(No Model.)

C. E. FRITTS.

METHOD OF MAKING ISOCHRONAL HAIR SPRINGS.

No. 350,584. Patented Oct. 12, 1886.

Fig 1.

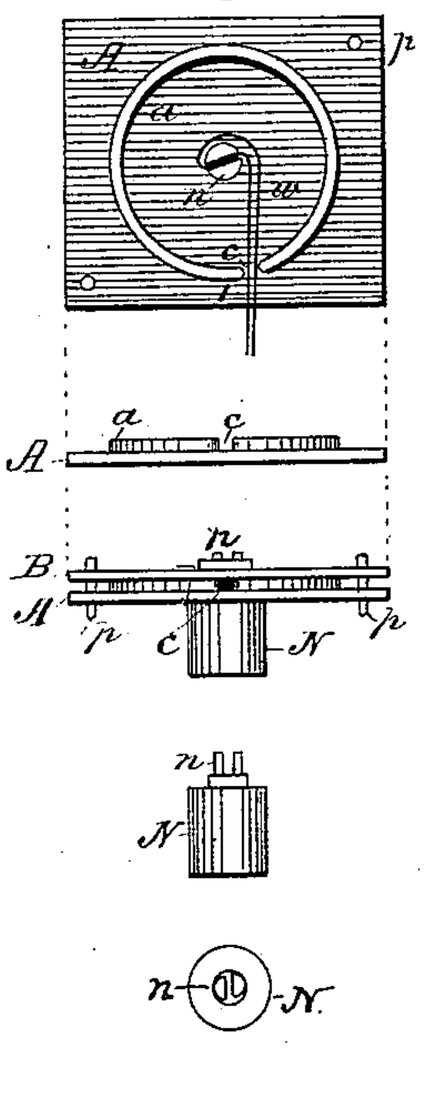


Fig. 2.

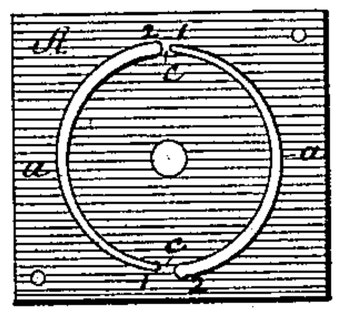


Fig. 4.

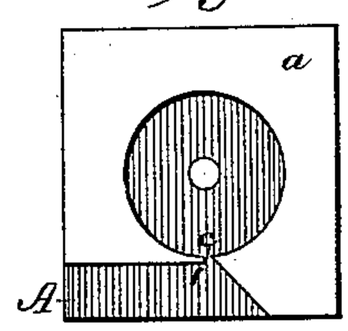


Fig. 3.

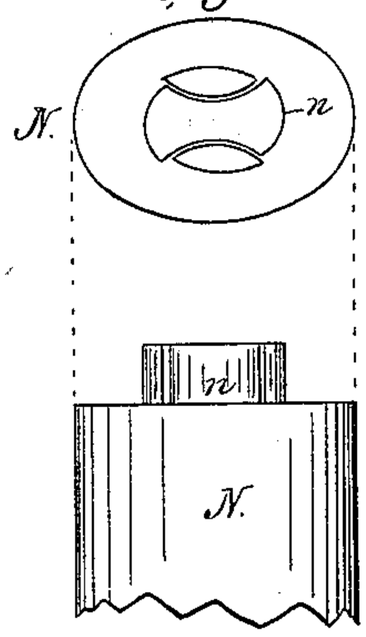


Fig. 5.

