H. H. HEINRICH.
Self-Adjusting Balance for Chronometers.

No. 208,238. Patented Sept. 24, 1878.

Fig: 1

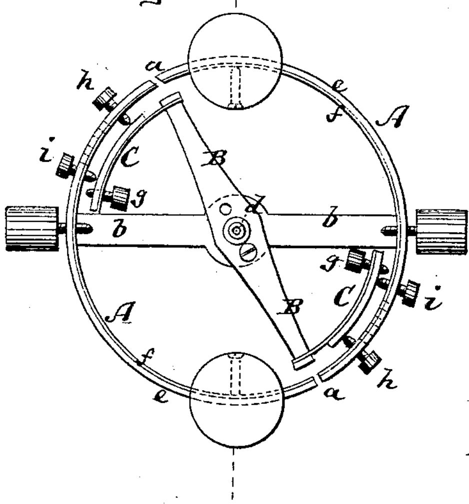


Fig: 5

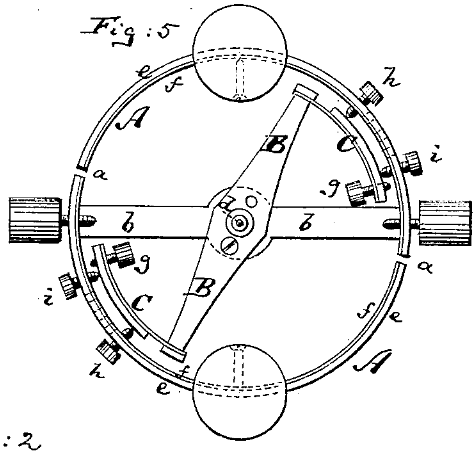


Fig: 2

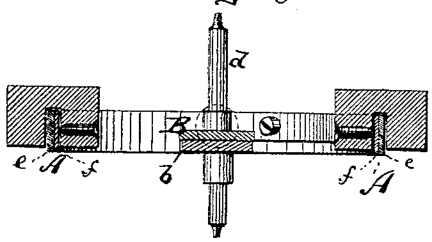


Fig: 3

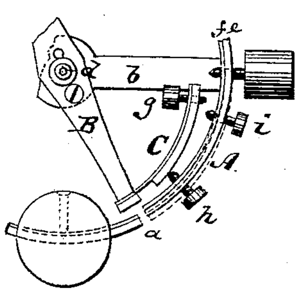
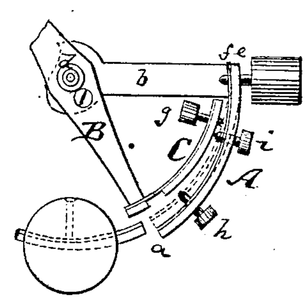


Fig: 4



Witnesses:

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UNITED STATES PATENT OFFICE.

HEIN H. HEINRICH, OF NEW YORK, N. Y.

IMPROVEMENT IN SELF-ADJUSTING BALANCES FOR CHRONOMETERS.

Specification forming part of Letters Patent No. **208,238**, dated September 24, 1878; application filed April 2, 1878.

To all whom it may concern:

Be it known that I, HEIN HINRICH HEINRICH, of the city of New York, county and State of New York, have invented a new and Improved Self-Adjusting Balance for Chronometers, of which the following is a specification:

Figure 1 represents a face view of my improved self-adjusting balance for chronometers. Fig. 2 is a vertical central section through the same. Figs. 3 and 4 are detail top views thereof, showing the balance under the effects of extreme heat and cold, respectively. Fig. 5 is a face view of a modification of the invention.

All the figures are drawn on an enlarged scale.

Similar letters of reference indicate corresponding parts in all the figures.

The object of this invention is to so construct an auxiliary balance for chronometers as to overcome the difficulty to which all chronometers are now subjected—namely, that of losing time in the extremes of heat and cold. The balance-spring during extreme heat expands and becomes weakened, and during extreme cold it contracts and becomes strengthened. The balance-wheel also expands and contracts under the influence of heat and cold. The difficulty is so to compensate during the expansion, caused by heat, that the weakened spring will meet with so much less resistance as to enable it to keep the proper time, and during the extreme of cold so to provide all contracted parts that the strengthened spring will meet with so much more resistance as to enable it to keep the proper time. In chronometer works, as now constructed, the additional resistance which is caused during the extreme of cold by decentralizing the weight of the balance-wheel is so much greater in proportion to the strength added to the spring by the contraction that the watch will lose in time. This is the case because, for the ordinary variations, the automatic adjustment of weight of the balance-wheel suffices to keep the work properly operative, and therefore it overreaches the mark during the extreme of cold. During the extreme of heat the mark is equally overreached, on the same principle.

My invention consists in splitting the rim of the balance-wheel, and in combining it with an inner arm mounted upon the same arbor, which arm carries on projecting springs small weights. The said springs are exposed to contact with pins that project inwardly from the rim of the wheel, and that will cause the springs to bend farther inward or outward, as the case may be, according to the position which the rim itself occupies while exposed to the extremes of heat and cold.

