No. 677,724. Patented July 2, 1901.

W. D. WATKINS.

AUTOMATIC TELEPHONE SWITCH.

(Application filed Oct. 18, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 2.

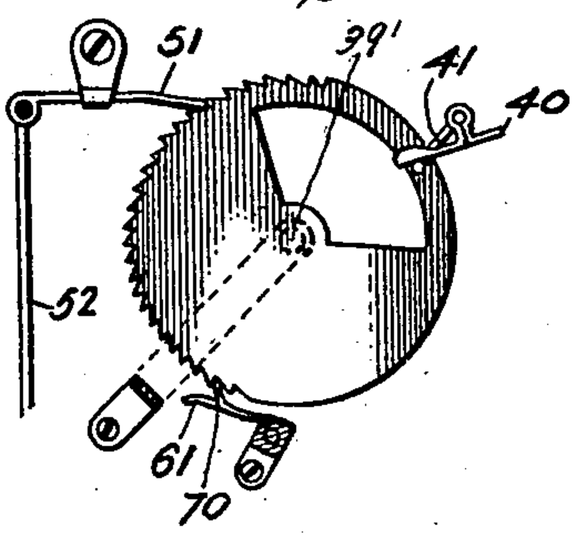


Fig. 4.

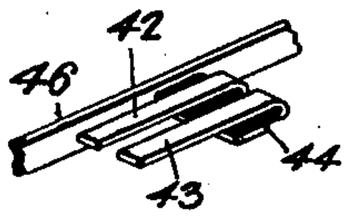


Fig. 3.

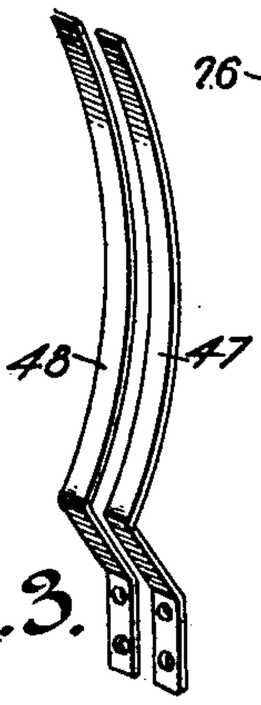


Fig. 8.

