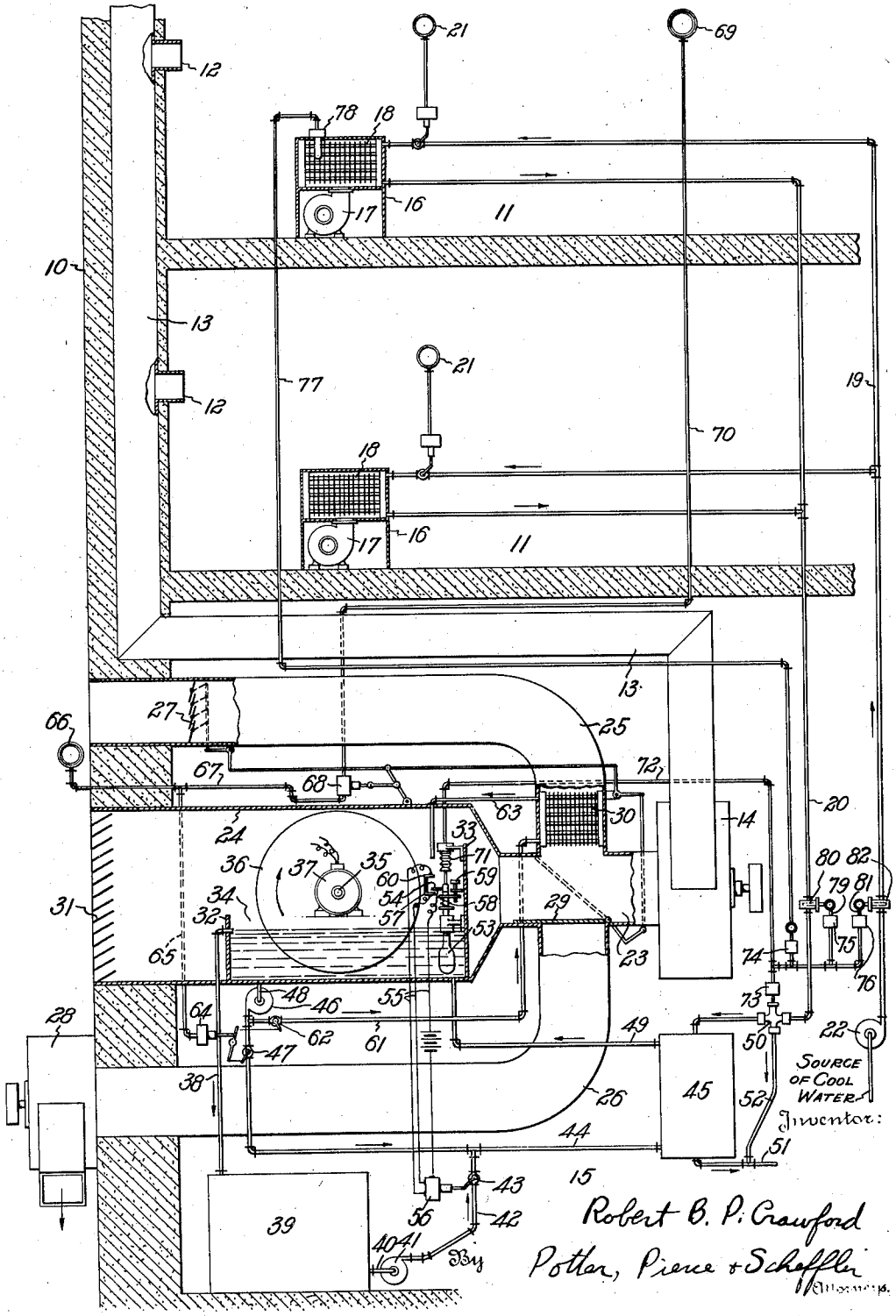
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AIR CONDITIONING

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AIR CONDITIONING

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This invention relates in general to air conditioning and more particularly to a method and apparatus for conditioning air to the health and comfort range in localities where dehumidification of the air is necessary only during separated periods of a definite maximum duration. The invention is generally applicable to all kinds of air conditioning and ventilating systems, but is particularly suitable for pressure systems employing split control as hereinafter described.

