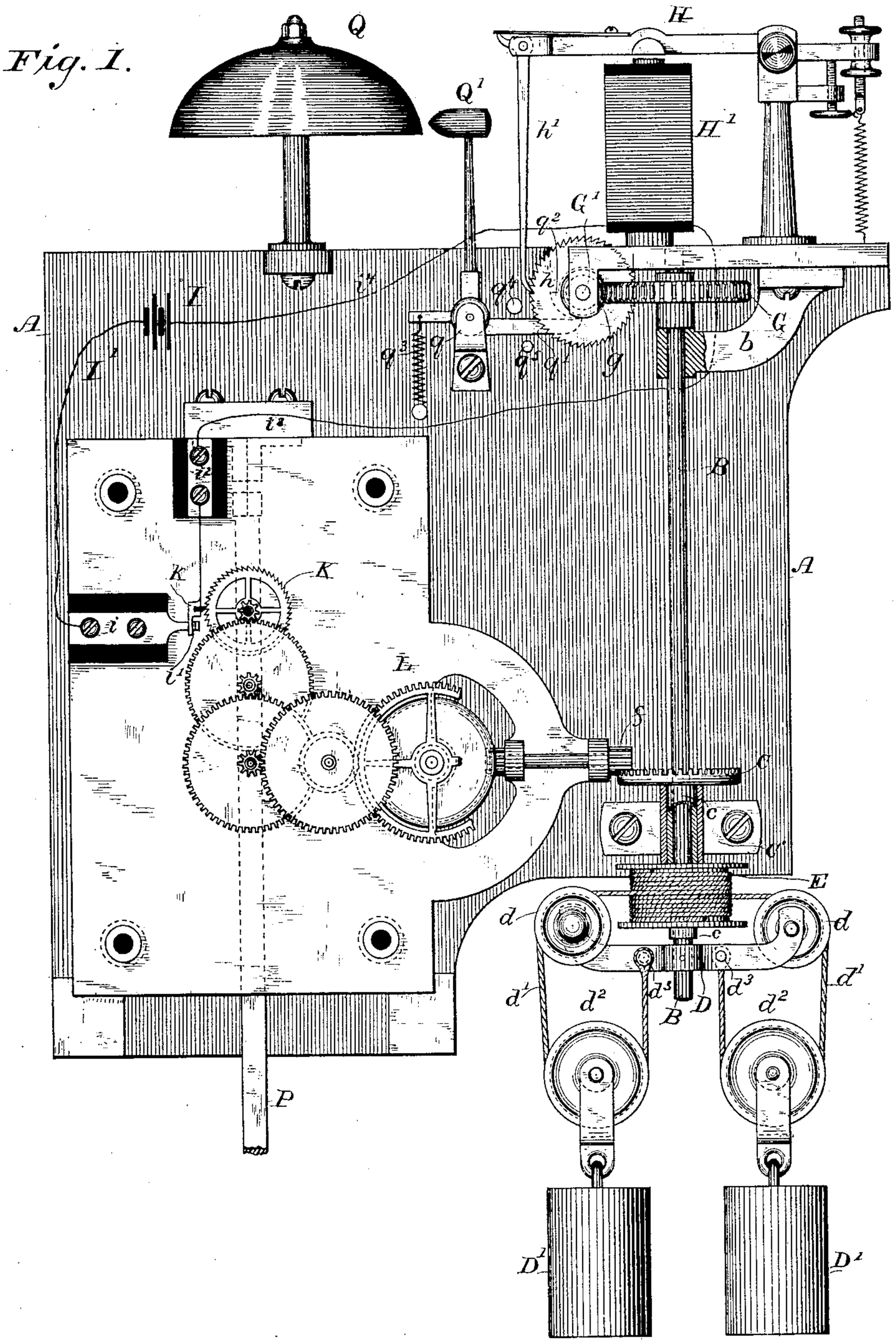
(No Model.) 3 Sheets—Sheet 1.

G. F. BALLOU.

ELECTRIC DEVICE FOR WINDING CLOCKS.

No. 277,104. Patented May 8, 1883.

Fig. 1.



WITNESSES.
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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

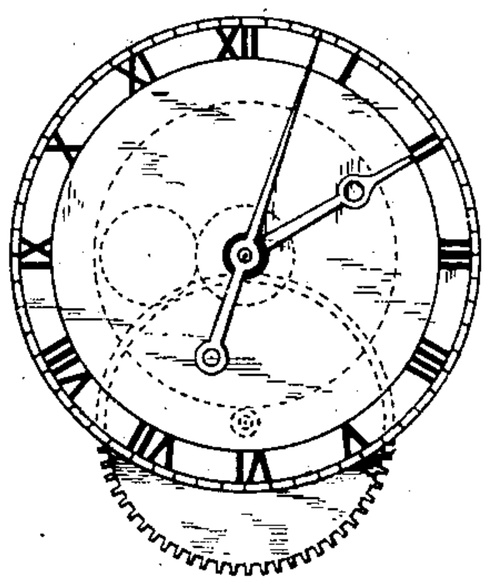

Fig. 4.

