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(54) Air dehumidifier and dehumidification method

(57) Desiccants (14) employed in dehumidifying moisturized air present within a water-damaged building (20) are themselves dehumidified to liberate collected moisture through the use of ambient air drawn over and about a heat exchanger (12) fired by diesel fuel. Moist air is drawn from building (20) through ductwork (72) and desiccant (14) by a blower (26). The desiccant (14) is dried by ambient air being drawn in through ductwork (70), around heat exchanger (12) and through the desiccant by a blower (24). The desiccant (14) may be in the form of a silica gel wheel (90, Fig 2).

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Description

[0001] This invention relates to dehumidifying air and to the restoration industry in general, and to the drying-out of water damaged buildings, in particular. It also relates to diesel fuel heated desiccant reactivation.

[0002] Mobile desiccant dehumidifiers have begun to be employed more and more in recent years to dry water damaged buildings to reduce health problems caused by the incipient mold which develops. As is also known, silica gel is often employed as the desiccant in a wheel through which the moistened air is pulled from the walls, the flooring, the concrete, etc. into the dehumidifying chamber. As the silica gel, or other desiccant employed, absorbs the moisture, however, it becomes necessary to additionally heat the desiccant to liberate the moisture it collects; this, then, serves to optimize the operation in a continuous cycle, allowing the desiccant to continually absorb the moisture in the building. Where large-scale desiccant equipment is employed, the heat energy required is typically provided by electric heating or propane heating. However, problems exist with both these methods of reactivating the desiccant.

[0003] For example, electric heating requires a large amount of electric power, which many damaged buildings will not have available. Utilizing alternatively provided generators, on the other hand, adds additional expense from their rental, along with an accompanying high fuel bill. Propane fired dehumidifiers, on the other hand, exhibit many disadvantages of their own: a) Special permits are frequently required to transport the propane to the work site by trailer or other vehicle; b) Additional permits are often required for working with propane at the work site itself; c) A resupply of propane may not be readily available, as when the building being dried is at a remote location, or when a resupply is needed in the middle-of-the-night, or on a Sunday; d) Firing the dehumidifier with propane produces a moisturizing effect which undesirably wets the processed air being dried; and e) Propane, itself, is highly flammable.

[0004] Still, as the need to reactivate the silica gel or other desiccant continues, dehumidifiers of these types continue to be used, both when carried on the bed of a trailer, or when off-loaded alongside the building.

[0005] Aspects of the present invention seek to provide a new and improved manner of reactivating the desiccant in these humidifying apparatus.

[0006] Aspects of the invention also seek to provide such a manner of reactivation without adding offsetting limitations.

[0007] Aspects of the invention further seek to provide such a manner of reactivation which is readily available to use, and economical in operation.

[0008] Apparatus according to the invention for dehumidifying moisturized air present within a building from a point external thereto includes an enclosure housing a heat exchanger, a desiccant, a first blower drawing ambient air from outside the enclosure over the heat exchanger through the desiccant in a first direction, a second blower drawing the moisturized air from within the building through the desiccant in a second direction, and means for firing the heat exchanger with diesel fuel. The enclosure, in one embodiment, may rest on a ground surface adj acent to the building in which the moisturized air is present. In a second embodiment, the enclosure may rest on a trailer or truck bed on which it is carried to the work site adjacent to the building to be dehumidified. In such instances, the desiccant may include a silica gel composition, for example, in the form of a rotating silica gel wheel. In operation, the ambient air once heated is drawn through the desiccant in a direction opposite to that in which the moisturized air is drawn. The heated ambient air thus serves to liberate the moisture collected by the desiccant, in reactivating it for continuing use.

[0009] A method is thus provided for dehumidifying the moisturized air present within the building by providing a dehumidifying chamber including the heat exchanger and the desiccant. Ambient air from outside the building in which the moisturized air is present is drawn over the heat exchanger and through the desiccant in a first direction. The moisturized air present within the building is drawn through the desiccant in a second direction, with the desiccant itself being dehumidified by the ambient air passing over and around the heat exchanger. In accordance with the invention, the method includes the firing of the heat exchanger with diesel fuel. In a preferred embodiment, the dehumidifying chamber provided includes a desiccant of silica gel composition, and in the form of a rotating silica gel wheel.