In certain localities, as for example, the south western states of this country, the dew point of the air remains between narrow limits during the greater portion of the hot season. This dew point range is such that the air can be conditioned by cooling alone. However, during certain portions of the hot season the dew point of the air is above that desirable for health and comfort and dehumidification is necessary. Weather records show that these portions of the hot season are made up of relatively short separated periods of a rather definite maximum duration.

In view of the fact that dehumidification of the air is necessary only during separated periods, the aggregate of which constitutes the smaller portion of the hot season, it is apparent that the elaborate systems designed for localities where continuous or substantially continuous dehumidification is necessary because their high initial cost, up keep, operation costs, etc., would increase the cost of the conditioning unnecessarily.

Systems for intermittent dehumidification of air have been proposed. These systems as a rule make use of moisture absorbents such as silica gel, calcium chloride brine, and the like, for dehumidifying the air and the absorbent used is periodically reactivated in various ways, all of which involve additional apparatus and expenditure of energy that must be supplied by still other apparatus. Furthermore, the absorbent agent used ordinarily takes no part in the humidification when conditions require humidification. With such systems humidification is sometimes accomplished by another medium. For these reasons the cost of dehumification in the localities mentioned, using the proposed intermittent systems, is much higher than it need be.

The present invention provides a method and apparatus whereby the air of the localities mentioned may be conditioned to the health and comfort range during the whole of the hot season at a minimum expense by means of a medium which serves both as a humidifying agent and a dehumidifying agent without requiring separate reactivating apparatus or heat from an apparatus source. In one embodiment of this invention a simple air and liquid contact unit is provided through which is circulated the humidity regulating medium. The medium preferred is a brine having a definite affinity for moisture such as a solution of calcium chloride, lithium chloride, and the like. With the unit is associated a reservoir of a capacity sufficient to hold the amount of the chosen brine necessary to dehumidify the air during the humid period of maximum duration.

The outlet of the unit is connected to lead the conditioned air to the enclosures to be conditioned under a pressure sufficient to prevent infiltration of atmospheric air and to insure that sufficient air passes to the atmosphere to keep the conditioned enclosures in a wholesome and comfortable condition. In each of the enclosures is provided one or more combined air circulating and heat exchange devices which continuously circulate the whole body of air and are automatically controlled to maintain the air at the temperature desired. The heat exchangers circulate cold water from a deep well, a regenerative cooling tower or other convenient source. This water after passing through the exchangers is used to cool the brine. Automatic means are associated with the water circulation system which by controlling the temperature and the concentration of the brine used prevent the dew point of the air supplied to the enclosures from rising above the temperature of the surfaces of the elements of the water circulation system in order to prevent condensation on said surfaces.

To the outlet of the gas and liquid contact unit is connected a pair of conduits which open to the atmosphere, one through a valved opening and the other through a fan. A heat exchanger adapted to circulate brine is positioned in the first of said pair of conduits. Valve means are provided for controlling the proportion of the air passed from the gas and liquid contact unit to the enclosures and from said unit through the second of said pair of conduits to the atmosphere. This valve means and the valve means in the first of said pair of conduits are connected to operate as a unit under the primary control of a humidity sensitive device which is effective to fully open the first of said pair of conduits when the moisture content of the outside air is such that neither humidification nor dehumidification is necessary and which is ef-

fective to fully close the first of said pair of conduits when the moisture content of the outside air is such that dehumidification is necessary. A secondary humidity sensitive device is connected to control the valves during humidification to vary the proportion of atmospheric and humidified air making up the air supplied to the enclosures to maintain a desired humidity.