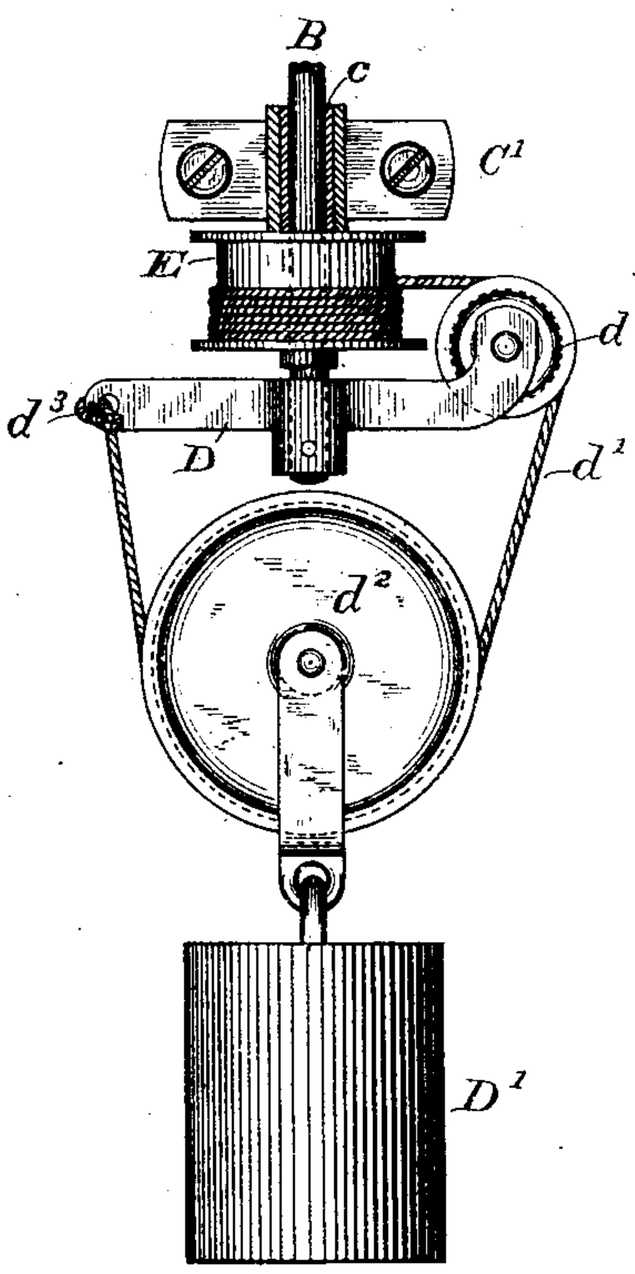

Fig. 2.

