No. 611,974. Patented Oct. 4, 1898.

L. G. NILSON.

AUTOMATIC SWITCHING AND TELEPHONE SYSTEM.

(Application filed Mar. 9, 1896.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.

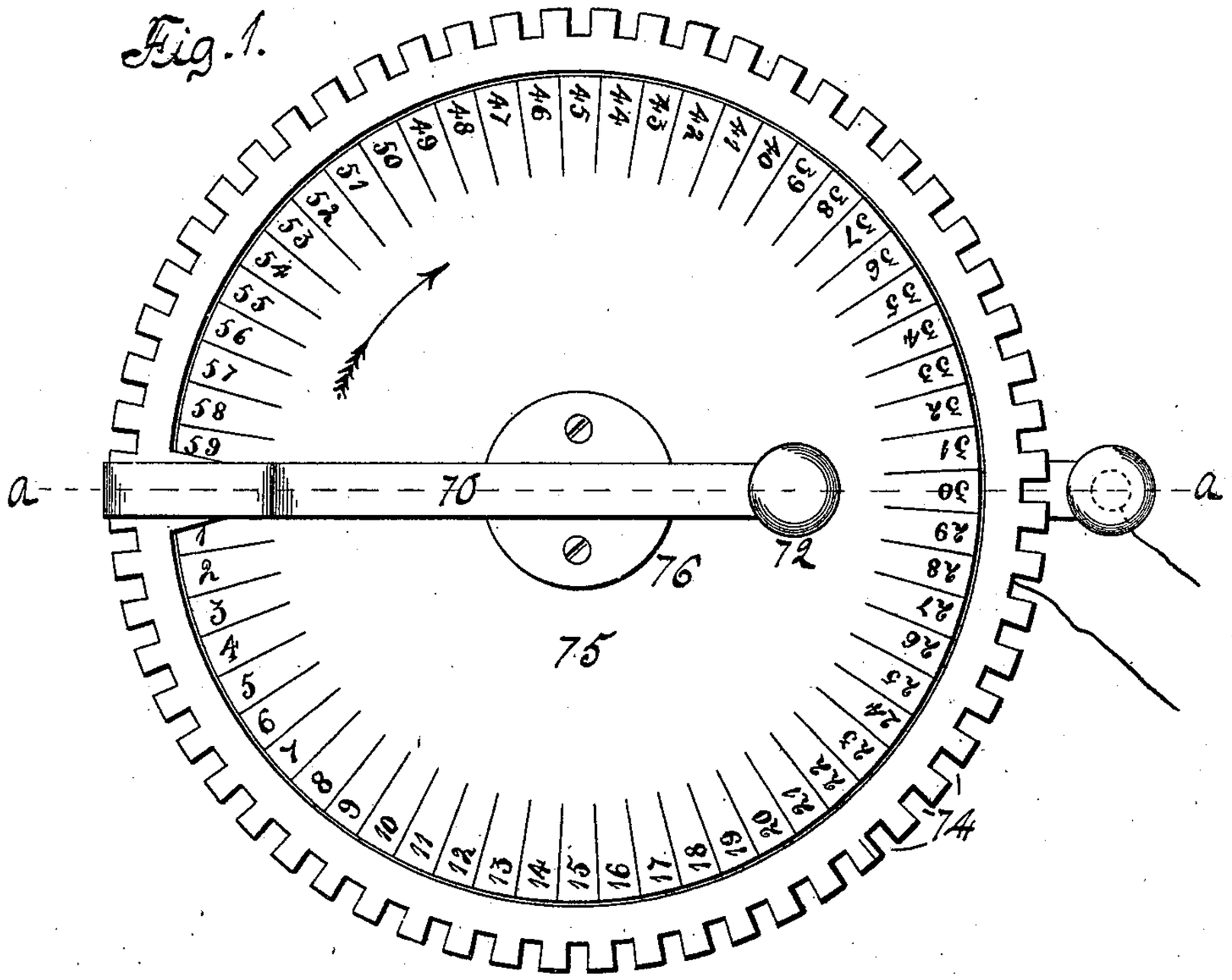
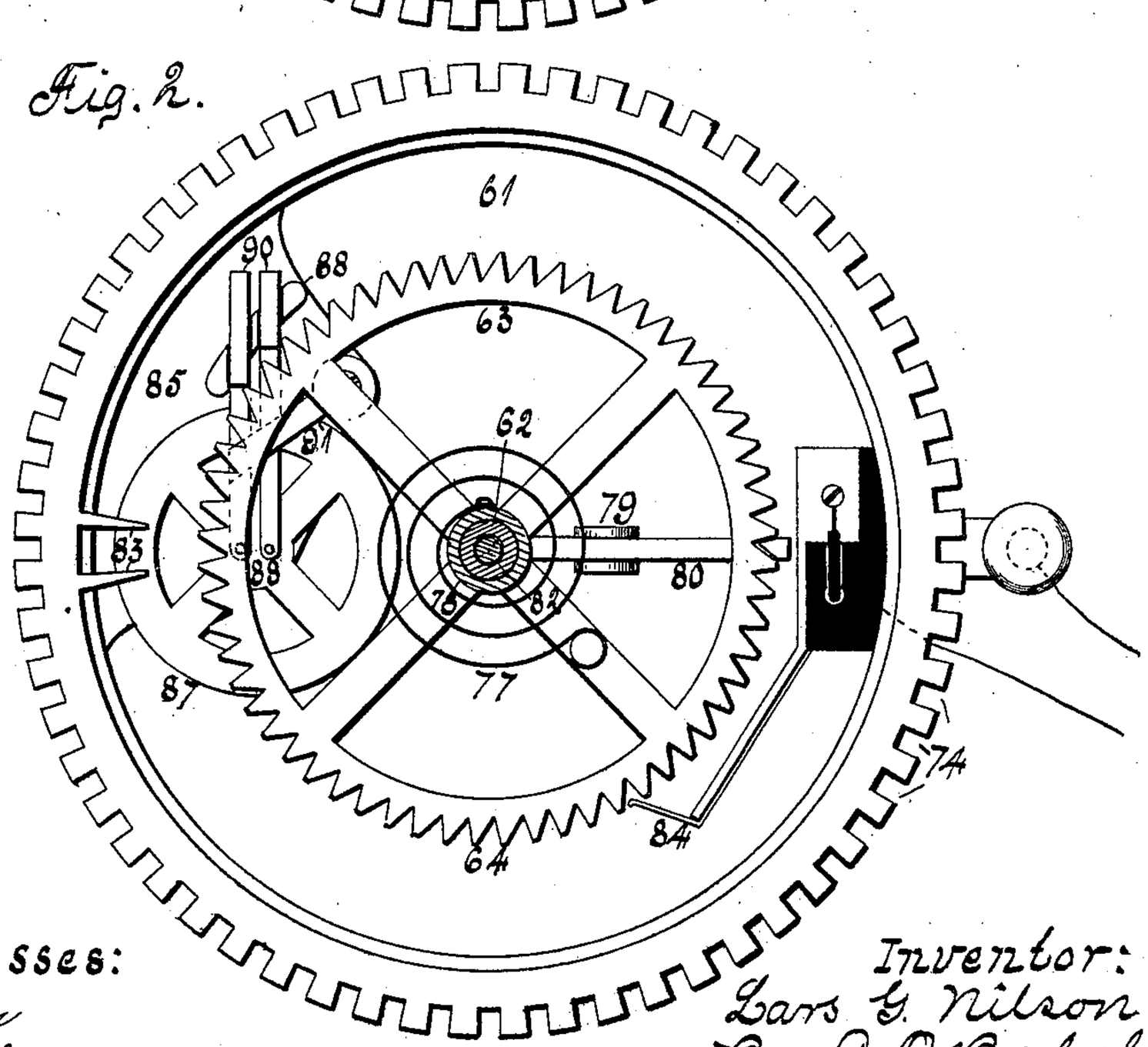