Thus when the dew point of the outside air is at or above the value at which dehumidification is necessary the primary humidity sensitive device will act to cause all of the air supplied to the enclosures to be drawn from the gas and liquid contact unit. By means of a concentration sensitive control the circulation of the medium is so regulated that the air passing through the unit contacts with medium of a constant predetermined concentration and will leave the unit at a constant predetermined relative humidity. The absolute humidity of the air leaving the unit does not vary with variations in the dew point of the outside air above value at which dehumidification is necessary since the air passing through the unit always attains a water vapor pressure substantially equal to that of the medium. When the dew point of the outside air reaches the value at which no dehumidification is necessary the primary humidity sensitive device will act to cause all of the air supplied to the enclosures to be drawn through the first conduit of said pair of conduits and the air passing through the unit to pass to the atmosphere through the second conduit of said pair.

At this time the medium is not precooled so that its vapor pressure is raised above that of the outside air and moisture is abstracted from it by the air passing through the unit. In order to keep the vapor pressure of the medium above that of the outside air at this time and to supply the air to the enclosures at a temperature below that of the outside air, the medium is passed through the heat exchanger in the first of said pair of conduits. If this is not done the abstraction of heat from the medium due to evaporation of water therefrom would soon lower its vapor pressure to or below that of the air passing through the unit.

As the dew point of the outside air drops below the value at which humidification becomes necessary the secondary humidity sensitive device gradually opens communication between the unit and the enclosures and proportionately closes communication between the atmosphere and the enclosures to maintain the air supplied to the enclosures at the predetermined moisture content. At this time the concentrating effect on the medium will continue as before until the beginning of the next humid period when dehumidification will again take place.

A principal object of the invention is the provision of apparatus and a method for conditioning air adapted to the localities mentioned in which a single medium is used to humidify the air or dehumidify the air as required to condition the air to the health and comfort range.

The invention has for a further object apparatus and a method for intermittently dehumidifying air by means of moisture absorbing medium in which the medium is reactivated without the use of separate reactivation apparatus or the expenditure of apparatus heat, and said medium during reactivation is utilized for air conditioning work.

The invention has also for an object apparatus and a method of the character described which is controlled by simple temperature and humidity sensitive devices.

Other objects and advantages of the invention will be apparent from the following description of a preferred embodiment thereof with particular reference to the accompanying drawing in which the single figure is a diagrammatic representation of a complete air conditioning and ventilating system embodying the principles of this invention.

Referring to the drawing:

The building 10 to be conditioned and ventilated is shown sub-divided into a plurality of floors 11. Floors 11 may be further sub-divided into corridors and rooms. Ducts 12 open into floors 11 and are connected to a vertical duct 13 which serves to lead the ventilating and conditioning air from fan 14. Fan 14, which together with the conditioning apparatus associated therewith is located in the basement 15 or other convenient part of building 10, supplies conditioning and ventilating air to floors 11 under a pressure sufficient to prevent the infiltration of outside air through the cracks and crevices in and around the windows and other openings and sufficient to insure the passage from floors 11 of the required volume of air to maintain the desired ventilation. Ducts 12 and 13 are intended to represent broadly means for conducting the ventilating and conditioning air to floors 11 rather than the preferred means, and either or both may be supplied by a convenient passageway such as a stair case, elevator shaft, pipe shaft, or the like, as may be available.

In each of floors 11 are one or more units 16 each of which comprises a motor driven fan 17 and a finned heat exchanger 18. The fan 17 is adapted to circulate continuously all of the air of the floor on which it is located over its associated heat exchanger 18. The inlets of the heat exchanger 18 are connected to a water feed line 19 and the outlets to a water line 20. In each of floors 11 is also an adjustable thermostat 21 which through a capillary tube and suitable diaphragm controls the valve in the water inlet of its associated unit 16. By this arrangement it is possible to maintain each of floors 11 at the temperature desired by the occupants. Water feed line 19 is connected to the outlet of pump 22 which has its inlet connected to a well or other source of cool water supply.

