Jan. 6, 1953 A. G. ELEGAR 2,624,420

APPARATUS FOR CONTROLLING HUMIDITY

Filed Feb. 13, 1950

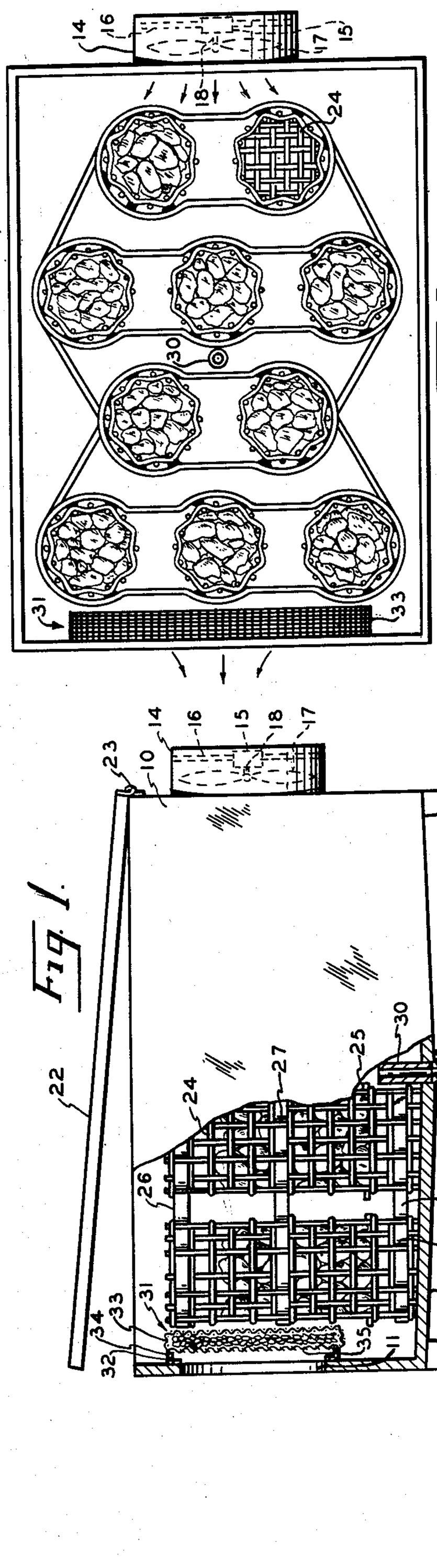

Fig. 1.

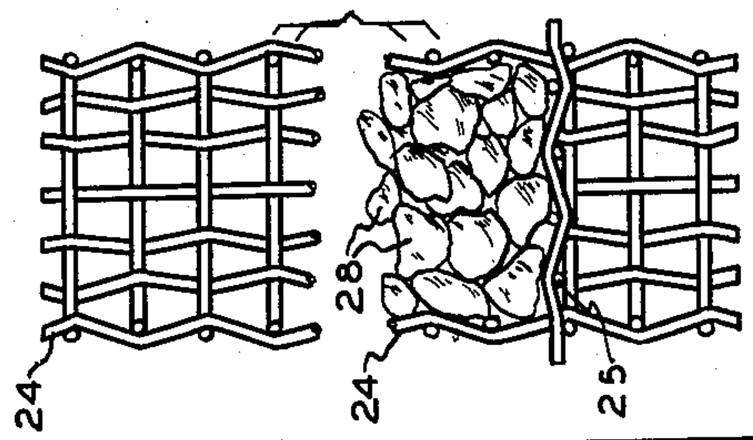

Fig. 2.

