No. 871,163. PATENTED NOV. 19, 1907.

S. W. CRAMER.

HYGROMETER FOR HUMIDIFYING AND AIR MOISTENING APPARATUS.

APPLICATION FILED JULY 23, 1906.

3 SHEETS—SHEET 1

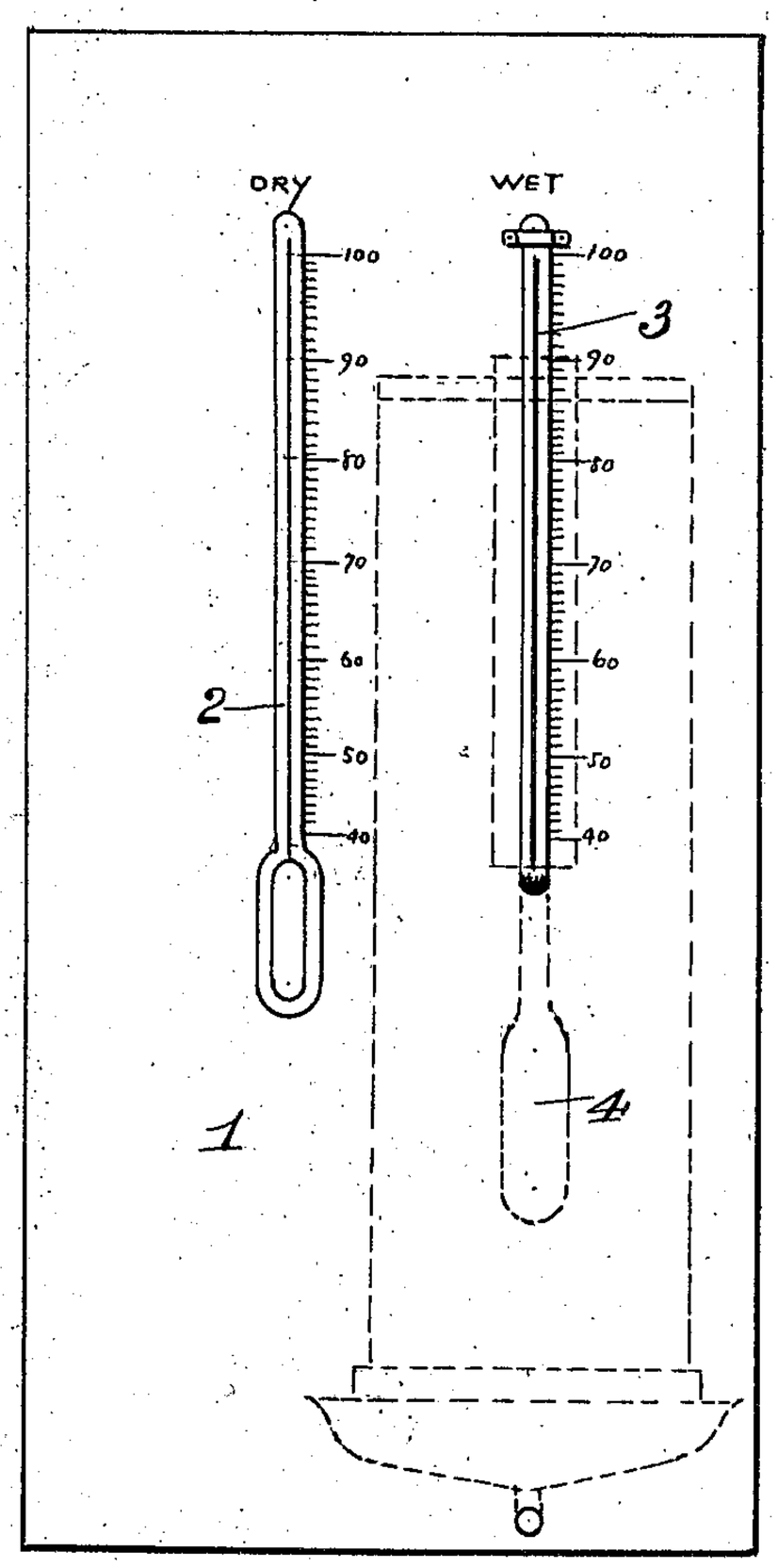

Fig. 1

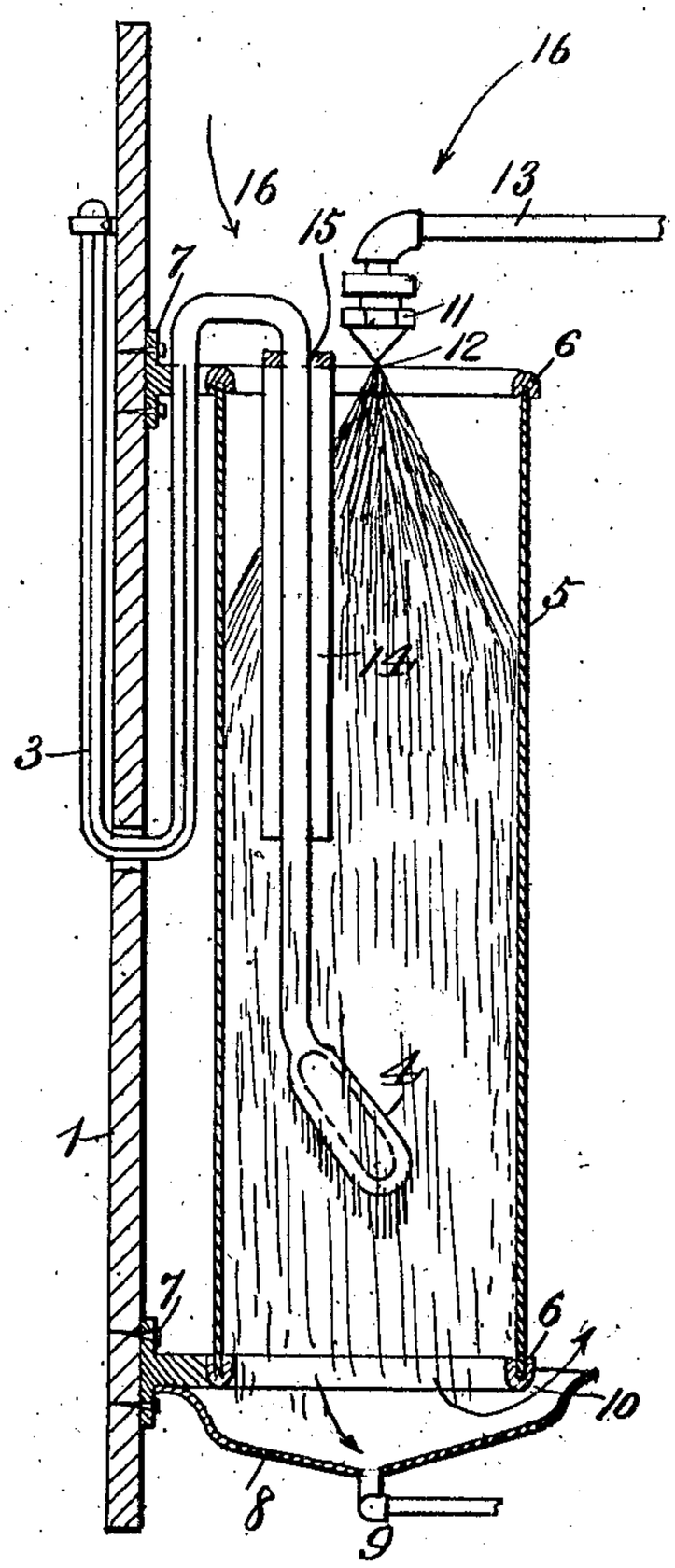

Fig. 2

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