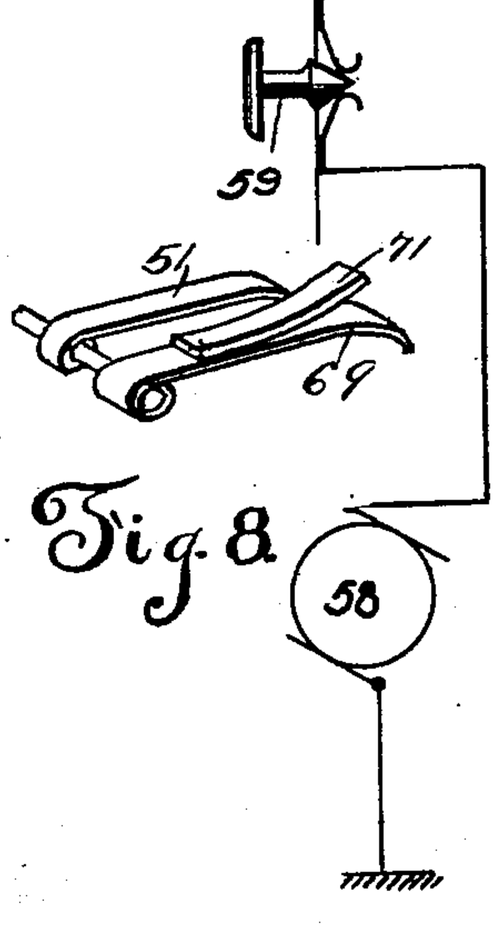
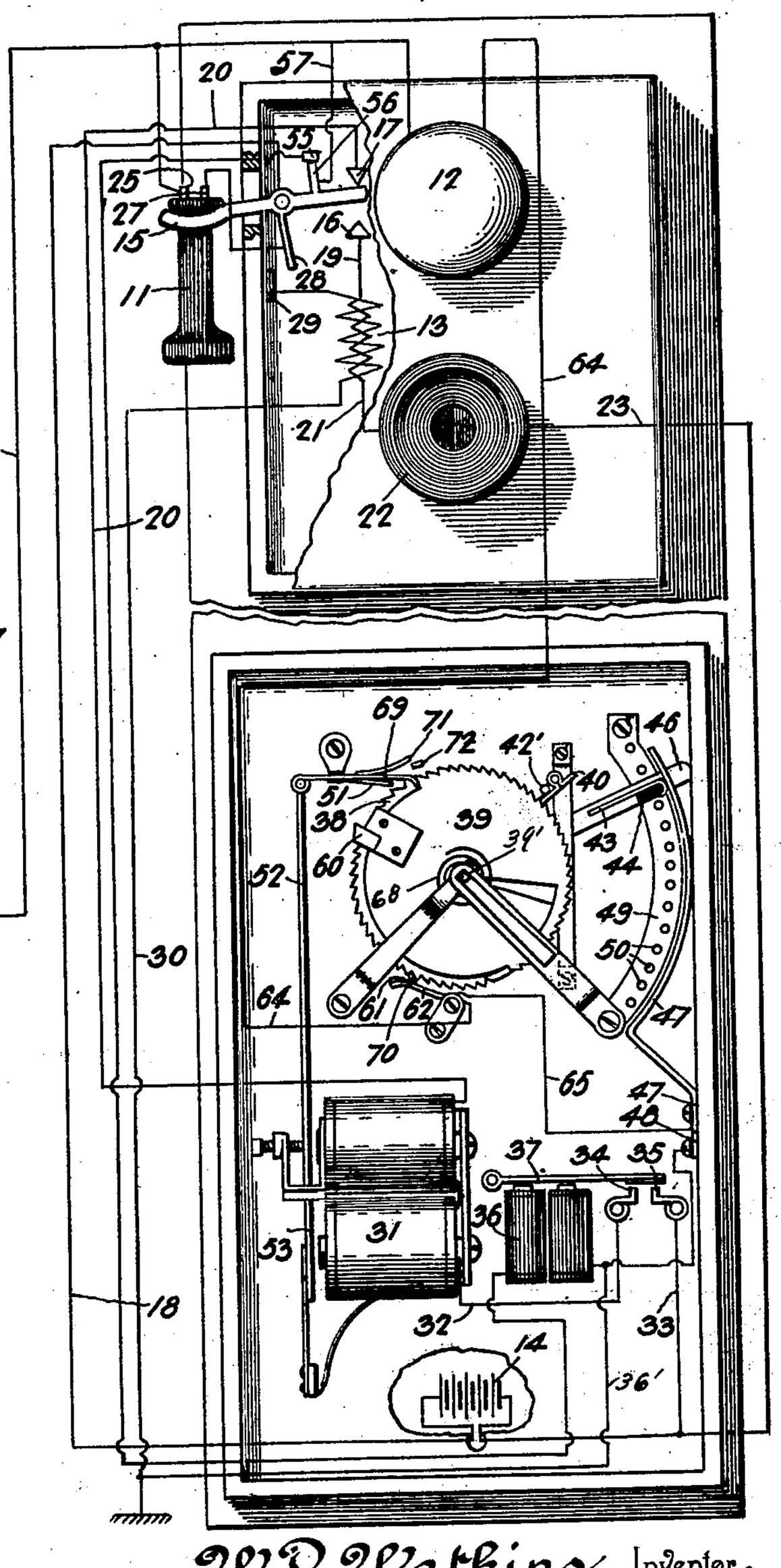


Fig. 1.