In the accompanying drawing, the letter A represents the rim of the auxiliary balance. Said rim is cut in two places, as is shown in *a a* in Fig. 1, so that it really consists of two nearly semi-annular pieces, which pieces are secured upon a common cross-bar, *b*, that is mounted upon the arbor *d*. The rim itself is constructed of two thicknesses of metal, an outer thickness, *e*, of copper or other soft metal, and an inner thickness, *f*, of steel or other hard metal. The hard metal *f* is much thinner than the other, as clearly shown in Figs. 1, 3, and 4, for the purpose of not offering too much resistance to the requisite curving of the rim. Being thus made of two thicknesses of soft and hard metal, each semi-annular piece of the rim will necessarily seek to bring its ends nearer together when exposed to great heat, because the soft metal will expand more than the hard metal *f*, and will, therefore, be drawn into a closer curve by the resisting hard metal.

Fig. 3 shows the end of the rim A bent inward under the effect of extreme heat. The dotted lines in said figure indicate the normal position of said rim. Under the effect of extreme cold, the semi-annular pieces that constitute the rim seek to approach nearer to a straight line, and the ends of said pieces, therefore, bend outward, as indicated in Fig. 4, where the dotted line shows the normal position.

Having thus demonstrated how the ends of the semi-annular pieces that constitute the rim of the balance act with reference to extremes of heat and cold, it is only necessary now to show how this motion is utilized by me for the purpose of constructing a self-adjusting balance.

Upon the spindle or arbor *d* I fit an arm, B, which carries at each end a projecting spring-arm, C, that has a weight, *g*, at its free end. During the normal condition of temperature the spring of this arm C causes it to bear against the points of two screws, *h* and *i*, that extend through the rim A, as shown in Fig. 1; but when the rim contracts under heat, as in Fig. 3, the screw *h*, which is nearest to the contracting end of the rim A and nearest the fast end of the spring C, bears against said spring and pushes it inwardly, as clearly shown in Fig. 3, thereby carrying the weight *g* nearer to the center. The motion of the weight *g* is quite considerable as compared with that of the screw *h*, and depends upon the length of the lever-arm of the spring C. Therefore, as the balance-spring is weakened under the extreme of heat, the auxiliary balance compensates for this weakening by carrying the weight *g* of the balance-wheel proportionately very much nearer to the center of the balance-wheel, thus reducing the resistance to the balance-spring.

During the extreme of cold, when the rim A expands, as in Fig. 4, the spring C seeks to follow, by its elastic property, the rim A, and thereby retains contact with the screw *i*, as shown in Fig. 4, and consequently the weight *g* is carried farther outward; but it will be noticed that this outward motion is proportionately much less than was the inward motion of the same weight during the extreme of heat, and this is necessary because the several weights which are attached to the balance-wheel are already carried out in conformity with the outward motion of the rim, and compensate for the increase of strength of the spring; nay, they more than compensate by such outward motion, and the reduced outward motion of the weight *g* counteracts the effect which too much of an outward motion of the remaining weights would have upon the watch, and the watch therefore keeps its time properly where otherwise it would lose time by too far an outward motion of the usual weights of the balance-wheel. Thus, by my auxiliary attachment, I overcome the difficulty under which all balances heretofore were made to suffer—namely, that of not contracting enough in the extreme of heat, and of becoming too large in the extreme of cold. For adjusting this balance the rim A has several perforations, so that the screws *h* and *i* may be placed at suitable distances apart, the dotted lines in Fig. 1 indicating the several perforations. If the distance between these two screws *h* and *i* is increased the chronometer will run faster in both extremes of temperature, and if their distance be decreased the contrary effect will be produced.

In setting the instrument, the distance between the two screws must be adjusted until the correct length of the arm C between them is found, which will enable the chronometer to run correctly in both extremes of temperature.

The arm B with its spring C, which, in fact, constitute the auxiliary balance, can be turned on the staff *d* to further adjust the instrument. The more the arm B is turned to bring the fast end of the spring C nearer the screw *h* the faster will the chronometer run in heat, and the slower in cold, because in heat the weight *g* would be carried farther inward, whereas in cold it would be carried farther outward. The contrary effect may be produced when the arm B is set in opposite direction.

After the exact proper position of the arm B and screws *h* and *i* has been found, the arm should be fastened by a suitable set-screw or otherwise to prevent the parts from becoming deranged.

Fig. 5 shows a modification, in which the direction of the springs C C on the arm B is shown to be reversed, which arrangement is applicable to balances already in use, provided they have been cut. The operation of the modified construction will, of course, be fully understood by reference to the preceding description.

I claim—

1. The auxiliary balance composed of the cut rim A, having pins or screws *h i*, in combination with the spring C, having the weight *g*, substantially as herein shown and described.

2. The movable arm B, carrying springs C C, and weights *g g*, in combination with the slit rim A, which is constructed of two thicknesses of metal and carries the pins or screws *h i*, substantially as and for the purpose specified.

The foregoing description of my invention signed this 1st day of April, 1878.

HEIN HINRICH HEINRICH.

Witnesses:

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