(No Model.) 3 Sheets—Sheet 1.

A. L. CREELMAN.

CIRCUIT PROTECTING SOUNDER.

No. 584,465. Patented June 15, 1897.

Fig. 1.

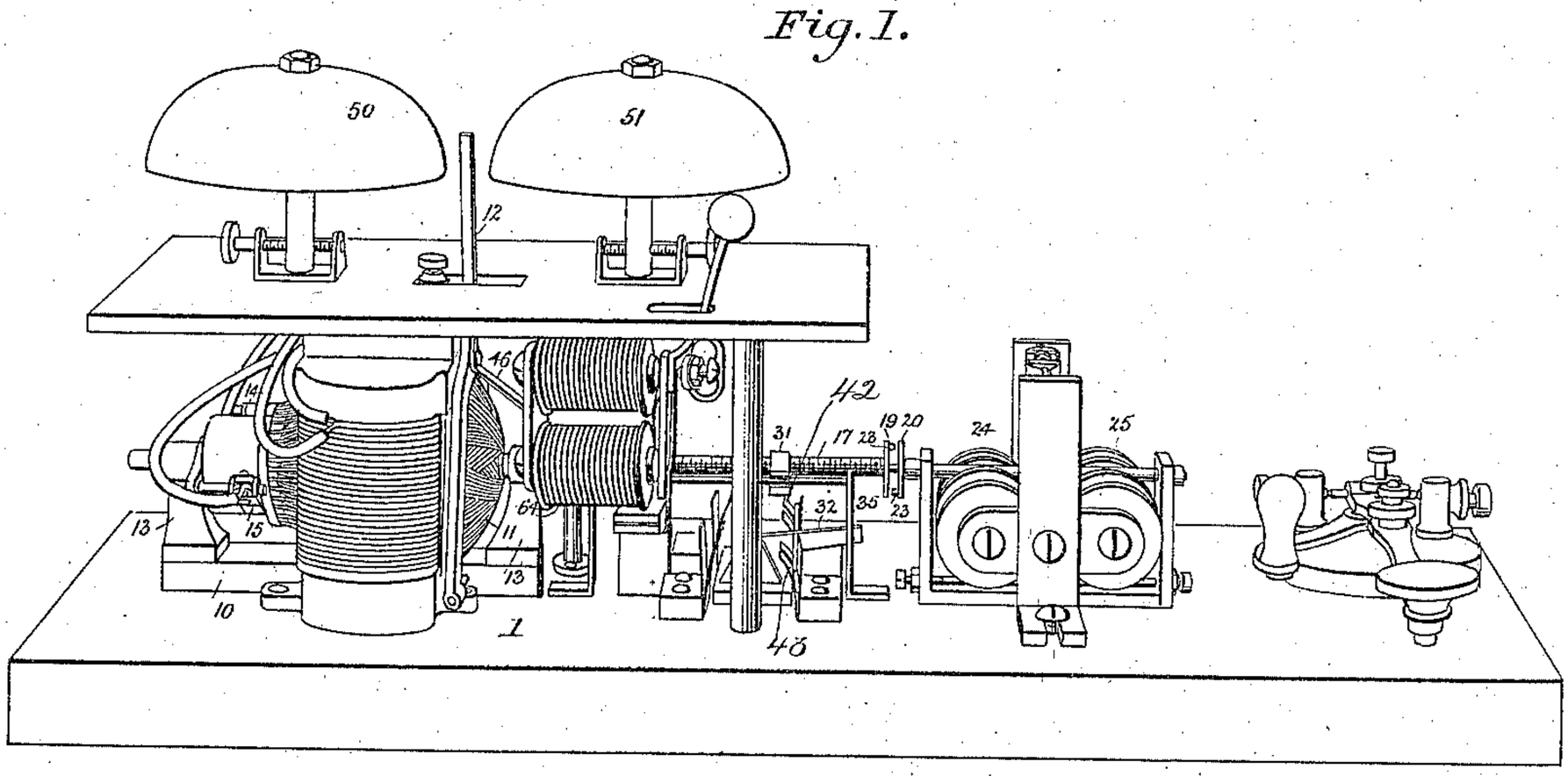
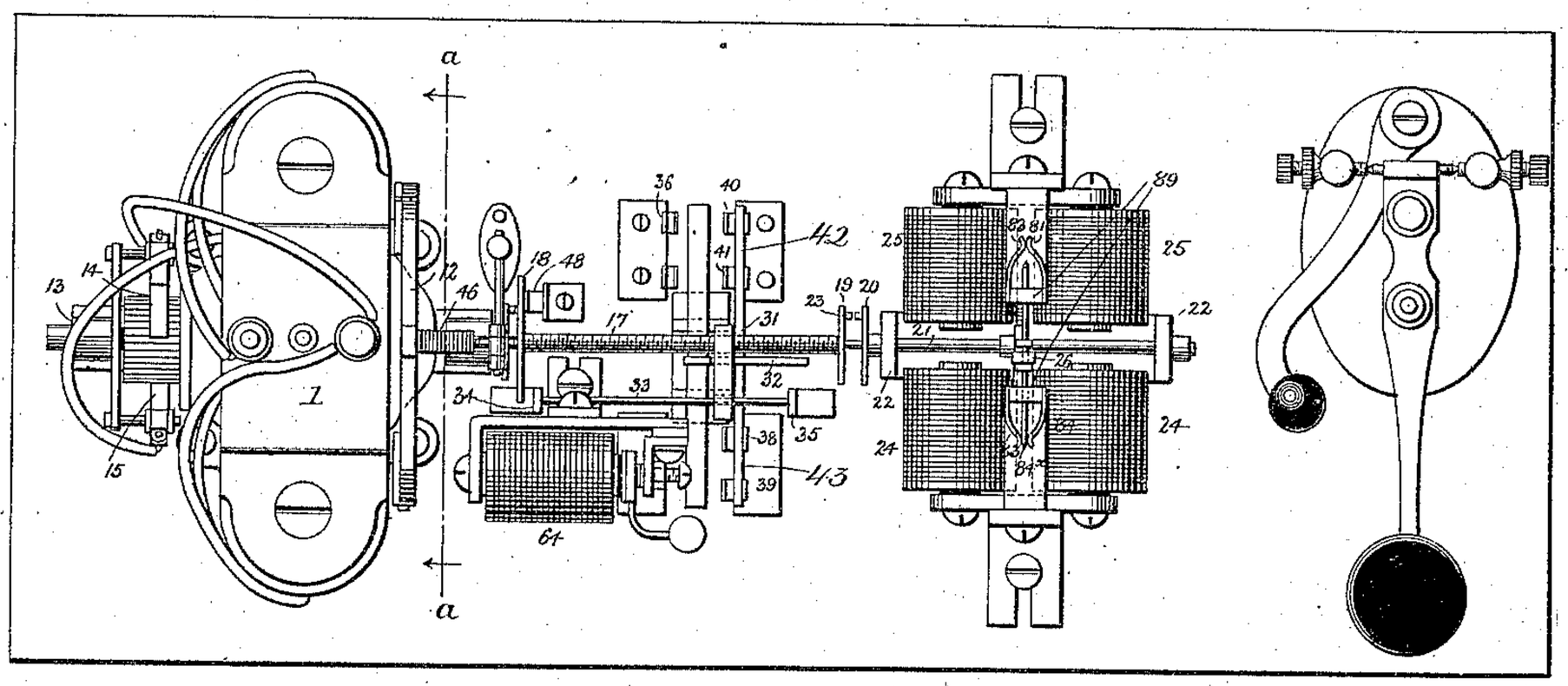