[0010] As will be appreciated by those skilled in the art, the diesel fuel employed in the heating process is available virtually anywhere diesel trucks serve as a means of transportation. Because diesel fuel provides a greater amount of BTU's per gallon than propane, less fuel is required to provide the heat for the desiccant with diesel fuel than with propane, resulting in a cost savings in use. Also, because the diesel fuel bums without producing moisture, the processed air becomes that much dryer, enabling the reactivation of the desiccant to be accomplished faster, thereby increasing performance in operation. Because the desiccant dehumidifier of the invention operates more efficiently, its construction allows for a reduction in the required power of the reactivation blower pulling the ambient air over the heat exchanger. This resulting in a more compact machine for easier transportation.

[0011] These and other features of the present invention will be more clearly understood from a consideration of the following description, taken in connection with the accompanying drawings, in which:

Figure 1 is a block diagram helpful in an understanding of the apparatus and method for dehumidifying moisturized air present within a building from a point external thereto; and

Figure 2 illustrates a preferred construction of the desiccant employed.

[0012] Referring to FIGURES 1 and 2, the desiccant reactivation apparatus of the invention and its method of operation both follow from the use of an enclosure 10 having a heat exchanger 12 and a desiccant 14. Reference numeral 20 identifies a building in which moisturized air is present which the apparatus of the invention is to dehumidify, with the enclosure 10 having a bottom surface 16 which may rest upon a trailer or truck bed adjacent the building 20 once driven to the work site. Alternatively, the enclosure 10 could be off-loaded from the trailer or truck bed onto the ground itself. Reference numeral 18 indicates a diesel fuel burner having an exhaust gas stack 22. As will be understood, the diesel fuel burner 18 heats the exchanger 12 from the inside out.

[0013] A first, or reactivation, blower 24 draws ambient air from the surrounding via 45.7cm (18 inch) ductwork 70, for example, into the enclosure 10, over and about the diesel fired heat exchanger 12 and through the desiccant 14 in a first direction, as illustrated by the arrows 50; the heated air, freed of moisture, through the desiccant 14 is discharged outside the enclosure 10 as shown by the arrows 51-52. A second, or processed air, blower 26 draws the moisturized air from within the building through similar ductwork 72 and the desiccant 14 in a second direction (shown by the arrows 60), which traps the moisture therein before discharging the dried air out the enclosure 10 as shown by the arrows 61-62. The diesel fired heat exchanger 12 thus dehumidifies the desiccant 14 of the moisture collected from the wet building air in reactivating the desiccant 14 for continuing use. As previously noted, the diesel fuel is readily available, clean burning, and efficient in operation. And, as a result, the desiccant dehumidifying apparatus can be rented out for use at a lowered cost, reducing the expenses in restoring water damaged buildings to their original conditions.

[0014] In the embodiment depicted in Figure 1, the ambient air from outside the enclosure 10 is shown as being drawn through the desiccant 14 in a direction opposite to that in which the moisturized air is pulled from the building through the desiccant 14. In such manner of use, a desiccant 14 including a silica gel composition is particularly attractive in collecting the moisture from the water-damaged building's air. Figure 2 illustrates the desiccant 14 as being in the form of a rotating silica gel wheel 90 in a frame 92 within the enclosure 10. Because the apparatus employing the diesel fuel firing is of increased efficiency, the power requirements of the reactivation blower 24 pulling the ambient air are significantly reduced, in allowing the enclosure 10 to be of lesser size. The enclosure could then be permanently mounted on a trailer and brought to the work site mobilized for use.

[0015] The method of employing the invention then follows, whether with a desiccant of silica gel composition, or in the form of a rotating wheel, or otherwise, simply by providing the dehumidifying chamber with the heat exchanger and the desiccant, drawing the ambient air from outside the building over and about the heat exchanger through the desiccant in a first direction, and drawing the moisturized air out from the building through the desiccant in a second direction. Throughout this process the heat exchanger is fired with the diesel fuel. As with the described apparatus, an improved environmental drying results, quickly, simply and efficiently, thereby reducing the severe health and/or carcinogenic problems associated with water damaged buildings.

