W. JANDUS.

THERMOMETER.

APPLICATION FILED NOV. 2, 1906.

969,106. Patented Aug. 30, 1910.

2 SHEETS—SHEET 1.

FIG. I.

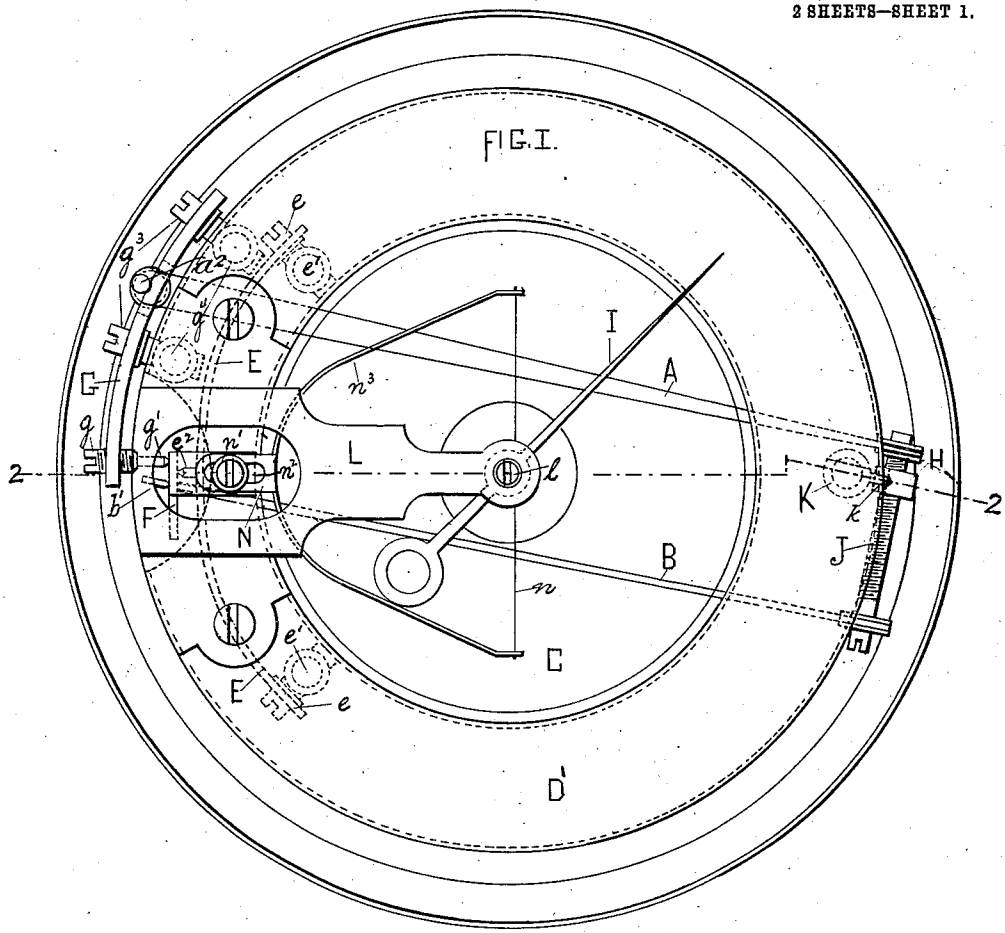
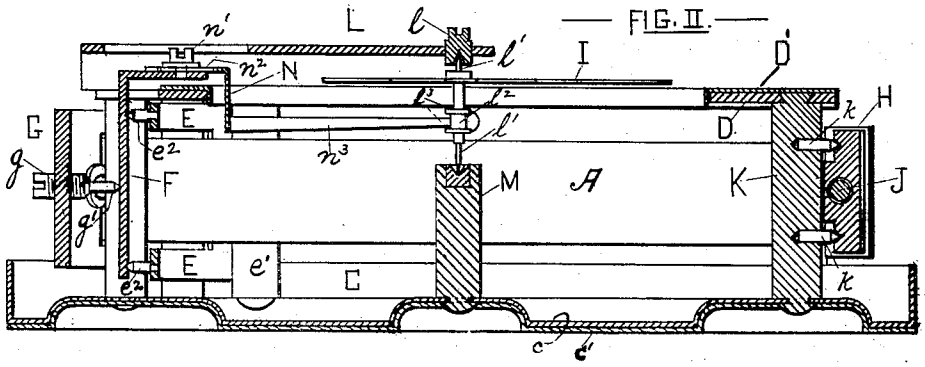