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

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CIRCUIT PROTECTING SOUNDER.

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Fig. 3.

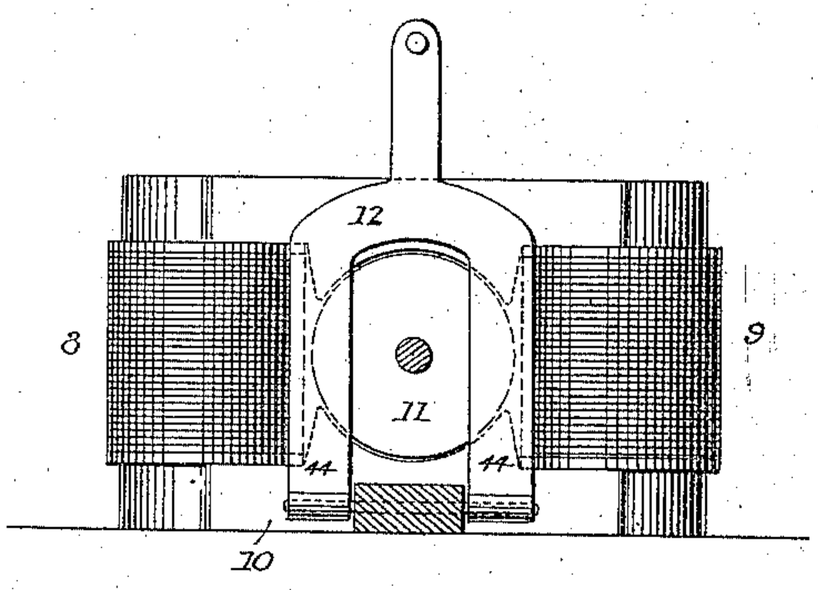


Fig. 4

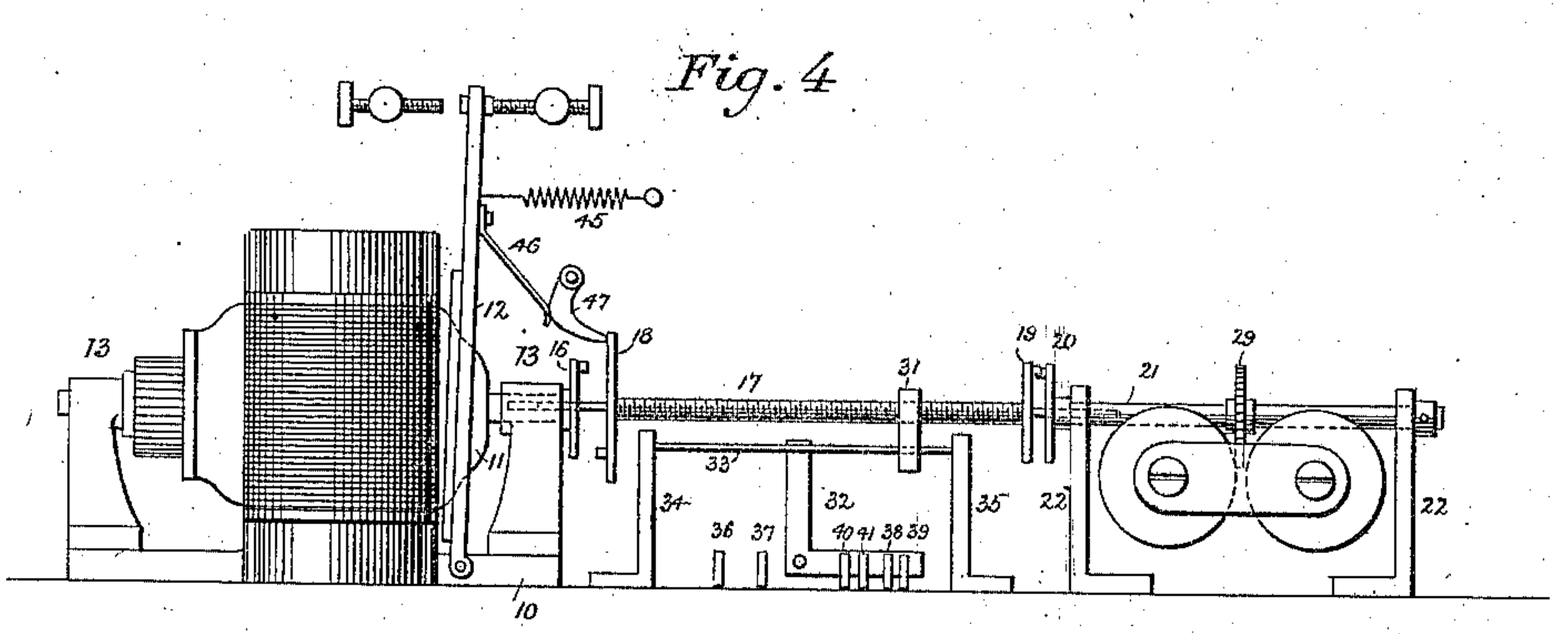