The inlet of fan 14 is connected through a duct 23 to the outlet of the humidity regulating unit 24 and ducts 25 and 26. In the inlet of duct 25 is provided an adjustable damper 27 positionable to control the volume of atmospheric air admitted into duct 25. To the atmospheric end of duct 26 is connected a fan 28 which pulls air through duct 26 to the atmosphere. A butterfly damper 29 is placed in duct 23 which in the position shown in full lines will shut off communication between unit 24 and fan 28, and in the position shown in dotted lines will shut off communication between unit 24 and fan 14, while in intermediate positions it will allow any desired proportion of air to pass from unit 24 to fan 14 and fan 28. Dampers 27 and 29 are connected by suitable linkage to be movable as a unit. The arrangement is such that when damper 29 is in the full line position, damper 27 is shut, and when damper 28 is in the dotted line position damper 27 is open. A heat exchanger 30 is located in duct 25 between the ends thereof.

Humidity regulating unit 24 comprises a casing having an inlet which opens to the atmosphere

and which is controlled by an adjustable damper 31. Adjacent the ends of the casing are provided partitions 32 and 33 which together with the bottom of the casing form the tank 34. A shaft 35 extends across the casing and has mounted thereon a plurality of discs 36. Shaft 35 is rotated by means of a driving device 37 which may include an electric motor or other power source. As shaft 35 and discs 36 rotate, discs 36 will pass through tank 34 and pick up some of the brine in tank 34 and thus provide a plurality of films of extended surface to the air passing through unit 24. The brine in tank 34 is prevented from rising above a predetermined level by means of overflow pipe 38 which connects to the top of reservoir 39. The bottom of reservoir 39 is connected by pipe 40 to the inlet of pump 41. The outlet of pump 41 is connected to pipe 42 and provided with a valve 43 which is controlled, as hereinafter pointed out, to regulate the flow of the brine from reservoir 39.

Pipe 42 is connected to a pipe line 44 which has one end connected to the brine inlet of a heat exchanger 45 and its other end connected to the outlet of a pump 46. Pipe 44 is provided with a valve 47 adjacent pump 46 for purposes explained hereinafter. The inlet end of pump 46 is connected to the front end of tank 34 by means of pipe 48. The brine outlet of heat exchanger 45 is connected by pipe 49 to the rear end of tank 34. Heat exchanger 45 has its water inlet connected to one of the outlets of T valve 50 and its water outlet connected to pipe line 51 which leads the water to the sewer or other place of disposal. The other outlet of valve 50 is connected by pipe 52 to pipe 51, the inlet of valve 50 being connected to line 20.

At the rear end of tank 34 is supported for free vertical movement a hydrometer 53 which carries an electrical contact device 54 connected in the usual manner by conductors in cable 55 to valve control device 56. A contact 57 which for convenience is called the dehumidifying contact cooperates with contact 54 and is also connected to control device 56 by conductors in cable 55.

The arrangement just described is effective to maintain a predetermined concentration of the brine in tank 34 during dehumidification of the air. Thus when due to the water absorbed from the air the concentration of the brine is reduced, hydrometer 53 will fall and contacts 54 and 57 come together to cause control device 56 to increase the opening of valve 43 thereby allowing an increased amount of the more highly concentrated brine to enter the brine circuit made up of tank 34, pipe 48, pump 46, pipe 44, heat exchanger 45 and pipe 49. When the amount of water absorbed by the brine decreases contact 54 will be carried away from contact 57 to cause the control 56 to restrict the opening of valve 43 and allow a lesser quantity of brine from reservoir 39 to enter pipe 44.

The brine used may be a solution of calcium chloride, lithium chloride, or the like having a definite affinity for moisture and is made up to such a concentration that the volume stored in reservoir 39 is sufficient to absorb the excess moisture in the air during a humid period of maximum duration without reducing the concentration of the brine in tank 34 below a predetermined value. The predetermined concentration at which the brine in tank 34 is maintained is that concentration which, at the temperature to which the brine is cooled in heat exchanger 45, will give a vapor pressure equal to the moisture vapor pressure of air at the desired humidity.

