Jan. 14, 1969 W. EGLI 3,421,575

HEAT EXCHANGER

Filed July 6, 1962 Sheet 1 of 2

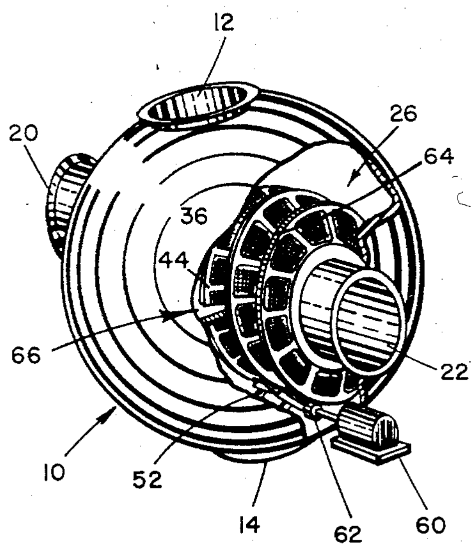

Fig. 1

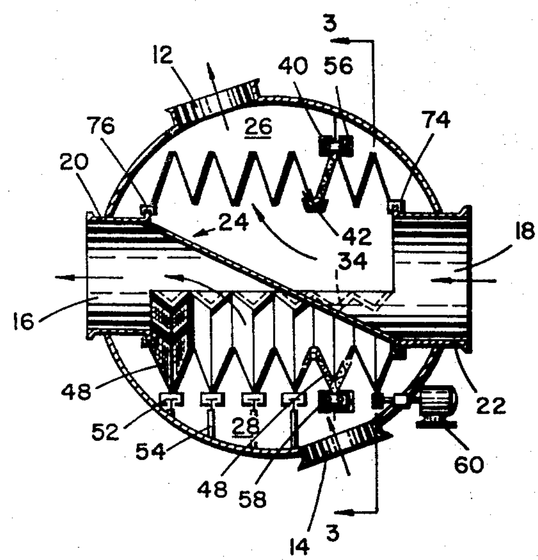

Fig. 2

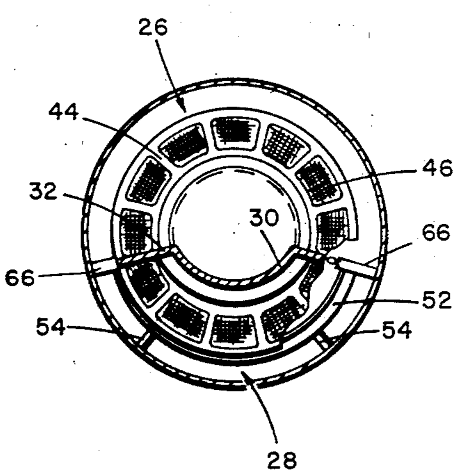

Fig. 3

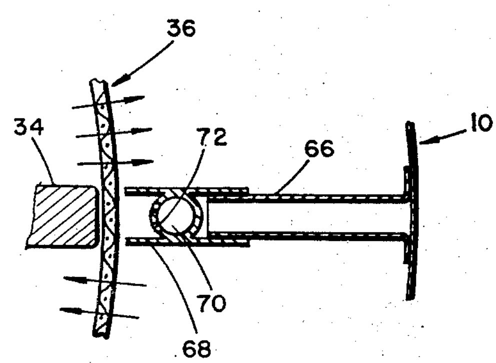

Fig. 4

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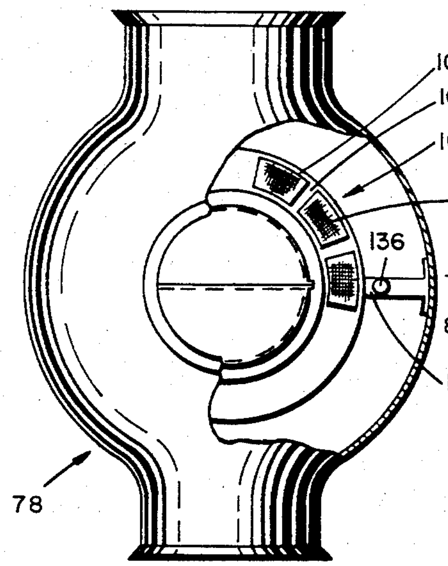

