June 8, 1954

R. S. KOPP

2,680,492

AIR DEHYDRATION UNIT

Filed June 22, 1951

7 Sheets-Sheet 1

Fig. 1

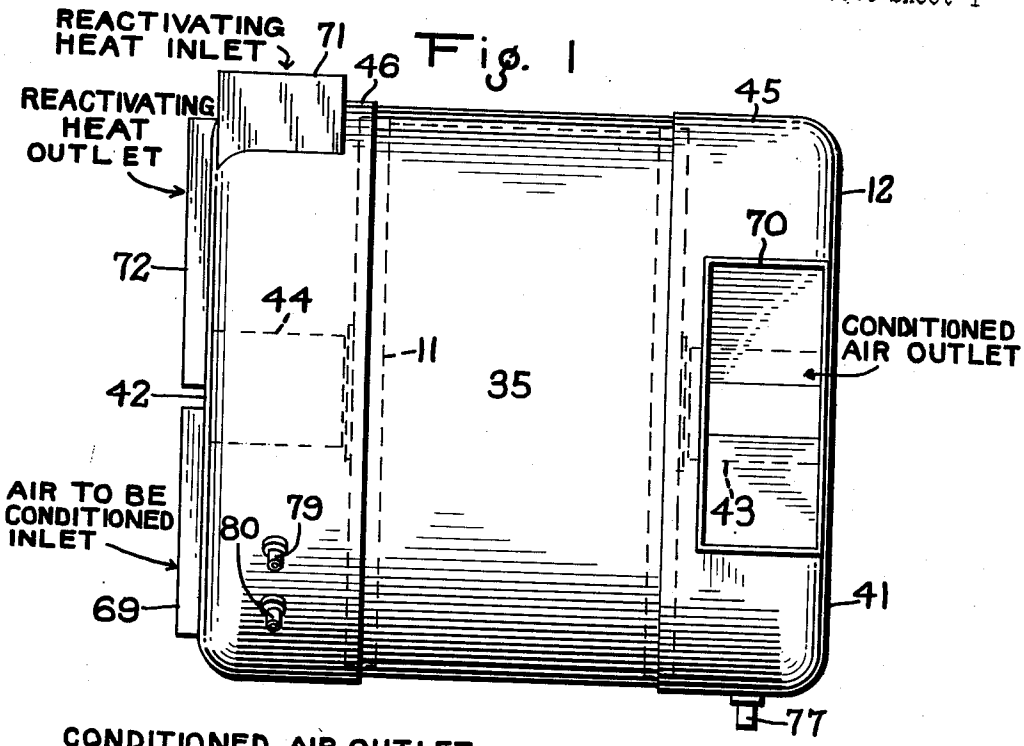
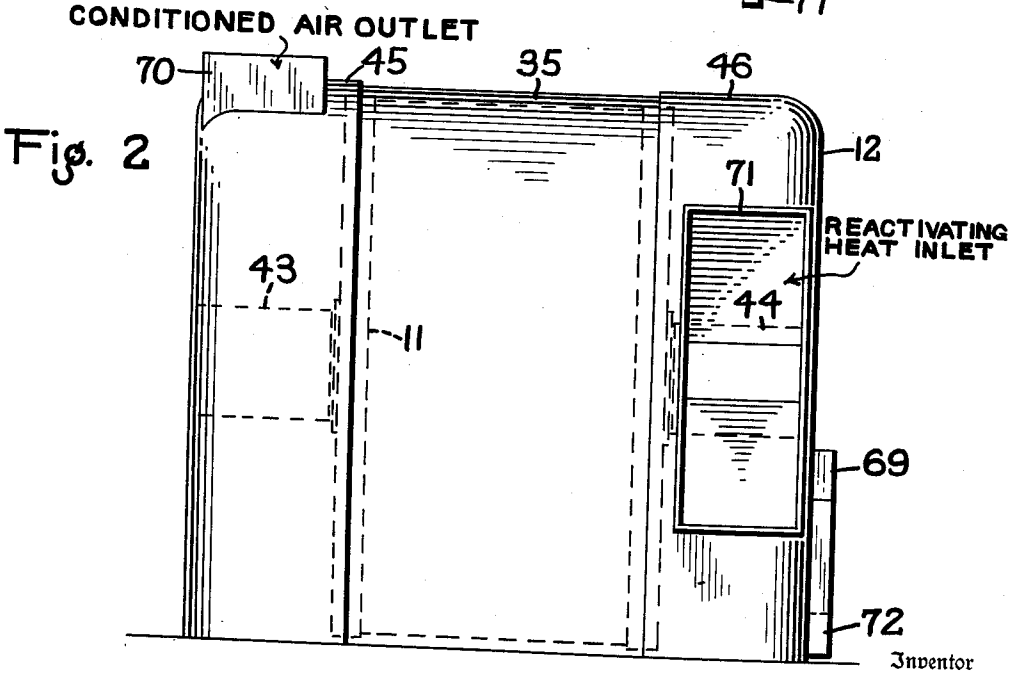


