

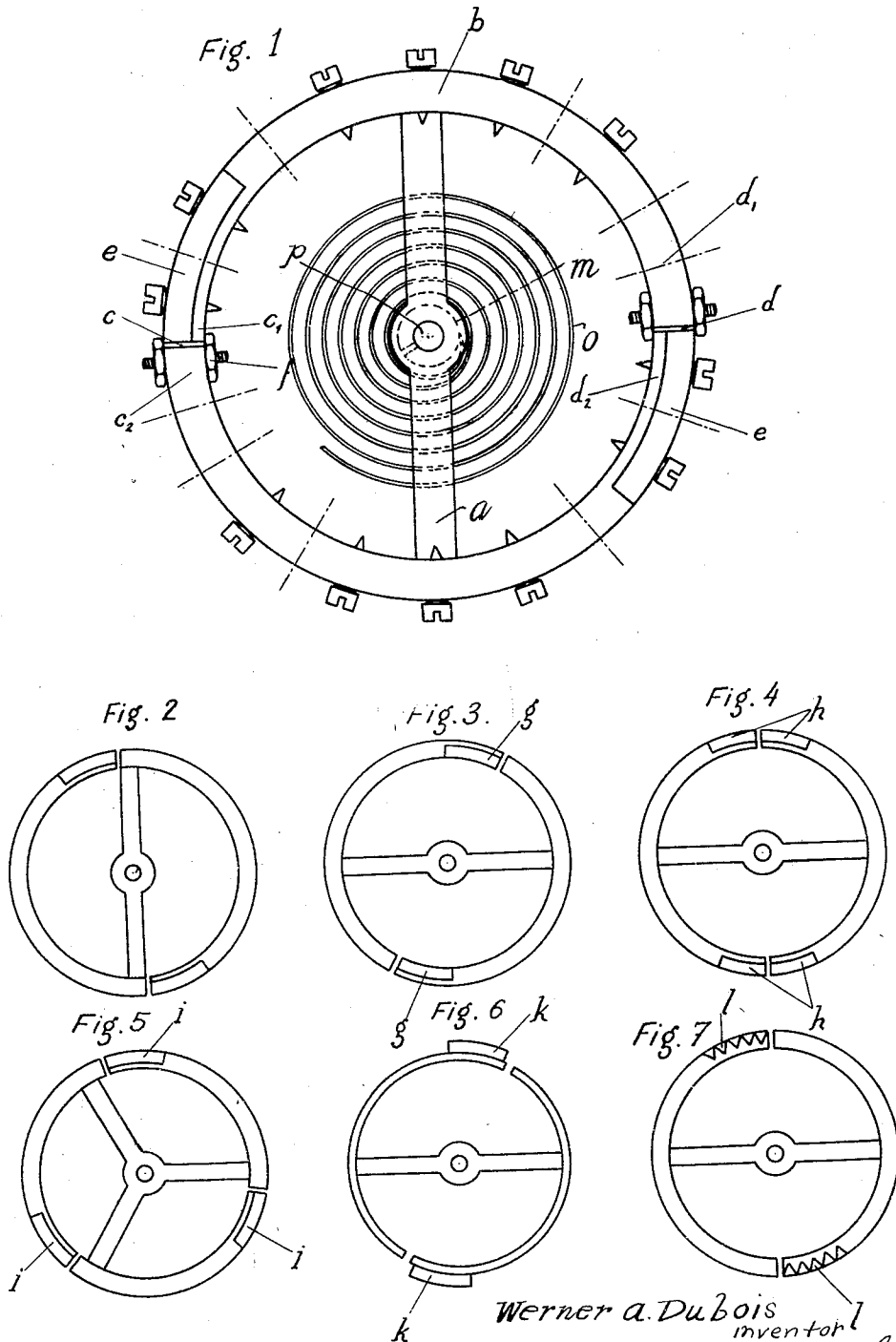
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REGULATING DEVICE FOR CLOCKWORKS

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REGULATING DEVICE FOR CLOCKWORKS

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It is a recognized fact that the period of oscillation of a system consisting in a spiral spring and a balance varies, among other things, in direct ratio to the square root of the inertia of the balance and in reverse ratio to the square root of the Young's modulus of the spiral spring. Since experience has shown that the Young's modulus decreases when the temperature rises, it has been necessary, should the period of oscillation be maintained constant, to provide for the diminishing of the inertia of the balance when the temperature rises. This feature has been achieved by means of the well known divided bimetallic balance, the rim of which is formed of an outer brass strip and an inner steel strip, viz., ordinary steel on clockworks wanting but an approximate adjustment and special nickel steel on those requiring a more accurate one.