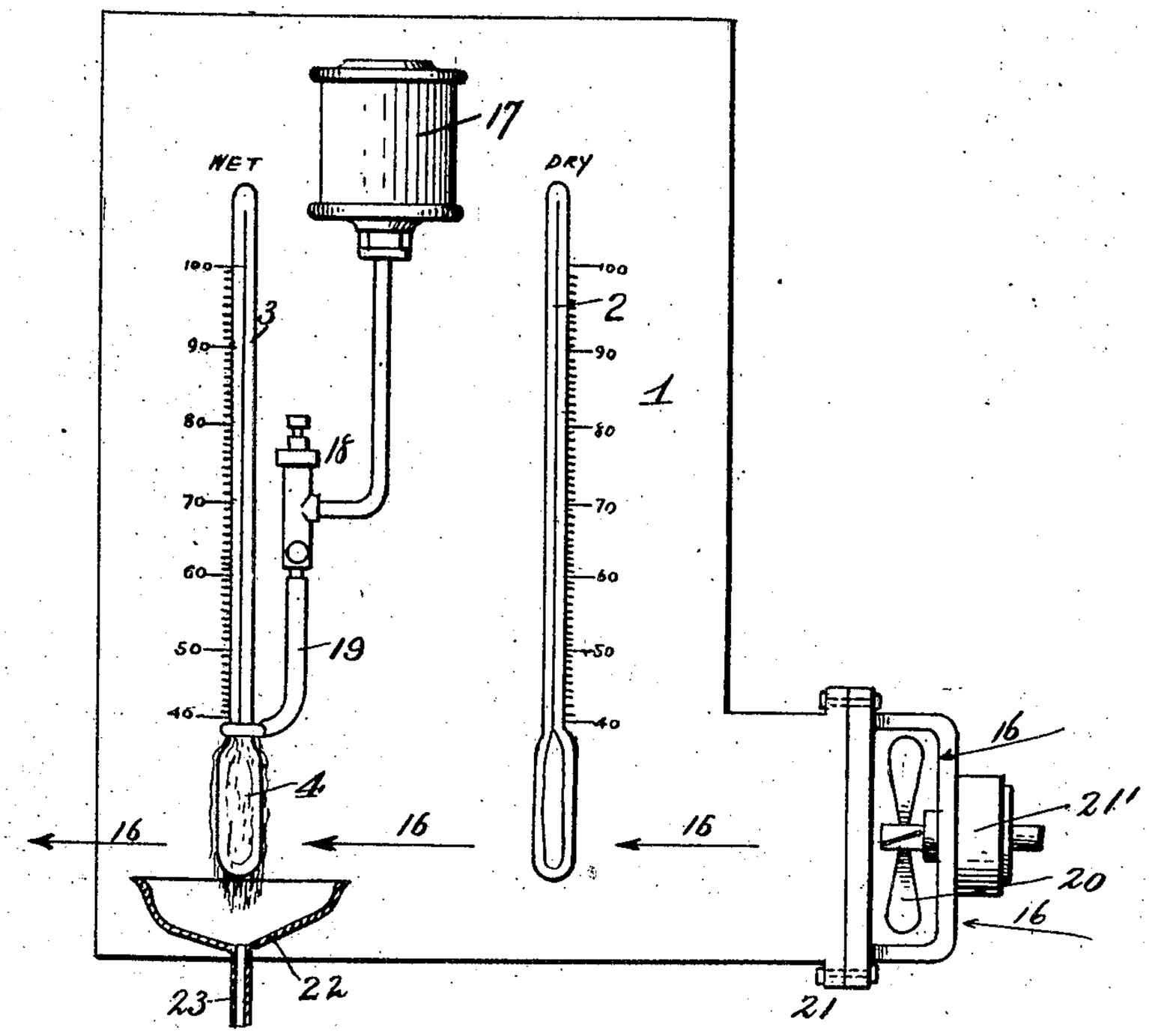

Fig. 3.

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3 SHEETS—SHEET 3.

Fig. 4.

