which subscribers' calls may be answered in the manner usual in manual switching practice, while associated with the cords are electromechanical apparatus or series of such apparatus, which effect connection with the desired lines. To assist in the first, or answering, operation there is included in every connecting circuit a listening key, which permits the temporary uniting of the operator's telephone set to the particular cord which is then being used in responding to the call. To govern the line selecting apparatus the operator has before her a controlling apparatus, which may be joined to any cord and which has keys corresponding to digits or other characters designative of lines, offices or districts. The operator upon noting the display of a line signal picks up the plug of an idle cord, inserts it in the jack indicated, throws the listening key of the cord used, receives the subscriber's order, and proceeds to depress the keys of the controller in accordance with said order to start the movable members of the selectors upon their search for the wanted line. As the number is being thus registered the operator should repeat it to the calling subscriber, and, if necessary, be able to receive a correction. For this reason the listening keys have locking means for retaining them in their active position until released. As it has been proposed heretofore to arrange the apparatus, the operator, after completing her manipulation of the controller keys,

was required to select from among her group the key of the cord which was in use, move the hand from above the keyboard through a considerable distance, perhaps a foot or more, and shift this listening key to its initial position. This calls for both mental and physical effort which may appreciably decrease the quickness of operation.

The object of my invention is to increase the operator's efficiency by reducing to a minimum the exertion required for this act of release, and it consists in providing the listening keys of each operator with a controlling means common to all of said keys, and, furthermore, in associating this means with the keys of the selector controller.

In the accompanying drawings, forming a part of this specification, Figure 1 illustrates diagrammatically two of a number of cord circuits situated at the position of a single operator, one of said circuits being shown as joined to a selecting apparatus; Fig. 2 is a similar representation of the operator's controller for all the cords; Fig. 3 is a top plan view of the controller keyboard; and Fig. 4 is an enlarged and partially diagrammatic representation of one of the listening keys in side elevation.

Referring to Fig. 1, C, C² designate cord circuits forming a portion of the equipment of a telephone operator, and each comprising main conductors L, L² and a third conductor L³, which terminate at one end of the cord in the tip, ring and sleeve, respectively, of the plug P. These plugs may cooperate with any one of the answering jacks J, situated before the operator, to which are connected the substation lines L¹ and the line signals O associated with the jacks and controlled in any suitable manner to indicate the calls of the subscribers. The substation lines are also multiplied, as shown at the right of Fig. 1, to fixed terminals s of electromechanical switches S, each of which is a portion of a selecting apparatus I, one of which appears in Fig. 1. This switch has a set of three movable contact members or arms s² to which the conductors of the cord C are shown as united, the selector of the other cord being omitted from the drawing. The selecting apparatus furnished by the switches with their relays and other mechanism is not essential to this invention and may be of any usual or convenient type,

and the same is true of the mechanisms and devices included in the cords, with the exception of the listening keys K^1 . The precise form of these keys is not important, they being here illustrated diagrammatically as of the well-known rocking type in which a sector 10 is pivotally mounted at 11 upon the frame 12 of the key. Rising from the sector is a finger piece 13, to enable the operator to move it, while depending below the frame is an arm 14 carrying a collar 15 of insulating material. When the arm 14 is moved to the right, as seen in the cord C in Fig. 1, it brings into contact by means of the collar 15, pairs of springs 16, 16^a; 17, 17^a; 18, 18 and 19, 19. Movement to the left separates normally closed contacts 20, 20^a. The contacts 16, 17 and 20, 20^a are without effect upon my invention, save that the spring 20 with the spring 16 serves to hold the sector with its finger piece and arm in a normally central position. They therefore need not be further considered. The contacts 18, 18 and 19, 19 connect leads L¹ and L² to the operator's telephone set, indicated at a, with the cord strands B and L². The contacts 16, 16^a are in circuit with an electromagnet M constituting an element of the key K, its winding being in a branch of a multiple conductor L¹ which with conductors L² and L³ connects all the cords at a position with a controller T, which will be hereinafter described. The armature 21 of the magnet M is carried by a spring 22, conveniently of the flat or leaf type and secured at one end to the sector 10, while at the opposite end of the spring the armature is mounted.

