C. KLINE.

Watch Spring.

No. 109,826. Patented Dec. 6, 1870.

Fig. 1,

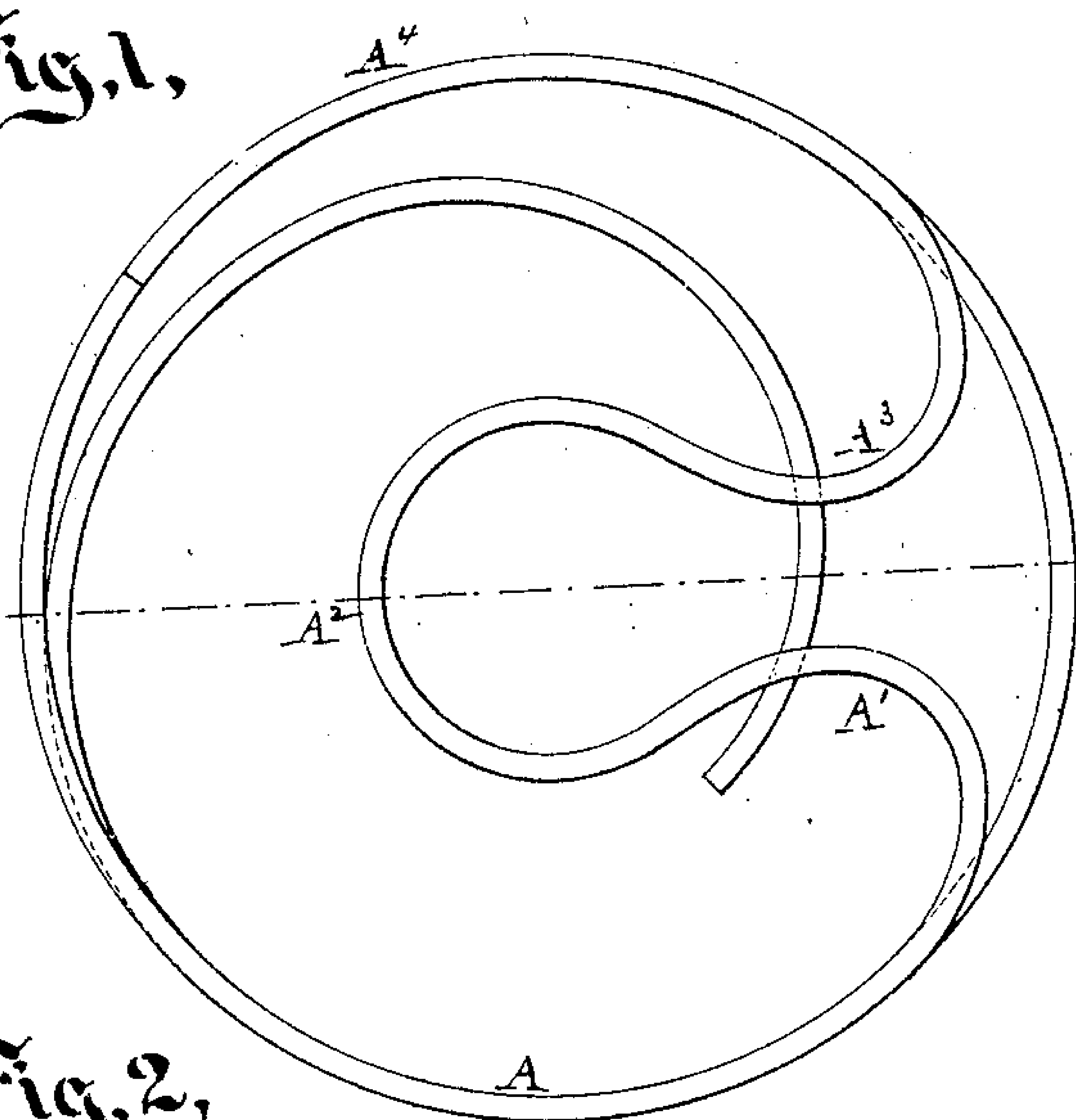


