W. M. DAVIS.

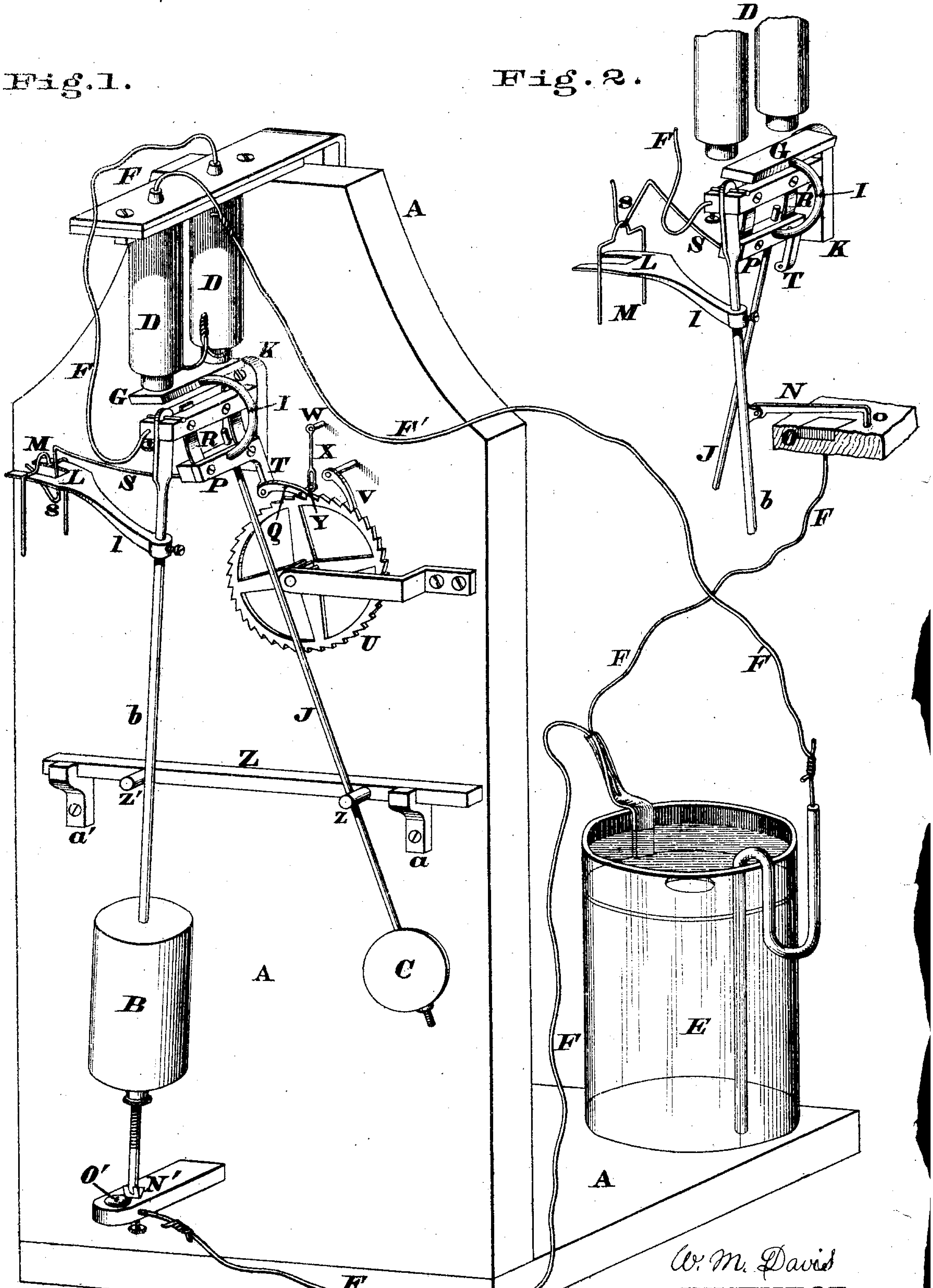
Electrical-Clock.

