

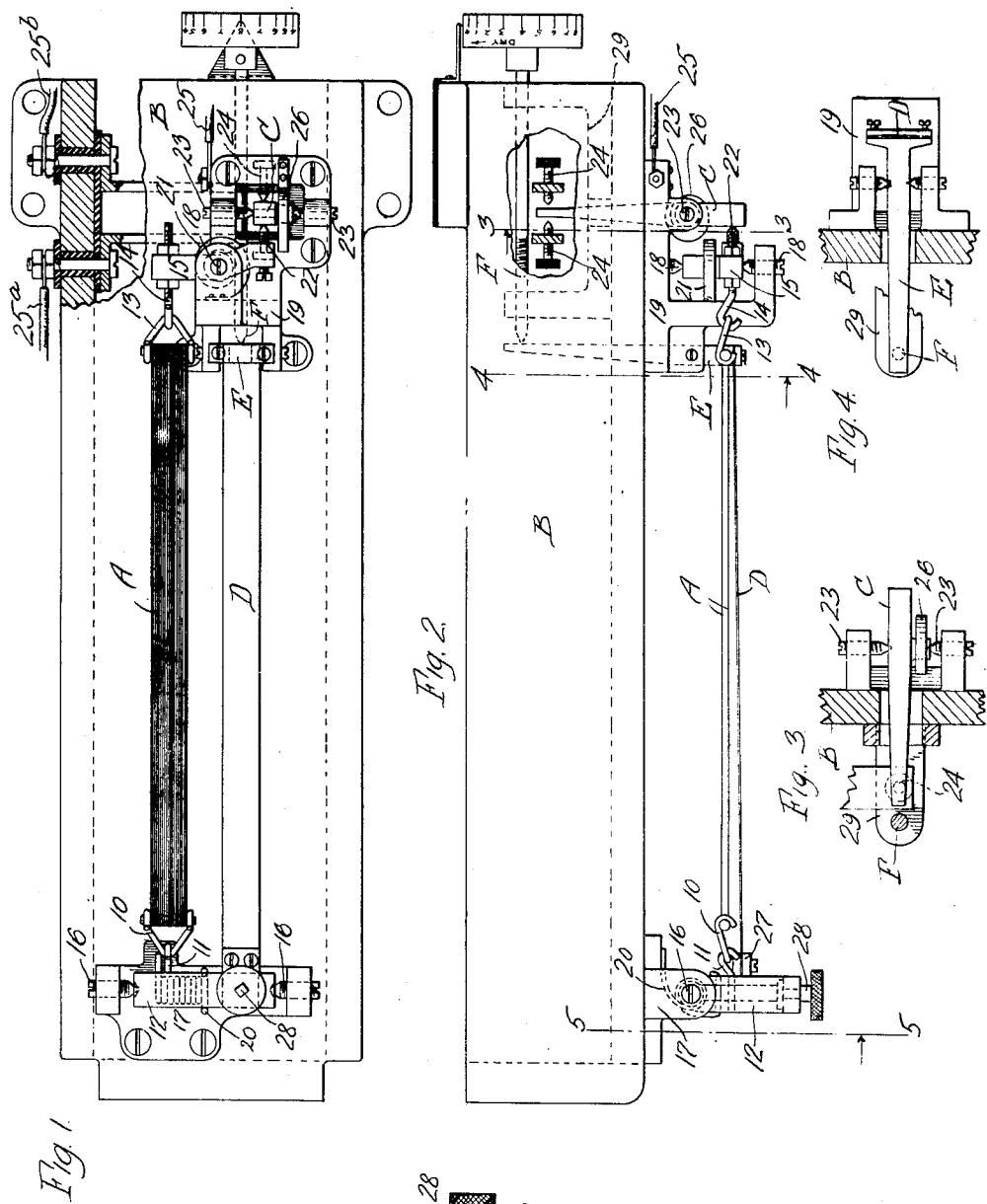
W. H. CARRIER.

HYGROSTAT.