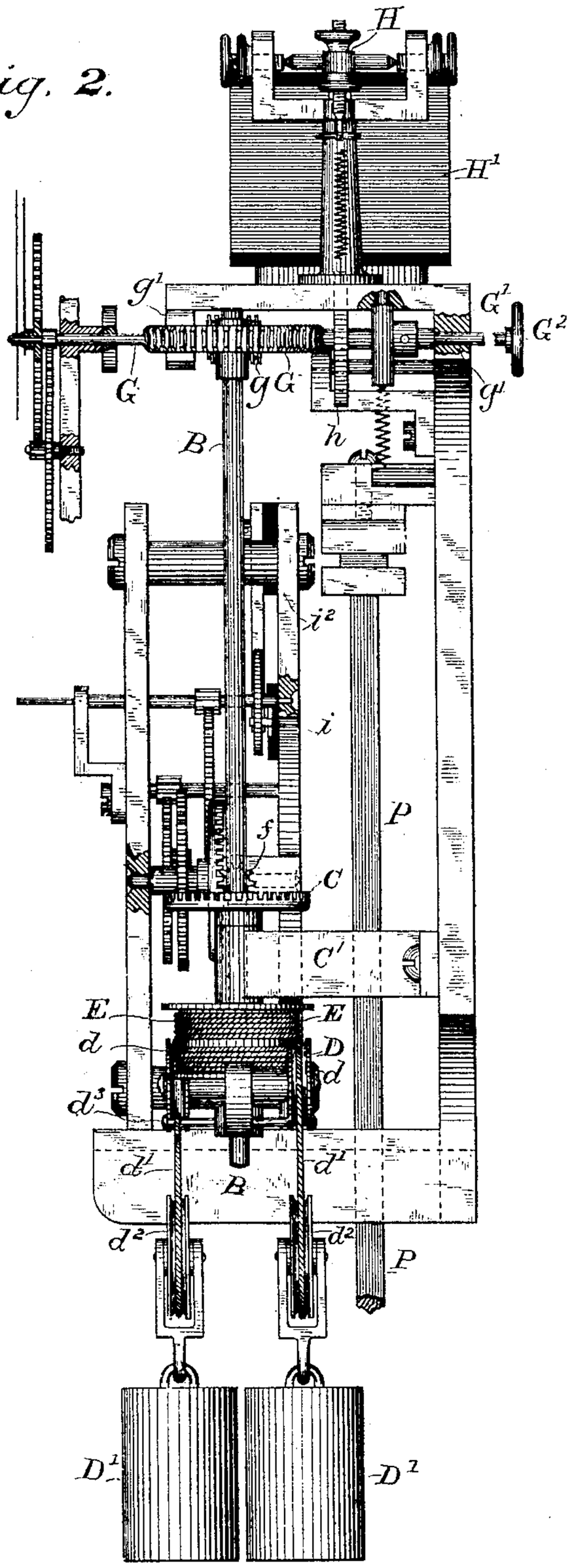

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Fig. 6.

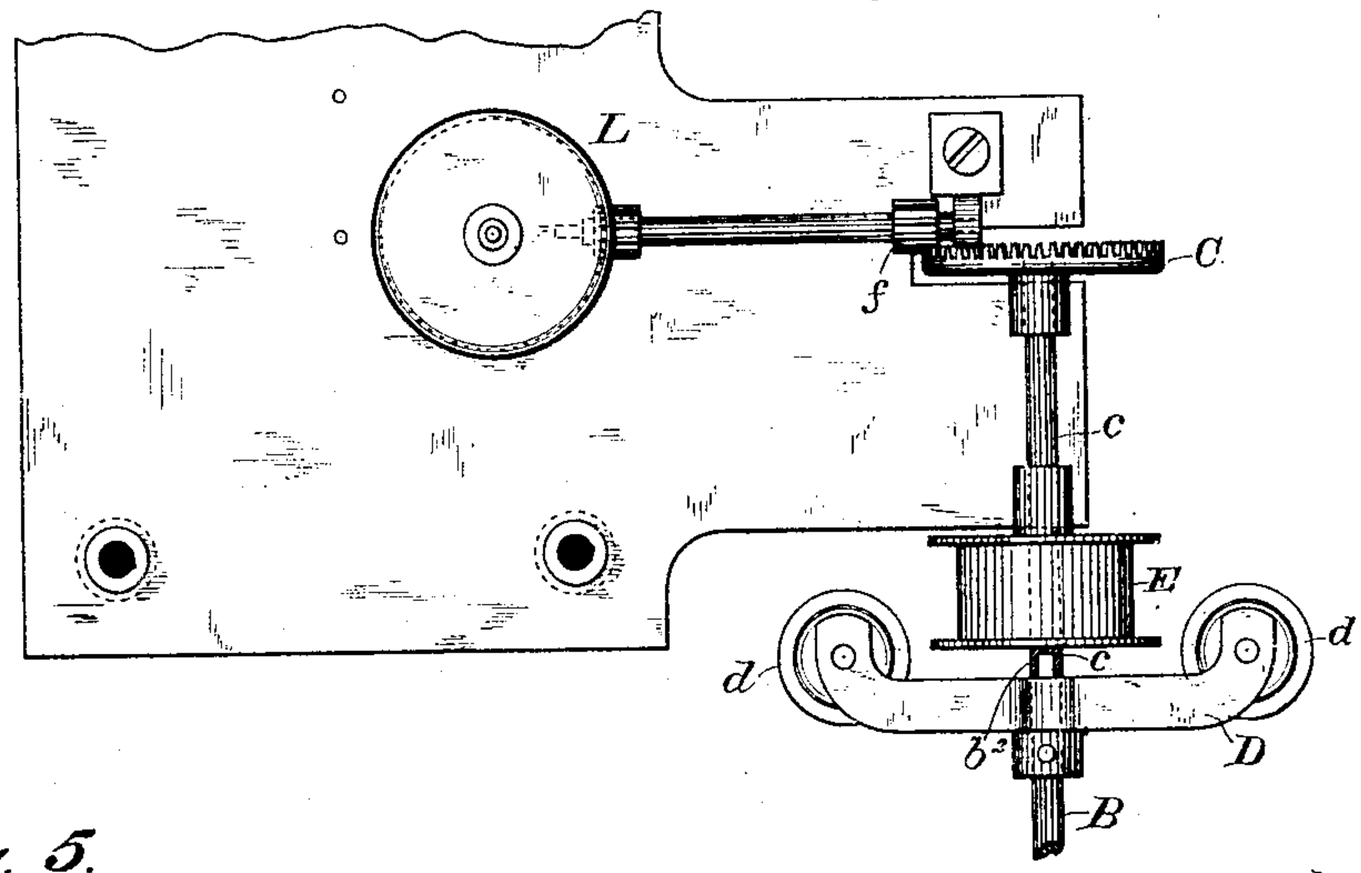


Fig. 5.