Fig.5

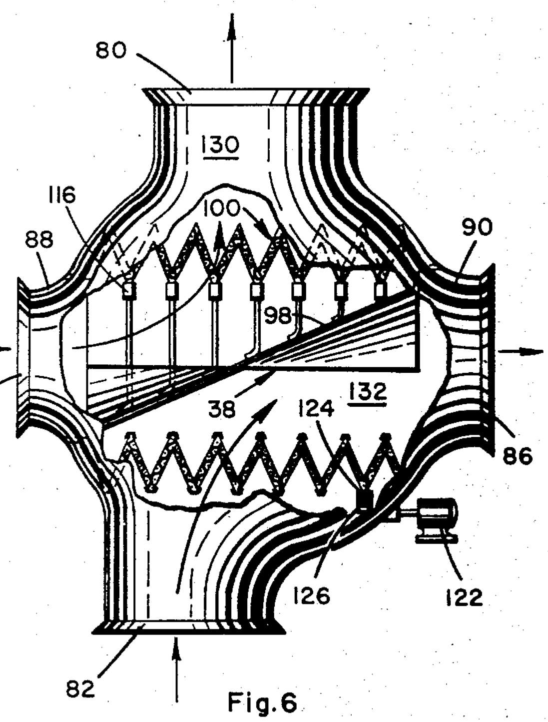

Fig.6

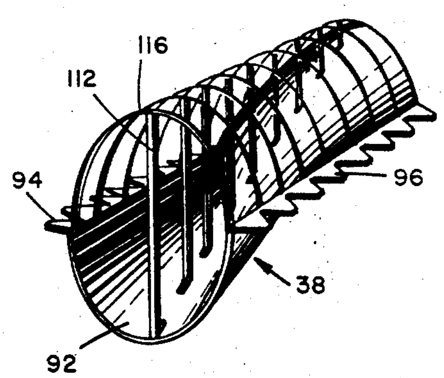

Fig.7

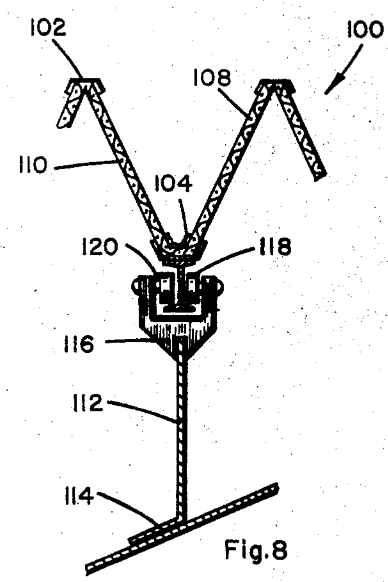

Fig.8

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3,421,575
HEAT EXCHANGER

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Int. Cl. F28d *19/00;* F23l *15/00*

This invention relates in general to heat exchangers and more particularly, to an improved cyclic or regenerative heat exchanger of the radial flow type which incorporates a rotating matrix and which is adapted for the efficient handling of gases.

In aircraft and space applications, and for mobile equipment in general, it is particularly important that heat exchangers perform efficiently and that they be of minimum volume and of minimum weight. It is further highly desirable that such exchangers be of simple and extremely rugged construction in view of the obvious difficulties incident to making repairs. Cyclic or regenerative type exchangers are well suited to such applications because of the compact heat transfer surface which can be utilized. In heat exchangers of this type which utilize a rotating matrix, the heat exchange surface presented by the matrix rotates periodically into and out of the hot gas flow side and the cold gas flow side, thus periodically effecting heat charging and heat discharging of the matrix and effecting heat transfer between the gases contacting either side of the matrix.

It is an object of this invention to provide an improved heat exchanger of the above type which improves the efficiency of the heat exchange and at the same time reduces the weight and volume of the unit as compared with prior such exchangers.

It is another object of this invention to provide a heat exchanger which is of simple, rugged construction and which, because of its additional qualities of light weight, minimum volume, and excellent heat transfer efficiency, is particularly well adapted for aircraft and space applications.

A further object of this invention is to provide a heat exchanger with a matrix having a high ratio of surface areas to volume which thus presents maximum of heat transfer surface within an envelope of minimum dimensions.

Yet a further object of this invention is to provide a heat exchanger in which the side of hot gas flow is sealed from the side of cold gas flow to prevent leakage therebetween responsive to differentials in pressure existing between the sides.

A further object of this invention is the provision of a heat exchanger in which the elements active in effecting heat exchange are maximized and the passive associated structure, minimized.