Each operator has an apparatus T (Fig. 2) by means of which the selector or selectors associated with any cord used in answering the calling subscriber may be caused to pick out the terminal of the line called for. As regards the present invention the general arrangement and operation of this controller is of no consequence. The only thing which is important is that the apparatus has sets of keys K^2 for depression by the operator to govern selection. Briefly, it may be further said that the contacts of these keys, aided by suitable relays or other mechanism, determine the travel of a motor driven switch S^2 similar to the selecting switches; this switch S^2 in turn controls the selecting apparatus T to which it is joined by the cord circuit. Only two sets of controller keys appear, corresponding to the tens and units digits, but whatever number of sets be employed they are preferably placed closely together for convenience in manipulation by the operator. In proximity to the selecting keys and forming a part of the controlling apparatus is a key K^3 for actuating the listening keys K^1 . The finger piece of this key K^3 may be furnished by an elongated

member or bar 23, preferably presenting an operating surface of considerably greater area than any one of the selecting keys, and this finger piece may be located in the same relation to the keys K^2 as is the spacing bar of a typewriter to the character keys. It is thus readily struck by the operator, whichever digit key she may have just touched. The bar 23, as illustrated, is mounted upon two pins 24, 24 guided by openings in a plate 25. Spiral springs 26, 26 surround the guide pins and maintain the key in a normally raised position. The finger piece also has a pin or projection 27, extending through a third opening in the base plate and cooperating with a spring 28 of a contact device, so that when the key is depressed said spring will be separated from a companion spring 29. The springs 28 and 29 control, in part, a circuit which, in the present instance, consists of the previously mentioned conductor L⁴ extending from one pole of a battery B, the other pole of which is grounded, through the windings of the electromagnets M of all keys K at the position of the operator using the controller T, and through normally separated springs 16, 16^a of said keys to ground.

When the operator observes the lighting of a line lamp O, she inserts the plug P of an unused cord C in the indicated jack J, and by means of its finger piece moves the key K of said cord so that the armature 21 approaches the pole of its magnet M, and the arm 14, through its insulating collar, closes the set of contacts at the right. As soon as the springs 16, 16^a meet, current flows from the battery B through the normally closed springs 28 and 29 of key K^3 , conductor L⁴ and winding of magnet M to ground at the key K. The attraction of the armature 21 by the magnet locks this key K in the listening position, the operator's set being now joined to the calling line by the conductors L¹ and L³ and the cord strands through the springs 18, 18 and 19, 19. The operator may at once remove her hand from the listening key, and upon receiving the order and while repeating it to the calling subscriber register it upon the keys K^2 of the controller T. If no correction of the number is made by the subscriber, the operator after depressing the necessary selecting keys is ready to receive another order, since the seeking for the terminals of the desired line, testing them and ringing the called subscriber goes on automatically. But before the succeeding call can be answered the operator's set must be disconnected from the cord with which it has just been used. To accomplish this the operator in whose switching apparatus my invention is embodied need not seek for the listening key previously used nor carry the hand to it. Instead, upon completing the correct registration of the number previously called, with-

out shifting the hands from above the key-board, she depresses the controller release key K². Since the springs 28 and 29 of this key govern the supply of current to any listening key at which the springs 16 and 16^a are in contact, their consequent separation deenergizes the magnet of the key in the cord C, and as this magnet ceases to attract its armature the key is released. This allows the springs to restore the movable elements to their initial position and opens the contacts, including those in the operator's set. She can now answer a new call with an idle cord, repeating the acts just described.

