

Nov. 15, 1966

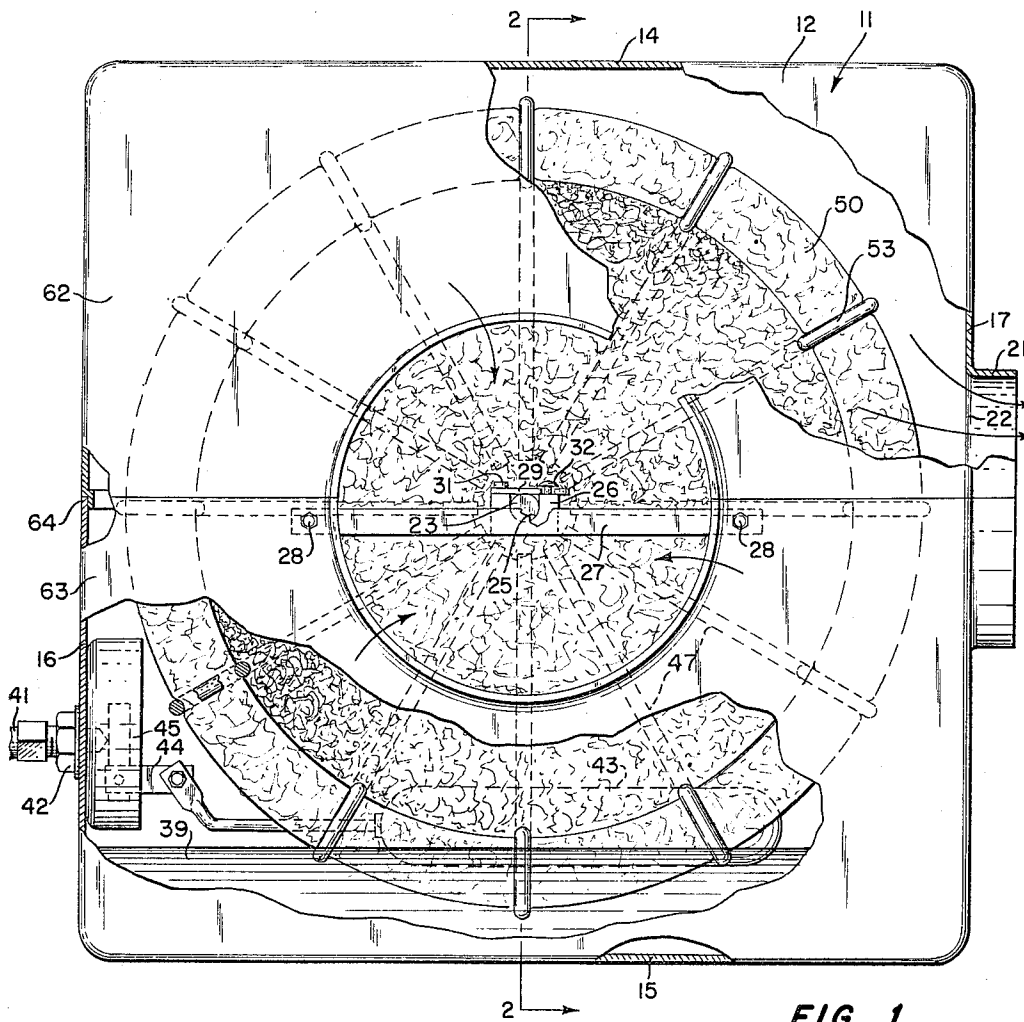
M. A. POWERS

3,285,586

HUMIDIFIER

Filed Nov. 29, 1963

5 Sheets-Sheet 1



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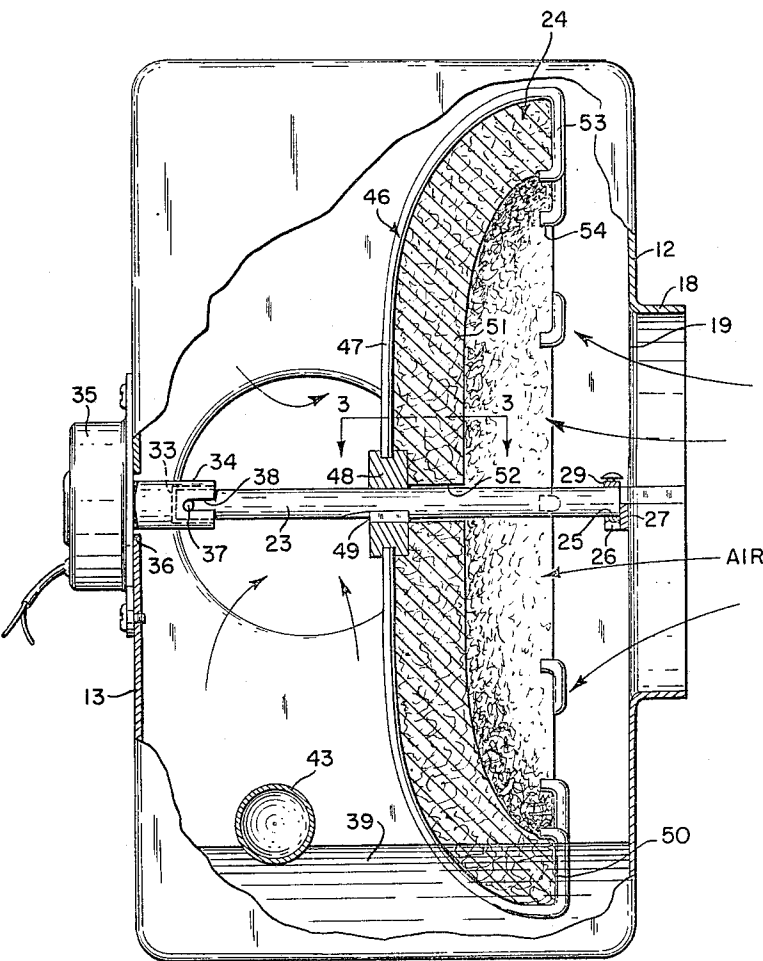