Fig. 2



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2,680,492

AIR DEHYDRATION UNIT

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Fig. 3

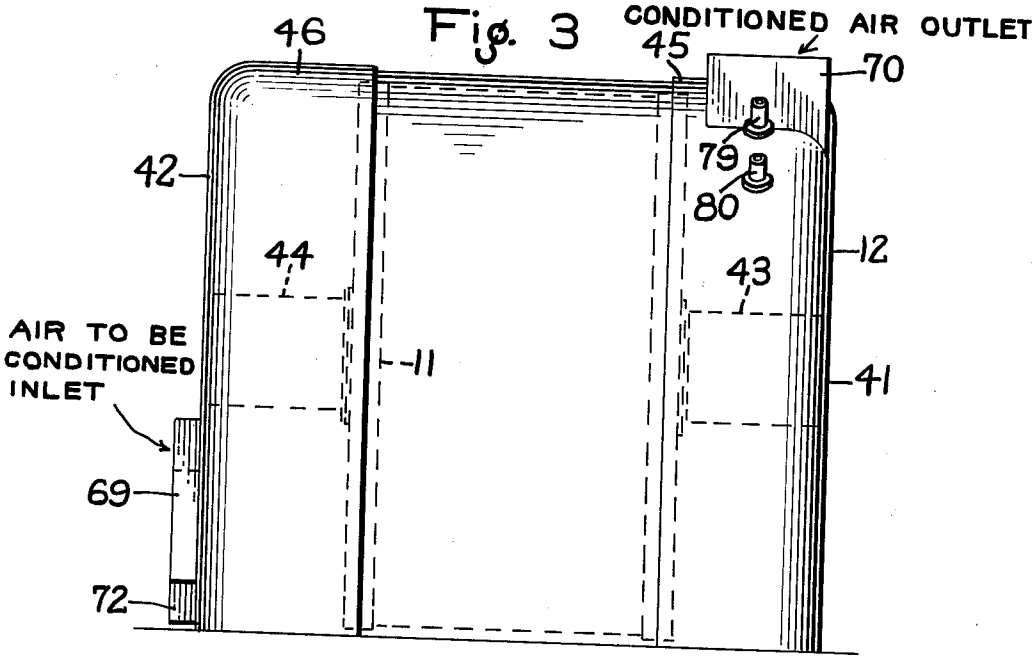
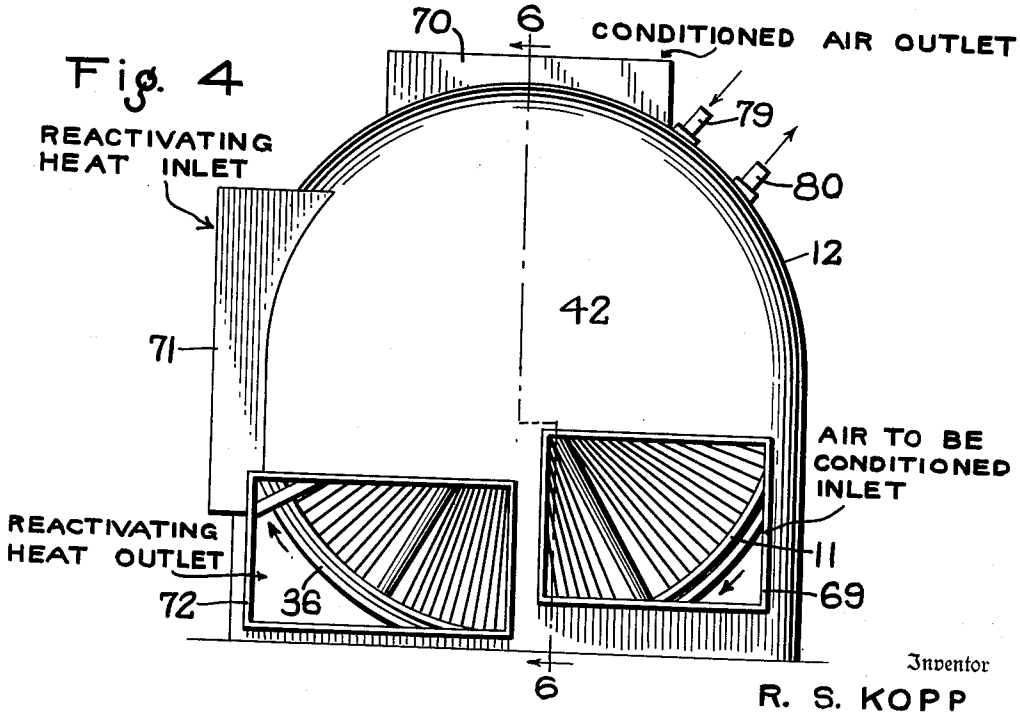


Fig. 4



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AIR DEHYDRATION UNIT

Filed June 22, 1951

7 Sheets-Sheet 3

Fig. 5

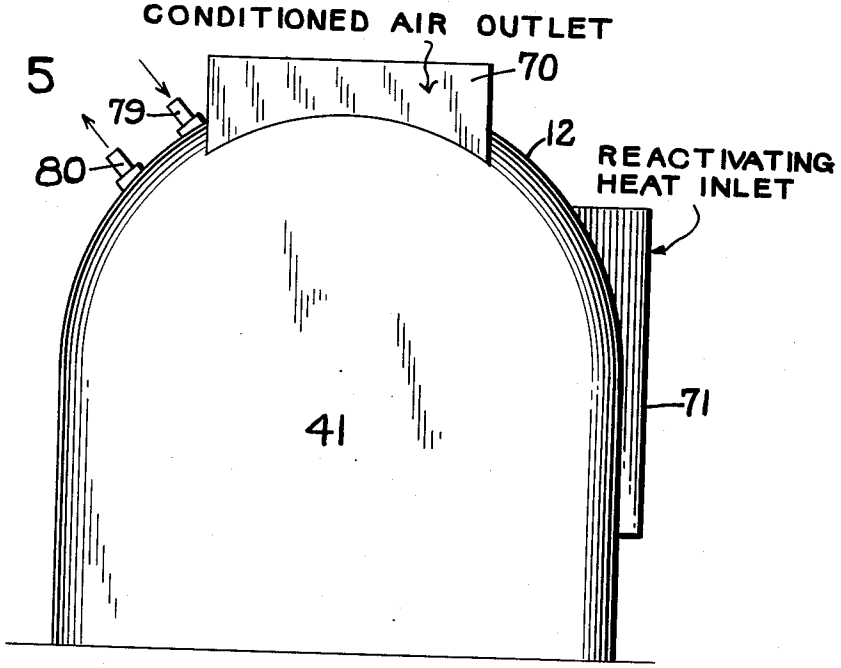
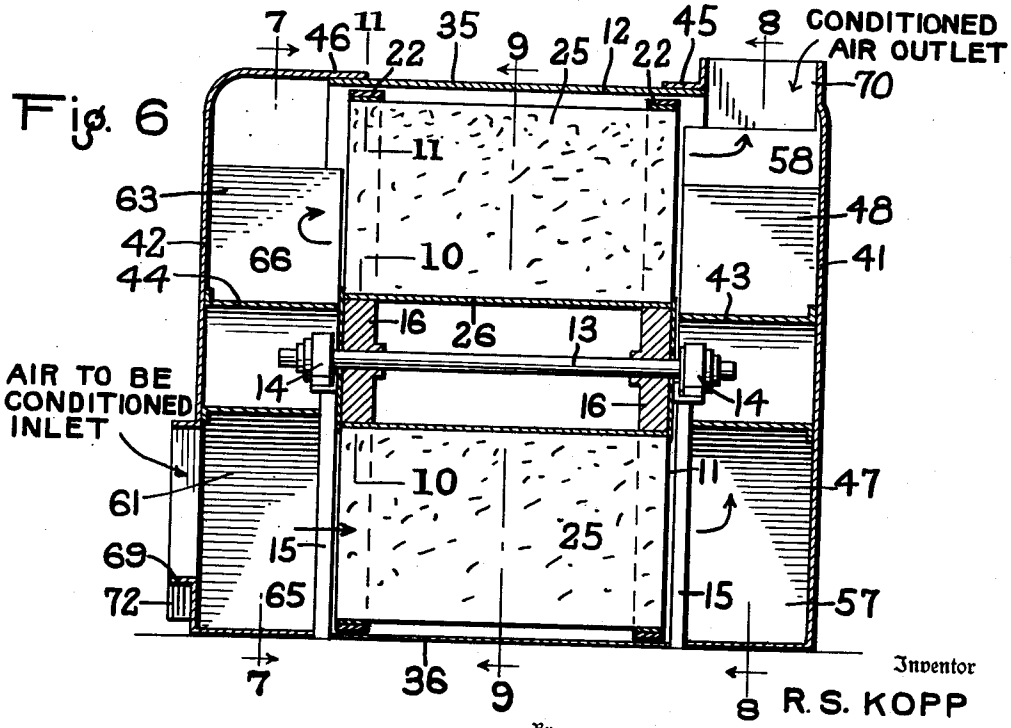