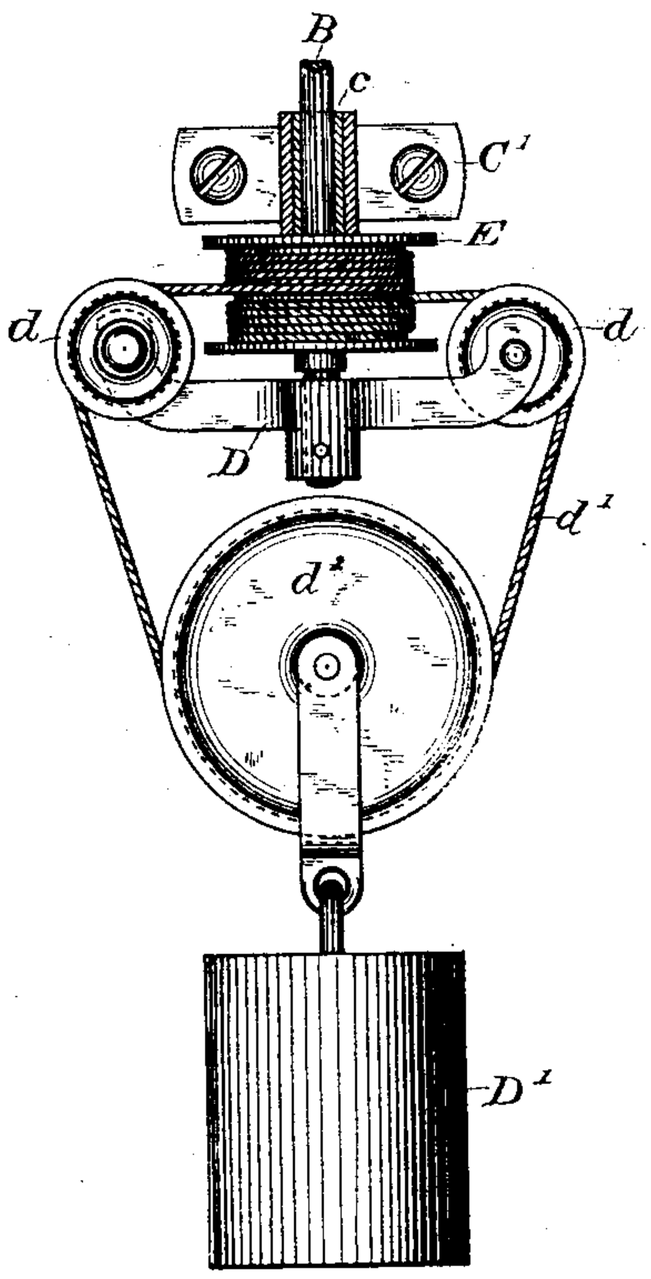


Fig. 8.

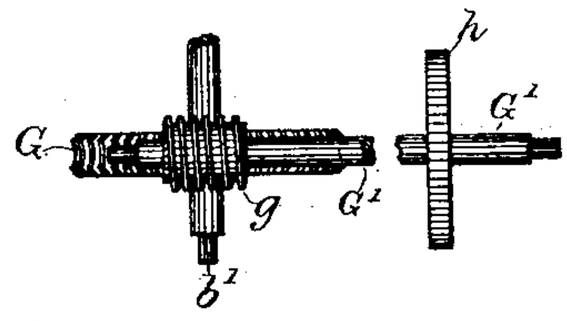
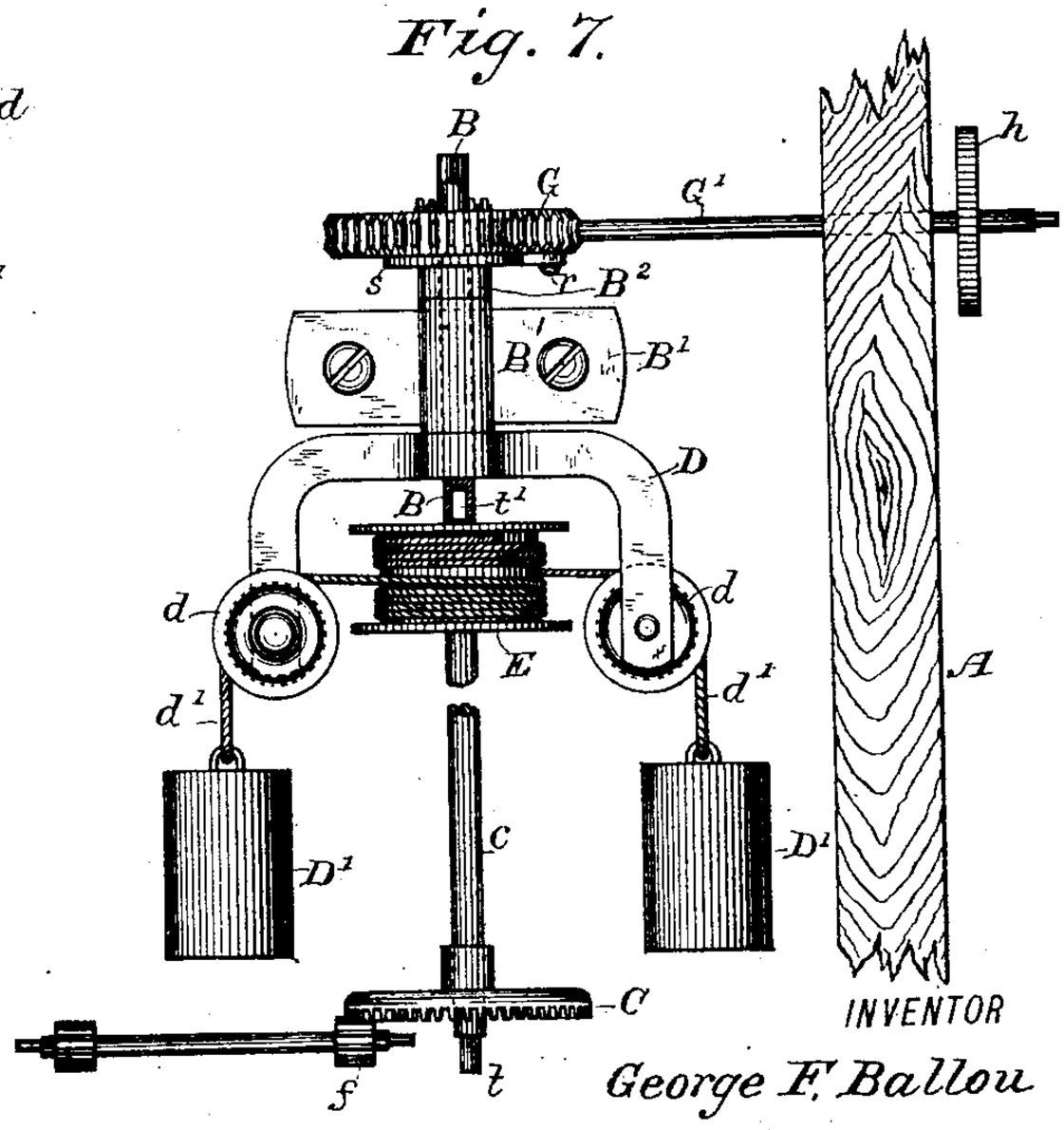


