F. ECAUBERT.

ESCAPEMENT REGULATOR.

APPLICATION FILED DEC. 11, 1908.

1,023,140.

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Fig.1.

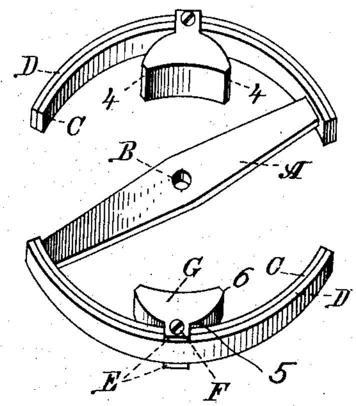


Fig.2.

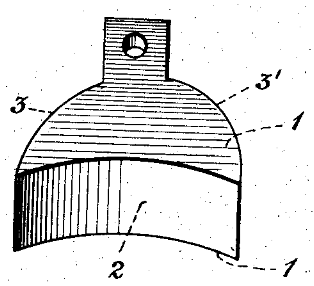
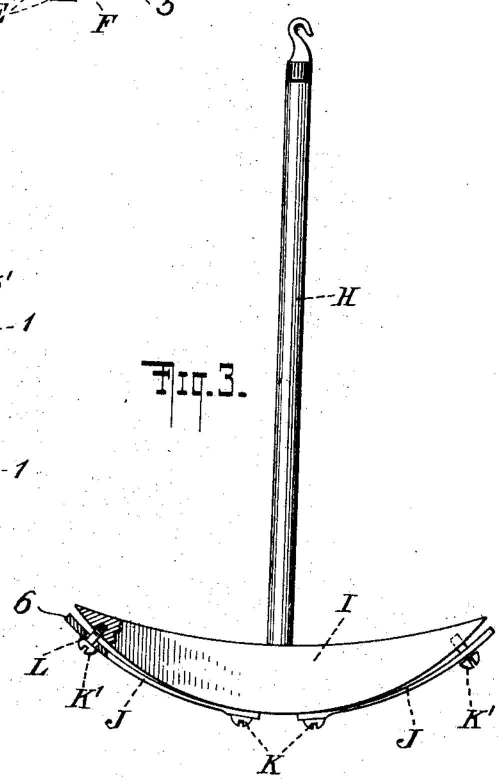


Fig.3.



WITNESSES

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ESCAPEMENT-REGULATOR.

1,023,140. Specification of Letters Patent. **Patented Apr. 16, 1912.**

Application filed December 11, 1908. Serial No. 466,961.

To all whom it may concern:

Be it known that I, FREDERIC ECAUBERT, a citizen of the United States, and resident of the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Escapement-Regulators, of which the following is a specification.

My invention relates to escapement regulators such as balance wheels for time pieces and pendulums and has for its object to compensate for variations due to changes in the density of the air, or in other words, variations due to changes of barometric pressure.

Hitherto various constructions have been proposed for the purpose of compensating for the effect of expansion and contraction due to changes of temperature, but this invention relates to mechanism to compensate for the influence of variations in air pressure by a compensating device which will take these variations into account. That variations in air pressure or density will affect the running of a time piece, is a fact which I have proved by actual test, by running one of the best chronometers now on the market in a vacuum, the result being that such chronometer gained about 12 seconds in 24 hours when running in a vacuum, as compared with the running at ordinary pressure, conditions of temperature being the same.

In the accompanying drawing I have illustrated several forms of my invention for accomplishing this air density compensation.

Figure 1 is a view of one form of such balance wheel; Fig. 2 is a view of the compensating member shown separately before it is incorporated in the balance wheel; Fig. 3 is a view of a pendulum to which my invention has been applied.

In Fig. 1 I have shown my air density compensator in connection with a balance wheel of the usual construction comprising the spokes A extending outwardly from the central perforation B. From the end of the spokes A extend circumferentially temperature compensating strips C, D, made of different metals. These strips C, D are very delicate and flexible being adapted to respond to every change in temperature. They are consequently sufficiently resilient to be readily affected at the deflecting surfaces of my compensator in proportion to the atmospheric densities. To this well known resilient or yielding wheel, I apply my air density compensator shown in Fig. 2 in the following manner. The spaced lugs E are arranged to embrace the compensating strips, C, D, and to be clamped thereon by means of the screw F. The air density compensator should be so located upon this balance wheel as not to interfere with the activity of the wheel as a temperature compensator. The air density compensator G has a peculiar formation shown in the drawing, the effect and action of which will be explained later. In Fig. 3, I have shown my invention as applied to a pendulum composed of the usual oscillating rod H, which carries the weight I, the lower surface of which is curved as shown in the drawing. The two springs J are each attached to the weight I at their inner ends by means of the screw K. The free end of the spring perforated at L is limited in its outer movement by the adjustable screw K′ which passes loosely through the opening L.