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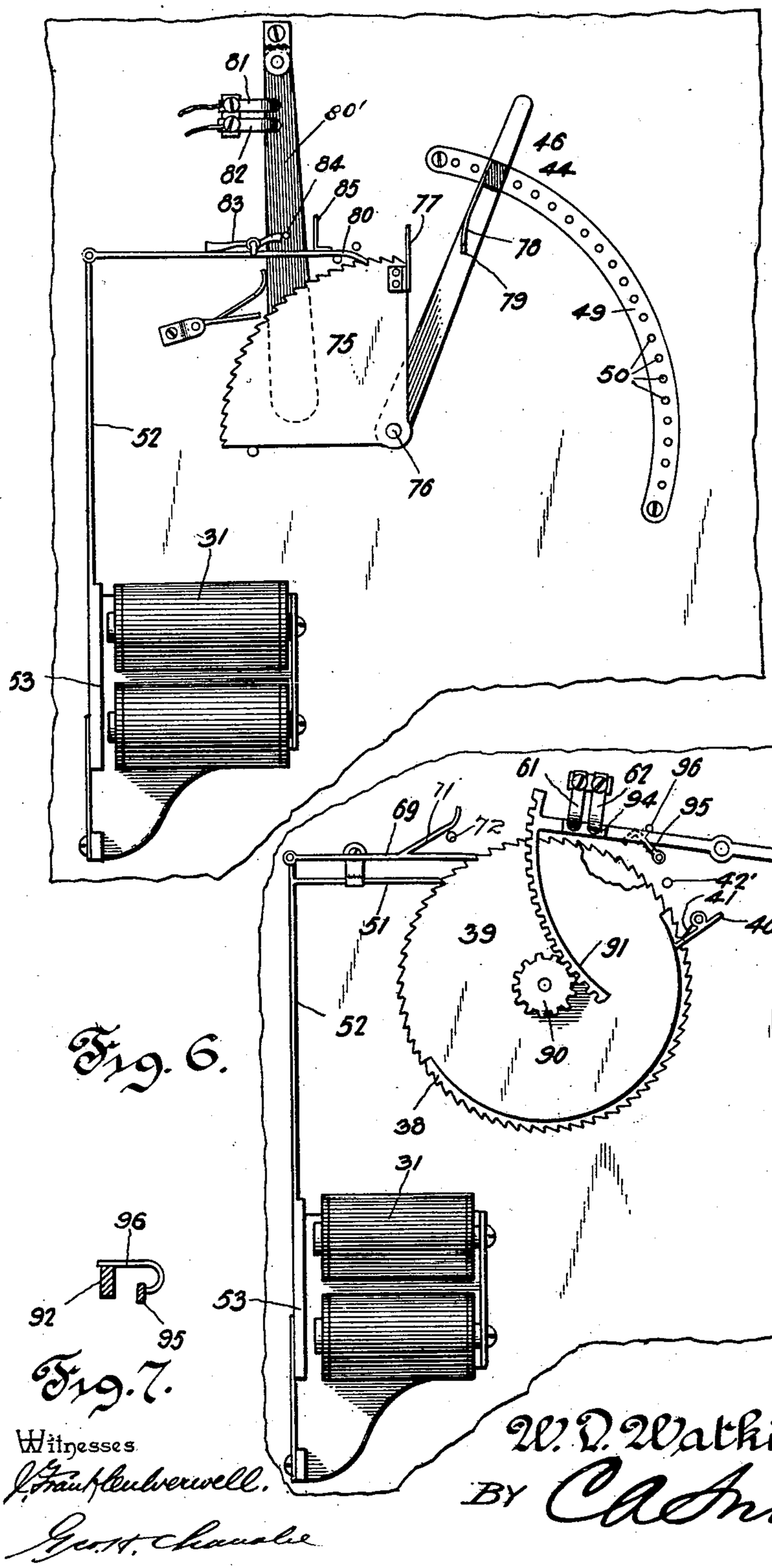

Fig. 5.

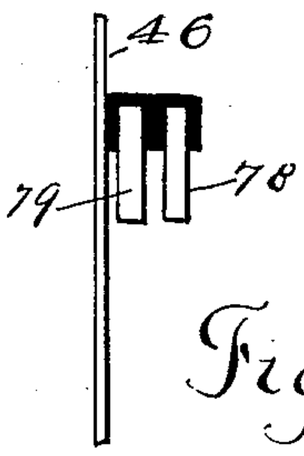

Fig. 9.

Fig. 6.

Fig. 7.

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UNITED STATES PATENT OFFICE.

WILLIAM D. WATKINS, OF SAN JOSE, CALIFORNIA, ASSIGNOR OF ONE-HALF TO JOHN W. BOLSTER, OF SAME PLACE.

AUTOMATIC TELEPHONE-SWITCH.

SPECIFICATION forming part of Letters Patent No. 677,724, dated July 2, 1901.

Application filed October 18, 1900. Serial No. 33,504. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. WATKINS, a citizen of the United States, residing at San Jose, in the county of Santa Clara and State of California, have invented a new and useful Automatic Telephone-Switch, of which the following is a specification.

This invention relates to automatic switches in general, and more particularly to that class used in telephony wherein electric pulsations transmitted over the line from central are caused to connect the proper subscriber's instrument corresponding to the number of pulsations sent.

One object of the invention is to provide a simple and efficient construction which may be easily operated by depressing a simple form of push-button at central the proper number of times and wherein the predetermined subscriber's instrument will be cut into the line without cutting in any other instrument or instruments, a further object of the invention being to provide a construction wherein the phone-battery may be utilized to energize the local circuit, including the electromechanical portions of the apparatus.

Additional objects and advantages of the invention will be evident from the following description.

