

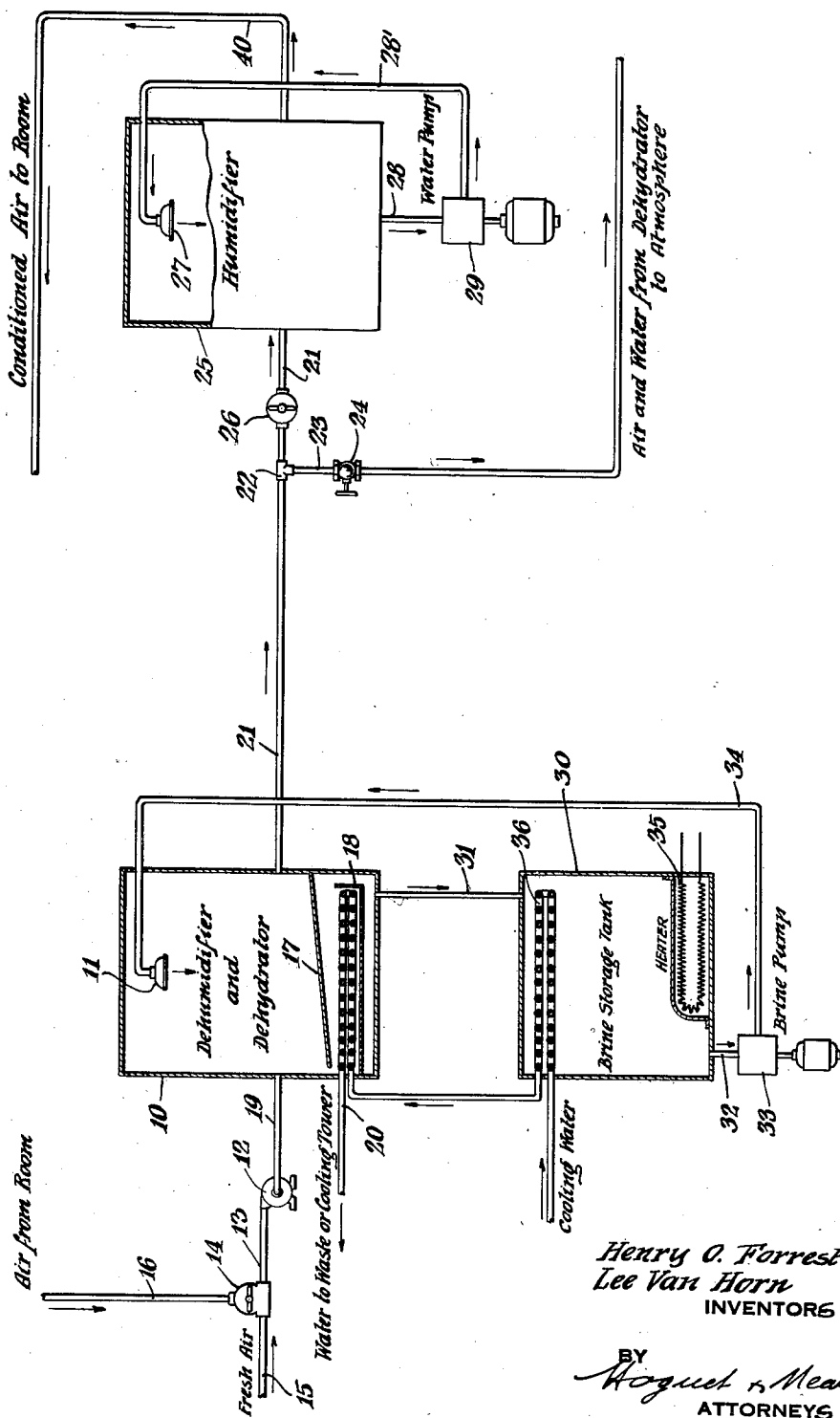
July 25, 1933.

H. O. FORREST ET AL

1,919,781

METHOD AND APPARATUS FOR CONDITIONING AIR

Filed Sept. 18, 1931



UNITED STATES PATENT OFFICE

HENRY O. FORREST, OF WEST ENGLEWOOD, AND LEE VAN HORN, OF ELIZABETH,
NEW JERSEY

METHOD AND APPARATUS FOR CONDITIONING AIR

Application filed September 18, 1931. Serial No. 563,596.

This invention relates to air conditioning and more particularly to a method and apparatus for conditioning air for small rooms and chambers usually occupied by a small number of people and only for a portion of the day.

In dwelling houses, office buildings and the like, the need for conditioning air for the health and comfort of occupants of the rooms in such buildings, exists only for a portion of the day. By virtue of this fact, it is unnecessary to provide a large and expensive device capable of continuously conditioning air.