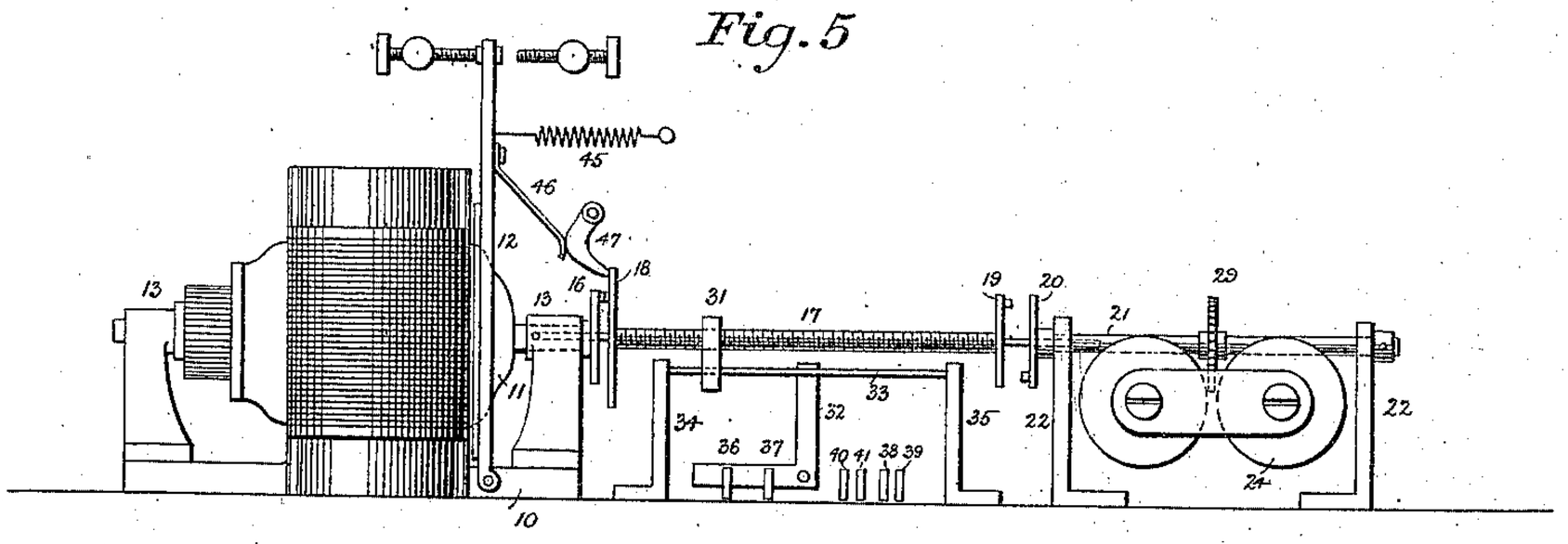


Fig. 5



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3 Sheets—Sheet 3.

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CIRCUIT PROTECTING SOUNDER.

No. 584,465.

Patented June 15, 1897.

Fig. 6.