FIG. II.



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2 SHEETS—SHEET 2.

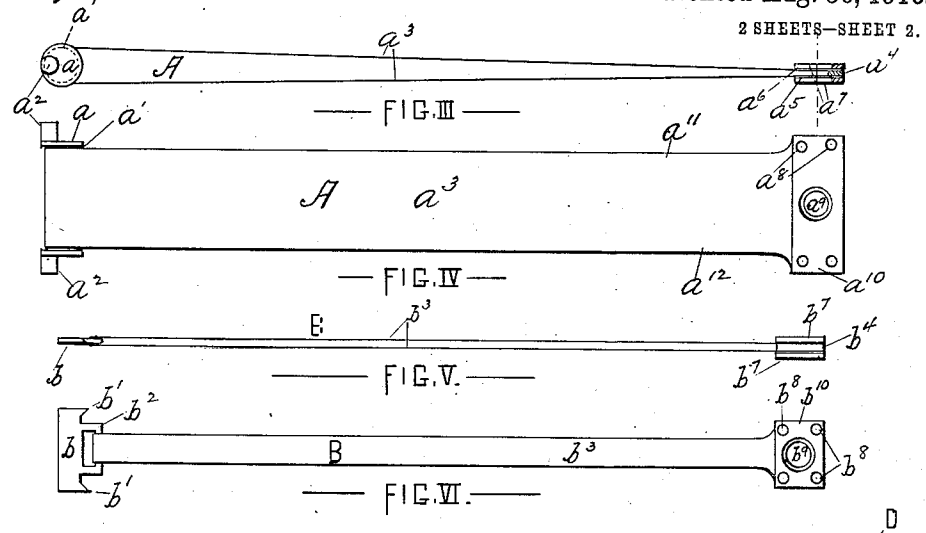

FIG. III

FIG. IV

FIG. V

FIG. VI

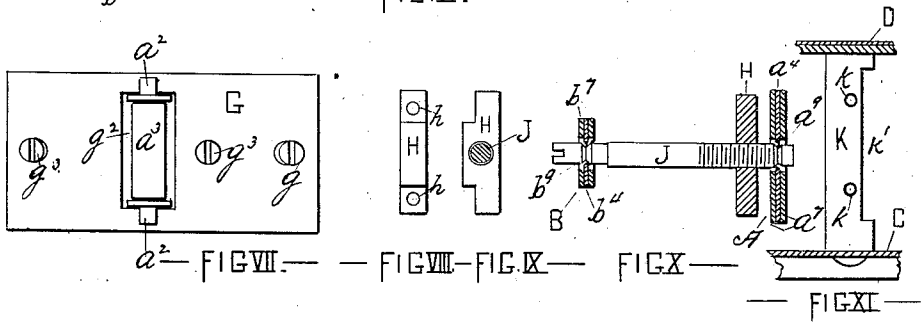

FIG. VII — FIG. VIII — FIG. IX — FIG. X — FIG. XI

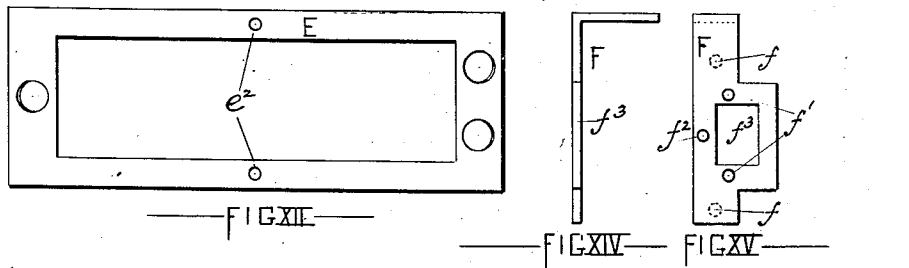

FIG. XII — FIG. XIV — FIG. XV

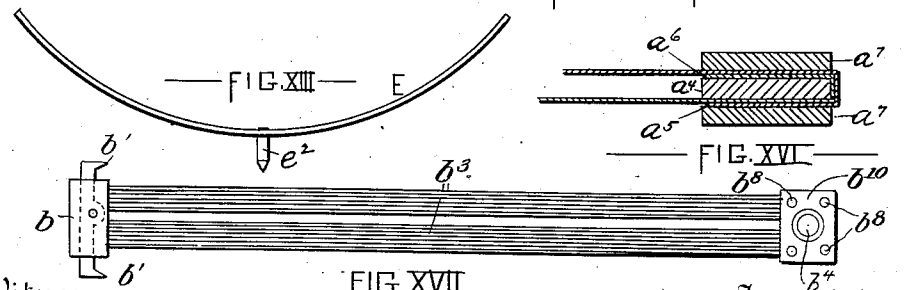

FIG. XIII — FIG. XVI

FIG. XVII

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THERMOMETER.

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Application filed November 2, 1906. Serial No. 341,709.

To all whom it may concern:

Be it known that I, WILLIAM JANDUS, a citizen of the United States, resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Thermometers, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

My invention relates to thermometers and particularly to a device of that kind in which the temperature element comprises a thin ribbon or a plurality of thin wires of a metal, such as aluminum, which is of high coefficient of expansion and very sensitive to changes of temperature.

The great subdivision of the metal which is used and the consequent extreme thinness of the same are very important features as contributing to the success and value of my invention. Many of the structural features of said invention are identical with or similar to those used for the same purposes in my invention in electro-metric appliances, which is shown and described in my pending application for United States Letters Patent, Serial No. 311,853, filed April 16, 1906: as, also, my invention in hygrometers, which is shown and described in my pending application for United States Letters Patent filed even date herewith.