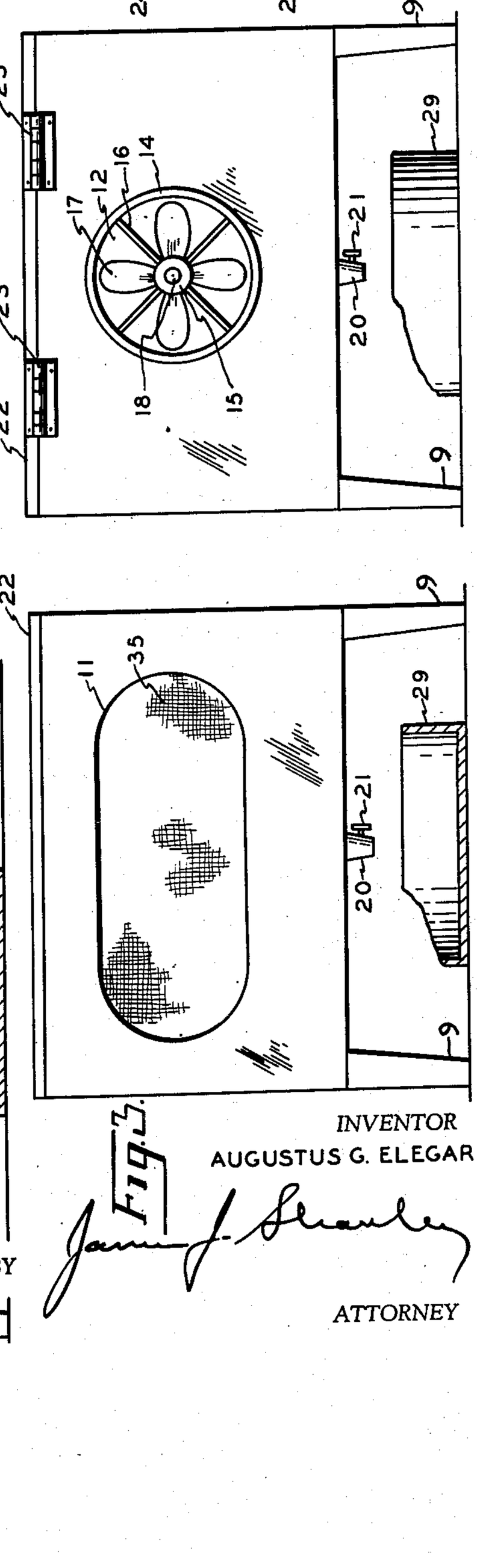

Fig. 4.

Fig. 3.

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Patented Jan. 6, 1953 2,624,420

UNITED STATES PATENT OFFICE

2,624,420

APPARATUS FOR CONTROLLING HUMIDITY

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Application February 13, 1950, Serial No. 143,872

1 Claim. (Cl. 183—4.0)

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This invention relates to humidity controlling apparatus and more particularly to apparatus for removing moisture from or adding moisture to the air in a building.

The present application is a continuation-in-part of my application Serial No. 131,333, filed December 6, 1949, entitled Apparatus and Method for Controlling Humidity, now abandoned.

As is well known, during the summer months in many parts of the country the air is very humid and when it contacts cool surfaces, condesation frequently occurs. This phenomenon is particularly noted in cellars and other enclosed spaces having relatively cool walls. The air containing a large amount of moisture contacts the walls, ceiling and floors of such rooms and deposits moisture thereon. The resulting dampness makes the room uninhabitable for most purposes and also results in a great deal of damage due to the mildew on the furnishings and articles kept in the room. The moisture also causes damage to the wallpaper and tends to rust the pipes in the room.

It has been previously proposed to prevent such condensation and resulting damage by dehumidifying the air in the room. This has been accomplished in various ways. The most common method is to place one or more containers holding a deliquescent material in the room in which the air is to be humidified. The air coming in contact with the material in the container is subjected to some drying action, but, on the whole, such a method has been found to be unsatisfactory. It has also been proposed to dehumidify the air by forcing the air by means of a fan through apparatus containing a deliquescent material. In such systems, the moisture absorbing substance has been supported upon shallow trays or pans arranged one above another in the apparatus, or else on screens or gratings supported by the walls of the apparatus. The forms of apparatus proposed have been relatively elaborate and expensive to manufacture. In some cases, it was necessary to take the apparatus apart in order to replenish the supply of deliquescent material therein.

Although it is often necessary to dehumidify the air in a room to prevent the condensation of moisture, during other seasons it may become necessary to add moisture to the air in a room so as to control the humidity thereof to an amount that is most healthy for the occupants of the room and also to prevent objectionable drying out of furniture and like articles in the room. Although many devices have been proposed to humidify the air in a room and many others to dehumidify the air, no apparatus is known wherein the air can be either humidified or dehumidified when desired by use of the same apparatus. Heretofore, a separate humidifier and a separate dehumidifier have been required with the resultant added expense and nuisance of two pieces of equipment instead of one.

