Jan. 7, 1958 N. A. PENNINGTON 2,818,934

MOISTURE-TRANSFERER FOR AIR-CONDITIONING

Filed Feb. 3, 1955

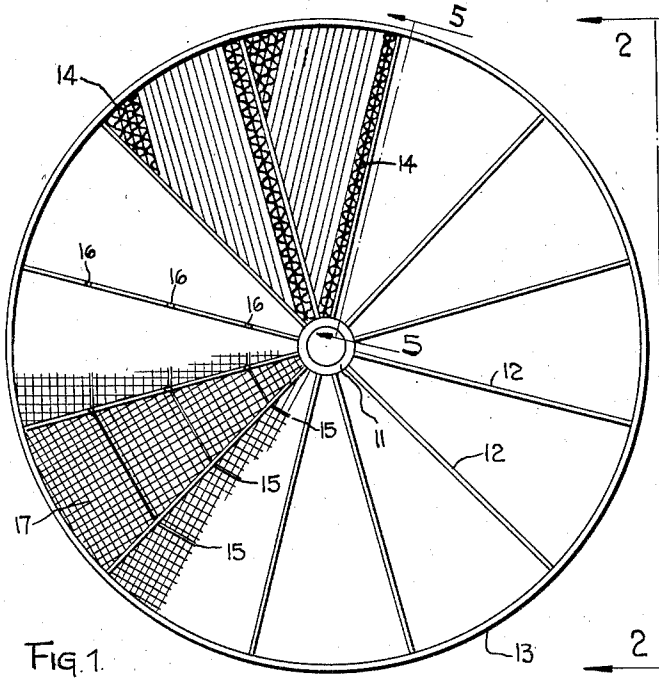


FIG. 1.

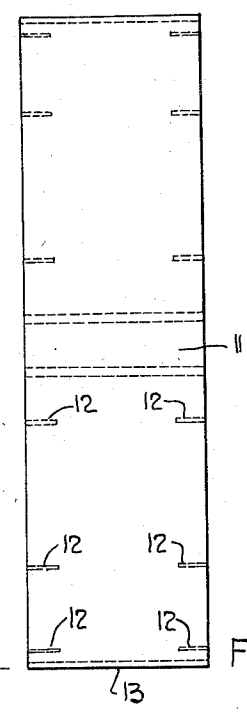


FIG. 2.

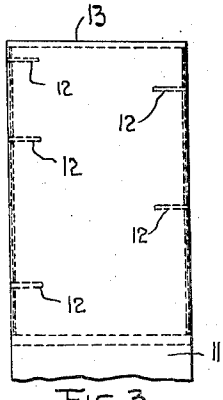


FIG. 3.

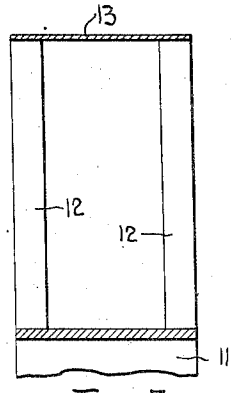


FIG. 5.

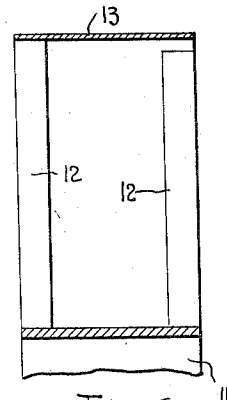


FIG. 6

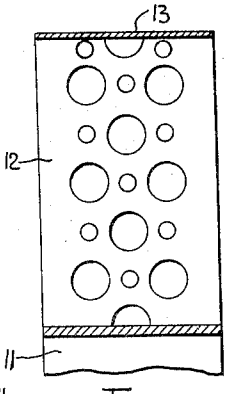


FIG. 7.

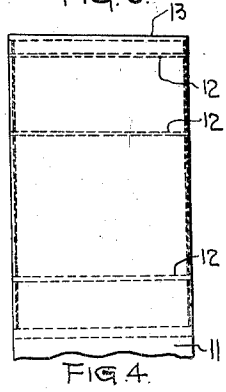


FIG. 4.

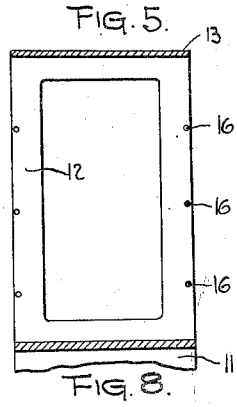


FIG. 8.

NEAL A. PENNINGTON,
INVENTOR.