Said invention in thermometers consists of means hereinafter fully described and specifically set forth in the claims.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings: Figure I represents a plan view of a thermometer embodying my invention; Fig. II represents a vertical section of the same, taken upon the planes indicated by the lines 2—2, Fig. I; Fig. III represents a plan view of one of the temperature elements, one end thereof being shown partially in section; Fig. IV represents a front elevation of such temperature element; Figs. V and VI represent, respectively, a plan view and a front elevation of the other temperature element; Fig. VII represents an elevation of the left-hand end of my invention; Figs. VIII and IX represent, respectively, front and side elevations of an oscillatory member pivoted upon the right-hand end of the thermometer intermediately of the right-hand ends of the two temperature elements, a cross-section of a bolt J adapted to have screw-threaded engagement with said member being shown in Fig. IX; Fig. X represents a partial vertical section of the right-hand end of the thermometer taken centrally and longitudinally of said bolt J which can be utilized to vary the distances between the two temperature elements A and B, respectively, and the pivoted member H shown in Figs. VIII and IX; Fig. XI represents an elevation of a post upon which said memoer is pivoted, as, also, broken sections of a top annular disk and the frame; Figs. XII and XIII represent, respectively, a front elevation and a plan view of a spring member upon which is pivoted the oscillatory plate F controlling the actuation of the indicating needle; Figs. XIV and XV represent, respectively, side and front elevations of such plate which pivotally carries one end of one of the temperature elements; Fig. XVI represents a broken enlarged sectional view of the right-hand end of the element A and Fig. XVII is a front elevation of a temperature element as illustrated in Fig. VI but using wires instead of tape.

