(No Model.)

# F. A. MILLS & T. A. MOSSOP.

## COMPENSATING PENDULUM.

No. 257,177. Patented May 2, 1882.

FIG. 1

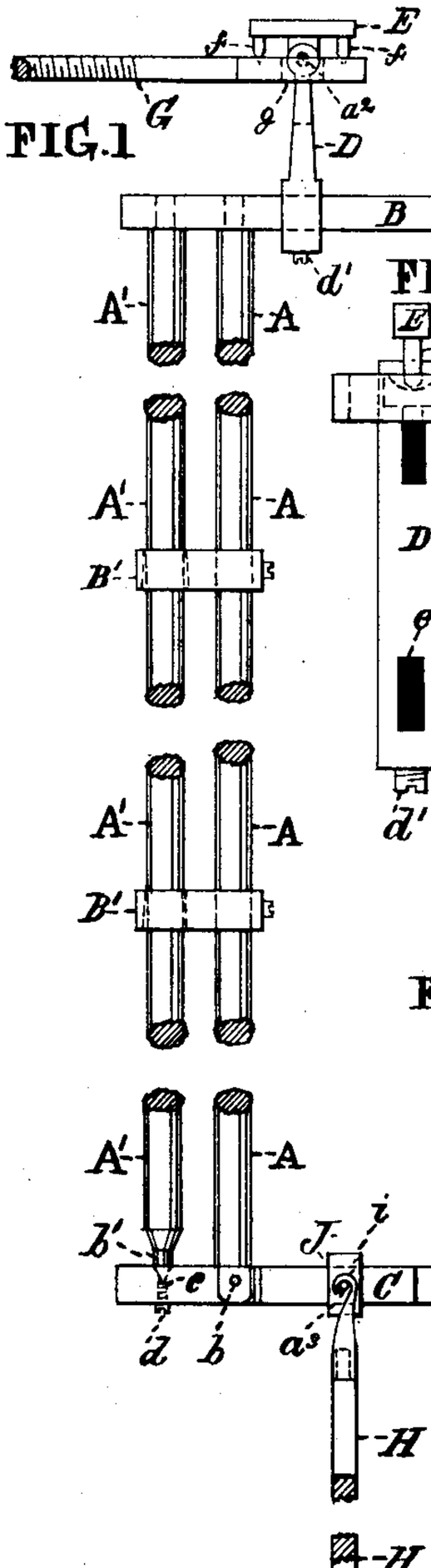



FIG. 6

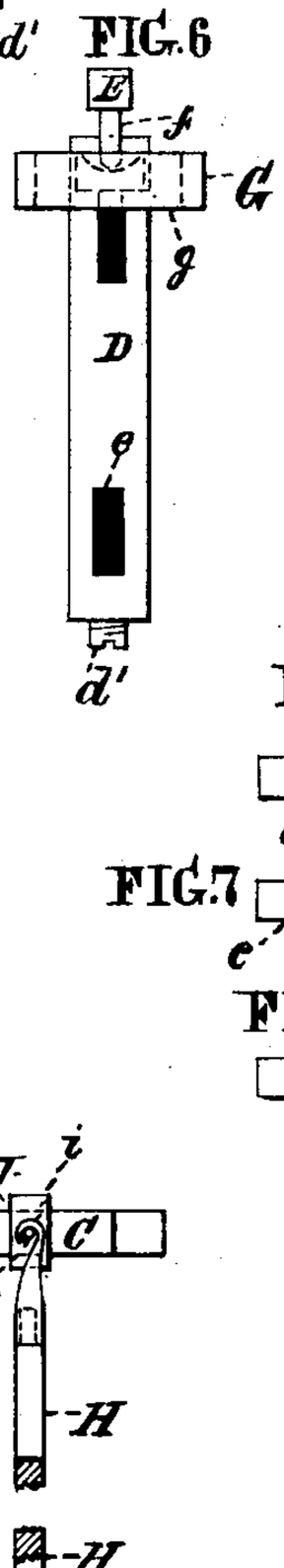



FIG. 3

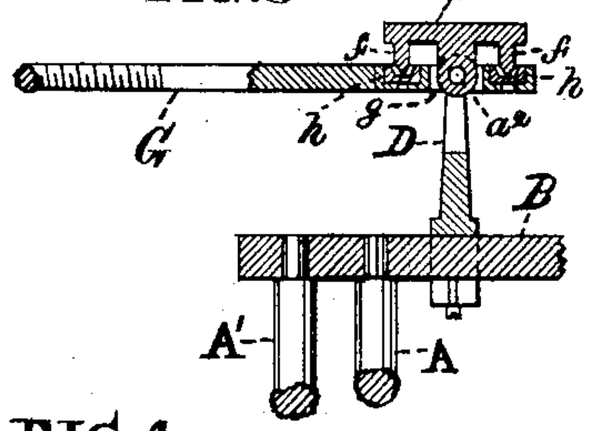



FIG. 2

