

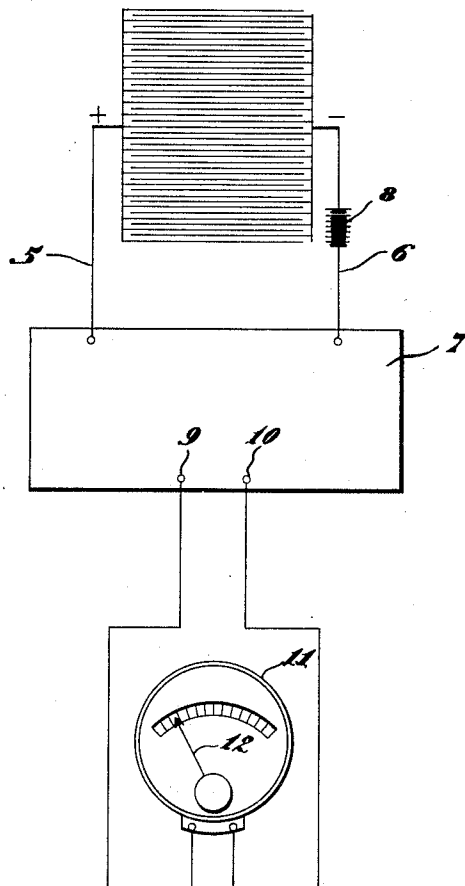
June 5, 1945.

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2,377,426

HUMIDITY RESPONSIVE DEVICE

Filed Dec. 3, 1943



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UNITED STATES PATENT OFFICE

2,377,426

HUMIDITY RESPONSIVE DEVICE

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Application December 3, 1943, Serial No. 512,819

7 Claims. (Cl. 201—76)

This invention relates to a humidity responsive apparatus for indicating or controlling variations in the moisture content of the atmosphere in which it is located.

The invention is based upon the discovery and determination that moisture content of hydrophilic gels responds promptly to variation in the moisture content of the surrounding atmosphere and that the electrical conductivity of the gel varies in accordance with its moisture content. This invention, briefly, contemplates a device consisting essentially of a membrane or a grid of the moisture responsive gel and means for measuring its conductivity or resistivity as determined, for instance, by the voltage drop of the current flowing through it.

A typical gel exhibiting these characteristics is gelatin; others are pectin, agar-agar, and the like, which are known in the art and which in the remainder of this specification are termed hydrophilic colloid gels whether they be employed alone or in admixture. While the various humidistats known in the past all have embodied mediums of one sort or another which respond physically as humidity responsive mediums the present compositions are very much superior to those which heretofore have been employed, such as hair, certain chemical salts and the like, because of the speed or promptness with which variations in atmospheric moisture content is manifested. Heretofore a lag of a half a minute to a minute or more has been considered acceptable primarily because better performance could not be expected. The mediums of the present invention respond in but a fraction of this time, equilibrium being reached usually within a second or so following the change. This property obviously is a very valuable one inasmuch as variations in humidity condition are measured as they occur and appropriate adjustments may be made immediately to offset them.

On the other hand, while the conductivity of the hydrophilic gels of the present invention is low even when their moisture content corresponds to the saturated atmospheric condition or 100% humidity, still the conductivity of the gel reliably conforms with its moisture content which in turn reliably conforms with the moisture content of the ambient atmosphere and for this reason the gels are accurate as well as prompt in response.

In their simplest form the devices of the present invention consist of a simple grid comprised, for example, of wires forming positive and negative electrodes which are spaced apart and the intervening spaces are spanned by the hydrophilic

gel medium. A grid of this sort is made conveniently by dipping the wires, after they have been suitably arranged, into a solution of the gel after which the solvent vehicle is liberated to leave the gel in the form of a membrane interconnecting the grid electrodes.

Upon impressing a voltage across the grid a current flows through the gel, the magnitude corresponding to the gel moisture content. This current is measured either to provide indications of an existing humidity condition or to actuate relays for humidity controlling purposes. The current flowing through the gel may be very small, for instance, of the order of the 10^{-6} amperes and it is, therefore, desirable to operate the grid in conjunction with a suitable amplifying device.

A representative embodiment of the invention is disclosed in the drawing in which Figure 1 is a diagrammatic illustration of the unit, and from the foregoing description of the principles upon which the invention is predicated, and the following description of the detailed structure, those skilled in the art readily will comprehend the various modifications to which the invention is susceptible.