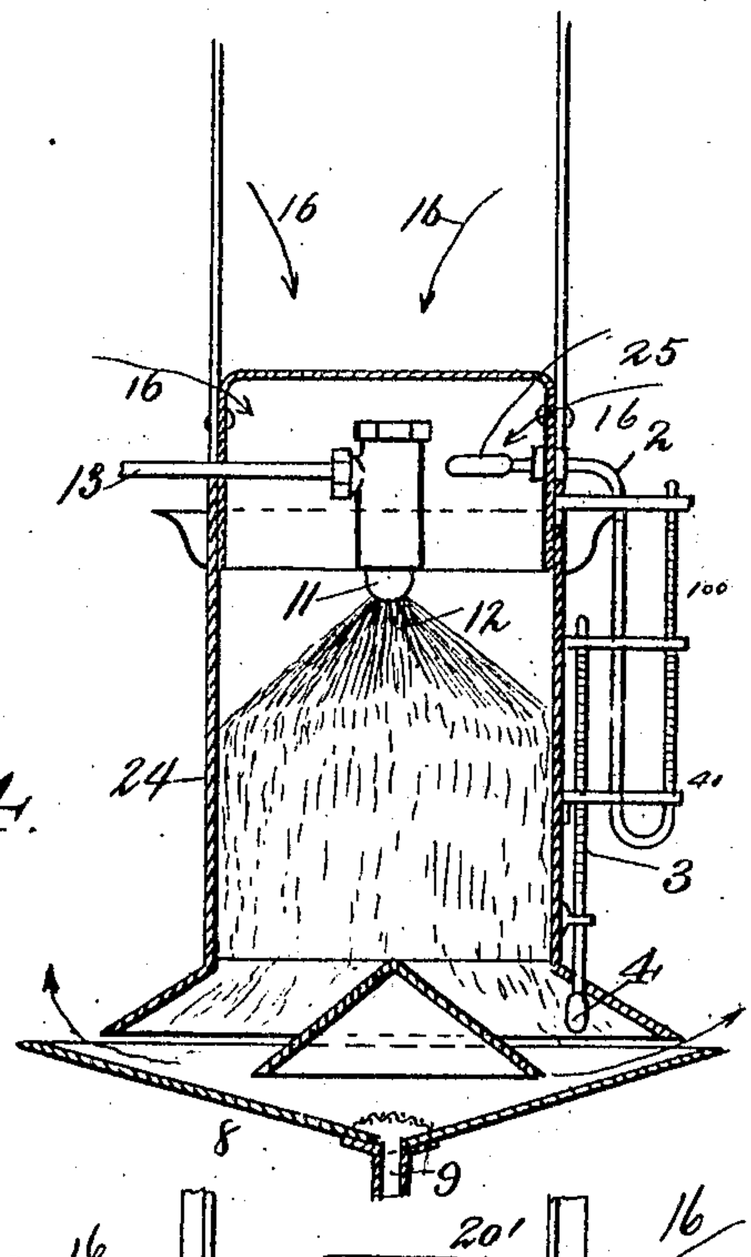
