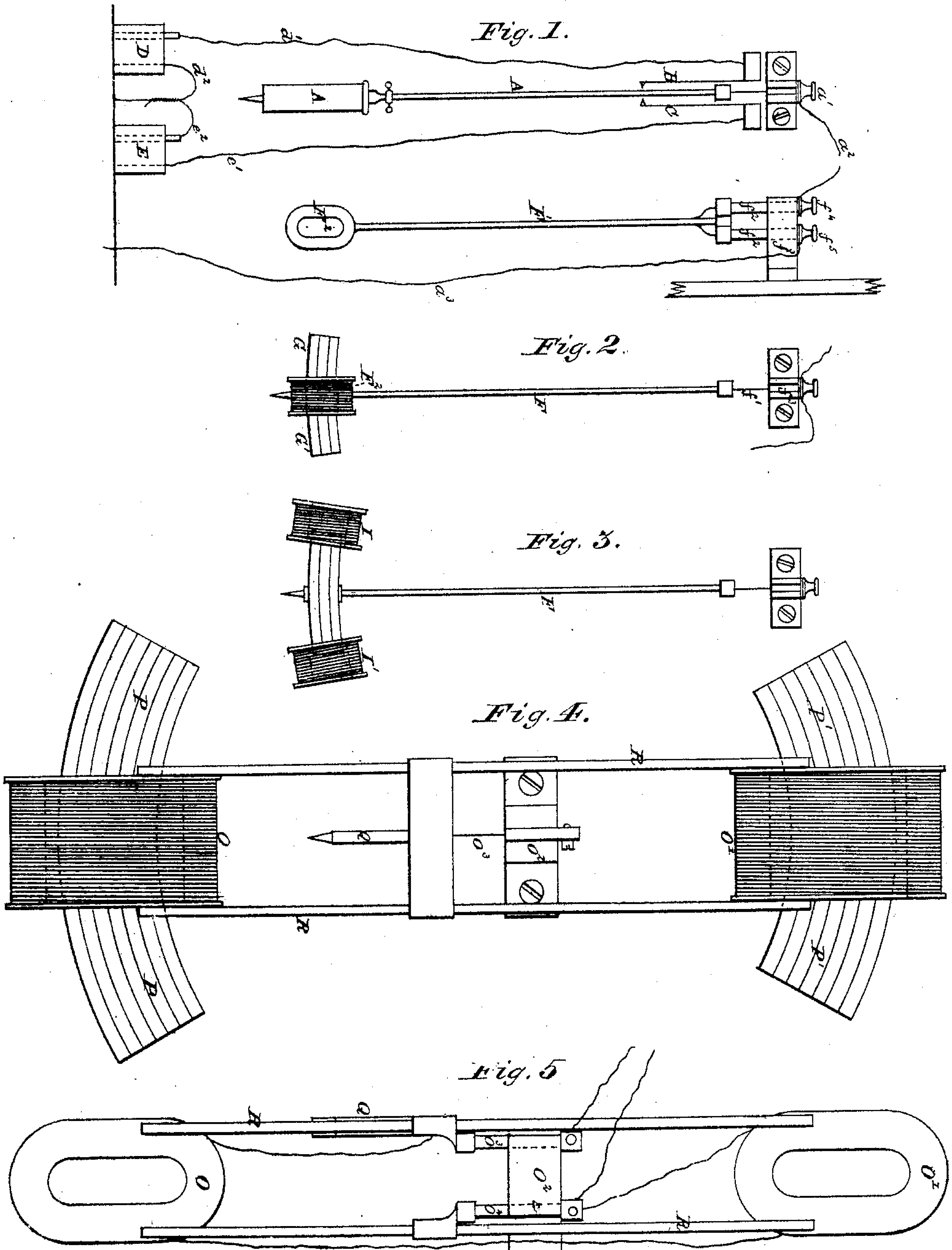
2 Sheets--Sheet 1.

F. J. RITCHIE.
Electric Clocks.

No. 143,847. Patented Oct. 21, 1873.