No. 120,185.

Patented Oct. 24, 1871.

Fig. 1.

Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIAM M. DAVIS, OF CINCINNATI, OHIO.

IMPROVEMENT IN ELECTRIC CLOCKS.

Specification forming part of Letters Patent No. 120,185, dated October 24, 1871.

To all whom it may concern:

Be it known that I, WILLIAM M. DAVIS, of Cincinnati, Hamilton county, Ohio, have invented a new and useful Electro-Magnetic Clock, of which the following is a specification:

This clock, as its name implies, is kept in motion by an electric current, and the regulating part is composed essentially of two pendulums and an electro-magnet. These pendulums, with their peculiar attachments, are called, respectively, the regulating and impelling-pendulum, and are connected with a train of wheels and corresponding dials, such as enter into the composition of a common clock, from which, however, my device differs in this: that the pendulum, by the aid of the electric current, impels the machinery instead of being impelled by it. This combination may be made directly between the impelling-pendulum and the clock-work; but in most applications of my device, as where a distant clock or number of clocks are to be driven, the communication will be made through the instrumentality of one or more supplementary impelling-pendulums interposed between the regulating-pendulum and the clock or clocks to be driven.

Figure 1 is a perspective view of an apparatus which embodies the essential features of my invention, the impelling-pendulum being at the right extremity of its beat and the armature at its nearest proximity to the magnet. Fig. 2 represents portions of the same parts when the impelling-pendulum is at the left extremity of its beat, and the armature at its furthest removal from the magnet.

A represents the face of a stand to which the operative parts are attached. B is a pendulum, which I call the regulating-pendulum because it regulates the motions of all the others, the number of which may be, as before stated, one or many. C is a pendulum with an attached armature, which may be called the impelling-pendulum because by the force it receives from a magnet, D, it impels the regulating-pendulum; and, when the clock is attached directly to this combination, it impels the clock also. The motions of these two pendulums, when moving in combination as a regulator, must be isochronous, but not simultaneous. In order that this isochronism may with certainty be kept up while thus moving, they must previously have been so adjusted as to have their normal periods of vibration as nearly equal as possible. E is a battery, and F F′ are wires which, including the rod *b* of the regulating-pendulum B, lead from the magnet to different poles of the battery. G is the armature of the magnet D, and is connected by a rigid attachment, I, to the pendulum-rod, J. K is the cock which supports the pendulums, being firmly secured to the stand for that purpose. Projecting from the pendulum-rod *b*, near its upper end, is an arm, *l*, which terminates in a fork, L. This fork is designed to receive the impulse-weight M, (hereafter to be described,) which is dropped upon it at the properly-recurring moments to keep the pendulum B in motion. To enable the fork L to perform its functions to the best possible advantage the arm *l* is curved upward so that the fork L, when the pendulum is at rest, shall be on a level with the center of motion of the pendulum. The bifurcated form of the arm L *l* allows the hook S *s* to play freely up and down between the prongs without touching them. M is a small weight, which may be called a detached gravity impulse, as it is designed to keep the pendulum B in motion by pressing on the fork L during a greater portion of its descending than of its ascending motion. It may be made in any suitable form; in this case it is a piece of fine wire nearly in the form of the letter **U**. N is a circuit-breaker attached to the pendulum-rod *b*, Fig. 2, and so adjusted as to draw its point *o* onto the metallic plate O by the swinging of the pendulum B. The plate O is a part of the electric circuit F, and is surrounded by a non-conducting material so that by the return swing of B the point *o* of the circuit-breaker N is pushed from the plate O and the circuit is broken. The pendulum-rod J is supported by a cross-bar, P, at its upper end, which cross-bar is connected with the cock K by two flexible supports, R R′. Into this cross-bar is inserted a lifting-arm, S, on the outer end of which is a fork, *s*, which is designed, during its upward stroke, to lift the weight M from the fork L. The pendulum-rod *b* is hung in the plane of the magnet in order that the disturbing effects of the latter on the motions of the pendulum B may be reduced to a minimum.