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It is an important object of the present invention to provide a single apparatus which can be used for either dehumidifying or humidifying large volumes of air rapidly and efficiently.

It is a further important object of the present invention to provide apparatus for controlling the humidity of air in which bodies of deliquescent or moist material make optimum contact with air to be treated.

It is a further object of the present invention to provide apparatus of this type in which the containers for the contact material are arranged in a manner so as to permit ready access thereto for refilling.

A further object of the present invention is to provide apparatus of this type in which a plurality of such containers are secured together so that they can be removed from the apparatus as a unit.

Other objects and the nature and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a view of the apparatus in side elevation, a portion being shown in section;

Figure 2 is a top plan view of the apparatus with the cover removed showing a modified method of attaching the bracing strips to the containers;

Figure 3 is a front elevational view of the apparatus;

Figure 4 is a rear elevational view of the apparatus, and

Figure 5 is a detail of one of the cylindrical containers partially filled with deliquescent material.

As shown in the drawings, the numeral 10 designates a casing mounted on legs 9 having a vent opening 11 in the front wall thereof and an opening 12 in the rear wall. A cylindrical casing 14 having a diameter corresponding to the diameter of the opening 12 is attached to the rear wall of the casing 10 surrounding the opening 12 therein. Mounted within the casing 14 is a fan motor 15 attached to the casing 14 and supported by metal spider 16. A fan blade 17 is mounted on a shaft 18 which is actuated by the motor 15. The

fan assembly thus forces air into the casing 10 through the cylindrical casing 14 and opening 12, which stream of air is vented through the vent hole 11 in the front wall of the apparatus. The bottom wall 19 of the casing 10 slopes slightly on all sides to the center thereof where a drain outlet 20 is provided which can be controlled by a petcock 21. The top of the casing 10 is covered by a cover member 22 which is hinged at 23 to the rear wall of the casing 10. The cover 22 may thus be pivoted about the rear wall of the casing to completely uncover the casing 10 to permit ready access to the interior thereof.

Mounted within the casing 10 resting on the bottom wall is an assembly of cylindrical containers 24 each of which is formed of wire mesh screen or hardware cloth open at the top and having a screen bottom member 25 spaced from the lower end of the container. The containers 24 are arranged within the casing 10 in alternately staggered rows as shown in Figure 2 so that the air blown into the casing by fan 17 will take a tortuous path with a maximum of contact with the substance contained in the cylinders before escaping through vent 11. The cylindrical containers may be readily made from rectangular strips of wire mesh screen, preferably ⅛ inch screen. The bottom member 25 is made from a piece of screen cut into the shape of a circle slightly greater than the diameter of the finished container with the ends of the screen wires extending outwardly about the circumference thereof. The circular piece of screen is positioned perpendicularly to the plane of the flat rectangular strip of screen and in a plane parallel to the top and bottom edges. The rectangular strip is then rolled about the circular piece of screen and the vertical edges are attached together in any suitable manner, such as by bending and hooking together the loose ends, thereby forming a cylinder. The cylindrical container 24 thus formed is open at one end and is closed near the other end by the circular piece of screen which is retained in position by the extending free ends of the wires of the screen as shown in Figure 5.

All of the cylindrical containers are connected together to form an assemblage by stiff bracing strips 26 at the upper, lower and intermediate portions so as to form a single unit which can be lifted out of the casing through the opening at the top when the cover 22 has been opened. A convenient form of attachment between bracing strips 26 and cylinders 24 is by passing strips 26 into and out of the interstices in the screen of the cylinders as shown at 27 in Figure 1. The parts of the containers and the strips may be soldered or welded together if more rigid connections are desirable as shown in Figure 2.

A deliquescent material 28, such as calcium chloride, may be charged into the plurality of cylindrical containers 24 through their open tops. The calcium chloride rests on the bottom member 25 as indicated in Figure 5 and is thus spaced from the bottom wall 19 of the casing 10. The moisture contained in the air blown through the apparatus is removed by the deliquescent material. The moisture thus extracted by the calcium chloride dissolves the chloride and the resulting solution drains from the containers 24 to the bottom of casing 10. A tray or other suitable receptacle 29 may be provided for receiving solution from drain 20.

