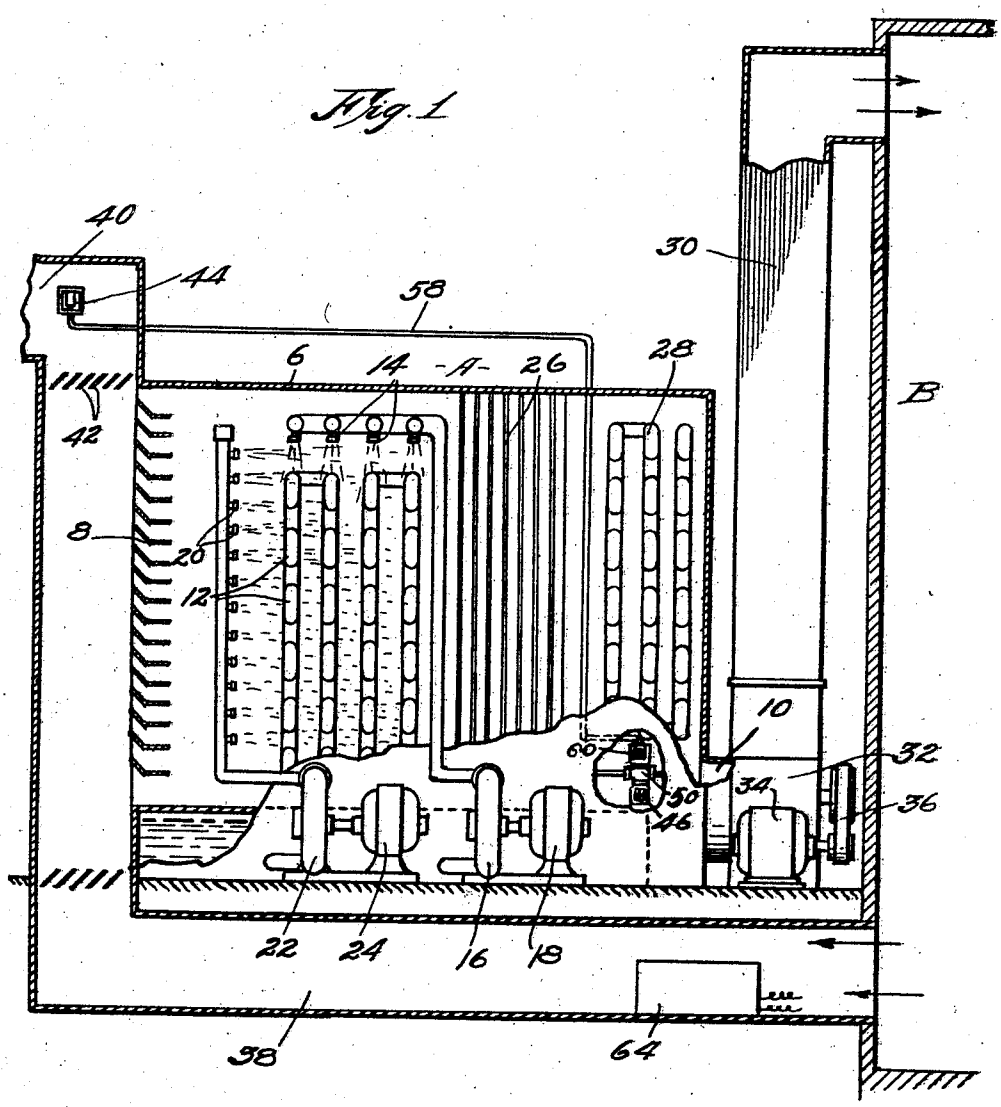
March 8, 1938. L. D. McDONALD 2,110,164

AIR CONDITIONING

Filed Oct. 3, 1930 2 Sheets-Sheet 1

Fig. 1



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Filed Oct. 3, 1930 2 Sheets-Sheet 2