Fig. 7.



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UNITED STATES PATENT OFFICE.

GEORGE F. BALLOU, OF WALTHAM, MASSACHUSETTS.

ELECTRIC DEVICE FOR WINDING CLOCKS.

SPECIFICATION forming part of Letters Patent No. 277,104, dated May 8, 1883.

Application filed July 6, 1882. (No model.)

To all whom it may concern:

Be it known that I, GEORGE F. BALLOU, of Waltham, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Clocks, of which the following is a specification.

My invention comprehends an electric clock-winding apparatus which keeps the clock constantly wound by a continuous action which takes place as the clock is running without in any manner affecting the strain of the weight upon the train. The latter feature of my invention—the winding of the clock without modifying the force of the weights upon the train—is applicable to clocks generally which are run by weights. The importance of such an organization and operation will be appreciated by those skilled in the art. The evil effects which result from relieving the train from the force of the weight of a clock in winding it are well understood, and ways of avoiding it by the use of "maintaining springs," which keep the train under tension during the winding, have been devised. No such spring or any supplementary weight is employed in my invention, no change is made from one force to another, which necessarily involves a modifying influence, but the clock-weight itself at all times exerts its constant uniform pull or strain upon the clock-train.

My invention will be found specially valuable in astronomical and other clocks, which are required to be of the greatest delicacy. As the clock is kept constantly automatically wound by a continuous uniform action and the strain of the weight upon the train is never changed, the liability of variation is reduced to the minimum, and the accuracy of the clock is increased in a very marked degree.

My invention further contemplates certain other minor improvements in construction and organization more or less incidental to the two main features above.

The details of my invention will now be fully set forth.

In the accompanying drawings, which illustrate my invention in the form now best known to me, Figure 1 is a front elevation of so much of the clock-work and frame of a clock with my improvements applied as is necessary to illustrate the invention. Fig. 2 is a side elevation of the same. Fig. 3 is a detail view of the winding indicating-dial. Fig. 4 is a detail view showing an arrangement of the barrel and cord where I employ a single weight. Fig. 5 is a view of a somewhat similar organization where a single weight is employed. Fig. 6 is a detail elevation showing a modified construction in which the winding actuating-shaft is placed below the barrel of the clock instead of above it, as in Figs. 1 and 2; and Fig. 7 is a detail elevation showing the winding-shaft passing outside of the clock-frame, so that the electric part of the apparatus may be removed from the clock-work, if desired.