I provide two temperature elements A and B, they being shown herein as bands or ribbons of thin metal, preferably aluminum, although it may be advisable, and I think probably preferable, to use a plurality of thin wires of some metal having a high coefficient of expansion, so that it will absorb and radiate the heat very quickly and thus render possible a quick reading.

The frame C of the structure is compensated for as to temperature, so that the operating differential in this instrument exists between the temperature elements A and B and the neutral frame C. There are various ways in which such compensation of the frame structure may be effected, that shown in Fig. I. being chosen for its simplicity merely, since the particular mode of effecting the compensation, *per se*, does not constitute a part of the present invention. In the mode thus illustrated the frame is composed simply of two superposed plates *c c'* having unlike coefficients of expansion, the relative rates of expansion being such that the more readily expansible metal will

cause the less readily expansible one to bulge in amount sufficient to take up or counteract the movement that would otherwise result. An annular disk D supports the mechanism adapted to actuate the indicating needle, and itself rests upon several uprights in the frame C, which uprights support various other elements of the device as hereinafter fully described.

A dial-plate without graduations is shown at D'; a spring-plate E is adjustably secured by screws e in posts e', two of said screws being provided upon one end of said plate, Fig. XII, so that it may be rigidly maintained in the proper vertical position. Said spring-plate E is further provided with pivotal pin-bearings e^2 upon which is adapted to oscillate a plate F, provided with bearing recesses for said pin-bearings e^2, also with bearing recesses f' for one end of the temperature element B and with a single bearing-recess f^2 for a pin-bearing g' carried upon a screw g secured through a plate G, which latter is adjustably supported by means of screws g^3 in posts g^4 mounted in the frame C. The temperature element B is provided at its left-hand end b with pivotal bearing-points b', which are adapted to engage the pivotal recesses f' of the oscillatory plate F, as plainly shown in the drawings. The temperature element A is provided at its left-hand end a with an axial portion a' upon which are eccentrically mounted two projecting circular lugs a^2, which are so secured in suitable grooves Fig. 1 in the plate G that they may turn or roll therein, but have no lateral motion lengthwise of said plate G. Upon the left-hand ends of both the temperature elements A and B the redoubled ribbons of metal are passed around the axial portion a' and through an eye b^2, respectively, so that said ribbons act as belts and are free to adjust themselves for even tension on these supports, the free terminals of said ribbons being fixedly held together at the other or right-hand ends of the latter, (Fig. I).

Upon the right-hand side of the instrument, Figs. I and II, is secured in the frame C a post K, upon the outer surface of which is pivoted a member H by means of pin-bearings k secured to said post and pivotal recesses h provided in said member H. The right-hand ends of the two temperature elements A and B are adjustably secured on the bolt J, said bolt passing through the member H, oscillating on the fulcrum pins k, the distances of the right-hand ends of the temperature elements A and B, respectively, from said fulcra determining, as will be seen, the respective leverages of said elements A and B upon said member H, the whole acting as a differential lever. The manner of securing together the free terminals of the thin ribbons of metal a^3 and b^3 of the temperature elements A and B, at the respective right-hand ends of said elements is as follows; as may be readily seen at the right-hand side of Fig. III, and also in Figs. X and XVI. One such terminal of the strip a^3 or b^3 is secured about a central plate a^4, at the right-hand end of the temperature element and the strip then wrapped around the left-hand end a and carried back to the right-hand end, where it is again wrapped around the plate a^4 and over that portion of itself which was first wrapped around said plate. This may be seen in Figs. III and XVI, if a^5 be considered as one end of the strip and a^6 the other end, such ends and the central plate a^4 then being all rigidly bound together by means of two outer sheaths a^7, which are secured thereto by means of small rivets a^8. This description of the right-hand end of the temperature element A will suffice for the right-hand end of the temperature element B, inasmuch as the strips of expansible material are secured alike upon both of said elements. The bolt J passes through suitable holes a^9 and b^9 provided in the temperature elements A and B, respectively, the right-hand ends of said elements being made somewhat larger, as shown in Figs. IV and VI, at a^{10} and b^{10} respectively, to compensate for the loss of strength in the material due to the provision of said holes a^9 and b^9. It will be noted that the adjustments affected at the right and left-hand sides, respectively, of the two elements A and B, by reason of changes in tension of the ribbons a^3 are at right angles relatively to each other, that is, the adjustment affected by a^2 and b' is due to a change in tension between the two sides of the band or wires a^3, as shown in Fig. III; whereas the adjustment affected at a^9 and b^9 is due to a change in tension between the upper and lower portions of the ribbon a^3, such as designated by a^{11} and a^{12} in Fig. IV.

