(No Model.)

P. G. RUSSELL.

BALANCED THERMOMETER.

No. 292,764. Patented Jan. 29, 1884.

Fig. 1.

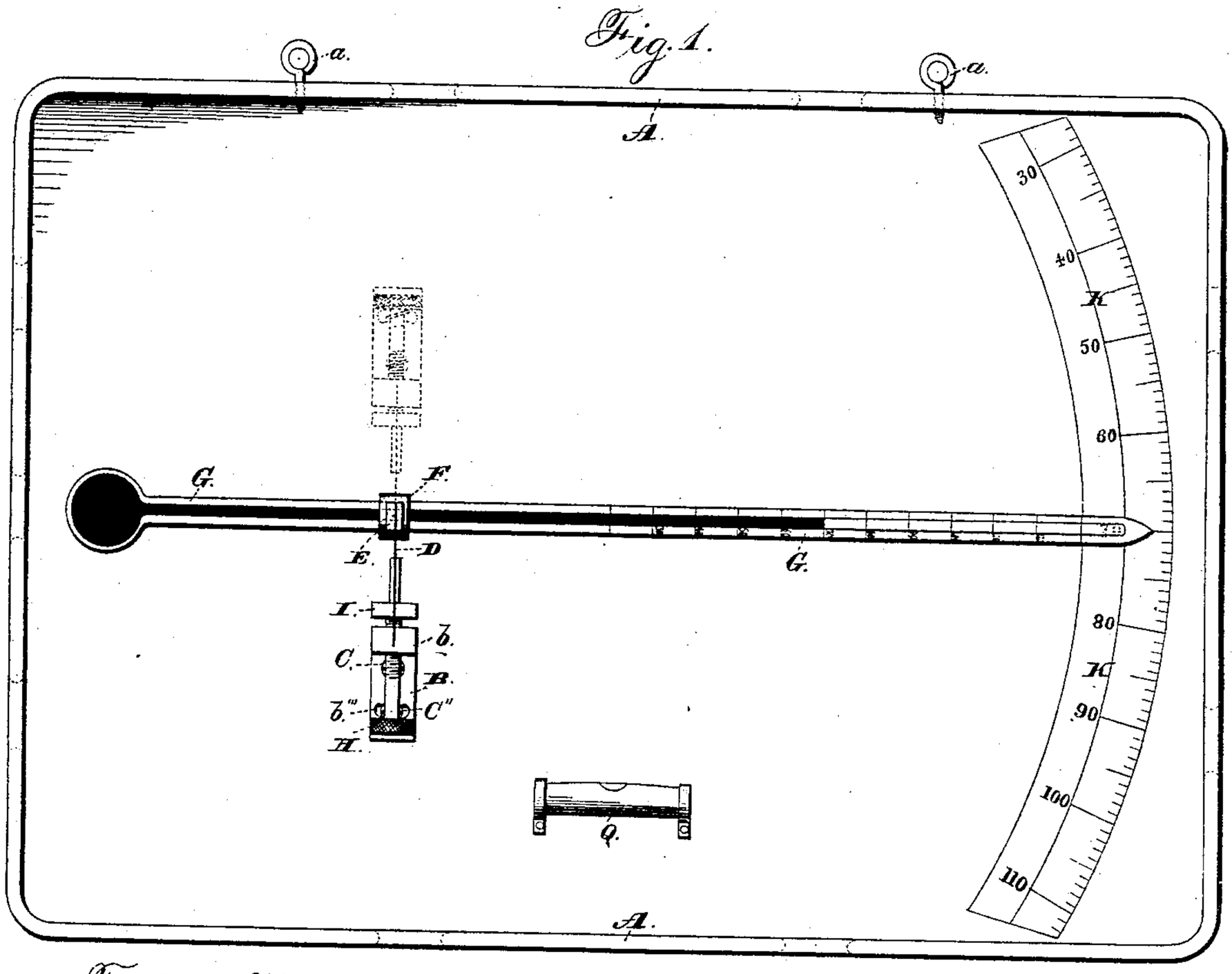

Fig. 2.

