June 24, 1930. A. J. LOEPSINGER 1,765,842

MEANS FOR SUPPLYING MOISTURE TO HYGROMETERS, HUMIDITY REGULATORS, AND THE LIKE

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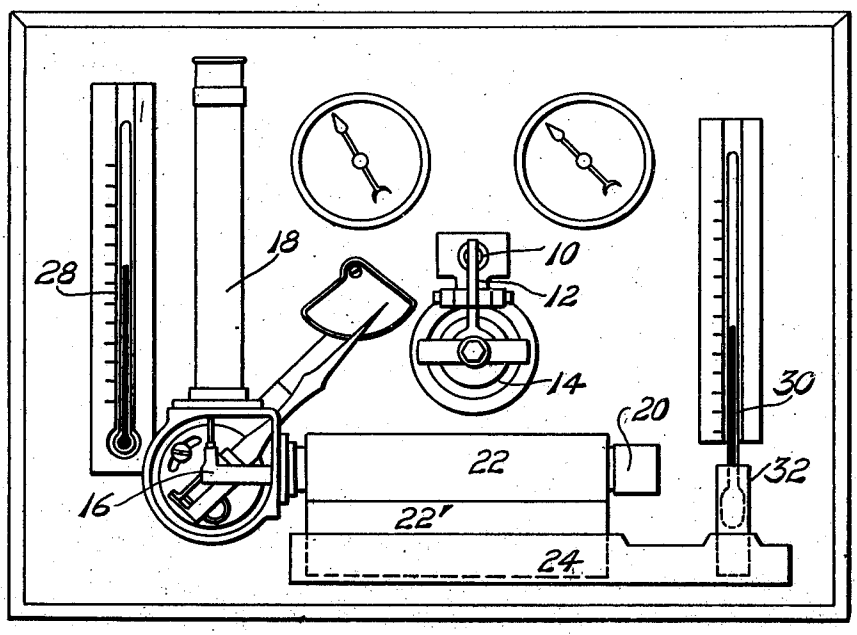


FIG. 1

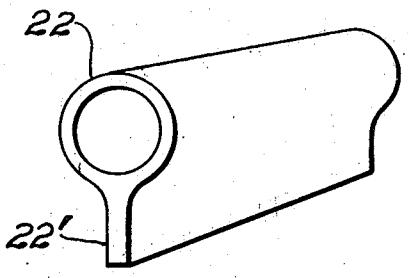


FIG. 2

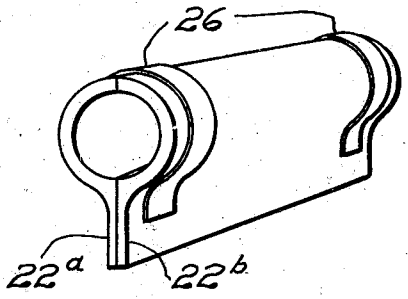


FIG. 3

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UNITED STATES PATENT OFFICE

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MEANS FOR SUPPLYING MOISTURE TO HYGROMETERS, HUMIDITY REGULATORS, AND THE LIKE

Application filed January 30, 1924. Serial No. 689,511.

This invention relates to means for supplying moisture to hygrometers, humidity regulators, and the like, for the wet bulb temperature.

In such instruments two equal thermally responsive elements, known as the wet and dry bulb elements, are exposed, the latter to temperature of the surrounding atmosphere, and the former to temperature which is lower, in a degree depending upon the dryness of the air, ascertained by the rate at which moisture evaporates into it with consequent depression of temperature. This wet bulb element is, in one type of instrument, supplied with moisture for evaporation by means of a wick rising from a supply of water and surrounding it. The wicks now in common use are preferably made of textile material, but this collects dirt which sooner or later clogs the fabric, so that water is not as readily taken up, or evaporated. Then follows an inaccurate operation of the wet bulb element, which is cured only by occasional cleaning or renewal of the wick. The elimination of wick troubles and consequent inaccuracies are objects of the present invention.

Among its features is the provision of a wick, which may also be a jacket for the wet bulb or wet bulb element, having the characteristic that in ordinary operation its surface does not become sensibly wet. Another feature is to have a wick whose surface exposed to air when in operation has little or no tendency to collect foreign matter.