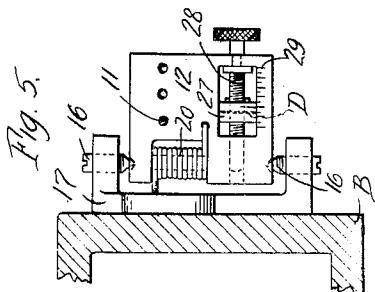
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UNITED STATES PATENT OFFICE.

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HYGROSTAT.

1,237,470.

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To all whom it may concern:

Be it known that I, WILLIS H. CARRIER, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Hygrostats, of which the following is a specification.

This invention relates to improvements in hygrostats of that kind in which the humidity regulating action is dependent upon a member or element of hygroscopic material which is affected by changes in the humidity of the air.

The object of the invention is to produce an accurate and reliable hygrostat of this kind in which provision is made for compensating for changes in the hygroscopic element due to changes in the temperature affecting the same, or for altering the operative effect of the hygroscopic element in accordance with changes in temperature in such a way as to obtain different desired humidity conditions. For instance, the hygrostat is adapted to maintain a constant relative humidity irrespective of variations in the temperature; or to cause the relative humidity to decrease with increments in temperature so as to maintain a constant absolute humidity; or to secure a humidity which increases at a definite rate with increments in temperature and vice-versa for maintaining a constant weight of moisture in a hygroscopic substance notwithstanding temperature variations.

35 In the accompanying drawings:

Figure 1 is an elevation of a hygrostat embodying the invention.

Fig. 2 is a plan view thereof.

Figs. 3 and 4 are transverse sectional elevations thereof on lines 3-3 and 4-4, respectively, Fig. 2.

Fig. 5 is a transverse sectional elevation thereof on line 5-5, Fig. 2.

A represents a flat band or strip composed of some suitable hygroscopic material, such for instance, as a series of raw silk fibers which are expansible and contractible under the influence of moisture. By preference the silk fibers or strands composing the band 45 A are, as shown in the drawings, arranged substantially in parallel relation in a single plane, or flat-wise in a single plane, since the several component strands or fibers of the band are in this way more fully exposed 50 to the surrounding air and act more uni-

formly than if they were bunched with some of the strands inclosed by others. The band A is shown in the form of an endless belt having two parallel runs or parts but these are separated so that the component strands or fibers of each part are in a flat band and are exposed on both sides of the band to the surrounding air. This hygroscopic band or element is attached at one end by a loop 10 and hook 11, or other suitable connections, to a pivoted supporting frame or lever 12, and is attached at its opposite end by a loop 13 and an adjustable screw hook 14, or other suitable connections, to a movable supporting lever 15. The frame or lever 12 and the lever 15 are pivotally mounted in any suitable way on a supporting base B which is made of some suitable material having a negligible coefficient of expansion, such for instance, as an alloy of steel containing a high percentage of nickel. The base B is 60 suitably secured at one end only to a support so as not to be affected by the expansion or contraction of the support. As shown, the frame or lever 12 is pivoted by adjustable cone screws 16 to a bracket 17 which is secured by screws or other fastenings to the supporting base B, and a frame or lever 15 is fulcrumed by adjustable cone screws 18 to a bracket 19 which is secured by screws or other fastenings to the supporting base B. A spring 20 attached to the frame or lever 12 and to the supporting bracket therefor and a spring 21 attached to the lever 15 and to its supporting bracket tend to swing the 70 levers 12 and 15 in a direction to tighten the hygroscopic band A or hold it under substantially constant tension. The spring 20 is stronger than the spring 21 for a purpose 75 hereinafter explained.