It may be that, at some time while the connection is up, the operator must listen in for the purpose of supervision. In this case the hand probably would not be removed from the listening key, and it would then be easier to restore it by direct actuation rather than by the use of the common controlling key. To furnish a certain lock, the attraction of the magnets for their armatures is made so strong that disarrangement might be somewhat difficult for the operator, were it not for the fact that the action of the locking means to direct release is modified by the mounting of the armature upon the spring 22. For this reason the operator has to first move the sector and arm only against the resistance of the spring, this being considerably less than that offered by the magnet, until the contact springs 16, 16^a are parted. This opens the circuit of the magnet, destroying its attractive force and leaving the key free to assume its normal position aided by the spring 16.

Having thus described my invention, I claim and desire to secure by Letters-Patent:

1. In a telephone exchange system, the combination with a plurality of operator's circuits for connecting substation lines, of a key individual to each connecting circuit, means for retaining each key in the position to which it is moved by the operator, and means common to the connecting circuits and under control of a telephone exchange operator for effecting the release of all the keys from the retaining means.

2. In a telephone exchange system, the combination with a plurality of operator's circuits for connecting substation lines, of a key individual to each connecting circuit, means for retaining each key in the position to which it is moved by the operator, and an exchange operator's keyboard including a key or device common to the connecting circuits and operable to effect the release of all the keys from the retaining means.

3. In a telephone exchange system, the combination with a plurality of operator's circuits for connecting substation lines, of a listening-key individual to each connecting

circuit, means for retaining each key in the position to which it is moved by the operator, and a device common to the connecting circuits and operable by a telephone exchange operator for effecting the release of all the listening keys from the retaining means.

4. In a telephone exchange system, a plurality of listening keys situated at the position of a single operator and manually operable to a closed position, and operator's controlling means operable to restore said keys to their normal open position, said controlling means being common to all the keys but mounted independently and separated therefrom.

5. The combination with a plurality of listening keys adapted for use by a telephone operator, of means for temporarily locking each key in the listening position, an electromagnetic releasing mechanism for each key, and a contact device in circuit with all the releasing mechanisms and under the control of the operator, substantially as described.

6. In a telephone exchange system, the combination with manual switching means and mechanical switching means, of means for governing the movement of elements of both said switching means, controlling circuits for the governing means, and a controlling apparatus comprising keys having contact devices in the controlling circuits of the manual and mechanical switching means.

7. A telephone switching system comprising manually operable switches and electromechanical switches, connecting circuits for the two classes of switches, keys included in the connecting circuits, and controlling apparatus for the electromechanical switches, said apparatus having associated with it means for controlling the keys of the connecting circuits.

8. The combination with telephone line selecting apparatus and controlling apparatus therefor, of an operator's cord circuit, a locking listening key included in said circuit, means for releasing the key, and means for actuating the releasing means, said actuating means being separated from the listening key and situated in proximity to the selector controller.

9. A telephone system comprising operator's cord circuits, selecting apparatus which may be connected therewith, a listening key included in each cord circuit, and apparatus provided with keys for manipulation by the operator and being adapted to control both the selecting apparatus and listening keys.

10. A telephone system comprising operator's cord circuits, selecting apparatus which may be connected therewith, a listening key included in each cord circuit, means for retaining each listening key in the position to which it is moved by the operator,

electromagnetic releasing means for the retaining means, and controlling apparatus having keys determining the movement of the selecting apparatus and a key governing the supply of current to the releasing means, substantially as described and for the purpose set forth.

11. The combination with a telephone key, of means for retaining the key in the position in which it moved, and means for permitting a limited movement of the key toward its normal position while the retaining means remains in engagement with said key.

12. A key comprising a movable member, a magnet and its armature for locking the movable member, and a spring movable with said member and upon which the armature is supported.

13. In a telephone exchange system, the combination with a listening key including a movable member, an electromagnet and an armature for said electromagnet mounted upon the member and being movable independently thereof, of an energizing circuit for the electromagnet, and a plurality of contact devices in the energizing circuit, one of which contact devices is controlled by the movement of the key, substantially as and for the purpose set forth.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this 23d day of August 1907.

WILLIAM CHRISTENSEN.

Witnesses:

GEO. WILLIS PIERCE,
JOSEPH A. GATELY.