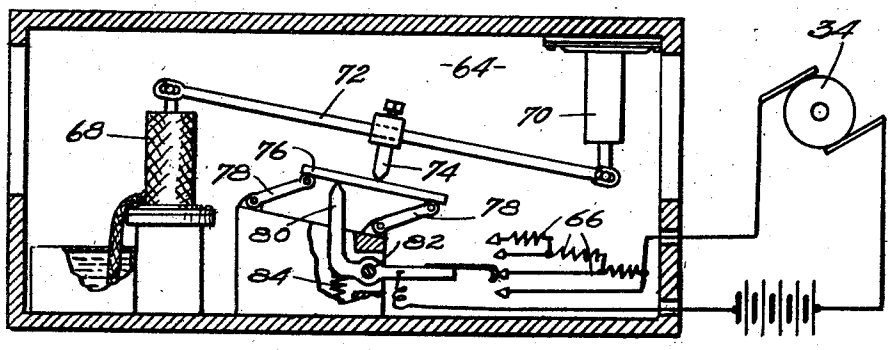

Fig. 2.

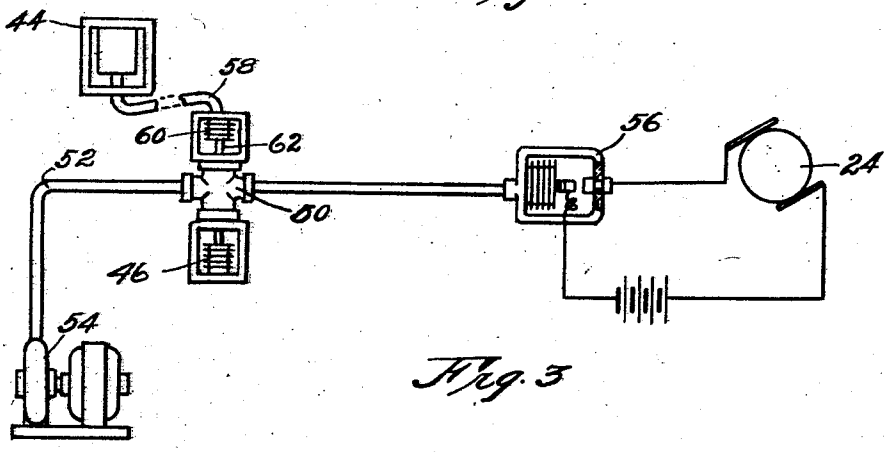

Fig. 3

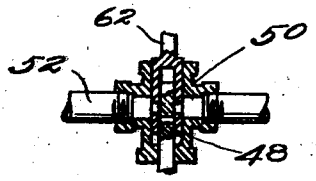

Fig. 4

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Patented Mar. 8, 1938 2,110,164

UNITED STATES PATENT OFFICE

2,110,164

AIR CONDITIONING

Lawrence D. McDonald, Kansas City, Mo.

Application October 3, 1930, Serial No. 486,122

10 Claims. (Cl. 261—11)

This invention relates to apparatus for controlling temperature and humidity within an enclosure and is especially adapted for use in connection with theatres or similar places where the audience is to be housed within a room maintained at a temperature substantially lower than the outside temperature during the summer time and at a predetermined desired temperature during the colder months.

The primary object of the invention is the provision of apparatus especially adapted for controlling the temperature and humidity within an enclosure by controlling the total volume of air introduced into said enclosure.

A yet further object of the invention is the provision of combined temperature and humidity regulating apparatus, the volume of air passing therethrough to the enclosure being treated, and regulated by the relative humidity of the air passing from said enclosure.

One of the further objects of the invention is the provision of temperature regulated means within a dehumidifier which is actuated by the change in temperature in a manner to alter the amount of spray water used within the dehumidifier.

The invention further contemplates the combination with a dehumidifier of ordinary structure of a pair of thermometers which are interconnected and positioned adjacent the air inlet and air outlet in a manner which allows setting the same to maintain a temperature differential at the air inlet to the humidifier and at the point of entrance of the treated air into the enclosure. It is well known in this art that where an enclosure is to be maintained at a predetermined temperature and humidity that some regulation must be provided as the number of things within the enclosure is varied.

In the present invention it is contemplated to alter the total air volume passed through the enclosure in order that the air temperature and humidity might be controlled and it is also a point of the invention to control the temperature of the air prior to its being introduced into said enclosure.

