

[54] TRANSFERRER OF THE
THERMODYNAMIC CHARACTERISTICS
OF TWO GASES

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Primary Examiner—Albert W. Davis, Jr.

Related U.S. Application Data

[62] Division of Ser. No. 745,431, July 17, 1968, Pat. No. 3,587,723.

Foreign Application Priority Data

July 20, 1967 Sweden..... 10725/67

[52] U.S. Cl..... 165/9, 55/390

[51] Int. Cl..... F28d 19/00

[58] Field of Search..... 165/8, 9, 10; 55/390

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UNITED STATES PATENTS

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[57] ABSTRACT

A rotary exchanger in which the thermodynamic characteristics of two gas currents are transferred from one current to the other while they are being passed through the exchanger body in zones separated from one another while it is being rotated within a casing, adjustable sealing means being provided between the exchanger body and the casing to define the separate zones from one another.

1 Claim, 6 Drawing Figures

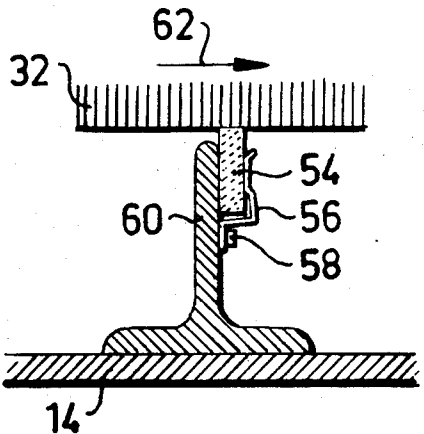
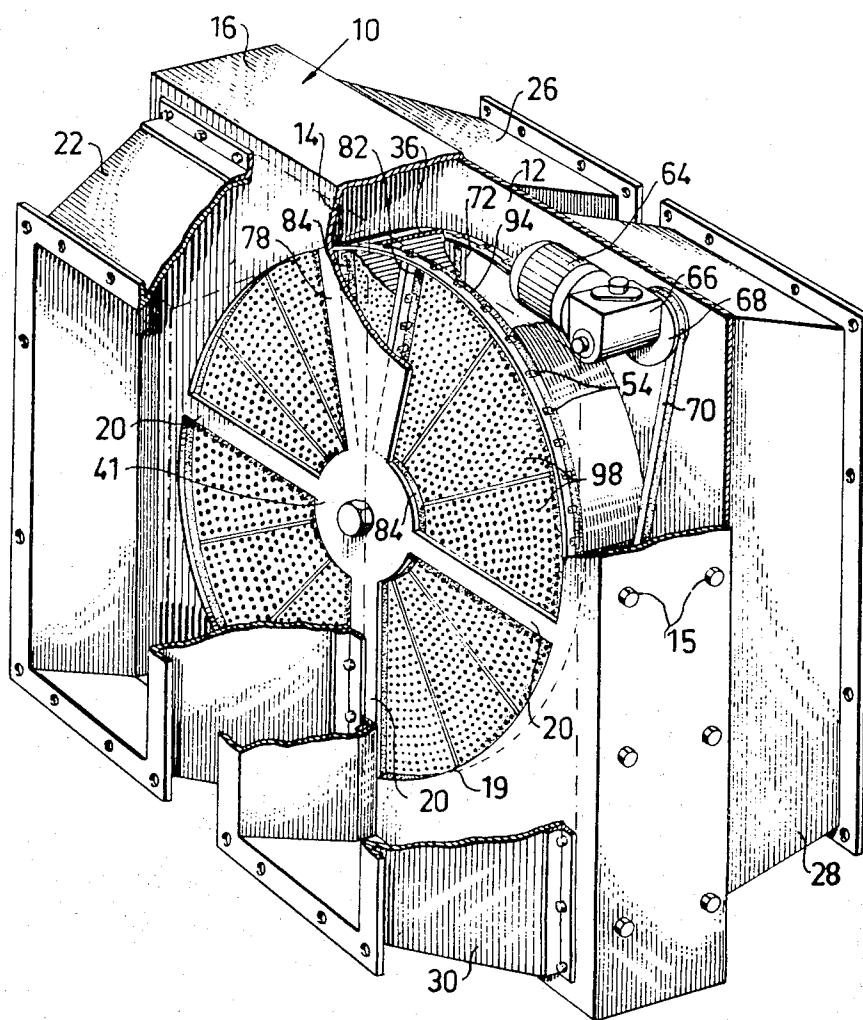