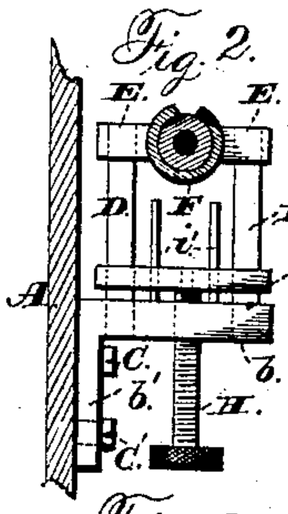

Fig. 2a.

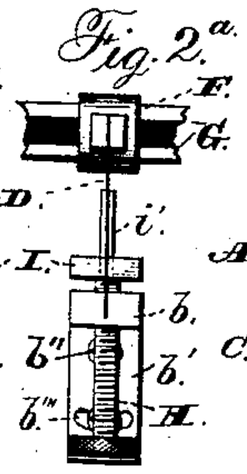

Fig. 3.

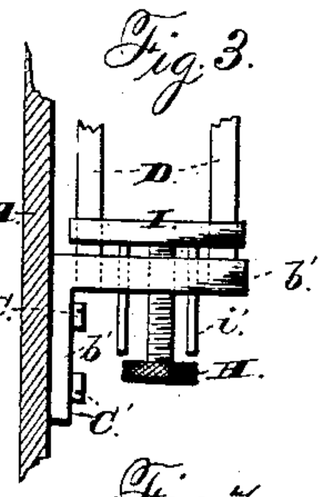

Fig. 4.

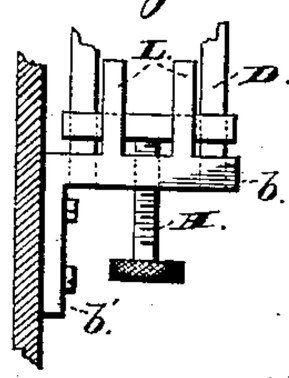

Fig. 4a.

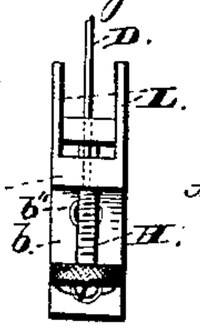

Fig. 5.

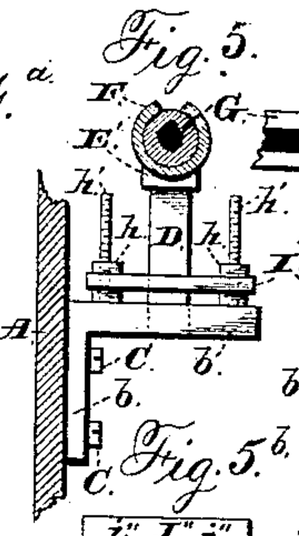

Fig. 5a.

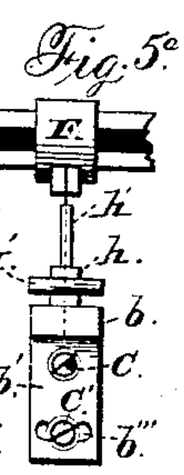

Fig. 5b.

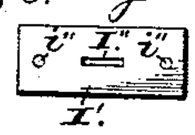

Fig. 6.

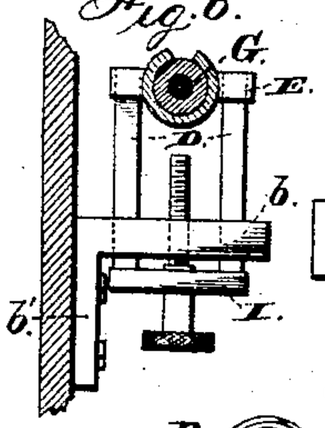

Fig. 6a.