In the warmer months it is desirable to maintain an enclosure of the character above set forth at a temperature not in excess of ten degrees lower than the atmospheric or outside air temperature. Means is provided in the structure made in accordance with this invention to maintain the air being introduced into the enclosure at a predetermined different temperature over that of the outside atmosphere.

The present invention further contemplates novel structures and combinations of parts whereby to carry out the objects of the invention as hereinabove set down. Such structural details and further minor objects of the invention will appear during the course of the detailed specification referring to the accompanying drawings wherein is shown in diagrammatical form an apparatus for controlling temperature and humidity within an enclosure. In the drawings:

Figure 1 is a vertical fragmentary sectional view through a dehumidifier showing the arrangement of parts as contemplated by this invention.

Fig. 2 is an enlarged vertical central section through a humidostat embodying the features of the present invention.

Fig. 3 is a diagrammatical lay-out of the interconnected thermostats showing their relation to the means for supplying the water to the cooling coils of the dehumidifier, and,

Fig. 4 is an enlarged fragmentary vertical section through the valve associated with the thermostat adjacent the air outlet.

The invention may be embodied in structures of various forms and characters and only the preferred form of the same is diagrammatically illustrated in the accompanying drawings, wherein like reference numerals are used to designate similar parts throughout the several views.

In carrying out the invention a well known dehumidifier A may be used to act upon air passing to the enclosure B, wherein the temperature and humidity is likely to be constantly and suddenly altered by the entrance and exit of a large number of people. The dehumidifier with which the parts made in accordance with this invention are combined with effect comprises a housing 6, having an air inlet opening 8 and an air outlet 10, between which is located a series of cooling coils 12, within which is provided a refrigerant of some sort sufficient to cool the incoming air as it passes thereover. Coils 12 should have water sprayed thereover and in the instance shown there is provided a plurality of spray heads 14 which spray water downwardly over coils 12 and which will supply it with water through the intermediacy of a pump 16 driven by motor or analogous means 18. In addition to the spray heads 14, a plurality of spray heads 20 is provided which force a substantially horizontal spray against coils 12. Likewise, a pump 22, driven by motor 24, supplies water to spray heads 20. Air passing into the dehumidifier through intake 8 leaves the coils 12 by the way

of a plurality of serpentine paths formed between eliminators 26 where a vast majority of the water carried by the air is lost along said paths. From the description set down next above, it is obvious the air dehumidifier or conditioning apparatus should include, besides the cooling coils, the pumps, the interconnected temperature regulated means, means to control the supply of water to said coils, and a plurality of eliminators to form serpentine paths wherein moisture is lost from the air as it travels. In case the apparatus is to be used in winter or during the colder months, a heating coil 28 should be provided to receive steam for the purpose of treating the air passing into enclosure B to the desired temperature.

An air shaft 30 connects with a fan 32 which is interposed between enclosure B and dehumidifier A. This fan is driven by a motor 34 through the use of a belt or similar structure 36 and draws air through the air outlet 10 and forces it to the enclosure B through air shaft 30 as shown in Fig. 1. Air leaving enclosure B passes through conduit 38 which is in communication with the dehumidifier A. A certain amount of outside or atmospheric air should be taken into the apparatus through outside air inlet 40, but a series of dampers 42 may be provided to regulate the amount if necessary. Dampers 42 should never be entirely closed to preclude circulation but must be open to some degree at all times.

It is desirable in practicing this invention to combine with the apparatus a thermostat 44 which is positioned in the path, and is acted upon by, the incoming outside atmospheric air. A second thermostat 46 is positioned in the path of travel of air leaving the dehumidifier A and is preferably located where the temperature of the air striking the same will not be different from the temperature of the air entering enclosure B. Thermostat 46, when actuated by the change in temperature, moves a plunger 48 to open and close a valve 50 interposed in an air line 52. A sutiable motor driven air pump 54 supplies air under pressure to air line 52 and when valve 50 is opened, air will pass through line 52 and close switch 56 which controls the current to motor 24. Obviously, the opening and closing of valve 50 starts and stops respectively, motor 24. A small bleeder valve should be interposed in line 52 between valve 50 and switch 56 to insure against trapping of air and to positively release air pressure which is great enough to hold switch 56 closed. This valve is so small that it does not affect air pressure from pump 54. Thus will spray through heads 20 be cut off or allowed to flow as thermostat 46 is moved, by the change in temperature at the air outlet 10.