Fig.1



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Fig. 2

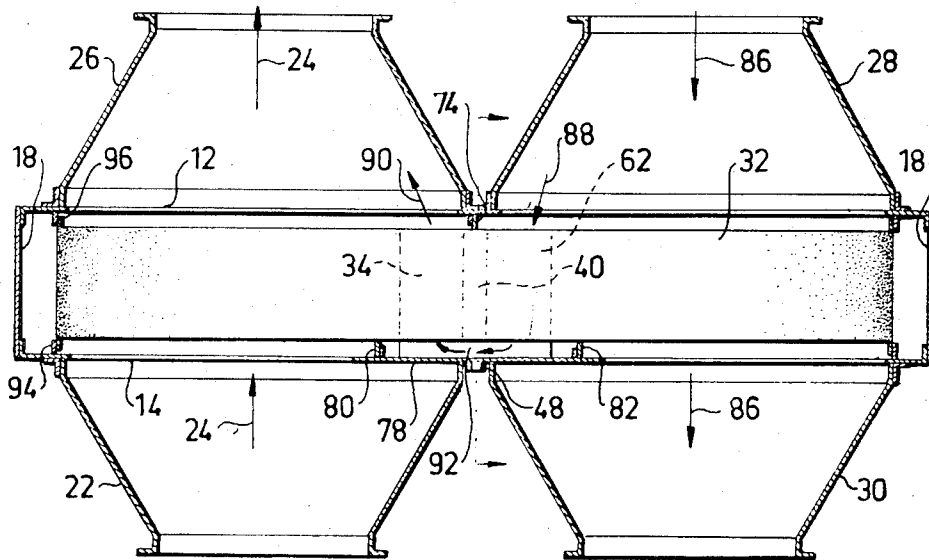


Fig. 3

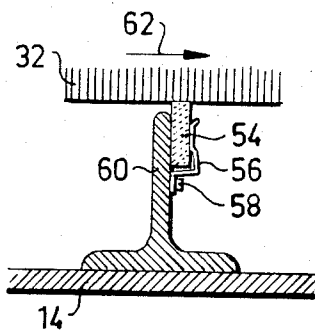
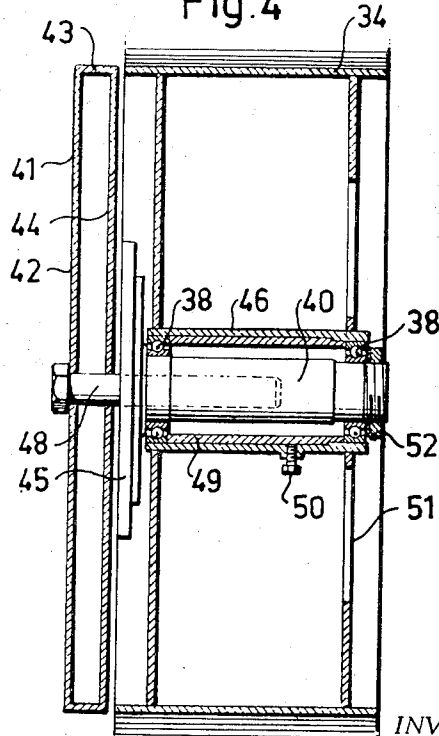