Fig. 6



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AIR DEHYDRATION UNIT

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Fig. 7

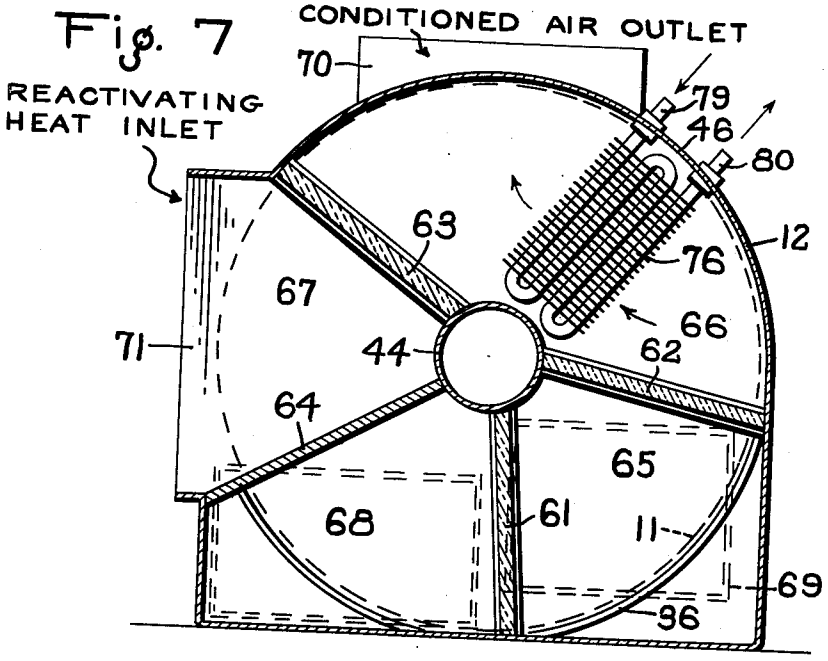
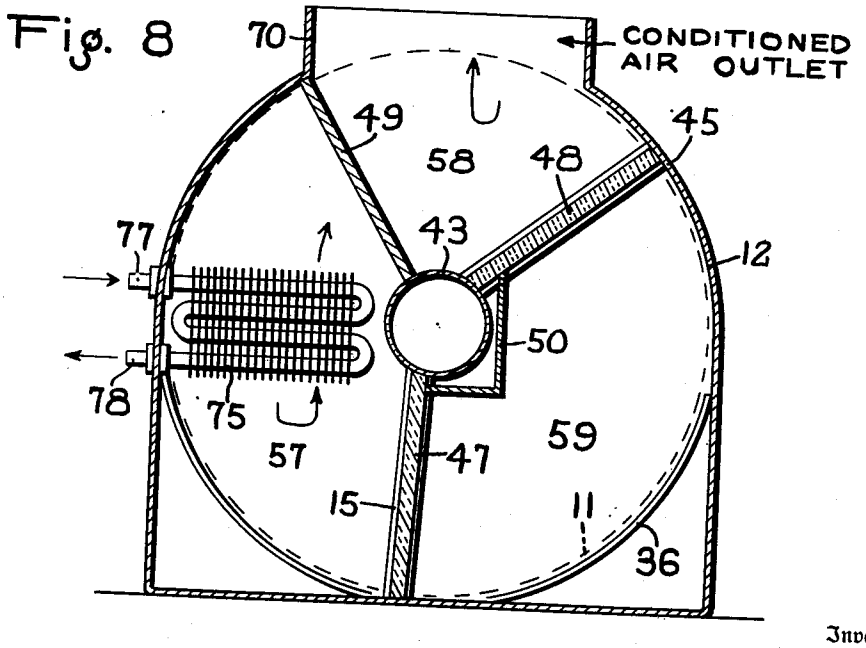


Fig. 8



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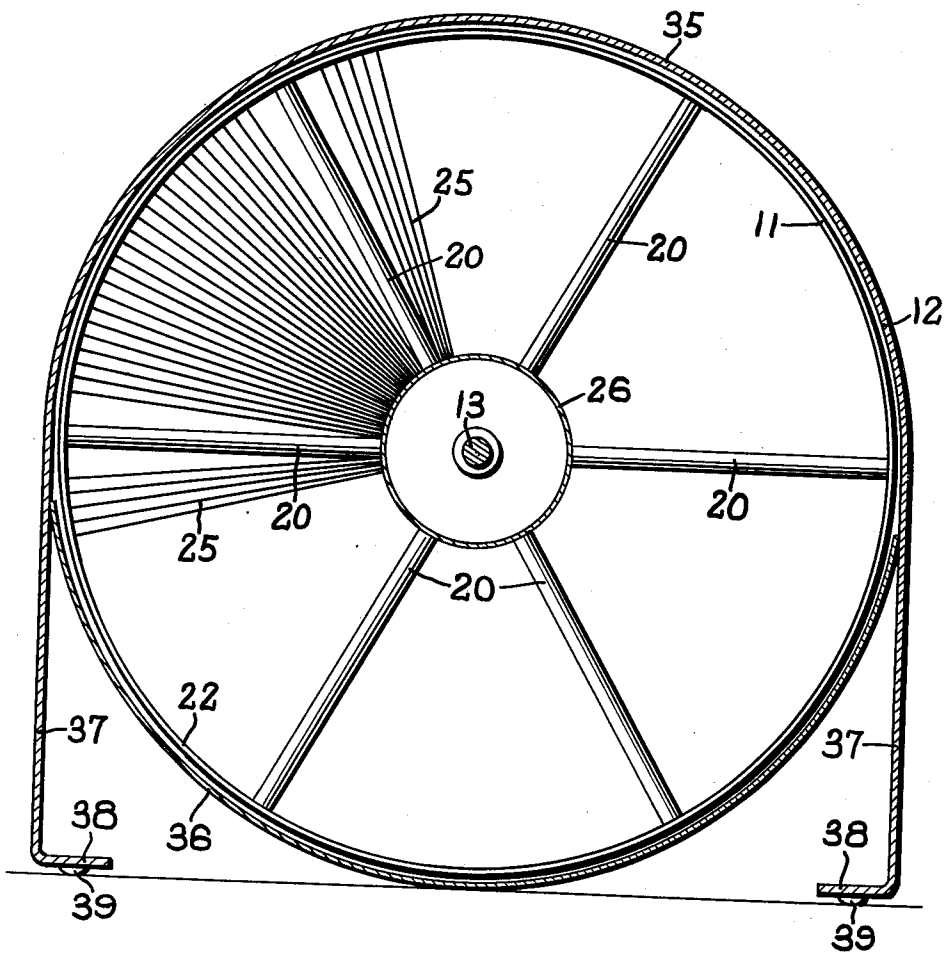
AIR DEHYDRATION UNIT

