Dec. 4, 1928. 1,694,107

W. R. STARKINS

SYSTEM FOR DETECTING AND CONTROLLING HUMIDITY VARIATIONS

Filed March 24, 1926

FIG. 1.

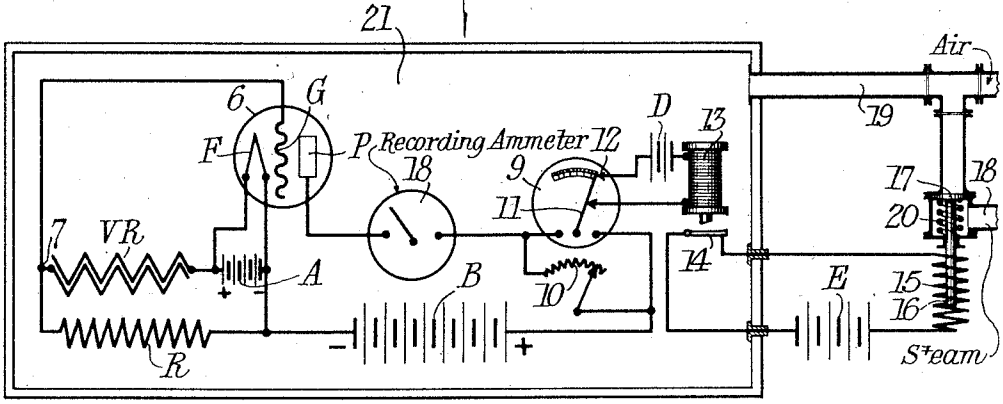


FIG. 2.

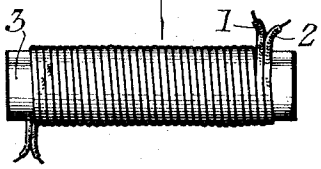


FIG. 3.

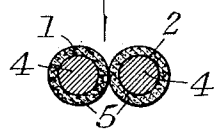
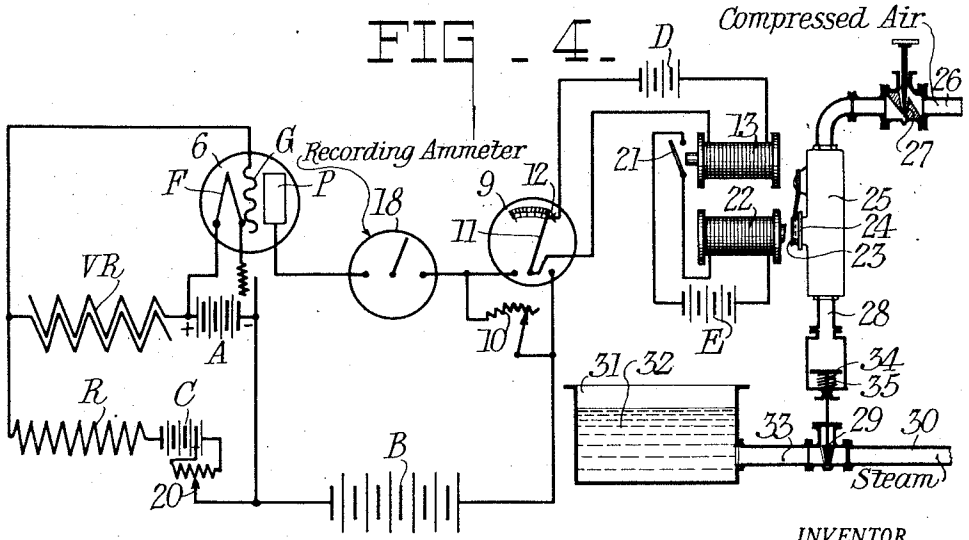


FIG. 4.



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UNITED STATES PATENT OFFICE.

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SYSTEM FOR DETECTING AND CONTROLLING HUMIDITY VARIATIONS.

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This invention relates to a system for detecting changes in the humidity of the atmosphere and for controlling the relative humidity in an enclosed space.

Among the objects of my invention are to provide such a system which will be automatically operative independently of the temperature and without the necessity of controlling temperatures as well as humidity, and which will be simple and reliable. These and other objects are attained by incorporating in an electrical circuit an element whose resistance is a function of the humidity; detecting the variations caused by changes in the resistance and utilizing these to control the introduction of moisture into the atmosphere.

Reference will be made to the accompanying drawing wherein

Fig. 1 is a diagram illustrative of a simple embodiment of my invention.

Fig. 2 shows one form of my variable resistance element.

Fig. 3 is a section through two wires forming my variable resistance element.

Fig. 4 is a diagram illustrative of another embodiment of my invention.