Referring specially to Figs. 1 and 2, A is a portion of the frame-work of the clock upon which the clock-train frame and the other parts of the mechanism are mounted. A vertical shaft, B, having its upper bearing in a bracket, *b*, passes centrally through the crown-wheel C and its elongated sleeve-hub *c*, and carries at its lower end the weight-frame D. The hub *c* of the crown-wheel has its bearing in a bracket, C′, secured on the frame A. The barrel E of the clock mechanism is secured rigidly to the lower end of the sleeve *c* of the the crown-wheel C, the sleeve preferably passing through the barrel, as indicated in the drawings. The vertical shaft B therefore passes centrally through the crown-wheel C and through the barrel E, and revolves with the weight-frame D independently of them. The weight-frame, which is a small transverse frame secured centrally upon the shaft B, is provided with pulleys *d d* at each end. The weight-cords *d′* are attached to opposite sides of the barrel E, and then pass over the pulleys *d* on the ends of the weight-frame, around pulleys d^2, connected with the weights D′, and are then connected to the weight-frame at d^3. The cords being wound upon the barrel by the revolution of the weight-frame in a manner to be described, the pull of both weights will tend to revolve the drum in the same direction. As the drum is vertical and concentrically arranged with reference to the shaft B, which carries the weight-frame, it will be obvious that by revolving the shaft B in the proper direction the weight-frame will revolve beneath the barrel, and will wind the cords thereon without at all removing or in any way modify-

ing the strains of the weights upon the barrel and train. The crown-wheel C gears with the pinion *f*, which actuates the clock-train in the usual manner. This is well understood, and needs no special description in this connection.

By the organization above described it will be perceived that the strain of the weights is kept constantly upon the barrel and train of the clock as well when the clock is being wound as at other times. The upright shaft B may extend up through the top of the clock-case and be actuated by a key in the ordinary manner at stated intervals to wind the clock, or by gearing the shaft may be wound from the side or bottom, as is most convenient. In either case, however, an ordinary ratchet-and-pawl arrangement, such as is shown in Fig. 7, and hereinafter described, should connect the worm-wheel G with the shaft, so as to permit the shaft to be rotated by the key without affecting the worm. In order, however, to keep the clock constantly wound by a continuous action, I employ an automatic electric winding arrangement, which I will now describe. The upright shaft B carries at its upper end a worm-wheel, G, which gears with a corresponding small worm, *g*, on the shaft G′, mounted on suitable bearings, *g′ g′*, in the clock-case. The shaft G′ carries a ratchet-wheel, *h*, which is actuated by a spring push-rod, *h′*, carried at the outer end of the vibrating-armature H of the electro-magnet H′. Each vibration of the armature will revolve the ratchet-wheel one tooth, and through the shaft G′, worm *g*, worm-wheel G, shaft B, and weight-frame D will wind the clock. The electric circuit runs from the battery I, by wire I′, to the insulated circuit-plate *i*, circuit-breaker *i′*, insulated plate i^2, by wire i^3, to coil of the electro-magnet, and by wire i^4 from the electro-magnet to the opposite pole of the battery. Each swing of the pendulum P will operate an escapement and permit the break-wheel K to revolve one tooth, The passage of this tooth past the insulated snubbing-tooth *k* of the circuit-breaker causes a break and make in the circuit, which produces a vibration of the armature H, and a consequent revolution of the ratchet-wheel *h*, a partial rotation of the weight-frame D, and a consequent winding of the weight-cord on the barrel of the clock. The scape-wheel may be on the same shaft with the break-wheel K. The details of the escapement may be of any well-known character. It is deemed unnecessary to show and describe them.

The number of teeth in the break-wheel K, the ratchet-wheel *h*, the worms, and the other gearing should be arranged with reference to each other, so that the makes and breaks in the circuit will cause a rotation of the weight-frame D relatively to the rotation of the barrel, which will be just sufficient to keep the cords wound upon the barrel in a uniform position and the weights at a constant unvarying height. Thus, as the barrel turns and the clock runs, the cords will be constantly wound with an equivalent speed, and the clock can never run down. Any expert can arrange the gearing to accomplish this result. Thus the ratchet-wheel *h* might have one hundred and fifty teeth and the break-wheel thirty teeth, and be revolved once a minute. It would thus take five minutes for the ratchet-wheel to make one revolution. The worm-wheel G may have, say, two hundred and eighty-eight teeth. If the wheel L is arranged to be revolved once in twenty-four hours, or one thousand four hundred and forty minutes, the gearing properly timed, and the battery I is kept in good order, and no accidents occur, the weight-frame will revolve in the same time, and consequently the clock will be kept uniformly wound. The drawings show different numbers of teeth on the wheels from those above given; but the point is immaterial.

As before remarked, in order to wind the clock by an ordinary key under the organization shown in Figs. 1 and 2, the end of the shaft B might be squared and arranged so as to project above the top of the clock-case; or it might be wound from the side of the clock by suitable gearing, the worm-wheel being connected to the shaft by an ordinary ratchet-and-pawl arrangement; or the end of the shaft G′ may project beyond the clock-case and be squared or provided with a thumb-piece, G^2, by which the shaft may be actuated, in which case the push-rod *h′* will slip on the ratchet-wheel and permit the winding without disturbing the electric winding part of the apparatus. It is desirable to have such an ordinary key-winding arrangement in connection with a continuous automatic electric winder, so that the clock may be wound in case of any accident to the electric part of the apparatus.