A spring 58 rests on a support on hydrometer 53. Above the end of spring 58 is a collar supported from baffle 33 and vertically adjustable through thumb screw 59. By means of spring 58 and thumb screw 59 the concentration to be maintained in tank 34 may be set at will. Above contact 57 is a second contact 60 which for convenience will be called the concentrating contact. Contact 60 is also connected through conductors in cable 55 to valve control device 56.

A pipe 61, having a valve 62 therein, is connected to pipe 44 between pump 46 and valve 47 and serves to lead brine from pump 46 to the brine inlet of heat exchanger 30. A pipe 63 is connected to the brine outlet of heat exchanger 30 and leads the brine back to tank 34. Valves 47 and 62 are connected by suitable linkage to be controlled as a unit, so that when valve 47 is opened valve 62 is closed and vice versa. A diaphragm 64 connected through capillary tube 65 to a dew point thermostat 66, which is located out of doors, actuates the linkage controlling valves 47 and 62, so that when the air requires dehumidification valve 47 will be open and valve 62 closed and at all other times valve 62 will be open and valve 47 closed.

Dew point thermostat 66 is also connected through capillary tube 67 to a diaphragm 68 which actuates the linkage that controls dampers 27 and 29. Dew point thermostat 66 exercises primary control over dampers 27 and 29 and fully closes damper 27 and brings damper 29 to the full line position whenever dehumidification of the outside air is necessary, and fully opens damper 27 and brings damper 29 to the dotted line position whenever the outside air requires no modification of its moisture content. Dampers 27 and 29 are also under the secondary control of a humidostat 69, located on one of floors 11. Humidostat 69 is also connected to diaphragm 68 through a capillary tube 70 and can alter the positions of dampers 27 and 29 during the time when humidification of the outside air takes place.

Thus at the end of any humid period dew point thermostat 66 will fully open damper 27, move damper 29 to the dotted line position, open valve 62 and close valve 47. This will cause the air drawn through unit 24 to pass to the atmosphere through duct 26 and fan 28 and the brine drawn from tank 34 by pump 46 to pass through pipe 61 to heat exchanger 30, where it is heated to a temperature in the neighborhood of the temperature of the outside air, and from heat exchanger 30 through pipe 63 back to tank 34. The fact that the brine does not circulate through heat exchanger 45 at this time, but passes through heat exchanger 30 results in the vapor pressure of the brine being raised above the value maintained during dehumidification so that the air passing through unit 24 will absorb moisture from the brine and thus concentrate it. As the concentration progresses hydrometer 53 will rise until contact 54 meets contact 60. When this happens valve control device 56 will open valve 43 to allow a volume of brine to enter pipe 44, heat exchanger 45, pipe 49 and tank 34 in excess of the volume of water carried away by the air so that a portion of the concentrated brine will overflow through pipe 38 to reservoir 39. The amount of brine flowing into tank 34 through line 49 is not enough to materially reduce the temperature of the brine in tank 34.

During the time that humidified air is passed to floors 11 the concentration of the brine continues in the manner just mentioned.

An expansible pressure operated capsule 71 having corrugated sides is positioned above hydrometer 53 so that it may be expanded to depress hydrometer 53 to thereby increase the flow of brine to tank 34 during dehumidification of the outside air. To capsule 71 is connected a capillary tube 72 which is also connected to diaphragm 73 and relays 74, 75 and 76. Diaphragm 73 controls the flow of water through valve 50 and upon increase in pressure in capillary tube 72 increases the amount of water flowing from pipe 20 to heat exchanger 45 and also increases flow of brine from reservoir 39, and upon decrease in pressure decreases the amount of water flowing to heat exchanger 45 and decreases flow of brine in reservoir 39. Relay 74 is connected through valved capillary tube 77 to a settable reverse acting thermostat 78 embedded in the heat exchange surface of the one of heat exchangers 18 located in the floor 11 in which humidostat 69 is located. Relay 75 is connected through a valved capillary tube 79 to a settable reverse acting thermostat 80 embedded in water line 20. Relay 76 is connected through a valved capillary tube 81 to a settable reverse acting thermostat 82 embedded in the water inlet line 19.