Claims

1. Apparatus for dehumidifying moisturized air present within a building (20) from a point external thereto comprising: an enclosure (10) housing a heat exchanger (12), a desiccant (14), a first blower (24) drawing ambient air from outside said enclosure over said heat exchanger through said desiccant in a first direction, a second blower (26) drawing said moisturized air though said desiccant in a second direction, and means (18) for firing said heat exchanger with diesel fuel.

2. The apparatus of claim 1 wherein said enclosure (10) rests on a ground surface adjacent said building (20) in which said moisturized air is present.

3. The apparatus of claim 1 wherein said enclosure (10) rests on a trailer or truck bed adjacent said building (20) in which said moisturized air is present.

4. The apparatus of any of claims 1 to 3, wherein said desiccant (14) includes a silica gel composition.

5. The apparatus of any of claims 1 to 3, wherein said desiccant (14) includes a rotating silica gel wheel.

6. The apparatus of any of claims 1 to 5, wherein said first and second blowers (24, 26) draw said ambient air and said moisturized air though said desiccant (14) in opposite directions.

7. A method for dehumidifying moisturized air present within a building (20) from a point external thereto comprising the steps of:

   providing a dehumidifying chamber (10) including a heat exchanger (12) and a desiccant (14);
   drawing ambient air from outside the building over said heat exchanger and through said desiccant in a first direction;
   drawing moisturized air from within the building

through said desiccant in a second direction; and
firing said heat exchanger with diesel fuel.

8. The method of claim 7 wherein said desiccant (14) includes a silica gel composition.

9. The method of claim 7 or 8, wherein said desiccant (14) includes a rotating silica gel wheel.

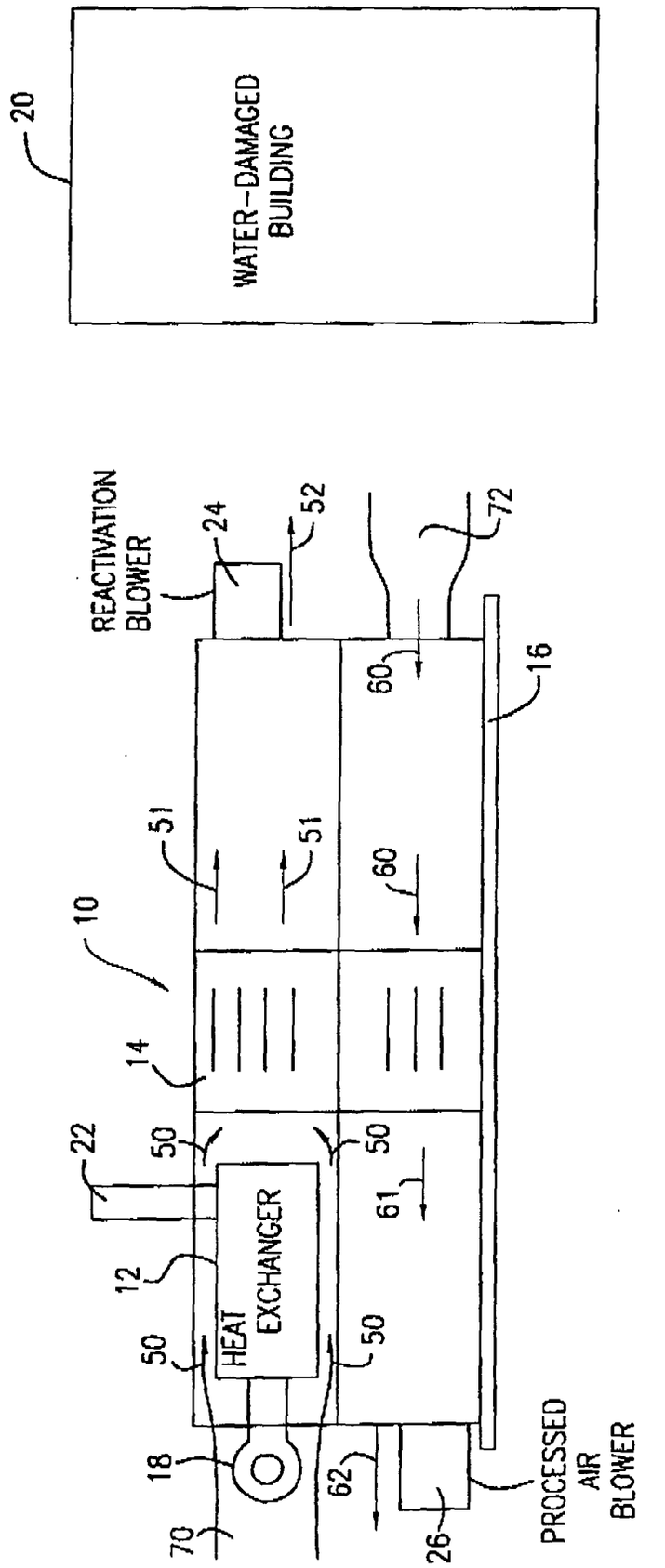
20
WATER-DAMAGED BUILDING
REACTIVATION BLOWER
24
52
72
60
16
51
51
60
10
14
22
50
50
61
12
HEAT EXCHANGER
50
50
18
62
70
26
PROCESSED AIR BLOWER