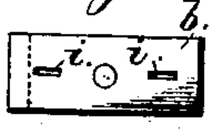

Fig. 7.

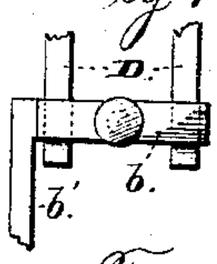

Fig. 7a.

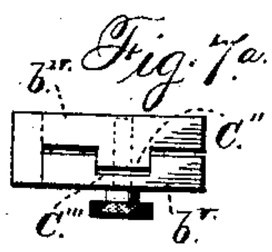

Fig. 8.

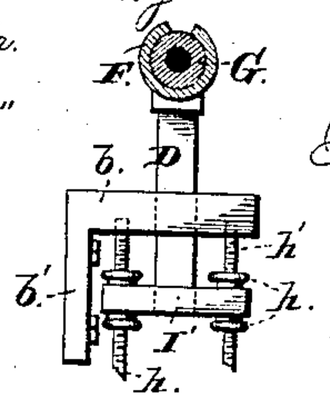

Fig. 8a.

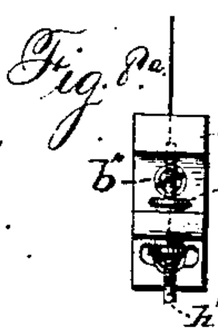

Fig. 10.

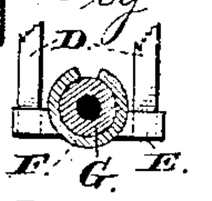

Fig. 9.

Fig. 11.

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N. PETERS. Photo-Lithographer. Washington. D. C.

UNITED STATES PATENT OFFICE.

PHILIP G. RUSSELL, OF WASHINGTON, DISTRICT OF COLUMBIA.

BALANCED THERMOMETER.

SPECIFICATION forming part of Letters Patent No. 292,764, dated January 29, 1884.

Application filed October 4, 1883. (No model.)

To all whom it may concern:

Be it known that I, PHILIP G. RUSSELL, of Washington, in the District of Columbia, have invented certain new and useful Improvement in Thermometers; 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 shows a view in front elevation of my improved balanced thermometer; Figs. 2 and 2ª, detail views, in side and front elevation, respectively, of the supporting and holding devices for the thermometer tube or bar, showing the form of adjustment for the stress of the fulcrum-springs; Fig. 3, a detail view, in side elevation, of the bracket and fulcrum-springs, with a modified form of adjusting device; Figs. 4 and 4ª, similar views, in side and front elevation, respectively, of a modified form of bracket and guide for the follower of the spring-adjusting device; Figs. 5 and 5ª, similar views of a modified form of spring-fulcrum, showing also the modified form of the tube-holding clamp and spring-adjusting devices to be used with this form of fulcrum; Fig. 5ᵇ, a detail plan view of the follower shown in Figs. 5 and 5ª; Fig. 6, a detail view, in side elevation, of a modified form of bracket and spring supporting and adjusting means; Fig. 6ª, a detail plan view of the bracket shown in Fig. 6; Figs. 7 and 7ª, detail views, in side elevation and plan, of a modified form of adjusting-support for the springs; Figs. 8 and 8ª, views in side and front elevation, respectively, of a modified means of supporting and adjusting the stress of the single spring form of fulcrum; Fig. 9, a detail plan view of the tube or bar holding clamp; Fig. 10, a detail side view of a modified form of the same, to be used when the springs forming the fulcrum for the tube or bar are suspended from above; and Fig. 11, a detail view, in front elevation, of a thermometer-bar to be used, as desired, in place of the tube.

The object of my invention is to provide an improvement in balanced thermometers; and to this end it consists in the construction, arrangement, and combination of parts, as hereinafter described, and specifically pointed out in the claims.