FIG. 2

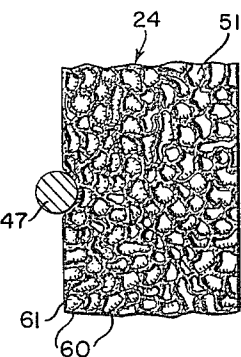


FIG. 3

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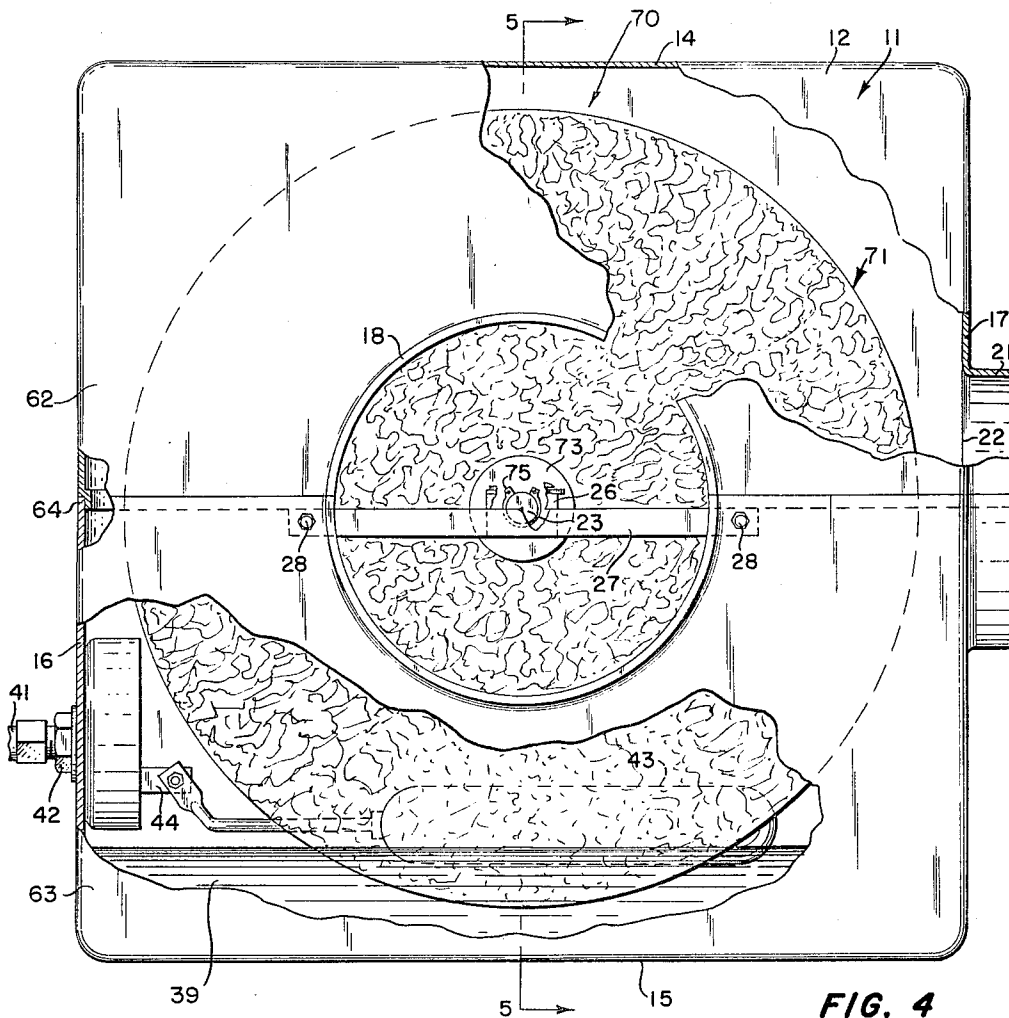
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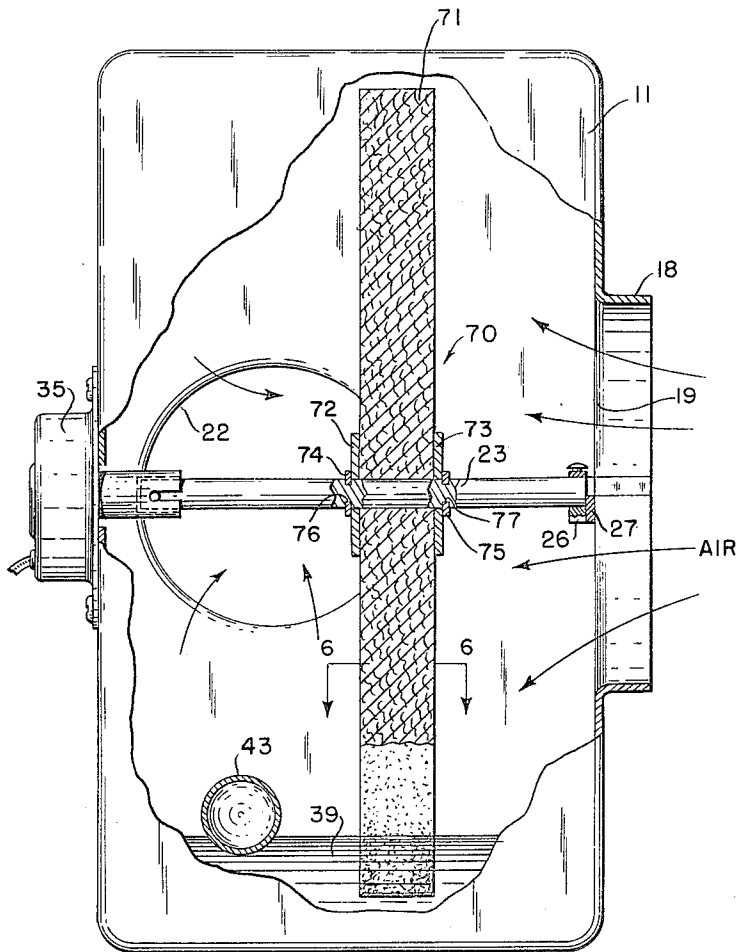