Witnesses:
A. Moore
T. C. Brecht.

Inventor:
F. J. Ritchie
by his attorney
T. D. Stetson

2 Sheets--Sheet 2.

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Fig. 6.

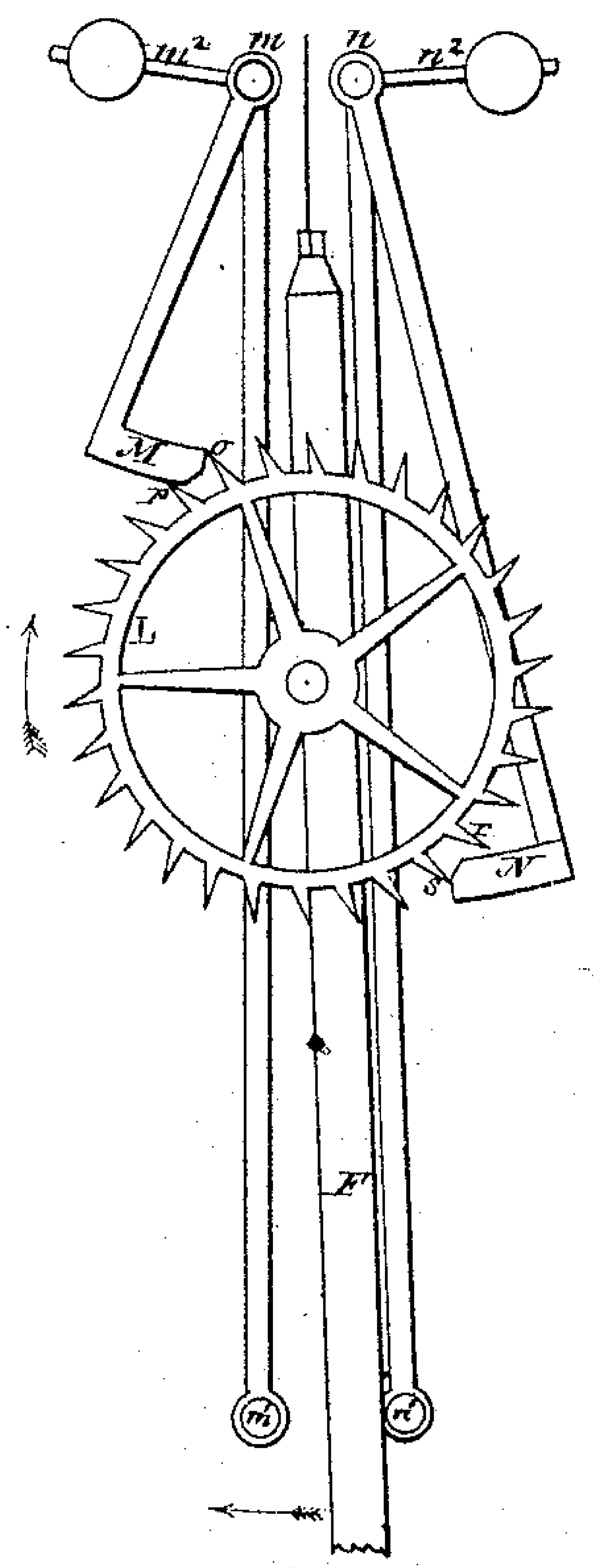


Fig. 7.