By setting thermostats 78, 80 and 82 at the proper temperatures and opening the valves in capillary tubes 77, 79 and 81 the cooling of the brine in heat exchanger 45 and the concentration of the brine in tank 34 is controlled to prevent the dew point of the air supplied to floors 11 during dehumidification of the outside air from rising to values at which condensation will take place on the surfaces of lines 19 and 20 and heat exchangers 18. If desired any one or any combination of relays 74, 75 and 76 may be used.

When the various controls have been set to maintain the desired conditioning and ventilation of floors 11 and the dew point of the air is such that dehumidification is required, humidostat 66 will cause damper 27 to close, damper 29 to move to the full line position, valve 62 to close and valve 47 to open so that all of the air supplied to floors 11 passes through unit 24 and all of the brine circulated through unit 24 passes through heat exchanger 45. The air in passing through unit 24 comes into intimate contact with the films of brine on the rotating discs and gives up moisture thereto until the vapor pressure of its moisture content is equal to the vapor pressure of the brine. Since the brine in passing through heat exchanger 45 is cooled the air entering floors 11 is not only dehumidified but also cooled to a temperature below that of the outside air. As the brine absorbs water from the air passing through unit 24 its concentration will soon decrease with the result that hydrometer 53 will fail to carry contact 54 onto contact 57 and thereby cause valve 56 to increase the flow of the concentrated brine to line 44. The action of hydrometer 53 is such that it allows just enough brine to enter line 44 to take care of the water absorbed and maintain the concentration at the predetermined value.

The air upon entering floors 11 is drawn, together with the rest of the air in each of floors 11, into the inlets of fans 17 and passed over the heat exchangers 18 to bring the whole body of air in each of the floors to the temperature at which the thermostats 21 have been set. The pressure at which the air enters floors 11 is such as to prevent infiltration of outdoor air and to insure sufficient escape of air to keep the air in each of floors 11 in a wholesome condition.

If for any reason the temperature at any of thermostats 78, 80, or 82 falls below the value at which the particular thermostat has been set so that there is a possibility of condensation of moisture at that point, the particular thermostat so affected will cause a rise in pressure in capillary tube 72 with the result that the cooling of the brine in heat exchanger 45 is increased through the action of diaphragm 73 and the concentration of the brine in tank 34 is increased through the action of capsule 71 and hydrometer 53. The brine in tank 34 will as a result have its vapor pressure decreased and the air entering fan 14 will have a reduced dew point. When the temperature at the particular thermostat again rises above the set value the vapor pressure of the brine will come back to the value for which hydrometer 53 has been set. By this arrangement condensation in floors 11 or on the piping leading thereto is automatically prevented. The change of the dew point of the air under the influence of thermostats 78, 80 and 82 will be sensed by humidostat 69 but since humidostat 66 is now in control the positioning of dampers 27 and 29 will not be changed.

When the humid period has run its course, the concentration of all or a portion of the brine in the system has been reduced to the value at which the brine in tank 34 is maintained. At the end of the period the dew point of the outside air is such that neither humidification nor dehumidification is required. Humidostat 66 will now act to open damper 27, move damper 29 to the dotted line position, close valve 47 and open valve 62 so that the air passing to fan 14 will pass through duct 25, fan 28 will take care of all the air passing through unit 24, and the circulated brine will pass through heat exchanger 30 instead of heat exchanger 45. As previously stated the vapor pressure of the solution in tank 34 will be above that of the moisture in the air and concentration of the brine will take place.

As the dew point of the outside air drops below the value at which dehumidification is desired the air entering floors 11 will be dryer than desired with the result that humidostat 69 will act to move damper 29 toward the solid line position and proportionately close damper 27 until sufficient of the humidified air is mixed with the atmospheric air to maintain the desired humidity conditions in floors 11.