The pendulum B is put in motion so as to draw the point *o* of the circuit-breaker N into the metallic plate O, which closes the electric circuit, and causes the magnet D to attract the armature G. This draws the pendulum C aside, (to the right in the drawing,) and drops the weight M onto the fork L, (see Fig. 1,) thus giving an impulse to the pendulum B *b*. As N is pushed from the plate O by the return swing of B *b*, the circuit is broken and the armature, released from magnetic attraction, allows C to swing to the left, thus lifting the weight M from the fork L, as represented in Fig. 2. The above-described movements will be constantly repeated so long as the battery-power is sufficient to keep the pendulum C in motion, for the pendulum B receives a constant supply of moving force from C through the medium of the weight M, while C receives a constant supply from the magnet, which in turn receives it from the battery through the circuit-making function of B. Any irregularity in the motion of C arising from varying force in the battery power will not affect the motion of B, for the impulses which the latter receives from the weight M will be sensibly constant within certain wide limits in the variation of the battery force. These limits are, on the one hand, when the battery power becomes too weak to keep the pendulum C in motion; and on the other hand, when it becomes so forcible as to derange the whole apparatus. To prevent the occurrence of this last catastrophe as far as practicable a check-bar, Z, is placed in front of the pendulum-rod J, so that the rod shall come in contact with the studs *z z'* of this check-bar, and thus limit the swing of the pendulum within the proper bounds. This check-bar is supported by two brackets, *a a'*, and is free to slide endwise in either direction as the rod J may push it. This will remedy the evil effect of too much battery power unless this force is exceedingly great, which will rarely, if ever, occur. Such a check-bar is to be applied to all the driving-pendulums in the circuit.

We come now to a description of the connection between the regulating-pendulum B *b* and the clock movements. Anywhere in the electric circuit may be placed one or more pendulums, called supplementary pendulums, precisely similar to C, which pendulums are connected with electro-magnets similar to D. These supplementary pendulums will be operated upon by the action of B *b* in making and breaking the electric circuit in the same manner and at the same time as the impelling-pendulum C is. Each one of these supplementary pendulums becomes an intermediate link between the regulating-pendulum and the clock movement with which it is connected; and it now remains to show how this connection is made. From the cross-piece P on the rod J there extends downward a small lug, T, to which is attached by a delicate joint the feed-hand Q. At each alternate swing of the pendulum C this feed-hand Q moves forward the notched time-wheel U of the clock, which is provided with a catch-pawl, V, to prevent a retrograde movement of the wheel U as Q is withdrawn by the return swing of C. As the pendulum C may be subjected to various lengths of swing by the varying power of the battery, a provision has been made to prevent it from moving the time-wheel more than one tooth at each forward swing of the pendulum. This provision is shown at W, where a pin projects from the stand A and holds at its outer end by a suitable joint a bridle, *x*, of slender wire. This bridle embraces a small wrist, Y, that projects from the side of the feed-hand Q very near its point. This wrist slips quite freely up and down to a certain extent within the loop of the bridle, as shown in Fig. 1. The length of this bridle and its point of support are so adjusted that the feed-hand shall be lifted above the point of the tooth which it is at the time feeding forward, just at the moment the catch-pawl T falls into the notch next to the one it last occupied. In the return swing of the pendulum C the feed-hand is again lifted by the bridle above every tooth except that one which is next to the tooth it last moved forward.