These objects are attained by providing a wick of ceramic material molded or otherwise formed to such shape and size as to fit snugly about the bulb of the wet bulb thermometer, or to form a casing for the "wet bulb element" (so called whether there be any bulb or not), to which water is brought through a depending portion arranged for immersion. Such a wick can be made in one piece, or in two or more parts, in which latter case each part by itself should have access to the water supply. A quality of ceramic material is contrived or selected which is so porous as to take up water readily by capillary action, and yet is so finely porous that at ordinary operating humidities the water which it raises is evaporated as rapidly as it is raised, whereby the wick surface which is accessible to touch, or to foreign bodies floating by in the air, always feels dry. This superiority of evaporative power over capillary power, which is not attainable in ordinary cotton wicking, nor is necessarily found in a ceramic wick, is attained by imposing sufficient restraint on the capillary power. The effect is enhanced by having a surface which is free from filamentary projections. It is not inconsistent with this described dryness that a change of color may be seen in the surface, consequent upon immersion of the base of the wick; nor does this necessarily mean that the surface of the wick would not wet an article laid upon it, as for example, a piece of cloth. It has been found possible to get the benefits of the invention under circumstances in which sufficient moisture is present for each of those phenomena to occur, and yet there is no water visible in the form of beads, or film, nor discoverable by the touch of one's finger, which condition is herein referred to as absence of sensible moisture or dryness. As a consequence the facilities for evaporation remain substantially uniform during the operative life of the wick, and the temperature readings of the wet bulb thermometer continue correspondingly accurate.

A particular ceramic material which has been found suitable is crystalline alumina of the type produced by electric furnace and known in the trade as alundum or refractory alumina. Experiments with one of the coarsest commercial grades of this, as made for filtering devices, known commercially as having porosity "R A 98", have given satisfactory results. For the purposes of the invention the ceramic wick should be unglazed and have a surface not likely to collect lint, fuzz or dirt. Owing to its porosity this filtering material has capillary power to raise water; and owing to its earthy nature it is insoluble, rigid, and may be suf-

ficiently strong and thick to be satisfactorily resistant to fracture.

The invention is shown herein as applied to a well known commercial form of humidity controller in which both a thermostatic element and a thermometer bulb are disclosed, each having its appropriate form of wick; but these embodiments are to be considered as merely illustrative and not as limitations of its field of application. It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty exist in the invention disclosed.

In the accompanying drawings:

Figure 1 is an elevation of a humidity controller embodying wicks having the characteristics of the present invention;

Figure 2 is a perspective of one of the ceramic wicks shown in Figure 1; and

Figure 3 is a perspective showing a modified form of such wick.

The drawings illustrate a humidity controller embodying principles which are more particularly disclosed in United States Patent No. 1,481,251, granted January 22, 1924. In this the operation of humidifying apparatus (not shown) is controlled by air pressure conveyed by suitable connections through a lever valve 10 whose opening and closing are effected by a lever 12 connected with the diaphragm of a relay valve 14. The movements of this diaphragm are dependent upon the pressure exerted upon it by air admitted and released therefrom through a ratio valve 16. This valve in turn is actuated by the relative or co-operative effect of the expansions and contractions of a dry bulb element 18 and a wet bulb element 20, the former being responsive only to temperature changes in the atmosphere and the latter being influenced also by the humidity content of the air.

Surrounding the wet bulb element is the ceramic wick 22 of the present invention which may be considered as being a part of the wet bulb element. As shown in Figure 2 it is formed in one integral body having a cylindrical shell with a fin 22′ projecting downward therefrom. This fin dips under water in a suitably long and narrow well or reservoir 24, from which water is drawn up through the pores of the material by capillary action into the part of the shell immediately surrounding the wet bulb element. Preferably the space inside the shell is slightly larger than the element 20 in order that the latter may be substantially free from contact therewith. From this shell the water evaporates, reducing the temperature of the wet bulb element more or less, according to the rate of evaporation, which, in turn, depends upon the degree of humidity in the atmosphere. This produces contraction of the wet bulb element either visibly, as at the thermometer 30, or operatively as in the case of the thermostatic element 20. In the latter case illustrated it keeps the wet bulb member always set so as to represent the combined effect of existing temperature and humidity of atmosphere while the dry bulb element 18 represents the coincident temperature of atmosphere, and these two co-operate in determining the setting of the ratio valve 16. The function of the latter is, on proper occasions, to admit air under pressure to the diaphragm valve 14, whereby the lever 12, is swung to shut off escape through the lever valve 10. This results in the initiation of action by the humidifying apparatus to deliver moisture to the atmosphere. As the relative humidity of the air increases, the evaporation of water from the wick decreases, causing less depression of temperature in the wet bulb element, from atmospheric temperature, and thus causing relative elongation of this element. This in turn affects the setting of the ratio valve, until, when the moisture content of the atmosphere has reached a predetermined degree, the ratio valve will close, and thereby will bring about a cessation of action by the humidifying apparatus.

