

Sept. 21, 1937.

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2,093,767

RELATIVE HUMIDITY INDICATOR

Filed Aug. 25, 1934

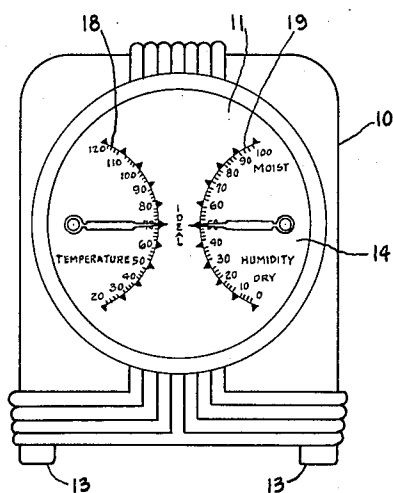


FIG. 1

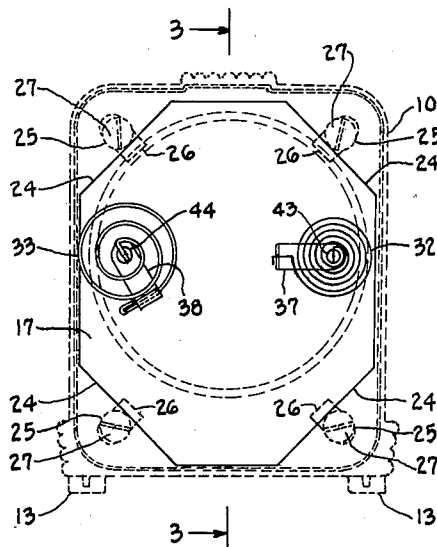


FIG. 2

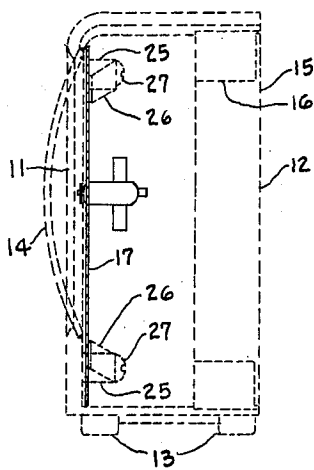


FIG. 3

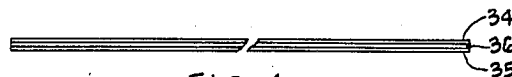


FIG. 4

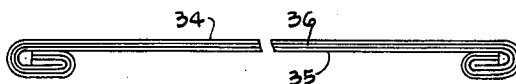


FIG. 5

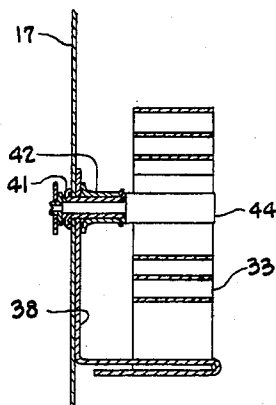


FIG. 6

FIG. 7

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## UNITED STATES PATENT OFFICE

2,093,767

## RELATIVE HUMIDITY INDICATOR

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Application August 25, 1934, Serial No. 741,485

6 Claims. (Cl. 297—1)

The present invention relates primarily to a relative humidity indicator and the process of its manufacture.

Among the objects of the present invention are the provisions of the following:

An improved relative humidity indicator;

A unique process for the manufacture of a humidity indicator;

A novel combination of a humidity indicator and a thermometer in a single housing;

Novel instrumentalities for indicating temperature and relative humidity that are compactly assembled with conveniently disposed indicator scales in juxtaposition; and

A thermometer and a relative humidity indicator on a single panel and each comprising a coiled spring.

These objects and such other objects as may hereinafter appear are obtained by the novel construction, unique combination, and improved arrangement of the several elements which constitute the invention, one embodiment of which is illustrated in the accompanying single sheet of drawing, hereby made a part of this application, and in which:

Figure 1 is a front elevation of a device embodying the subject matter of the present invention;

Figure 2 is a rear elevation of the device shown in Figure 1, the case or housing being shown in dotted outline, and the telescoping back cover being removed;

Figure 3 is a vertical section on the line 3—3 of Figure 2;

Figure 4 is a side elevation of a band used for indicating relative humidity in the initial stage of its manufacture;

Figure 5 illustrates the manner in which the ends of such band are treated;

Figure 6 is an end elevation illustrating the humidity indicator spring coiled for operation; and

Figure 7 is an enlarged sectional detail illustrating how adjustments are made for the humidity indicator.

