L. Bradley.

Pendulum.

No. 31,524.

Patented Feb. 26, 1861.

Fig. 1

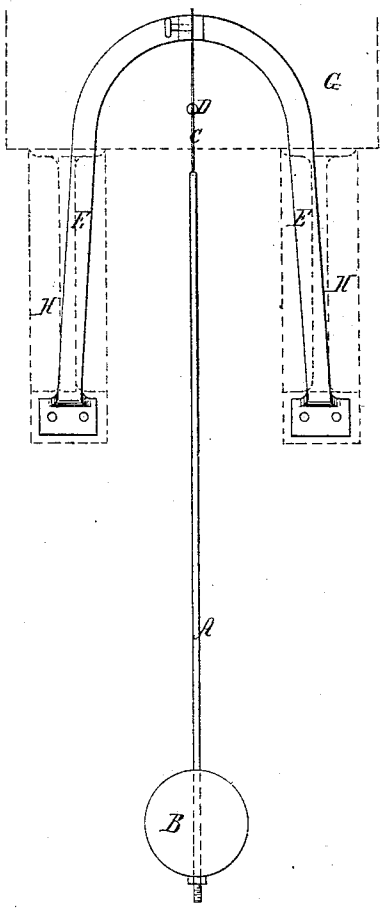


Fig. 2

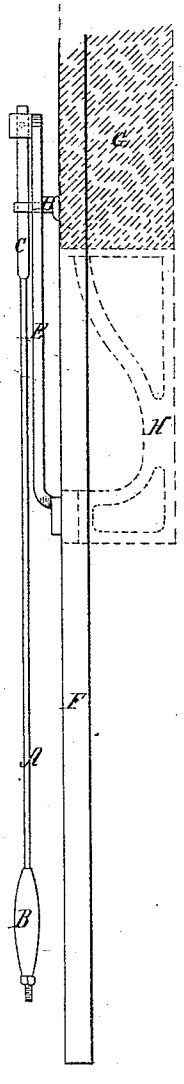
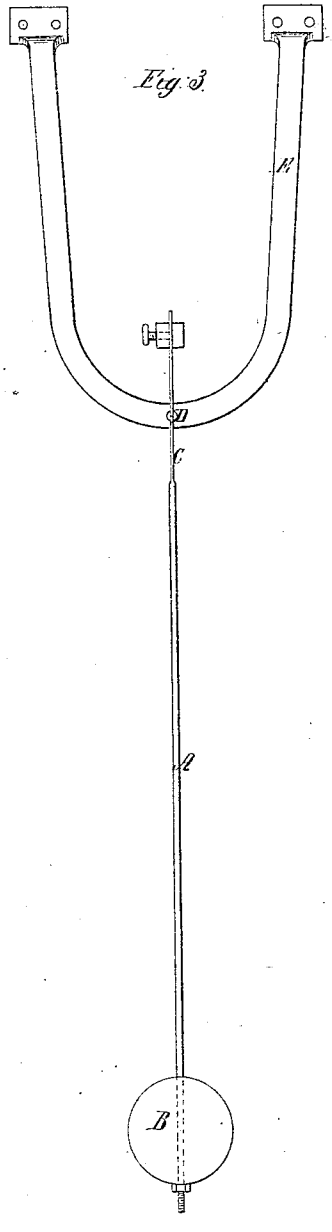


Fig. 3



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UNITED STATES PATENT OFFICE.

LEWIS BRADLEY, OF HARTFORD, CONNECTICUT.

COMPENSATING PENDULUM.

Specification of Letters Patent No. 31,524, dated February 26, 1861.

To all whom it may concern:

Be it known that I, LEWIS BRADLEY, of the city and county of Hartford, in the State of Connecticut, have invented a new and Improved Compensating Pendulum; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings.

It is a well known fact that all timepieces that are regulated by the ordinary pendulum are subject to variations in consequence of the expansion and contraction of the pendulum rod by the change of temperature.

It is the object of the invention which I am about to describe, to counteract all such variations and in a very simple manner produce a "compensating pendulum."