BY Roger Sherman Hoar

ATTORNEY.

United States Patent Office

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MOISTURE-TRANSFERER FOR AIR-CONDITIONING

Neal A. Pennington, Tucson, Ariz., assignor of one-fifth to Robert H. Henley, Tiptonville, Tenn., and one-fourth to Roger Sherman Hoar, South Milwaukee, Wis.

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16 Claims. (Cl. 183—2)

This invention relates to new and useful improvements in a moisture-transferer for air-conditioning, and more particularly to a rotating wheel-like moisture-transfer element for use in a humidity-changer such as shown, described, and claimed in the patent of the present inventor, No. 2,700,537, reference to which may be made for any details not described and shown herein, especially as to details of the environment in which the present invention is intended to be used.

Still more particularly this present invention relates to a wheel-like moisture-transfer element in which the carrier for the hygroscopic impregnant (which carrier constitutes the packing for the wheel-like casing) is of a special sort to be described later herein.

The principal objects of the present invention are to provide a casing less heavy, less expensive, and less axially heat-conductive than the casing shown and described in the copending patent application identified earlier herein.

A further object is to cover utilizing inherent characteristics of the type of packing employed, rather than utilizing the imperforatedness of the spokes and rim, to prevent the leakage of air therethrough.

In addition to these four objects, the present invention involves a number of new and useful details, which become readily evident as the description progresses.

The present invention consists in the novel parts and in the combination and arrangement thereof, which are defined in the appended claims, and of which several embodiments are exemplified in the accompanying drawings, which are hereinafter particularly described and explained.

Throughout the description the same reference-number is applied to the same member or to similar members.

Figure 1 is an elevation, showing one face of the wheel-like moisture transfer element of the present invention. Packing is shown (partly diagrammatically) in two of the sectors of the casing. And in one, and parts of two other, of the sectors, is shown one means of securing the packing therein.

Figure 2 is a side elevation, showing the rim of one variant of this element, taken along the lines 2—2 of Figure 1.

Figure 3 is a partial side elevation, showing the rim of the second variant of this element, taken along the lines 2—2 of Figure 1.

Figure 4 is a partial side elevation, showing the rim of the third or fourth variant of this element, taken along the lines 2—2 of Figure 1.

Figure 5 is a side elevation of one of the spokes of the first variant, i. e., that of Figure 2, taken along the lines 5—5 of Figure 1.

Figure 6 is a side elevation of one of the spokes of the second variant, i. e., that of Figure 3, taken along the lines 5—5 of Figure 1, and showing another of the spokes in the background.

Figure 7 is a side elevation of one of the spokes of the third variant, i. e., that of Figure 4, taken along the lines 5—5 of Figure 1.

Figure 8 is a side elevation of one of the spokes of the fourth variant (also representable by Figure 4), taken along the lines 5—5 of Figure 1.

Turning now to Figure 1, it will be seen that the casing comprises a hub 11, spokes 12, and a rim 13. The spokes and rim are quite thin; but, as will be seen from all the other figures, the hub and the rim extend to each face of the casing. The same is true of the spokes in all variants herein shown, except the variant of Figures 3 and 6, in which variant the spokes are staggered, and each extends to only one face of the casing. This extension to the faces of the casing is very advisable, in order to prevent the leakage of air, at the faces of the casing, from one to the other of the two air-passages across which the casing is designed to rotate.

Formerly it was supposed that it was necessary for the spokes to be imperforate, in order to prevent the leakage of air from one sector to the next. This imperforatedness is still essential with most types of packing; but, in the present invention, the selected type of packing serves to supply the necessary imperforatedness.

Not only are perforated spokes non-detrimental if a proper type of packing be employed; but such spokes constitute an improvement by reducing the weight and cost of the casing, and the axial conduction of heat thereby. Axial conduction of heat by a rotary heat or moisture-transferer is detrimental to high efficiency.

Various sorts of perforation are shown in Figures 2 to 8, which will be discussed later herein.

Due to the construction of the casing, it is highly advisable that the packing be built-up in sectoral shape, that is to say in wedge-shaped pieces, bounded by four flat faces and one curved face. Two of the flat faces are parallel, and occur adjacent the two faces of the casing. The other two flat faces converge to nearly an edge at the hub of the casings; these two faces will herein be called "radial" inasmuch as they lie radially with respect to the cylindrical casing. The curved face fits against the inside of the rim of the casing.

In Figure 1, there are shown two such sectors of packing 14, consisting of corrugated paper made of asbestos, plastic, or other appropriate liquid-absorbing (preferably non-heat-conducting) material. This packing should be inserted with its corrugations running axially of the casing, so as to permit the passing of air axially therethrough, and to impede the passing of air in other directions.