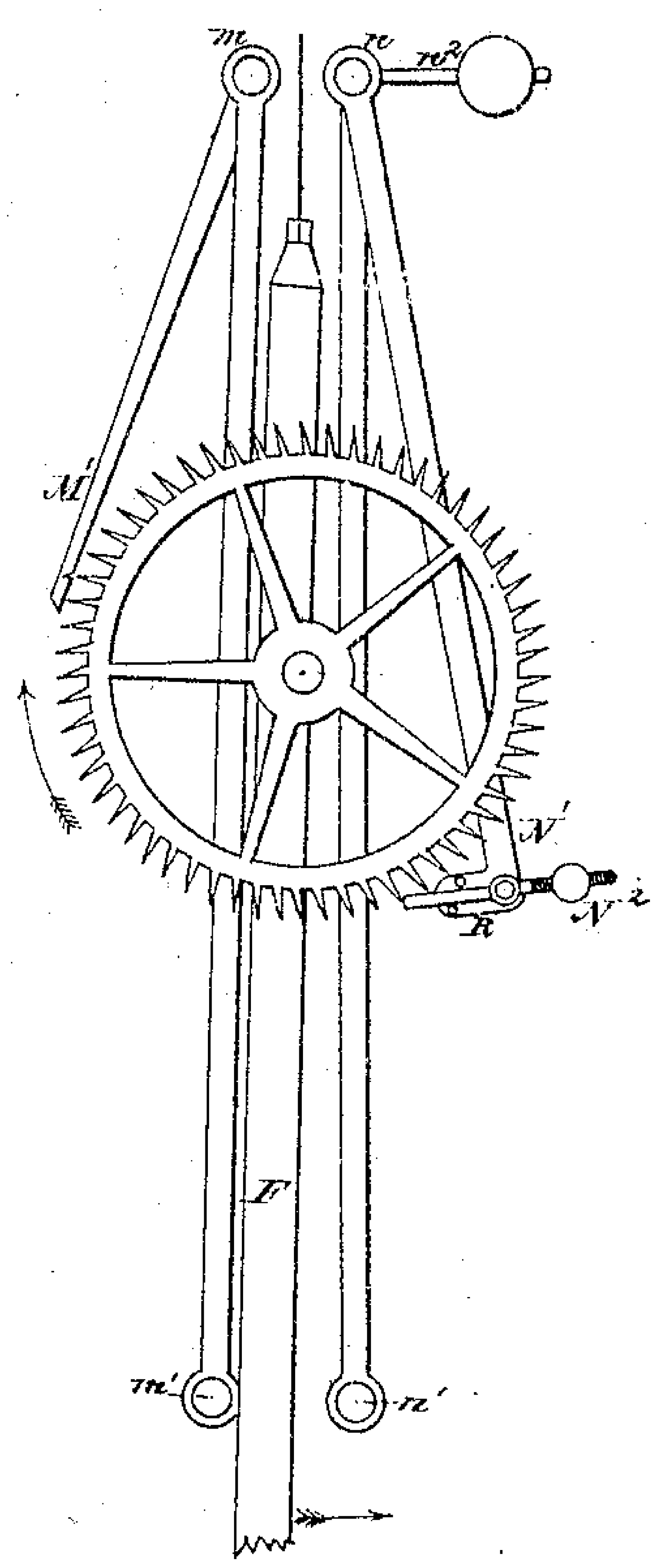


Fig. 9.