In the drawings making a part of this specification, Figure 1 is a front view and Fig. 2 a side view of my pendulum in its most practicable forms. Fig. 3 is another arrangement of the same parts.

I will first describe Figs. 1 and 2. As the construction of clocks is varied, the pendulum being sometimes behind the clock movement and sometimes in front, of course the peculiar manner of supporting the different parts will vary, and consequently the data for the mathematical demonstration hereafter appended. But as the most common position is in front of the clock movement, I shall assume that as the position and describe the several parts accordingly, taking the data for the mathematical calculation from the same supposition. A, is a pendulum of the usual form with weight B at bottom and spring C, at top. D, is a slotted pin attached to the face plate G, of the clock movement. Through the slot in this pin passes the spring C, of the pendulum rod the top of which spring is attached to and supported by the frame E, which is made of some metal having great expansive properties. H, H, are two cast iron brackets attached to the back of the clock and supporting at their tops the frame G of the clock movement, and having the frame E, attached at the bottom.

When the pendulum is in motion, its operative length is from the pin D, down to its center of gravity. Now we will suppose an increase of temperature, the rod A, expands, also the brackets H, H, and the face plate G, and the length of the pendulum therefore increased an amount equal to the sum of the expansion of the rod A, bracket H, and that portion of face plate G, below the pin D. But the frame E, is of such length that in consequence of its great expansive properties, it expands as much as the sum of the expansions of the other three pieces just mentioned, and thereby draws the spring C up through the slotted pin D, just enough to keep the operative length of the pendulum constantly the same. In a different arrangement of the parts the frame E, might be attached to the back of the clock case or some other support thereby dispensing with the brackets H, H. The principle remains the same, the only difference being in the length of the frame E.

In order to demonstrate the above mathematically we have—since the ratio of the expansion of the different metals is constant between 32° and 212° it is evident that if we give the pendulum the proper length at 32° and so adjust the dimensions of the different metals that their respective expansions will precisely counteract each other at 212°, then their respective expansions and contractions must exactly counteract each other through the whole range. To effect this adjustment I find the vertical expansion at 212° of the portion of the brass frame of the clock movement G, below the slotted pin D, and of the steel rod A. From the sum of these expansions I subtract the expansion of that part of the zinc frame E, which is above the top of the brackets H, H. The remainder must be counteracted by the difference in the vertical expansion of the equal lengths of zinc and cast-iron down to *i*. To find this distance, I divide this remainder of expansion to be counteracted, by the excess of the expansion of zinc over that of cast-iron for 1 inch, and the quotient must evidently be the number of inches of H, down to *i* (*i. e.* the length of the brackets H, H, from the top down to where the frame E, is attached to them,) which added to the distance that E, extends above H, gives the vertical length of E. ∴ Performing the operation, the rod A, extending above the pin D, 2 inches, and the frame E, extending above H, 5 inches. The plate or frame supporting the clock move-

ment G, being brass, the rod A, steel, the frame E, zinc, and brackets H, H, cast-iron, we have—

Expansion of G, below D. = .00193 + 3 = .00579
" " A =
(39.125 + 2) × .0011447 = .0470757875

.00579 + .0470757875 = .0528657875

Subtract expansion of that part of E above H. = .002942 × 5 = .01471

We have the remainder ..... .0381557875

$$\frac{.0381557875}{(.002942 - 0011111)} = 20.84$$

to which add 5 in. and we have the vertical length of E, 25.84 in.

In case any other metals should be substituted for one or more of those used in this demonstration, of course a corresponding change must be made in the figures.

This device is so simple that no more extended explanation is necessary to enable any one skilled in the business to fully understand its construction and operation.

Fig. 3 represents another arrangement of the same parts—in which the top of the rod A is attached to a support taking the place of pin D in Fig. 1, and pin, D is supported by frame E which is inverted.

The operation is evident from the description of Figs. 1 and 2.

Now having fully described my invention what I claim as new and desire to secure by Letters Patent is—

The slotted pin D, and the metal frame E, or their equivalents when used in the manner and for the purpose substantially as herein described.

LEWIS BRADLEY.

Witnesses:
C. G. CRANE,
THOMAS BIRCH.