Fig. 2,

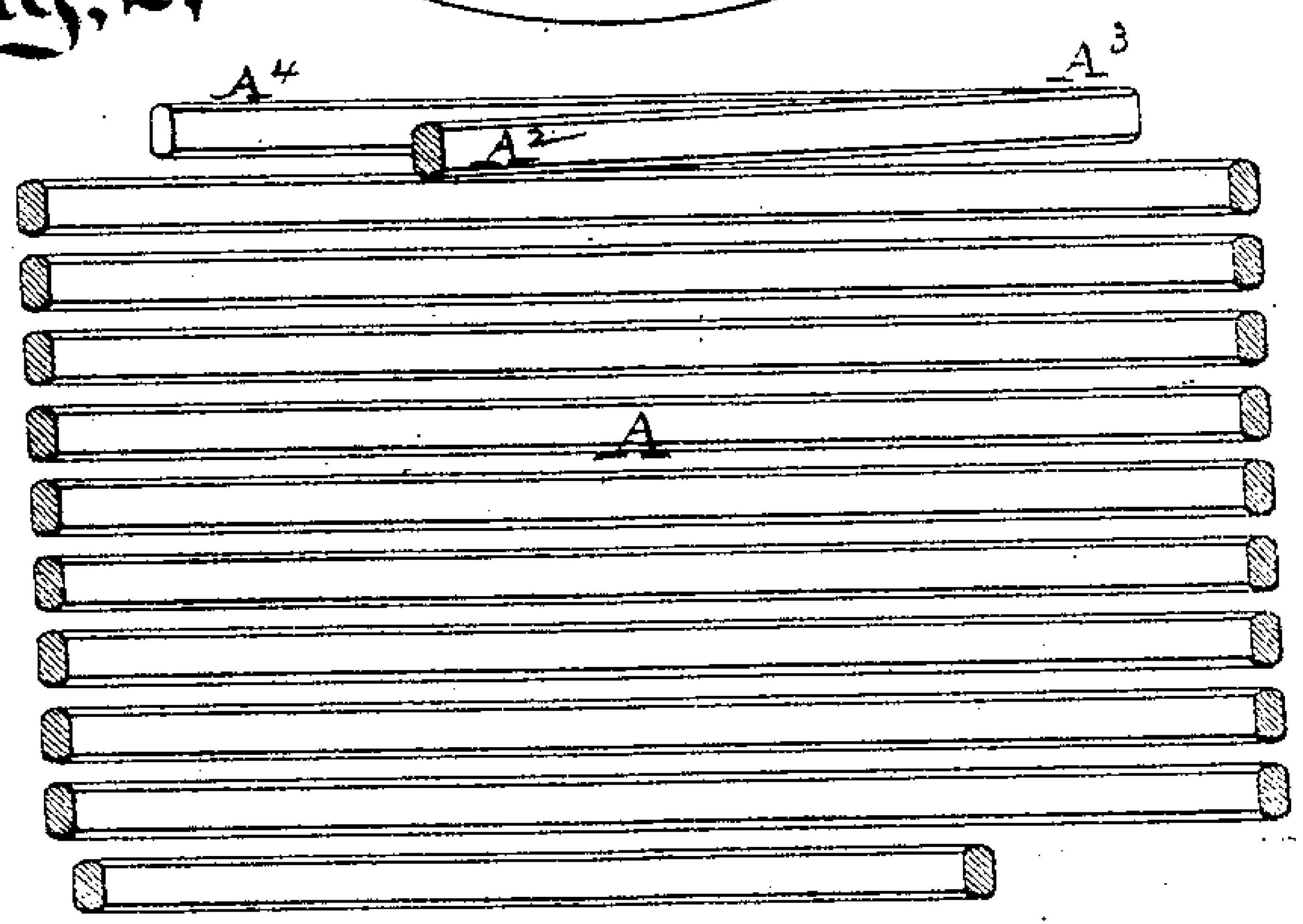
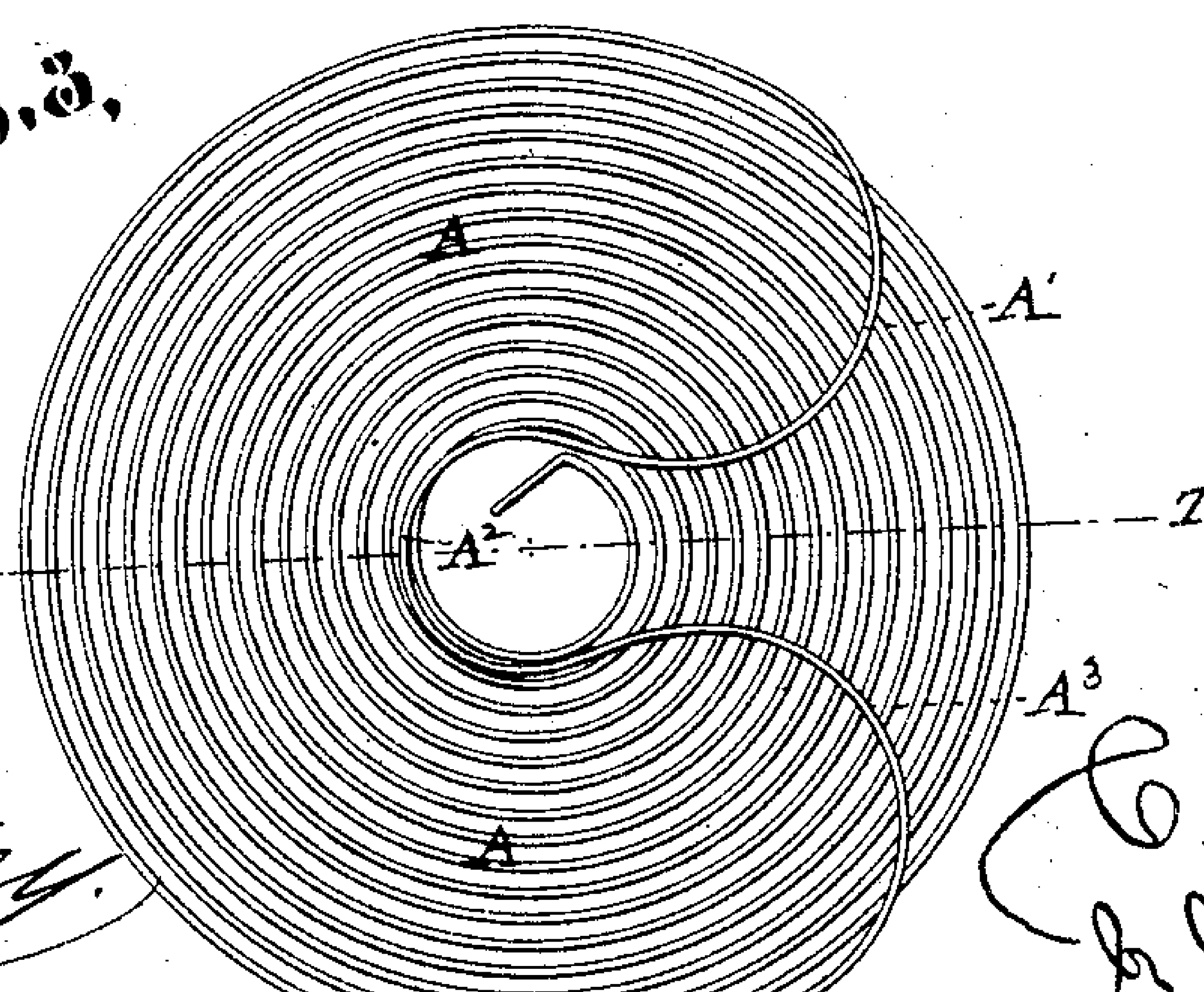