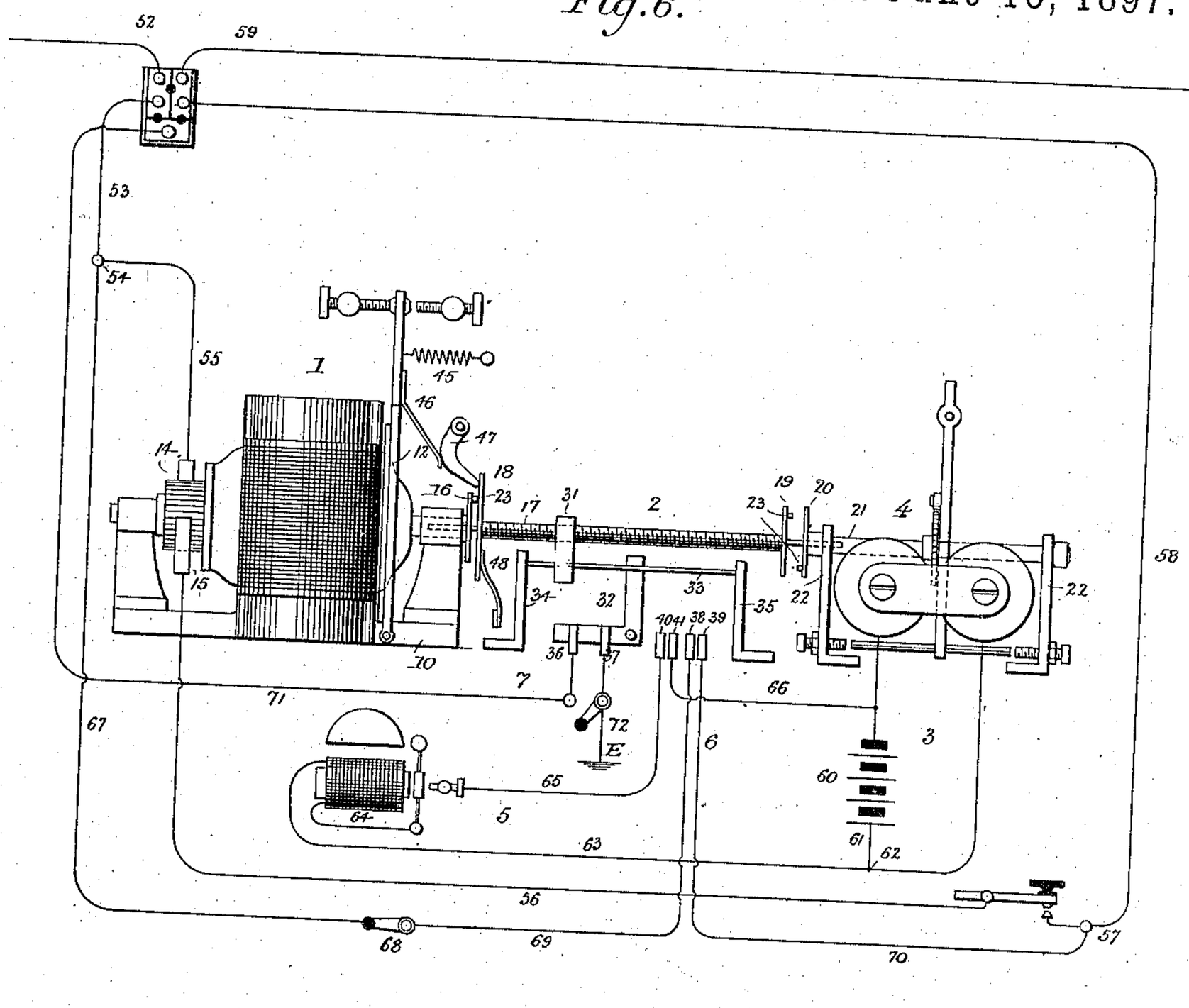
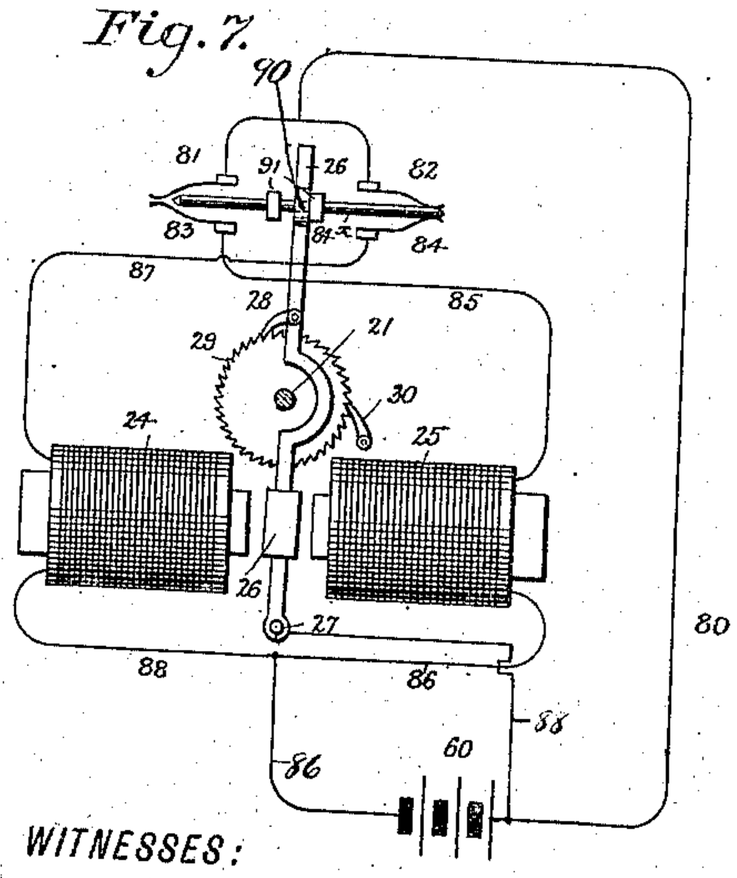


Fig. 7.



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UNITED STATES PATENT OFFICE.

ALVAH L. CREELMAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE CIRCUIT PROTECTING SOUNDER COMPANY, OF MEMPHIS, TENNESSEE.

CIRCUIT-PROTECTING SOUNDER.

SPECIFICATION forming part of Letters Patent No. 584,465, dated June 15, 1897.

Application filed May 18, 1896. Renewed February 26, 1897. Serial No. 625,178. (No model.)

To all whom it may concern:

Be it known that I, ALVAH L. CREELMAN, of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Circuit-Protecting Sounders, of which the following is a specification.

This invention has reference to sounders and circuit-protectors to be used more particularly in connection with telegraphic circuits; and the invention consists in an improved apparatus combining the functions of a sounder and circuit-protecting devices, the said parts operating to automatically give an alarm and shunt the instruments when the main-line current is interrupted for a predetermined time and to open a ground-circuit.

