No. 759,914. PATENTED MAY 17, 1904.

J. H. PURDY.

COMPENSATING BALANCE.

APPLICATION FILED JULY 28, 1902.

NO MODEL.

Fig. 1.

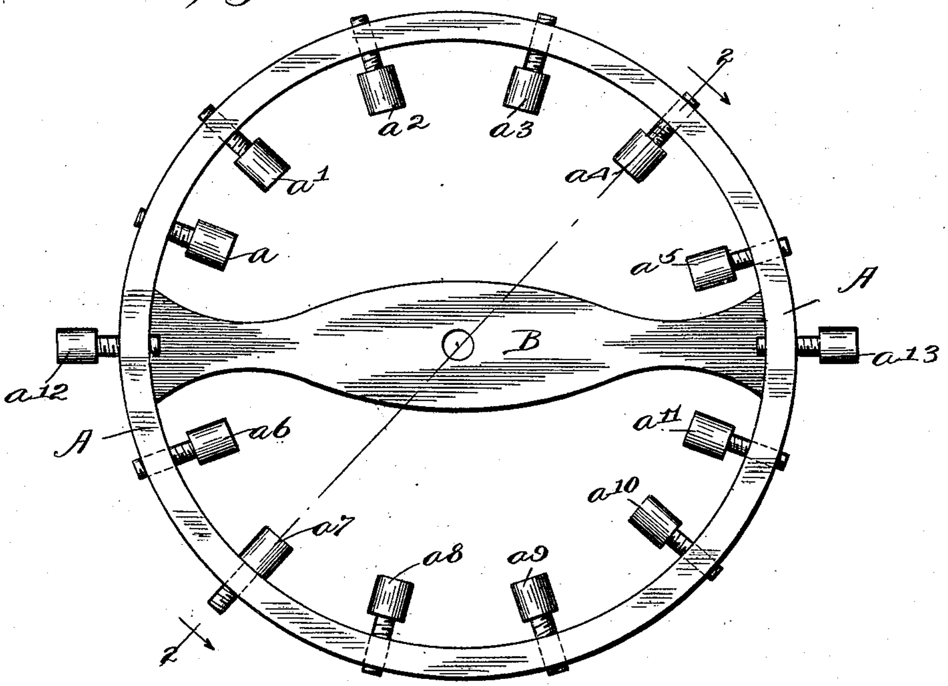
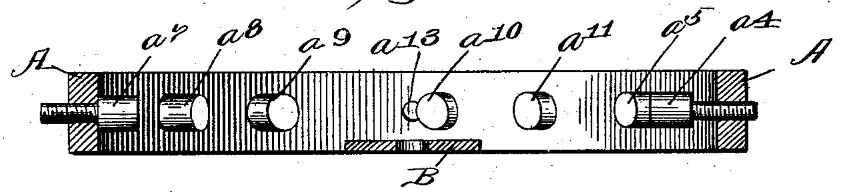


Fig. 2.



Witnesses:
Harry B. White.
Ray White.

Inventor:
John H. Purdy
By Jonie Bain Attorney.

No. 759,914. Patented May 17, 1904.

UNITED STATES PATENT OFFICE.

JOHN H. PURDY, OF CHICAGO, ILLINOIS.

COMPENSATING BALANCE.

SPECIFICATION forming part of Letters Patent No. 759,914, dated May 17, 1904.

Application filed July 28, 1902. Serial No. 117,358. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. PURDY, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Compensating Balances; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to improvements in compensating balances for clocks, watches, chronometers, and the like.

The primary object of my invention is to construct the oscillating balance of a watch or chronometer so as to render the rate or velocity of the train independent of the varying temperature by compensating for the rise and fall of temperature automatically by precisely varying the inertia of the said balance coincident with the change of temperature.

More specifically, one of the objects of my invention is to provide a balance having a rim made in a solid piece and to so arrange the compensating portions that there will be an even consistent relatively equal shifting of the weights to vary the inertia of the said balance-wheel without unequally changing the position of the rim.