Fig. 2.



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(No Model.) 5 Sheets—Sheet 2.

Fig. 3.

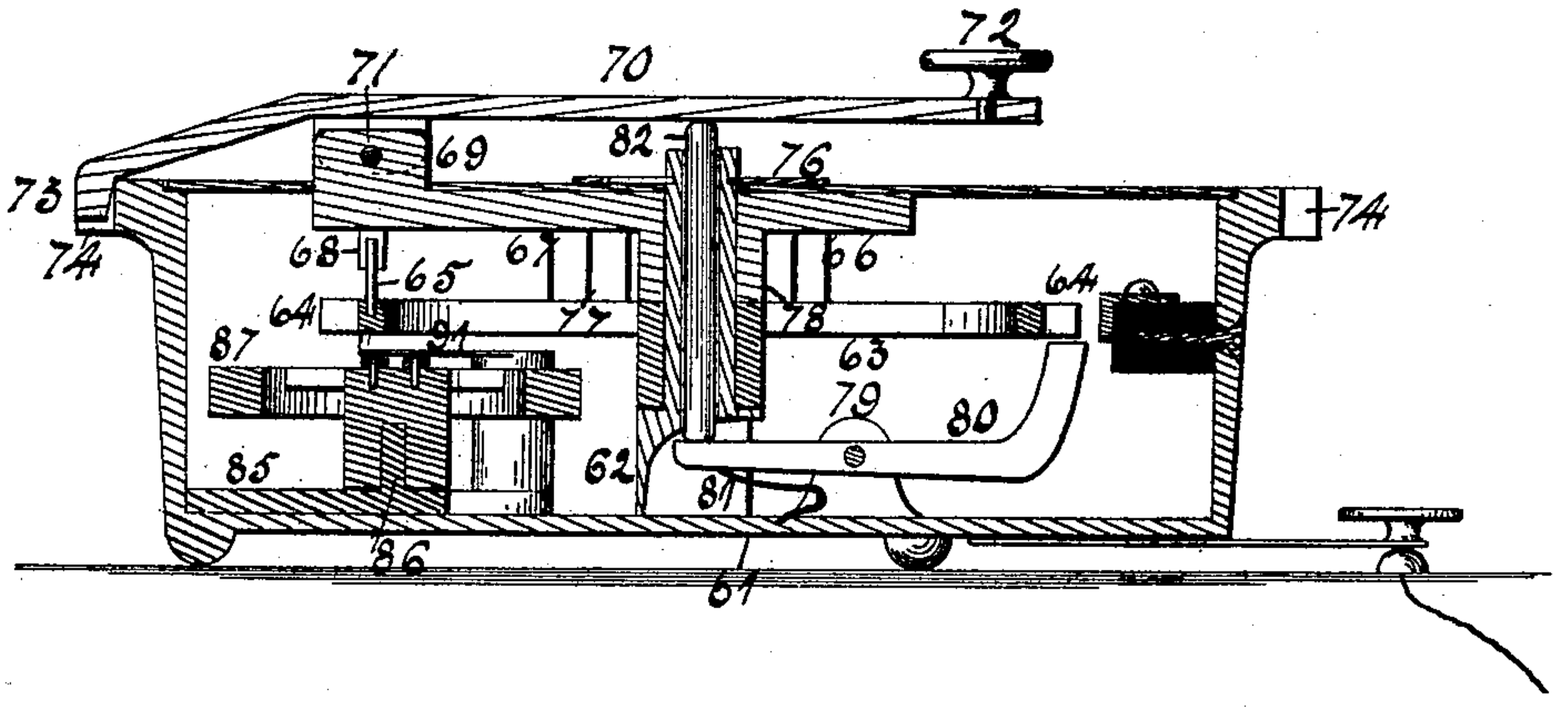


Fig. 4.

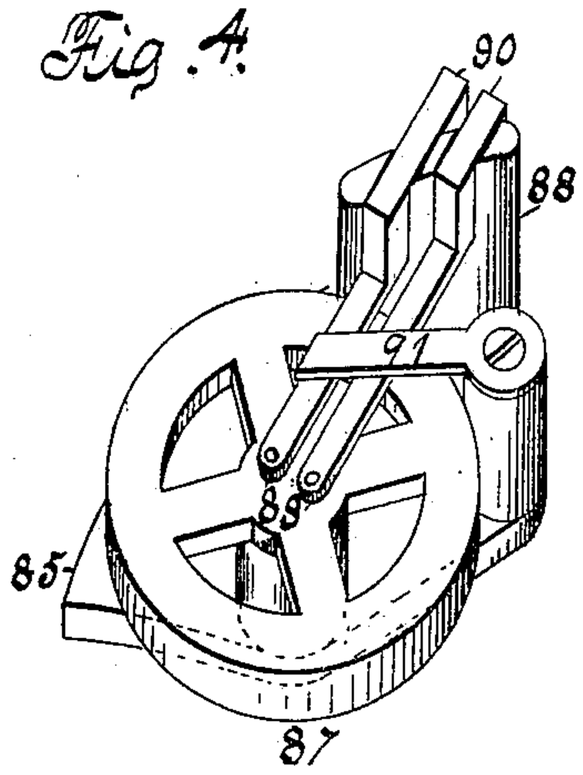
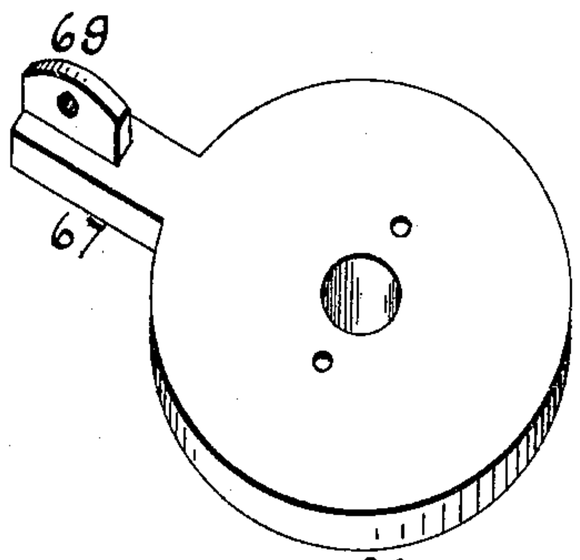


Fig. 5.