Such paper usually, if not always, consists of layers of flat uncorrugated paper, alternating with layers of corrugated paper. With such paper it is highly advisable that each sector of packing be so arranged that at least one radial face of the sector consists of imperforate uncorrugated material, as shown in Figure 1. To illustrate this arrangement clearly in that figure, the parallel lines represent such layers of uncorrugated material, and only a few of the corrugated layers have been drawn-in.

The softness of absorbent paper of any sort, especially when wet, is the reason why the packing itself cannot be depended upon to prevent leakage of air at the faces of the casing, radially outwardly and from air-passage to air-passage, and why accordingly the rim and at least enough of the spokes should extend to each face of the casing, to prevent such respective leakage.

The packing can be impregnated with some appropriate hygroscopic liquid, such as glycerine, one of the ethylene glycols; or a solution of some hygroscopic salt, such as lithium chloride, lithium bromide, calcium chloride, calcium bromide, or some combination of these. For use primarily as a heat-transferer, the packing could preferably be impregnated with some appropriate non-hygroscopic liquid, such as mineral-oil, or even not impregnated at all.

It should be noted that all rotary moisture-transferers transfer some sensible heat; and that all rotary heat-transferers transfer some moisture under certain atmospheric conditions.

The packing can be held in place by some screenlike means at each face of the casing, such for example as spider-web of wires **15**, threaded through holes **16** in spokes **12** very near the edges of these spokes. The presence of such holes is not to be considered as being sufficient to prevent this portion of the spokes from being imperforate. The spider-webbing may be supplemented by sectoral pieces of screening **17**. This latter is quite advisable, due to the softness of the packing, mentioned earlier herein.

An alternative, and very practical, retaining-means, not available to other types of packing, is to cement the packing to the casing, with some appropriate adhesive which is proof against water and the impregnant used, at the temperatures to be encountered, such for example as the adhesive known by the trade-name of "Tuff-Bond."

The four variants of the present invention will now be discussed.

In the first variant, namely that of Figures 2 and 5, the whole middle portion of each spoke **12** is omitted, leaving only the portions at each face of the casing.

In the second variant, namely that of Figures 3 and 6, all of each spoke **12** is omitted, except the portion along first one face and then the other of the casing. In other words, the spokes are staggered.

In the third variant, namely that of Figures 4 and 7, the spoke extends from face to face of the casing, but is perforated by many holes.

The fourth variant, namely that of Figures 4 and 8, resembles the first variant, except that there is also retained the portion along the rim and the portion along the hub.

There will now be summarized how the casing of the present invention differs from the casing of Patent No. 2,700,537, mentioned earlier herein. In the casing of that prior patent, the spokes were what might well be called, for want of a better term, "complete," that is to say: extending imperforate from one face to the other of the casing and from hub to rim. By contrast, the spokes of the present invention might well be called, for want of a better term, "incomplete," meaning that they lack some portion of the "complete" spokes as above defined. Thus the characterizing of spokes herein as "incomplete" will be generic to perforated spokes (for example, such as spokes of the sort shown in Figures 4 and 7) and spokes with portions completely missing (for example, such as spokes of the sorts shown in Figures 2 and 5, in Figures 3 and 6, in Figures 4 and 7, and in Figures 4 and 8).

The best mode contemplated by the inventor for carrying out his invention is the casing of Figures 1, 2, and 5, with the rim imperforate, each sector being packed with corrugated asbestos paper, which packing is held in place by both spider-webbing and sectoral pieces of metal screening, and is impregnated with calcium chloride.

Now that several forms of the invention have been described and illustrated, it is to be understood that the invention is not limited to the specific forms or arrangements of parts herein described and shown.

What is claimed is:

1. A rotatable cylindrical transferer for use in an air-conditioning unit, to transfer, between two air-streams passing through said unit, a thermodynamic characteristic of air, said transferer comprising: a wheel-like casing, having spokes, a hub, and a rim, said hub and said rim being of substantially the same width in an axial direction, at least some of said spokes being incomplete; a packing of liquid-absorbing corrugated paper, the corrugations of which run axially of the casing, said packing being capable of being impregnated with a non-volatile liquid, and completely filling the casing, and being packed therein with such compactness as to remain freely air-permeable in an axial direction and yet be so self-supporting as to be substantially immovable with respect to the casing during the rotation of the casing even in a vertical plane; and means to retain the packing in the casing.