In the drawings, A designates the box or casing of my thermometer. This box is to be made of paper, wood, or metal. It is quite shallow, being just deep enough to allow of free movement of the thermometer tube or bar within it, and its front is preferably to be closed with a sheet or pane of glass. It is provided with suitable eyes or screw-staples, *a a*, by which it can be suspended. Where the front is closed by glass, openings are provided in the sides, as represented in dotted lines in Fig. 1, so as to admit of free access of air from without to the interior of the box.

Within the box and fastened to its back, as shown, is the bracket B, which consists of the horizontal part *b* and the vertical attaching portion *b'*. This latter portion is provided with a screw-hole at *b''*, through which screw C passes, and is driven into the back of the box, and near its lower end with a slot, *b'''*, through which screw C' passes, and is also screwed into the back of said box. With this arrangement and construction the bracket can be adjusted about the screw C as a center for the purpose and with the object to be hereinafter set forth. This bracket B is, as shown in Figs. 1, 2, and 2ª, adapted to receive and hold the ends of the thin leaf-springs D D, which, at their other ends are inserted and fastened in the horizontal arms E E, extending from the circular clamp F, adapted to receive and hold firmly and securely the thermometer-tube G. The bracket is preferably made of brass, as is the clamp F with its arms described above. The springs D D can be made of steel or brass, as desired.

Through the horizontal portion of the bracket works a thumb-screw, H, bearing upon the end which projects through said bracket between the springs a follower, I, which closely embraces one of the springs at each end in a slot, *i*, provided therefor, and is prevented from turning with the screw by pins *i' i'*, attached to arm *b* of the bracket, and passing through holes *i'' i''* in the follower. By means of this screw and follower, the stress of the springs against binding can be readily and nicely adjusted, for by moving the follower toward or from the ends of the springs, the portion of said springs which will be free to bend can be made shorter or longer. The mercury-thermometer tube G is preferably to be, as shown in the drawings, one with the graduation-marks on it. Such are common and well known in the market, and can be purchased

or made quite cheaply. I do not, however, limit myself to the use of such graduated tubes. The old form of thermometer-tube, without markings, or a bar of expansible metal, as shown in the drawings and as hereinafter to be described, can be used.

In dotted or broken lines in Fig. 1 is shown the spring-supporting bracket placed above the tube with the springs extending downward therefrom, and supporting the holding-clamp for the thermometer tube or bar at their lower ends. With the bracket and springs so arranged I prefer to use a slightly-modified form of clamp, as shown in Fig. 10, though no change in the form of clamp from that shown and already described is necessary. The clamp shown in the figure referred to has its arms, in which the ends of the springs are fastened in any desired way, extending out from its sides on a line below the horizontal line through the center of its curvature. A scale, K, is provided, as shown, curved to correspond with the curve of the arc of travel of the end of the thermometer tube or bar. This scale is provided with graduations corresponding with those on the tube, but covering much greater space. The manner of graduating this scale and its office in connection with the thermometer-tube will be explained hereinafter.

In the modification of bracket and spring-adjusting device shown in Fig. 3, the springs are arranged and held as in Figs. 2 and 2ª; but the follower-guiding pins are in this form attached to the follower and extend downward through holes provided therefor in the horizontal arm of the bracket. The form shown in Figs. 4 and 4ª is the same as that in Fig. 2, with the exception of the guides for the follower, which consist of the upward-projecting lugs or ears L L, which can be formed in one piece with the bracket-arm or made separately and fastened thereto. As shown, they do not extend through the follower, but bear against its sides.

In Figs. 5 and 5ª are shown still further modifications of the devices shown in the detail views already described. In this form a single-leaf spring is employed, fastened below in the bracket-arm *b* and above in the short ear or lug E′ on the bottom of the tube-clamp F. The stress of the spring against bending is regulated in this case by changing the length of the effective portion of said spring by raising or lowering the follower I′ and setting it at any point of its possible vertical movement by means of the nuts *h h* on the screw-threaded fixed pins *h′ h′*. The follower, as shown in the detail plan view of the same in Fig. 5ᵇ, is provided with a central slot, I″, through which passes the fulcrum-spring D′, and with two small holes, *h″ h″*, through which pass the pins *h′ h′*, fixed on the bracket-arm *b*.