An overflow pipe 30 may be connected to and supported by drain 20. This overflow pipe may be removably received by drain 20 either by friction fit, by screw threads or in any suitable manner such that the connection is sealed against leakage of solution in the bottom of the casing. Overflow pipe 30 extends upwardly to a point adjacent to but below the bottom members 25 of the containers. When the overflow pipe is used petcock 21 may be left open. As solution drains from the containers 24 to the bottom of casing 10 the overflow pipe causes a pool of the solution to collect. This solution is normally in super-saturated condition and as time passes crystals of the salt are precipitated out of the solution onto the bottom of the casing to form a growing cake of the salt. Overflow solution passes through the overflow pipe, out the drain and into tray 29. When a substantial cake of the salt has collected on the bottom of the casing 10 overflow pipe 30 is removed. The collected pool of solution is then drawn off through drain 20 into tray 29. This exposes the cake of salt in the bottom of the casing to the air being circulated through the casing and this salt thereupon acts to remove moisture from the air in the same manner as the deliquescent material in the containers. Thus by use of the overflow pipe the super-saturated condition of the solution draining down from the containers is taken advantage of to produce and recover salt for subsequent use. Petcock 21 can be used for the same purpose where overflow 30 is omitted but the deposition of the crystals in the bottom of the casing tends to stop up drain 20 so that on opening petcock 21 drain 20 must be cleared. In either case whether the pool of liquid is collected in the bottom of the casing by means of the overflow pipe 30 or by means of petcock 21, the pool of liquid itself acts to remove additional moisture from the air passing through the casing. Where the overflow pipe is used this results in the additional feature that the layer of water on top of the pool and therefore that part of the pool which drains off through the overflow pipe is in less saturated condition and may be run off to a sewer without danger of clogging of the sewer by crystallization of the salts.

When it is necessary to replenish the deliquescent substance 28, the operation is readily accomplished by swinging the cover 22 up and away from the casing about the hinges 23 and pouring the salt crystals into container 24 through their open tops.

Provision may be made for deodorizing the air by passing it through activated charcoal as it passes into or out of the casing 10. Reference numeral 31 indicates generally such a means in association with the vent 11. A flange 32 surrounds the inside edge of the vent opening 11. Removably fitted on this flange is a receptacle 33 formed of one-eighth inch mesh wire which is filled with activated charcoal. This receptacle carries a friction lip 34 engaging the flange 32. Stretched across vent 11 and held in place between flange 32 and friction lip 34 is a sheet of spun glass cloth 35. This structure associated with vent 11 removes odors from the air and by means of spun glass cloth sheet 35 further filters dirt out of the air.

When the containers 24 have been filled with the deliquescent substance, and the cover 22 has been closed tightly, the apparatus is ready to dehumidify the air in a room, petcock 21 is closed and the fan is started. The air in the room is thus circulated through the apparatus entering through casing 14 at the rear thereof and passing in contact with the deliquescent

substance contained in the containers 24, leaving the apparatus through the vent opening 11. The dried air is blown from the casing into the room, creating a continuous circulation of air. The air thus continually circulated through the room and in turn through the apparatus causes all parts of the room to be contacted by dried air, thus rapidly evaporating any moisture on the walls, floors or on any articles in the room to which the air has access. When the air is recirculated through the apparatus, the moisture thus evaporated into the air is removed by the repeated contact of the air with the deliquescent substance. Since this process is continuous as long as the fan operates, the moisture content of the air within the room is reduced to the desired level by control of the fan. The solution collecting in the bottom of the apparatus does not contact the deliquescent material in the containers 24 since the latter is retained above the bottom members 25 and is thus above the level of the pool of solution. The solution can be drained at intervals or allowed to drip continually into a tray or other container 29 placed below the drain pipe 20. When necessary, the deliquescent material can be replenished as described above. Containers 24 have been shown and described as being of cylindrical form with their axes vertical. This form, together with the staggered relationship of the containers, causes maximum turbulence of the air passing through the casing and therefore, maximum contact of the air with the salt held in the containers. However these containers may be of any suitable shape with their axes in vertical or horizontal planes so long as the containers are staggered to cause the air passing through the casing to be forced against one and then another of the containers without any path being open to air passing directly through the casing without contacting salt in a container. Thus the assemblage of containers is always so formed that there is no straight line path between the entrance end of the casing and the exit end of the casing which does not pass through at least one container.