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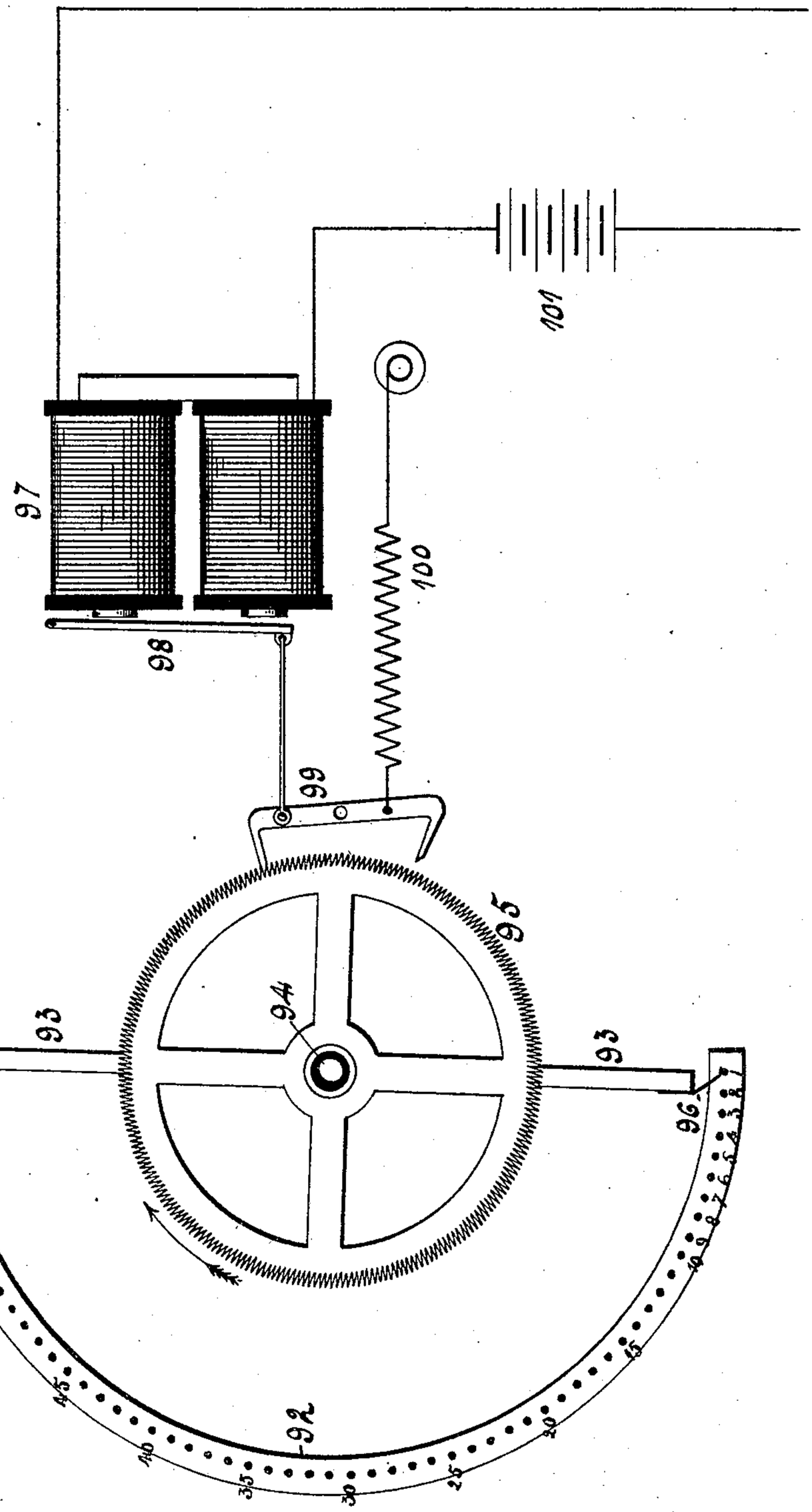
(Application filed Mar. 9, 1896.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 6.



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(Application filed Mar. 9, 1896.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 7.