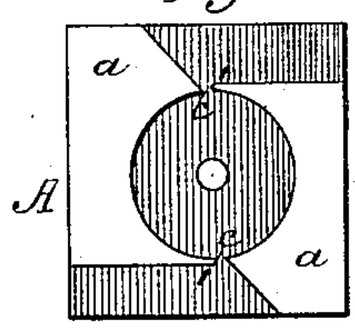


Fig. 6

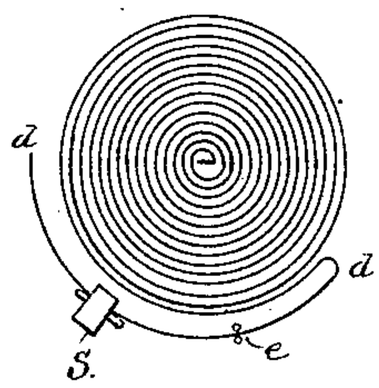
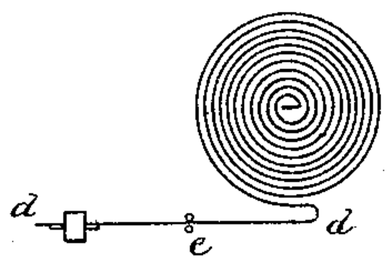


Fig. 7.



WITNESSES

INVENTOR

Charles E. Fritts

Attorney

UNITED STATES PATENT OFFICE.

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

METHOD OF MAKING ISOCHRONAL HAIR-SPRINGS.

SPECIFICATION forming part of Letters Patent No. 350,584, dated October 12, 1886.

Application filed March 26, 1884. Serial No. 125,520. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. FRITTS, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in the Art of Making Isochronal Hair-Springs for Chronometers, Watches, and other Articles, of which the following is a specification.

In making isochronal hair-springs the usual course with flat springs is to raise the outer coil up by means of two elbows or bends, and to curve this coil toward the center over the other coils, such a spring being known as a "Bréguet spring." This kind of spring requires great skill and experience to shape properly, and is also difficult to harden and temper properly, and is, consequently, expensive to make. It also requires considerable depth in the movement, owing to the room occupied by its two superposed coils with the necessary space between them, and therefore can only be used in movements of considerable thickness.

My improvement consists in forming a terminal curve for isochronal purposes in the same plane as the rest of the spring, so that it can be used in any watch, however thin. It can also be formed without the distortion and injury to the metal which is commonly produced in forming the Bréguet spring. The terminal curve being in the same plane as the other coils, my spring is free from the tendency to twist which the Bréguet spring has, and which interferes with perfect isochronal action.

Furthermore, it consists in giving to the spring the desired form or configuration, and then giving it the desired temper or hardness equally and perfectly throughout its entire length while held in the form which it is to permanently have—something very difficult, if not impossible, to do with the Bréguet spring, on account of its peculiarly irregular and straggling form, but easy to do with this form of spring.

My invention also consists in the means for forming the spring in the proper shape and holding it so while giving it the desired hardness or temper. I thus produce an isochronal flat hair-spring having a terminal curve in the same plane as the body of the spring, and having a uniform hardness or temper throughout its entire length—something entirely new—and it can be made about as cheaply as the ordinary flat springs.

Figure 1 represents the means for forming this spring, both in plan and in perspective. Fig. 6 shows a spring thus made. Fig. 2 is a modification for making two or four springs at once, and Fig. 3 shows the winding-arbor for making four springs. Fig. 4 represents a modification for making a spring such as shown in Fig. 7, and Fig. 5 is a modification for making two or four at the same time.

In Fig. 1 is shown, in plan at the top and in side view below, a thin plate, A, of steel, copper, brass, or any other suitable material on which is formed an elevated ring or templet, *a*, whose height is equal to the breadth of the proposed spring, and whose thickness is substantially equal to the distance between the outer coil and the over-coil. At *c* is a slit or opening through which the spring-wire *w* is wound in by the usual arbor, N, with the slot *n* in its top. The lip 1 is suitably rounded to give a gradual curve to the spring-wire, which, after the cavity within *a* is filled, is bent back over the lip *c* at 1 and around the circle *a*. The spring-wire having been inserted in the slot of the arbor *n*, and projecting through the opening *c*, the cover B is put on and held by friction, by the pins *p p*, or otherwise. One or both of the pins *p* may be screws. The arbor being turned and the wire wound into the cavity till filled, in the usual way, the ends are then turned backward around the ring *a* to any desired distance, and then twisted around one of the pins *p* or over the edge of the box A, to secure the ends. When the spring is to be thus wound backward more than half a turn, outside of the bend *d*, the screws or pins *p p* must be replaced by some other means for holding the plates together, as by a nut on the outer end of the winding-arbor or otherwise. This is the method I prefer, as the outermost wire then covers the other and protects it from the air while hardening and tempering. Its shape will be slightly different from the other, and may either be used for suitable purposes, or the over-coil can be broken off when finished, thus converting it into the usual hardened and tempered flat spiral spring, while the other is a spring of my improved form. If the space required be-

tween the different coils of the spring is greater than would be produced by winding two springs up together, as described, three or more may be wound together and made at once, either all alike, as just explained, or one or more of the wires may be cut off at the opening *c* before hardening and tempering.

