No. 755,774. PATENTED MAR. 29, 1904.

F. HOLDEN.

ELECTRIC CLOCK.

APPLICATION FILED APR. 16, 1900.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

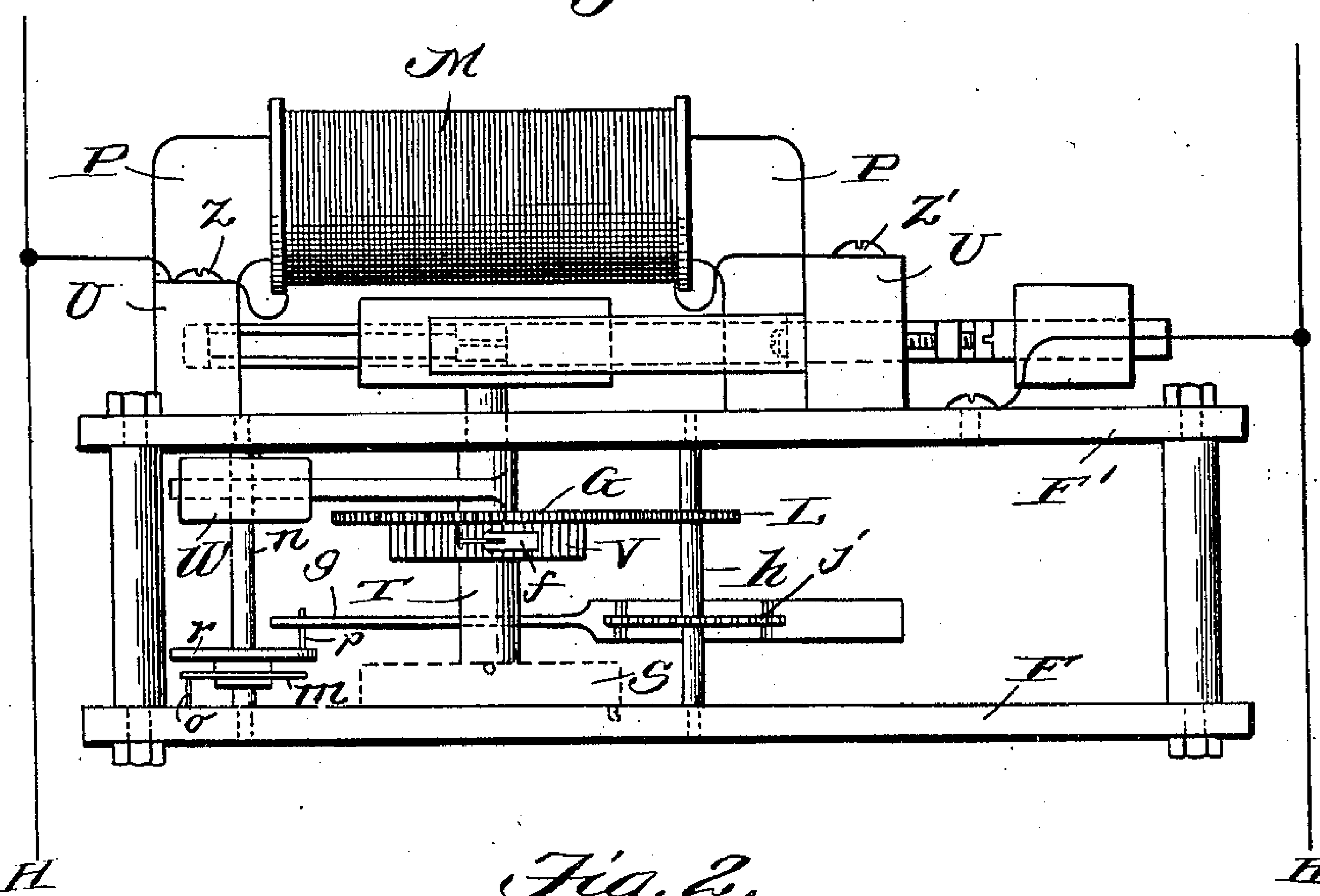
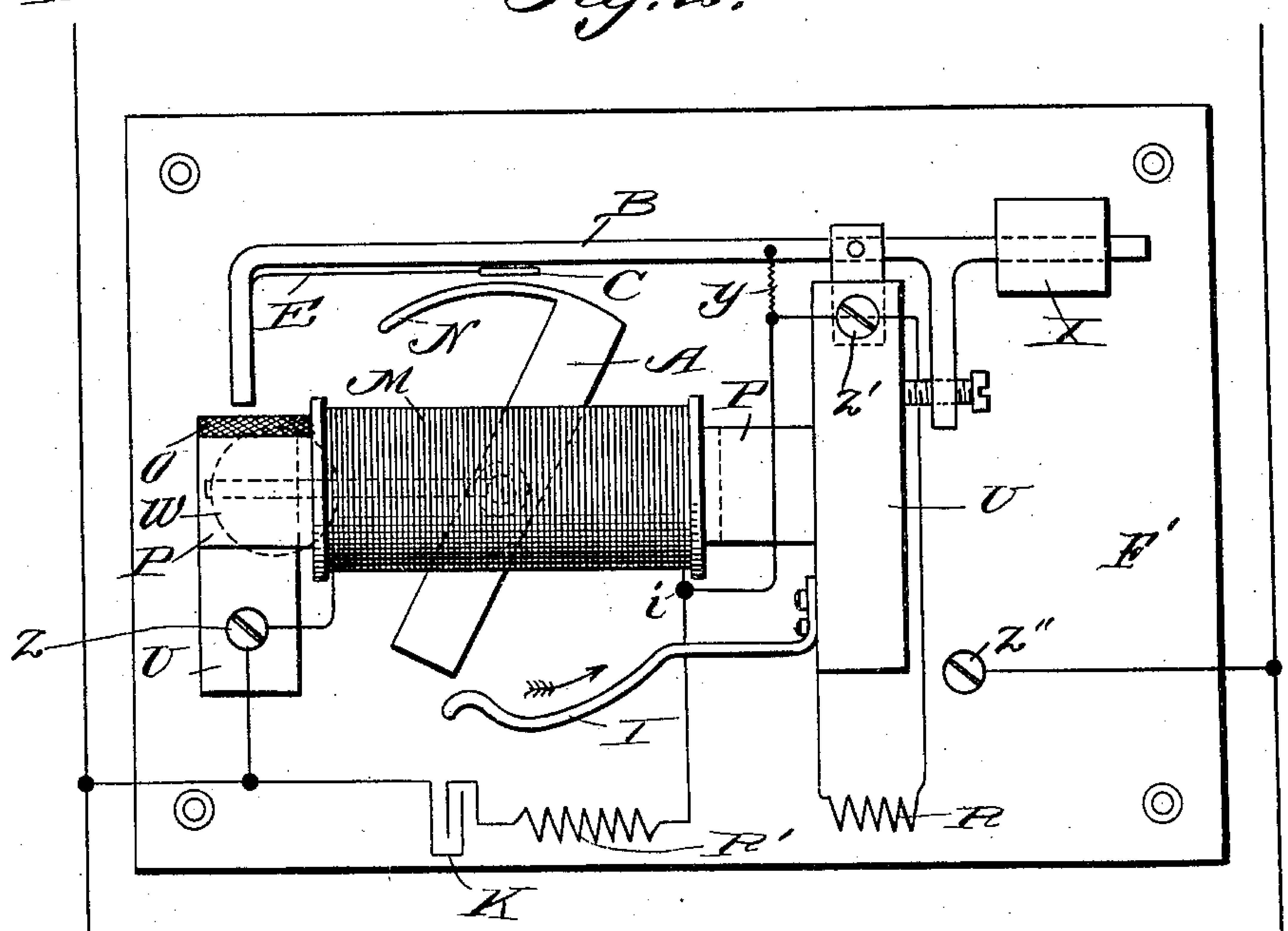