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Fig. 9



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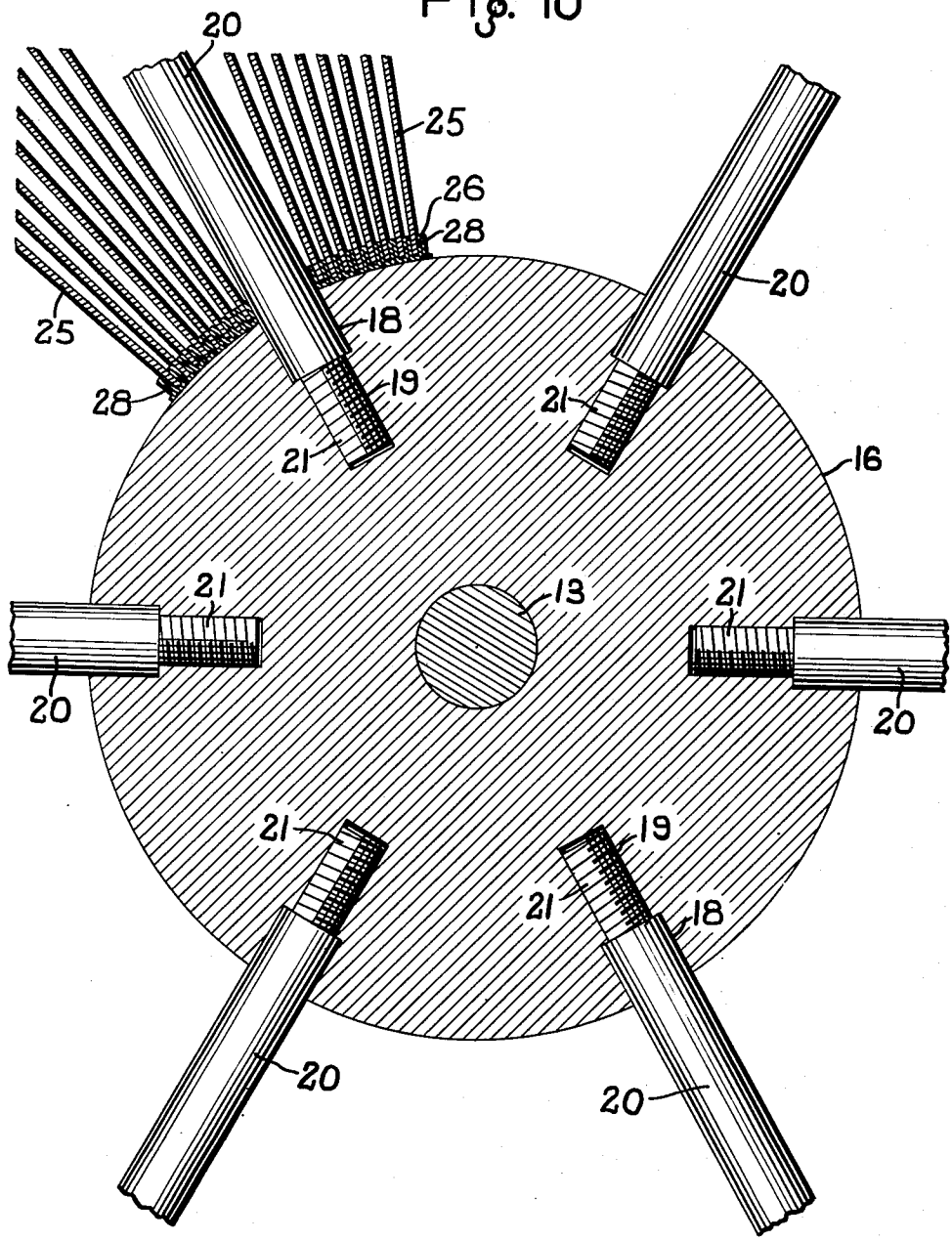
2,680,492

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Fig. 10



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2,680,492

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Fig. 11

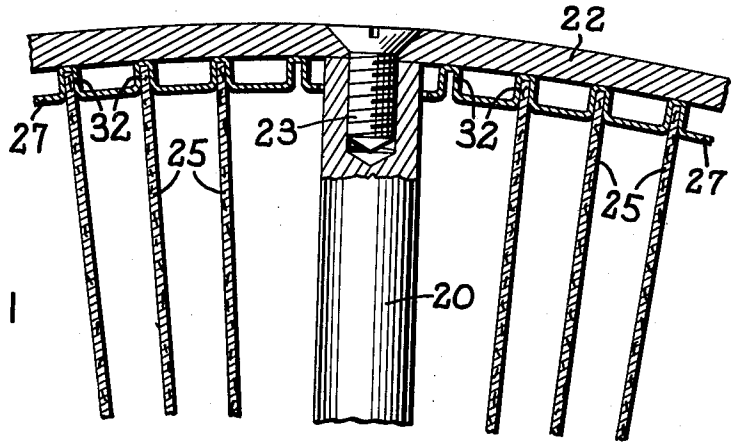
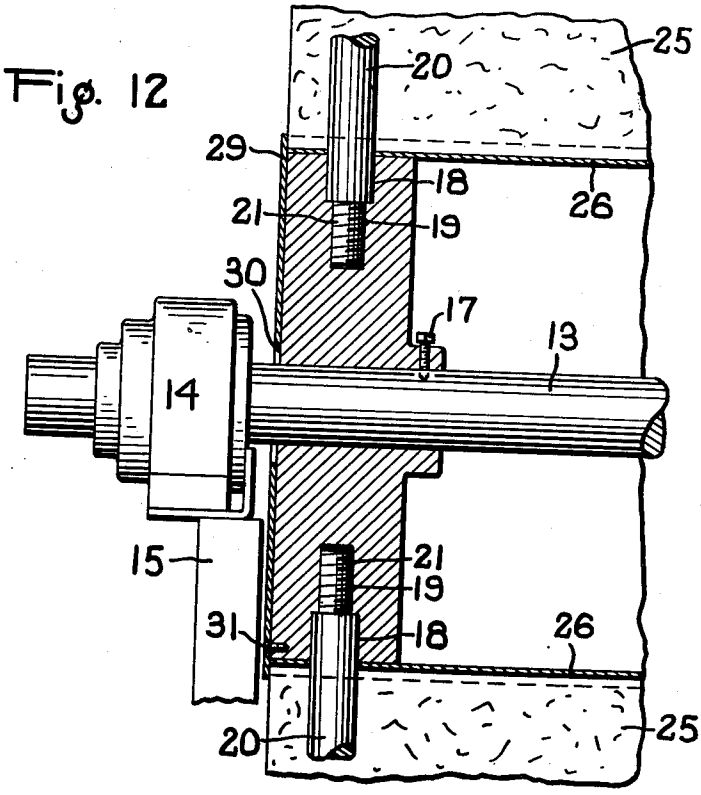


Fig. 12



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Patented June 8, 1954

2,680,492

UNITED STATES PATENT OFFICE

2,680,492

AIR DEHYDRATION UNIT

Roger S. Kopp, Arlington, Va.