2. A rotable cylindrical moisture-transferer for use in an air-conditioning unit, to transfer moisture between two air-streams passing through said unit, said moisture-transferer comprising: a wheel-like casing, having spokes, a hub, and a rim, said hub and said rim being of substantially the same width in an axial direction, at least some of said spokes being incomplete; a packing of liquid-absorbing corrugated paper, the corrugations of which run axially of the casing, said packing being impregnated with an hygroscopic impregnant, and completely filling the casing, and being packed therein with such compactness as to remain freely air-permeable in an axial direction and yet be so self-supporting as to be substantially immovable with respect to the casing during the rotation of the casing even in a vertical plane; and means to retain the packing in the casing.

3. A moisture-transferer according to claim 2, characterized by the fact that, at each face of the casing, at least some of the spokes have an imperforate portion extending from the hub to the rim and extending inwardly from the face of the casing for a material distance.

4. A moisture-transferer according to claim 3, further characterized by the fact that at least some of the spokes consist entirely of one such imperforate portion.

5. A moisture-transferer according to claim 2, characterized by the fact that at least some of the spokes have, at both faces of the casing, an imperforate portion extending from the hub to the rim, and extending inwardly for a material distance.

6. A moisture-transferer according to claim 5, further characterized by the fact that at least some of the spokes consist entirely of said two imperforate portions.

7. A moisture-transferer, according to claim 2, characterized by the fact that at least some of the spokes have, at both faces of the casing, an imperforate portion extending from the hub to the rim, and extending inwardly for a material distance, and that the remaining portions of at least some of these spokes contain perforations.

8. A moisture-transferer according to claim 2, characterized by the fact that the packing is arranged in sectors, at least one radial face of each sector consisting of imperforate uncorrugated material.

9. A moisture-transferer according to claim 8, further characterized by the fact that, against each incomplete spoke there abuts at least one such face.

10. A moisture-exchanger according to claim 2, characterized by the fact that the packing is arranged in sectors, at least one radial face of each sector consisting of uncorrugated material, the sectors being all so oriented that, in proceeding angularly around the casing in one direction, such face of each sector is the face always first encountered.

11. A moisture-exchanger according to claim 2, characterized by the fact that the packing is corrugated asbestos paper.

12. A rotatable cylindrical moisture-transferer for use in an air-conditioning unit, to transfer moisture between two air-streams passing through said unit, said moisture-transferer comprising: a wheel-like casing, having spokes, a hub, and a rim, the hub and the rim extending to both faces of the casing, and at least some of the spokes extending to each face of the casing; a packing of liquid-absorbing corrugated paper, the corrugations of which run axially of the casing, said packing being impregnated with an hygroscopic impregnant, and completely filling the casing, and being packed therein with such compactness as to remain freely air-permeable in an axial direction and yet be so self-supporting as to be substantially immovable with respect to the casing during the rotation of the casing even in a vertical plane; and adhesive means for cementing the packing to the casing, said means being proof, at

the temperatures intended to be encountered, against water and the impregnant.

13. A rotatable cylindrical transferer for use in an air-conditioning unit, to transfer, between two air-streams passing through said unit, a thermodynamic characteristic of air, said transferer comprising: a wheel-like casing having a hub, a rim, and spokes extending radially between the hub and rim and forming partition members to divide the space between the hub and rim into a plurality of sectoral compartments, the hub and the rim being of substantially the same width axially, and the spokes being apertured centrally but each presenting an imperforate area adjacent to at least one face of the casing; and a packing of a plurality of layers of liquid-absorbing paper fitted in the sectoral compartments, some of the layers of such paper being corrugated and other layers thereof alternating with the corrugated layers and being flat and uncorrugated, with at least one flat uncorrugated layer being disposed against at least one face of each spoke, the corrugations in the corrugated layers being arranged to run axially of the casing.

14. A rotatable cylindrical transferer for use in an air-conditioning unit, comprising: a wheel-like casing having a rim and a hub, radial partitions extending between the hub and rim thereby dividing the area between

the hub and rim into a plurality of sectoral compartments, each of the compartments containing a packing composed of alternating layers of corrugated and uncorrugated paper, with the corrugations in the corrugated layers extending axially of the hub, and at least one uncorrugated layer disposed against one face of each partition.

15. A rotatable cylindrical tranferer according to claim 14, characterized by the fact that the partitions are perforated in areas located inwardly of the faces of the casing, and the uncorrugated layers disposed against the partitions extend over and cover the perforations in the partitions.

16. A moisture-transferer according to claim 2, further characterized by the fact that the rim is imperforate.

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