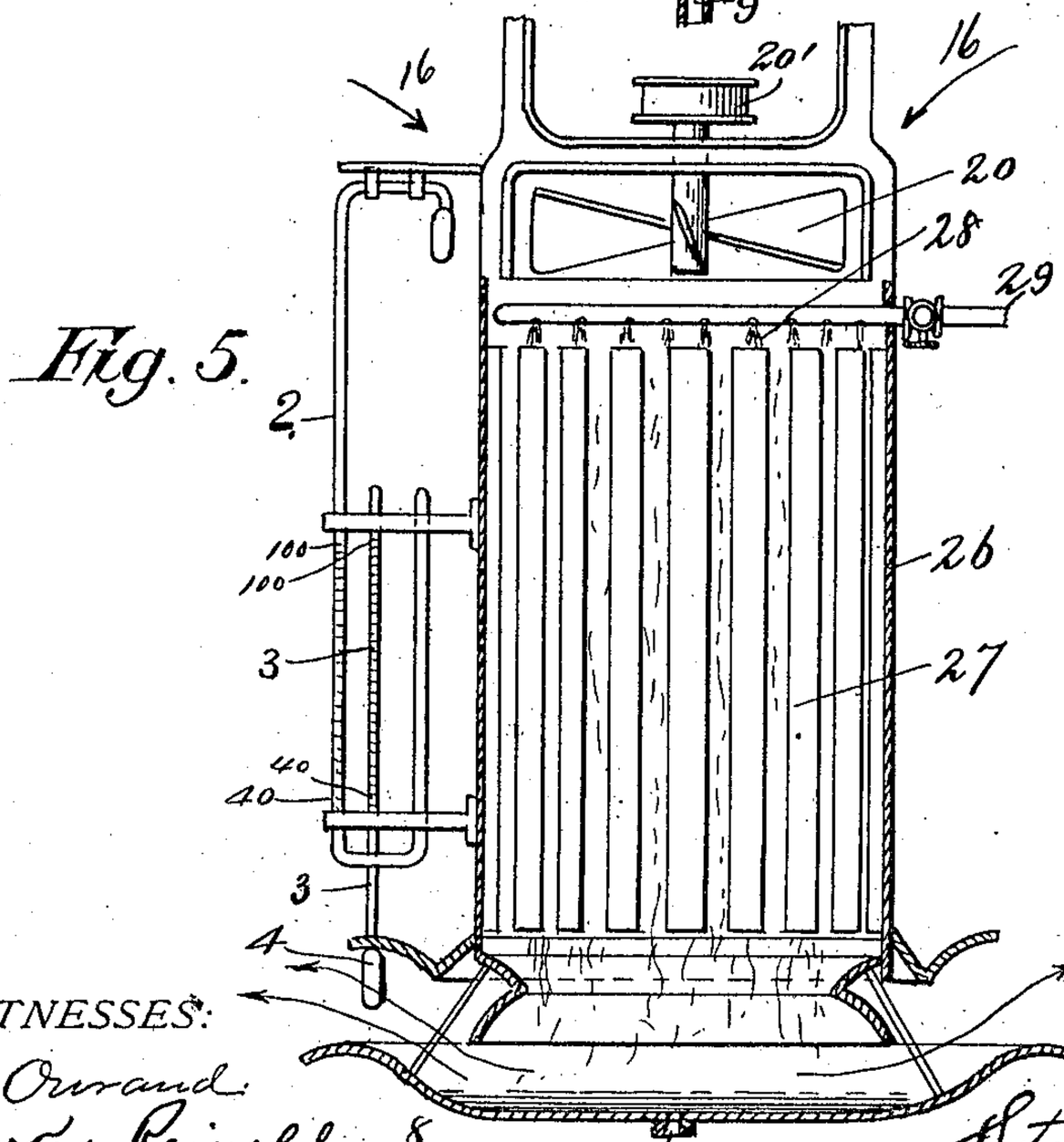