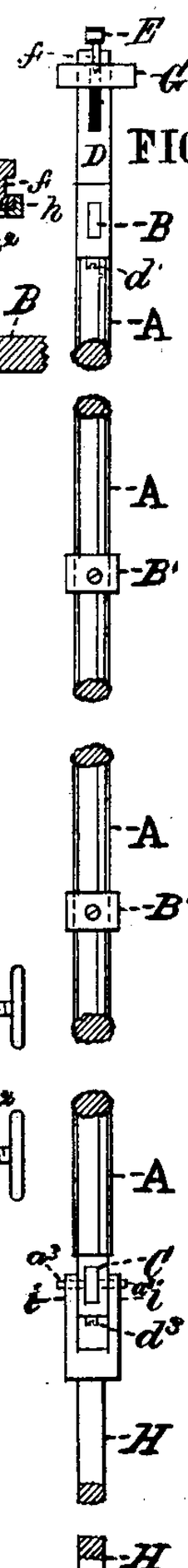



FIG. 4

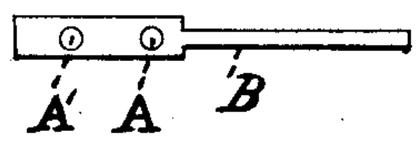



FIG. 5

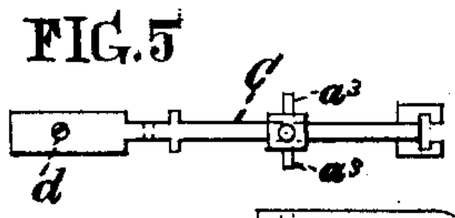



FIG. 7

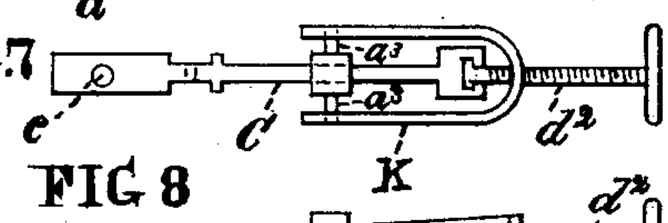



FIG. 8

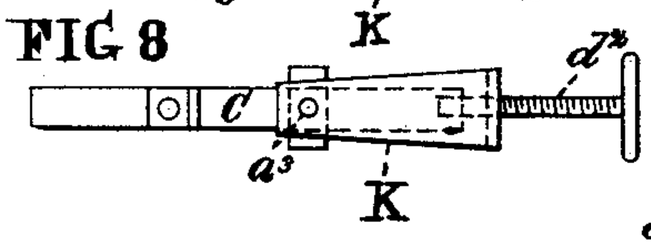
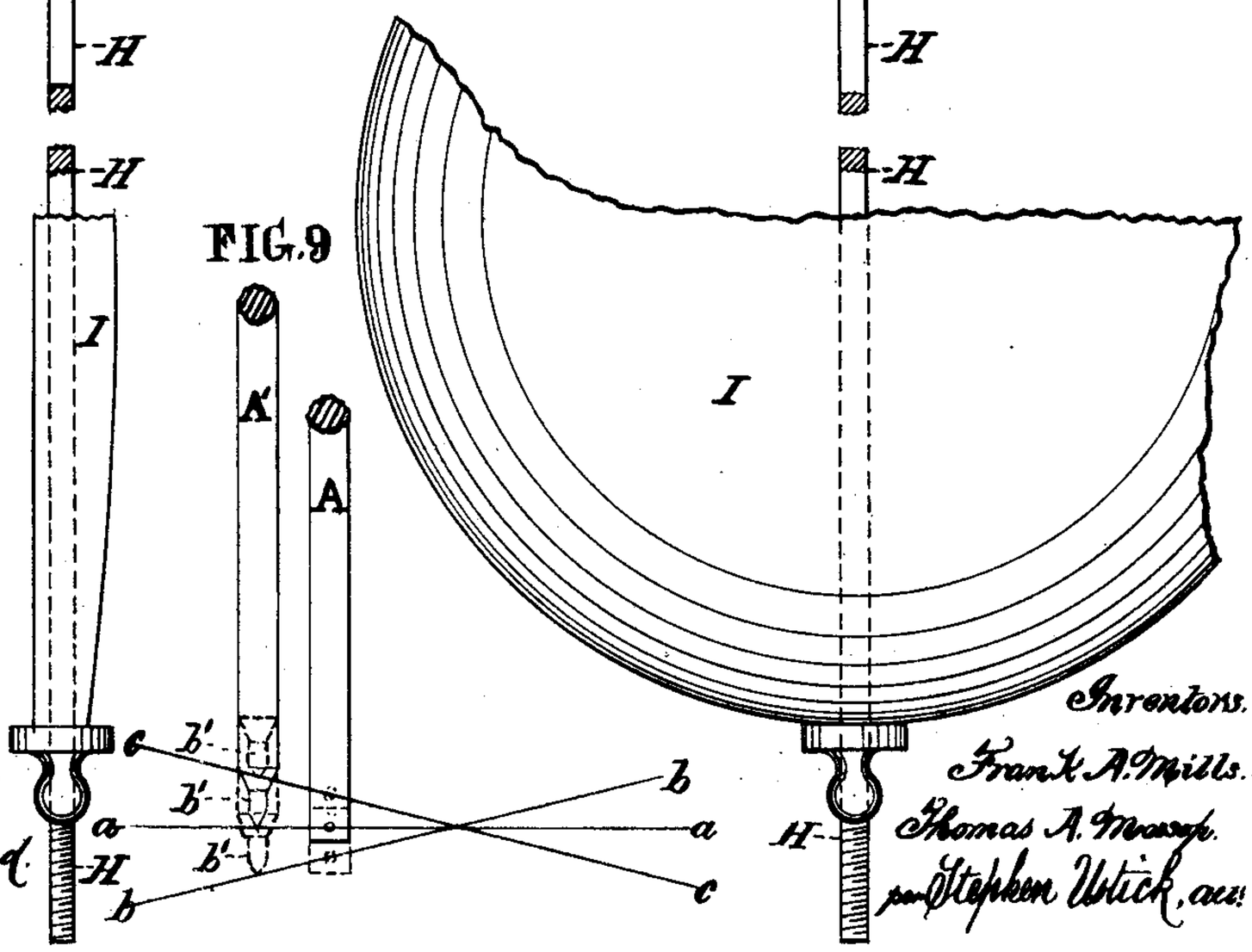