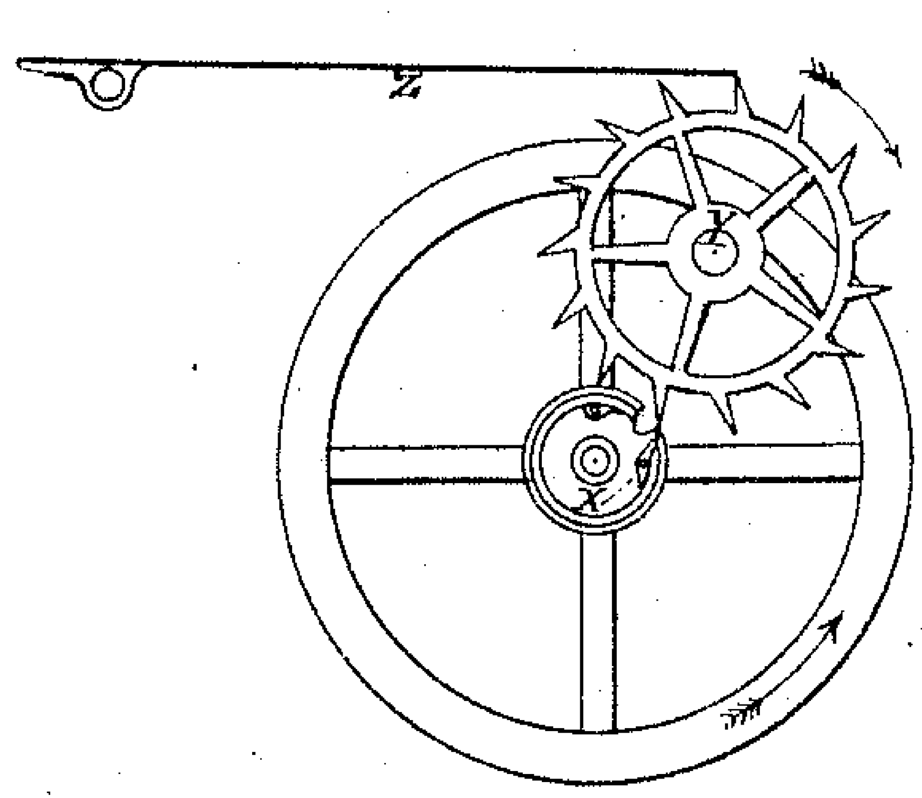
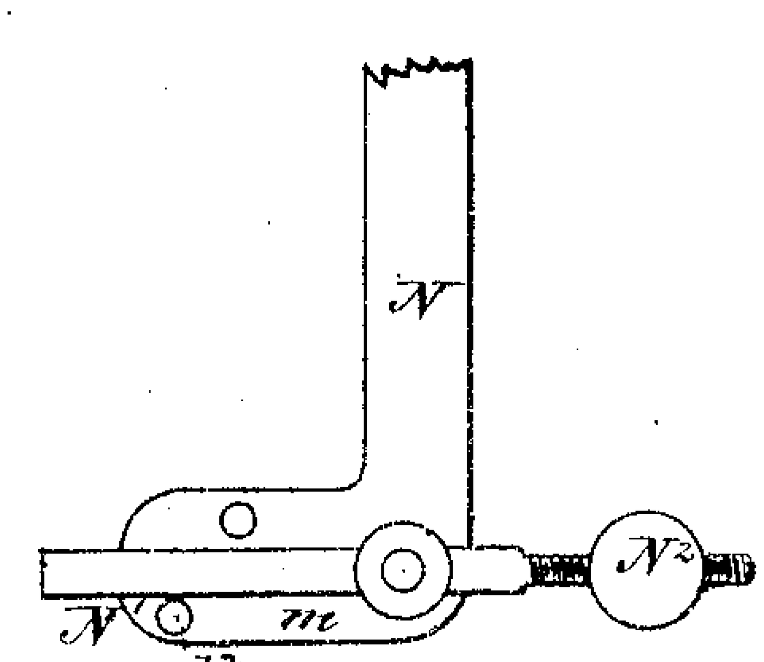


Fig. 8.



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F. J. Ritchie
by his attorney T. D. Stetson

UNITED STATES PATENT OFFICE.

FREDERICK J. RITCHIE, OF EDINBURGH, SCOTLAND.

IMPROVEMENT IN ELECTRIC CLOCKS.

Specification forming part of Letters Patent No. **143,847**, dated October 21, 1873; application filed October 8, 1872.

To all whom it may concern:

Be it known that I, FREDERICK JAMES RITCHIE, of the city of Edinburgh, Kingdom of Scotland, watch and clock maker, have invented certain Improvements in Sympathetic Clocks, of which the following is a specification:

Currents of electricity have long been transmitted at regular intervals, governed by a standard or regulator clock, through wire communicating with clock-work at one or more distant points, by which the time is shown. The arrangement causes all the clocks to show the same time, and the time is more or less perfect, according to the perfection of the standard or regulator clock at the center. The clocks which are thus operated or controlled by the currents transmitted may be designated companion clocks or sympathetic clocks. I will use these terms in this specification.