Fig. 2 shows two openings through the ring *a*, so that two or four springs of my improved form may be made at once, in the manner already described. When they are to be held firmly during the entire hardening and tempering process, I prefer to not make the ring *a* of uniform thickness, as shown in Fig. 1, but with the end 2 of the segment slightly thicker than the lip 1, so that as the over-coil is wound around the ring *a* it will ride evenly on top of the wire bent over the lip 1, and the over-coil will thus be either concentric with the balance-axis or slightly divergent, as may be preferred in each case.

The slotted end *n* of the winding-arbor N, Fig. 3, may be cylindrical; but it would be better to make the quadrants slightly snail-shaped, so that each wire, when it reaches the next slit, will be raised to the level of the top of the wire therein, and so will ride evenly upon it without any bend or departure from the true spiral form in the coil.

It is of course understood that different escapements or kinds of movements may require different forms to be given to the over-coil in order to secure isochronal action in each case. and the elevated part or templet *a* must be so shaped as to give it such form, and while the form shown in Fig. 6 will be satisfactory in most cases, it may be necessary in others to have the over-coil less curved, or in some supposable cases even curved in the opposite direction; but it will very seldom be required to diverge more than shown in Fig. 7. This shape is imparted by means of the mold or templet *a*, formed as in Figs. 4 and 5, as already described. My method of making springs is therefore capable of securing isochronism in a flat spiral spring in any supposable circumstances.

In the process of ascertaining the precise form of spring required to produce isochronal action in any particular movement, I would say that the action of the spring can be varied in different ways—as (1) by changing the length from the center to the bend *d*, (2) by changing the length from the bend *d* to the stud S, or (3) by changing the diameter or the shape of the bend *d*. The first item depends on the thickness of the spring-wire and the space between the winding-arbor and the ring or templet *a*. The second item can be changed after the spring is formed, hardened, and tempered by moving the stud S along the outer coil. This over-coil, as before stated, may be of any length desired by the watch-maker in each case, either a part of a circle or turn, or one or more full turns outside of the bend *d*, all being in the same plane as the central spiral. The third item is preferably varied while constructing the spring. The bend is shown in the drawings as semicircular, but may be of any other form necessary to secure perfect isochronism in any particular case, and to cause the outer end of the central spiral to approach the center (or balance-axis) in proportion to the force of the pull upon the bend *d* when the balance is revolved, so as to keep the inner spiral from being either drawn or pressed bodily in any direction, and cause it to remain always truly concentric with the balance-axis, so that the balance-pivots will not be pressed by the spring against the sides of their jewel-holes, as is well understood by watch-makers to be necessary. For instance, instead of *d*, Fig. 6, being semicircular, the inner spiral may retain its own proper form to *d*, and the over-coil may curve inward toward that point, where they may be united by a short bend in the spring; or, *per contra*, the over-coil may be regular to *d*, and the inner spiral curve outward to meet it; or the short bend may be midway between the two spirals, and both be suitably curved to it, so as to avoid bringing the two reversed spirals any closer together, except near the bend *d*. All this may be ascertained as well understood by those versed in the art by careful trials with a movement having such a train, escapement, balance, &c., as the proposed springs are required to be isochronal with, so that when the spring under trial has been brought to perfect isochronism its form shall be a correct guide for shaping the templet for use in manufacturing duplicates thereof, so that ordinary spring-makers may then readily make them in any desired number. It is only necessary, after the proper form has been ascertained by calculation or experiment, to construct a mold or templet which will hold the spring in said form while the necessary hardness, temper, or set is given to the over-coil or terminal curve. I call the part *d d* in Fig. 7 a "terminal curve," because, although straight, it is one of the possible forms or curves of the terminal coil.