The supporting mechanism and means of actuating the indicating needle I are identical with that shown and described in my above-mentioned applications upon electrometric appliances and hygrometers and comprise a member L supported upon the upper annular member D and extending inwardly slightly beyond the axial line of the instrument, it being provided in said axial line with an adjustable screw l, in the recessed lower portion of which is mounted the upper end of an arbor l', the lower end of which is mounted in a recessed bearing in a post M. A thread or belt n is wrapped about a drum l^2 formed between two flanges l^3 provided upon the arbor l', to which arbor the indicating needle I is secured. Adjustably secured to the plate F by means of a screw n' secured through a slot n^2 is a fork N, which is provided with flexible curved tines n^3 to the ends of which is secured the

thread or belt n, such thread being of such a length that a great latitude of flexure is secured, so that the friction upon the drum l^2 is greatly reduced.

It should be noted that the temperature element A is several times as large as the temperature element B, so that a part of the latter's greater distance from the fulcrum K is compensated for; that the post K is cut away as shown at k', Fig. XI, in order to allow the temperature element A, if necessary, to be secured very closely to said post; that the left-hand ends a and b, respectively, of the temperature elements A and B, pass through suitable apertures g^2 and f^3 in the plates G and F, respectively; that, by reason of having the lugs a^2 eccentrically-located relatively to and outside of the axial line of the portion a', the left-hand end a of the element A cannot be shifted out of position; that the screw g can be adjusted to vary the tension of the point g' upon the plate F; and that the spring-plate E can be adjusted as to its tension by means of the screws e. When the elements of the thermometer are being assembled, the spring-plate E, the plate G and the bolt J are in their slack or loose positions. When the temperature elements A and B have been placed in position, the screws e are tightened up which tightens the two coils A and B but would not necessarily change the relationship between them. The adjustment by means of the bolt J is then made to adjust the swing of the needle for the whole scale, after which the final adjustments are easily made by means of the screws g^3 and g which allow the needle to be adjusted with reference to the zero point upon a predetermined scale. When the elements are thus adjusted there is practically no further movement of the bearings a^2 in the recesses in the plate G, both bearings a^2 and the element A having speedily adjusted themselves during such assemblage by reason of the belt-like movement of the ribbon of metal around the portion a'.

From the above description, it will be readily apparent that any change in temperature will affect the force with which the pivotal bearings b' bear upon the oscillatory plate F, and cause a relative compensating movement of that portion of the spring-plate E which is under tension, and that the movements of said plate F will affect the fork N to cause the consequent movement of the indicating needle I to show the required reading. Practically the whole operative function depends upon the large coil A, since its expansion alone may be reduced or increased by leverage according to its distance from the fulcrum k, the effective expansion of the element B remaining constant, since the whole value of the small coil B is of only comparatively little use because of its long leverage. An increase in the leverage of the small coil B increases the play of the oscillatory plate F, and so increases the sensitiveness of the indicating needle I. If the coil B were neutral to heat and cold, then it would be simply a counterbalance and the coil A would act alone. In practical effect the elements A, J and B are only one temperature member which is pivoted upon the pin-bearings k, substantially all the working effect of the instrument residing in so much of said member as is located upon one side of said pivoted points, viz., upon the upper side thereof, Fig. I. Two particular advantages of the instrument are that its arrangement permits an adjustment to a predetermined scale, and the fact that the very thin plates A and B, or the plurality of very thin wires which might be used, present a large surface which is readily affected by changes in temperature and provides a quick reading.