Fig. 5.



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HYGROMETER FOR HUMIDIFYING AND AIR-MOISTENING APPARATUS.

No. 871,163. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed July 23, 1906. Serial No. 327,428.

To all whom it may concern:

Be it known that I, STUART W. CRAMER, a citizen of the United States, residing at Charlotte, in the county of Mecklenburg and State of North Carolina, have invented certain new and useful Improvements in Hygrometers for Humidifying and Air-Moistening Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to instruments for indicating the degree of moisture in the atmosphere, and consists in certain improvements in construction, which will be fully disclosed in the following specification and claims.

In the accompanying drawings, which form part of this specification:—Figure 1 represents a front elevation of my improved hygrometer. Fig. 2 a vertical transverse section of the same. Fig. 3 a front elevation, showing a modified form of hygrometer. Fig. 4 a vertical section partly in side elevation showing the hygrometer applied to one of the spray type of humidifiers, and Fig. 5 a like view showing the hygrometer applied to one of the saturated air or evaporative type of humidifiers.

The quantity of moisture in the air under different conditions of temperature and at different percentages of saturation, is usually measured by two entirely separate and distinct devices. The most convenient device would be the type of hygrometer which, for want of a better term, I may designate as the "mechanical type;" in this type the sensitive member of the instrument is usually of vegetable or animal origin, the operation of which in the presence of varying amounts of moisture in the atmosphere causes movement of the indicating means of the instrument. The sensitive substance generally contracts or expands, or twists or untwists, or otherwise changes its form or dimension, which motion in turn by suitable mechanism is communicated to the indicating means and translated generally into the motion of a needle on a graduated dial. This type of instrument is the most convenient of all devices, and requires practically no attention whatever after being once set. Were its accuracy equal to its convenience, it would be the only device adopted. Unfortunately, however, it is utterly untrustworthy on account of two difficulties inherent in its type. The one being that humidity affects the instruments to a different degree at different temperatures; and the other being the susceptibility of the surface pores of the sensitive substances to being choked or filled up by dust, lint, etc., a thin coating of which causes the indications to become both sluggish and erratic. The second type of instrument referred to, and the one which is recognized as the standard for that purpose, is of the well known wet and dry bulb thermometer type. This type may be further sub-divided as follows: One (and the one best known to the public) which, in order to secure accurate readings, it is necessary to safeguard it from drafts; the makers of such instruments furnish printed precautions with them, stating that they should be exposed in the shade, free from air currents, and that the covering of the wet bulb must be very thin, and that it must be kept constantly moist, and that the water used must be distilled water to minimize the deposits on the wicking which tend to lessen the absorbent power of the material whereby the wet bulb is kept moist. This type of instrument is adapted and designed for continuous usage, and is intended to indicate at all times and be ready for inspection at any moment. The other subclass is the sling, or whirled, psychrometer, the instrument in use by observers at all stations of the U. S. Weather Bureau; in this type of instrument, satisfactory results cannot be obtained from observations in relatively stagnant air, but, on the contrary, a strong current is absolutely necessary to accuracy. This type of instrument is undoubtedly the most perfect one in existence for measuring the percentage of atmospheric moisture, for not only does it come into contact with the average conditions of the atmosphere in its locality, but the muslin covering the wet bulb is always kept in good condition, for it is inspected each time the instrument is used,—its use being intermittent and not continuous. In my improved form of construction, I propose to incorporate the desirable features of both these classes of wet and dry bulb hygrometers, retaining the continuous indicating feature of the one type and the averaging of conditions in the ther type, combined with the further and radical change in construction of doing away with the muslin cover or wicking on the wet bulb entirely.

Humidity, with a wet and dry bulb type of hygrometer, may be said to be measured by the cooling effect of the evaporative power of the atmosphere at different temperatures and different percentages of saturation. It is obvious that as the temperature of the wet bulb is the same as the temperature of the water on the wicking surrounding the bulb, that the wet bulb thermometer simply indicates that temperature. Therefore, it only remains to measure with any kind of a thermometer the temperature of water similarly cooled to the point of saturation of the atmosphere to obtain the equivalent of a wet bulb reading,—from whence it is evident that under proper conditions the usual wet bulb covering or wicking, as it is generally termed, can be omitted. These proper conditions referred to are necessarily those in which the proper precautions are taken to insure that the reduction of the temperature in the act of saturation that air is communicated without appreciable loss to the bulb of the indicating thermometer. In practice it is found that this reduction of temperature can be accomplished in either one of three different ways, and satisfactorily applied to effect the proper depression of what may still be termed the wet bulb.

(1) By saturating the air, and immediately directing it against the bulb of a thermometer. In order to insure saturation in such a case, it is desirable to have the air, if possible, slightly surcharged with moisture.

(2) By directing a finely divided spray of water of high velocity against the bulb, carrying with it sufficient air to accomplish the necessary evaporation.