FIG. 5

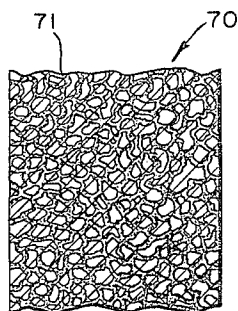


FIG. 6

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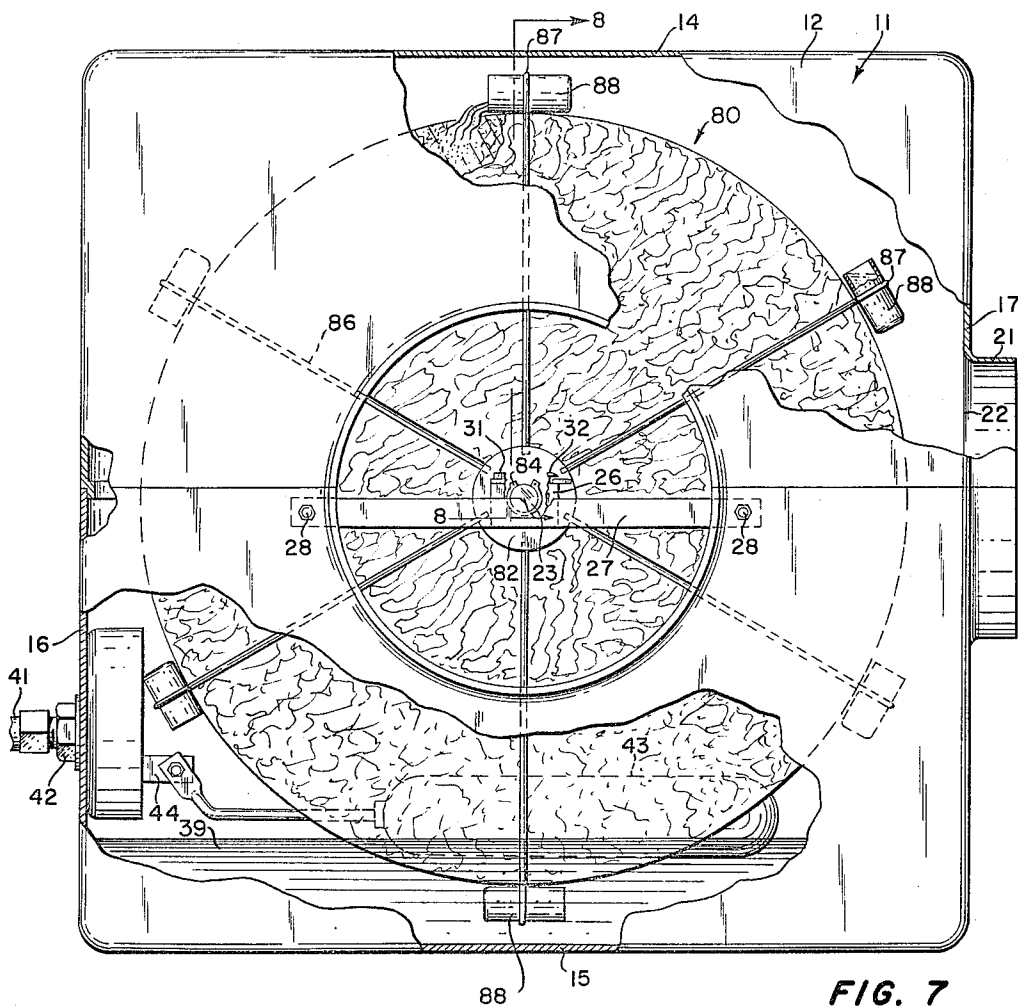