When the temperature is too high, valve 50 should be opened so that switch 56 may be closed, causing pump 24 to send an additional spray through the incoming air to cool or lower the temperature of the same.

It is desirable to maintain a predetermined difference between the temperature of air passing to enclosure B and the outside air. To set up this predetermined difference an operative connection between thermostat 44 and thermostat 46 is established by introducing an air tube 58 which extends from thermostat 44 to bellows 60 which raises and lowers a plunger 62 as the pressure of air is increased or decreased within tube 58 by thermostat 44. The lower, innermost end of plunger 62 acts as a seat for plunger 48 and, obviously, when plunger 62 is moved upwardly, Fig. 4, it will take a greater stroke on the part of plunger 48 to entirely close valve 50. As the outside temperature varies so does the position of plunger 62 and, accordingly, the proper differential between the outside temperature and the temperature of the air entering enclosure B will be maintained.

In combination with the temperature control as just above set forth, it is a feature of this invention to provide means to control the volume of air to enclosure B which is actuated by the condition of air passing from the enclosure. Within air conduit 38 is positioned a humidostat 64 which is associated with a controller 66, which in turn alters the speed of motor 34 as the various resistance coils of controller 66 are thrown into and out of the circuit. Broadly speaking, and since the humidostat 64 alters the speed of motor 34 in accordance with the humidity of the air passing from enclosure B, this structure may be said to constitute one of the most important features of the present invention. Specifically, the humidostat 64 includes a wet bulb thermostat 68 and a thermostat 70 which are connected together by a bar or similar device 72 having an adjustable fulcrum arm 74 which may be moved along a bearing platform 76 carried by links 78 so as to maintain the platform 76 in operative position upon lever 80 which is pivotally supported as at 82.

Compression spring 84 maintains the point of lever 80 against the platform 76 and as the same is moved up or down, lever 80 pivots about the pivotal point 82 to throw in or out, as the case may be, the series of coils forming a part of controller 66. Thus the speed of motor 34 is altered in accordance with the relative movement between wet bulb thermostat 68 and thermostat 70, which is expressed in terms of the movement of fulcrum arm 74.

Manifestly, the humidostat may be set for any desired humidity and any increase above that predetermined humidity will cause the fan 32 to reduce its speed until the air introduced into enclosure B is reduced and the humidity is decreased to the desired point. Since the temperature of the air is also controlled before it enters enclosure B, it is possible to maintain a desired temperature or humidity within the enclosure without the use of further devices.

It is understood that substitutions for the instruments herein described might be made so long as the performances of the same are substantially identical to those described and are capable of performing a like function. Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In an apparatus for controlling temperature and humidity within an enclosure, the combination of an air dehumidifier having an air inlet, an air outlet, a fan for drawing air into the dehumidifier and forcing it into said enclosure, said dehumidifier comprising cooling coils within the dehumidifier, a pump for spraying water over the cooling coils and interconnected temperature regulated means adjacent said air inlet and air outlet having means for controlling the supply of spray water passing over said cooling coils.

2. In an apparatus for controlling temperature and humidity within an enclosure, the combination of an air dehumidifier having an air inlet, an air outlet, a fan for drawing air into the dehumidifier and forcing it into said enclosure, said dehumidifier comprising cooling coils within the dehumidifier, pumps for spray-

ing water over the cooling coils, a thermostat at the air inlet, a thermostat at the air outlet, a connection between said thermostats whereby said first mentioned acts upon the second mentioned to vary the action thereof and a switch for starting and stopping one of said pumps, said switch being controlled by action of said outlet thermostat whereby to control the supply of spray water passing over said cooling coils.