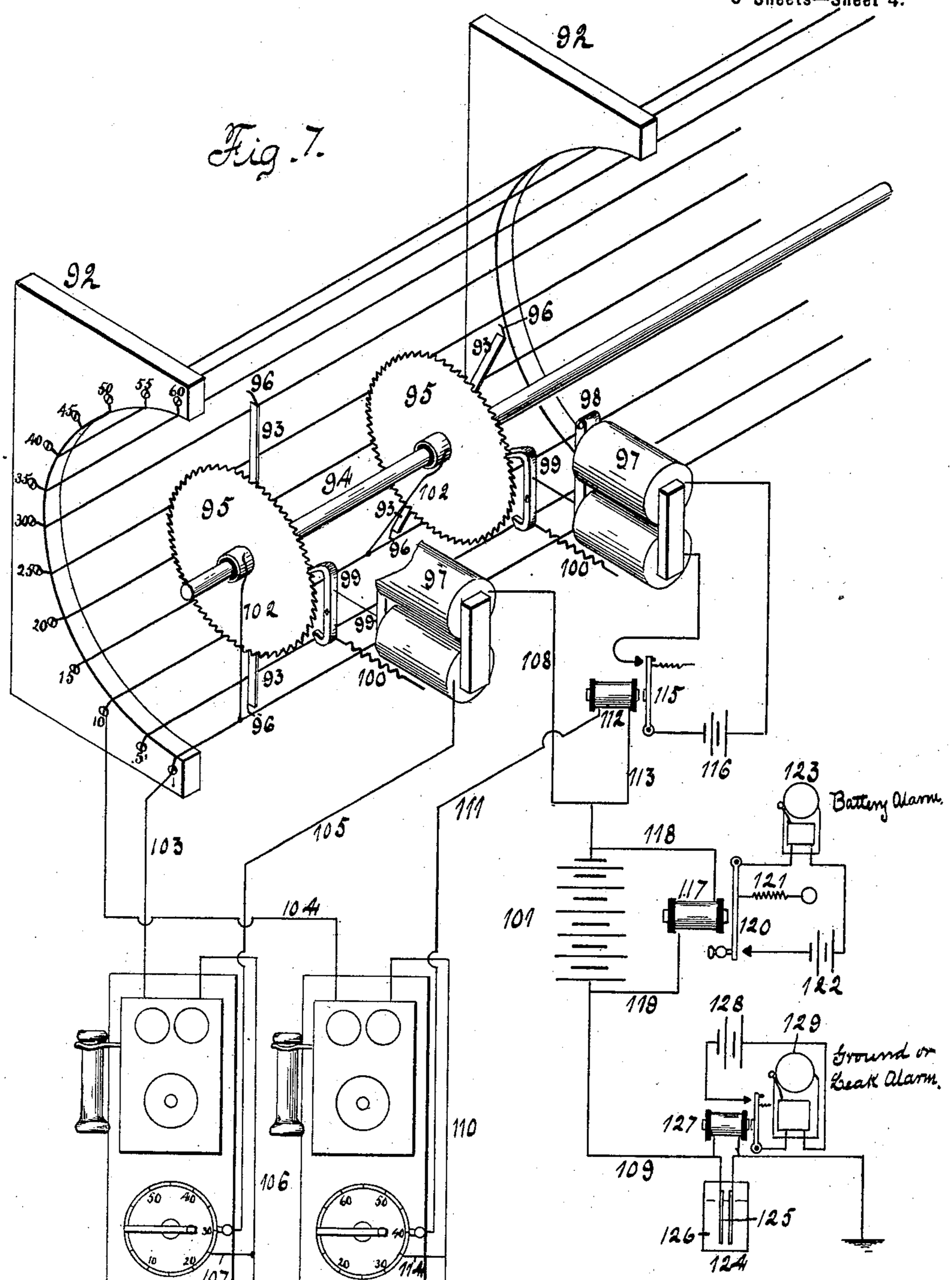

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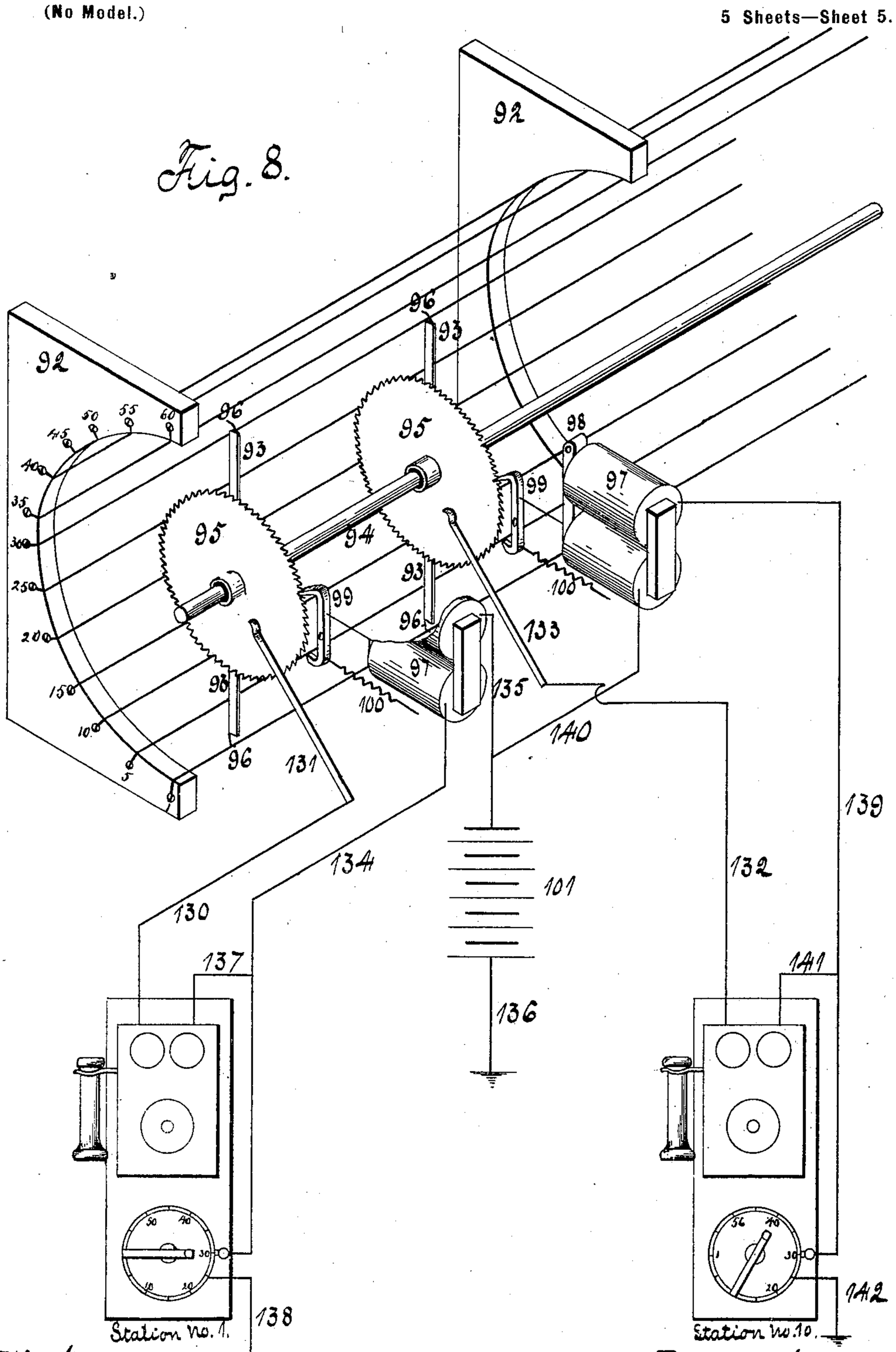
Fig. 8.