The lever 15 is provided with a point 22, preferably formed by an adjustable screw, by which it bears against a regulating lever or device C. The movement of this regulating lever C can be utilized through the medium of instrumentalities of any suitable kind for regulating the humidity of the air affecting the hygroscopic element, or for performing other desired regulating action under the control of the humidity affecting 80 the hygroscopic element. As shown, the regulating lever is pivoted by adjustable screw cones 23 on the bracket 19 and extends between and co-operates with two electrical contacts 24 for controlling the flow of 105 110

current through a conductor 25 connected with the regulating lever C and through one or the other of two conductors 25^a, 25^b to electrically actuated means (not shown) for performing the humidity regulating action. A spring 26 attached to the regulating lever C and to the supporting bracket 19 tends to move the free end of the regulating lever C against one of the contacts 24 and to hold this lever in contact with the coöperating lever 15. This spring 26 is of such strength as to hold the levers C and 15 in engagement and prevent lost motion without exerting material pressure on the lever 15.

15 D represents a thermoresponsive element of some suitable material having a high coefficient of expansion, such, for instance, as phosphor bronze, which is adapted to expand or contract rapidly and sensitively with changes in the temperature affecting the same. Preferably the thermoresponsive element is in the form of a thin band, which is adapted to respond readily to sudden changes or fluctuations of temperature.

20 25 This strip is attached at one end to the pivoted frame or lever 12 and at the opposite end to an adjusting lever or member E. As shown, the thermoresponsive strip is attached to the frame or lever 12 by a block 27 which is slidably mounted in the frame or lever 12 to move toward and from the pivot thereof, and is adapted to be moved toward and from the pivot by an adjusting screw 28. The adjustment can be indicated

25 30 35 40 by any suitable means, such as a mark on the block coöperating with a suitably calibrated scale 29 on the block guide, see Fig. 5. By this means the connection of the thermoresponsive strip with the frame or lever 12 can be adjusted nearer to or farther from the fulcrum of the lever for decreasing or increasing the leverage with which the thermoresponsive strip acts on the lever.

The adjusting lever E is suitably ful-

45 crumed, as by means of adjustable cone screws on the bracket 19 and bears at one end against an adjusting screw F which has a screw-threaded engagement in a threaded hole in a suitable supporting bracket 29 se-

50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 cured on the supporting base. The adjusting screw is provided at its end with a wheel or handle for turning the same to adjust the lever E, and this wheel or handle is preferably graduated and provided with suitable indicia to indicate the humidity condition which the instrument is set to maintain. When the lever E is adjusted in one direction the supporting frame or lever 12 for one end of the hygroscopic band will be moved correspondingly by draft of the thermoresponsive strip D which connects the levers, and when the lever E is adjusted in the opposite direction the spring 20 will correspondingly move the frame or lever 12. The spring 21 is not strong enough to op-

pose the movement of the frame or lever 12 by its spring 20 and will permit the supporting lever 15 for the other end of the hygroscopic band to follow the adjustment of the frame or lever 12. The hygroscopic band will thus always be held under substantially constant tension but the position of the lever 15, which actuates the regulating lever, will be changed by the adjustment of the adjusting lever E so as to give different regulating effects.

The instrument can therefore be set by appropriate adjustment of the screw K to maintain a desired humidity condition, and its action will not be changed by variations in temperature. By appropriately adjusting the connection between the thermoresponsive element D and the lever 12, the thermoresponsive element D can be caused to act as if it had substantially the same coefficient of expansion for temperature as the hygroscopic element A', so that the hygroscopic and thermoresponsive elements will expand or contract substantially equally with changes in the temperature affecting them and thus compensate for changes in the length of the hygroscopic element due to variations in temperature affecting it. This instrument, however, has a wider range of usefulness since by appropriate adjustments of the connection between the thermoresponsive element D and the frame or lever 12 toward or from the fulcrum of the frame or lever 12, the thermoresponsive element can be caused to compensate for, augment or reduce the effect of temperature changes on the hygroscopic element A. It is also adapted to operate accurately when the temperature changes or fluctuates rapidly. Thus in this instrument the hygroscopic element can be made to maintain either a constant or a varying relative humidity with rapid or sudden fluctuations in temperature, to give a humidity which increases at a definite rate with increases in temperature, or to obtain other desired results.