The element VR which I use as a resistance which is variable as a function of the humidity of the atmosphere comprises two pieces 1 and 2 of ordinary electrical bell wire, that is copper wire with a single layer of cotton insulation, which are intercoiled on a porcelain tube 3. In Fig. 3 a section of the two closely adjacent wires is shown, each having the wire core 4 and the insulation 5. The tube acts merely as a support. These wires may be intertwisted or interwound in any way, so long as they are closely adjacent for a considerable length. The cores are not, however, in contact at any point. This form of element is shown in Fig. 2, but in the diagrams the element is merely shown formally as two closely adjacent resistances and is designated in a whole in each instance as VR.

In dry condition, the resistance of this element is extremely high and with low voltages the currents flowing through it are practically indetectible. As the humidity of the atmosphere increases, it is absorbed by the cotton and the current flow through the element increases.

A simple form of circuit is shown in Fig. 1 wherein the element VR is connected to the terminals of a battery A, there being shown also a resistance R of fixed, predetermined magnitude in series with VR. Across the battery A is also connected the filament F of an audion 6, having a grid G connected to a point 7 between R and VR and a plate P. A second battery B is connected to the negative end of the filament F and to the plate P, there being in this second circuit a recording ammeter 18, and a galvanometer 9 having a shunt rheostat 10. The galvanometer needle 11, when in one position, closes through contacts 12 a third circuit including battery D and electromagnet 13, the armature 14 of the latter controlling a fourth circuit through battery E and the electro-magnet 15, the core 16 of which, acting against spring 20, opens a valve 17 admitting steam from a supply pipe 18 to a pipe 19 through which air is supplied to the chamber 21 in which is the element VR, the air supply being somewhat drier than is desired in the chamber.

Current will flow through the audion from battery B and this will be affected by the potential of the grid G. This in turn will vary as the resistance of VR varies. The ammeter 8 and galvanometer 9 constitute direct reading indicators showing the current flowing in the plate circuit. For any particular installation and setting they may be calibrated in terms of humidity.

I have found that especially at ordinary room temperatures and with rather high humidity, the current flow is nearly a linear function of the relative humidity.

In the system shown in Fig. 1, the galvanometer needle 11 closes the third circuit when the current attains a value which may be predetermined by adjustment of rheostat 10. The magnet 13 when actuated, opens the fourth circuit which is normally closed. The magnet 15 holds valve 17 open, admitting steam at low pressure to the air supply system. When the humidity in the chamber attains a definite value, the galvanometer needle closes the third circuit and relay 13 opens the fourth circuit, the valve 17 seating itself and shutting off the steam from the air supply. When the air in the room becomes drier and the conductivity of the resistance element less, the galvanometer needle will move and open the third circuit and steam will again be admitted.

The system shown in Fig. 4 is essentially the same as that of Fig. 1, but certain refinements are added that have been found useful in practice. The same reference characters are used as far as they are applicable. In the first circuit an additional battery C

is used to put a negative charge on the grid, as is common practice in such circuits, with an adjustable resistance 20 in parallel with one cell. The galvanometer 9 is so designed that the needle 11 will contact with 12 to close the third circuit when the current is at a certain minimum. Electromagnet 13, when energized, closes a switch 21 in a fourth circuit including battery E and electromagnet 22, the armature 23 of the latter opening a valve 24 in an air pressure tank 25. This tank 25 is connected to a high air pressure main 26, there being a needle valve 27 between the two. The tank is connected by pipe 28 to the pneumatically controlled valve 29. This valve controls the passage of steam from supply pipe 30 to a pipe 33 leading to the tank 31, which is partially filled with water 32. The pipe 33 enters the tank 31 below water level. The pneumatic piston 34 holds valve 29 seated against the force of spring 35. The tank 31 is in the air system with element VR, and may be either in the chamber itself or in an air supply system therefor. The operation of this system is obvious. When the humidity of the air becomes lower than the value for which the system has been adjusted, the current in the second circuit will be so small that the galvanometer needle will close the third circuit, and magnet 13 will cause the closure of the fourth circuit. Magnet 22 will cause valve 24 to open, releasing the air pressure in the tank and spring 35 will open the valve 29 admitting steam to the tank 31, raising the temperature of the water and causing more water vapor to be given off into the air.

It is apparent that numerous embodiments are possible and I consider as included in my invention all such modifications and equivalents as fall within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Means for detecting variations in the humidity of the atmosphere comprising an electrical circuit including an element, the conductivity of which is a function of the humidity of the surrounding atmosphere, the change of conductivity due to change in humidity being of a magnitude compared to which the change of conductivity due to change of temperature is negligible, and a source of current and means for detecting variations of current in said circuit due to changes in the conductivity of said element.