According to our invention, we provide a method of conditioning air and apparatus for carrying out the method which will impart to air being conditioned desired characteristics of temperature and humidity for a portion of the day without reactivation of the conditioning medium. In one embodiment of our invention we condition air first by contacting it by a dehydrating fluid such as calcium chloride or lithium chloride brine which will dehumidify the air to a relative humidity lower than that necessary for comfort. The next step in conditioning the air is to contact the air with a humidifying fluid sprayed therethrough and rehumidify it to the degree that imparts to the air characteristics of humidity which, for that particular temperature, places the air within the healthful comfort range.

In absorbing water from the air, the temperature of the dehydrating fluid is increased. For this reason, we provide a cooled surface to contact the dehydrating fluid as it circulates through the system. By absorbing the heat resulting from the absorption of water, the dehydrating step is carried on without an increase in air temperature so that when the humidifying step is effected, the temperature of the air will be lowered. From the foregoing discussion it is apparent that we are able to dehumidify and cool the air to place it within the healthful comfort range without the use of refrigerants in the usual meaning of the term.

At the end of a period of time and when the rooms cease to be occupied by people so

that it is unnecessary to continue the conditioning of air, we shut down the air conditioning system and regenerate the dehydrating fluid. This regeneration process when a dehydrating liquid such as calcium chloride brine is used includes heating the liquid to about 140° F. and spraying it through the dehumidifying chamber as done during the air conditioning process. While doing thus, a blast of air is forced through the fluid and since the fluid is at a high temperature, it heats the air so that it will absorb water from the fluid and by so doing, bring it to a desired degree of concentration.

The third step of this intermittent process merely involves the circulation of a cooling fluid, such as water through cooling coils which contact the regenerated dehydrating fluid and bring its temperature back to the desired degree of coolness.

A primary object of our invention is to condition air and regenerate the conditioning medium intermittently.

Another object of the invention is to provide a compact air conditioning device capable of successively conditioning air and regenerating the conditioning medium.

Other objects will be apparent to those skilled in this particular art from the description in the specification in connection with the drawing in which:

The figure is a schematic layout of an apparatus adapted to intermittently condition air and regenerate the conditioning medium.

In the embodiment of the invention which has been chosen for the purposes of illustration, and referring now to the drawing, there is shown a dehydrating chamber 10 in the upper portion of which is located a spray member 11. A blower 12 has an inlet portion 13 which through a damper controlled fitting 14 draws fresh air from the atmosphere through a duct 15 and air from a room (not shown) through a duct 16 and forces it into the chamber 10, through a duct 19. A pair of suitable baffle members 17 and 18 are located in the lower portion of the chamber 10 and disposed therebetween are a plurality of cooling coils 20.

An air outlet duct 21 is connected to the

chamber 10, on the side opposite the air inlet 19, and is adapted to carry the air which has been treated in the chamber 10 to a humidifying chamber 25. A T-fitting 22 is located in the duct 21 and has a duct 23 leading to the atmosphere and which is here shown at right angles to the duct 21 that connects the chambers 10 and 25. A suitable damper 24 is located in the duct 23 and a similar damper 26 is located in the duct portion 21 intermediate of the fitting 22 and the chamber 25.

Disposed below the chamber 10 is a tank 30 which is connected to the lower portion of the chamber 10 by a pipe 31. A pipe 32 connects the lower portion of the tank 30, through a pump 33 and pipe 34, with the spray member 11, and with pump 33 as a flow actuator, a liquid circulatory system is provided. A heater 35, which is here shown as an electric heater but which may also obviously use, as a source of heat, either a gas flame, live steam or any other desired heat source, is located in the lower portion of the tank 30 and a cooling coil 36 similar in character to the cooling coil 20 is located in the upper portion of the tank 30. The function of the several parts enumerated will now be described in connection with the operation of the device.

In the operation of this device when being used to condition air for rooms occupied by people for a portion of the day, and referring especially to conditioning the room at a time of the year when both the temperature and humidity are too high for considerations of health and comfort, fresh air and air from the room being conditioned is forced into the chamber 10 by means of the blower 12 and there is contacted by a spray of suitable dehydrating fluid sprayed through the chamber by means of the member 11. This fluid may be any suitable solution having dehydrating powers, such as calcium chloride or zinc chloride brine, and in view of the process contemplated as a part of this invention, the tank 30, which acts as a storage base for this solution, must be sufficiently large to contain an ample quantity thereof. The fluid that has been sprayed through the air strikes the baffle 17 and flows across the cooling coils 20 and then flows over an overflow portion of the baffle 18 into the bottom of the chamber 10, from where it is conducted through the pipe 31 to the tank 30. From the tank 30 the fluid flows through the pipe 32 to the pump 33 and then is forced through the pipe 34 back to the spray member 11.

When this fluid contacts the air, which under the conditions stated, has a high aqueous content, it absorbs a quantity of water therefrom, depending in amount upon the nature and concentration of the dehydrating solution and the length of time of contact. In absorbing water from this air in a normal adiabatic process, the temperature of

the air or of the solution, or of both, will rise due to the release of heat by the absorption of water and to make this process an isothermal one with respect to air, it is necessary to remove heat from the dehydrating solution and it is for this reason the cooling coils 20 and 36 are provided.