In the drawings forming a portion of this specification, and in which like numerals of reference indicate similar parts in the several views, Figure 1 is a view showing the complete apparatus located at a subscriber's station, the electric circuits being shown in diagram. Fig. 2 shows in elevation the rear circuit-closing disk with its operating-pawl and the pivoted contact carried by the disk. Fig. 3 is a perspective view showing the contact-strips through the medium of which contact is made with one pair of contact-fingers. Fig. 4 is a perspective view showing a portion of the setting-lever and the contact-fingers carried thereby. Fig. 5 is an elevation showing a different form of mechanism for closing the local circuit at the subscriber's station. Fig. 6 is an elevation showing a second modification of mechanism for closing the local circuit at the subscriber's station. Fig. 7 is a sectional view showing the pivoted lever of Fig. 6 with the retaining-pawl having its pin or finger engaged with the lever. Fig. 8 is a detail view showing the pawls of Fig. 1 for rotating the ratchets.

Referring now to the drawings, and more particularly to Figs. 1 to 4 thereof, each subscriber's station includes the usual transmitter 22, a receiver 11, and a call-bell 12, the receiver being included in the secondary of an induction-coil 13, while the transmitter is included in the circuit of the primary of said coil, and this primary circuit is energized through the medium of a battery 14. The receiver 11 hangs, when not in use, upon a lever or hook 15 of usual construction, and which forms one element of a switch including also points 16 and 17, the lever resting against the upper point 17 when the receiver is in place and resting against the point 16 when the receiver is removed from the hook. The hook is connected with one terminal of the battery 14 by means of a wire 18, while the two points 16 and 17 are connected with the opposite terminal of the battery through wires 19 and 20, respectively, and apparatus connected therewith. The wire 19 leads to the primary of the induction-coil above referred to, and from which leads a wire 21 to the transmitter 22, and from the transmitter 22 there leads a wire 23 direct to said second terminal of the battery. Thus when the receiver is removed from the hook the circuit is from the battery 14, through wire 18 to receiver-hook, to point 16, through wire 19 to primary of induction-coil, to transmitter 22, through wire 23 to battery.

The receiver 11 has one binding-post 25 connected direct to the line-wire 26, while the other post 27 is connected with one terminal 28 of a switch, said terminal being in the form of a finger which is carried by and movable with the hook into and out of contact with a contact-block 29, which is connected electrically with one terminal of the secondary of the induction-coil, the opposite terminal of said secondary being connected with the ground through wire 30. Thus when the receiver is on the hook it and the secondary of the induction-coil are cut out of the line, while when the receiver is removed from the hook the finger 28 engages the block 29, and the receiver is cut into circuit. It

will of course be understood that a different specific switch may be used for thus cutting the receiver and transmitter separately into operative relation to the line when the receiver is removed from the hook and for cutting them out of such operative relation when the receiver is again hung on the hook.

The switch mechanism, which cuts the bell into the line-circuit, is operated through the medium of an electromagnet 31, from one terminal of which leads the wire 20 to the contact 17 of the hook-switch or receiver-switch above described, the opposite terminal of said electromagnet being connected with the pole of the battery 14 opposite to the connection of the wire 20 through wires 32 and 33. The adjacent ends of the wires 32 and 33 are connected with the contact-points 34 and 35 of a relay 36, the armature 37 of which is adapted to bridge the points 34 and 35 when the relay is energized. Thus when the receiver is upon its hook the switch-operating apparatus is in operative relation to the line while the transmitter and receiver are cut out, while when the receiver is off of the hook the receiver and transmitter are cut into operative relation to the line and the switch-operating mechanism is cut out.

The switch-operating mechanism includes two mutilated ratchets 38 and 39, which are loosely mounted upon a common spindle 39′ and with their ratchet-teeth disposed in the same direction. The ratchet 38 carries a contact-finger 40, which is pivoted at the outer end of an arm 41, which extends radially from the ratchet, the outer end of this contact-finger projecting beyond its pivot and being prevented from upward movement from its normal position by means of a stop-pin 42′ on the face of the ratchet. This pin, however, does not prevent downward movement of the outer end of the contact-finger, as will be readily understood.

