(No Model.) 2 Sheets—Sheet 1.

C. E. EMERY.

METHOD OF ADJUSTING HAIR SPRINGS TO WATCH BALANCES.

No. 453,927. Patented June 9, 1891.

Fig. 1.

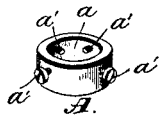


Fig. 2.

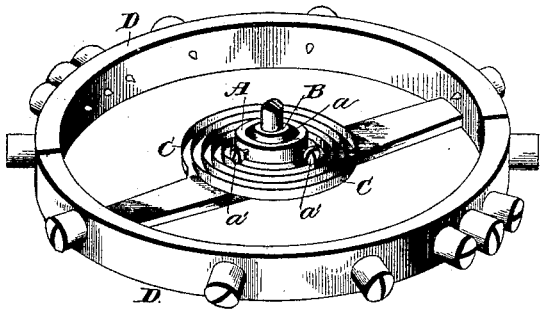


Fig. 3.

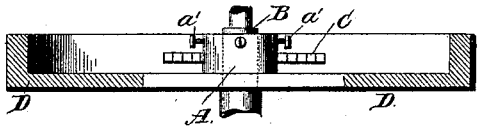


Fig. 4.

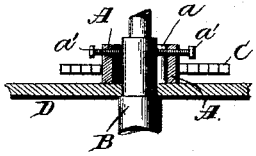
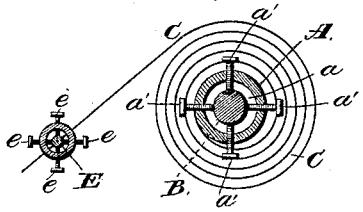


Fig. 5.



Witnesses
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Inventor
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(No Model.) 2 Sheets—Sheet 2.

C. E. EMERY.

METHOD OF ADJUSTING HAIR SPRINGS TO WATCH BALANCES.

No. 453,927. Patented June 9, 1891.

Fig. 6.

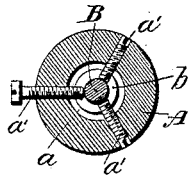


Fig. 7.

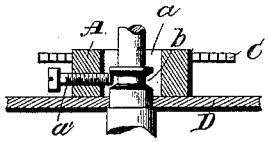


Fig. 8.

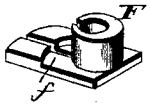


Fig. 9.

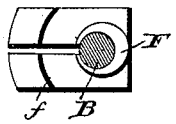


Fig. 10.

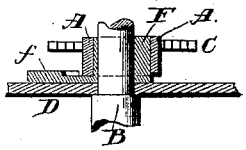


Fig. 11.

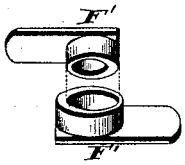


Fig. 12.

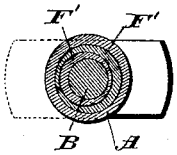
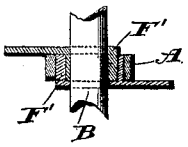


Fig. 13.



Witnesses
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UNITED STATES PATENT OFFICE.

CHARLES E. EMERY, OF NEW YORK, N. Y.

METHOD OF ADJUSTING HAIR-SPRINGS TO WATCH-BALANCES.

SPECIFICATION forming part of Letters Patent No. 453,927, dated June 9, 1891.

Application filed October 5, 1888. Renewed November 17, 1890. Serial No. 371,642. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. EMERY, of New York, in the county of New York, and in the State of New York, have invented certain new and useful Improvements in the Adjustment of Watches; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

Figure 1 is a perspective view of the hair-spring collet preferably employed. Fig. 2 is a like view of the same combined with a watch-balance arbor and hair-spring. Fig. 3 is a sectional side elevation of said parts. Fig. 4 is a central section of the same upon a line with the axis of the balance-arbor. Fig. 5 is a section of said parts and of an adjustable hair-spring stud upon a plane having a right angle to the axis of said arbor. Fig. 6 is a like view of a modified form of collet. Fig. 7 is a side elevation of the balance-arbor and a central section of the collet shown in Fig. 6. Fig. 8 is a perspective view of an eccentric adjustment and counter-balance. Fig. 9 is a plan view of the same. Fig. 10 is a section of said eccentric combined with a collet, arbor, and balance. Fig. 11 is a perspective view of two eccentrics for combined use in adjusting the collet. Fig. 12 is a cross-section of the same as arranged for use, and Fig. 13 is a section of said parts and a collet upon a line with the axis of the balance-arbor.