In Fig. 6 is shown a further modification of the bracket, springs, and adjustment for the latter. As shown in Fig. 6ª, the arm *b* of the bracket is in this case provided with two slots, through which the springs D D pass. These springs, at their lower ends, are fixed in the follower, and are supported entirely thereby. The adjusting-screw H, tapped through the bracket, affords ready means of moving the follower up and down, so that the length of the effective portions of the springs above the bracket-arm *b* can be adjusted and the position of the thermometer tube or bar supported on such spring be changed vertically, as desired.

In the modified form of supporting-bracket shown in Figs. 7 and 7ª, the arm *b* of said bracket is made in two parts, b^{IV} and b^{V}, divided on a vertical plane. The part b^{IV} is in one piece with or rigidly attached to the upright attaching portion *b′*. Its middle portion is provided with a squared enlargement, C″, which exactly fits the recess C‴ in the other movable half of the bracket-arm. A screw passing through the central portion of the latter half, as shown, and into the other part, b^{IV}, serves to hold the parts together. Between the two halves of the bracket-arm are clamped, as shown, the lower ends of the tube-supporting leaf-springs. With this arrangement the lengths of the effective portions of the springs above the bracket-arm can be changed and adjusted by loosening the screw, sliding the springs up or down, and tightening the screw again, so that they are held firmly between the halves of arm *b*.

In Figs. 8 and 8ª are shown adjusting devices for a single supporting leaf-spring—such as is shown in Fig. 5—when said spring extends down through the bracket-arm, as do the springs shown in Fig. 6, already described. The follower in this case supports the lower end of the spring, and is moved up and down on the screw-threaded guide-pins *h′ h′* by means of the nuts *h h* on the pins.

In Fig. 9 is shown a plan view of the tube or bar holding clamp, and in Fig. 10 is shown a modified form of the same in end elevation. This latter form is intended for use where the fulcrum-springs are held from above by the bracket, and support the clamp on their lower ends.

The thermometer-bar shown in Fig. 11 is intended for use where desired, instead of the tube already described. It consists of the long arm M, of material which is very sensitive to changes in temperature, and which will expand and contract readily and to considerable extent under the influence of heat and cold. The portion N of this bar on the other side of the point at which the supporting and holding clamp is situated is to be made of material as little as possible affected by heat and cold. As shown, this portion is to be much shorter than the long arm M, and a weight, O, is provided to counterbalance the long arm. This weight can be adjusted toward or from the fulcrum by turning it in one direction or the other upon the screw P, upon which it is threaded. A small spirit-level, Q, can be provided, if desired, attached to the box, as shown in Fig. 1, to show when the box