Application June 22, 1951, Serial No. 232,990

10 Claims. (Cl. 183—4.6)

1

This invention relates to air conditioning units of the type adapted to be used in air conditioning and cooling systems of rooms, buildings, and the like for the purpose of maintaining relative humidity of any desired degree therein.

An object of the invention is to provide an improved air conditioning unit having a rotatable wheel composed of a plurality of radially disposed absorption plates, which wheel is so arranged within a casing that the air to be conditioned flows through the wheel in such a manner that the moisture in the air is absorbed by the wheel.

Another object of the invention is to provide an improved air conditioning unit comprising a wheel rotatable solely by gravity and composed of a plurality of radially disposed absorption plates, and having a casing enclosing the wheel and formed with a series of plenum chambers so arranged at each end of the wheel that the air flows through the wheel only in a direction substantially parallel to the axis of rotation of the wheel.

Another object of the invention is to provide an improved air conditioning unit comprising means for causing the air to flow in contact with an absorption material adapted to absorb moisture from the air, means for exposing the wet material for contact with heated air having a predetermined temperature in a drying chamber for drying the wet material, and means for subsequently exposing the dried material to the air to be conditioned whereby a constant relative humidity of any desired degree can be maintained in the treated air by the degrees of proportionate temperature used in drying the wet material.

Another object of the invention is to provide an improved air conditioning unit comprising means for causing the air to flow in contact with an absorption material adapted to convert the latent heat of the air into sensible heat and to increase the sensible temperature of the air proportional to the quantity of moisture absorbed, and means for reducing the sensible temperature of the dehumidified air.

Another object of the invention is to provide an improved method of dehumidifying air which comprises causing the air to flow in contact with a compressed fibrous material having a hygroscopic salt uniformly distributed therethrough, successively exposing dry material for contact with the air at a rate proportional to the rate of absorption of moisture by the material, and subsequently exposing the wet material for contact with heated air to remove the moisture therefrom.

2

A still further object of the invention is to provide an improved method of air conditioning which comprises causing the air to be treated to flow in contact with a compressed fibrous material having a hygroscopic salt uniformly distributed therethrough, successively exposing dry compressed fibrous material for contact with the air to be treated at a rate proportional to the rate of absorption of moisture by the material, and subsequently exposing the wet material for contact with heated air having a predetermined temperature in a drying chamber whereby the material is dried a predetermined amount so that a constant relative humidity of any desired degree can be maintained in the treated air by the degrees of proportionate temperature used in the drying chamber.

With the foregoing and other objects and advantages in view, the invention consists in the preferred construction and arrangement of the several parts which will be hereinafter more fully described and claimed.

In the accompanying drawings:

Fig. 1 is a top plan view of an air conditioning unit embodying the present invention;

Fig. 2 is an elevation of the unit shown in Fig. 1, looking at the reactivating heat inlet side thereof;

Fig. 3 is an elevation looking at the side opposite to the side shown in Fig. 2;

Fig. 4 is an elevation looking at the rear of the unit;

Fig. 5 is an elevation looking at the front of the unit;

Fig. 6 is a vertical section taken along the line 6—6 of Fig. 4;

Fig. 7 is a vertical section taken along the line 7—7 of Fig. 6;

Fig. 8 is a vertical section taken along the line 8—8 of Fig. 6;

Fig. 9 is a vertical section taken along the line 9—9 of Fig. 6;

Fig. 10 is an enlarged section of the hub of the wheel taken along the line 10—10 of Fig. 6;

Fig. 11 is an enlarged section of the rim of the wheel taken along the line 11—11 of Fig. 6; and

Fig. 12 is an enlarged section of the hub portion of the wheel shown in Fig. 6.

Referring to the drawings, and especially to Fig. 6, the improved air conditioning unit comprises a rotatable wheel 11 enclosed by a casing 12 of specific construction to be hereinafter more fully described.

The wheel 11 has a shaft 13 of suitable length, and a bearing 14 is mounted on the shaft near

each end thereof so that the shaft and the wheel thereon are free to rotate in the manner to be hereinafter referred to. Each bearing 14 is supported by a standard 15, as shown best in Figs. 6 and 12.

The wheel 11 has a pair of spaced hubs 16 fixed to the shaft 13 by means of set screws or other suitable fastening means, indicated at 17, Fig. 12. Each hub 16 is formed with a plurality of radial bores 18 which extend inwardly from the outer periphery of the hub, the inner portion of each bore 18 being formed with screw threads 19.

A rod 20, having an inner end threaded portion 21, is mounted in each bore 18, the screw threads of the portion 21 of the rod engaging the screw threads 19 of the bore 18 so that the rod is tightly secured to the hub 16.

In the present instance, each hub 16 is shown as being provided with six rods 20. It will be understood, however, that any suitable number of rods 20 may be employed, depending upon the size of the wheel and other structural characteristics which might enter into the design and construction of the invention.

Encircling the outer ends of the rods 20 carried by each hub 16, is an annular band 22 which is secured to each rod by means of a screw or other suitable fastening element, as indicated at 23, Fig. 11. Each band 22 is located in substantially the same plane as is each hub 16 of the wheel, and said bands constitute the rims or fellies of the wheel, as shown in Fig. 6. The rods 20 are the spokes of the wheel.

Disposed between the hubs 16 and the rims or bands 22, is a plurality of plates 25. These plates 25 are preferably formed from rectangular sheets of suitable material, and all of said plates should preferably be of equal size and weight, so that when the plates are assembled in the wheel, the wheel will be balanced and free to turn on its axis. In order to provide means for retaining the plates 25 in position an inner retainer 26 is fastened to the hubs 16, and an outer retainer 27 is fastened to each band or rim 22.

As shown in Fig. 10, the inner retainer 26 may be in the form of a tube of corrugated sheet metal, which tube encircles the hubs 16 and encloses the portion of the shaft 13 between said hubs (see also Figs. 6 and 12). This tube with the corrugations formed lengthwise thereof, provides a series of radially disposed slots or grooves 28, into each of which is inserted an edge portion of a plate 25.

In order to prevent shifting movement of the plates lengthwise of the retainer 26, a plate 29 is mounted on the outer face of each hub 16. The plate 29 is formed with a central opening 30 somewhat larger in diameter than the diameter of the shaft 13, so that when it is desired to remove or insert a plate 25, the plate 29 can be detached from the hub 16 and then shifted to dispose the outer periphery thereof inwardly with respect to the outer periphery of the hub 16. The plates 29 may be detachably secured to the hubs 16 by screws or other suitable fastening means, as indicated at 31, Fig. 12.