(3) By directing a fine spray upon the bulb, or covering the bulb with a thin film of water, and directing an air current upon the bulb at the same time.

I propose utilizing each of these three methods of cooling the wet bulb thermometer, and dispensing with the use of the wicking or muslin covering. Repeated observations with certified thermometers show that the methods of cooling the wet bulb given above are as accurate as readings can be made with even a sling psychrometer. In order to insure extreme precision, it is of course necessary to subject the bulb that is to be used as the dry bulb to the same velocity of the air as that used to obtain the cooling effect on the one to be used for the wet bulb.

Reference being had to the drawings and the designating characters thereon, the numeral 1 indicates the board on which the apparatus is supported.

2 is the dry bulb thermometer of the usual form.

3 is the wet bulb thermometer constructed according to the Sixe form, with the naked or exposed wet bulb 4, extended and slightly bent.

5 represents a casing open at both ends into which the wet bulb leg of the wet bulb thermometer projects. It is supported by rings, 6, attached to a bracket 7, screwed to the board 1. Underneath the casing 5 is a funnel shaped receptacle 8, provided with a drip pipe 9, which receives the water and conveys it to a suitable receptacle, not shown. This funnel is open on the back and the sides at 10 to allow the spray and air passing through the casing to escape and dissipate itself into the atmosphere.

11 is a spray head, either of the ordinary atomizer type or water under pressure, that is designed to break up into a fine spray, 12, more or less cone shaped that is to be projected through the casing 5.

13 is the liquid supply pipe for the spray head.

14 is a glass insulating tube fitted to the leg of the thermometer by a cork 15, and extended within the casing. The function of this tube, 14, is to keep the temperature of the water as it issues from the spray head 11, from affecting the temperature of the thermometer before the spray issuing from the spray head has had time to be cooled down to what may be termed the wet bulb temperature by the evaporation of the fine particles of moisture comprising the spray, when commingled with the currents of air 16, induced by the jet of spray and driven through the casing 5.

The operation of this instrument has already been indicated in the description. It is only necessary to remark, therefore, that the casing 5, can advantageously be made of glass, so that the working of the instrument can be observed at any or all times. The length of the casing 5, is governed by the force and the amount of spray that it is designed to use, bearing in mind the fact that the bulb 4, must be at such a distance from the spray head 11, that the current of air and fine spray passing through the chamber will have been lowered to what I have already termed the wet bulb temperature.

In Fig. 3 I have shown a modification of an instrument constructed along these general lines. 17 represents a water supply that may be supported on the front or back of the hygrometer board 1, that supplies a device known as a sight feed lubricator 18. This sight feed lubricator is of the well known type, to the bottom of which is attached a rubber tube 19, that drips water slowly, drop after drop, which spreads itself in a fine film over the surface of the naked or exposed wet bulb 4. 20 is a propeller fan of the well known type, driven by an electric motor 20′, which is clamped on to the side of the board 1, by a support 21. It drives currents of air 16 past the dry bulb thermometer, 2 and on

past the bulb 4 of the wet bulb thermometer, over which the thin film of water is trickling. The evaporation of the thin film of water by the air blast reduces the temperature of the wet bulb thermometer to its proper point. 22 is a drip cup provided with a waste connection 23, to take away the superfluous water. In this type of instrument it is particularly necessary to be careful that the thin film of water is so small in quantity that the temperature of the water will not affect the temperature of the wet bulb.

In Fig. 4 I have shown the application of the thermometers following this general line of construction, to the usual and well known type of spray humidifier. The humidifier casing is indicated by the numeral 24. The dry bulb thermometer in this case, it will be noticed, is indicated by the numeral 25. The currents of air are shown by arrows indicated by the numeral 16, as heretofore, and the spray by the numeral 12. It is thus easily seen that the draft of air passing the dry bulb, 25, causes the dry bulb thermometer to indicate the temperature of the air going through the apparatus; and the temperature indicated by the naked or exposed wet bulb 4, in the path of and exposed to the spray and cooled air shows the proper wet bulb temperature in the other thermometer.

