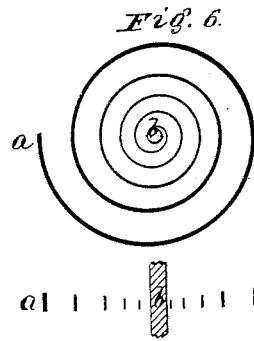
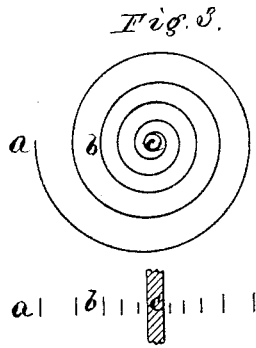
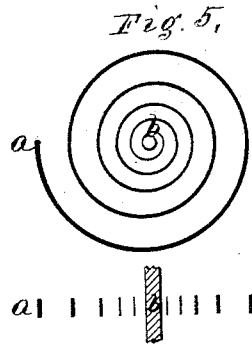
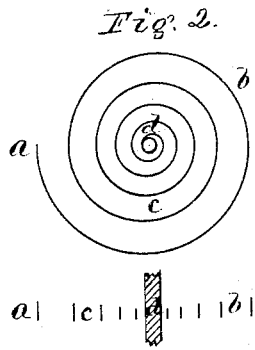
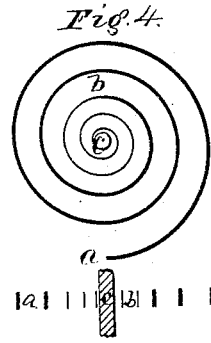
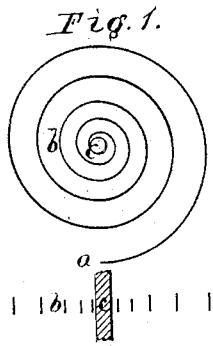


M. D. BERLITZ & H. P. MORGAN.
Balance-Spring for Time-Keepers.

No. 209,642.

Patented Nov. 5, 1878.



Witnesses.

Geo. D. Jewett
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Inventors.

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UNITED STATES PATENT OFFICE.

MAXIMILIAN D. BERLITZ, OF PROVIDENCE, AND HENRY P. MORGAN, OF WESTERLY, ASSIGNORS OF ONE-THIRD THEIR RIGHT TO ELLIOT HOLBROOK, OF PROVIDENCE, RHODE ISLAND.

IMPROVEMENT IN BALANCE-SPRINGS FOR TIME-KEEPERS.

Specification forming part of Letters Patent No. **209,642**, dated November 5, 1878; application filed May 16, 1878.

To all whom it may concern:

Be it known that we, MAXIMILIAN D. BERLITZ, of Providence, in the county of Providence and State of Rhode Island, and HENRY P. MORGAN, of Westerly, in the county of Washington and State of Rhode Island, have invented certain new and useful Improvements in Balance-Springs for Time-Keepers; and we do hereby declare that the following is a full, clear, and exact description thereof, whereby a person skilled in the art can make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Like letters in the figures indicate the same parts.

Our invention relates to balance or hair springs, such as are usually used in watches and chronometers; and it has for its object the rendering of the beats of the balance-wheel isochronal in longer or shorter arcs of vibration.

Our invention consists in the construction of a balance-spring of unequal cross-section throughout its length, so that there is a difference in the flexibility of the coils. This may be accomplished by changes in the width or thickness of the spring, or both.

In the accompanying drawing, Figures 1, 2, and 3 show top views and cross-sections of springs having changes in the width. Figs. 4, 5, and 6 show top views and cross-sections of springs having changes in the thickness.

In Fig. 1 the spring is supposed to be of a uniform section from *a* to *b*, and of a uniform section, but narrower, from *b* to *c*. In Fig. 2 the spring is of uniform section from *a* to *b*, of uniform section, but narrower, from *b* to *c*, and of uniform section, but still narrower, from *c* to *d*. In Fig. 3 the spring is of uniform sec-

tion from *a* to *b*, and diminishing in width with a gradual taper from *b* to *c*. In Fig. 4 the spring is of a uniform width throughout, but of two different thicknesses, being uniform from *a* to *b*, and uniform, with a different thickness, from *b* to *c*. In Fig. 5 the spring is of a uniform width, but tapering in thickness from *a* to *b*. In Fig. 6 the spring is tapering in both width and thickness from *a* to *b*.

The foregoing shows several forms of the application of our invention, the principal feature of which is the construction of the spring with a diminishing area of cross-section as the convolutions become smaller, and this may be done gradually or tapering, or may be made in successive steps.

The form of our invention that we prefer as being the most simple in construction, and at the same time admitting of the easy adjustment of the proportions of the two parts, so that the vibrations of the balance to which it is attached shall be isochronal, is the spring composed of two parts, each of uniform cross-section, the inner one of which is the more flexible. Good results can, however, be obtained with either of the forms of springs above described.

What we claim as our invention is—

A balance-spring having a varying area of cross-section in different parts of its length, substantially as herein described.

MAXIMILIAN D. BERLITZ.
HENRY P. MORGAN.

Witnesses to Berlitz's signature:

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Witnesses to Morgan's signature:

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EUGENE B. PENDLETON.