FIG. 9

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# UNITED STATES PATENT OFFICE.

FRANK A. MILLS AND THOMAS A. MOSSOP, OF PHILADELPHIA, PA.

## COMPENSATING PENDULUM.

SPECIFICATION forming part of Letters Patent No. 257,177, dated May 2, 1882.

Application filed November 14, 1881. (No model.)

*To all whom it may concern:*

Be it known that we, FRANK A. MILLS and THOMAS A. MOSSOP, citizens of the United States, residing in Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Improvement in Compensating Pendulums, of which the following is a specification.

The principal object of our invention is such a construction of the pendulum as will cause the maintaining of its proper length under all the variations of temperature to which it may be subjected. Another object is such a connection of it with the suspension-bracket as will compensate for any variations of the latter from its normal horizontal position, thereby dispensing with a considerable amount of time and trouble incidental to the ordinary mode of making the connection, in which much difficulty is experienced in arranging the bracket with the requisite exactness for the correct oscillating of the pendulum; and the nature of our invention consists in the construction of what is technically called the "pendulum-rod" of two independent rods of unequal degrees of expansion and contraction, connected together in the manner hereinafter described, which rods we preferably have one of steel and the other of brass, and we combine with the said rods a lever and slide, to which the pendulum-bob is attached, as hereinafter described, whereby a further compensation is effected to insure the exact length required for the pendulum, and also to insure its perfect oscillation in the vertical plane of its point of suspension; and our invention further consists of a novel mode of connection of the pendulum with the suspension-bracket, which avoids the necessity of adjusting the bracket in an exact horizontal position, as is indispensable to the ordinary mode of connection.

As our invention is fully described in the body of the specification, a further description is omitted in this place.

In the accompanying drawings, which make a part of this specification, Figure 1 is a side elevation of our improved compensating pendulum. Fig. 2 is a front elevation of the same. Fig. 3 is a vertical section through the suspension-bracket G and parts immediately connected therewith. Fig. 4 is a top view of the double-rod part of the pendulum with upright D, slide J, and parts attached removed therefrom. Fig. 5 is a bottom view of the lever C. Fig. 6 is an end view of the bracket G, lever E, and upright D, on an enlarged scale. Figs. 7 and 8 are top and edge views of yoke K, screw $d^2$, lever C, and slide J. Fig. 9 is a diagram illustrative of the principle involved in the combination of rods A and A′.

Like letters of reference in all the figures indicate the same parts.

A represents a steel rod, and A′ a brass rod, firmly connected at the upper ends with the horizontal bar B and at their lower jointed to the compensating lever C. The end of the rod A is slotted and connected with the lever by means of the joint-pin *b;* and the rod A′ has a steel foot, *b′*, which connects with the step *c* in the tail end of the vertical adjusting-screw *d*, whereby the lever is adjusted to a horizontal position at a medium temperature of the rods A and A′.