Instead of the frame C being neutral it might, of course, be so constructed as to contract during an increase in temperature, while the temperature element would be expanding, in which case the frame would become an operative element in the structure and render the thermometer more sensitive although it would act more sluggishly and, consequently, not give so quick a reading.

Having thus described my invention in detail, that which I particularly point out and distinctly claim, is:—

1. In a thermometer, a temperature element comprising end supports and a ribbon of expansible metal secured to one of said supports and freely movable about the other support.

2. In a thermometer, a temperature element comprising end supports and a very thin ribbon of a metal of a high coefficient of expansion mounted on said supports.

3. In a thermometer, a temperature element comprising end supports provided with pivotal bearings and a ribbon of expansible metal secured to one of said supports and freely movable about the other support.

4. In a thermometer, a temperature element comprising end supports, pivotal bearings therefor, and a ribbon of expansible metal mounted on said supports, the axes of said pivotal bearings being angularly disposed with respect to each other, whereby the tensions exerted upon said ribbon are similarly related.

5. In a thermometer, a temperature element comprising end supports, pivotal bearings therefor, and a ribbon of expansible metal mounted on said supports, the axes of said pivotal bearings being right-angularly disposed with respect to each other, whereby the tensions exerted upon said ribbon are similarly related.

6. In a thermometer, a temperature element comprising end supports and a redoubled ribbon of expansible metal having its free terminal secured to one support and wrapped intermediately of such terminals about the other support so as to be freely movable about the latter.

7. In a thermometer, a temperature element comprising end supports provided with pivotal bearings and a redoubled ribbon of expansible metal having its free terminals secured to one support and wrapped intermediately of such terminals about the other support so as to be freely movable about the latter, said bearings and ribbon being so arranged that the tensions upon the latter at said two end supports are exerted and adjusted at right-angular relationship.

8. In a thermometer, a temperature member comprising end supports, two ribbons of expansible metal respectively supported at one end upon said supports, and means to which the other ends of both of said ribbons are secured, said means being provided with pivotal bearings.

9. In a thermometer, a temperature member comprising end supports, two ribbons of expansible metal respectively supported upon said supports, and means to which the two ends of both of said ribbons are secured, said means being provided with pivotal bearings located intermediately of said corresponding ends.

10. In a thermometer, a temperature member comprising end supports, two ribbons of expansible metal respectively supported upon said supports, and means to which the two ends of both of said ribbons are secured, said means being provided with pivotal bearings located intermediately of said corresponding other ends, said means being adapted to vary the respective distances between said ends and said pivotal bearings.

11. In a thermometer, a temperature member comprising end supports, two ribbons of expansible metal respectively supported upon said supports, so as to be freely movable thereon, and means provided with pivotal bearings and adapted to rigidly support the two ends of both of said ribbons.

12. In a thermometer, a temperature member comprising two end supports each provided with pivotal bearings, two ribbons of highly-expansible metal each supported upon one of said supports, respectively, and means provided with pivotal bearings and adapted to rigidly support the two ends of both of said ribbons, said bearings and ribbons being so arranged that the tensions upon the latter at their respective supports are exerted and adjusted in right-angular relationship.

13. In a thermometer, a temperature member comprising two end supports each provided with pivotal bearings, two ribbons of highly-expansible metal each supported upon one of said supports, respectively, so as to be freely movable thereon, and means provided with pivotal bearings and adapted to rigidly support the two ends of both of said ribbons, said bearings and ribbons being so arranged that the tensions upon the latter at their respective supports are exerted and adjusted in right-angular relationship.