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UNITED STATES PATENT OFFICE.

LARS G. NILSON, OF SIOUX CITY, IOWA.

AUTOMATIC SWITCHING AND TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 611,974, dated October 4, 1898.

Application filed March 9, 1896. Serial No. 582,449. (No model.)

To all whom it may concern:

Be it known that I, LARS G. NILSON, a citizen of the United States, residing at Sioux City, in the county of Woodbury and State of Iowa, have invented certain new and useful Improvements in Automatic Switching and Telephone Systems, of which the following is a specification.

My invention relates to a switching system by means of which any number of stations (all connected by wires to a central station) may be connected to any one of the others automatically.

In the accompanying drawings, Figure 1 is a plan view of my improved signal-box. Fig. 2 is a similar view in which the dial and switching-lever have been removed. Fig. 3 is a vertical section on dotted line *a*, Fig. 1. Fig. 4 is an isometrical representation of the escape mechanism. Fig. 5 is an isometrical representation of the plate 66. Fig. 6 is an end elevation of the switching mechanism located at a central station. Fig. 7 is an isometrical representation of the switching mechanism of the central station and the arrangements of the circuits connecting the subscriber's and central stations, also showing an arrangement for giving an alarm when the battery operating the switching mechanism is reduced in strength to a point bordering upon failure and the arrangement for giving an alarm should the circuit be closed sufficiently to endanger the efficiency of the main battery. Fig. 8 is an isometrical representation of the central switching mechanism and an arrangement for establishing a metallic circuit between the subscriber's station through the central station.

The construction of the signal-box will be explained. The case 61 is deep enough to contain the operative parts, and from its center rises a stud 62, having a central opening. The upper portion of this stud is reduced in diameter. Upon the reduced portion of the stud is located an escape-wheel 63, having its periphery formed with inclined teeth 64, and from its upper face near its periphery rises a stud 65. Directly over this escape-wheel and upon the stud is located a plate 66, having an extension 67, from the under face of which depends a stud 68, located the same distance from the center as the stud 65, in order that they may come in contact. From the upper face of the extension 67 rises a perforated ear 69, to which is pivoted a lever 70 by a pin 71. The inner end of this lever has a knob 72 rising therefrom, and its outer end is provided with a projection 73, which is adapted to enter notches 74, formed in a flange extending from the upper or open end of the case 61.

A dial 75 is marked off in divisions corresponding to the notches 74 in the case and is located on top of the plate 66, having a central perforation to receive the stud 62, and is connected to the plate by a disk 76, having screws passing through the parts. The dial in this instance is divided into sixty divisions corresponding to the number of notches 74.

A spiral spring 77 surrounds the hub 78 of the plate 66 and is connected thereto by one end. Its other end has a connection with the escape-wheel 63, thereby forming a connection between the lever 70 and escape-wheel.

From the bottom of the case rise ears 79, between which is pivoted a dog 80, having one end lying underneath the central opening in the stud 62, its other end upturned and located beneath and in close proximity to the teeth of the escape-wheel. A spring 81, operating upon the dog, acts to hold the dog free of the escape-wheel.

A pin 82 is located in the vertical opening of the stud 62, its end extending above the end of the stud and its lower end resting upon the inner end of the dog 80. By the depression of the lever 70 the end in engagement with the notches 74 will be raised clear thereof, and by means of the pin 82 the dog will be moved upon its pivot and its upturned end will engage one of the notches of the escape-wheel, thereby forming a connection between the escape-wheel and the case in order that it may be held against rotation, and the lever 70 and its supporting-plate may be moved upon the stud 62 as a pivot in the direction indicated by the arrow until the required number on the dial comes between the stationary fingers 83 of the case, when the projection 73 of the lever will be allowed to enter a notch in the case, thereby holding the lever stationary in connection with the case. The turning movement of the lever will wind the spring and separate the stops 65 and 68, and upon allowing the lever to en-

gage the case the dog will release its engagement with the escape-wheel and the spring will carry the escape-wheel in the same direction the arm had been moved until the stop 65 of the escape-wheel comes in contact with the stop 68, when its movement will be arrested.