The parallelism of the rods A and A′ is maintained by their flexible connection with the lever C during their expansion and contraction, and thus all strain upon them is prevented, and they freely expand and contract in the direction of their longitudinal planes, whereby the length of the pendulum is accurately preserved.

B′ B′ are braces connected with the rods A and A′ to preserve their parallelism with each other. The holes which connect with the steel rod A fit it snugly, and the rod is firmly connected therewith by means of set-screws, as shown in the drawings; but the rod A′ has a loose fit and the holes are somewhat enlarged at the lower side of the bars, as represented in Fig. 1, to admit of the rod moving slightly through them in accommodation to the unequal expansion and contraction of the two rods. The bar B is projected in front of the steel rod A and provided with an adjustable upright, D, which has a slot, *e*, in its lower end that has an easy fit upon the said bar B for the purpose of adjustment, the slide being confined, when adjusted, by means of the set-screw *d′*. With the upper end of the upright is connected the cross-head E by means of the joint-pin $a^2$.

Projected from the under side of the cross-head are pins *f f*, which are slightly rounded on their points, which are in line with the center of the joint-pin $a^2$. The head of the upright D is projected partly through the slot *g* of the suspension-bracket G, and the points of the pins *f f* rest in the agate steps *h h* of the bracket, which become the points of suspension of the pendulum, whereby it has a very sensitive movement and is free to assume its normal positions independent of any deviation of the suspension-bracket G from its normal horizontal position.

H is a supplemental rod with which the bob I is connected, and J an adjustable slide on the compensating lever C. The rod H is suspended by means of its hooks *i i* with the fulcrum-pins $a^3$ of the slide, and the slide is adjusted on the said lever the proper distance from the steel rod A by means of the screw $d^2$ and yoke K, with which the screw is connected, as seen in Figs. 7 and 8, so as to bring the rod H in line with the vertical plane of oscillation of the pendulum, and when so adjusted the slide is secured in its adjusted position by means of the screw $d^3$. The adjustment of the slide is made when the rods A and A′ are at a medium temperature, and the pins $a^3$, to which the rod H is connected, always remain the same distance from the point of suspension of the pendulum in the various degrees of expansion and contraction of the rods A and A′, as illustrated by the diagram, Fig. 9.

If different rods of the same kind of metal always possessed the same degree of expansion and contraction at a certain temperature, the exact position of the slide J could be determined without such trial adjustment; but as such is not the case, it being impossible to get two rods of the same density, and any variation in their density varies the degrees of expansion and contraction, and hence the slide has to be moved to find the exact position required, the fulcrum-pins $a^3$ of the slide J on the lever C being in range with the horizontal line *a a* at a medium temperature of the rods A and A′, and at the line *b b* when the rods are unequally expanded by a certain higher temperature, and at the line *c c* when they are contracted by a corresponding lower temperature, the lines always crossing each other at the same fulcrum-point; and other degrees of expansion and contraction of the rods A and A′ would of course produce the same result; and hence it clearly appears that by the combination of the two rods A and A′, of unequal degrees of expansion and contraction, and the compensating lever C, having an adjustable slide, J, the normal length of the pendulum will be accurately maintained in all of the various degrees of temperature to which the pendulum may be subjected.

We sometimes dispense with the supplemental rod H by making the rods A and A′ the whole length of the pendulum and connecting the bob I with the upper side of the compensating lever C in any convenient manner, the bob being perpendicular to the fulcrum of the lever.

We claim as our invention—

1. The combination of the joint-pin *a* and set-screw *d*, having a step, *c*, with the compensating lever C, and rods A and A′ for the horizontal adjustment of said lever, substantially as described.

2. The combination of the compensating lever C, having a slide, J, with the rods A and A′, by means of the joint-pin *a* and adjustable step *c*, the slide having fulcrum-pins $a^3$ and being adjusted by means of the screw $d^3$ and yoke K or other suitable device, substantially as described.

3. The supplemental rod H, having hooks *i i*, and provided with the bob I, in combination with the compensating lever C, having the adjustable slide J, provided with fulcrum-pins $a^3$ $a^3$, substantially as and for the purpose set forth.

4. The combination of the adjustable upright D with the bar B and cross-head E, having pins *f f* and joint-pin $a^2$, substantially as and for the purpose set forth.

5. The combination of the cross-head E, having pins *f f*, with the suspension-bracket G, having agate steps *h h*, which constitute the points of suspension of the pendulum, the cross-head being connected with the upright D of the pendulum by means of the joint-pin $a^2$, substantially as described.

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