Fig. 4



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Fig.5

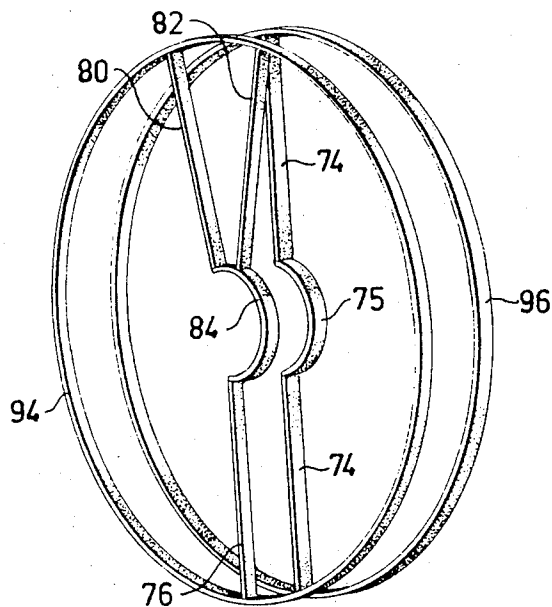
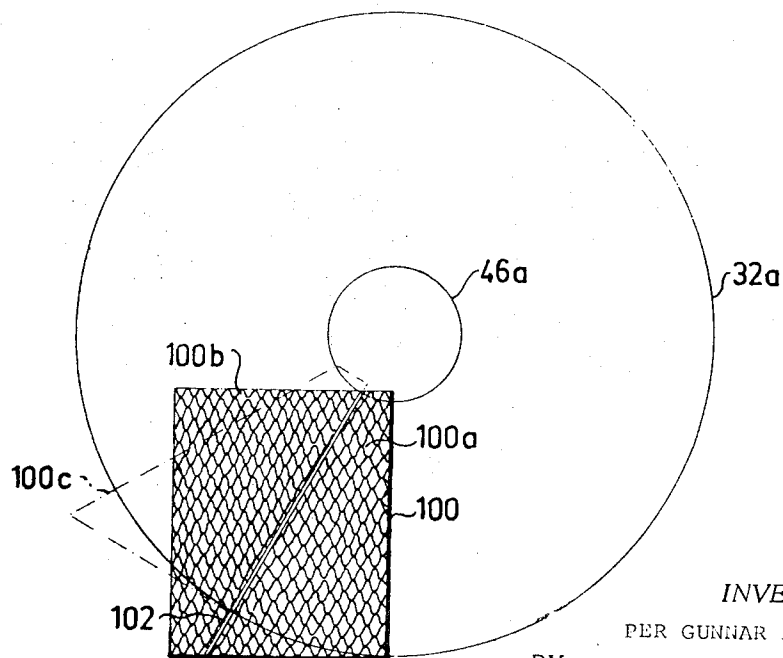


Fig.6



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TRANSFERRER OF THE THERMODYNAMIC CHARACTERISTICS OF TWO GASES

This is a division of application Ser. No. 745,431 filed July 17, 1968, now U.S. Pat. No. 3,587,723, granted June 28, 1971.

BACKGROUND OF THE INVENTION

This invention relates to a transferrer of the thermodynamic characteristics of two gases.

More particularly this invention relates to a regenerative transferrer of the thermodynamic characteristics of two gases, by means of which heat and/or moisture are exchanged between two currents of gases, forming a primary current and a secondary current, said transferrer comprising a rotatable body or rotor consisting of or containing a transfer medium formed with channels or passageways open in an axial direction, said rotary body being passed through zones separated from one another by said two gas currents, a clean-blowing zone or a purging zone being provided in the transition from the secondary gas zone to the primary gas zone by the rotary body, in which purging zone, secondary gas remaining in the passages of the rotary body is blown away to the secondary gas zone by means of primary gas.

The primary gas may be constituted by fresh atmospheric air which is introduced into a space or room for ventilation thereof and which in the transferrer exchanges heat and moisture with the consumed room air which thus constitutes the secondary gas current. At the moment when a portion of the rotor leaves the secondary air zone, the passageways thereof are filled with consumed air which desirably should not follow with the fresh air into the room. Therefore, this consumed air should be allowed to escape with the secondary air into the ambient atmosphere.

The aim in the ventilation of rooms is usually to introduce a quantity of fresh air into the room which is equal to amount of air which is withdrawn from said room. In structures hitherto known one had to rely for control and adjustment of the quantities of air passing through the rotary body to take into consideration the disturbance of the distribution of air caused by the clean-blowing or purging zone when the primary air at one end face of the rotor, viewed in the axial direction, merges with secondary air at the opposite end face of the rotor through the purging zone. Calculations for determination of compensation of the disturbance can be made, but they are relatively complicated and remain in spite thereof uncertain, which involves a considerable complication in the initial and subsequent adjustments of transferrer apparatus and devices.

SUMMARY OF THE INVENTION

One main object of the invention is to overcome this drawback by providing a transferrer of the kind in consideration with a purging device having a purging passageway including a purging zone, the inlet and outlet of the purging passageway discharging into the primary gas zone and the secondary gas zone, respectively, opening at the same end face of the rotary body and being in communication with one another through said rotary body.