is properly supported with its upper and lower edges horizontal. The division-lines on scale K are, as indicated above, numbered to correspond with the numbering of the graduation-marks on the tube. The scale is so graduated that the line marked with any number will indicate the position of the end of the thermometer-tube when the temperature of the surrounding air is of the degree corresponding with such number. For instance, when the temperature is 90°, the mercury in the tube will be at the 90° point of the graduations on the tube, and the end of the tube will point to "90" on the scale. The tube is caused to tilt up and down from a horizontal line against the stress of the fulcrum-springs, by the contraction and expansion of the mercury in the tube, and the consequent throwing of the tube and its contents out of balance with respect to its fulcrum. The distance to which the end of the tube travels above or below the horizontal line of course depends upon the amount of contraction or expansion of the mercury in the tube and the consequent amount of weight transferred from the portion of tube on one side of the fulcrum to that on the other side thereof. With the pivoted balanced thermometer heretofore used no two thermometer-tubes were likely to be so nearly alike that the same scale would do for both, to indicate properly and exactly the points at which the end of the tube would come to rest when the mercury within it was influenced by temperature of a certain degree. With the spring-fulcrum as used by me, however, with the adjusting means for the same, and the supporting-bracket, the stress of the spring or springs can be regulated easily and quickly to suit any tube, and the same scale will do for any and all tubes. The great objection to the balanced thermometers now on the market is therefore avoided with my construction. The tube or bar used can also be adjusted longitudinally in the clamp F or F'. The thermometer is to be adjusted before being put on the market, and the right length of the portion of the tube to be on one side of the clamp is to be indicated by a small notch or mark on the tube itself. The proper adjustment of the follower upon the spring or springs can also be indicated by a mark on the latter. When, then, my thermometer is to be packed for transportation, the tube or bar can be slipped out of its clamp and packed separately, and, if desired, the follower can be adjusted upon the springs so as to hold and protect them from all possible injury or disarrangement by shocks or jars in handling the boxes.

The follower and adjusting-screws can obviously be made of metal which will expand enough to compensate for the expansion of the springs under the influence of heat, so that the effective or free portion of the springs above such followers will always be of the same length, and I contemplate so constructing them, if desired.

With the forms shown in Figs. 6 and 8 such construction of the adjusting devices would be very advantageous, for the clamp for holding the tube or bar would be always maintained at the same point vertically, and the stress of the spring against bending would be at the same time maintained constantly the same. Where the bracket is placed above, as indicated in dotted lines in Fig. 1, the supporting spring or springs can be made much more delicate than is possible with the other arrangement.

As is evident, the various other forms of brackets and springs, with their adjustments shown and described, can, by simple inversion and without change, be used where the tube-clamp is to be supported from above, as well as the form of the same shown in Fig. 1. If cheapness is especially desired, and great accuracy and delicacy in the indications of temperature are not sought for or found necessary in any case, the adjustments shown and described can, of course, be omitted.

When the bracket is attached to the box, as shown, by the two screws, one passing through a hole in the upright portion of the bracket, and the other through the curved slot in said portion, the bracket can be adjusted upon the former screw, as a pivot, so that the fulcrum spring or springs attached to the bracket can be swung and adjusted in a plane parallel to the back of the box, so as to be in or as near as desired to a true vertical plane.

Instead of the leaf spring or springs, as already described, for supporting the tube or bar holding clamp, the spring-fulcrum may obviously consist of a torsion-spring adapted to resist with yielding force the tilting of the tube or bar. This may either be a narrow leaf-spring or a spring-wire supported and held at or near each end in an arm or standard attached to a bracket like that described hereinbefore. These arms or standards are attached to the bracket at the inner and outer ends of the horizontal part thereof, and extend perpendicularly to this arm, either above or below it. The ends of the torsion-spring are attached to these arms at or near their ends, so that said spring will be horizontal. Fixed to the middle portion of the spring is the tube or bar holding clamp. I contemplate, where it is found desirable, providing the standard-arms with means for receiving and holding the ends of the spring, which shall be capable of being turned in or on said arms on a horizontal axis, so that the torsion of the spring can be adjusted as desired in adjusting the thermometer to indicate the degrees of temperature properly on the scale.

As a means for regulating the tension of the spring, a screw is to be tapped through one of the arms and to bear against the inside of the other; or it can be tapped through one arm, and attached at its end to the other by means of a connection which will allow said end to turn in the arm, but have no longitudinal movement therein. By this screw the arms can be sprung farther apart or brought nearer to-

gether, to adjust the tension of the spring to suit any particular tube or bar, so that the index end of said tube or bar will rightly indicate the temperature on the scale. With this form of adjustment the change in length of the torsion-spring under the influence of change in temperature is compensated for, and the tension of said spring is maintained substantially the same. When under the influence of an increase of temperature, the spring becomes longer, so that its tension would be less if the standard-arms remained fixed the same distance apart as before. The screw also is lengthened, and forces the ends of the arms farther apart. By this means the tension upon the spring will obviously be kept at all temperatures substantially at the point to which it was adjusted by the turning of the screw.