FIG. 7

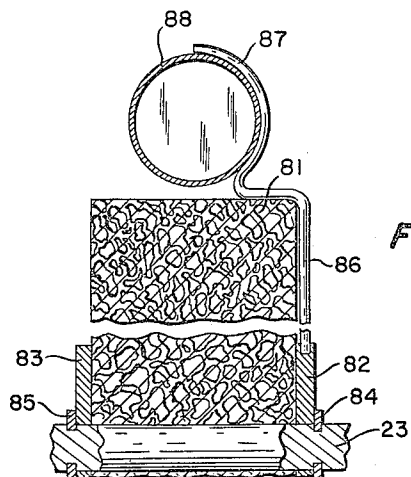


FIG. 8

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HUMIDIFIER

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10 Claims. (Cl. 261-92)

This is a continuation-in-part of my copending application Serial No. 181,567 filed March 22, 1962 for Rotary Drum Humidifier and System.

This invention relates to air humidifiers of the type wherein a rotor is driven at a relatively slow speed with part of its periphery passing through a body of water, and the rotor lifts water out of the body into the path of the air to be humidified.

A humidifier of this type wherein the rotor is preferably in the form of a drum containing a surface layer of open pore foamed polyurethane or the equivalent is disclosed in my copending application Serial No. 181,567 filed March 22, 1962 for Rotary Drum Humidifier and System. The present application represents certain variations and improvements over the basic disclosure of said pending application, such comprising mainly the use of flocked open pore polyurethane foam on the rotor and various rotor configurations.

It is therefore the main object of this invention to provide a novel humidifier wherein the rotor embodies a water pick-up layer of flocked open pore polyurethane foam or the equivalent.

It is a further object of the invention to provide a novel humidifier wherein the rotor mounts an annular body of open-pore plastic such as foamed polyurethane, which is preferably flocked, said body being mainly in the form of a disc which may be dished.

It is another object of the invention to provide a novel humidifier having a rotor mounting an annular body of material adapted to pick up water from a relatively shallow bath through which its lower periphery passes during rotation and including novel arrangements for increasing the efficiency of the body of material in uniformly presenting maximum water for evaporation in the path of an air stream to be humidified. This latter may take the form of flocking a body of open pore foamed polyurethane, or the like, or in some cases even where the body is of unflocked open pore material it may take the form of receptacles on the rotor for picking up charges of water from the body and depositing them in turn upon the section of the body in the path of said air.

Further objects of the invention will appear as the description proceeds in connection with the appended claims and the annexed drawings wherein:

FIGURE 1 is an end elevation, partially broken away and in section, showing humidifier apparatus according to a preferred embodiment of the invention;

FIGURE 2 is a side elevation, partially broken away and sectioned substantially along line 2-2 of FIGURE 1, further showing the humidifier apparatus;

FIGURE 3 is an enlarged fragmentary section showing the flocked open pore foam structure of the water carrying element of the humidifier rotor;

FIGURE 4 is an end elevation similar to that of FIGURE 1, broken away and sectioned to show a further embodiment of the apparatus using a flat disc water carrying element;

FIGURE 5 is a side elevation, partly broken away and in section along line 5-5 of FIGURE 4 showing further detail of this apparatus;

FIGURE 6 is an enlarged fragmentary view showing details of the structure of the rotor;

FIGURE 7, is an end elevation, partially broken away

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and sectioned, showing a further embodiment of the humidifier apparatus of the invention; and

FIGURE 8 is an enlarged fragmentary section showing a detail of the water pick-up receptacle of FIGURE 7.

In all embodiments of the invention a rotor rotates slowly about a substantially horizontal axis with a lower portion of its periphery immersed in water or a like liquid to be evaporated into the air to be humidified, and the rotor is specially constructed and arranged to insure that its major portion which is disposed in the path of the air to be humidified always contains sufficient distributed water for evaporation over substantially the entire area that is moving across the air path whereby optimum uniform efficient humidifying action is obtained. In some embodiments this is attained by a special flocked plastic open-pore foam structure that serves as a water lifting and distributing element in the apparatus, and in another it is attained by incorporating external water pick-up receptacles with the rotor.