The purging zone is thus subdivided into two portions which preferably are designed to be of equal size with the result that the surging air stream need not be taken

into consideration when balancing the flows of primary and secondary air. If thus the remaining effective front area of the rotary body is of equal size in both zones and the drop in pressure in both said zones is adjusted to the same value, the same quantities of air will automatically pass through the transferrer via the zones and thereby the quantities of air introduced into, and withdrawn from, the space to be ventilated become balanced. In response to the actual conditions at hand, each of the two zones of the transferrer can be brought to communicate with the fresh air side or with the consumed air side. It is only necessary to choose the direction of rotation of the rotary body so as to cause the purging zone to be located on the right side between the zones.

Another object of the invention is to provide a bearing for the rotary body which is simple and inexpensive in manufacture, permits easy assemblage and disassemblage and in spite thereof ensures correct position of the rotary body.

Still another object of the invention is to provide a sealing means for transferrers of the type in consideration which is simple in structure, easy to assemble and which for its correct operation does not require any extreme precision with respect to the shape of the stationary housing encasing the rotary body.

Still an object of the invention is to provide a rotary body composed of layers in which the layers are combined into sections which are glued together, which makes it possible to manufacture rotary bodies having very large diameters.

The transferrer according to the invention can also be adapted to operate as a dehydrator, the primary current then representing the air to be dried and the secondary current being constituted by regenerating air or gas which is heated to higher temperature so as to be capable of removing the moisture which the transfer medium of the rotary body, such as the layers thereof, have picked up in the primary air zone.

Further objects and advantages of the invention will become apparent from the following description considered in connection with the accompanying drawings which form part of this specification and of which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a transferrer intended for room ventilation and constructed according to the invention, and with parts thereof assumed to be cut off for improved clarity.

FIG. 2 is a view of the transferrer of FIG. 1 with its stationary parts shown in a horizontal section following a plane located above the axis of the rotary body.

FIG. 3 is a partial view of the rotary body, a stationary portion of the casing of the transferrer and a sealing member provided there between represented in a cross-sectional view.

FIG. 4 is a longitudinal sectional view of a portion of the casing and the hub of the rotary body.

FIG. 5 is a perspective view of sealing members disposed on both sides of the rotary body.

FIG. 6 is a diagrammatic representation of the assemblage of the rotor from sectors cut out from quadrangular blocks.

Referring to the drawings, reference numeral 10 generally denotes a casing of a transferrer intended for room ventilation and composed of two mutually parallel end pieces 12, 14 joined together by means of plates

16, 18 to be assembled and disassembled by means of bolt connections 15 and projecting around the edge portions of said end pieces. These end pieces are formed with circular openings 19 (FIG. 1) located directly opposite one another and subdivided into sectors by means of spokes 20, the number of which in the embodiment shown is four, distributed by-90° relatively to one another. In the illustrated embodiment the openings are divided vertically into two equal half-portions of which one half is passed by the entering fresh air and the other portion by the escaping consumed room air. Rigidly secured onto the end pieces 12, 14 are tubular connection jackets 22 and 26 which in turn are in connection with ducts leading to and from the room or space and the ambient air, respectively. The tubular jacket 22 of this type is joined to the end piece 14 and connects the transferer 10 with the room or space to be ventilated and is transgressed by the consumed air in the direction of the arrow 24 (FIG. 2). The other end piece 12 carries the jacket 26 which constitutes a continuation of the passageway or zone for the consumed or secondary air. The fresh air is introduced through a jacket 28 into the transferer and escapes therefrom through a jacket 30 into the room. These tubular jackets may have an elongated square shape as becomes evident from FIG. 1.

Provided within the space defined by the end pieces 12, 14 and the plates 16, 18 is a rotary body or rotor, which has a hub 34 and an annular body 32 disposed about said hub and composed of layers which form narrow interspaces or passageways extending from end to end in the axial direction of the rotor. Disposed about said body at the outer circumference thereof is a strip 36. The shape of the layers will be described in detail more below.

The hub 34 is mounted by means of two ball bearings 38 (FIG. 4) on a rotationally stationary bearing shaft 40 which is fixed at its one end only in the one end piece 14, the spokes 20 of which with circular end walls 42, 44 and an angular flange 43 are joined to a central plate 41 for this purpose. The bearing shaft 40 is rigidly secured onto a circular plate 45, which is centered and fixed by pressure on the end wall 44 by means of a bolt 48 penetrating through the centering plate 41 and screwed into the shaft 40.