There are two distinct systems on which such clocks are operated. In one the works are turned by a weight or other driving power maintained in each separately, and which requires periodical winding. Under such system the function of the electrical force transmitted is to regulate the motion. It may restrain or urge forward the motion, which would otherwise be approximately correct. In the other the works of the sympathetic clocks are propelled by the direct force of the electro-magnet operated by the electrical pulsation.

My invention relates to this latter class. It is also of the class in which the force is received on pendulums in the several sympathetic clocks. The several pendulums being adjusted to swing in approximately correct time, but a little too slow, the impulses received from the standard or regulator clock urges forward the motion. The force is exercised in such a way as to maintain the beats of the pendulum and shorten its time of vibration by sufficient increments, according to the circumstances, to compel an exact conformity with the true standard clock.

I employ means of communicating motion to the sympathetic clock, and by which, in consequence of the small battery-power requisite to sustain the motion of the pendulum, the liability of derangement is small. This is shown by means of Figures 1 and 2 on Sheet 1 of the accompanying drawings.

A is the pendulum of the master clock or standard clock, which may be assumed to be driven in the usual manner by very perfect clock-work, and of course requires periodical winding up. B and C are insulated slender springs, so placed that the rod of the pendulum A comes in contact alternately with each. D and E are batteries, represented as just below the pendulum, but which may in practice be placed in any convenient position. The positive terminal d^1 of the battery D is connected with the spring B, and the negative terminal e^1 of the battery E is connected with the spring C. The other terminals of each battery d^2 and e^2 are connected together and to the earth.

F in Fig. 1 is a front view, and F in Fig. 2 is a side view, of the pendulum of one of the sympathetic clocks or sets of clock-work. The pendulum carries a coil of insulated copper wire, F^2, one end of which terminates in a spring, f^1, and the other in the corresponding spring, f^2. These two springs, mounted side by side, suspend the pendulum. They are both insulated from the fixed suspension-piece f^3, and are insulated from each other, except by the communication through the coil F^2. A wire, a^2, connects the spring f^1 with the terminal screw a^1 of the standard pendulum A, and through it with its pendulum-rod. Another wire, a^3, leads from the spring f^2 to the earth. G and G′ are permanent magnets, combined together, as shown, and curved to correspond to the motion of the coil F^2, which turns on the center of suspension above, and loosely incloses without touching them. The similar poles of these magnets are placed together, so that they act in unison as a single powerful permanent magnet, with the coil F^2 adjusted to vibrate freely over them.

The action may be thus explained: When the master pendulum A oscillates to the left, it comes in contact with the spring B, and sets in motion a positive current from the pole d^1 of the battery D, through the coil F^2, in a direction to cause an attraction between the latter and the left-hand pole G of the permanent magnet, causing also a repulsion from the right pole G′. Supposing the pendulum to be already in motion, this condition favors its motion to the left, and quickens its motion in that direction. The train by which this motion is communicated will be apparent from the drawings. The current flows upward from the battery through the wire d^1; thence downward through the spring B into the pendulum-rod A; thence upward through its suspension-spring, and outward through its screw-cap a^1; or, thence through the wire a^2 and screw f^4, down through the spring f^1, and thence through the coil F^2, where it induces the magnetism; from thence it flows upward again through the spring f^2, out through the screw f^5, and down through the wire a^2 into the earth. At the proper time, the normal or master pendulum A returns, and breaks contact from the spring B, causing its influence to cease upon the coil F^2. A little later the normal pendulum A has moved sufficiently to the right to come in contact with the spring C, when an opposite condition is induced in the coil F^2 by a negative current being transmitted from the battery E through the same series of connections as were before employed. This latter condition induces a tendency in the coil F^2 to swing to the right, and thus, the tendency to swing in the opposite directions being changed at the proper moment, by the action of the normal or master pendulum A, the several sympathetic clock-works are maintained at the proper rate of motion.