Since the humid periods are separated and make up the smaller portion of the summer season, it will be apparent from the above description that the method and apparatus of the invention are fully able to effect the reactivation of the brine during the rest of the summer without adding to the cost of the conditioning of the air other than for the energy required to run fan 28. Further, since the weather in the localities mentioned does not change greatly from year to year, it is possible by passing the proper amount of air through unit 24 during the dry periods to prevent the concentration of the brine in reservoir 39 from exceeding a predetermined maximum value. However, if the concentration of the brine in reservoir 39 does exceed the initial concentration there is no interference with the working of the invention since the hydrometer control in tank 34 in any case maintains a predetermined concentration in tank 34 during dehumidification.

It is possible to utilize the heating effect of

solar energy to assist in concentrating the hygroscopic agent by increasing its temperature so that concentration of the hygroscopic agent by the air passing over it will be even more efficient. In this way the method and apparatus of the invention may be utilized in localities where the humid periods are of increased extent and the range of applicability of the invention is thereby considerably widened. This can be accomplished by passing all or a portion of the diluted hygroscopic agent in the periods when dehumidification of the air is not required through a receptacle having an extended surface exposed to the sun's rays and then passing the heated agent to the contacting chamber or passing atmospheric air over the surface of the agent in the receptacle.

Although the apparatus of the invention has been described in connection with summer conditioning it should be obvious that it can be adapted to effect the necessary conditioning during the rest of the year by providing a suitable water spray, controlled by a humidity sensitive device such as humidostat 69 and by passing heated water or steam through line 19 and units 18.

I claim:

1. A method of conditioning air to a predetermined relative humidity condition which comprises contacting the air with a hygroscopic solution, maintaining the solution in contact with the air at a concentration in substantial equilibrium with air of the predetermined relative humidity by supplying thereto solution of higher concentration during periods when the air requires the removal of moisture therefrom and by supplying thereto a solution of lower concentration when the air does not require the removal of moisture therefrom, storing solution concentrated during the latter periods and using it for maintaining the concentration of the solution in contact with the air in the former periods.

2. A method of conditioning air to a predetermined relative humidity and temperature condition which comprises contacting the air with a moisture absorbing agent having a moisture absorptive capacity adequate to reduce the moisture content of the air to the predetermined relative humidity condition during a period when the air requires the removal of moisture therefrom, reconditioning said moisture absorbing agent by the removal of moisture therefrom by contacting it with air during periods when the air does not require the removal of moisture, supplying the air to an enclosure and circulating the air in said enclosure over temperature modifying means.

3. A method of conditioning air to a predetermined relative humidity and temperature condition which comprises contacting the air with a moisture absorbing agent having a moisture absorptive capacity adequate to reduce the moisture content of the air to the predetermined relative humidity condition during a period when the air requires the removal of moisture therefrom, reconditioning said moisture absorbing agent by the removal of moisture therefrom by contacting it with air during periods when the air does not require the removal of moisture, supplying the air to an enclosure, circulating the air in said enclosure over temperature modifying means and regulating the moisture content of the air supplied to the enclosure to prevent the condensation of moisture from the air in said enclosure.

4. A method of conditioning air to a predetermined relative humidity and temperature condition which comprises contacting the air with a moisture absorbing agent having a moisture absorptive capacity adequate to reduce the moisture content of the air to the predetermined relative humidity condition during a period when the air requires the removal of moisture therefrom, reconditioning said moisture absorbing agent by the removal of moisture therefrom by contacting it with air during periods when the air does not require the removal of moisture, supplying the air to an enclosure, circulating the air in said enclosure over temperature modifying means and regulating the moisture content of the air supplied to the enclosure to prevent the condensation of moisture from the air on the temperature modifying means in said enclosure.

5. A method of conditioning air which comprises contacting the air with a moisture absorbing agent having a moisture absorptive capacity adequate to reduce the moisture content of the air to below a predetermined relative humidity condition during a period when the air requires the removal of moisture therefrom, mixing said air with uncontacted air in a proportion to give a mixture having the predetermined relative humidity, and reconditioning said moisture absorbing agent by the removal of moisture therefrom by contacting it with air during periods when the air does not require the removal of moisture.