The hub is adjustable in the axial direction relatively to the shaft 40 via a sleeve 46 which is displaceable in relation to the bearings. The sleeve 46 is locked in desired position in relation to a spacing sleeve 49 mounted between the bearings by means of a screw 50 which is accessible from outside through openings 51 formed in the one end wall of the hub 34. A retaining ring 52 is screwed onto the shaft 40 outside of the outer ball bearing 38.

This bearing device permits easy installation and disassembly of the rotary body. The rotary body 32 is fixed in its operative position or dismounted, respectively, by operating a single screw 50. As the end walls of the hub 34 do not at all or only to an insignificant degree project past the plane end surfaces of the rotary body 32, the rotor can be introduced into and removed out from the casing 10 upon removal of the plates 18 on one side thereof. The one-sided supporting of the rotary body 32 has the further advantage that the axis of the body always maintains its fixed position relative to the end wall 14 onto which it is secured. A small displacement of the two end walls in relation to one another

during transportation or installation of the transferer can be permitted without the rotor thereby being given an inclination involving the danger of jamming thereof.

Disposed around the edges of the rotary body and between the two zones formed in the transferer are sealing members, as is most clearly shown in FIGS. 3 and 5. Said sealing members are fixed onto the end pieces 12 and 14 and collaborate with the lateral plane surfaces formed by the layers of the rotary body. FIG. 3 shows a sealing strip 54 which by means of resilient clamps 56 and a screw 58 is supported by a flange 60 secured onto one end piece such as the end piece 14. The sealing strip 54 is made from a suitable material such as cork, fibers, asbestos, plastic or the like. It is retained in position by the mutually spaced resilient clamps 56, as also will be seen from FIG. 1, and it has some possibility of movement within said clamps when the rotary body is being installed. When the rotary body 32 is mounted in place within the casing the strips 54 may be inserted in their clamps but may be retracted for subsequent manual advancement towards the plane lateral faces of the rotary body. Due to their resilient mounting the strips can automatically adjust themselves in response to unavoidable inclined positions of the rotary body 32 or similar small irregularities so that they produce an effective seal against the rotary body 32 with only small play about the whole circumference and along the radial partition walls. The direction of revolution of the latter is preferably in accordance with the arrow 62 in FIG. 3 so that the strip 54 can yield along with the clamps 56 which act as springs if the strip should come into direct contact with the rotary body during the running in period of the transferer. Thus the strip 52 is prevented from becoming damaged or causing damage to the layers of the rotary body.

The rotary body 32 is rotated by means of a motor 64 which over a reduction gear 66 drives a pulley 68. A belt 70 is positioned about said pulley 68 and the cylindrical strip 36 of the rotary body 32. In a transferer for ventilation purposes the number of revolutions of the rotary body may be of the order of 10 revolutions per minute.

Provided on that side of the rotary body, which separates the flow passageways formed by the ducts 26 and 28 from one another are, both above and below the centering plate 41, several relatively narrow spokes 20 which carry sealing strips 74 according to FIG. 5 and which are joined together by means of a semi-circular strip portion 75 along the flange 43 of the centering plate 41. Provided at the opposite side below the centering plate 41 is a similar narrow spoke 20 with which a sealing strip 76 cooperates. Above the axis of the rotary body, the spoke 78 is, however, devised as a sector from which a section of equal shape and size extends peripherally past the vertical spoke 20 on the other side of the rotary body. The sector-shaped partition member 78 cooperates with two sealing strips 80, 82 which are united with one another and with the lower sealing strip 76 by a semi-circular strip portion 84 which is carried by the centering plate 41. Thus a double purging section is formed within the transferer 10 between the two zones of flow. When the rotary body rotates in accordance with the arrow 62 (FIG. 2) and passes through the left-hand zone formed by the ducts 22 and 26 for the escaping consumed room air, heat, and moisture present in the same will be picked up by the layers

of the rotary body (winter conditions assumed to prevail) to be delivered thereupon to the fresh air streaming through the rotor in countercurrent via the other zone of the transferrer. It is not desirable that the room air, which is present in interspaces of the rotary body 32 when the layers of the rotary body are just passing over into the fresh air zone flows along with the fresh air current according to the arrow 86 into the room. It is the purpose of the purging to introduce fresh air into the interspaces of the rotary body 32 when these arrive at the fresh air zone, and this fresh air flows through the interspaces and cleans them from consumed air to escape together with said consumed air through the outlet duct 26. In the purging section, the air initially flows according to the arrow 88 to the interspace 92 screened off by the strips 80, 82 inside of the partition member 78 and then makes a turn and reverts into the other half of the purging section according to the arrow 90 to escape into the duct 26 together with the consumed air. By reason of the shape of the purging zone the quantities of air which, respectively, leave the ventilated room and are entrained in the purging zone pass through the transferrer 10 without being changed quantitatively. The drop in pressure within the flowing zones can therefore be utilized as a direct measuring unit for the magnitude of the quantities of air in consideration, which renders possible a simple adjustment and control of the magnitude of said quantities. This is of particular importance when the pressure levels on the primary air side and the secondary air side differ substantially from one another.