Other objects and advantages of this invention will become apparent from the following description, when taken in conjunction with the drawings in which:

FIGURE 1 is a perspective view of one embodiment of the invention, partially broken away to disclose interior structure;

FIGURE 2 is a view in vertical section on a plane passed diametrically through the FIGURE 1 embodiment to longitudinally bisect the baffle;

FIGURE 3 is a view in section taken on the line 3—3 of FIGURE 2, partially broken away to disclose the matrix support means;

FIGURE 4 is a view in section enlarged to show the details of the sealing means;

FIGURE 5 is a view in end elevation of another embodiment of the invention, partially broken away;

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FIGURE 6 is a view in side elevation, partially broken away to disclose the baffle and the support means associated therewith;

FIGURE 7 is a view in perspective, somewhat enlarged, to illustrate the baffle and the structure for matrix support carried thereby; and

FIGURE 8 is a fragmentary view, enlarged to illustrate means utilized for supporting the matrix in its rotation about the baffle.

Generally described, the invention comprises a hollow housing within which is carried for rotation upon cradling support members, a porous matrix or heat exchange element of generally cylindrical bellows shape. An imperforate baffle encircled by the matrix and having end portions of oppositely directed concavity traverses the housing interior to divide the housing into first and second sides or chambers, respectively serving for receipt of the hot gas and the cold gas and exposure of the rotating matrix thereto. Communicating with each of these chambers are inlet and outlet ports for the passage of the gases through the chambers and the porous matrix rotatably disposed therein. Means are provided for driving the matrix in rotation to cause its various surface portions to periodically pass through each of the above chambers to expose such portions to heat charging and heat discharging as a result of temperature differentials existing between the gases admitted to the two chambers. The baffle means is of substantially uniform mean diameter with a central curved portion of generally smooth contour laterally terminating in side margin wing members. These wing members or marginal side aprons are of notched or saw tooth configuration and closely bound the interior surface of the matrix as the latter rotates about the baffle. Similarly, a saw tooth configuration is presented by a pair of diametrically opposed manifolds of the sealing means which lie closely adjacent the outside surface of the rotating matrix, and which with the wing members straddle the matrix. Gas under pressure is ported from the manifolds to prevent passage of gases between the exchanger hot and cold sides. Although not shown, similar sealing means may be employed in the baffle to complement the above sealing means and may, if desired, serve as the sole gas-porting source.

Two invention embodiments are illustrated, the first being shown in FIGURES 1 through 4, and the second embodiment being shown in FIGURES 5 through 8. Turning to the first embodiment, in FIGURES 1 and 2 there is shown a hollow housing **10** of generally spherical shape provided with a pair of diametrically opposed ports **12** and **14** and a similarly disposed pair of ports **16** and **18**. The cylindrical members **20** and **22** which respectively define ports **16** and **18**, extend interiorly of the housing to provide end support for the baffle and the matrix, as hereinafter described. In order to afford maximum utility in space and aircraft applications, the housing **10** has been illustrated as of spherical shape because of the high strength-to-weight ratio achievable through use of such shape; however, it will be appreciated that the housing is not limited thereto but may assume other shapes which are capable of accommodating the housed elements and which will not cause undue turbulence of the gas as it flows through the chambers. Although a wide variety of materials are suitable for the housing, where high temperatures are contemplated, a material such as "Rene," a high temperature alloy produced by the General Electric Corporation, is suitable.

As shown in FIGURES 1, 2, and 3, an imperforate baffle **24** extends diametrically of the housing **10** to divide it into two integral chambers, a first or hot side chamber **26** and a second or cold side chamber **28**. The baffle **24** includes a curved center portion **30** from either side margin of which extend laterally outward aprons or winged members 32 and 34 appropriately shaped, as presently described, to conform with the adjacent perimeter of matrix 36 which encircles the baffle. The baffle is fixedly secured at either end to the inner extremities of port-defining cylindrical elements 20 and 22. As is shown in FIGURES 2 and 3, the baffle center portion 30 is of a fixed diameter or width, and is of double concave shape with maximum degrees of curvature at either end, being concave downwardly at its left end and concave upwardly at its right. A smooth transition between these oppositely directed curved end portions is effected by progressively reducing the degree of curvature toward the middle of the baffle, while maintaining said fixed diameter. The general shape of the baffle may be better visualized by reference to FIGURE 7, which illustrates a generally similar baffle 38, utilized in the second embodiment. However, it should be noted that although the baffle 38 of FIGURE 7 is of 180° curvature at either end, baffle 24 of the first embodiment is of 220° curvature at its left end, as viewed in FIGURE 2, and is of 140° curvature at its right end (see FIGURE 3). Such curvature governs the relative amount of exposure of the matrix to the hot and cold sides of the exchanger and is subject to change to achieve the matrix exposure desired. FIGURE 7 is further helpful in disclosing the saw-tooth or notched side margin configuration assumed by similarly shaped aprons 34 and 36. With margins so shaped, the baffle assumes a position closely adjacent the inner peripheral surface of the matrix, to effectively minimize the possibility of gas passage between chambers 26 and 28. From the above, it can be seen that the baffle is adapted to serve several important functions. It divides the housing into two compartments, while providing through its side margin configuration, compartment integrity. At the same time, with its smoothly contoured, oppositely directed, double concave shape, it defines concave channels over a portion of the chamber lengths traversed by the gases. As with the housing, the material of the baffle plate may vary, although the "Rene" alloy, earlier mentioned herein, is suited to high temperature applications.