As shown in Fig. 11, the outer retainer 27 may be in the form of a strip of corrugated sheet metal which is secured in any suitable manner to the inner face of each band 22. The metal strips 27 provide a series of slots or grooves 32 into each of which is inserted an edge portion of a plate 25.

Since the plates 25 are arranged radially of the wheel, the grooves 28 are disposed close together, and the grooves 32 are disposed somewhat farther apart with respect to the spacing of the grooves 28. In actual practice the wheels 11 have been constructed with approximately 180 plates. In this way the plates were spaced apart an angle of approximately 2 degrees.

In Fig. 9 a typical arrangement of the plates 25 between two of the spokes or rods 20 has been shown. It will be understood that in both Fig. 9 and Fig. 10, the plates extend entirely around the hub of the wheel, said plates being uniformly spaced apart.

The plates 25 are preferably formed of inert, fibrous, light-weight material with a high factor of absorption. One material suitable for use in constructing the plates is rock wool, or as is commonly known, asbestos, since such material can be molded or formed into boards or sheets of different thicknesses, and it is also adapted to various degrees of density and rigidity which, in consequence, permits its use over such a range as to meet the conditions which may be imposed upon it by differences in mechanical design.

In addition to asbestos fibres, other suitable materials for the base of the plates 25 are balsam wool, kapok, eel grass, rock cork, sugar cane fibre, cotton linters, wood pulp and the like textile fibres, and, in fact, any other known inert fibrous material.

Since the plates 25 should be treated so as to render them highly absorbent to moisture in air flowing through the unit, any method may be used to prepare the inert fibrous materials for use as dehydrating materials.

By one method I have used the standard rock wool or asbestos boards or sheets as produced by manufacturers of asbestos products. These sheets are saturated in a solution of hygroscopic salt, such as calcium chloride ($CaCl_2$), or any other hygroscopic salt. In some cases compounds of several of the hygroscopic salts have been used.

In order to properly saturate the plates 25, the latter are submerged in a salt solution until the fibres of the plates are thoroughly wet. Usually it requires approximately one hour for the submerged plates to become thoroughly saturated. Of course, the amount of time the plates should be submerged in the salt solution depends upon the kind of material and the density thereof, but ordinarily after the plates have been submerged in the salt solution for an hour they are thoroughly saturated. The saturated plates are then dried to remove the moisture therefrom. In drying the plates, they may be placed in a continuous dryer under a counter-flow of air heated to a temperature of 180° F. to 220° F. Usually the plates must remain in the dryer for approximately one hour before the moisture is entirely removed therefrom. When the plates are thus prepared, the hygroscopic salt or salts will be evenly distributed throughout the inert base material in fixation in its dry state.

In addition to calcium chloride referred to above, lithium chloride (LiCl), lithium bromide (LiBr), calcium bromide ($CaBr_2$), and other hygroscopic salts having in their normal state low vapor pressures may also be used for treating the plates for use in the apparatus of the present invention.

When exposed to air or gases having a higher vapor pressure than the hygroscopic salt, the salt absorbs vapor from the air or gases until saturation occurs. Namely, saturation occurs when the vapor pressure of the hygroscopic solution is raised by absorbing so much moisture and

diluting the hygroscopic solution to that point where absorption ceases and equilibrium occurs.

The upper portion of the wheel 11 is enclosed by a wall 35 which constitutes the central portion of the casing 12, and the lower portion of the wheel is enclosed by a wall 36, as shown best in Fig. 9. The walls 35 and 36 are arranged close to the outer periphery of the wheel 11, the clearance between said walls and the wheel being sufficient to permit free rotation of the wheel. Preferably the walls 35 and 36 are formed from sheet metal, the wall 36 being somewhat arcuate or U-shaped in form and the wall 35 being somewhat of inverted U form and having substantially vertical portions 37 which extend from the arcuate upper portion of the wall 35 downwardly toward the floor. The lower edge 38 of each portion 37 may be bent inwardly so as to provide a structure for supporting feet 39.

The wheel 11 may be constructed of any desired size. That is to say, the diameter and the axial length or width of the wheel depends upon the number of square feet of plate surface required for a predetermined air dehumidifying condition.

In operation, the air to be conditioned is adapted to flow through the wheel in a direction parallel to the axis of rotation of the wheel. That is to say, the air flows through the spaces between the radially disposed plates 25 in a direction parallel to the shaft 13. Since the walls 35 and 36 enclose the periphery of the wheel 11, chambers are formed in the casing 12 at each end of the device. Each end of the wheel 11 is spaced a suitable distance from the end wall 41 and the rear wall 42 of the casing 12. The space between these end walls of the casing and the ends of the wheel is divided by partitions or walls into a plurality of compartments or chambers, the purpose of which will be hereinafter more fully described.

At the front of the device and located between the end of the wheel 11 and the front wall 41, there is a tube 43 which has its longitudinal axis coincident with the axis of the wheel shaft 13.

At the rear of the device and located between the end of the wheel 11 and the rear wall 42, there is a tubular member 44.

The ends of the tubes 43 and 44 adjacent to the end walls 41 and 42, respectively, may be formed with flanges by which said tubes are connected to said end walls.

The tubes 43 and 44 provide means for enclosing the bearings 14, as shown in Fig. 6, and the inner ends of said tubes are spaced slightly from the ends of the wheel 11, so that the wheel is free to turn.

The front wall is formed with an inwardly extending peripheral flange 45 which overlaps the front edge of the wall 35. Likewise, the rear wall 42 is formed with a flange 46 which overlaps the rear edge of the wall 35.

The front end portion of the device is provided with three partitions 47, 48 and 49. These partitions or walls extend from the tube 43 outwardly to the flanged portion 45 of the front wall 41, as shown best in Fig. 8. Preferably the walls 47 and 48 are formed of suitable heat insulating material, as illustrated. In this way there is formed a plurality of plenum chambers 57, 58 and 59 at the front portion of the device. If so desired, an L-shaped wall 50 may connect the walls 47 and 48.

The rear end portion of the device is provided with four partitions or walls 61, 62, 63 and 64

which extend from the tube 44 outwardly to the flange 46 and divide the rear of the device into a plurality of plenum chambers 65, 66, 67 and 68. The chamber 65 is connected to an air to be conditioned inlet by means of a flanged opening 69, and the chamber 58 is connected to an outlet for the conditioned air by a flanged opening 70. The chamber 67 is connected to a reactivating heat inlet by means of a flanged opening 71, and the chamber 68 is connected to an outlet for the reactivating heat by means of a flanged opening 72. Suitable conduits (not shown) are adapted to be connected to the flanged openings 69, 70, 71 and 72, in well known manner.

The air to be conditioned entering the chamber 65 through the inlet 69 passes through the portion of the wheel 11 defined by the partitions 61 and 62 and enters plenum chamber 57 at the front of the device where it is restricted by the plenum and forced to flow through or over the face of the coils of a radiator 75 arranged in the chamber 57 substantially between the top and bottom of the chamber, as shown in Fig. 8.