The invention comprehends, incidentally, various features of construction and combinations of parts, which will be fully pointed out in the specification and claims.

In the accompanying drawings, Figure 1 is a perspective view of my improved apparatus in the form in which it is embodied for practical application to telegraphic circuits. Fig. 2 is a top plan view of the same with portions of the mechanism removed to expose other parts to view. Fig. 3 is a sectional elevation of the sounder as taken on the line *a a*, Fig. 2, and viewed in the direction indicated by the arrows therein. Fig. 4 is an elevation on an enlarged scale of the apparatus, showing the sounder-armature and other parts in the position they will occupy when the main-line circuit has remained open for a predetermined time. Fig. 5 is a similar view with the parts in the positions they will occupy when the main-line circuit is closed and in operation. Fig. 6 is a view, in the nature of a diagram, of the apparatus and circuits controlled thereby. Fig. 7 is a similar view of one branch of the local circuit by which a portion of the apparatus is operated.

Referring to the drawings, my apparatus comprises a sounder 1, a circuit-controlling mechanism 2, controlled by the sounder, a normally closed local circuit 3, including mechanism 4, operating in conjunction with the sounder, a normally open alarm-circuit 5, included in the local circuit, a normally open shunt-circuit 6, and a ground connection 7, adapted to be opened when the shunt and alarm circuits are closed. The parts and circuit connections operate to automatically close the alarm and shunt circuits when the main-line current is interrupted or broken for a predetermined time and to incidentally open the ground-circuit, so that when the main line is thus shunted around the inoperative instruments there will be no liability of grounding the line. The sounder, which is shown more particularly in Figs. 3 and 4, consists of two electro field-magnets 8 and 9, fixed to a suitable base 10, a revolving core-armature 11, which operates the circuit-controller 2, and a vibrating armature 12, which acts as a sounder, as will be more fully described hereinafter.

The rotary armature is mounted in suitable bearings 13, rising from the base on opposite sides of the magnets, and is provided, as is usual in electromotors, with commutator-brushes 14 and 15, by which the current in the main-line circuit is conducted to the magnets. When the main line is in operation or closed, this armature revolves continuously and gives motion to a clutch-disk 16, fixed to its inner end. Extending in line with this armature is an exteriorly-threaded horizontal shaft 17, sustained so as to be capable of a limited endwise movement. On its opposite ends the shaft is provided with clutch-disks 18 and 19, which are adapted by the end motion of the shaft to be engaged alternately with the clutch-disk on the rotary armature and with a clutch-disk 20 on the inner end of a continuously-rotating shaft 21, mounted in bearings 22, rising from the base of the instrument, as shown in Fig. 1. The bearings for the ends of the threaded shaft are formed by the inner ends of the rotary armature-shaft and rotary shaft 21, respectively, which shafts are formed with longitudinal sockets or openings in which the ends of the threaded shaft loosely extend, the parts being so formed that the threaded shaft will be capable of a slight endwise movement sufficient to permit of the alternate engagement and disengagement of the clutch-disks. The clutch-disks on the ends of the threaded shaft are provided on their faces with projecting lugs

or pins 23, which when either of the disks is moved adjacent to either of the rotary disks will extend in the path of corresponding pins on the rotary disks, and the threaded shaft will thereby be driven in the direction of the engaging rotary disk. The length of the pins on the clutch-disk and the amount of end motion of the shaft are such that the latter may occupy an intermediate position between the disks 16 and 20, in which position, neither of the disks being engaged, the shaft will remain motionless.

The rotary shaft 21 is operated by electromagnets 24 and 25, included in the normally-closed local circuit 3, through the medium of the continuously-vibrating armature 26. This armature is pivoted at its lower end on a horizontal axis 27, parallel to the axis of the shaft, and vibrates between the electromagnets, which are located on opposite sides of the shaft, means being provided, as will be more fully described hereinafter, to energize and deënergize the magnets alternately by the movements of the armature to cause the uninterrupted vibration of the latter. The armature where it extends past the shaft is bent outward to avoid the same, and is provided with a pawl 28, in position to engage the teeth of a ratchet-wheel 29, fixed to the shaft, every alternate stroke of the armature being thus caused to advance the ratchet-wheel and the connected shaft. The reverse movement of the shaft is prevented by a fixed dog 30, in position to engage the teeth of the wheel. By the means described the armature is vibrated rapidly and continuously. The energizing and deënergizing of the magnets being caused automatically by the movement of the armature, the latter will impart to the shaft a practically continuous rotary motion in a direction opposite to that of the rotary sounder-armature before alluded to.

The threaded shaft 17 is by its rotation in opposite directions caused to move a finger or nut 31 back and forth, and this nut is arranged to engage and operate a circuit opener and closer 32, which when in one position maintains the closure of the ground-circuit at that point and when in the other position maintains the closure of the alarm-circuit 5 and the shunt-circuit 6. The nut is formed in its end with a notch which embraces a rod 33, fixed between the upper ends of two standards 34 and 35, rising from the base. The rod serves to prevent the nut from being carried around with the shaft, the result being that the rotation of the shaft will advance the nut along the same.

The circuit opener and closer 32 is in the form of an angular lever pivoted at its corner between the contact-points of the several circuits referred to, which contact-points are each in the form of two spring-fingers, those of the ground connection being indicated at 36 and 37, the shunt-contacts at 38 and 39, and the alarm-circuit contacts at 40 and 41. Lateral arms 42 and 43 on the angular lever are adapted to extend, respectively, between the spring-fingers of the contact-points when the lever is thrown in its different positions.