I claim as my invention:

1. The combination of an element of hygroscopic material adapted to expand and contract with changes in the humidity of the air, a device actuated thereby, and a thermoresponsive element correlated with said hygroscopic element to compensate for the effect of said hygroscopic element on said device due to changes in temperature affecting said hygroscopic element.

2. The combination of an element of hygroscopic material, a device operatively connected therewith and adapted to be actuated by reason of changes in said element produced by changes in the humidity of the air affecting the element, and a thermoresponsive element which is affected by changes in temperature and is correlated with said hy-

groscopic element to alter the operative effect thereof on said device in accordance with changes in temperature affecting said thermoresponsive element.

5 3. The combination of a hygroscopic element which is affected by variations in the humidity of the air, a thermoresponsive element which is affected by temperature changes, a movable device the action of 10 which is dependent upon the operative effect thereon of both of said elements, and means for altering the operative effect of said thermoresponsive element on said device.

4. The combination of a hygroscopic element, a device which is actuated by said element in response to changes in said element due to variations in the humidity of the air, a thermoresponsive element, and means whereby said thermoresponsive element can 20 be caused to alter to a greater or less extent the operative action of said hygroscopic element on said device.

5. The combination of an operable device, an element of hygroscopic material and a 25 thermoresponsive element arranged to actuate said device respectively in response to hygrometric and temperature changes affecting said elements, and means for altering the action of said thermoresponsive element on said device.

6. The combination of an element of hygroscopic material, a movable support for one end of said element, a device which is operatively connected to the other end of 35 said element and is actuated thereby, and a thermoresponsive element which is arranged to shift said support for the hygroscopic element in response to changes in temperature.

40 7. The combination of an element of hygroscopic material, a movable support for one end of said element, a device which is operatively connected to the other end of said element and is actuated thereby, a 45 thermoresponsive element which is connected at one end to said movable support for shifting it, and an adjustable support to which said thermoresponsive element is connected.

8. The combination of an element of hygroscopic material, a pivoted support for one end of said element, a device which is operatively connected to the other end of said element and is actuated thereby, a thermoresponsive element arranged to move said 55 pivoted support, and means for adjusting the operative connection between said pivoted support and said thermoresponsive element relative to the pivot for said support.

9. The combination of an element of hy-

groscopic material, levers to which said element is attached at opposite ends, springs which act on said levers to tension said element, a device actuated by one of said levers, and a thermoresponsive element connected to said other lever for moving the same. 60 65

10. The combination of an element of hygroscopic material, levers to which said element is attached at opposite ends, springs which act on said levers to tension said element, a device actuated by one of said levers, 70 a thermoresponsive element connected to said other lever for moving the same, and adjusting means for shifting the position of said last mentioned lever.

11. The combination of an element of hygroscopic material, levers to which said element is attached at opposite ends, springs which act on said levers to tension said element, a device actuated by one of said levers, a thermoresponsive strip connected at one 80 end to said other lever, and an adjustable device to which the other end of said thermoresponsive strip is connected. 75

12. The combination of an element of hygroscopic material, levers to which said element is attached at opposite ends, springs which act on said levers to tension said element, a device actuated by one of said levers, and a thermoresponsive strip secured at one 90 end and having an adjustable connection at its other end with said other lever. 85

13. The combination of an element of hygroscopic material, levers to which said element is attached at opposite ends, springs which act on said levers to tension said element, a device actuated by one of said levers, a thermoresponsive strip having an adjustable connection at one end with said other lever, and an adjustable support for the other end of said thermoresponsive strip. 95

14. The combination of an element of hygroscopic material, levers to which said element is attached at opposite ends, springs which act on said levers to tension said element, a device actuated by one of said levers, and a thermoresponsive element connected to said other lever for moving the same, the actuating spring for the lever to which said thermoresponsive element is connected being of greater strength than said other 110 spring. 105

Witness my hand this 12th day of April, 1915.

WILLIS H. CARRIER.

Witnesses:

HOWARD C. RICE,
F. RUECKERT.