14. In a thermometer, a temperature member comprising end supports, two ribbons of expansible metal each supported upon one of said supports, respectively, so as to be freely movable thereon, a bolt adapted to support the two ends of both of said elements, and an oscillatory member provided with pivotal bearings and internally screw-threaded to engage with said bolt.

15. In a thermometer, a temperature element; a frame provided with a spring support having pivotal bearings, said frame being self-compensating as to temperature; a plate oscillatorily mounted upon said bearings, one end of said temperature element being pivoted upon said plate; and an indicating needle adapted to be actuated by the movement of said plate.

16. In a thermometer, a temperature element; a frame provided with an adjustable spring-plate having pivotal bearings, another plate oscillatorily mounted upon said spring plate one end of said temperature element being pivoted upon said last-named plate and exerting pressure upon the latter; and an indicating needle adapted to be actuated by the movements of said temperature element.

17. In a thermometer, a temperature element; a frame provided with an adjustable spring-plate having pivotal bearings; a plate oscillatorily mounted upon said bearings, one end of said temperature element being pivoted upon said plate; and an indicating needle adapted to be actuated by the movements of said plate.

18. In a thermometer, a temperature element; a frame provided with an adjustable spring-plate having pivotal bearings; said frame being self-compensating as to temperature; a plate oscillatorily mounted upon said bearings, one end of said temperature element being pivoted upon said plate; and an indicating needle adapted to be actuated by the movements of said plate.

19. In a thermometer, a temperature element; a frame provided with an adjustable support having pivotal bearings, said frame being self-compensating as to temperature; a plate oscillatorily mounted upon said bearings; a pivoted support in said frame, one end of said temperature element being pivoted upon said plate and the other end

thereof rigidly supported by said pivoted support; and an indicating needle adapted to be actuated by the movements of said plate.

20. In a thermometer, a pair of temperature elements, a frame adapted to be self-compensating as to temperature; means supporting one end of each of said elements and pivoted upon said frame, the other end of one of said elements being also supported in said frame, the other end of said second element being pivotally supported in opposition to the corresponding end of the first element.

21. In a thermometer, a pair of temperature elements; a frame; a member pivoted upon the latter and adapted to support one end of each of said elements; two plates supported by said frame, the other end of one of said elements being supported upon one of said plates; the latter being adapted to hold the second plate under tension; a member oscillatorily mounted upon said second plate so as to act in conjunction with said first plate, to thus hold said second plate under tension, the other end of the second element being supported upon said oscillatory member in opposition to said first plate.

22. In a thermometer, a pair of temperature elements; a frame; a member pivoted upon the latter and adapted to support one end of each of said elements; two plates adjustably supported in said frame, the other end of one of said elements being supported upon one of said plates; a member oscillatorily mounted upon the second plate and provided with a bearing; means located in said first plate and engaging with said bearing to exert pressure upon said oscillatory member, the other end of the second temperature element being supported upon said oscillatory member in opposition to the pressure exerted by said means.

23. In a thermometer, a pair of temperature elements; a frame; a member adapted to support one end of each of said elements and pivoted in said frame intermediately of the points supporting said ends; a spring-plate supported in said frame; a member oscillatorily mounted upon said spring-plate, the other end of one of said temperature elements being pivoted upon said oscillatory member, the corresponding end of said second element being pivoted upon said second plate, the latter being provided with means adapted to exert pressure upon said oscillatory member in opposition to the pressure exerted by said other end of the first temperature element, the pressure exerted by the latter and said means effecting a tension in said spring-plate.

24. In a thermometer, a temperature member comprising two temperature elements, amember pivotally mounted in the frame of the mechanism and internally screw-threaded, and a bolt engaging with said screw-threaded member and adapted to support one end of the respective tension elements of the temperature member on each side of the fulcra of said pivotally mounted member.

Signed by me, this 26″ day of October, 1906.

WILLIAM JANDUS.

Attested by—
E. S. BUCK,
G. W. SAYWELL.