Like reference characters are used to designate similar parts in the drawing and in the description of the invention which follows.

A suitable case 10 having a front aperture 11 and open back 12 is provided. The case 10 may have feet 13 as shown and may have ornamentation, as illustrated. A suitable glass 14, preferably a convex crystal, is seated in the aperture 11. A slip cover 15, which may be of metal or "bakelite" and which should be foraminous, may

be supplied, there being wings 16 upon said back which frictionally engage opposed walls of the case or housing to secure the cover in position when telescoped therein.

A panel 17 which comprises a mounting for the thermometer and humidity indicator and a support for the indicator hands is disposed in proximity to the front of casing 10. Upon the front face of the panel are two segmental scales, scale 18 for indicating temperature, and scale 19 for indicating relative humidity. Eyelets extend through the panel and provide journals for the shafts, the outer ends of each of which is supplied with a frictionally attached hand, one of which is readable against the scale 18 to indicate temperature, and the other of which is readable against the scale 19 showing relative humidity.

The panel 17 may be of any suitable material. It is generally rectangular. Each of the corners 24 thereof is cut away, as is shown in Figure 2. Bosses 25 of truncated coniform configuration are arranged at each corner of the case or housing and project rearwardly. Each boss has a central threaded aperture.

The edges of the corners 24 of panel 17 fit against the adjacent coniform wall of the bosses 25, the bosses serving as a centering and guiding device. On each of the bosses 25 is a spring 26 of flat material which is held in position by a screw 27, there being an apertured portion of the spring resting upon the boss and engaged by the head of the screw 27. A longer portion of the strip spring 26 extends angularly into the direction of the panel 17, there being a rounded free end upon the strip to engage the back face of the panel to resiliently but firmly hold it in position in the casing.

The shaft for the thermometer indicator hand and the shaft for the humidity indicator hand extend rearwardly a distance equal to or greater than the width of the bimetallic or laminated coil members which are secured thereto.

Secured in position by each of the eyelets is an L-shaped bracket, one leg of which is held between the outer beaded portion of an eyelet and the panel. The other leg of the L-shaped member extends normally to the first mentioned leg and provides suitable anchoring means for the end of the bimetallic or laminated strip member secured thereto. One end of each strip member is inserted in a slot in the shaft to which it is secured, while the other end is suitably anchored in the rearwardly projecting leg of the L-shaped member, the other leg of which is frictionally secured by an eyelet upon the panel or base.

The L-shaped member is moved clockwise or counterclockwise about the eyelet as an axis to provide adjustments. The frictional engagement of the leg upon the panel is sufficient to maintain the L-shaped member in a selected position.

The thermometer coil 32 is bimetallic and is of invar and brass. In the form of the invention illustrated, such bimetallic element is approximately  $\frac{1}{8}$  inch wide and .010 inch thick. It is wound in a spiral starting on a  $\frac{1}{8}$  inch mandrel with a maximum diameter of  $\frac{7}{8}$  inch. The outer end of the coil is radial and it extends  $\frac{1}{8}$  of an inch from the center of the coil.

The coil is of such length that it will give 130 angular degrees rotation for a change of temperature from 20 degrees Fahrenheit to 120 degrees Fahrenheit. The finish of the coil is at right angles to the start of the coil at a temperature of seventy degrees Fahrenheit. The invar is at the outside of the coil. The coils are set, after forming, by being heated to a temperature of 300 degrees Fahrenheit for one hour, after which they are allowed to cool slowly to room temperature. The heating may be done either in an oven or in an oil bath and the coils are disposed therein so that they are free to move about during their heating and during their cooling.

The humidity coil 33 is made from cellulose tape 34 and shim brass 35, .003 inch thick. The tape is made up of a cellulose sheet and an adhesive 36 consisting principally of latex, the cellulose being .0015 inch thick and the adhesive being .002 inch thick. Thus the total thickness of the material of the coil will approximate .0065 inch. The adhesive is of a non-drying type. The tape is produced in rolls of suitable width with adhesive applied thereto ready for use as hereinafter described.