Letters of like name and kind refer to like parts in each of the figures.

In the use of watches in which the usual coiled hair-spring is employed it is found that the weight of the spring will cause it to sag more or less when the plane of the balance-wheel is vertical, and as such sag slightly lessens the effective strength of the spring the general tendency is to cause the watch to run at a slightly slower rate in all vertical positions, as compared with its rate when placed horizontally. When the moments of inertia of the different coils of the hair-spring under the conditions of sag are not the same in relation to the effective tensions in all vertical positions—that is, when the hair-spring is not perfectly centered or poised in a dynamic rather than a static sense—some of the rapidly-moving coils near the longitudinal center of the spring are by the sag brought farther from the center in some positions than in others, and the effect is to cause the watch to run at different rates in the various vertical positions.

In practice the errors named are sometimes corrected by throwing the balance out of poise; but usually by varying the terminal curves of the hair-spring, which latter involves the tedious process of bending the spring a little and then trying the result according to rules which vary with each individual adjuster. Such rules, it is believed, are not always applicable, and while skilled adjusters can secure tolerably satisfactory results the different variations have to be tried until the desired adjustment has been obtained, so that the operation frequently requires a year of time for the finer grades of watches.

I have found by experiment that the rate in at least two opposite vertical positions out of four can be varied in a hair-spring by bending the inner terminal curve so as to shift the collet radially and thus center the main portion of the spring differently with relation to the balance-staff; but as the spring may readily be bent in the wrong direction or to an improper extent all the work previously done may be thus lost and the operator baffled, if not thrown entirely out of the proper routine.

My invention has for its object to provide means whereby the center of a hair-spring may be easily and readily varied with relation to the balance-staff without change of or interference with the terminal curves of the spring; to which end said invention consists in the method employed, substantially as and for the purpose hereinafter specified.

While various means may be employed for carrying my invention into practice, it will sufficiently illustrate such invention if the mechanism preferably used is described, which, as shown in the drawings, consists of a collet A, that is provided with a central opening *a*, which is larger in diameter than the balance-staff B, and is provided with a number of radial set-screws *a'* and *a'*, that are preferably arranged at a point above that occupied by the hair-spring C, so as to be easily accessible when combined with a spring, bal-

ance-staff, and balance-wheel D. The collet A thus constructed is adapted to be secured in place upon the balance-staff B by means of the screws a' and a', and for such purpose the portion of said staff which receives the inner ends of said screws may either be plain, as shown in Fig. 4, or may have a peripheral groove b, as seen in Fig. 7, for the reception of the said screws' ends. In the use of such groove it should be located so as to cause the screws to bear upon its outer side only, by which means said screws will operate to hold said collet firmly down upon the balance-wheel D, as well as to insure its position radially upon said staff.

In practice the collet A, having the inner end of the hair-spring C pinned or otherwise secured to its periphery in any usual way, is placed upon the staff B and secured thereon, so as to bring it concentric with said staff, after which the outer end of said spring is fastened to or within a stud E, and the watch then run in each of four vertical positions to show the errors of centering, if such exist.

When it has been determined that the center of the hair-spring should be moved with relation to the staff and the direction and probable amount of movement decided upon, the collet with spring is removed and a dummy collet of the same size substituted therefor and thrown out of center the predetermined distance, after which the balance is poised, said dummy collet removed, the collet with hair-spring replaced with corresponding eccentricity, and the watch then tested in its vertical positions.

In order to facilitate the adjustment of the hair-spring, the stud E is made adjustable radially by means of four screws e and e, whereby the outer end of said spring may be moved to correspond to its inner end. In practice the stud is set so that the spring is under no strain on the flat with the balance in mid-position. As shown in the drawings, said stud is placed at an exaggerated distance from the balance and the terminal curve has a straight line between said parts; but it will be understood that any form of terminal curve may be used in connection with said stud. After another trial of the balance the adjusting operation would, if necessary, be repeated; but the poising of the balance for every trial could, however, be generally dispensed with.