Fig. 2.



Witnesses.

C. L. Kesler

Inventor

Frank Holden

By James L. Norris

Atty.

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F. HOLDEN.

ELECTRIC CLOCK.

APPLICATION FILED APR. 16, 1900.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

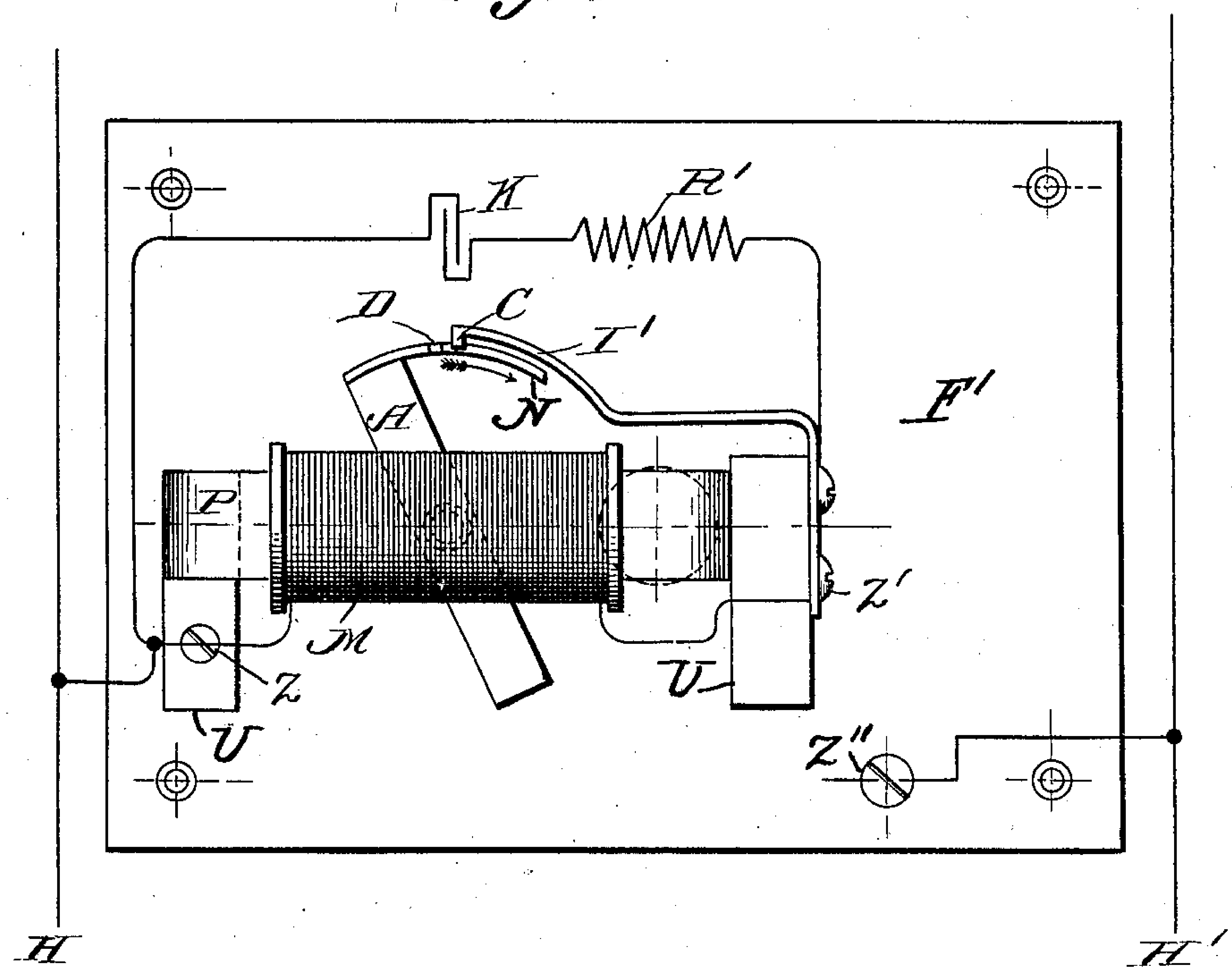
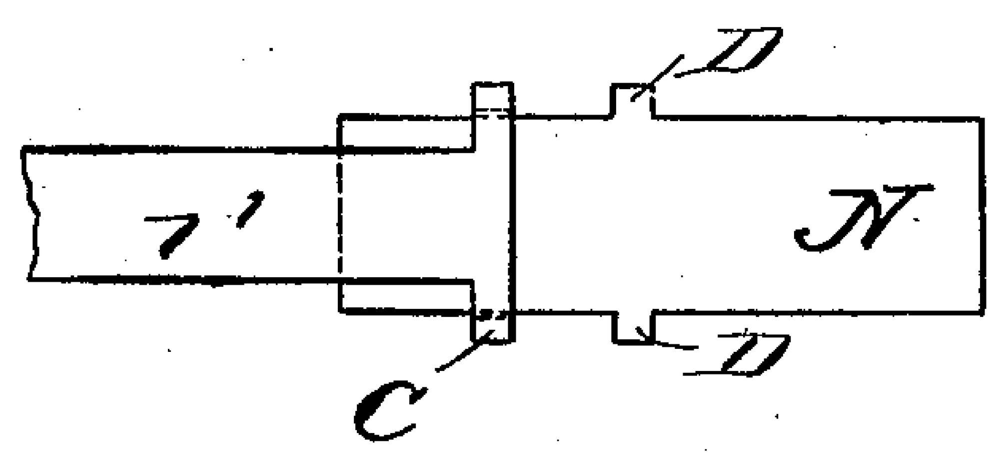


Fig. 4.