The apparatus of the present invention can be used also as a humidifier and air cleaner. Most heating systems do not furnish moisture to the air and have a tendency to reduce the moisture content in a room to a point where the air is so dry as to be injurious to occupants and furniture. To increase the humidity of the air in a room, the present apparatus can be utilized by substituting an absorbent substance such as cotton or cloth for the deliquescent material, and by filling the bottom of the casing 10 with water to a level such that the absorbent material is in contact therewith and thus soaks up the water in the manner of a wick. As the air is blown through the machine, its water content is restored by the evaporation of the water soaked up into the absorbent material which presents an extended moist surface to which water is continuously supplied by capillary attraction in the absorbent material.

The conversion of the apparatus from a dehumidifier to a humidifier is effected by changing the humidity affecting material and is readily accomplished by removing the deliquescent material from the containers 24 and substituting the absorbent material such as cotton. When water has been added to the casing 10 to the proper height, the apparatus is ready for operation as a humidifier. In order to make all the water in the bottom of the casing available for

this purpose absorbent can be inserted in that part of the container below bottom 25 or the assembly of containers can be inverted.

It should be noted that when the apparatus is used to reduce the humidity of air or to increase the humidity thereof, the air flowing through the apparatus contacts a wet surface, either the deliquescent material in the first case or the absorbent material in the second. This has the effect of washing the air since dust particles and other foreign bodies adhere to the damp surface. The air leaving the apparatus is thus dust-free. The fact that containers 24 are rigidly interbraced and connected together makes it possible to remove them as a unit to clean out the dirt removed from the air.

It will be apparent that so long as the humidifying action is not desired, any suitable means may be utilized to maintain the salt in the containers 28 spaced above the pool of solution collecting in the bottom of casing 10 and not necessarily the means provided by spacing bottom walls 25 above the lower ends of containers 28. It follows in each case that the axes of containers 28 need not necessarily be vertical so long as the staggered relationship is maintained as described above.

If desired, instead of using air purification means 31, one or more rows of the containers can be filled with an odor absorbent means, such as activated charcoal, to remove any odorous impurities from the air.

The apparatus described herein is particularly useful in basements, game and recreation rooms, record and storage vaults, stock rooms, warehouses, and the like to regulate the humidity therein. In normal climates during the winter when artificial heating systems are in use in buildings, particularly homes, the air is too dry for human comfort. Use of the present invention will raise the relative humidity to that point where a much lower ambient temperature will result in comfort to humans besides preventing the drying out of furniture and articles in the building.

Obviously, the fan can be started up and stopped in response to the relative humidity of the surrounding air by the use of any well-known hygrometer control.

I claim:

Apparatus for controlling and affecting the humidity of air comprising a casing having a bottom, side walls and a top, means for holding a body of liquid in the lower part of the casing and establishing a maximum liquid level therein, an air entrance opening in one side wall, an air vent in an opposed side wall, the air entrance opening and the air vent being above the maximum liquid level, a plurality of elongated spaced foraminous containers adapted to contain humidity affecting material, the longitudinal axes of the foraminous containers being parallel and vertical, each foraminous container extending substantially above the air entrance opening and air vent and extending downwardly toward the bottom of the casing to a point substantially below the air entrance opening and the air vent, the foraminous containers being spaced from one another and arranged in rows extending transversely to the path of air flowing between the air entrance opening and the air vent with containers in adjacent rows staggered so that air flowing between the air entrance opening and the air vent will impinge on the humidity affecting material in a plurality of foraminous containers, a

fan for circulating air through the casing from the air entrance opening to the air vent, each foraminous container having an open end for filling the container with humidity affecting material and a humidity affecting material supporting member extending across the foraminous container in the lower portion thereof, but above the maximum liquid level, and means unattached to the casing interbracing and rigidly interconnecting the foraminous containers so as to combine the individual containers into an invertible unit.

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