The new feature of my invention resides in the construction of the compensators G in the one case, and J in the other. In the case of the compensators G, they are generally made of a metal which will retain its shape without distortion or corrosion under the conditions which are commonly obtained in the use of time pieces. They may be attached to any form of balance wheel in any suitable manner. The compensator G is substantially flat, having two plane surfaces such as 1, which are parallel to the plane in which the wheel moves and therefore are subject only to surface friction as the wheel moves. The inner surface 2 of the compensator G is preferably curved to correspond with its circle of oscillation; consequently, as the wheel oscillates, this inner surface will be subject only to the surface friction. The outer surface 3 of the compensator presents a curved surface to the air. This outer surface forms an angle with the cylindrical surface 2, and may for instance be a portion of a cylinder whose axis is parallel with that of the wheel but eccentric thereto. If the member G were of any regular form, for instance a circular disk, the balance wheel would swing more slowly as the air pressure or density increases owing to the greater resistance opposed by the air having a higher density. The deflecting surfaces of the weight G and J respectively have outer ends at 5 and K respectively and inner ends at 6. By inner ends I mean those ends which are nearest to the axis of oscillation and by outer ends those which are farthest away from it. It will be seen that in each form of my invention there are two mating deflecting surfaces which diverge from their outer ends 5 and K respectively to their inner ends 6 and terminate at such inner ends.

With my improved compensator, the inclined surface 3 clearly has a tendency to deflect the resilient member D inward as the wheel swings, by reason of the resistance offered by the air through which the inclined surface tends to force its way. The inward shifting of the compensator G will have a tendency to draw in the arm C, D, and by thus bringing the weight of the wheel nearer the center B, will make the wheel swing more rapidly. By a proper choice of dimensions and by a proper shape of the surface 3 I can so regulate the inward deflecting force above described as to compensate it to any desired degree for the slowing effect due to any increase in barometric pressure. I can, if desired overcorrect for the effect of variations in air pressure. Of course, it will be understood that when the air pressure decreases, the resistance of the movement of the wheel is diminished and there is therefore a tendency to swing more rapidly, which however, is counteracted by the fact that the inward deflection due to the inclined surface 3 meeting the air pressure is less, so that a compensation is again effected.

It is apparent that the principle on which the operation of this device depends is that the outer end of the outer surface of the weight G or J shall be located nearer the axis of oscillation than the central line of the imaginary cylindrical zone which is formed by a movement of the weight G or J around said axis, and that said outer end shall be nearer the axis of oscillation than the point of attachment; the inner surface should also be so shaped that its resistance to the air shall be as small as possible. In other words, the line defining the curvature of the inner surface shall be shorter than the line defining the outer surface.

In general I usually prefer to make the compensating weight G of such a shape that it will slightly over-compensate; they may be made exactly alike by automatic machinery in the shape shown in Fig. 2. To then secure exact compensation the points or cusps 4 may be beveled off as indicated in Fig. 1, so as to reduce the inward deflecting tendency in the required manner.

In the ordinary balance wheel as now in use, any increase in the barometric pressure would tend to make the wheel move slower because of the increased resistance offered by the increased density of the air to the swinging movement. By the use of my inventions as the pressure increases, the tendency of the wheel to slow up is counteracted by the tendency of my compensator to accelerate its speed, so that one tendency balances the other and makes the wheel run alike for the variations in pressure.

In some balance wheels the outward throw due to centrifugal force seems to be greater when the wheel is moving in one direction than when the wheel is moving in the opposite direction. For very exact compensation in such cases, I can give the air density compensator G a special unsymmetrical shape so that the inward deflecting action will be greater when the wheel swings in one direction than when it moves in the opposite direction. This is accomplished as shown in Fig. 2 by forming the curve 3 on a circle having a larger diameter than that of the curve 3—1. Of course, in practice, the object being to get different increase of obliquity, the particular selection of curved surfaces depends on particular conditions and they may be selected accordingly.