2. Means for detecting variations in the humidity of the atmosphere comprising an electrical circuit including a source of current, a resistance having a definite, predetermined value and a second resistance, which is variable as a function of the humidity of the atmosphere, the change of conductivity due to change in humidity being of a magnitude compared to which the change of conductivity due to change in temperature is negligible, and means for detecting variations of potential at a point between said resistances due to variations in said variable resistance.

3. Means for detecting variations in the humidity of the atmosphere comprising an electrical circuit including a resistance element, said element comprising non-contacting conductors and a non-metallic material between said conductors; change of conductivity of said material due to change in humidity being of a magnitude compared to which the change of conductivity due to change in temperature is negligible, and a source of current and means for detecting variations of current in said circuit due to changes in the conductivity of said element.

4. Means for detecting variations in the humidity of the atmosphere comprising an electrical circuit including a resistance element, said element comprising non-contacting conductors and a water absorbent material between said conductors, the conductivity of the material being a function of the humidity of the surrounding atmosphere, and a source of current and means for detecting variations of current in said circuit due to changes in the conductivity of said element.

5. Means for detecting variations in the humidity of the atmosphere comprising two closely adjacent, unconnected, extended conductors, a separating material between said conductors capable of absorbing moisture and the conductivity of which is a function of the humidity of the surrounding atmosphere, a source of current, an electrical circuit including connections from said source to the wires and means for detecting variations of current in the circuit due to variations of conductivity of the separating material.

6. Means for detecting variations in the humidity of the atmosphere comprising an electrical circuit including a resistance element comprising two closely adjacent, unconnected, extended conductors with a separating material between said conductors capable of absorbing moisture and the conductivity of which is a function of the humidity of the surrounding atmosphere, a resistance having a definite predetermined value and a source of current, means for detecting variations in potential between said resistances due to variations in such conductivity, and means controlled by said last named means for indicating such detected variations.

7. Means for detecting variations in the humidity of the atmosphere comprising an electrical circuit including a source of current, and a resistance element the conductivity of which is a function of the humidity, and a second circuit including a thermionic valve having a plate, grid and filament, a source of current and an electromagnetic de-

vice, the grid being connected to a point in the first circuit whereby variations in the current flow therein will affect the flow of current through the second circuit, the electromagnetic device being responsive to such variations in the second circuit.

8. A system for controlling the humidity of the atmosphere in a chamber comprising means for introducing moisture into the said atmosphere, and an electrical circuit including an element in the chamber, the resistance of the element being a function of the humidity of the surrounding atmosphere, a source of current and means responsive to variations of current in said circuit and controlling the first named means.

9. A system for controlling the humidity of the atmosphere in a chamber and comprising an air supply system for said chamber, electrically controlled means for introducing moisture into said air supply system, an electrical circuit including a source of current, a resistance of definite predetermined value, a second resistance, said second resistance being in the chamber and varying as a function of the humidity of the atmosphere in the chamber, and means responsive to variations of potential at a point in said circuit between said resistances and controlling the first named means.

10. A system for controlling the humidity of the atmosphere in a chamber and comprising means for introducing moisture into the chamber, an electrical circuit including a source of current and a resistance element the conductivity of which is a function of the humidity, a second circuit including a thermionic valve having a plate, grid and filament, a source of current and an electromagnetic device, the grid being connected to a point in the first circuit whereby variations in the current flow therein will affect the current flow through the second circuit, and a third circuit including means for controlling the moisture introducing means and a switch controlled by the said electromagnetic device.

11. A system for controlling the humidity of the atmosphere in a chamber and comprising means for introducing moisture into the chamber, an electrical circuit including a source of current, a resistance having a definite predetermined value, and a second resistance element in the chamber and whose conductivity is a function of the humidity, a second circuit including a thermionic detector having a plate, grid and filament, a source of current and a magnetic relay, the grid being connected to a point in the first circuit between said resistances, and the relay being responsive to variations of current in the second circuit due to variations of potential in the first circuit detected by said grid connection and a third circuit controlled by said relay and including a source of current, and an electromagnetic device for controlling the means for introducing moisture.

12. A system for controlling the humidity of the atmosphere in a chamber and comprising an air supply system for said chamber, electrically controlled means for introducing moisture into said air supply system, an electrical circuit including in series a source of current, a resistance of definite predetermined value and a second resistance element in the chamber and comprising two extended, non-contacting, closely adjacent conductors with a separating material between them capable of absorbing moisture and whose conductivity is a function of the humidity, a second circuit including a thermionic detector having a plate, grid and filament, a source of current and a magnetic relay, the grid being connected to a point in the first circuit between said resistances, and the relay being responsive to variations of current in the second circuit due to variations of potential in the first circuit detected by said grid connection, and a third circuit controlled by said relay and including a control for said moisture introducing means.

Signed at Rochester, New York, this 16th day of March, 1926.

WALTER R. STARKINS.