The air within the chamber 10 that has been sprayed by the dehydrating fluid and dehumidified is conducted by the duct 21 to the chamber 25. In the chamber 25 this air is contacted by a suitable humidifying solution, such as water, or if it is desired to remove carbon dioxide therefrom, a suitable solution of an alkali such as calcium hydroxide. This humidifying fluid is sprayed through the air by means of a spray member 27. The excess of water or alkaline solution sprayed through the air falls to the bottom of the chamber 25 and is removed therefrom by means of a pipe 28, which conducts it to a water pump 29, by means of which it is returned to the spray member 27 through the pipe 28'. The air, in absorbing water from the fluid sprayed therethrough falls in temperature so that the air which is discharged from the chamber 25 and conducted by the duct 40 to the point of use, (not shown) has been given the desired degree of humidity and temperature by means of extremely simple apparatus and without the use of refrigeration in the ordinary sense of the word.

Because of the fact that in dehumidifying the air only a small amount of water is absorbed therefrom in proportion to the bulk of the dehydrating fluid, and in the humidifying chamber only a relatively small amount of water is absorbed in imparting to the air the desired degree of humidification, this conditioning process can be carried on for a substantial portion of 24 hours without requiring reactivation of the dehydrating fluid or renewal of the supply of humidifying liquid. The cooling water supplied to the coils 36 and 20 may be either a supply of city water when available, and when the cost of water is not excessive, or in large installations, cooling water may be obtained from a closed circulatory system utilizing a cooling tower, not shown, and a pump, also not shown, for the proper circulation of the cooling medium. The fluid circulated through the humidifier may be cooled if deemed desirable and renewed by means of a first water source.

At the end of the period of time when the process of conditioning air is no longer desirable or necessary, the supply of cooling water may be shut off in the coils 18 and 36 and the heater 35 may be turned on. When this heater has imparted to the brine solution a temperature of approximately 140° F., the damper 26 leading to the humidifier may be closed, and the damper 24 leading to the atmosphere may be opened, the blower 12 is started and a supply of fresh air is blown through the

heated brine solution sprayed through the chamber 10. Since the brine solution is now at a comparatively high temperature, the air sprayed therethrough is heated and its ability to absorb water is considerably increased. In view of this condition the air contacting the heated dehydrating solution will absorb water therefrom and this air and water will be discharged from the chamber 10, which is now acting as a dehydrator, to the atmosphere. When a sufficient amount of water has been removed from the dehydrating solution to bring it to the desired concentration, the heater 35 may be shut off and the pump 33 and the blower 12 may be shut down and cooling water run through the coils 20 and 36 a sufficient length of time to cool the fluid a desired amount. When this is done this system is ready to operate again as an air conditioning device.

The operation of the apparatus just described contemplates its use in the summer time when the outside air has characteristics of temperature and humidity too high for considerations of health and comfort. In the winter time, however, for considerations of health and comfort, it is necessary to raise both the temperature and humidity of air in order to impart thereto characteristics of temperature and humidity which will place it within the healthful comfort range. The apparatus herein described is readily adapted to perform this operation for the incoming air may be sprayed in the dehumidifying chamber with heated brine of proper hydration characteristics so that its temperature is raised and humidity is imparted to it, or it may be sprayed in the dehumidifier chamber with heated brine of lower hydration characteristics and be further sprayed in the humidifier chamber 25 by a fluid of controlled temperature for desired length of time so that desired characteristics of humidity are imparted thereto.

A specific device and its method of operation have been described in some detail but it is to be understood that changes, additions, substitutions and omissions may be made therein within the spirit of the invention as defined by the appended claims.

1. In an air conditioning apparatus designed for intermittent use and having a dehumidifying chamber, a humidifying chamber and a brine storage tank, a heater disposed within said brine storage tank adapted to heat said brine for reactivation purposes and means to circulate said heated brine through said dehumidifying chamber and contact it with a blast of air whereby excess water is removed from said brine.

2. The method of intermittently conditioning air which includes the steps of contacting said air successively with a dehumidifying and humidifying fluid for a period of time and reactivating said dehumidifying fluid by raising its temperature and contacting it with a blast of air.

3. The method of intermittently conditioning air which includes the steps of contacting said air successively with a dehumidifying and humidifying fluid for a period of time and reactivating said dehumidifying fluid by raising its temperature and spraying said heated fluid through a current of air.

4. An air conditioning apparatus designed for intermittent operation and having a dehumidifying chamber, a humidifying chamber and a brine storage tank, a heater located in said brine storage tank to raise the temperature of said brine, and means to spray said heated brine through a current of air in said dehumidifying chamber and a conduit associated with said chamber adapted to carry the contacted air and water absorbed thereby to the atmosphere.

HENRY O. FORREST.
LEE VAN HORN.