While selecting for illustration the form here presented, because practically tested by me, I reserve the right to employ any obvious modification of the operative parts. For example, instead of using the detached gravity impulse M an attached gravity impulse may be used. This form of the gravity impulse may be represented by a small bar of metal or other material, with one end secured to some part of the stand by a delicate or flexible joint, the other end pressing on the impulse arm L, being raised from it at the proper moment by the same mechanism which lifts the detached impulse M; or the force of a spring may be used to give motion to the regulating-pendulum, and have its pressure withdrawn at the proper moments by the same mechanism, or its equivalent, which relieves the pendulum from the gravitative force of M.

Instead of using the combination of the time-wheel U and the feed-hand Q to communicate motion to the clock-train, I may use other forms of mechanism—such, for example, as that described by Edmund Beckett Denison, M. A., at pp. 132 and 133 in his "Rudimentary Treatise on Clock and Watch-Making: London, 1850." According to this author the object may be effected simply by reversing the escape-wheel and pallets of an ordinary recoil-escapement, and causing the pendulum to drive the machinery instead of being driven by it. In the form in which the escape-wheel is now usually made this plan will not allow of so wide a swing of the driving-pendulum as the one used by me without deranging the operative parts.

In the drawing two circuit-breakers are represented, one of which has already been described. The other is represented at N' O' at the lower end of the pendulum-rod *b*. N' is a knife-edge of platinum or other suitable metal, secured to the lower end of the rod *b*. O' is a globule of mercury held in a metallic cup, which is represented forming part of the electric circuit. As the pendulum B *b* swings back and forth the knife-edge N' enters and leaves the mercury O', and the circuit is alternately made and broken. Other forms may still be suggested. A platinum or other suitable metallic point may be caused to dip vertically into a vessel of mercury instead of a knife-edge; or a metallic spring attached to the rod *b*, and allowed by the swing of the pendulum to fall on a metallic plate, which is connected with the other pole of the battery, may be used to discharge these functions.

Among the many advantages of this clock the following may be mentioned: As the regulating part is moved by electric force alone there is no necessity of having frequent access to it; therefore it may be inclosed in an air-tight case, thus reducing the atmospheric resistance to a constant quantity. Being thus inclosed, it may be placed in a cellar or vault specially prepared for it, and by that means removed from all thermic changes, a very important desideratum for all accurate time-keepers.

It will be seen, when the mechanism is well-considered, that the force which impels the regulating-pendulum must be sensibly constant, notwithstanding there may be a great variation in the battery power. This, combined with the slight variable resistance it has to overcome, viz.: making and breaking the electric circuit, seems to give ample assurance of uniform motion.

I claim as my invention—

1. The combination of the regulating-pendulum B and its impulse power M with the impelling-pendulum C and its moving power—the electric magnet D.

2. The combination of the lifting-arm S on the pendulum-rod J and the impulse power M, whether that be the force of gravity or of a spring, with the arm L *l*, or its equivalent, on the rod *b*.

3. The combination of the regulating-pendulum B and an electric circuit with impelling-pendulum or pendulums C, whether near or distant.

4. The combination of the pendulum B having an impulse-arm, L *l*, and the circuit-breaker N O, with the impelling-pendulum C having a lifting-arm, S *s*, and weight M, and the attached armature G and magnet D, or the essential equivalents of these separate parts, operating in unison, substantially as and for the purpose described.

5. The combination of the check-bar Z and the impelling-pendulum C, for the purpose described.

6. The described combination of the elements G, C, D, J, L, M, and S with an electric circuit, so as to telegraph time from the regulating-pendulum B to any number of clock-dials, whether near or distant.

7. The combination of the impelling-pendulum C, as above described, with the feed-hand Q and bridle X, or its equivalent, and the wheels of an ordinary clock movement, for the purpose of indicating time.

8. The method of communicating motion to and of controlling the motions of an impelling-pendulum, C, whether near or distant, by means of an attached armature actuated by an electro-magnet which is charged at isochronous intervals by a regulating-pendulum, B.

In testimony of which invention I hereunto set my hand.

WILLIAM M. DAVIS.

Witnesses:
GEO. H. KNIGHT,
JAMES H. LAYMAN.

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