It may not be necessary to explain that, in the battery E, the respective poles are so arranged that the current through the wire e^1 is in the opposite direction, or electricity of the opposite kind, to that in the wire d^1. The contact of the pendulum A with the wire C induces a motion, in common language, upward through the terminal wire a^3, down through the spring f^2; thence through the coil F^2 in an opposite direction to that before induced, and thence all the way in the opposite direction to that induced by the contact with the spring B. The alternate currents of positive and negative electricity, induced at regular intervals by the action of the normal clock, give motion to any number of subsidiary or sympathetic pendulums, the number, of course, depending somewhat on the power of the original batteries. Any number within proper limits may thus be caused to vibrate in unison with each other and with a regulator-clock. Only a slight battery-power is required, inasmuch as the magnetic influence of the current is applied to the extreme end of the pendulum, where the most powerful effect is produced. From the momentum of the pendulum the currents may be intermitted for several seconds without causing its motion to cease. The presence of the pendulum in each of the systems of sympathetic clock-work thus serves important functions, both as a means of receiving the impulses favorably, and as a regulating and steadying element of the mechanism. It is persistent to maintain an approximately true motion under all conditions, yet subject to the action of the magnetic impulses to control it.

Instead of the wire coil being attached to the pendulum-rod of the subsidiary pendulum and the magnets fixed to the clock-case, the coil or coils may be fixed and the magnets carried on the pendulum, as in Fig. 3, Sheet 1, where H are the magnetic bars carried on the pendulum, and I I′ are fixed coils, into which the poles of the magnets enter. One end of the wire in one coil is connected to one end of the wire in the other coil, and the other ends are led, one to the screw a^1 of the normal pendulum, and the other to the earth. Instead of magnetic bars H, small coils of wire, rendered magnetic by the passing of a current, may be substituted.

I propose to use a pendulum loaded above its center of suspension, so as to beat approximately with the normal pendulum when it is desirable to have corresponding beats, but where, from want of room, this cannot be conveniently obtained by a pendulum of the same length. For this purpose I use a coil or coils of wire or magnetic bars below, and the same above, the point of suspension, working into or around magnets or coils fixed in the casing, as represented in drawings, Figs. 4 and 5, which are, respectively, a front and side view. O and O^1 are coils of wire, mounted on a frame, R R R R, and suspended on the fixed piece O^2 by the springs O^3 and O^4. The magnets P and P′, having their similar poles in proximity, are placed so that the coils vibrate freely over them. The currents from the normal clock enter, by the spring O^3, into the coil O, thence into the coil O^1, and pass on, by the spring O^4, to the line-wire. The action is closely similar to that in Fig. 1, but somewhat affected by passing through two coils.

I employ means for propelling a train of wheel-work (which carries the hands) by the oscillations of a pendulum, acting on two arms or pallets suspended on arbors or springs, alternately pressing, by force of gravity or otherwise, on the teeth of the escapement-wheel. This is represented in the drawings, Fig. 6, Sheet 2, and may thus be described: L is the escapement-wheel, carrying the second-hand, and is cut into thirty teeth. *m* and *n* are arbors, carrying pallets M and N, the points or ends of which pallets press, by force of gravity, on the teeth of the scape-wheel L, causing it to move in the forward direction till stopped by the arc formed on each pallet, respectively. On the same arbors *m* and *n* are also fixed arms, carrying studs m^1 and n^1 to either side of the pendulum-rod F, so as to be alternately acted on or raised by oscillations of the pendulum. The wheel L is shown at rest on the pallet M, the end of which presses against the one tooth, *o*, while the succeeding tooth *p* rests upon the arc on the under surface of the pallet. When the pendulum oscillates in the direction of the arrow the stud n^1, by force of gravity, follows it, and, after the pallet M has been removed by the action of the pendulum upon the stud m^1, allows the arm carrying the pallet N, by force of gravity, to move forward the tooth s, against which it has been pressing, until the tooth t is stopped by the arc formed on the upper side of the pallet N. The reverse oscillation of the pendulum operates upon the pallets in the same way, but in the reverse order.

Additional gravity-weights may be added, if necessary, on arms m^2 and n^2 secured to the arbors. Instead of arbors, suspension-springs may be substituted for the action of gravity in propelling the wheel.