A flat spring 84 has a connection with the case, but electrically insulated therefrom. This spring in its normal position stands between the teeth of the escape-wheel, and upon the rotary movement of the escape-wheel the teeth will come in contact with the spring, thereby closing a circuit at each contact. It is necessary that the escape-wheel be held from rotating too rapidly in order that the circuit may be closed and opened at proper equal intervals, and I have designed a device for this purpose consisting of a base-plate 85, secured to the bottom of the case and from which rises a stud 86, upon which is mounted a balance-wheel 87 in a pivotal manner. A support 88 rises from this plate and is provided with two grooves in which are guided reciprocating pallets 89, having a pivotal connection with the balance-wheel on opposite sides of its center. These pallets have an extension 90 and are so located with relation to the teeth of the escape-wheel that they are alternately moved by the teeth of the wheel, which will impart an oscillatory movement to the balance-wheel, and this movement will retard the running movement of the escape-wheel.

The lever 70 may be moved a certain number of notches in advance of the escape-wheel, and upon releasing the lever the escape-wheel will advance the same number of teeth, causing the circuit to be closed and broken a like number of times. The connections between the lever 70 and dog 80 are such that the dog will engage the escape-wheel before the projecting end of the lever is free from its engagement with the notches of the case, and the lever will engage the case before the dog is free of the escape-wheel in order that the spiral spring may be wound and finally unwound to its normal condition. An arm 91 overlies the pallets 88, holding them in position.

At Figs. 6, 7, and 8 is represented the switching device located at a central office, consisting in this instance of sixty wires located in a semicircle and supported in heads 92, of insulating material.

Upon the rod 94 are supported toothed wheels 95 and insulated therefrom, the rod being the center of the wires located in semicircle. The number of teeth in these wheels is twice the number of wires, in this instance being one hundred and twenty. Each wheel has two arms 93, each carrying a brush 96 and located diametrically opposite each other and of a length that the brushes will form a contact with the wires located in the semicircle. It will be noticed at Fig. 6 that the wires of the central station do not occupy a complete semicircle, but one wire less, in order that the brushes of both arms may not make contact with two wires at the same time, and after one arm has broken contact with wire No. 60 the other arm will make contact with wire No. 1. There are as many wheels and arms of this construction as there are wires, and when the wheels are in their position of rest they will make contact with their respective wires. Each wheel has a like mechanism for rotating it, consisting of an electromagnet 97, an armature 98 therefor, and a pallet 99, having a pivotal connection with a suitable support. This pallet has a connection with the armature at one end, and a spring 100, having a connection with the pallet, holds its opposite end in contact with the teeth of its wheel. When the electromagnet is energized, its armature will move the pallet, causing the end to which the spring is connected to engage the teeth of the wheel, and when the electromagnet is demagnetized the spring will cause the other end to engage the teeth of the wheel, and owing to the slant of the teeth and the slant of the ends of the pallet the wheel will be rotated step by step, and one complete movement of the pallet is necessary to move the arm of the wheel from one wire onto the next. A battery 101 forms the motive power for rotating the wheel and is located at the central station.

In the arrangement shown at Figs. 6 and 7 an electrical connection is formed between the wheels 95 and their respective wires in the central station by a wire 102.

The circuit for forming an electrical connection between the central office and stations Nos. 1 and 10 (shown at Fig. 7) will be explained. Wire No. 1 of the central station is connected to station No. 1 by a wire 103, and wire No. 10 of central station is connected to station No. 10 by wire 104. A wire 105 connects the casing of signal-box of station No. 1 with its electromagnet in the central station. A wire 106 connects station No. 1 with the ground, and to which is secured a wire 107, connecting it with the spring-arm 84 of the circuit-making device of the signal-box. From the electromagnet 97, station No. 1, in the central station runs a wire 108, connecting it with the battery 101 and by a wire 109 to the ground. A wire 110 connects station No. 10 with the ground. By moving the lever 70 of the signal-box until No. 10 of the dial appears between fingers 83 the escape-wheel will make and break the circuit ten times, which will carry the arms 96, formerly located on wire No. 1, to wire No. 10 in the central station. A circuit will thus be formed between stations Nos. 1 and 10 by the following wires: from station No. 1 by wire 103 to wire No. 1 in central station, by wire No. 102 and arm 93 with wire No. 10 of the central station, by wire 104 to station No. 10, by wire 110 to ground, through the ground and by wire 106 to station No. 1. This forms the talking-circuit, and by moving the lever 70 of station

No. 1 to its original position, which will complete one revolution of the dial and escape-wheel, the arm 96, which was opposite wire No. 1 in the central station, will be brought into contact with wire No. 1, the toothed wheel 95 having made one-half revolution. This arrangement of circuits for switching and talking may be adopted for each station, or when the line is of great length a relay may be employed at the central station for each line, such as shown at Fig. 7 in connection with station No. 10, which I will now explain. A wire 111 connects the signal-box of station No. 10 with a relay 112, located at central station, a wire 113 connecting the relay with the battery 101 and to the ground by wire 109, a wire 114 connecting the circuit-making device of the signal-box of station No. 10 with the ground-wire 110. This relay 112 exerts its influence upon an armature 115, located in a local circuit, in which is included a battery 116 and the electromagnet 97 of the switching device of station No. 10, located at the central station. As the circuit, including signal-box of station No. 10, relay 112, and battery 101, is made and broken, the armature 115 of the local circuit will be actuated, making and breaking the local circuit, and likewise controlling the operation of the armature 98 of the electromagnet of station No. 10, located in the central station.