The matrix or heat exchange element 36 is of rigid bellows shape with a uniform mean diameter. Annular members 40 and 42, concentrically disposed about the bellows longitudinal axis, respectively define the major and minor diameters of the matrix. These members serve with intermediate radially directed members 44, to define a rigid, skeletal, matrix framework with a plurality of apertures 46, the latter provided for receipt of perforate or porous members 48. The porous members are disposed to extend entirely across the apertures and it is through such porous members that the gases pass during heat exchange. Accordingly these members are arranged herein to present a great exposure or frontal surface area for heat exchange between the matrix and the gases. The porous matrix portions 48 are preferably made up of fine mesh screen. A suitable such screen may be fabricated by superposing a plurality of screens of similar mesh, size and shape and thereafter sintering them. The size of mesh and the number of layers of screen will vary, depending upon the particular application involved. However, good heat exchange may be accomplished by employing screens of 60 x 60 x .0075" mesh and using some 30 to 40 layers sintered with their apertures in general alignment. High temperature applications involving temperatures in the vicinity of 2500° R. may be handled by employing a ceramic material such as the metal ceramic compound "Cerametalix," a product of Bendix Aviation Corporation.

Support means for carrying the matrix in its rotation are illustrated in FIGURE 1 as comprising curved members 52 of T-shaped cross section secured in spaced relation with the walls of housing 10 by radially directed members 54. As shown in FIGURE 2, the ring members 40 may be provided with flanges 56 shaped to extend about the flanges of members 52, with friction reducing bearings 58 or other suitable friction reducing means being positioned therebetween. It is thus apparent that the matrix is cradled in a framework of support members 52 which aggregately define a support of concave cradle shape. The use of curved members 52 of approximately semi-annular shape in lieu of support members of full annular shape, permits a considerable weight saving.

The matrix is driven in its rotation by a motor 60 driving a spur gear 62 which engages a ring gear 64 encircling a major diameter of the matrix. However, other means may obviously be employed for driving the matrix in its rotation. Speed of such rotation will vary with the particular application, but it is to be noted that higher speeds of rotation may be employed with the exchanger of this invention than generally employed with conventional exchangers having the same total matrix weight. Thus speeds in the vicinity of 600 r.p.m. may be utilized under favorable conditions.

In FIGURES 3 and 4, there is shown the means for sealing chambers 26 and 28 against passage of gases therebetween, the arrows indicating the directions of gas passage through the matrix in the two chambers. The sealing means is comprised of structural support members 66 secured opposite each of the edge margins of the baffle wing members interiorly of the housing 10. Members 66 each support at their inner ends gas manifolds 68 fed from gas conduits 70 through a plurality of ports 72. Conduits 70 are in communication with a pressurized gas source (not shown). Each of the manifolds 68 is suitably notched to accommodate the bellows shaped matrix and with its associated notched wing member closely straddles the matrix. Gas at pressure higher than either medium involved in the heat exchange process is ported to manifolds 68, in order to form a gas barrier between chambers 26 and 28. The gas introduced into the system through manifold 68 may be one of the gases involved in the heat exchange process, thereby making it possible to prevent contamination of one of the two heat exchange gases.

Although not shown, a similarly constructed sealing arrangement may be employed in each of the baffle wing members 32 and 34, either to supplement the above described sealing means or as an alternative sealing arrangement. Thus the edge or outer margin of each wing member may be appropriately utilized as a manifold to port gas, as above, but interiorly of the matrix. Should the sealing means in the baffle be employed as an alternative to the manifolds 68, the inner margins of the manifolds 68 would be blanked off, i.e., shaped similar to the notched continuous edge margin of baffle wing member 34 (FIGURE 4).

Labyrinth seals 74 and 76 are provided at either end of the matrix to effectively seal same, being defined by matrix minor diameter end rings and mating annular members encircling the inner extremities of cylindrical port-defining members 20 and 22.