In the drawing the grid is indicated generally at 1. It consists of one or a plurality of positive electrodes 2 and one or a plurality of negative electrodes 3 which are spaced apart from one another. The spacing between the electrodes is not of critical importance but should not be too great, otherwise the resistance of the unit will be so high that an excessive impressed voltage may be necessary. The electrode wires of the grid are enmeshed or in connection with a substantially continuous film of hydrophilic colloid which forms the moisture responsive medium. As previously indicated this film is provided on the grid most conveniently by dipping it into a solvent solution of the hydrophilic colloid so that the colloid adheres to the grid and spans the intervening spaces between the electrode as a film. Thus the film is indicated generally at 4. Following this operation the solvent is expelled leaving the film of colloid intact. Thus, as a typical example, a suitable aqueous solution of gelatin of approximately 5% strength is prepared which leaves a film of approximately .002 inch thick enveloping the wires. The thickness, of course, will vary upon the spacing of the wires and the concentration of the gel. While a grid may be prepared from only one positive and one negative grid wire with the film established in between them, it is usually better, as a matter of precaution, to use three or four wires so that if there are variations at local portions of

the grid, the electrical response will be according to the most sensitive portion. The grid wires suitably may be spaced about one-sixteenth to one-eighth of an inch or more apart.

As an alternative method, suitable sheets of the hydrophilic gel to be employed may be mounted at one or both faces of the grid with suitable precautions being taken to insure good contact between the grid electrodes and the hydrophilic sheets for uniformity in operation of the unit.

The positive and negative electrodes preferably are connected, through the leads 5 and 6, to a suitable amplifier 7, and the circuit is furnished with energy from a battery 8 or other source of electrical potential. The amplifier apparatus may be of any conventional type and, inasmuch as it does not form any part of the present invention, is not described here in detail. It has the usual amplifier function of furnishing at its terminals 9 and 10 a current of greater magnitude which may be impressed upon and indicated by the ammeter 11. When the grid is employed with an amplifier apparatus it is preferable to shield the grid with an open mesh or screen connected to the ground in order that the grid will not act as an aerial with respect to the amplifier circuit.

While an amplifier usually is desirable, the invention also contemplates direct measurement of a current flowing through the grid without amplification should suitable microammeters which are more sensitive than those now available become known. In either case the needle 12 of the meter responds according to the voltage drop across the grid or more specifically according to the voltage drop in the hydrophilic colloid of the grid.

The apparatus is calibrated conveniently by denoting the position of the meter needle when the grid is surrounded by an atmosphere of known moisture content. Such atmospheres may be obtained by exposing the grid in chambers which are subject to the known vapor pressure of selected substances. A series of readings obtained in this manner from zero to 100% humidity enables the scale to be calibrated over its full scale with suitable interpolation. It is to be noted that the grid does not lose its conductivity at a condition corresponding to complete atmospheric dryness of the zero humidity, and responds, therefore, over the entire humidity range. The promptness of response of the apparatus may be illustrated by the fact that the meter needle is deflected over its entire scale when the grid is breathed upon and returns to its initial setting position promptly thereafter. The gels of the present invention, so far as I have been able to determine, lose or dissipate their moisture content as the surrounding atmosphere becomes drier at substantially the same rate as their moisture content is increased

with an increase in humidity. Therefore they display prompt response to an increase or decrease in humidity. While the current output of the magnifier is connected with a meter as shown in the drawing, the output may be exerted also upon a pilot controller or relay which may be arranged to actuate valves for replenishing moisture or dampers for controlling air supply.

The term moisture has been used throughout this specification to denote water vapor but it also has been determined that such grids of the present invention respond in similar manner to the vapor of other liquids including organic solvents such as alcohol. The term moisture responsive, therefore, is intended in this specification to denote response to variations in the atmospheric vapor content of such substances.

Having described my invention, I claim:

1. A humidity responsive apparatus including a pair of spaced conductors and a film of conductive organic hydrophilic colloid connecting said conductors, whereby variations in the electrical resistance of said film, as caused by variations in the humidity of ambient atmosphere, may be measured.

2. A moisture responsive grid, comprising a plurality of spaced electrodes and a film of gelatin connecting said electrodes, whereby the electrical resistance of the gelatin, as varied by changes in the humidity of ambient atmosphere, may be measured.

3. A moisture responsive grid, comprising a plurality of spaced conductors and a film of organic hydrophilic colloid selected from the class comprising gelatin, pectin and agar-agar connecting said conductors, whereby variations in the electrical resistance of the film, as caused by variations in humidity of ambient atmosphere, may be measured.

4. A humidity responsive apparatus, comprising spaced conductors interconnected with one another conductively through an organic hydrophilic gel, whereby variations in the resistance of said gel, as caused by variations in the humidity of ambient atmosphere may be measured.

5. A humidity responsive apparatus, comprising spaced electrodes connected together through a film of gelatin which conductively envelopes said electrodes, whereby variations in the resistance of the gelatin, as caused by variations in humidity of ambient atmosphere, may be measured.

6. A humidity responsive apparatus, comprising spaced electrodes connected together through a film of agar-agar which conductively envelopes said electrodes.

7. A humidity responsive apparatus, comprising spaced electrodes connected together through a film of pectin which conductively envelopes said electrodes.

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