In order to tell whether the electric winding apparatus is operating, it is best that an indicating apparatus should be provided. I have shown two forms of such apparatus in the accompanying drawings.

In Figs. 2 and 3 an ordinary time-dial, provided with hour and minute hands, is mounted upon the shaft G′, which carries the electric clock-winding mechanism. The hands of this auxiliary indicating-dial are so geared as to move at the same rate as the regular time-indicating hands on the dial-face of the clock, which latter are not represented in the drawings, as their illustration seems unnecessary. If any accident should happen to the battery or winding mechanism, the hands on the auxiliary indicating-dial would stop, and it could therefore be readily perceived by a comparison of the two dials how long and at just what time the winding mechanism had ceased to operate. The gearing to actuate the hands of the indicating-dial isochronously with those of the ordinary time-dial can be arranged in any suitable usual manner. It is deemed unnecessary to describe it in detail.

In Fig. 1 of the drawings I have shown another indicating apparatus, consisting of an alarm-bell, which is sounded once in each revolution of the ratchet-wheel *h*—that is to say,

every five minutes. The arrangement is as follows: The bell Q is mounted on the top of the clock-case, and the hammer Q′ is pivoted in a bracket, *q*, on the inside of the clock-case. A right-angle extension or arm, *q′*, of the hammer-lever projects laterally under the ratchet-wheel shaft G′ and is gradually raised at each revolution of the shaft by a cam, q^2. The effect of this is to draw the hammer away from the bell; but upon the arm riding past the lip of the cam a coil-spring, q^3, draws the hammer down upon the bell and sounds the alarm. The arm *q′* vibrates between two studs, q^4 q^5. When the hammer is drawn forward by the spring to strike the bell the arm *q′* will strike the stud q^4 before the hammer reaches the bell; but the hammer-lever is sufficiently yielding and the leverage is such that the hammer will spring over far enough to sound the bell. In case it is desired to throw the bell out of action, the spring q^3 may be released and the hammer tilted back so as to rest upon the stop q^5, where it will be out of action. Other forms of indicators may be employed without departing from the broad principle of my invention.

In Fig. 4 I have shown an arrangement in which a single weight, D′, is employed. In this organization a single-weight cord, *d′*, is attached to the barrel, passes over the pulley *d* on the weight-frame under the pulley d^2, carried by the weight, and is attached to the frame at d^3. The effect will be the same as that of the double-weight arrangement illustrated in Figs. 1 and 2. The figure does not need further description.

A single weight is also employed in the organization shown in Fig. 5. In that figure the weight-cord passes over the pulley d^2, carried by the weight up over the pulleys *d d* on the weight-frame, and its ends are then secured to the opposite side of the barrel, as in Fig. 1. The effect is the same as in Fig. 1.

In Fig. 6 the vertical winding-shaft B extends downward any suitable distance relatively to the clock mechanism, and carries near its lower end the worm-wheel G. The horizontal shaft G′, carrying the ratchet-wheel *h*, which is actuated by the electric winding mechanism, may be extended laterally any suitable distance from the clock-case, so as to remove the electric part of the apparatus from the works of the clock, which may be found advantageous in some cases. In this organization the lower end of the shaft B can have its bearing in a suitable stepping at *b′*, while its upper end may have its bearing within a sleeve or bracket, which forms the bearing for the crown-wheel C; or the upper end of the shaft may have its bearing at b^2, in the lower end of the shaft or sleeve *c*, which carries the crown-wheel C and the barrel of the clock. Any suitable arrangement will answer, and it is immaterial so far as the organization is concerned, provided that the bearings are such that the rotation of the shaft B will not have any effect upon the barrel. In the arrangement shown in this figure the weight-frame is similar to that shown in Fig. 1; but, for convenience of illustration, the weights and cords have been omitted. The end of the shaft G′, which extends out through the clock-case, may be squared at its end for the reception of an ordinary winding-key.

Fig. 7 illustrates an arrangement in which the winding-shaft B is extended up to or through the top of the clock-case, while the shaft G′, which is actuated by the electric winding apparatus, extends out laterally through the side of the case, so that the electric part of the apparatus may be removed from the clock-work. Under this organization the shaft B has its bearings in a tubular bracket or sleeve, B′, the shaft being provided with a bearing-collar, B^2, which sustains it in place. The worm-wheel G is placed loosely upon the shaft B, but is locked with it when revolved in one direction by a pawl, *r*, on the wheel which engages in a ratchet, *s*, secured on the shaft. The ratchet and bearing-collar B^2 may be formed in a single piece and securely pinned to the shaft. The shaft *c*, which carries the barrel E, has its lower bearing in any suitable stepping at *t*, while its upper end has its bearing in the lower end of the shaft B at *t′*. The weight-frame in this organization is of an inverted construction, the arms which carry the pulleys *d* depending and the barrel revolving between them. The cords from the weights pass up over the pulleys, and their ends are attached to opposite sides of the barrel. The operation is the same as that of the weights and frame in the other figures of the drawings. The upper end of the shaft B is shown as squared for the reception of an ordinary winding-key. The ratchet-and-pawl arrangement *r s* causes the worm-wheel D to revolve the shaft B and wind up the clock when the shaft G′ is actuated by the electric apparatus. When, however, an ordinary winding-key is applied to the squared end of the shaft B, the ratchet and pawl *r s* permit the shaft B to revolve independently of the worm-wheel G, so as to revolve the weight-frame and wind up the clock irrespective of the electric apparatus. The ratchet and pawl hold the shaft B and prevent it from turning back.

