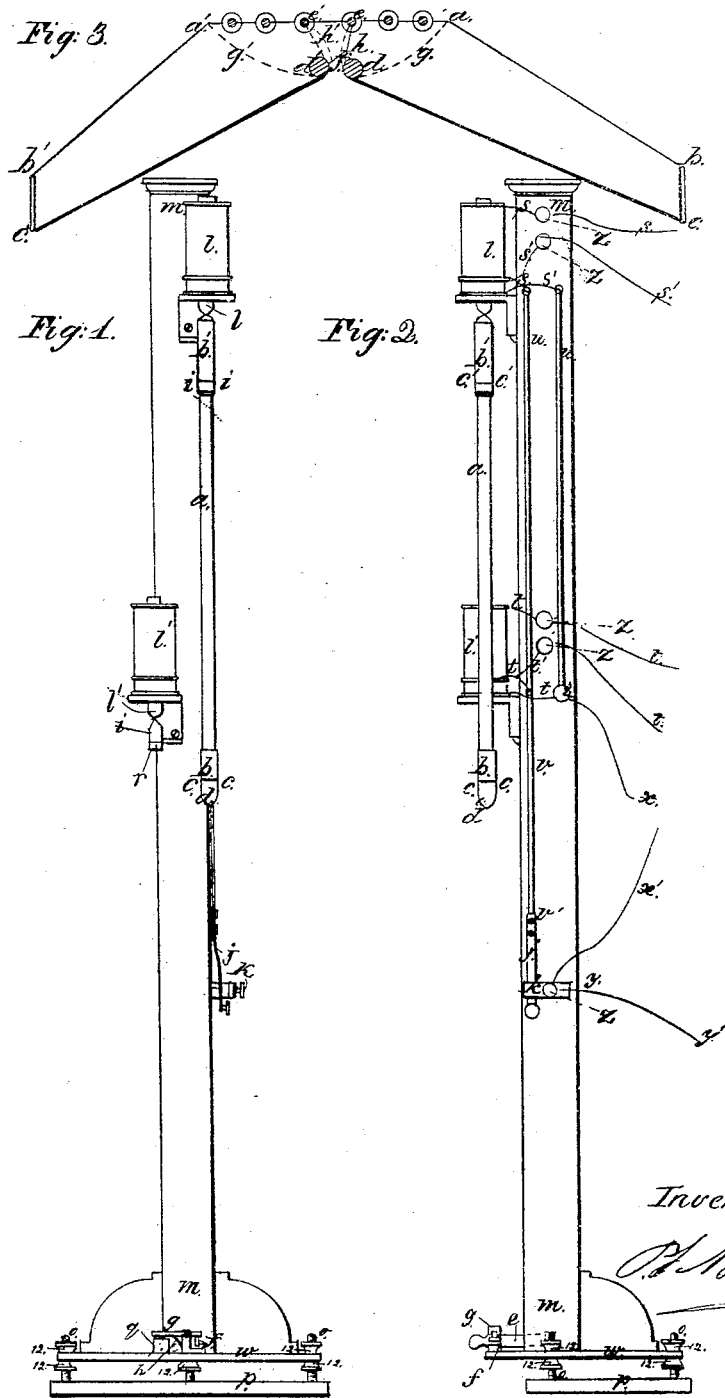


P. LE BOULENGE.

Electric Clock.

No. 51,905.

Patented Jan. 2, 1866.



Inventor

P. Le Boulengue

# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN ELECTRO-BALLISTIC CHRONOGRAPHS.

Specification forming part of Letters Patent No. 51,905, dated January 2, 1866.

*To all whom it may concern:*

Be it known that I, PAUL LE BOULENGÉ, of Antwerp, in the Kingdom of Belgium, have invented a new and useful machine for measuring with great precision very short periods of time, and more especially the time occupied by a projectile in traversing a given portion of its course; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings, making a part of this specification, in which—

Figure I is a facial view of the apparatus. Fig. II is a back view. These two figures are sufficient to understand and put together the apparatus. Fig. III represents the position of the piles and circuits.