In the path of operative movement of the contact-finger 40 are two fingers 42 and 43, which are insulated from each other through the medium of a block 44, to which their ends are attached by bending around an edge of the block, this block being fixed to a pivoted lever 46, the pivot of which is formed by the spindle 39′, upon which the ratchet-disks are mounted, and the outer ends of the said fingers 42 and 43 being in rubbing contact with spaced spring-metal strips 47 and 48, whereby electrical connection with the said fingers may be made through these strips for a purpose which will be presently explained, it being seen from the foregoing that when the end of the finger 40 contacts with the fingers 42 and 43 the strips 47 and 48 are electrically connected. The lever 46 is pivotally mounted in order that the fingers 42 and 43 may be so positioned with respect to the normal position of finger 40 that the ratchet 38 must be moved through a predetermined degree to effect a contact of the said fingers, the lever of course enabling this degree of necessary movement to be changed at will. To hold the lever set in proper position, a segmental plate 49 is provided and has perforations 50 for successive engagement by a pin upon the lever. This lever is shifted only in installing the apparatus to set it to operate under proper conditions. The ratchet 38 is rotated with a step-by-step movement by means of a spring-pawl 51, carried by an extension 52 of the armature 53 of the electomagnet 31, said armature being mounted for vibratory movement under the influence of pulsatory energization of the electromagnet. The pawl 51 has such movement that each time the armature 53 is attracted by the electromagnet 31 the ratchet will be advanced one step, and if the contact-fingers 42 and 43 are so positioned that the ratchet must be advanced three steps to bring the finger 40 in contact with fingers 42 and 43 then the circuit of the electromagnet must be closed three times to effect this result. If the fingers 42 and 43 are positioned five steps away, then the circuit must be closed five times in order to cause engagement of the contact-fingers.

It is of course understood that each subscriber on a line has an apparatus, as herein described, which are connected in series, so that the same pulsations that actuate the magnet 31 of one apparatus actuate the corresponding magnets of all of the others. Furthermore, the fingers 42 and 43 of the several subscribers' instruments are spaced different angular distances from the corresponding fingers 40, so that supposing the instrument herein shown to respond operatively to three pulsations then in actuating the magnet 31 to move the finger 40 three steps all of the other instruments, as will be readily understood, will have their fingers 40 moved three steps, and the finger 40 of the instrument that responds operatively to one pulsation will have engaged its corresponding fingers 42 and 43, as will also the instrument which responds to two pulsations, and some means must be provided for preventing the fingers 40 of the one and two step instruments from completing the circuits of their bells when the three-step or any other instrument is being operated. To explain the manner in which this is done, it is necessary first to trace the circuit from central, which actuates the relay, and also the local circuit. The local circuit has been heretofore traced from the battery 14 through the receiver-switch to the magnet 31 and thence to the contacts of the relay and back to the battery. One terminal of the winding of the relay is connected direct to ground through wires 36′ and 30, or to the metallic return, if that be used, while the other terminal is connected with a contact 55 in the path of movement of a finger 56, carried by the lever of the receiver-switch and which is connected by wire 57 with the line-wire 26. The contacts 55 and 56 are engaged when the receiver is in place upon the hook and are disengaged when the receiver is removed. The

relay is energized by the ringing-dynamo 58, located at central and which is brought into the line by depression of a push-button 59. Thus when the push-button is depressed the relay is energized to attract its armature, which bridges the terminals 34 and 35, thus closing the circuit of battery 14 through the magnet 31, it being understood that at this time the receiver is upon its hook. Each time the push-button at central is operated the circuit of the relay is made and broken, so that the local circuit of battery 14 is correspondingly made and broken, and the magnet 31 is intermittently energized to actuate the pawl to advance the ratchet-wheel 38 one step, and thus if the push-button be depressed three times the finger 40 will be advanced three steps, which will cause it to contact with the fingers 42 and 43.