As the direction and degree in which the collet is to be moved depend principally upon the nearness with which the spring is poised dynamically, no definite rule for such can be stated in advance. When all parts are apparently poised, the collet may first be moved toward the point where the watch is fastest and the result tested, when if the error is increased said collet may then be moved in an opposite direction, thereby locating the direction of the proper center of the spring to poise it dynamically, and by repeated trials said spring may be placed nearer and nearer such center until the rate with opposite ends of the same diameter uppermost is nearly or entirely equalized. By the same method the rate will preferably be approximately equalized in a direction at or nearly at a right angle to the first. When the angle at which the watch runs fastest falls between two of the adjusting-screws, such screws must be moved so that the resulting motion will be in the direction intended. When all the parts of the watch are in proper condition, the average rates for each diameter, averaging both ends, should be the same, so that by equalizing the rate for two diameters at or nearly at right angles the adjustment of the watch for vertical positions should be complete. If, however, there should be considerable error between the average of two vertical positions and the average of two horizontal positions, and the comparative error cannot be corrected by other means, the adjusting-screws may be used to equalize the rates for the most important positions—as, for instance, "pendant up," "pendant right," and "pendant left" may be made nearly alike, with greater error in "pendant down."

It is preferred that but three set-screws be used for centering the spring-collet, although four will be found convenient; but in either case it is desirable that there should be some distinguishing marks about the same—as, for instance, that the heads of two should be very small or that they should have no heads and be contained nearly or wholly within the collet, as shown in Fig. 6, while the remaining screw should have a large head and should be used by the operator in removing or replacing the collet, by which means the adjustment of the screws will not be affected by such operation. If desired, the adjusting-screws may be placed in the balance-arbor or in lugs formed upon the arm or hub of the balance-wheel; but it is believed that the most convenient arrangement is as shown within the collet.

In place of the adjusting-screws the collet may be moved radially by means of an eccentric F, (shown in Figs. 8, 9, and 10,) which has an axial opening that adapts it to fit upon the balance-staff and peripherally has such diameter as to enable it to fit within the collet. To the narrow side of such eccentric is attached a thin plate f, which extends radially outward and forms a counter-balance for the same and preferably for the eccentrically-located collet placed upon said eccentric. Said plate and the adjacent side of the eccentric are split, as shown, so as to enable the latter to be sprung upon the staff.

In using the eccentric adjustment a number of eccentrics having different degrees of eccentricity and corresponding counter-balances would be provided and by trial that one would be selected which would most nearly locate the collet. By simply turning the former within the latter the point of greatest eccentricity of said collet could be

changed at will with relation to the balance-staff.

In Figs. 11, 12, and 13 are shown two eccentrics F′ and F′, which are adapted to cooperate, one being fitted upon the balance-staff, the other being fitted upon and adapted to rotate around the periphery of the first eccentric, while the collet is sprung over and turns upon the outer eccentric. As thus arranged, it will be seen that when said eccentrics are placed in opposite directions—that is, with the thin side of one adjacent to the thick side of the other—the collet will be held concentric with the balance-staff, and by varying the relative positions of said parts any amount of eccentricity of said collet may be secured within the limits of the combined action of said eccentrics, while by moving them bodily in the right direction the point of greatest eccentricity of said collet may be located circumferentially at any desired point upon said staff.

For the purpose of illustration the collet, hair-spring, stud, and the means employed for adjusting the same to position are much exaggerated in size, while in actual practice such parts would be so small as to escape the observation of all but skilled workmen.

Having thus fully described my invention, what I claim is—

1. As an improvement in the adjustment of watches, the method of adapting a hair-spring to a balance-staff, which consists in moving the center of the spring diametrically with relation to the balance-staff until said spring will run approximately in the same time with the watch in position to bring either end of such diameter upward, substantially as and for the purpose specified.

2. As an improvement in the adjustment of watches, the method of systematically testing hair-springs, which consist in varying the possition of the collet diametrically until a new center is found for the spring which will cause it to run approximately in the same time with either end of such diameter upward, substantially as and for the purpose shown.

3. As an improvement in the adjustment of watches, the method of selecting a hair-spring for use with a particular balance, which consists in running different springs upon such balance and shifting their centers diametrically until a spring is found that responds to an adjustment of its center radially in either direction, substantially as and for the purpose set forth.

4. As an improvement in the adjustment of watches, the method described, which consists in changing the center of a hair-spring diametrically with relation to the balance-staff by shifting thereon the collet and then counterpoising the eccentricity of said collet, substantially as and for the purpose specified.

5. As an improvement in the adjustment of watches, the method described, which consists in changing the position of the outer end of a hair-spring by the radial adjustment of the hair-spring stud, substantially as and for the purpose shown.

6. As an improvement in the adjustment of watches, the method described, which consists in changing the center of the hair-spring diametrically with relation to the balance-arbor and then shifting the hair-spring stud radially until in mid-position said hair-spring is free from strain, substantially as and for the purpose set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 23d day of August, 1888.

CHAS. E. EMERY.

Witnesses:
GEORGE C. PENNELL,
ROBT. M. REEVS.