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No. 755,774. Patented March 29, 1904.

UNITED STATES PATENT OFFICE.

FRANK HOLDEN, OF LONDON, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 755,774, dated March 29, 1904.

Application filed April 16, 1900. Serial No. 13,126. (No model.)

To all whom it may concern:

Be it known that I, FRANK HOLDEN, electrical engineer, a citizen of the United States of America, residing at 83 Cannon street, London, E. C., England, have invented a certain new and useful Improvement in Electrically-Operated Clocks, (for which I have applied for Letters Patent in England, provisional application, in the joint names of The British Thomson-Houston Company, Limited, and Frank Holden, under date of September 25, 1899, and in France in the joint names of Frank Holden and Alexander Stanley Garfield, under date of March 24, 1900;) and I do hereby declare that the following is a full, clear, and exact specification of the same.

The present invention relates to electrical mechanisms for rewinding clocks or other apparatus.

Referring to the drawings, Figure 1 is a side elevation of a clock and its winding mechanism for use on either alternating or direct current circuits, and Fig. 2 is a plan view. Fig. 3 is a plan view of a simplified mechanism for use on direct-current circuits only. Fig. 4 is a detail of the contacts of the mechanism of Fig. 3.

The apparatus to be described is composed of a clock mechanism and a winding mechanism, the former including a weight W or equivalent mainspring S, intermediate gears, pinions, and escapement device, which latter includes balance or escapement lever *g*, escapement-wheel *j*, balance-wheel *r* on shaft *n*, and balance-wheel spring *m*, one end of which is attached to the wheel *r* and the other to the pin *o*. The balance-lever *g* has a forked end which engages a pin *p* on balance-wheel *r*, as is usual in clock mechanism.

The winding mechanism comprises an electromagnetic motor for lifting the weight W or winding the spring S of the clock and in addition suitable contacts for making and breaking the electric circuits of the motor at predetermined intervals. I prefer to use a weight in place of a spring, and the former is mounted on an arm attached to the shaft T. If a spring is used, one end is fastened to the base F of the frame supporting the clock and winding mechanism and the other end to the shaft. A ratchet-wheel V on the shaft T drives the gear G, mounted loosely on the same shaft, by means of a pawl *f*, pivoted on the gear. The pinion L, mounted on the shaft *h*, is driven by the gear G. The shaft T passes through the upper base F′ and carries the armature A of the motor. The relative movements of the several parts of the clock and winding mechanism when the weight is falling or the spring unwinding are indicated by arrows in Figs. 2 and 3. The iron magnet-core of the motor is represented by the letter P and the magnetizing-winding by the letter M. The armature A and the curved wing N are of iron. Insulating-blocks U U are used to support terminal-screws Z Z′ and other current-carrying parts of the motor device. The counterweight X brings back the arm B to the position shown in Fig. 2 each time the circuit of the motor is broken at contact C and wing N. The piece of insulating material O prevents sticking between arm B and magnet-core P. The contact-piece C is mounted on light springs E, attached to the arm B, as shown, and does not make contact with the surface of the curved wing N when in the position shown in Fig. 2. This method of mounting the contact C is necessary in the case of alternating-current circuits to avoid vibration and sparking at the contact C. The mechanism of Fig. 3 does not work on alternating-current circuits, because the spring I′ is so light that it vibrates in an alternating field, causing sparking at the contact C. I therefore adopt the arrangement of Fig. 2 for alternating-current circuits, where the arm B, of large moment of inertia, replaces the light spring I′. The vibration of spring I′, and consequent sparking at contact C, is thereby practically eliminated. The same arrangement will of course operate equally well on continuous-current circuits of about one hundred and twenty-five volts and less; but the simpler form of Fig. 3 is equally satisfactory and less expensive.