The general operation and arrangement of the other parts of the apparatus are the same as that under the organization shown in Fig. 1, the position of the several parts, so far as shown in this figure, being indicated by corresponding reference-letters.

In the weight-frames illustrated in the different figures of the drawings the pulleys at each end or side of the frame are placed at the opposite diagonal corners, so that the pulleys will be in line with tangents drawn from the opposite sides of the barrel in opposite directions. This insures a direct pull of the cord on the barrel and avoids the cramping of the parts.

Other modifications than those already described and indicated in the drawings will readily suggest themselves to those skilled in

the art; and it will of course be obvious that many such changes may be made without departing from the principle of my invention, the broad features of which have been briefly indicated at the beginning of this specification. So far as a mere modification in the character of the weights employed is concerned it will be obvious under the organizations shown in Figs. 1, 6, and 7 that a single solid cylindrical weight might be employed, the cords being attached to it at opposite points.

In case of any accident to the battery, or where the necessity for replacing the battery arises, there would be a loss of a certain number of movements of the armature-lever which actuates the winding mechanism. This loss could be made up very readily by placing a break-key in the circuit, which could be actuated to wind the weights to the proper position. The loss in any event would be a very small one, the change of the battery only requiring a few moments' work; or the loss could be made up by operating the shafts B or G′ by an ordinary key, as described.

I am aware that Letters Patent No. 31,242, granted January 29, 1861, describe a weight-clock which is kept constantly wound. In that clock, however, the clock-train was driven at different points at intervals, first from one winding-drum and then from another. Such an arrangement necessarily involves a loss of motion and imparts a shock through the train when the two driving-gears are alternately thrown into operation. The strain of the weight is therefore not kept without variation upon the train.

What I claim as my invention is—

1. The combination of the clock mechanism, the vertical barrel, the weight-frame, and automatic electric winding mechanism which rotates the weight-frame and winds up the clock.

2. The combination of the clock mechanism, the vertical barrel, the weight-frame, an electric circuit, a circuit-breaker, and an electromagnetic step-by-step actuating mechanism operated by each break and make in the circuit to rotate the weight-frame and wind up the clock, substantially as set forth.

3. The combination of the clock mechanism, the vertical barrel, the shaft carrying the weight-frame arranged concentrically with the barrel, the weight-frame, the counter-shaft G′, the gearing, the ratchet-wheel on the counter-shaft, an electric circuit, a circuit-breaker actuated by each movement of the escapement, and the electric step-by-step mechanism, actuated by each break and make in the circuit to revolve the ratchet-wheel and rotate the weight-frame to wind up the clock, substantially as set forth.

4. The combination of clock mechanism, weight-sustaining devices which enable the weights to exert a never-varying constant strain upon the train, and automatic electric mechanism for winding the clock without modifying the strain of the weight upon the train, substantially as set forth.

5. The combination of clock mechanism, a vertical actuating-barrel, and an independently-rotatable weight-frame.

6. The combination, substantially as set forth, of the clock mechanism, the vertical barrel, to which the weight cord or cords are attached, the weight-frame which supports the weights, and mechanism for revolving the weight-frame independently of the barrel to wind the cords on the barrel without removing the strain of the weights from the clock-train.

7. The combination of the clock mechanism, the vertical barrel, the winding-shaft arranged concentrically with the barrel, the weight-frame carried by the shaft, the weights and cords, and means for rotating the winding-shaft to wind up the clock without removing the strain of the weight from the train, substantially as set forth.

8. The combination of clock mechanism, clock-weight-sustaining devices which maintain the strain of the weight constantly and without variation on the train, and means for winding the clock without changing the strain of the weight upon the train.

9. The combination of the clock mechanism, automatic electric-winding mechanism which operates continuously to keep the clock wound as the clock is running, and an indicating device to indicate that the winding mechanism is operating, substantially as set forth.

10. The combination of the clock mechanism, the automatic winding mechanism, which operates continuously to keep the clock wound, and an auxiliary indicating-dial, the hands of which are actuated by the winding mechanism and are geared to move isochronously with the regular dial-hands of the clock, substantially as and for the purpose set forth.

In testimony whereof I have hereunto subscribed my name.

GEO. F. BALLOU.

Witnesses:
W. R. WILLS,
CHARLES F. STONE.