Fig. 3,



Witnesses,
Wm C. Dey
R. Roulston

Inventor,
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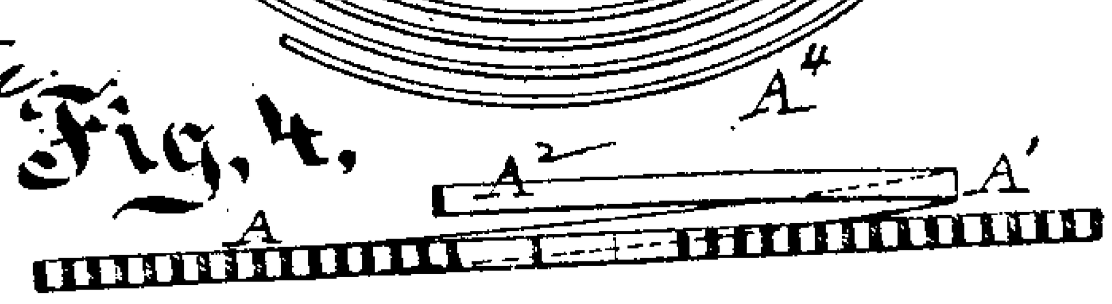
Fig. 4,



N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

United States Patent Office.

CALVIN KLINE, OF BROOKLYN, NEW YORK, ASSIGNOR TO HIMSELF AND GEORGE E. HART, OF NEWARK, NEW JERSEY.