The alarm-bell or call-bell 12 has one terminal connected with the line-wire 26, while the other terminal thereof is connected to ground through the electrically-operated circuit-closer that includes the fingers 40, 42, and 43, above described. Thus the call-bell would be brought into circuit with the ringing-dynamo at central if the circuit were completed when the fingers 40, 42, and 43 were engaged, and it is to prevent completion of this circuit at such times that the additional ratchet-wheel 39 and its coöperating parts are provided. The ratchet-wheel 39 carries a contact plate or finger 60, which is adapted for contact with two fingers 61 and 62 when said finger 60 is rotated with the ratchet-wheel or disk to its lowermost position. The fingers 61 and 62 are insulated from each other, the finger 61 being connected with the bell 12 through the wire 64, while the finger 62 is connected with the contact-strip 47 by wire 65, the second strip 48 being connected to ground through the ground-wire 66 of the relay. If then after the finger 40 has been engaged with the fingers 42 and 43 the finger 60 is engaged with fingers 61 and 62, the circuit of the bell will be completed, the current from the ringing-dynamo coming in over the line 26 to the bell, to finger 61, to finger 60, to finger 62, to strip 47, to finger 42, to finger 40, to finger 43, to strip 48, and through wire 66 to the ground and back to the dynamo at central. The finger 60, however, must not be permitted to engage fingers 61 and 62 until the finger 40 of the instrument being called has contacted with its corresponding fingers 42 and 43, and for this reason the disk 39 is held with the finger 60 raised until the proper number of pulsations have been sent in over the line from the ringing-dynamo to close the local circuit a sufficient number of times to give the required steps to the disk 38 and the finger 40 thereon to contact said finger 40 with fingers 42 and 43. For this purpose the following mechanism is provided: It must be understood that the disk 38 stands normally with the finger 40 raised to its highest point and the arm which carries said finger lying against the stop-pin 42′, this position being insured by removing a segmental piece from the disk 38 adjacent to the contact-finger, so that the opposite portion of the disk is heavier. Also the disk 39 stands normally with the finger 60 in contact with fingers 61 and 62 and may be held in this position yieldably by gravity or by means of a spiral spring 68, attached thereto and to a suitable support. A second pawl 69, of spring metal, is carried by the extension of the armature 53 and in operative relation to the teeth of the mutilated ratchet 39, and when the said armature is in its normal or unattracted position the pawl 69 is in contact with the ratchet 39, while the pawl 51 is out of contact with the ratchet 38. When the two pawls are advanced by energization of the magnet 31, the pawl 69 gives ratchet 39 a sudden shove, which throws it up to or approximately to the position shown in Fig. 1, while corresponding movement of pawl 51 moves ratchet 38 a certain definite angular distance, which is one step in its movement. Each successive sudden forward movement of the armature 53 and therewith of the pawls advances both disks unless the disk or ratchet 39 has reached the position in Fig. 1, the disk 38 being continued in its advancement so long as the pulsations are sent in until it has reached its limit of movement, while after disk 39 has been rotated through about ninety degrees the mutilated portion of the disk is brought into play and the pawl 69 moves idly over it; but the last tooth of said ratchet-disk prevents return movement of the disk until the pawl 69 is raised bodily therefrom, as will be hereinafter explained. When the disk 38 has reached the limit of its movement, its mutilated portion also comes into play and the pawl 51 has no further effect of rotation. To prevent return movement of the ratchet-disk 38, a retaining-pawl 70 is provided and is carried by the contact spring-finger 61, and this retaining-pawl remains in contact with the disk 38 until disk 39 is released to permit engagement of finger or plate 60 with fingers 61 and 62, when finger 61 is depressed to a sufficient extent to withdraw the pawl 70 from the ratchet-disk.

It being understood that the present apparatus requires three electrical impulses to operate it, the push-button at central is pushed twice quickly and on the third push is held down. These three pushes effect the operation of the pawls in the manner hereinbefore described, the disk 38 being advanced three steps to contact its finger 40 with fingers 42 and 43. The first movement of pawl 69 raises plate or finger 60 from its normal position against fingers 61 and 62 and may or may not move it to its limit, while the second movement of said pawl may or may not move the disk 39 to its limit if it has not already reached that point. If it has reached its limit, the pawl plays idly in the mutilated portion of the ratchet-disk. On the third impulse, which

moves the finger 40 into contact with fingers 42 and 43, the disk 39 must be released to permit finger or plate 60 to return to contact with fingers 61 and 62. To raise the pawl 69 to release disk 39, an upward and forward projection 71 is formed on said pawl, and when the pawl is moved forward to its limit this projection strikes and rides upwardly upon a pin 72, the upward riding movement being sufficient to raise pawl 69 from disk 39. So long as the third depression of the button at central is maintained so long will the pawls 51 and 69 be held in their forward positions, the pawl 51 holding the ratchet-disk 38 with its finger 40 against fingers 42 and 43 and the plate or finger 60 lying against fingers 61 and 62 to complete the circuit of the bell 12, it being understood that when the circuit of the bell is thus completed the current from the dynamo at central divides at the subscriber's instrument, part passing through the relay to hold it closed and part passing through the bell to operate it, the bell and relay being connected in multiple. When the push-button at central is released after the last continued push, the relay-circuit is broken, which breaks the local circuit, and the bell is cut out because the pawls 51 and 69 are released to permit the disks 38 and 39 to return to their normal positions hereinbefore mentioned. Supposing that a subscriber on the line is called whose instrument has fingers 42 and 43 located five steps from the normal position of finger 40, then the three-step instrument will not be operated to complete its call-bell circuit, for the reason that the third pulsation sent over the line will be just as short as the first and second pulsations, and while the finger 40 will contact with fingers 42 and 43 the pawl 69 will not be operated to release the disk 39 to contact the plate 60 with fingers 61 and 62. It is only the fifth impulse that is made long when the five-step instrument is to be operated. This explanation applies to all of the instruments as to why the few-step instruments are not operated successively when an instrument with more steps is operated.