The brass is cut into sheets of suitable size. Both surfaces of the brass are thoroughly cleaned with naphtha, lacquer solvent, or any solvent which will satisfactorily remove oil and dirt.

The cellulose is cut into sheets from the preformed rolls as it is mounted on the brass. The tape will unroll most readily if the roll thereof is warmed slightly.

To unroll the tape, a strip of "bakelite"  $\frac{1}{4}$  or  $\frac{3}{8}$  inch wide and  $\frac{1}{8}$  inch thick is attached to the end of the tape. Such strip extends the full width of the roll. By grasping this strip the tape may be slowly unrolled. No attempt should be made to unroll the tape rapidly for otherwise some of the adhesive may be separated from the cellulose.

When a suitable length of tape has been unrolled, i. e., sufficient to allow the cellulose to extend slightly over the ends of the brass sheet, two parallel strips of "bakelite" should be laid across the width of the tape and the tape cut between these two strips. This will leave a strip attached to the roll for starting the next sheet and a strip of "bakelite" at each end of the severed sheet of cellulose.

Great care must be exercised in handling the cellulose tape not to permit it to come into contact with any material whatsoever before it is laid upon the brass. The tape is next laid upon the clean brass sheet. It is usual to start it at one end and to roll the tape against the brass evenly with a steel or brass roller not over one inch in diameter. Great care should be had to see that no air bubbles gather between the tape and the brass.

Pressure may be used against the roller after

the cellulose has been laid. The entire sheet should be gone over several times to make certain that the tape is in close contact with the brass. The length of the cellulose should be such that it reaches at least to the end of the brass and it may be desirable to overlap the cellulose to the underside of the brass at each end. The sheet as prepared may be cut into strips  $\frac{1}{8}$  inch wide and  $6\frac{1}{2}$  inches long. Care must be exercised in the shearing of the strips to see that no burrs or turned up edges are left by the shearing apparatus.

The ends of the strips are turned over as is shown in Figure 5. The strips before being coiled have their ends folded over twice as is shown in Figure 6, the folded over sections each being  $\frac{1}{8}$  inch wide. The folded over sections are squeezed tightly together. The folding over should be done with the cellulose on top, thus making certain that the cellulose and brass will be held together firmly without reliance upon the adhesive.

The strips thus prepared will be coiled into a spiral starting on a  $\frac{1}{8}$  inch mandrel. After the coil has been started and a half revolution has been made, a strip of armite or fibre .005 inch thick should be started in the coil and wound between the turns. Uniform tension should be kept against the coil at all times. When the winding is complete, the coil is removed carefully from the mandrel and a seal is made at the end by making a double fold as in the start, squeezing the overlapped parts tightly together. The coil is wound invariably with the cellulose on the outside.

The parts directly attached to the dial plate 17 are a temperature bracket 37, a humidity bracket 38, a pair of telescoping eyelets to hold thermometer coil bracket 37, and two other telescoping eyelets 41 and 42 to hold humidity coil brackets, the eyelets 41 and 42 being identical with the eyelets holding bracket 37. The holes in the dial plate for the shafts are .090 inch in diameter. The front eyelet for the thermometer bracket and eyelet 41 are inserted in one of the holes in the dial from the front and the rear eyelet for the thermometer bracket and eyelet 42 from the back. Over the front eyelets from the back are placed respectively the temperature and humidity brackets 37 and 38, and then the rear eyelets are telescoped thereover with their faces against the temperature and humidity brackets. The eyelets are then closed in an eyelet setting machine.

The holes in the eyelets are next broached out with a hardened steel broach so as to provide a smooth and true bearing for the shaft mounting the indicator hand. The hole in the bushing of the clock hand fits on to the shoulder at the end of the shaft, the center of which is bored out to provide a V-shaped point of slight depth so that the end may be squeezed over to hold the hand firmly in place. Care should be taken in squeezing the hand in place not to strike the punch too hard or the shaft may be crushed.