From the upper portion of the chamber 57 the air counterflows back through the wheel 11 (see Fig. 6) and enters the portion of chamber 66 directly above the wall 62 to complete the second passage of the conditioned air through the wheel.

After the second passage of air through the wheel 11 into plenum chamber 66 the conditioned air passes through the coil surface of radiator 76, arranged in said chamber in the manner shown in Fig. 7. The air then counterflows again through the wheel 11 and flows through the section of said wheel in line with and to plenum chamber 58, and from thence to the outlet 70.

The radiator 75 is formed with an inlet connection 77 and an outlet connection 78. The direction of flow of the cooling fluid through the radiator is indicated by arrows, Fig. 8. The purpose of the radiator 75 is as follows:

When the moisture from the air passing through the first stage is absorbed by the plates 25 of the wheel, this absorption converts the latent heat into sensible heat and increases the sensible temperature proportionate to the quantity of moisture absorbed. This heat is removed either in part or in whole from the air as it flows past the first radiator 75.

The radiator 76 has an inlet connection 79 and an outlet connection 80. The direction in which the cooling fluid flows through said radiator is indicated by arrows in Fig. 7.

The purpose of the radiator 76 is identical with the purpose of radiator 75, but the radiator 76 has an added function, in that by reducing the temperature of the air that is about to pass over the plates 25 of the wheel in its third passage through the wheel, this cooled air absorbs the specific heat from the plates which has been absorbed in the drying process or reactivation, thereby presenting a lower temperature plate and in consequence a greater difference of vapor pressure becomes available for more efficient absorption of moisture by the plates.

The plates 25 of the wheel will absorb up to approximately 80 per cent of their normal dry weight in moisture or water content. It is the weight of this accumulation of moisture by the plates to one of the vertical axis of the wheel which acts as a lever and causes the wheel to rotate (see my Patent No. 2,115,226). The plates in the section of the wheel between chambers 57 and 65 are wetter than the plates between

the chambers 57 and 66, and the plates between chambers 58 and 66 are drier than the plates of the wheel disposed between chambers 57 and 66.

The counterflow of air through the wheel above referred to is important. The plates between chambers 65 and 67 being wetter, have a higher vapor pressure, but the air, making its first passage through the plates of the wheel disposed between chambers 65 and 57, also has its higher vapor pressure under any given condition and, therefore, permits the moist plates of the wheel to absorb quantities of moisture from the moist air.

The second passage of air through the wheel is of that air which has been partially dried, and this drying process will reduce the vapor pressure of the air, but the section of the wheel disposed between chambers 57 and 66 which is comprised of drier plates, also because of its relatively greater lower vapor pressure, will extract additional moisture from the practically dry air which has passed through the wheel between chambers 65 and 57.

The heated reactivating air enters the separate plenum chamber 67, Fig. 7, and flows through the wheel in the same manner as the air to be conditioned flows through the wheel into chamber 59, Fig. 8, and counterflows through the wheel and into chamber 68, Fig. 7, from which it is exhausted through the outlet 72, Fig. 4. This passage of heated air through the wettest part of the wheel dries the moisture from the plates, thereby permitting the wheel to turn in its normal cycle as it accumulates more moisture from the air being conditioned in the manner above referred to.

It should be noted that the plates 25 of the wheel 11 which are disposed between the chambers 59 and 67 are drier than the plates disposed between the chambers 59 and 68.

The temperature of the air supplied to the reactivating heat inlet 71 which is used to dry the plates of the wheel 11 need not exceed 150° F. under normal operating conditions. The entering reactivating heated air in passing over the drier section of the wheel, first picks up a quantity of moisture, and in so doing, the sensible heat of the drying air is reduced. This is caused by the absorption of moisture by the drying air. This sensible temperature of the heated air is then further reduced as the air absorbs more moisture from the wetter plates in its second passage through the wheel between chambers 59 and 68. Consequently, effective drying is obtained at relatively low temperatures, which in turn permits accurate control through the heat exchange that occurs on the adiabatic line, as all drying temperatures are within this definite range.

This adiabatic range also permits application of the quantity and volume of heat so that any degree of dryness of the plates within basic chemical limits may be applied, which in turn is the means through which any desired vapor pressure difference within chemical limits can be obtained through which the air to be conditioned is subjected.

From the foregoing it will be noted that I have provided a new method of dehumidifying air which comprises passing the air in contact with a compressed fibrous material having a hygroscopic salt uniformly distributed therethrough. This action converts the latent heat of the air into sensible heat and consequently increases the sensible temperature of the air in proportion to the quantity of moisture absorbed. Since the wheel 11 becomes overbalanced as it collects moisture in the section thereof defined by the plenum chambers 57 and 65, the wheel slowly rotates so that fresh material is successively exposed for contact with the air at a rate proportional to the rate of absorption of moisture. The method further includes reducing the sensible temperature of the air by passing the air successively through the radiators 75 and 76. Finally, the wet absorption material of the wheel is exposed for contact with the heated air admitted through the inlet 71, and thus the moisture is removed therefrom before this portion of the wheel moves into alignment with the upper plenum chamber 58.

The laws governing water vapor absorption from air by calcium chloride solutions have been determined in experimental and full size units. It is found that the amount of water absorbed in unit time on unit area of absorbent is directly proportional to the difference in vapor pressure of water in the air and in the absorbing solution, and to the 0.8 power of the velocity of the air past that area.

This relationship is expressed thus:

$$w=0.0301\ {}^{\Delta}pV^{0.8}A \text{ gms./hr.}$$
$$=0.462\ {}^{\Delta}pV^{0.8}A \text{ grains/hr.}$$

where

w=the weight of water absorbed.

${}^{\Delta}p$=millimeters of Hg difference in vapor pressures of water between the air and the absorbing solution.

V=velocity of air past the solution in F. P. M. measured about ⅜ inch from the surface.

A=area of solution surface in sq. ft.

For a velocity of 1000 F. P. M. over the absorbing surface, $V^{0.8}$=approximately 252 and

$$w=7.59\ {}^{\Delta}p\ A \text{ gms./hr.}$$
$$=117\ {}^{\Delta}p\ A \text{ grains/hr.}$$

This formula agrees accurately with those which can be calculated from heat transfer coefficients and the relation between heat transfer and water vapor diffusion. They are independent of temperature.

The same formula in reverse applies on the drying side of the wheel.

Without the application of heat to the drying side the wheel will turn and the plates absorb until the wheel attains equilibrium. However, when drying is started or occurs on the reactivating side of the wheel, the moisture deleted thereby provides absorption capacity equal to the amount dried. The more completely the plates are dried in reactivation, the greater is the amount which they can absorb on the conditioning side.

In like manner the lower the temperature of the drying air the more water or moisture is left in the plates and the lower is the ability of the plates to absorb. It is accurately proportional and equal to the mean temperature difference.