These springs can be used either with or without a regulator. In the latter case the terminal curve *d d*, Fig. 6, may be moved through the stud S to adjust the spring for isochronism, and the watch may then be rated by means of the balance-screws. In the case of Fig. 7, or any other irregular form, the stud may be made adjustable, and preferably in the form of a screw-clip, which is caused to grasp the spring *d d* between its jaws when placed at the proper point.

If a regulator is used with the spring, Fig. 6, it works along the terminal curve *d d*, as usual, *e* representing the two pins of the regulator. If the terminal curve *d d* is not concentric with the balance-axis, the regulator center can be set central with the curve of the over-coil *d d*. In the case of the curve, Fig. 7, the regulator can move in a straight line along the terminal curve.

I do not give directions for hardening, tem-

pering, setting, polishing, coloring, &c., as they are well understood by those versed in the art, and any desired process may be followed in making my springs. I would also say that in some cases it may be desirable to make the outer coil (shown as parallel to the over-coil *d d* in Fig. 6) diverge somewhat from the spiral form for a greater or less distance back from the bend *d*, either in order to bring *d d* concentric with the balance-axis or for isochronal purposes. This is easily done by altering the spring when finished, or by making it as desired, by causing the interior surface of the templet *a* to take the form desired, instead of making it in a circular form, as shown.

There are many other ways in which, without departing from the principle thereof, the details of my invention may be varied to suit particular cases, as will readily occur to those versed in the art.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is—

1. That improvement in making isochronal hair-springs which consists in bending or winding the spring-wire into a spiral form, then forming upon the outer end an over-coil in the same plane as the other coils, giving said over-coil the form or curvature required for securing isochronal action in the conditions for which the spring is intended, holding the spring in said form, and giving it the proper hardness, temper, or set while so held in its final form.

2. That improvement in the art of making hair-springs isochronal which consists in forming upon the spring an over-coil in the same plane as the other coils, and giving it the predetermined isochronous form or curvature, which will secure for the spring an isochronal action.

3. That improvement in the art of making hair-springs isochronal which consists in forming upon the spring an over-coil in the same plane as the other coils, but reversed in direction, and giving it an isochronous form or curvature.

4. That improvement in the art of making isochronal hair-springs which consists in having the outer portion formed in a terminal curve in an opposite direction, but in the same plane as the rest of the spring.

5. That improvement in the art of making hair-springs which consists in making the spring with a reversed over-coil and terminal curve.

6. In a box or device for use in making isochronal hair-springs, a mold or templet having a configuration suitable for giving the desired shape to a terminal curve in the same plane as the rest of the spring, and adapted for holding it in said shape while giving the spring the proper hardness, temper, or set.

7. A box for use in making hair-springs, having a cavity for the spiral portion and a templet for forming the terminal curve in the same plane.

8. A box or device for use in making hair-springs, having a cavity for forming the spiral portion, a mold or templet for giving the required shape to the outer coil and terminal curve in the same plane as the spiral portion, and a cover for confining the spring in its position.

9. A device for use in making hair-springs, consisting of a box having a cavity for the spiral portion and a templet for forming the terminal curve in the same plane as the spiral portion, a cover for confining the spring, and a winding-arbor, substantially as set forth.

10. That improvement in the art of making isochronal hair-springs which consists in rolling a part of the spring-wire in spiral form, then forming the remainder into a suitable over-coil and terminal curve in the same plane as the rest of the spring, and giving the entire spring the desired hardness, temper, or set uniformly from end to end while held in its final form.

11. That improvement in the art of making isochronal hair-springs which consists in having the body of the spring and the isochronizing over-coil and terminal curve in the same plane.

12. That improvement in the art of making isochronal hair-springs which consists in making the spring in two spirals, one outside of the other and reversed in direction, connected by a bend in the spring, the whole being in one piece, and both spirals formed in the same plane.

CHARLES E. FRITTS.

Witnesses:
D. H. HOPKINSON,
EDWIN CLARK.