My invention provides a more cheaply constructed and more easily adjusted balance and a means whereby the relative positions of the parts are maintained under all conditions of adjustment.

My balance may be entirely non-magnetic, since neither steel nor other metals susceptible of magnetic induction are necessarily a part of its construction. All parts of my balance may be made of diamagnetic materials.

In the drawings, Figure 1 represents a plan view of an exemplification of my invention. Fig. 2 is a section through line 2 2 of Fig. 1.

A is the unbroken rim of the wheel.

B is a bar joining opposite sides of the rim and providing an axis at which the said wheel is pivoted.

a to a^{11} are a series of shiftable weights or screws placed through the rim from the interior and radiating from the axis of the said rim. They are preferably placed equal distance apart on the said rim, and necessarily with the heavy portion, or the head, extending on the inside of the rim and toward the axis.

The rim A should be made of a metal or material having a low coefficient of expansion. The shank of the screws a to a^{11} when screws are used should be made of a metal or other material having a comparatively high coefficient of expansion. The heads of the various screws may be made of a metal having a relatively high specific gravity, such as condensed or swaged gold or lead or like material. These heads may be made of separate material from that of the shank and may be fastened thereto by any convenient means.

The two oppositely-disposed screws a^{12} and a^{13} are called "mean-time" screws. They are not necessarily, but may be used primarily, for altering the rate of the timekeeper and need have nothing to do with the compensation. They produce comparatively little effect upon the compensating function of my device, provided they are made of a material which has a very low coefficient of expansion; otherwise they may be considered as a factor in the adjustment for temperature.

In every balance-spring of sufficient length there is a part which is isochronal, or nearly so, and this length being found it is not desirable to alter it in bringing the machine to time, for if shortened the long vibrations will be quicker than the short ones and if lengthened the short vibrations will be quicker than the long ones. To avoid this source of error, the two screws a^{12} and a^{13} have been introduced, the drawing out of which from the center causes the machine to lose and the screwing them in to gain. These screws may be used or not, as may be desired, and the compensating screws may be adjusted accordingly.

The operation of my device is as follows: The bar B may be of a suitable non-expansive or slightly-expansive material and joined at opposite points to the rim A. This rim I prefer to make of such metal or material which will have a very small coefficient of expansion. Glass or other vitreous or similar material may be substituted for metal. It is well known that glass has a very low coefficient of expansion, and being non-magnetic it will answer the purpose very well. The shanks of the screws a to a^{13} may be screwed into bushings through the edge of the rim, or the screw-threads may be made directly into the glass portion thereof. When the screws are placed in the rim in the manner shown in the drawings, upon the increase of temperature the shanks of the screws, being highly expansive, will move the heads of the screws bodily and radially toward the axis of the wheel, so that the mean or average weight of the balance being brought closer to the said axis than before the inertia of the device will thereby be decreased, and the effect of the balance-spring with relation to the balance-wheel, although weakened by increased temperature, will be such as to maintain the movement of the train at a constant velocity. Conversely, when temperature decreases and the balance-spring becomes stronger the outward movement of the weights relative to the axis and relative to the less expansive rim, due to contraction, results in the movement of the mean weight of the balance away from its axis of oscillation, thereby increasing the inertia of the balance, so that it compensates for the increase in strength of the balance-spring and maintains constant the velocity of movement of the spring-actuated train.

The length of the shanks of the screws contained between the inside surface of the rim and the heads of the said screws regulate the extent of expansion with the variation of temperature. If by the increase of temperature the weights are shifted too much toward the axis or center of the wheel, so that the inertia of the wheel becomes too small for the loss of power of the spring as a result of the increased temperature, then the screws should be turned farther in the rim, so that the heads will be brought closer to the inside surface of the rim or farther removed from the axis, and a smaller length of the shank will then be effective for shifting the position of the head by the expansion of the shank of the said screw. After a screw has been set in, so as to entirely perforate the rim, and when it projects through the rim to the outer side, as shown at a^7, the portion which is projecting beyond the surface of the outer circumference of the rim compensates to some extent in an opposite direction from that portion which remains on the inside of the rim. Therefore a very fine adjustment may be secured by shifting the screws on either side of the said rim, and weights may be added to the outer ends of the screw-shank to facilitate this effect.