When the angular lever is in the position shown in Figs. 5 and 6, the lateral arm 42 thereon will extend between the spring-fingers of the contact-points 36 and 37 of the ground-circuit and the circuit will be closed at this point. When, however, the angular lever is thrown on its pivot to the opposite position, that shown in Fig. 4, the arm 43 thereon will extend between the spring-fingers of contact-points 38, 39, 40, and 41 of the alarm and shunt circuits and these circuits will be closed. The angular lever is so arranged relatively to the traveling nut that when in either position one leg of the lever will be in a vertical position in the path of the nut, so that the movement of the nut back and forth will act to throw the lever first in one position, closing certain circuits and opening others, and then in another position, opening the closed circuits and closing the open ones. In order that this action of the circuit making and breaking lever may be governed and controlled by the sounder, I construct the vibrating armature 12 with two legs 44 at its lower end, which legs are pivoted to the base of the magnet and which extend in the lines of force of the two magnets. At its upper end the armature is acted on by a spring 45, which tends to pull the same in opposition to the magnets and to the position shown in Fig. 4. Below the spring the armature is provided with a finger 46 in position to engage a pivoted pawl 47, which in turn engages the clutch-disk 18 of the threaded shaft. When the sounder-magnets are energized, the vibratory armature will be drawn to a vertical position and the finger and pawl being disengaged the threaded shaft will be forced to the left by a spring 48, fixed to the base and engaging the disk 18, and the latter will be caused to engage the disk 16 of the rotary sounder-armature. When, however, the sounder-magnets are deënergized, the spring 45 will pull the vibratory armature to the position shown in Fig. 4, and the finger thereon will engage the pawl 47 and force the latter against the clutch-disk 18, and the threaded shaft will be moved slightly to the right, disengaging itself from the rotary sounder-armature and engaging with the rotary shaft 21.

Under normal conditions when the main line is in operation in transmitting messages the vibratory armature will be vibrated corresponding to the "make" and "break" of the telegraphic code, and the threaded shaft will, by the movement of the armature and its spring 48, be alternately disengaged and engaged with the clutch-disk of the rotary armature, but not long enough to permit the armature to impart a rotary motion to the shaft, and the parts will remain in the position shown in Fig. 5 with the nut to the left and the alarm and shunt circuits open. If now the current in the main line be inter-

rupted for a longer period of time than occurs during the transmission of messages, as by imperfect connections or the accidental leaving of the key open, the vibratory armature will be pulled by its spring to the position shown in Fig. 4, and the finger acting through the pawl on the disk will push the shaft to the right and engage the same with the rotary shaft 21. The rotation of the threaded shaft will feed the nut to the right, and the latter, engaging the angular lever 32, will turn it on its pivot to the position shown in Fig. 4, thereby opening the ground-circuit and closing the alarm and shunt circuits. This will cause the alarm to be sounded and will shunt the entire mechanism. The nut 31 will be fed along to the right until it contacts with post 35, which will arrest its motion. The continued rotation of the shaft, in consequence of the obstruction to the motion of the nut, causes the shaft to be moved bodily to the left through the nut, thereby disengaging the clutch-disks 19 and 20, and the motion of the shaft will cease. The parts will remain in this position until the mechanism is "reset," which is accomplished by positively opening the shunt-circuit, as at normally-closed switch 68, and the main current, which in the meantime has been reëstablished, passing to the sounder-magnet, the vibratory armature will be attracted and the spring 48 will throw the threaded shaft to the left in engagement with the rotary armature. The shaft will be revolved now in the opposite direction and the motion will feed the nut to the left and will turn the angular lever to its opposite position, thereby opening the alarm and shunt circuits at these points, and the mechanism will operate as before.

When the main-line current is intact and the line closed through the transmitting-key when the latter is not being used, the vibratory armature being in an upright position, the spring 48 will tend to engage the clutch-disks 16 and 18, the result being that the nut 31 will be fed against the post 34. The motion of the nut being arrested by the post, the continued rotation of the shaft will move it bodily to the right through the nut to an intermediate position between the disks 16 and 20, and the clutches being disengaged the shaft will come to a rest.

The sounder vibratory armature 12 may vibrate at the upper end between the usual stops or between the alarm-bell 50 and a second bell 51, located adjacent thereto.

The arrangement and course of the various circuits referred to above are as follows:

The main-line circuit enters a switchboard 52 and passes thence through conductor 53 to binding-post 54, thence through conductor 55 to the sounder, and leaving the same passes by the conductor 56 to binding-post 57, thence through conductor 58 to the switchboard, and finally leaves the same by conductor 59.

The alarm-circuit is a branch of the local circuit 3, before alluded to as operating the rotary shaft 21. It is fed by local battery 60, whence it passes in one direction through conductor 61 to binding-post 62, thence through conductor 63 to the bell-magnet 64, thence through conductor 65 to contact-point 40. It passes from the battery in the other direction through conductor 66 to contact-point 41. As before stated, these contact-points are in the form of spring-fingers which are adapted to receive between them the arms on the angular lever, which acts to close the circuit at this point.

The shunt-circuit starts from the binding-post 54 and passes by conductor 67 to normally-closed switch 68, which is employed for resetting the instrument, as described, whence it passes by conductor 69 to contact-point 38. The circuit starts again at contact-point 39 and passes by conductor 70 to binding-post 57 in the main-line circuit.

The ground-circuit starts from the switchboard and passes by conductor 71 to contact-point 36, and starting again at contact-point 37 it passes by conductor 72 to the ground, as at E. This circuit is normally disconnected at the switchboard, and when the line is operating the angular lever maintains the closure of the circuit at the contact-points, so that in a case of emergency, when the line is in operation, if it is desired to ground the same it will only be necessary to insert the proper plug. When the line is inoperative, as before described, and shunted around the mechanism by the closure of the shunt-circuit, the ground is broken at the contact-points, so there will be no liability of the main line being grounded and the main circuit interrupted at this particular station. In the event of its being desired to ground the main line when the ground-circuit is open at the contact-points I propose to provide a normally-opened switch 73 in the ground-circuit, which switch, when closed, will shunt it beyond the contact-points.