Some years ago, a new steel alloy called "elinvar" was discovered. This alloy belongs to the same class of alloys as the well known "invar" metal, but contains in addition to nickel and steel from 10 to 20% of a metal such as chrome, copper or manganese which are capable to form an alloy in any proportion with ferronickel, and a small percentage of tungsten or vanadium. The Young's modulus of this alloy does not vary at all or varies very little with the temperature, at least between the limits between which watches run. It seems therefore that a "self-compensating" spiral spring, combined with an undivided unimetallic balance would give a constant period of oscillation whatever the temperature may be; yet this is not quite the actual case. Experience in fact has shown that nearly always the modulus varies slightly, and that the variation curve not only is a different one for each casting of elinvar, but changes as well, according to the physical treatment, in different spiral springs, although they may be made of the same casting. Consequently, in order that watches

may keep a steady running, it is necessary, even when using self-compensating spiral springs, to provide for the modifying of the inertia of the balance; this, however, has to be done on a smaller scale than is customary with spiral springs made of ordinary steel.

Referring to the Swiss Patent No. 91,169, it has been suggested to combine self-compensating springs with an undivided unimetallic balance to which small bimetallic strips are fastened, so that the said modification of the inertia may be obtained. But the fastening of the strips is a very difficult operation; moreover, should the variations of the inertia be rather important, the strips have to be given too large dimensions and, owing to their small size, they offer all the more trouble in manufacturing and fastening, if the variations do not exceed a rather low figure.

My invention aims at the suppression of these inconveniences. It relates to a regulating device for clockworks comprising a self-compensating spiral spring and a unimetallic balance, its distinctive feature being that the unimetallic balance is divided and bears at least two additional masses secured to it and having a coefficient of expansion different from that of the material used for the balance.

The accompanying drawings illustrate several balances corresponding to my invention and designed to be employed together with a self-compensating spiral spring.

The balance (see Fig. 1) comprises an arm a and a rim b made either of the same metal or of the same alloy. The spiral or hair spring c of elinvar metal is fixed in conventional manner to the split collar m carried by the balance arbor p . This arm a is divided at c and d and presents consequently four free ends c^1 , c^2 , d^1 , d^2 . The ends c^1 and d^2 have each a recess filled with a mass e of metal or alloy having a coefficient of expansion different from that of the rim. If we suppose that the rim is made of steel, the masses e

may be made of brass; such being the case, the ends c^1 and d^2 will move slightly to the inside, when the temperature rises, and thereby diminish the movement of inertia.

Small variations of the Young's modulus of the spiral spring can thus be cared for in function of the variations of the temperature, and the compensation achieved by means of screws displaced on the rim, in the same way as is done when balances of the ordinary type are used. The nuts f represent stops for the adjustment of the maximum play of the ends c^1 and d^2 (auxiliary compensators).

In the embodiment according to Fig. 2, the rim, instead of being divided at points between its connection to the arm a , is cut off at points adjacent of the latter. In that way, the maximum effect of the centrifugal force is obtained, while the minimum one is obtained by means of the construction as illustrated in Fig. 1.

In the embodiment according to Fig. 3, the additional brass masses g are cast in recesses on the inner side of the rim, so that the inertia of the balance increases when the temperature rises.

In the embodiment according to Figure 4, the additional masses h are located at each end of each half rim and adjacent the slit in the balance.

In the embodiment according to Fig. 5, the rim is divided in three parts, each one having at its free end an additional mass i .

In the embodiment according to Figure 6, the two additional masses k , instead of filling the recesses milled out of the rim, are cast on the outer side of same, so that they project beyond it.

In the embodiment according to Figure 7, the two additional masses l are cast in serrated cells fashioned in the outer periphery of the rim. These cells may also receive a semi-circular shape.

The additional masses will preferably be cast in the rim, but may be secured in another way, say by means of screws or rivets. Theoretically, they may be located on any point whatever of the rim. I will however point out that the farther they are from the free ends of the latter, the larger the amount of play of the ends referred to will be. Now, the mark aimed at is to obtain a small amount of play; therefore, the additional masses will practically be fastened to or close to the aforesaid ends. By modifying somewhat either the size of the additional masses or their position towards these ends, it will be possible to find out for each elinvar casting the balance offering the best compensation.

I claim:—

In a regulating device for watches, the combination with a self compensating spiral spring of elinvar metal, of a compensating balance having a pivoted supporting arm, a

plurality of mono-metallic segments secured to the arm, each segment having at least one free end and being provided with a recess extending from the free end of the segment over a relatively short length of the segment, and a monometallic element of the same length as that of said recess placed in each recess to form an integral part of the segment, said mono-metallic elements having a coefficient of expansion differing from that of the said segments.

In testimony whereof I affix my signature.
 WERNER ALBERT DUBOIS.