With this construction and the circuits described it will be seen that with the receiver upon its hook the receiver is out of circuit with the line, as is also the transmitter, while the relay is in circuit with the line, as is also the bell, save for the automatic circuit-closer. Also the local circuit of magnet 31 is closed save for the relay, and the apparatus may be operated, as above described, to ring up the subscriber. When the receiver is removed from its hook, however, the bell, the relay, and the switch-magnet 31 are cut out of their respective circuits, while the transmitter is cut into the local circuit of battery 14 and the receiver is cut into the line, and the instrument is then ready for talking. Thus by operating the push-button at central the proper number of times the corresponding subscriber's bell will be operated.

Central is of course provided with the usual switchboard for connecting up the different subscribers on different lines, and this structure need not be herein described.

In Fig. 5 of the drawings there is shown a modification wherein a single ratchet 75 is employed, which is in the form of a segment pivoted at its center of curvature upon a spindle 76, and this ratchet carries a contact-finger 77, adapted for movement with the ratchet, into contact with the fingers 78 and 79, corresponding to the fingers 42 and 43, to close the bell-circuit, the ratchet 75 being moved by means of a pawl 80, carried by the extension of the armature of the switch-magnet 31, the pawl acting to advance the ratchet one step for each time the circuit of the magnet is closed. Additional contact-fingers 81 and 82 are included in the bell-circuit and correspond to and are for the same purpose as the fingers 61 and 62 above described, the circuit between these fingers being closed by means of a pendulum 80′ when the latter is in its normal position. To prevent engagement of the pendulum with fingers 81 and 82, excepting when the circuit of the magnet 31 is held closed for longer than usual, a dog 83 is pivoted upon the pawl 80 and rests with its forward end against a pin 84 upon the pendulum, while adjacent the outer end of the pawl is an upright 85. When the magnet 31 is operated to bring the finger 77 up to the fingers 78 and 79 by the short closing of the circuit of the magnet, as hereinbefore described, the dog 83, acting against the pin 84, throws the pendulum 80 forwardly and from the fingers 81 and 82, so that the pin travels beyond the upright 85, and when the pawl 80 is returned for the next forward stroke it moves more quickly than does the pendulum, so that the pin 84 lodges behind the upright 85, and this upright swings the pendulum at the next forward movement of the pawl. So long as the strokes of the pawl are short so long the pin 84 stays beyond the upright 85; but when the push-button at central is finally held down on the last push the upright is retained at the forward limit of its movement, which is beyond the path of movement of the pin 84, and the pendulum is permitted to swing back and engage the fingers 81 and 82 to complete the circuit of the bell. When the circuit of magnet 31 is broken, the pawl 80 returns and the ratchet is permitted to rotate rearwardly and move its finger from the fingers 78 and 79.

In Fig. 6 of the drawings there is shown a construction including two disks 38 and 39, the same as in the first instance, the disk 38 carrying the finger 40 for contact with fingers 42 and 43. (Not shown.) The disks are operated in the same manner forwardly; but to return the disk 39 it is provided with a pinion 90, with which is engaged a segmental gear 91 at the end of a pivoted lever 92, having a counterbalancing-weight 93. The weight holds the lever normally in position to contact a plate 94, corresponding to plate

60, with fingers 61 and 62, which correspond to the fingers in the first construction described. When the disk 39 is shoved forward by its pawl, the pinion is rotated to bring the segmental gear down and draw the plate 94 from the fingers 61 and 62, and when the said pawl is finally operated to disengage the disk 39 the weight of the lever operates it to lift the segmental gear and reverse the pinion and return the disk 39, the plate 94 returning to engage the fingers 61 and 62. The retaining-pawl 95 for the disk 38 is pivoted in the path of movement upwardly of a pin 96 upon the lever 92, and when this lever is in its normal raised position the said retaining-pawl is held thereby out of engagement with the disk 38. When the lever is moved downwardly, however, the retaining-pawl is dropped into operative position.

The structure of the circuit-closer has the same general operation in each instance, and it will be understood that in practice various modifications of the structures shown may be made and that any suitable materials and proportions may be used for the various parts without departing from the spirit of the invention.