6. A method of conditioning enclosures which comprises contacting air with a hygroscopic agent, supplying said air to enclosures under pressure sufficient to cause outflow of air from said enclosures in predetermined amount, circulating the air in said enclosures over temperature modifying elements and modifying the vapor pressure of said hygroscopic agent in response to changes in the temperature of said temperature modifying elements to prevent the dew point of the air supplied to said enclosures from rising above the temperature of said temperature modifying elements.

7. Apparatus for conditioning air comprising a chamber for contacting air with a hygroscopic solution, a storage vessel for said hygroscopic solution, transport means for effecting transfer of hygroscopic solution from the contacting chamber to the storage vessel and from the storage vessel to the contacting chamber, and means actuated by variations in the concentration of said hygroscopic solution for controlling said transport means.

8. Apparatus for conditioning air comprising a chamber for contacting air with a hygroscopic agent, means providing a conduit for atmospheric air to said chamber, means providing a conduit for air from said chamber to an enclosure to be conditioned, means providing a conduit for air from said chamber to the atmosphere, and means for causing variable proportions of the air passing through said chamber to pass to the enclosure to be conditioned and to the atmosphere.

9. Apparatus for conditioning air comprising a chamber for contacting air with a hygroscopic agent, means providing a conduit for atmospheric air to said chamber, means providing a conduit for air from said chamber to an enclosure to be conditioned, means providing a conduit for air from said chamber to the atmosphere, and means actuated by variations in the humidity of the atmospheric air for causing variable proportions of the air passing through said chamber to pass to the enclosure to be conditioned and to the atmosphere.

10. Apparatus for conditioning air in an enclosure comprising a chamber for contacting air

with a hygroscopic agent, means providing a conduit for said air from said chamber to the enclosure, a temperature modifying device in said enclosure, means for circulating air in said enclosure over said temperature modifying device and means actuated by variations in the temperature of said temperature modifying device for modifying the moisture absorbing capacity of said hygroscopic agent to prevent the dew point of the air supplied to the enclosure from rising above the temperature of the temperature modifying device.

11. Apparatus for conditioning air in an enclosure comprising a chamber for contacting air with a hygroscopic agent, means providing a conduit for atmospheric air to said enclosure, means providing a conduit for air from said chamber to said enclosure, means providing a conduit for air from said chamber to the atmosphere and means for causing variable proportions of the air from the atmosphere and air from the chamber to pass to the enclosure.

12. Apparatus for conditioning air in an enclosure comprising a chamber for contacting air with a hygroscopic agent, means providing a conduit for atmospheric air to said enclosure, means providing a conduit for air from said chamber to said enclosure, means providing a conduit for air from said chamber to the atmosphere and means actuated by variations in the humidity of the atmospheric air for causing variable proportions of the air from the atmosphere and air from the chamber to pass to the enclosure.

13. Apparatus for conditioning air in an enclosure comprising a chamber for contacting air with a hygroscopic agent, means providing a conduit for atmospheric air to said enclosure, means providing a conduit for air from said chamber to said enclosure, means providing a conduit for air from said chamber to the atmosphere, and means for causing variable proportions of the air from the atmosphere and air from the chamber to pass to the enclosure and for causing correspondingly variable proportions of the air from the chamber to pass to the atmosphere.

14. Apparatus for conditioning air in an enclosure comprising a chamber for contacting air with a hygroscopic agent, means providing a conduit for atmospheric air to said enclosure, means providing a conduit for air from said chamber to said enclosure, means providing a conduit for air from said chamber to the atmosphere and means actuated by variations in the humidity of the atmospheric air for causing variable proportions of the air from the atmosphere and air from the chamber to pass to the enclosure and for causing correspondingly variable proportions of the air from the chamber to pass to the atmosphere.

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