I have determined by test that it is possible to have a kind and grade of ceramic material in which there is an approximate balance between the amount of water sucked up by the capillary ability of the wick, and the amount of water evaporated from it, so that its surface is not sensibly wet. I have further found that a wick suitable for use at high humidity also produces substantially the hygrometric wet bulb temperatures at low humidity. From this it follows that in choosing the proper grade of ceramic material, one need but select a grade that will give the desired results at the maximum degree of humidity at which it is to be used, and thereafter the wet bulb member will represent atmospheric conditions of humidity with the accuracy which is requisite for the practical and reliable operation of the apparatus to which it is applied.

In consequence of its freedom from sensible moisture, and the absence of filamentary projections, particles floating in the air are not caught and held on the wick's surface. The freedom from such held particles prevents loss of the desired state of superficial dryness. Impurities found in water under ordinary operating conditions do not appear to affect operation of the capillary ceramic passages which lead to this surface from the well beneath.

In Figure 3 the wick is illustrated as it may be made in two parts, 22^a and 22^b, each part forming approximately one half of the shell and each having its extension

into the well. Any suitable non-corrosive clips 26 may serve to hold the parts together about the wet element.

In the controller illustrated there are the usual dry and wet bulb thermometers 28, 30. The latter, at the right, is provided with a ceramic wick 32 shaped to conform to the configuration of the bulb, and dipping into the water in the well 24 below.

As the degree of coarseness of the ceramic material chosen increases, a greater evaporative power is necessary to keep its surface dry. Hence it may be found in practice that where the capillary power is relatively large the surface may become wet at the higher degrees of humidity. Nevertheless, the benefits of the invention may be had whenever the operative range at which the apparatus is expected ordinarily to work is low enough so that the evaporative power equals or exceeds the capillary power. And even when the surface becomes wet there still remain some advantages from the use of the material described.

Although the invention has been herein described as it may be applied in apparatus wherein the wick is in close proximity to the wet bulb element which is to be cooled thereby, it will be understood that the benefits of the invention may likewise be had in other types of apparatus wherein a capillary and evaporative element is to be employed for cooling a wet bulb element.

I claim as my invention:

1. A capillary and evaporating cooling device for a thermally responsive element, having a portion encasing said element and a fin integral therewith for feeding said portion with water by capillary action; said device being of porous, capillary ceramic material having a surface free from filamentary projections.

2. A capillary and evaporative cooling device, for a thermally responsive element, made of ceramic material having capillary capacity in such relation to its capacity for evaporation that the exposed tangible surface of said device is not sensibly wet by the capillary feed.

3. A wick of ceramic material arranged for supplying moisture to be evaporated in the region of a thermally responsive element; said wick having a relatively smooth surface and having pores so fine that the exposed tangible surface is maintained not wet.

4. A wick of rigid, earthy material for supplying moisture to be evaporated in the region of a thermally responsive element, having such a relation between its capillary and its evaporative powers that only as much water is supplied as is immediately evaporated, thereby leaving the surface of the wick substantially dry.

5. The combination of a capillary and evaporative cooling device with a thermally responsive element; a mechanism arranged to be actuated kinetically by said element; and a liquid supply; said device comprising a ceramic body having an evaporative surface free from filamentary projections; and having a capillary connection between said supply and said evaporative surface.

6. A capillary and evaporative cooling device for a thermally responsive element, comprising the combination, with said element, of a stiff body of porous solid material, of which a part is immersed in liquid, and another part is exposed on all sides to air; said stiff body having a space within it in which said element is set substantially free from contact therewith.

7. A capillary and evaporative cooling device for a thermally responsive element, comprising the combination, with said element, of a liquid supply; a receptacle for the element, having walls of stiff, porous material capable of losing moisture by evaporation, constituting a chamber, for receiving the element, of such dimension as provides an evaporative space between said element and said walls; and means for supplying liquid to said chamber walls; the whole constituting a wet bulb element.

8. A capillary and evaporative cooling device for a thermally responsive element, comprising a receptacle, made of ceramic material within which said element may be placed and remain dry; the walls of said receptacle being capable of losing moisture by evaporation, and capillary feeding means for supplying moisture thereto.

9. A capillary and evaporative cooling device for a thermally responsive element, comprising a receptacle with ceramic walls the exterior and interior tangible surfaces of which are dry, and capillary feeding means for supplying moisture to the internal portions of said walls; the said walls being capable of losing said moisture by evaporation without the said surface becoming sensibly wet.

10. A capillary and evaporative cooling device for a thermally responsive element, comprising a receptacle of ceramic material with a portion immersed in and a portion upstanding from a supply of liquid, said upstanding portion having a dry chamber for receiving said element; the said upstanding portion taking moisture from said immersed portion by capillary feed and being capable of losing the same by evaporation whereby the element is cooled.

Signed at Providence, Rhode Island, this twenty-sixth day of January, 1924.

ALBERT J. LOEPSINGER.