The circuits and mechanism for automatically and alternately energizing the magnets which drive the rotary shaft 21 are included in local circuit 3, as shown in Figs. 6 and 7. From the battery 60 the circuit passes by conductor 80 to contact-points 81 and 82. Opposite these contact-points are located two contact-points 83 and 84, all of which are in the form of spring-fingers, between which a rod $84^{\times}$, hereinafter described, is adapted to extend and close the circuits at these points. From the contact-point 83 the current passes through conductor 85 to magnet 25, thence back to the battery by conductor 86. From the contact-point 84 the current passes by conductor 87 to magnet 24, thence by conductor 88 to battery.

The rod for closing the circuits at the contact-points is movable horizontally and transversely of the shaft 21 and is mounted in fixed guides 89. It extends freely through an opening 90 in the vibratory armature 26, and on opposite sides of the armature it is provided

with fixed abutments or stops 91, which as the armature vibrates are engaged by the same and the rod is caused to be moved endwise and alternately between the contact-fingers 81, 83, 82, and 84. Assuming the parts to be in the position indicated in Fig. 7, with the bar extending between contact-points 82 and 84, the circuit is completed by the conductors described through magnet 24, which will immediately attract the armature, rotating the shaft 21 through the ratchet-wheel and causing the rod to be pushed to the left, thereby breaking the circuit at contact-points 82 and 84 and establishing the other circuit at contact-points 81 and 83 and energizing the magnet 25. This magnet will now attract the armature and pull it back, thereby again establishing the circuit through contact-points 82 and 84 and magnet 24 and breaking it at contact-points 81 and 83 and through magnet 25. It is seen, therefore, that the making and breaking of the two circuits are performed automatically, and that consequently the armature will be vibrated continuously between the magnets and will impart to the shaft 21, through the medium of the ratchet-wheel, a continuous rotary motion.

I propose to connect the battery with the armature 26 by means of conductor 88, so that if the contact-bar does not make perfect contact with points 81 and 82 the circuits through the magnets will be completed through the armature instead of through the conductor 80, which is connected to contact-points 81 and 82. When thus connected, assuming the parts to be in the position shown in Fig. 7, the circuit through magnet 24 will be completed through conductor 84 87, magnet 24, conductor 88, the battery, thence through conductor $88^{\times}$ to armature 26 and contact-bar $84^{\times}$. When the contact-bar is in its other position between points 81 and 83, the circuit through magnet 35 will be completed through conductors 83 85, magnet 25, conductor 86 $86^{\times}$, battery 60, conductor $88^{\times}$, armature 26, and contact-bar $84^{\times}$. It is seen, therefore, that both circuits are completed without the current traversing the conductor 80.

In a continuously-vibrating apparatus as heretofore constructed the circuits, as far as I am aware, have been broken immediately after being completed, the armature moving by the impetus given it during the temporary closure of the circuits. Hence the full force of the current has not been obtained. In my apparatus, however, owing to the space between the two abutments 91, the armature does not contact with said abutments and shift the contact-bar until it has reached the limit of its stroke under the positive attraction of the magnets. In this way I am enabled to utilize the full force of the magnet.

In the use of relays and sounders great difficulty has been experienced and constant attention is required to maintain their proper adjustments, more particularly in damp weather, when the vibratory armature has a tendency to adhere to the magnets when the current is stronger than usual. With my improved sounder the action of the armature is not interfered with in unfavorable weather or under the influence of strong currents for the reason that the current is continually changing from one leg of the armature to the other on account of the changing of the lines of force. Under these conditions the vibrating armature will move freely with each interrupted electric impulse without adhering. Further, far better results are obtained from a vibrating armature of my character operating in a magnetic field where lines of force are varying than with both forms of armatures.

Having thus described my invention, what I claim is—

1. The combination of a main-line circuit, a key and sounder therein, a normally open circuit adapted when closed to shunt the instruments, a circuit-controller for closing and opening said circuit, a mechanism for operating the circuit-controller to close the circuit, a second mechanism for operating the circuit-controller to open the circuit, an electrically-operated device included in the main-line circuit for operatively connecting the circuit-controller with one of its mechanisms when the main-line circuit is interrupted for a predetermined time and means for operatively connecting the circuit-controller with its other operating mechanism when the main-line circuit is closed.

2. The combination of a main-line circuit, a key and sounder included therein, a normally open circuit adapted when closed to shunt the instruments, a circuit-controller for closing and opening said circuit, a local circuit, a continuously-acting electrically-operated mechanism 4, included therein adapted to operate the circuit-controller to close said circuit, a continuously-acting electrically-operated mechanism 1, included in the main-line circuit for operating the circuit-controller to open said circuit, an electrically-operated device in the main-line circuit for operatively connecting the circuit-controller with the mechanism 4, when the circuit in the main line is interrupted for a predetermined time and means for operatively connecting the circuit-controller with the mechanism 1, when the circuit in the main line is closed, substantially as shown and described.