FIG. 1

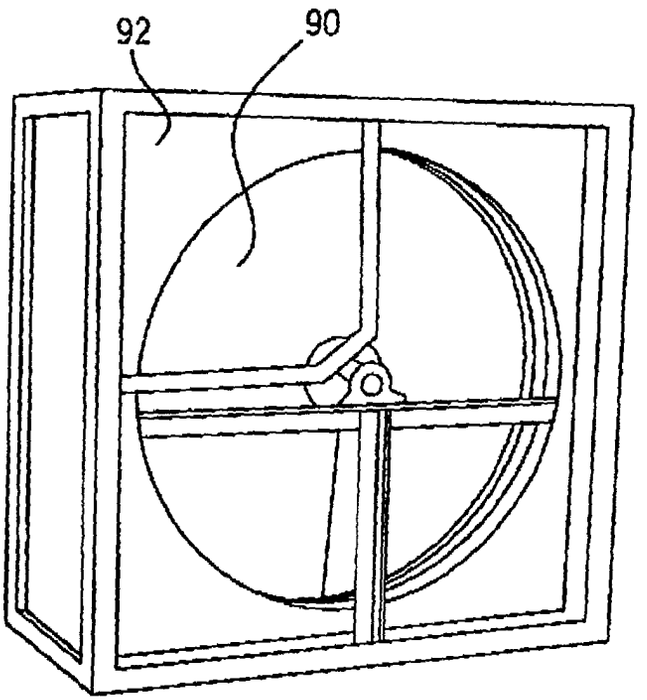

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 03 25 6904

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 3 036 382 A (SHOTTON JR THOMAS E) 29 May 1962 (1962-05-29) * column 2, line 13 - line 43; figure 3 * ---	1,7	F24F3/14
A	US 3 859 816 A (MCDONALD HOWARD E ET AL) 14 January 1975 (1975-01-14) * column 2, line 14 - line 22 * * column 3, line 28 - line 40 * ---	1,7	
A	US 3 914 955 A (MCCULLOUGH ORVILLE K) 28 October 1975 (1975-10-28) * column 4, line 30 - line 42 * * column 5, line 21 - line 34 * ---	1,7	
A	US 4 450 900 A (NATHAN NORMAN) 29 May 1984 (1984-05-29) * column 2, line 1 - column 3, line 49; figure 3 * ---	1,7	
A	US 6 418 744 B1 (NEAL EARNEST J) 16 July 2002 (2002-07-16) * column 3, line 32 - line 49 * -----	1,7	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F24F F26B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	23 March 2004	Valenza, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 25 6904

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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23-03-2004

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82