As the successful operation of an automatic switch system largely depends upon the constancy of the main battery 101, I have invented an arrangement which I call a "battery-alarm" and also a "ground" or "leak" alarm. The battery-alarm consists of a high-resistance magnet 117, connected by wires 118 and 119 across the battery. When the battery is in good working order, the magnet will hold an armature 120, attracted against the action of a spring 121, and should the battery become weak or out of order the magnet will lose its power and allow the armature to be withdrawn by the spring, which will close a local circuit in which is included a battery 122 and vibrating bell 123, thus giving an alarm showing the main battery needs attention.

The ground-alarm consists of a small storage-cell 124, with the plates 125, and a solution 126 for electrolyte. Across this storage-cell is connected the magnet of a relay 127, keeping the battery exhausted.

The electricity used for operating the switches of the system is compelled to go through the storage-cell and the relay 127 in a divided circuit, and thence to ground; but in ordinary use for operating the system the current will not be sufficient to charge storage-cell. If, however, a dial should get out of order, keeping the circuit closed constantly, or if any of the switch-wires should become grounded, the constant flow of current would charge the storage-cell within a time depending upon the size of the plates sufficiently to cause relay 127 to close the circuit of another local battery 128 through a vibrating bell 129, as shown, and thus give the alarm, so that the faulty wire may be disconnected and the main battery saved from running down and the balance of the system not interfered with.

At Fig. 8 I have shown the arrangement of circuits for establishing a metallic talking-circuit, which is necessary when the electrical disturbances are sufficient to interfere with a ground-circuit. This figure shows stations Nos. 1 and 10 in communication, station No. 10 having established the communication.

The line-wire 130 connects station No. 1 with an arm 131 in electrical contact with the wheel 95 of this station, located in the central station, and a line-wire 132 connects an arm 133 and station No. 10 in the same manner.

A wire 134 connects the signal-box of station No. 1 with its electromagnet located in the central station, and a wire 135 connects this magnet with the battery 101, the battery being connected to ground by wire 136. A wire 137 connects station No. 1 with the wire 134, and a wire 138 connects the escape-wheel of the signal-box of station No. 1 and the ground.

A wire 139 connects the signal-box of station No. 10 with its electromagnet located in the central station, and a wire 140 connects this magnet with the battery 101. A wire 141 connects station No. 10 with wire 139, and a wire 142 connects the escape-wheel of the signal-box of station No. 10 and ground.

The switching-circuit—for instance, station No. 1—is by signal-box, wire 134, electromagnet 97, wire 135, battery 101, wire 136, ground, and wire 138, and the talking-circuit for stations Nos. 1 and 10 consists of wire 130, arm 131, wheel 95, to wire 1, along said wire to arm 93 of station No. 10, through wheel 95, arm 133, wire 132, station No. 10, wires 141 and 139, electromagnet 97 of station No. 10, wires 140 and 135, through electromagnet 97 of station No. 1, and wires 134 and 137 to station No. 1. By this arrangement a metallic talking-circuit is provided, and one wire of this circuit and the ground are employed over which to do the switching.

It is evident that three arms 93 may be employed and the wires located in a third of a circle and four arms for a quarter of a circle, and by such arrangement easy access may be had to the operative parts.

I claim as my invention—

1. In a box adapted to transmit electrical impulses, the combination of a suitable casing having a slotted flange, a dial supported on a movable plate and a tilting lever pivotally connected to said dial-supporting plate and normally in engagement with its slots, but movable from engagement therewith, the downward movement of said lever serving to lock the internal mechanism of the box and its upward movement to release the same.

2. In a box adapted to transmit electrical impulses, the combination of a suitable cas-

ing, a dial-plate, a tilting lever pivotally connected to the dial-plate, a hollow stud, an escape-wheel mounted on the stud, a pin within the stud and a lever operated upon by the tilting lever through the pin adapted to lock the escape-wheel.

3. In a box adapted to transmit electrical impulses, the combination of a suitable casing, an escape-wheel, a movable dial having a circular series of numerals on its face, a tilting lever, a pin, and a device operated by the pin for automatically locking the wheel against rotation during the change of the position of the dial and automatically releasing the same when the dial has been moved into the required position.

4. In a box adapted to transmit electrical impulses, a retarding appliance consisting of a pivoted balance, projecting parts extending from a passing body, and two slidable pallets adapted to be alternately moved by the projecting parts of the passing body.

5. In a box adapted to transmit electrical impulses, the combination of a suitable casing, a notched or toothed wheel suitably supported within the casing, a spring making electrical contact with the projections of the wheel and a retarding mechanism acting directly upon said wheel.

6. In a box adapted to transmit electrical impulses consisting of an escape-wheel, a balance, two slidable pallets adapted to impart an oscillatory movement to the balance by being acted upon by the escape-wheel.

7. In a switching system, the combination of a switching mechanism located at a central station, means located at subscriber's station for controlling the movements of the switching mechanism, a battery located at the central station forming the energy for operating the switching mechanism and an alarm for automatically giving warning of a ground or leak in the circuit consisting of a storage-cell in the main-line circuit, a relay connected across the storage-cell, a local battery and bell in a circuit to be closed by the relay.

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