Referring to the mechanism of Figs. 1 and 2, the weight W in falling or the spring S in unwinding causes the armature A to rotate in the direction as shown by the arrows until the lower end of the armature establishes a rubbing contact with the end of the spring I. At this instant the magnet-winding M will be connected to the supply-mains H H′ and the current will flow from the main H to the terminal Z, thence to terminal Z′ through the winding M, resistance R, spring I, armature A and base F′; terminal Z″, and thence to the other main H′. The magnetized core P will now attract the iron armature A and the iron contact-carrying arm B, thus bringing the contact C into firm touch with the curved wing N of the armature A, thereby shunting the resistance R. The current will now flow as follows: from main H to terminal Z, magnet-winding M, junction-point *i*, and thence by one path to terminal Z′, resistance R, spring I, armature A, base F′, and terminal Z″ to main H′. The other path open to the current is from junction-point *i* by wire *y* to arm B, thence by spring E, contact C, wing N, armature A, base F′, and terminal Z″ to the main H′. The magnetic forces due to the first contact between the end of the armature A and the spring I are not great enough to rotate the armature A; but with the increase in current through the winding M due to the closure of another circuit of lower resistance through the contact C and wing N, thereby shunting the resistance R, as above explained, the armature A rotates in the direction opposite to that indicated by the arrow in Fig. 2. The contact between the end of the armature A and the spring I is broken immediately the armature is rotated by the magnetic attraction of core P; but there is no sparking, since this contact is already shunted at contact C and wing N. As soon as contact between the end of armature A and spring I is broken the current from main H flows to main H′ as follows: from main H to terminal Z, magnet-winding M, junction-point *i*, wire *y*, arm B, spring E, contact C, wing N, armature A, base F′ and terminal Z″ to main H′ It is evident that current no longer flows through resistance R after contact between the end of armature A and spring I is broken, as above described. The wing N is made of such a length that contact C does not leave it until the armature A has almost reached the position of maximum pull; but the latter continues to rotate through a greater angle until its kinetic energy is entirely consumed in lifting the weight W or in winding the spring S. It is advantageous to connect a condenser K in shunt to the winding M, thereby reducing sparking at contact C to a negligible quantity, a resistance R′ of suitable value being connected in series with the condenser to prevent excessive charging-currents. For circuits of one hundred and twenty-five volts or less the condenser may be suppressed and the high resistance R′ retained as a permanent shunt to the winding M to prevent sparking at contact C on opening the circuit at this point.

The mechanism of Fig. 3 is intended for use on direct-current circuits. The spring I and the resistance R of the mechanism of Figs. 1 and 2 are suppressed and the simpler contacts of Fig. 4 substituted for that shown in these figures. The external resistance R is not used, since it is practically possible to wind the magnet for continuous-current circuits of one hundred and twenty-five volts or less without too great expense and with a wire of such resistance that the magnet will not burn out if the voltage should drop below the normal to such an extent that the motor no longer moves. The contact C is now mounted directly on the spring I′ of magnetic material. The rotation of the armature A in the direction shown by the arrow will establish contact between contact C and the projections D of the curved wing N, (see Fig. 4,) thus closing the circuit of the magnet-winding M, and the current flows from main H, terminal Z, magnet-winding M, terminal Z′, spring I′, contacts C and D, wing N, armature A to base F′, terminal Z″ to main H′. The under surface of the contact C is at once brought into firm touch with the outer surface of the wing N because of the magnetic attraction between these parts due to the creation of a magnetic field of force by the motor magnet-winding M, some of the magnetic lines of force being closed through the path offered by the iron wing N and the spring I′ of magnetic material. The armature A is at once returned to or beyond the medial position, thus lifting the weight W or winding the spring S. The circuit of the motor is interrupted at the contact C when this leaves the tip of the curved wing N. A condenser K and resistance R′ or the resistance R′ only may be permanently shunted across the winding M to prevent any sparking at contact C.

By the above-described arrangement of the motor and the contacts a cyclical movement of the several parts is obtained and good electrical contacts are thus secured, an indispensable condition to the successful operation of such devices.

Referring to the mechanism of Figs. 1 and 2, the operation is as follows: The resistance R is used to limit the current flowing through the winding M on establishing contact between armature A and spring I. Upon closure of the circuit of the magnet-winding M and the series resistance R on the supply-mains H H′ by contact between the end of armature A and spring I the magnet-core P becomes magnetized, attracts the arm B and brings together the contact C and wing N, thereby shunting the resistance R, as already explained, and thus allowing a larger current to pass through the winding M. The magnetic forces due to the first contact are designedly not great enough to rotate armature A; but with the increased current consequent on closing the contact C on wing N the armature A rotates. For example, in a winding mechanism for two hundred-volt circuits if the line voltage falls to one hundred and seventy volts the magnetic forces due to the closure of the circuit at the end of armature A and spring I are insufficient to close the contact C on wing N and the armature A does not rotate. The magnet-winding M and the resistance R thus remain in series across the main supply-circuit H H′ until the voltage rises again to above one hundred and seventy. The ohmic value of the resistance R is made sufficiently high to prevent the burning of the magnet-winding M whenever the line voltage falls below one hundred and seventy volts. By this construction a much smaller magnetizing-coil is used than in other winding mechanism for use on commercial circuits of one hundred and twenty-five volts and above and an important saving of wire is made.