This method of computing time is based on the laws which govern the fall of heavy bodies.

My chronometer consists of a hollow metallic cylinder, *a*, the upper part of which is made of steel and forms the armature of an electro-magnet. Two receiving-wrappers, *b* and *b'*, are placed with a loose pressure around the cylinder and rest on the sockets *c c* and *c' c'*. They are paper tubes rolled and glued, upon which are to be impressed the marks which serve for the measure of time. The detent or escapement is the mechanism which makes the mark. (See the references on the drawings.) The detent or escapement is set free by the fall of the weight *i*, which is also suspended by an electro-magnet, *l*. The disjoiner *j k*, which is explained below, serves to break at exactly the same moment the two currents which magnetize the electro-magnets *l* and *l'*.

The chronometer and the weight being suspended to their respective electro-magnets *l* and *l'* and the escapement being set or cocked, if the finger be applied to the knob of the disjoiner, the two circuits are simultaneously broken and the chronometer and the weight fall. The chronometer in its fall passes near the knife *f*. The weight falls on the tablet or platform of the hooked lever *g* and effects the release of the knife, which is thus caused to make a mark on the lower wrapper, *b*. By measuring the height of the mark above the lower edge of the wrapper and adding five hundred millimeters—the distance of the sock-

et *c c* of the chronometer, when in position, from the edge of the knife *f*—the height of fall *H* is obtained, corresponding to a time, *T*. This time is that of the fall of the chronometer before the mark is made, provided the two circuits are simultaneously broken. If, instead of being broken simultaneously by the disjoiner, they are broken successively by the passage of a projectile through two frame targets, breaking first the circuit of the magnet *l*, and then after a time, *t*, (about 0.1'',) that of *l'*, the fall of the chronometer will precede that of the weight, and the mark will in this case be made on the upper wrapper, *b'*. We have then a second height of fall *H'*, (the distance of the second mark, the chronometer being in position from the blade of the knife,) corresponding to a time, *T'*. The difference *T T'* gives exactly the time *t* occupied by the projectile in passing from one target to the other. Be *E* that space,  $\frac{E}{t}$  will be the speed

of the projectile between the targets. To obtain the simultaneous interruption of the two currents they are so combined that, though independent, they yet have a common point in their circuits. A disjunction in this part operates on both circuits at once. It is effected by destroying the contact of the spring *j* with the thumb-screw *K*, which are parts of the common conductor.

Fig. III represents the arrangement of piles and circuits adapted to obtain this result. Two Bunsen piles of the same number of elements are metallically joined by their carbon poles *c* and *c'*. The chronometer-circuit, passing from the zinc pole *a*, passes over the first target *b c*, returns to the apparatus, where it passes at *d* on the spool of the electro-magnet of the chronometer, and thence to the carbon pole *c* by the conductor *d e*. The weight-circuit follows an analogous path by *a' b' c' d'*; but instead of completing its course directly by *d' e'*, this conductor is supplanted by *d' f e e'*. The part *f e* is therefore common to the two circuits, and it is that part which is disconnected by the disjoiner. Beside these circuits each electro-magnet has a second circuit, derived from the same pile, but wound in the contrary direction on the spool. This, which I shall call the "inverse circuit," is neither

broken by the disjoiner nor by the projectile. It serves to reverse suddenly the poles of the electro-magnet when the direct circuit is broken.

The armatures are of steel to prevent the change of poles, from which would result effects of attraction during the first moments of the fall.

What I claim as my invention, and wish to secure by Letters Patent, is—

1. The use of a body falling free and without friction for the measure of time, substantially in the manner herein set forth.

2. The arrangement of piles and circuits to obtain a simultaneous interruption without mechanical aid, as set forth.

3. Regulating the action of the electro-magnets on their armature by means of inverse circuits and by the substitution of steel for soft iron, (*fer doux*), as set forth.

P. LE BOULENGÉ.

In presence of—

G. VIC MEERT,  
A. HUYSMAN.