The humidifier comprises a housing 11 having walls here designated as front wall 12, rear wall 13, top wall 14, bottom wall 15 and opposite side walls 16 and 17.

Front wall 12 is integrally formed with a forwardly projecting boss 18 surrounding an air inlet opening 19. Side wall 17 is formed with an integral outwardly extending boss 21 surrounding an air outlet opening 22. Bosses 18 and 21 are telescoped into suitable air conditioning, furnace or like conduit connections in practice, whereby air in the system is humidified by forced passage through housing 11 wherein it picks up water by evaporation, and since no furnace or conduit detail forms part of the invention such will not be described herein. While openings 19 and 22 are indicated as inlet and outlet for purposes of this description, the air flow may be reversed through humidifier 11.

Interiorly housing 11 mounts a shaft 23 carrying a rotor 24 and preferably coaxial with circular wall opening 19. The front end of shaft 23 rests rotatably in a suitable upwardly open bearing recess 25 formed in a block 26 fixed on a narrow rigid strap 27 that extends across opening 19 without appreciably blocking air flow and is secured at opposite ends to the inner sides of wall 12, as by fastener assemblies 28. The top of recess 25 is closed by a strap 29 pivoted upon block 26 as at 31 and having a hooked end connection with a rivet 32 in latched position.

The rear end of shaft 23 extends coaxially slidably within a socket 33 on the end of shaft 34 of a low speed electric motor unit 35 that extends through aperture 36 in wall 13. A pin 37 slidable in an axial slot 38 of socket 33 provides a drive coupling between the shafts, but enables their ready disconnection for a purpose to appear. The motor unit 35 is secured in fluid tight relation over aperture 36 upon the rear wall 13.

Within the lower end of housing 14 is a reservoir containing a body of water 39 that is maintained at a constant level by a suitable float and valve assembly. Here the incoming water supply conduit 41 terminates in a nozzle 42, and a float 43 acts through linkage 44 to urge closure element 45 against the nozzle opening when the desired water level is present, and to uncover the nozzle to permit water flow to replenish the water of body 39 when the level has become lowered. This float and valve assembly may preferably be that of my U.S. Letters Patent No. 3,099,286 issued July 30, 1963.

In this embodiment of the invention the rotor 24 comprises a dished skeletal wire frame 46 consisting of a plurality of equiangularly spaced spokes 47 having their inner ends fixed in a hub 48 non-rotatably secured on shaft 23 as by key 49. Frame 46 is concave in the direction of air inlet opening 19, and it serves as a support for a flexible body 51 of foamed synthetic plastic material

that has a central aperture 52 through which passes shaft 23.

Preferably body 51 is a normally flat flexible circular mat of suitable uniform thickness conformed to the illustrated dish shape by pushing it, from right to left in FIGURE 2, into lining relation with frame 46. At their outer ends each spoke 46 is bent radially inwardly at right angles at 53 to overlie the outer peripheral edge 50 of body 51 and then turned axially inwardly at right angles at 54 to extend over the adjacent surface of body 51. In this manner the body 51 is secured in saucer or dish shape on the shaft 23, and as shown in FIGURE 2 its lower periphery extends into the water of reservoir 39 a distance only about equal to the edge thickness of body 51.

The body 51 is preferably a mat of an open pore plastic of controlled pore size and which does not absorb water, more advantageously open cell foamed polyurethane. Other open pore of foamed plastics are available such as those of cellulose acetate, polyvinyl chloride, polystyrene, polyethylene, foamed phenolics, foamed silicones and foamed epoxy resins.

Polyurethane foam is preferable because it is usually fire resistant, readily flexible, and it does not sag when the pores are full of water.

In the invention I prefer to use a polyurethane foam of the type disclosed in said copending application Serial No. 181,567. This is an open-pore foam having a pore size of between ten and thirty pores per lineal inch, more advantageously about twenty pores per inch. The foregoing and other characteristics of the polyurethane foam which make it so unexpectedly advantageous for the invention are disclosed in said Serial No. 181,567 to which reference is made for further needed detail.