In order to maintain a mechanical as well as a compensating balance, I prefer to adjust the screws so that they will occupy about the same relative uniform position with reference to the rim.

The longer the shank of screw that is left extended from its support the greater will be the movement of the weight attached thereto produced by a given variation of temperature, so that if an increase of temperature causes the timepiece to lose or a decrease to gain it shows that the compensation is not sufficiently active—*i. e.*, the inertia of the balance is not altered sufficiently to compensate for the effect produced by the increased or diminished elasticity of the balance-spring—and consequently the weight must be set out from the inner surface of the rim and nearer to the axis of the wheel to leave a greater length of screw to be affected by temperature changes, so as to move the weights a greater distance for a given variation.

I do not confine my invention to a balance in the form of a rim or wheel, as any means of support, such as radial arms having projections at or near their outer ends for supporting the converging expansive devices, may be employed in lieu of a continuous rim without departing from the gist of my invention.

Having described my invention, what I claim as new and useful, and desire to secure by Letters Patent of the United States, is—

1. A compensating balance, including a support, an axis for said support, and a series of inwardly-converging weights composed of material capable of expanding or contracting under variations of temperature enough more than said support expands or contracts to shift said weights radially sufficiently to compensate for the increase or decrease in the elasticity of the balance-spring, for the purpose set forth.

2. A compensating balance comprising a support composed of material of relatively low expansibility, an axis for said support, and a series of inwardly-converging weights mounted on said support, said weights being composed of material of relatively higher expansibility than the supports and so proportioned relative to the support that the movements of the weights in expanding and contracting under changes of temperature more than compensate for the concomitant movements of the support, whereby the disposition of the mean weight of the balance relative to its axis is varied by changes of temperature.

3. A compensating balance comprising a support composed of material of relatively low expansibility, an axis for said support, and a series of screws having shanks composed of material more expansive than the support threaded into said support with the heads converging toward the axis of the balance, said screws being so proportioned, as to mass, relative to the support that the movements of the screws in expanding and contracting under changes in temperature more than compensate for the concomitant movements of the support, whereby the disposition of the mean weight of the balance relative to its axis is varied by changes of temperature.

4. A compensating balance comprising a support composed of material of relatively low expansibility, an axis for said support, and a series of screw-threaded devices threaded into said support and converging toward the axis of said balance, said screw-threaded devices being composed of material of relatively higher expansibility than the supports, and weights fixed to the inner ends of said screw-threaded devices and so proportioned as to mass relative to the support, that the movements of the weights caused by the expansion and contraction under changes of temperature of their threaded supporting devices more than compensate for the concomitant movements of the support, whereby the disposition of the mean weight of the balance relative to its axis is varied by changes in temperature.

5. A compensating balance comprising a support composed of material of relatively low expansibility, an axis for said support, a series of weights between said support and the axis of the balance, and devices having a higher coefficient of expansion than the support arranged between said support and said weights, and adapted and arranged to shift said weights radially under variations in temperature, the weights being so proportioned as to mass relative to the support that the movements of the weights due to the expansion and contraction of their shifting devices under changes in temperature more than compensate for the concomitant movements of the support, whereby the disposition of the mean weight of the balance relative to its axis is varied by changes of temperature.

6. A compensating balance comprising a round rim composed of material of relatively low expansibility, an axis for said rim, a series of elongated axially-converging weights, composed of material of relatively higher expansibility than the support, and so proportioned relative to the support that the movements of the weights in expanding and contracting under changes of temperature more than compensate for the concomitant movements of the support, the said weights being radially adjustable relative to the said rim.

7. A compensating balance comprising a support, an axis for said support, a series of screws of material more expansive than the rim threaded through the rim and adapted to project on both sides thereof, said screws being provided with heads converging toward the axis of the support.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

JOHN H. PURDY.

In presence of—
CHARLES S. PERRY,
FORÉE BAIN.