Referring now to the construction shown in Fig. 3, it will be apparent that the resistance of the air offered to the oblique surface of the spring J will either tend to force it slightly away from the screw head K′, or counteract the tendency of the spring to swing outward against the screw head K′ due to the centrifugal motion and accelerates the movement of the pendulum in proportion to the increase in the air density. By moving a part of the weight toward the center of oscillation or preventing a part of the weight from moving away from the center of oscillation, the centrifugal action having a tendency to throw a part of the weight outward will be counteracted. This is the principle of operation of this device. Thus if the pendulum works correctly under a certain pressure and the pressure is increased the air density opposed to the bulk of the pendulum will tend to slow its movement but the activity of the spring J as above described will compensate for this slowing tendency so as to keep the pendulum running true even under the increased pressure.

I claim:

1. An escapement regulator comprising an oscillating arm extending radially from the axis of oscillation and attached to said arm the circumferentially extending member or members comprising a part yielding in radial directions and a rigid part united thereto, the inner and outer surfaces of said rigid part being so shaped that the outer or free end of the outer surface shall be nearer the axis of oscillation than the central line of an imaginary cylindrical zone defined by the movement of said rigid part about the axis of oscillation.

2. An escapement regulator comprising an oscillating arm extending radially from the axis of oscillation and attached to said arm the circumferentially extending member or members comprising a part yielding in radial directions and a rigid part united thereto, the inner and outer surfaces of said rigid part being so shaped that that part of the outer surface which is farthest away from the radial arm is nearer the axis of oscillation than that part of the outer surface where it adjoins the yielding part, and that the line defining the curvature of the inner surface of the rigid part from its outer extremity to a radial line drawn through the point of junction between the rigid and the yielding part is shorter than the corresponding line of the outer surface.

3. An escapement regulator comprising an oscillating arm extending radially from the axis of oscillation and attached to said arm, a circumferential member or members comprising a part yielding in radial directions and a rigid part united thereto, the outer and inner surfaces of said rigid part consisting of curved planes of which the outer plane is drawn with the radius shorter than that employed in drawing the inner surface.

4. An escapement regulator comprising an oscillating arm extending radially from the axis of oscillation, a flexible arm attached thereto in a circumferential direction, a weight carried by said flexible arm having an inner surface approximately concentric with the movement of the escapement, and a curved outer surface progressing from a point near the point of attachment between weight and flexible arm to a point farther away from the connection between the radial arm and flexible arm, said last named point being nearer the axis of oscillation than the point of connection between weight and flexible arm.

5. An escapement regulator comprising an oscillating arm extending radially from the axis of oscillation, a flexible arm attached thereto in a circumferential direction, a weight carried by said flexible arm having an inner surface shorter than the outer surface and a curved outer surface progressing from a point near the point of attachment between weight and flexible arm to points nearer the axis of oscillation than the point of attachment between flexible arm and weight.

6. An escapement regulator comprising an oscillating arm extending radially from the axis of oscillation, a flexible arm attached thereto in a circumferential direction, a weight carried by said flexible arm having an inner surface shorter than the outer surface, and a curved outer surface progressing with two different degrees of curvature from a point near the point of attachment between weight and flexible arm to points nearer the axis of oscillation than the point of attachment between flexible arm and weight.

7. An escapement regulator comprising an oscillating arm extending radially from the axis of oscillation, a flexible arm attached thereto in a circumferential direction, a weight carried by said flexible arm having an inner surface shorter than the outer surface, and a curved outer surface progressing from a point near the point of attachment between weight and flexible arm to a point farther away from the connection between the radial arm and flexible arm, said last named point being nearer the axis of oscillation than the point of connection between weight and flexible arm, the outer edge of said weight where the inner and outer surfaces are joined being beveled.

8. An escapement regulator provided with a yielding member carrying an approximately lunar-shaped weight, the surved surfaces of which are approximately parallel to the axis of oscillation of said regulator.

9. A weighted member for an escapement regulator being approximately lunar-shaped, having two parallel plane surfaces perpendicular to the axis of oscillation and a curved surface facing the axis of oscillation.

In witness whereof I hereunto set my hand in the presence of two subscribing witnesses.

FREDERIC ECAUBERT.

Witnesses:
JOHN A. KEHLENBECK,
JOHN LOTKA.