I have thus obtained a mechanism of very simple construction compared to the purely mechanical devices heretofore used for opening and closing the contact of the motor-winding and one which will not burn out if an unusual drop in the voltage in the supply-circuit occurs.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. An electrical winding mechanism consisting of an electromagnetic winding-motor, a resistance in series with the magnet-winding of the motor, a switch closed by the armature of the motor during the unwinding period and connecting the magnet-winding in series with the resistance and across the supply-mains, and another switch arranged to short-circuit the series resistance, the latter switch being closed by attraction of the magnetic parts of the switch due to the closure through these parts of a portion of the lines of force of the magnetic field of the motor, created by the electric current passing through the magnet-winding of the motor on closure of the first switch.

2. An electrical winding mechanism consisting of an electromagnetic winding-motor and a switch closed by the armature thereof during the unwinding period and connecting the magnet-winding across the supply-mains, thus creating the magnetic field of the motor, and magnetic parts actuated by the field thus established to reinforce the contact engagement, thereby improving the electrical contact between switch-terminals.

3. The combination with a clock, of an electrical winding mechanism consisting of an electromagnetic winding-motor, a resistance in series with the magnet-winding of the motor, a switch closed by the armature of the motor during the unwinding period and connecting the magnet-winding in series with the resistance across the supply-mains, and another switch arranged to short-circuit the series resistance, the latter switch being closed by attraction of the magnetic parts of the switch due to the closure through these parts of a portion of the lines of force of the magnetic field of the motor, created by the electric current passing through the magnet-winding of the motor on closure of the first switch.

4. The combination with a clock, of an electrical winding mechanism consisting of an electromagnetic winding-motor and a switch closed by the armature thereof during the unwinding period and connecting the magnet-winding across the supply-mains, thus creating the magnetic field, and magnetic parts actuated by a part of the lines of force of said field to reinforce the contact engagement, thereby improving the electrical contact between switch-terminals.

5. In combination, a clock mechanism and a rewinding-motor and switches comprising a magnet-core P, exciting-winding M, armature A connected to the shaft T of the clock mechanism to which is also attached the mainspring S; contact-spring I, wing N, contact C carried by the magnetic arm B, counterweight X, and the resistance R short-circuited by the closure of the contact C on wing N as described and shown.

6. In combination, a clock mechanism and a rewinding-motor and switches comprising a magnet-core P, exciting-winding M, armature A connected to the shaft T of the clock mechanism to which is also attached the mainspring S; or its equivalent, contact-spring I, wing N, contact C carried by the magnetic arm B, counterweight X and the resistance R short-circuited by the closure of the contact C or wing N as described and shown.

7. A motor-wound clock-train, comprising an electromagnetic winding device, a switch operated after a determinate period of operation of the clock, an electromagnetic switch controlled thereby for throwing the electromagnetic winding device into operation, and means for opening said switch and holding it in the open position after a determinate range of winding movement.

8. The combination of a wheel-train, a magnetically-operated winding device, a switch controlled by a determinate range of unwinding for cutting into circuit the winding device, an auxiliary switch controlled thereby for short-circuiting the preliminary switch, said preliminary switch being adjusted to open during the short-circuiting period, and means for causing a snap-break of the short-circuiting switch after a determinate range of the winding movement.

9. The combination of a clock-train, a magnetically-operated winding device, a switch closed by the unwinding, a circuit containing said switch and the winding-magnet, a resistance in said circuit and an auxiliary switch

operated on closure of the circuit for short-circuiting the resistance, and means for quickly breaking contact at said switch after a determinate range of unwinding movement.

10. The combination of a clock-train, of an electromagnetic winding device therefor, a switch closed by a definite range of unwinding, a normally open auxiliary switch closed automatically when the first switch is closed, and means whereby the operation of the device opens both switches.

In witness whereof I have hereunto set my hand, this 29th day of March, 1900, in the presence of two subscribing witnesses.

FRANK HOLDEN.

Witnesses:
H. D. JAMESON,
A. NUTTING.