In the present invention the open-pore polyurethane foam is flocked, that is it is soaked in a light bodied adhesive which essentially coats all surfaces including the internal pore walls and flock consisting of very short length fibres is blown therethrough. This flock attaches itself substantially uniformly to all of the adhesive coated surfaces when the adhesive hardens, some of the flock standing on end, and this flocking is indicated at 60 in FIGURE 3, the open pores being shown at 61. The flocking 60 is preferably cotton or some water absorbent material, and it may be fireproofed. The cotton flock usually consists of fibres about one-tenth of an inch or less in length.

The housing 11 preferably is composed of upper and lower halves 62 and 63 having a separable central horizontal overlap edge joint 64 (FIGURE 1). Each half is a one-piece molded plastic member, the plastic having a sufficiently high content of asbestos or like heat resistant material to render it to withstand temperatures up to 300° F. without warping or softening. The top half 62 is readily removable, thereby exposing the rotor, valve and other parts for servicing. When the rotor pores become choked with lime or other deposits, the entire rotor assembly is speedily removed for cleaning by detaching shaft 23 from socket 33 and bearing 26.

In operation air to be humidified enters opening 19 into the concave surface end of the rotor and passes through the body 51 before exiting through opening 22. With reference to FIGURE 2 it will be apparent that the major area of the polyurethane foam body 51 which is directly traversed by the air is never immersed in the water reservoir, and only a minor peripheral area is immersed in the water at 39. It has been found that the slowly rotating body 51, about one half revolution per minute, lifts a considerable amount of excess water out of the reservoir 39, all of this water being carried upward in the open pores 61 around the periphery as the rotor rotates. By excess water is meant that the immersed area picks up more water than will be evaporated therefrom. The pores carrying the water reach a position about 1/4 of the way through the upper right quadrant in FIGURE

1, assuming counterclockwise rotor rotation, excess water in the pores will by gravity flow down within and over the open pore structure, thereby distributing water uniformly over the entire area to foam body 51 above the reservoir. Since the rotor 24 rotates at only slow speed there is practically no centrifugal force opposing this gravity feed of water, and the pore size and other factors can be so selected and controlled that the entire major area of foam body 51 in the path of the moving air will be maintained wet enough to provide a desired evaporation rate.

Float 43 and the associated valve assembly keep the level of reservoir 39 high enough to supply the necessary water pick-up.

By using flocked foam at 51, it has been found that the water pick-up and evaporation capacity of the body 51 is greatly increased, since the capillary action of the absorbent flock slows drainage and retains water on the rotor in the air path sufficiently long enough to insure prolonged exposure for optimum evaporation. The flock therefore acts not only to absorb and thereby pick-up and lift added excess water from the reservoir to raise it to a higher point from which it drains down over the non-submerged area, but it functions to prolong the wetted time and increase the wetting action of the entire rotor with respect to the air being humidified. It has been found that by flocking the foam larger pore sizes, with attendant larger water pick-up capacity, may be used.

The invention therefore provides a novel rotary element humidifier wherein only a minor portion of the area of the cellular plastic water pick-up and evaporating element is repeatedly submerged in the water reservoir, but means is provided for insuring that sufficient water is picked up that the entire area of that element traversed by the air to be humidified is maintained wet at all times. This is different from known prior humidifiers of this class which require that the entire area of the water pick-up material on the rotor be repeatedly submerged.

A real advantage of this is that less power is required to drive the rotor and maintain it wetted.

In a successfully operating humidifier built according to FIGURES 1-3 wherein the flocked polyurethane foam body 51 has an outer diameter of about eleven inches and an edge thickness 50 of one inch, with the rotor turning at one-half revolution per minute, the evaporation rate into 165° F. air was about three pounds of water per hour.

FIGURES 4-6 illustrate a further embodiment of the invention wherein the rotor 70 is a flat disc rather than the caged saucer of FIGURES 1-3.