The motion of the second-hand is instantaneous, and rests "dead" on the division of the dial; and no force, however great, will cause the wheel to move forward at any time beyond the arc of the pallet on which it is resting. The wheel cannot be turned backward, except by a force greater than the weight of the gravity-arms.

For clocks in exposed situations, a simple detent or catch is provided, which, falling into each tooth when advanced by the pallet, prevents any force from turning the wheel backward.

In Figs. 4 and 5 the projecting part Q takes the place of the pendulum-rod in Fig. 6 in imparting motion. It may act on similar studs m^1 and n^1 attached to the pallets M N.

An important part of my improvement relates to the adaptation of the means of propulsion described above so as to enable a half-second pendulum to beat seconds. For this purpose I use only one gravity-arm having a jointed pallet, which presses forward the wheel at every alternate swing of the pendulum until locked, as before, on the arc on the upper side of the pallet, as shown in Fig. 7, Sheet 2. T is the scape-wheel carrying the second-hand, and is cut into sixty teeth. The arbor n carries an arm, N, with a jointed pallet, N^1, the weight of which is slightly overbalanced by an adjustable poise, N^2. Two studs, p^1 p^2, are placed to limit the play of the pallet. The end of this pallet, pressing against the tooth of the wheel, causes it to move forward until the succeeding tooth touches and presses the pallet against the lower stud p^1, beyond which no force will cause the wheel to move. Another arbor, m, carries an arm, M, with a small notch, k, which falls upon the point of a tooth of the wheel, and, until relieved, no force will cause the wheel to move either backward or forward. When the pendulum F oscillates toward the right hand in the direction of the arrow it leaves the notch on M′ holding the wheel firmly, and then raises the arm N (carrying the jointed pallet N^1) out of contact with the wheel. When the arc has cleared the tooth of the wheel, the point of the hinged pallet N^1 is raised by the preponderance of the weight N^2, and will, on the return swing of the pendulum, press against the following tooth of the wheel in readiness to move it forward as soon as the pendulum-rod, acting on the stud m^1, raises the arm M′ from the tooth. The wheel is then carried forward by the weight of the pallet N and its connections until locked as before.

Fig. 8, Sheet 2, is an enlarged drawing of the hinged pallet N^1 and the adjacent parts.

Another part of my improvement relates to applying the foregoing to a vibrating balance-wheel instead of and acting in place of a pendulum. The escapement I have invented for this is shown on Fig. 9, Sheet 2. Y is a wheel in connection with the train of wheel-work carrying the hands, and is held steady by a very slender spring, z. X is a roller fixed to the arbor of the balance, and has a jointed pallet, x, projecting beyond its periphery, which is pressed outward by a slender spring. When the balance vibrates in the direction of the arrow, the projecting pallet carries forward the tooth of the wheel. The pallet, in returning, clears the tooth by the action of the joint, and, being then pressed outward by its spring, is in readiness to carry forward the succeeding tooth upon the next vibration of the balance.

In all these different methods it will be seen that it is the oscillations of the pendulum or balance, and not the currents from the normal or standard clock, which are recorded by the wheel-work, so that any accidental stopping of the current for even several seconds will not affect the time shown by the sympathetic clock.

My improvements can all be applied to pendulums which are of different lengths from that of the normal clock.

Having explained the way in which my improvements are worked out, I do not claim as new all that has been described; but

What I claim as my invention is—

1. The insulated springs B C, with their respective connections d^1 e^1, in combination with master pendulum A and the connection a^1 a^2 to one or more sympathetic clocks, as herein specified.

2. The positive detent M′, as constructed with notch k, in combination with ratchet-wheel L, pendulum F, and impulse-pawl N, as shown and described.

FRED. J. RITCHIE.

Witnesses:

ANDREW B. STEWART,
Of No. 1 India Buildings, Edinburgh, Solicitor's Clerk.

W. D. CAMPBELL,
Of No. 1 India Buildings, Edinburgh, Solicitor's Clerk.