The sealing device has circular strip portions 94, 96 extending about the circumference on both sides of the contact insert of the rotary body 32 so that leakage in this way is effectively counteracted.

The disclosed type of sealing means comprising axially displaceable, easily accessible and adjustable sealing strips results in saving the stationary parts of the transferrer from wear and minimizes high precision mounting thereof. Possible variations in play between the rotary body 32 and the parts carrying the sealing strips 54 are thus equalized in a simple manner when the sealing strips are finally adjusted in relation to the rotary body.

The contact insert may be composed of thin layers or sheets in the manner disclosed, for example, in U. S. Pat. No. 3,231,409. Said layers form narrow axial interspaces or channels extending from end to end and are preferably alternately plane and corrugated or pleated, the height of the corrugations being preferably as low as between 1 and 3 millimeters. The layers may be made of asbestos as disclosed in said patent and they may be impregnated with a hygroscopic substance, such as lithium chloride, for example.

The inserts forming the rotary body 32 may be composed of sector-shaped portions 98 (FIG. 1) which in turn are obtained from blanks having the form of rectangular blocks 100 as will be seen from FIG. 6. These blocks are built up from mutually parallel layers glued together and then severed obliquely following the line 102 into two equal portions 100a and 100b of parallelly tapering or pointed trapezium contour of which the latter portion is turned to the position 100c, whereupon the portions are joined with one another. The outer and inner edges of the composite blocks are machined to a cylindrical contour along the lines 32a and 46a, respec-

tively. The sector-shaped blocks are joined together by means of a suitable adhesive such as an epoxy resin. In this manner rotary bodies having very large diameters can be manufactured. As the orientation of the layers in the individual sector-shaped blocks are different, the tendency of cracks or fissure formations between two layers along the surface extension thereof, is reduced considerably.

Due to the exchange of temperature and moisture for ventilation purposes brought about by the transferrer according to the invention, the major portion of the heat contained in the escaping room air is transferred to the entering, relatively colder fresh air during wintertime.

Furthermore, the rotary body 32, picks up moisture from the escaping air which is delivered to the entering air, which particularly in wintertime, is of importance in order to minimize drying of the air in the room.

The apparatus can also operate as dehydrator, its purpose then being to dehydrate air by means of a regenerating an air current which has a high temperature such as in excess of 100° C. In this case also it is essential that the rotary body 32 is arranged to be easily dismantled and that the sealing members be mounted in an easily adjustable manner.

In a dehydrator, the area of the regeneration zone amounts to a minor fraction of the primary air zone, such as a fourth thereof.

It may occur that the primary air current and the secondary air current have different volumes. In this case also, it is of importance to have the possibility of measuring the volume of the currents or of adjusting them to the desired magnitude in the easy manner afforded by the invention.

While one more or less specific embodiment of the invention has been shown and described, it is to be understood that this is for purpose of illustration only and that the invention is not to be limited thereby, but its scope is to be determined by the appended claims.

I claim:

1. A wheel-like transferrer of thermodynamic characteristics of a plurality of air streams comprising:

a. a rotary transferrer body housed within a casing and composed of a plurality of thin corrugated sheets of fibrous material which engage one another at spaced intervals to form a mass of open-ended axial extending passages, the end portions of which passages form substantially flat faces at each end of said rotary body;

b. sealing means in said casing defining separate zones through which the air streams are passed in thermodynamic heat exchange relationship with one another;

c. said sealing means comprising a support surface perpendicular to the flat surfaces of the exchanger body, a sealing strip and a resilient clamping means for holding the sealing strip against the support structure while allowing the sealing strip to yield under a force exerted in a direction parallel to said flat surfaces and in the direction of rotation of the transferrer body so as to floatingly adjust themselves in response to irregularities in said flat faces and to the play of the transferrer body during the rotation thereof.

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