Rotor 70 consists of an integral flat circular periphery layer 71 of flocked polyurethane foam pierced by shaft 23 as shown in FIGURE 5. Layer 71 is fixed upon shaft 23 by flat metal discs 72 and 73 engaging opposite sides and held thereadjacent as by snap rings 74 and 75 seated in shaft grooves 76 and 77 respectively.

Operation of this embodiment is essentially the same as that of FIGURES 1-3, the evaporation element body 71 of the rotor having a minor outer peripheral area repeatedly submerging in the reservoir 39, and excess water lifted by the minor outer peripheral area draining down to wet the entire major nonsubmerged area in the direct path of air flow during rotation of the rotor.

FIGURES 7 and 8 illustrate another embodiment wherein the rotor assembly 80 is a flat disc 81 of open pore polyurethane secured on shaft 23 by a hub disc 82 and an opposed disc 83, axially held between snap rings 84 and 85. A spoked wire frame 86 extends radially outwardly from hub 82. In same embodiments rotors 80 may comprise even hitherto used water absorbent material such as kraft paper and other fibrous materials.

As in the other embodiments only a minor peripheral area of disc 80 is repeatedly immersed in the reservoir 39, but here the added excess water lifting function supplied by the flock of FIGURES 1-6 is accomplished by

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extending spokes 86 beyond the periphery of disc to form loops 87 in which are fixed receptacles 88 with their open ends facing the direction of rotation.

As shown in FIGURE 7 receptacles 88 scoop water up out of reservoir 39 and as they reach the upper part of the housing spill the water therefrom onto the edges of the disc body to drain down through the non-submerged major area in the path of the air to be humidified. Operation is otherwise essentially the same as in the other embodiments.

The scope of this invention is such as to include the use of flocked open pore plastic such as herein described on rotary drums such as disclosed for the preferred embodiment in said Serial No. 181,567.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrated and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. In a humidifier comprising a housing having a reservoir of water and means for directing air to be humidified therethrough, a rotor comprising a disc-like body of open-pore synthetic plastic material mounted for rotation on a horizontal axis within said housing with its lower periphery area immersed in said water during rotation of said rotor, means providing a water retaining layer of flocking material comprising relatively short water absorbent fibres attached substantially uniformly over the pore walls in said body, water from said peripheral area being continually distributed through the remaining area of said body during rotation of the rotor whereby substantially all of the rotor area in the path of said air is maintained wet during rotation of the rotor.

2. In the humidifier defined in claim 1, said plastic material being open-pore polyurethane foam coated with water absorbent fibres.

3. In the humidifier defined in claim 1, said rotor comprising a skeletal frame and at least one integral flexible layer of said material conforably secured upon said frame.

4. In the humidifier defined in claim 1, said body being substantially saucer-shaped.

5. In the humidifier defined in claim 4, said body being immersed in said reservoir for a depth approximately equal to the edge thickness of said saucer shape.

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6. In a humidifier having a reservoir of water to be evaporated and means for directing air therethrough, a rotor mounted on a horizontal axis and comprising a dish-shaped skeletal frame lined with a conformingly shaped layer of flexible open-pore synthetic plastic material, the outer edge of said layer facing substantially axially and being immersed in said water during rotation of the rotor and a portion of said frame extending substantially axially adjacent said outer edge.

7. A rotor assembly for a humidifier comprising a generally skeletal frame on which is attached a continuous body of open-pore plastic material having its pore walls coated with a water retaining layer of relatively short water absorbent fibers, and means on the frame to adapt said rotor assembly for connection to rotation means.

8. The rotor defined in claim 7 wherein said material is polyurethane.

9. The rotor assembly defined in claim 7 wherein said open-pore plastic material is polyurethane foam having a pore size of about ten to thirty pores per lineal inch.

10. The rotor assembly defined in claim 9, wherein said water absorbent fibres are cotton fibres about one-tenth of an inch in length adhesively attached to said pore walls.

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