Letters Patent No. 109,826, dated December 6, 1870.

IMPROVEMENT IN THE HAIR-SPRINGS OF WATCHES, &c.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, CALVIN KLINE, of Brooklyn, in the county of Kings, in the State of New York, have invented certain new and useful Improvements in Pendent-Springs or Hair-Springs for Chronometers and other time-keepers; and I do hereby declare that the following is a full and exact description thereof.

My invention relates to the form in which the spring is bent, either before or after the tempering. It insures a more equable action in all parts of the metal, and when properly carried out it gives almost or exactly perfect isochronism.

It has long been a desideratum to so adjust watches and time-keepers generally that, however the force of the main-spring may vary, or however the friction or other resistance may change from the evaporation or hardening of the lubricating material, or from the accumulation of dust or the like, the amount of oscillation of the balance or escapement-shaft may vary without in the least degree changing the time in which it completes a vibration.

I will proceed to describe what I consider the best means of carrying out my invention, and will afterward designate the points which I believe to be new therein. The accompanying drawing forms a part of this specification.

Figure 1 is a top view of a helical, or what is generally known as the chronometer style of spring, constructed according to my invention;

Figure 2 is a section on the line S S, in fig. 1;

Figure 3 is a top view of a flat spring, so called, the style commonly used in moderate-priced watches, constructed according to my invention; and

Figure 4 is section of the same on the line T T in fig. 3.

It will be understood that all the other parts of the mechanism may be as usual, and that my spring is attached to a fixed stud at one end, and to the vibrating shaft at the other, and that neither of the fastenings is represented.

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

A is the main body of the spring. The manufacture of the wire and its tempering may be conducted in the ordinary or any suitable manner. I prefer to give the spring, prior to the hardening, the exact form which it is to maintain when at rest. The usual method may be followed in coiling, with the exception of a portion near the end.

This portion I will designate A^1 A^2 A^3 A^4. The last part, A^4, is bent to agree with the curvature of the main portion A. The intermediate portions, A^1 A^2 A^3, extend across the spring, but not in a right line. The curvature of the parts A^1 A^3 is in the same direction as that of the main portion A, but is a quicker curve. The part A^2, which lies near the axis of the entire spring, has a curvature in the reverse direction.

My spring is adapted to be mounted in the ordinary manner, one end being fixed, with or without adjustability, to the escapement-shaft, or to a collar fitting tightly thereon, and the other end being fixed adjustably in the usual style, not represented.

The portion A^4, which corresponds in curvature and in position with the main body A, should be sufficiently long to allow adjustment forward and backward in the stud. It should, also, in case it is intended to apply the ordinary regulator, be made sufficiently long to allow, also, for that.

The connection of the stud and the regulator to the portion A^4, may be in the ordinary manner, the same as if the peculiarly curved portion A^1 A^2 A^3 was not present, and need not be minutely described.

Shifting the spring forward and backward in the stud has two entirely distinct effects. One is the ordinary effect, to make the watch go faster or slower, generally, in all conditions. This may, however, be counteracted by correspondingly changing the time-screws. Another effect is to change the condition with regard to isochronism.

It is important to understand that with my improved spring the spring must not be moved backward or forward in the stud to make the watch go faster or slower. The changes in that respect, to wit: the general change of the watch, so that under all conditions it will go faster or slower, must be made by screwing in and out the time-screws.

These screws are not represented, but are perfectly familiar to makers and adjusters of watches and chronometers. The screws are fitted into the periphery, and there is usually quite a number. Screwing in one or more of these screws has the effect of contracting the effective diameter of the balance-wheel, and making the watch or chronometer go faster. Screwing out one or more of these screws will make the watch go slower.

I will describe the adjustment for isochronism of a first-class chronometer.

In putting together the parts of a chronometer having my improved spring, I mount the spring with the stud about in the middle of the portion A^4, and firmly secure it there. Now when the chronometer has run a little while, I adjust the time-screws until it keeps good time under ordinary conditions. I am ready now to commence adjustment with regard to its isochronous condition.

I test the chronometer in this respect by any of the ordinary means. I will assume that the watch is run for a time in densely compressed air. The increased resistance due to this cause reduces the amount of motion of the balance-wheel. If the watch is in perfect adjustment with regard to isochronism, this fact will make no difference in its rate of running

The intent of my invention is to effect this great desideratum. Sometimes it will be found on a severe trial that the chronometer is perfectly isochronous on the first trial, but usually the reducing of the extent of the vibrations will change its rate. In such case I adjust the spring forward and backward in the stud, and such adjustment has the effect to change its condition in regard to isochronism.