What is claimed is—

1. A device of the class described comprising a plurality of sets of relatively fixed and movable contacts of which the contacts of one set are normally engaged, and electromechanical means for disengaging the normally-engaged contacts and simultaneously moving the movable contact of the other set toward engagement with its corresponding contact and subsequently permitting reëngagement of the first set of contacts.

2. A device of the class described comprising an alarm-circuit, a circuit-closer for said circuit comprising a plurality of relatively fixed and movable sets of contacts, of which the contacts of one set are normally engaged, and electromechanical means for disengaging the normally-engaged contacts and for simultaneously moving the movable contact of the other set toward engagement with its corresponding contact and for permitting reëngagement of the normally-engaged contacts after the second set of contacts are engaged.

3. A device of the class described comprising an alarm-circuit, a circuit-closer for said circuit comprising a plurality of series of relatively fixed and movable contacts, of which the contacts of one set are normally engaged, electromechanical means for disengaging the normally-engaged contacts and for simultaneously moving the movable contact of the other set toward engagement and for permitting reëngagement of the normally-engaged contacts after the engagement of the second set, and means for varying the relative positions of the contacts of the second set with respect to each other.

4. A device of the class described comprising two sets of relatively fixed and movable contacts, the contacts of one set lying normally disengaged and the contacts of the other set lying normally engaged, an electromagnet having an armature, independent means operably connected with said armature for moving the contacts simultaneously from their normal positions to engage the normally-disengaged contacts, means for holding the normally-engaged contacts in disengaged position, and means for releasing the normally-engaged contacts when the normally-disengaged contacts have been engaged, to permit reëngagement of the normally-engaged contacts.

5. A device of the class described comprising independently-pivoted ratchets each carrying a contact, contacts for engagement by the contacts of the ratchets, one pair of contacts lying normally engaged and the other pair lying normally disengaged, an electromagnet having an armature, a pawl for each ratchet operably connected with the armature for movement to operate the ratchets simultaneously from their normal positions to engage the normally-disengaged contacts, and means in the path of the pawl of the ratchet which carries the normally-engaged movable contact, for disengaging said pawl and holding it disengaged to permit said ratchet to return and reëngage the normally-engaged contacts.

6. A device of the class described comprising an alarm or signal circuit, a circuit-closer for said circuit comprising two sets of relatively fixed and movable contacts, the contacts of one set lying normally engaged and the contacts of the other set lying normally disengaged, a ratchet carrying each of the movable contacts, a pawl for operating each ratchet means for operating the pawls simultaneously to actuate the ratchets to move the contacts from their normal positions to their relatively opposite positions, a retaining-pawl for the ratchet carrying the normally-disengaged movable contact, and means for disengaging the pawl of the ratchet of the normally-engaged movable contact to permit it to return to its normal position, said retaining-pawl lying in the path of return movement of the normally-engaged contact for disengagement thereby from its ratchet.

7. A device of the class described comprising independently-pivoted ratchets each carrying a contact, contacts for engagement by the contacts of the ratchets, one pair of contacts lying normally engaged and the other pair of contacts lying normally disengaged, a pawl for operating each ratchet, a common means for actuating the pawls, the pawl of the ratchet that carries the normally-disengaged contact lying normally out of engagement with said ratchet and the other pawl lying normally in engagement with its ratchet, said ratchets when actuated being adapted to move their contacts from their normal positions to their opposite positions, a retaining-pawl for holding the normally-disengaged contact in operative position, said retaining-

pawl being operable by return movement of the normally-engaged contact to release said normally-disengaged contact, and means for releasing the pawl of the ratchet of the normally-engaged contact to permit it to return.

8. A device of the class described comprising an electric circuit, and a circuit-closer for said circuit, said circuit-closer including two pivoted ratchets, a movable contact carried by each ratchet, a fixed contact for each of the movable contacts, said contacts being included in said circuit, one pair of coöperating contacts lying normally engaged and the other pair lying normally disengaged, an electromagnet having a vibratory armature, an operating-pawl for each ratchet operably connected with the armature, the pawl of the normally-engaged contact lying normally engaged with its ratchet and the other pawl lying normally disengaged, a retaining-pawl for the last-named ratchet, said ratchets being movable by their pawls to move the contacts from their normal positions to their reversed positions, a stop in the path of movement of the pawl of the ratchet of the normally-engaged contact for raising said pawl from engagement, and means for returning the ratchets when released, the retaining-pawl being adapted for disengagement when the normally-engaged contact is returned, to permit return movement of the normally-disengaged contact.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

WILLIAM D. WATKINS.

Witnesses:
FRANK S. APPLEMAN,
GEO. H. CHANDLEE.