Where great accuracy is desired, the screw can easily be made of such material and length as to exactly counteract or compensate for the expansion or contraction of the torsion-spring, caused by changes in temperature.

The spring can be made in one piece extending from one standard-arm to the other, and the clamp supported upon or from it; or it can be made in two parts, each of which is attached at one end to a standard, and at the other to the clamp.

Having thus fully set forth the nature of my invention, what I claim is—

1. In a balanced thermometer, the holder adapted to receive and hold a thermometer tube or bar, and supported upon a spring-fulcrum suitably supported from the thermometer box or casing, substantially as and for the purpose set forth.

2. In combination with the clamp or holder adapted to receive and hold a thermometer tube or bar, a flat spring-fulcrum suitably supported at one end from the thermometer box or casing, and at the other fastened to the clamp, substantially as and for the purpose set forth.

3. In combination with the thermometer-tube, the spring-fulcrum supporting it and tending to keep it normally horizontal, and a suitably-graduated scale for measuring the deviation of the tube from its normal position, substantially as and for the purpose set forth.

4. In combination with a thermometer-tube supported by and rocking on a spring-fulcrum tending to resist such rocking, a scale suitably placed and graduated to indicate the different points at which the end of the tube will come to rest as such tube is caused to rock against the stress of its spring-fulcrum by the expansion and contraction of the contents of the tube under the influence of different degrees of temperature, substantially as shown and described.

5. In combination with the thermometer-tube, the spring-fulcrum therefor supported in a suitable bracket, substantially as and for the purpose described.

6. In combination with the spring-fulcrum provided at one end with means for receiving and holding a thermometer tube or bar, and supported at or near the other in a suitable bracket, means for adjusting the stress of said spring-fulcrum against bending, substantially as and for the purpose described.

7. In combination with the spring-fulcrum for a balanced thermometer, the bracket supporting the fulcrum, the supporting-screw passing through the vertical portion of the bracket and attaching it to the thermometer-inclosing box, and means for adjusting the bracket upon this screw as a pivot, substantially as shown and described.

8. In combination with the spring-fulcrum for the thermometer tube or bar, the bracket to which the fulcrum is fastened, the screw passing through the upright portion of the bracket and serving to attach it to the thermometer-inclosing box, the curved slot in this upright portion, and the screw passing through this slot and into the support for the bracket, substantially as and for the purpose set forth.

9. In combination with the spring-fulcrum for a balanced thermometer, automatic means for compensating for the expansion and contraction of such fulcrum under the influence of heat and cold, whereby the length of the effective portion of the spring or springs forming the fulcrum, and consequently the stress of such spring or springs, against the tilting of the thermometer tube or bar will be maintained substantially unchanged by any change in temperature, substantially as shown and described.

10. In combination with the spring-fulcrum for a balanced thermometer, means for adjusting the stress of such fulcrum against the tilting of the thermometer tube or bar, and for automatically compensating for changes in the length of the spring or springs forming such fulcrum under the influence of changes in temperature, whereby the stress of the spring-fulcrum will be maintained constantly at substantially the point to which it is adjusted, substantially as and for the purpose set forth.

11. In a balanced thermometer, the supporting-bracket, the flat springs fastened to and extending from the horizontal arm of the bracket, and attached at their other ends to a clamp or holder for the thermometer-tube, in combination with the screw working through the horizontal arm of the bracket, and carrying on its end a follower guided on suitable guide-pins and embracing the springs in slots provided therefor, substantially as and for the purpose set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 4th day of October, A. D. 1883.

PHILIP G. RUSSELL.

Witnesses:
HENRY C. HAZARD,
JAS. E. HUTCHINSON.