3. In an apparatus for controlling temperature and humidity within an enclosure, the combination of an air dehumidifier having an air inlet, an air outlet, a fan for drawing air into the dehumidifier and forcing it into said enclosure, said dehumidifier comprising cooling coils within the dehumidifier, a pump for spraying water over the cooling coils and interconnected temperature regulated means adjacent said air inlet and air outlet having means for controlling the supply of spray water passing over said cooling coils, said temperature regulated means being constructed to act upon the dehumidifier to maintain a predetermined difference in temperature between the air intake and air outlet.

4. In an apparatus for controlling temperature and humidity within an enclosure, the combination of an air dehumidifier having an air inlet, an air outlet, a fan for drawing air into the dehumidifier and forcing it into said enclosure, said dehumidifier comprising cooling coils within the dehumidifier, pumps for spraying water over the cooling coils, a thermostat at the air inlet, a thermostat at the air outlet, a connection between said two thermostats whereby the effective action of the latter is altered by the former and means controlled by the combined action of the inlet thermostat and said outlet thermostat to control the action of said spray pumps.

5. In an apparatus for controlling temperature and humidity within an enclosure, the combination of an air dehumidifier having an air inlet, an air outlet, a fan for drawing air into the dehumidifier and forcing it into said enclosure, said dehumidifier comprising cooling coils within the dehumidifier, pumps for spraying water over the cooling coils, an air conduit connecting the enclosure and said dehumidifier, a humidostat within said conduit to be acted upon by air passing therethrough from the enclosure and a controller for altering the speed of the fan operable by said humidostat whereby a greater or lesser volume of air is forced into the enclosure.

6. In an apparatus for controlling temperature and humidity within an enclosure, the combination of an air dehumidifier having an outside air inlet, an air outlet, a fan for drawing air into the dehumidifier and forcing it into said enclosure, said dehumidifier comprising cooling coils within the dehumidifier, pumps for spraying water over the cooling coils, an air conduit connecting the enclosure and said dehumidifier, a humidostat within said conduit to be acted upon by air passing therethrough from the enclosure, a controller for altering the speed of the fan operable by said humidostat whereby a greater or lesser volume of air is forced into the enclosure, said air being drawn through the dehumidifier over said cooling coils and means to adjust the amount of spray water to the coils including a thermostat at the outside air inlet, a thermostat at the air outlet from the dehumidifier, said last mentioned thermostat having means associated therewith and operable by the first mentioned thermostat for altering the effective action thereof whereby the temperature of the volume of air entering the enclosure under the control of said humidostat is controlled by said two thermostats.

7. In an apparatus for controlling temperature and humidity within an enclosure, means for controlling the volume of air forced into the enclosure including a humidostat positioned to be acted upon by air passing from the enclosure, a controller associated with said humidostat and a motor-driven fan operatively connected to said controller, said humidostat having a wet bulb thermostat, a thermostat and connection between the same, said connection being operatively associated with the controller to actuate the motor-driven fan at varying speeds as the relation between said wet bulb thermostat and thermostat is varied by air leaving the enclosure.

8. In an apparatus for controlling temperature and humidity within an enclosure, means for controlling the volume of air forced into the enclosure including a humidostat positioned to be acted upon by air passing from the enclosure, a controller associated with said humidostat and a motor-driven fan operatively connected to said controller, said humidostat having a wet bulb thermostat, a thermostat and a connection between the same, means to operate the controller and means to vary the relation between the connection and controller actuating means.

9. A method of conditioning air, consisting of passing all of the air to be conditioned through a chamber in which a cooling medium is located and controlling the temperature and/or relative humidity of the air by varying the area of said cooling medium exposed to contact with the air through the medium of interacting devices responsive to the temperature conditions before and after the air has passed through the chamber.

10. A method for conditioning air in a ventilating system, consisting of conducting the air through a chamber into which water at a predetermined temperature is discharged into the air stream in divided form, and controlling the temperature and/or relative humidity of the air by varying the volume of water through the medium of coacting temperature responsive devices located to indicate the condition of the air before and after passing through said chamber.

LAWRENCE D. McDONALD.

CERTIFICATE OF CORRECTION.

Patent No. 2,110,164. March 8, 1938.

LAWRENCE D. McDONALD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, lines 3 and 4, strike out the words "along said paths" and insert the same after "travels" and before the period in line 11; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of November, A. D. 1938.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.