3. The combination of a main-line circuit, a sounder included therein and formed in addition to its usual vibrating armature with a rotary core-armature 11, a normally open circuit, a circuit-controller for closing said circuit, a local circuit, an electrically-operated mechanism included therein, a rotary shaft adapted to be driven by said mechanism continuously in a direction opposite to that of the core-armature, an intermediate shaft, a finger mounted on said shaft and adapted to be moved thereby to operate the circuit-controller, devices acted on by the vibratory ar-

mature for operatively connecting the intermediate shaft with the rotary shaft 21, when the main-line circuit is interrupted for a predetermined time and means for disengaging said intermediate shaft and connecting it with the rotary core-armature when the main line is closed, substantially as described.

4. The combination of a main-line circuit, a sounder 1, included therein, a continuously-operating core-armature for said sounder in addition to its usual vibratory armature, a normally open shunt-circuit, a normally open local circuit including an alarm mechanism, a circuit-controller 32 adapted when moved in one position to close said circuits and when moved in the other position to open the same, a normally closed local circuit, a continuously-operating mechanism included therein, a horizontal shaft 21, driven continuously by said mechanism, an exteriorly-threaded intermediate shaft extending in line with the shaft 21, and the core-armature and capable of a limited endwise motion, clutch devices between the ends of said shafts, a nut or finger 31, encircling the said shaft and adapted to be moved back and forth by the rotation of the same in opposite directions, and to operate the circuit-controller, devices acted on by the vibratory armature to move the threaded shaft endwise and engage it with the shaft 21, when the main-line circuit is interrupted for a predetermined time and a spring or its equivalent for moving the threaded shaft in the opposite direction to engage it with the core-armature 11, when the main-line circuit is closed, substantially as described.

5. The combination of a main-line circuit, a sounder included therein, a normally open circuit adapted when closed to shunt the instrument, a circuit-controller for closing said circuit, a ground-circuit maintained normally closed at one point by said circuit-controller and adapted to be opened when the other circuit is closed and vice versa, a mechanism for operating the circuit-controller to close said first-named circuit, a second mechanism for operating the circuit-controller to open the same, devices acted on by the vibratory sounder-armature for operatively connecting the circuit-controller with the first-named mechanism when the main line is interrupted for a predetermined time, and means for operatively connecting the circuit-controller with the second mechanism when the main-line circuit is closed, substantially as described.

6. The combination with a main-line circuit of a sounder included therein and comprising opposite field-magnets, a rotary core-armature and a vibratory sounding-armature formed with legs or members extending in the lines of force of the field-magnets, and circuit-controlling mechanism adapted to be operated by the rotary core-armature, substantially as shown and described.

7. The combination of a main-line circuit, a key and sounder therein, a normally open circuit, a circuit-controller for closing and opening said circuit, a mechanism for operating the circuit-controller to close the circuit, a second mechanism for operating the circuit-controller to open the circuit, an electrically-operated device included in the main-line circuit for operatively connecting the circuit-controller with one of its mechanisms when the main-line circuit is interrupted for a predetermined time, and means for operatively connecting the circuit-controller with its other operating mechanism when the main-line circuit is closed.

8. The combination of a main-line circuit, a key and sounder therein, a normally open alarm-circuit adapted when closed to give an alarm, a normally open shunt-circuit adapted when closed to shunt the instruments, a circuit-controller for closing and opening said circuits, a mechanism for operating the circuit-controller to close the circuits, a second mechanism for operating the circuit-controller to open the circuits, an electrically-operated device included in the main line for operatively connecting the circuit-controller with one of its mechanisms when the main-line circuit is interrupted for a predetermined time, and means for operatively connecting the circuit-controller with its other operating mechanism when the main-line circuit is closed.

9. The combination of a main-line circuit, a key and sounder included therein, a normally open circuit, a circuit-controller for closing and opening said circuit, a local circuit, a continuously-acting, electrically-operated mechanism 4 included therein and adapted to operate the circuit-controller to close said circuit, a continuously-acting electrically-operated mechanism 1 included in the main-line circuit for operating the circuit-controller to open said circuit, an electrically-operated device in the main-line circuit for operatively connecting the circuit-controller with the mechanism 4 when the circuit in the main line is interrupted for a predetermined time, and means for operatively connecting the circuit-controller with the mechanism 1 when the circuit in the main line is closed.

10. The combination of a main-line circuit, a key and sounder therein, a normally open alarm-circuit, a normally open shunt-circuit, a circuit-controller for closing and opening said circuit, a local circuit, a continuously-acting electrically-operated mechanism 4 included in the local circuit and adapted to operate the circuit-controller to close the alarm and shunt circuits, a continuously-acting electrically-operated mechanism 1 included in the main-line circuit for operating the circuit-controller to open the alarm and shunt circuits, an electrically-operated device in the main-line circuit for operatively connecting the circuit-controller with the mechanism 4 when the circuit in the main line is interrupted for a predetermined time, and means for operatively connecting the circuit-con-

troller with the mechanism 1 when the circuit in the main line is closed, substantially as shown and described.

11. The combination of a main-line circuit, a sounder included therein and provided in addition to its usual vibratory armature, with a rotary core-armature 11, a normally open circuit adapted when closed to shunt the instruments, a circuit-controller for closing said circuit, a local circuit, an electrically-operated mechanism included therein, a rotary shaft adapted to be driven by said mechanism continuously in a direction opposite to that of the core-armature, an intermediate shaft, a finger mounted on said shaft and adapted to be moved thereby to operate the circuit-controller, devices acted on by the vibratory armature for operatively connecting the intermediate shaft with the rotary shaft 21 when the main-line circuit is interrupted for a predetermined time, and means for disengaging said intermediate shaft and connecting it with the rotary core-armature when the main line is closed, substantially as described.

In testimony whereof I hereunto set my hand, this 20th day of April, 1896, in the presence of two attesting witnesses.

ALVAH L. CREELMAN.

Witnesses:
CONRAD KOHLER,
ROBT. CLARK.