Fig. 5, as already stated, shows the evaporative type of humidifier 26. This one is of the type that is filled with internal expanded surfaces 27, over the surface of which the water 28, issues from a number of perforations, the water entering through the supply pipe 29. Saturated air issues from the apparatus between the casing and the collecting pan 3 of the humidifier. The bulb of the dry-bulb thermometer 2 is in the path of and exposed to the air entering the casing 26, and the naked or exposed bulb 4 of the wet bulb thermometer 3, is in the path of and exposed to the saturated air in its escape from the lower end of the humidifier. It is obvious, therefore, from the foregoing description that thermometers applied to this type of humidifier will also indicate correctly the wet and dry bulb readings for showing the relative humidity of the atmosphere that enters the casing,—in other words, which is supposed to represent the average conditions of the room.

In commenting upon these various type of apparatus, it is true the average humidifier is cut off occasionally, and in that event the instrument will be out of operation, for the thermometers will indicate correctly only when the humidifiers are running. I should explain, therefore, that it is my purpose not to use the application of my invention to indicate the humidity of the air in the room, but merely to indicate the condition of the air outside the room which is brought in and introduced into the room through the humidifier, a by no means unusual practice in ventilation. The readings of the thermometers attached to such a humidifier, therefore, would show the humidity of the incoming outside air—information that it is decidedly advantageous to have in the art of air conditioning so far as relates not only to humidity but to ventilation and temperature. The principal use to which I propose putting my invention therefore is, not one in combination with a humidifier, but in the construction of an improved type of hygrometer in which the usual troublesome wicking or wet bulb covering, is eliminated yet retaining all the accuracy and other advantages of the best types of wet and dry bulb thermometer instruments.

It is obvious that the kind of thermometers used is immaterial; they may be of the usual glass bulb mercury type, or of any other type of whatsoever kind or shape, this method of cooling the wet bulb particularly lending itself to large or unusual kinds of thermometers.

It is evident that the construction heretofore described and illustrated can be modified and varied in a number of ways without departing from the spirit of my invention. For instance, I propose applying it to my automatic hygrometer for regulating the humidity in mills, described in my Patent No. 811,383.

Having thus fully described my invention, what I claim is

1. A hygrometer comprising two thermometers, one of which thermometers is provided with an uncovered bulb; in combination with means for saturating a current of air which is applied to the surface of said uncovered bulb, and means for producing the current of air.

2. A hygrometer comprising a dry bulb thermometer and a wet bulb thermometer, the latter thermometer having an uncovered bulb; in combination with means for producing and supplying a finely attenuated spray of water to a current of air of requisite psychrometric wet bulb temperature and to which current of air said wet bulb is exposed, and means for producing the current of air.

3. In an instrument for indicating humidity, a dry bulb thermometer and a wet bulb thermometer, means for supplying a finely attenuated spray of water, and means for commingling air with said spray and directing said commingled air and spray upon said wet bulb.

4. In a humidifier, a dry bulb thermometer and a wet bulb thermometer, means for directing the air as it enters the humidifier across the surface of the bulb of the dry bulb thermometer, and means for directing the current of moistened and cooled air across the surface of the bulb of the wet bulb thermometer.

5. In a humidifier, a dry bulb thermometer and a wet bulb thermometer, the bulb of the dry bulb thermometer arranged in the path of and exposed to the air entering the humidifier, and the bulb of the wet bulb thermometer arranged in the path of and exposed to the moistened and cooled air issuing from the humidifier.

6. In a humidifier, a dry bulb thermometer having the bulb thereof arranged in the path of and exposed to the air entering the humidifier, and a wet bulb thermometer having the bulb thereof arranged in the path of and exposed to the moistened air issuing from the humidifier.

In testimony whereof I affix my signature, in presence of two witnesses.

STUART W. CRAMER.

Witnesses:
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W. PARKER REINOHL.