The wheel permits motion only if sufficient absorption occurs to overbalance it. The rate at which the wheel rotates about its axis and the capacity of the wheel within the formula is the direct reciprocal of the drying of the plates. For these reasons the device can maintain a constant relative humidity of any degree in the treated air by the degrees of proportionate temperature used on the drying side.

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

1. An air conditioning unit comprising a wheel including a plurality of radially disposed flat absorption plates, said absorption plates being uniformly spaced apart whereby the wheel is normally balanced, means for supporting said wheel for free rotation about a horizontal axis, a casing enclosing said wheel, a plurality of plenum chambers formed in the casing at each end of said wheel, means for conducting moist air into said casing and by means of said plenum chambers axially through a segment of said wheel to permit absorption of moisture by the plates then in said segment, and means for conducting heated air into said casing and by means of other plenum chambers axially through an angularly offset segment of said wheel to permit absorption of moisture by said heated air from the plates then in said offset segment, the absorption of moisture by the plates in one segment of the wheel operating with the loss of moisture by the plates in the angularly offset segment of the wheel to unbalance and effect rotation of the wheel.

2. Apparatus according to claim 1, including cooling means associated with said casing in the path of the moist air being conditioned.

3. An air conditioning unit comprising a wheel including a plurality of radially disposed flat absorption plates, said absorption plates being uniformly spaced apart whereby the wheel is normally balanced, means for supporting said wheel for free rotation about a horizontal axis, a casing enclosing said wheel, a plurality of plenum chambers formed in the casing at each end of said wheel, means for conducting moist air into said casing and by means of said plenum chambers axially through a segment of said wheel in a plurality of successive back and forth passes to permit absorption of moisture by the plates then in said segment, and means for conducting heated air into said casing and by means of other plenum chambers axially through an angularly offset segment of said wheel to permit absorption of moisture by said heated air from the plates then in said offset segment, the absorption of moisture by the plates in one segment of the wheel operating with the loss of moisture by the plates in the angularly offset segment of the wheel to unbalance and effect rotation of the wheel.

4. Apparatus according to claim 3, including cooling means associated with said casing in the path of the moist air being conditioned.

5. An air conditioning unit comprising a wheel including a plurality of radially disposed flat absorption plates, said absorption plates being uniformly spaced apart whereby the wheel is normally balanced, means for supporting said wheel for free rotation about a horizontal axis, a casing enclosing said wheel, a plurality of plenum chambers formed in the casing at each end of said wheel, means for conducting moist air into said casing and by means of said plenum chambers axially through a segment of said wheel to permit absorption of moisture by the plates then in said segment, and means for conducting heated air into said casing and by means of other plenum chambers axially through an angularly offset segment of said wheel in a plurality of successive back and forth passes to permit absorption of moisture by said heated air from the plates then in said offset segment, the absorption of moisture by the plates in one segment of the wheel operating with the loss of moisture by the plates in the angularly offset segment of the wheel to unbalance and effect rotation of the wheel.

6. An air conditioning unit comprising a wheel including a plurality of radially disposed flat absorption plates, said absorption plates being uniformly spaced apart whereby the wheel is normally balanced, means for supporting said wheel for free rotation about a horizontal axis, a casing enclosing said wheel, a plurality of plenum chambers formed in the casing at each end of said wheel, means for conducting moist air into said casing and by means of said plenum chambers axially through a segment of said wheel in three successive back and forth passes to permit absorption of moisture by the plates then in said segment, and means for conducting heated air into said casing and by means of other plenum chambers axially through an angularly offset segment of said wheel in two successive back and forth passes to permit absorption of moisture by said heated air from the plates then in said offset segment, the absorption of moisture by the plates in one segment of the wheel operating with the loss of moisture by the plates in the angularly offset segment of the wheel to unbalance and effect rotation of the wheel.

7. An air conditioning unit comprising a wheel including a plurality of radially disposed flat absorption plates, said absorption plates being uniformly spaced apart whereby the wheel is normally balanced, means for supporting said wheel for free rotation about a horizontal axis, a casing enclosing said wheel, a plurality of plenum chambers formed in the casing at each end of said wheel, means for conducting moist air into one side of said casing adjacent the bottom thereof and by means of said plenum chambers axially through a segment of said wheel in three successive back and forth passes to permit absorption of moisture by the plates then in said segment, each successive pass being through a higher portion of said segment, an outlet for conducting conditioned air out of the opposite side of said casing adjacent the top thereof, and means for conducting heated air into said casing and by means of other plenum chambers axially through an angularly offset segment of said wheel to permit absorption of moisture by said heated air from the plates then in said offset segment, the absorption of moisture by the plates in one segment of the wheel operating with the loss of moisture by the plates in the angularly offset segment of the wheel to unbalance and effect rotation of the wheel.

8. Apparatus according to claim 7, including plural cooling means associated with said casing in the path of the moist air being conditioned to cool said air between successive passes through the wheel.

9. An air conditioning unit comprising a wheel including a plurality of radially disposed flat absorption plates, said absorption plates being uniformly spaced apart whereby the wheel is normally balanced, means for supporting said wheel for free rotation about a horizontal axis, a casing enclosing said wheel, a plurality of plenum chambers formed in the casing at each end of said wheel, means for conducting moist air into said casing and by means of said plenum chambers axially through a segment of said wheel to permit absorption of moisture by the plates then in said segment, means for conducting heated air into one side of said casing and by means of other plenum chambers axially through an angularly offset segment of said wheel in successive back

and forth passes to permit absorption of moisture by said heated air from the plates then in said offset segment, the final heated air pass being through a lower portion of said offset segment and below the first heated air pass, and an outlet for conducting heated air out of said casing adjacent the bottom thereof, the absorption of moisture by the plates in one segment of the wheel operating with the loss of moisture by the plates in the angularly offset segment of the wheel to unbalance and effect rotation of the wheel.

10. An air conditioning unit comprising a wheel including a plurality of radially disposed flat absorption plates, said absorption plates being uniformly spaced apart whereby the wheel is normally balanced, means for supporting said wheel for free rotation about a horizontal axis, a casing enclosing said wheel, a plurality of plenum chambers formed in the casing at each end of said wheel, means for conducting moist air into one side of said casing adjacent the bottom thereof and by means of said plenum chambers axially through a segment of said wheel in three successive back and forth passes to permit absorption of moisture by the plates then in said segment, each successive pass being through a higher portion of said segment, an outlet for conducting conditioned air out of the opposite side of said casing adjacent the top thereof, means for conducting heated air into one side of said casing and by means of other plenum chambers axially through an angularly offset segment of said wheel in successive back and forth passes to permit absorption of moisture by said heated air from the plates then in said offset segment, the final heated air pass being through a lower portion of said offset segment and below the first heated air pass, and an outlet for conducting heated air out of said casing adjacent the bottom thereof, the absorption of moisture by the plates in one segment of the wheel operating with the loss of moisture by the plates in the angularly offset segment of the wheel to unbalance and effect rotation of the wheel.

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