I may repeat, that the adjustment will, of course, also change its condition with regard to its ordinary rate of running. But this, it will be understood, must be compensated for by a readjustment of the time-screws. It is now important only to attend to the isochronous condition. When the spring has been shifted forward or backward enough to make the chronometer perfectly isochronous, the time-screws may be afterward adjusted to make the time faster or slower, until it is just right.

Springs will vary, however exactly they are shaped and tempered, and some specimens may require to be adjusted further forward or backward in the stud to induce a given amount of change in regard to the isochronous condition. In some instances very little change may be induced by a considerable adjustment, and in others even the effect will be the reverse of that usually observed. Ordinarily, however, the shortening of the spring will tend to make the chronometer go slower with the short vibrations. I should commence with the spring-adjusting on that theory. If the spring required adjustment the other way, on discovering this fact I adapt my adjustment thereto, and it will be well in such cases to record the fact to aid in future adjustments. In case the spring be found not susceptible of adjustment in this manner, it should be rejected and another of my springs substituted and submitted to the same process of adjustment.

It is unnecessary to state that the testing for isochronism may be conducted with almost equal facility by putting the chronometer in a vacuum or partial vacuum, in which case the extent of the vibrations of the balance-wheel will be increased. A chronometer may be subjected to both tests, if preferred. In practice, usually, the changes due to an evaporation or loss of the lubricating material and hardening of the same in very cold weather, or the accumulation of dust and analogous resistants, all tend to diminish the extent of the vibrations, and it is this condition which it is especially important to provide for; but a watch or chronometer having my spring, when once properly adjusted, will be absolutely isochronous under either condition; that is to say, whether the balance-wheel vibrates to a lesser extent or to a greater extent than that to which it is originally intended to work.

It will, of course, be understood that the adjustments of the chronometer for time, and for expansions and contractions by heat and cold, may be repeated before and after the adjustments which I have described for isochronism, and this may be repeated any number of times which is found to be expedient to secure the very highest possible degree of perfection in the final result.

I have given as definite instructions as I am able in regard to the practical carrying out of my invention, and have demonstrated by experiment its success. It may not be necessary to lay down any theory in regard to its action.

I am not prepared as yet to demonstrate the reasons for the advantages due to the chief novel feature of my spring, to wit, the reversed curve therein; but I have proved by trial that it has decided advantages. I believe that it contributes, by the novel manner in which it presents the material to induce a positive stiffness in that portion of the spring, so that the elasticity of the reversed portion and of the quickly-curved portions adjacent is not fully availed of in the short vibrations of the spring, and, therefore, the spring is practically short for the short vibrations.

When the vibrations are increased in extent, the spring winds and unwinds so much as to draw upon the elasticity of the short curved portions A^1 A^2 A^3, and under these conditions the spring is longer.

Instead of setting the spring in a stud with a pin, as usual, I prefer resting it in a clamp having its jaws curved to exactly correspond with the curvature of the adjustable portion A^4 of the spring. But this is not absolutely essential, and it may be preferred by most constructors to fit it in the usual stud, as above described.

In order to be exactly understood in regard to what is here termed the reversed curve, it may be remarked that the portion A^1 A^2 A^3 of my spring is curved in two directions; that is to say, the parts A^1 and A^3 are curved in one direction, the same as the main portion of the spring, and the part A^2 is curved in the opposite direction, and that the curves of all these parts A^1 A^2 A^3 are quicker, or on smaller radii, than the main portion of the spring. I believe that the proportions and relations represented are the best which are possibly attainable.

Although the relative radii of the curves may be varied within moderate limits, I deem it absolutely essential to success that the curves be reversed; that is to say, that the curve A^2 be in the opposite direction to those adjacent thereto.

I claim—

The adjustable pendent-spring for time-keepers herein described, having a reversed curve of small radius, with a sufficient length of spring beyond it, as shown by A^4, to allow the adjustment to be made on material having the ordinary curvature, all substantially as and for the purposes herein set forth.

In testimony whereof, I have hereunto set my name in presence of two subscribing witnesses.

CALVIN KLINE.

Witnesses:

WM. C. DEY,

THOMAS D. STETSON.