The thermometer and humidity coils are mounted on the shafts 43 and 44, respectively, and the brackets provided for them and are cemented in place with a suitable lacquer cement. When the cement is placed care must be taken that no cement gets between the turns of any of the coils. The bracket for the humidity coils is folded over and squeezed tightly around the end of the coil, the coil cemented on both sides of the bracket, and the bracket crimped at 45 to further strengthen the joiner. At the shafts,

the cement should be placed around the diametric slot in the shaft where the start of the coil emerges. The purpose of using cement is to hold the coil firmly in place. After the cement around the coils is dried, a rough adjustment to the temperature and humidity of the room should be made and the apparatus is placed in a saturated atmosphere for a length of time after which it should be placed in a dry atmosphere for say two or three hours. Comparison should be made with wet and dry bulb thermometers and the units adjusted accordingly. The adjustments may all be made upon the panel and before the panel is inserted in the housing therefor. The adjustments are made by rotating the bracket clockwise or counterclockwise about the eyelet as previously indicated.

In the final assembly, the convex crystal is first put into place, the dial assembly laid upon it and clamped tight, after which the back is slipped into place.

Increased accuracy apparently may be obtained from the thermometer coils if the process of heat treating is repeated two or three times and if after the coils are set in place on the dial, they are subjected to the extremes of temperature at which they are intended to operate; namely, twenty degrees Fahrenheit and one hundred twenty degrees Fahrenheit, before the final adjustment is made.

The accuracy of the humidity coil depends upon the uniformity of the thickness of the component parts and the bond that is obtained between them. It is therefore evident that if air bubbles or wrinkles are permitted to exist in the cellulose film, the accuracy of the coil will be destroyed. It is important to operate the humidity coil over the extremities of the range in order to work out any wrinkles that may exist.

The description hereinabove given is specific to one form the invention has taken in commercial production. Modifications of casing, panel, arrangement, assembly and parts are in order without departing from the spirit of the invention.

Other humidity coils may be substituted for that described. For example, a coil may comprise brass and cellulose nitrate, brass and cellulose acetate, gelatine and cellulose nitrate, gelatine and cellulose acetate, gelatine and cellulose, and gelatine in combination with cellulose nitrate or cellulose acetate, or cellulose and brass for shaping. All of these give satisfactory results.

Cellulose and cellulose compounds may be used in suitable strip or sheet form with a suitable adhesive for bonding. Cellulose and cellulose compounds may be dissolved in suitable solvents and the solution applied to brass. Adhesives

other than latex may be employed, as those with a lacquer base. Any adhesive that bonds the elements together but which does not of itself enter materially into the reaction at the out-start or later is satisfactory. The adhesive should not dry out, stiffen, or become brittle. No adhesive is necessary between gelatine and a cellulose compound.

The effectiveness of cellulose and cellulose compounds or their combination with gelatine resides in that fact that they may be obtained in a uniform state. All coils made therefrom which are dimensionally the same will be uniform in their response to the absorption of water vapor. This effectiveness and uniformity is in striking contrast to materials such as leather, paper, hair, and the like which by their nature are not readily procured in a homogeneous and uniform state.

What is claimed as new and is desired to be secured by Letters Patent of the United States is:

1. A humidity indicator comprising a coiled compound strip of a thin sheet of metal, a thin sheet of cellulose acetate, and a non-drying adhesive therebetween.

2. A humidity indicator comprising a strip of thin metal, a strip of thin cellulose acetate, and a non-drying adhesive therebetween, the ends of the strip being folded over with the cellulose acetate at the outside.

3. A humidity indicator comprising a strip of thin brass, a strip of thin cellulose acetate, and a layer of non-drying adhesive therebetween, the strip of cellulose acetate being longer than the strip of brass and the ends of the strip being folded and the cellulose acetate being turned under the brass.

4. A humidity indicator comprising a thin strip of brass, a thin strip of cellulose acetate longer than the strip of brass and at one side of the brass strip, the ends of the cellulose acetate strip overlapping the opposite side of said brass strip, and non-drying adhesive between contacting surfaces of the brass and cellulose acetate, the ends of the compound strip being folded over with the cellulose acetate at the outside.

5. A humidity indicator comprising a coiled laminated strip comprising a layer of cuprous material, a layer of cellulose acetate, and a non-drying adhesive comprising gelatine securing said layers together.

6. A humidity indicator comprising a coiled laminated strip comprising a layer of brass, a layer of cellulose acetate, and a non-drying adhesive securing said layers together.

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