In operation, the cooler gas which is to be heated enters chamber 28, or the cool side of the exchanger, through port 14. The bearings 58 of the matrix support means are thus cooled by this entering gas. The gas then passes through porous members 48 of matrix 36 as same is driven in rotation by motor 60. During such passage the gas is heated by a portion of the heat-discharging matrix, earlier charged by its rotation through hot side chamber 26, which latter of course carries the hotter gas from which heat is to be extracted. The gas, at somewhat reduced pressure but at a substantially increased temperature, is directed by baffle 24 to pass from the interior of the matrix outwardly of chamber 28 through the port 16. Simultaneously with the above action, other portions of the matrix are being rotated from chamber 28 back into the hot side chamber 26, to be recharged by the action of the hot gas entering the chamber 26 through inlet port 18. This gas, which is directed through the open end of the rotating matrix 36, passes interiorly of same to be directed by the baffle plate 24 to pass upwardly and outwardly through outlet port **12**, heating the matrix as its passes through its porous members **48** to effect matrix recharging. In discharging from the port **12**, the gas is at a substantially lower temperature and at a lower pressure than when it entered the chamber through port **18**.

Describing now the second invention embodiment, illustrated in FIGURES 5 through 8, a hollow, generally spherical housing **78** is provided with a pair of opposed and slightly offset ports **80** and **82**, and a pair of diametrically opposed ports **84** and **86**. As in the first embodiment, the cylindrical members **88** and **90** which respectively define the ports **84** and **86**, extend interiorly of housing **78** to provide end support and effective labyrinth seals for the matrix extremities. As mentioned above, the spherical shape of the housing is not a limiting configuration, but rather one that has advantage in achieving high strength-to-weight ratios.

FIGURE 6 shows the baffle **38** extending diametrically of the housing **78**, and being fixedly secured at either end to the inner extremities of cylindrical port-defining members **88** and **90**. Like baffle **24**, the baffle **38** of this second embodiment is imperforate, with a curved center portion **92** (FIGURE 7) of double or inverted concave shape, with a uniform diameter. Thus, as viewed in FIGURE 7, the baffle at its left end is concave upwardly; whereas at its right end it is concave downwardly, the greatest degrees of curvature, i.e., 180°, occurring at their end of the baffle. Progressive variation through lesser degrees of curvature intermediate the ends effects a smooth transition. Apron or wing members **94** and **96** extend laterally outward from either side margin of matrix center portion **92**. These members are appropriately notched to conform with the configuration of the immediately adjacent surface of the encircling matrix to define a barrier between the chambers. From FIGURE 6 it is apparent that there is formed by the baffle an obliquely disposed linear backbone or boundary-defining portion **98** lying midway between the baffle side margins. This portion of baffle **38** provides support for the encircling matrix **100**, as illustrated in detail in FIGURE 8 and presently described.

The heat-exchanging matrix **100** of this embodiment is similar in shape to that of the first embodiment, being of rigid bellows shape with annular framework members **102** and **104** extending about the major and minor diameters, respectively. Members **102** and **104** serve, with radial members **106**, to define a rigid, skeletal, matrix framework with a plurality of apertures **108**, the latter traversed by a perforate or porous material **110**. As shown in FIGURE 8, the ring members **102** and **104** are bifurcated for receipt and retention of the perforate material **110**. The latter material may be constructed of fine mesh screen, as described in connection with the first embodiment, although such screen construction is of course not to be construed as a limitation upon the invention. However, as has been earlier indicated, this material performs an important heat exchange function and screen, with its great available exposure area, is excellently suited therefor.

FIGURES 6 and 8 show the means for supporting matrix **100** in its rotation as comprising upright bracket members **112** of progressively varying lengths fixedly secured by means of oblique flanges **114** to the backbone portion **98** of baffle **38**. Carried atop the brackets equidistant from the axis of the matrix are semi-annular members **116** of yoke shaped cross section which at spaced perimeter locations carry for rotation pairs of rollers **118** on shafts **120**. The annular members **104** track upon rollers **118** with their web portions interposed between the rollers and their flanges astraddle them, thus permitting matrix rotation while at the same time maintaining the matrix against longitudinal or transverse movement. It should be noted that, as with the first embodiment, semi-annular support members are suitable for supporting the matrix in its rotation.

Employed for rotating the matrix **100** is a motor **122** driving a major diameter ring gear **124** through a pinion gear **126**. This is but one of many arrangements which may be utilized for accomplishing such rotation. Speed of rotation of the matrix is of course subject to wide variation, depending upon the particular application contemplated.

Sealing means **128**, similar in construction to that illustrated for the first embodiment and likewise subject to the supplemental or alternative sealing means in the baffle, is provided to prevent the flow of gases between cold side chamber **130** and hot side chamber **132**. Manifolds **134**, which are in communication with conduits **136**, carry air or other suitable pressurized medium from a source (not shown) at a pressure sufficiently above that of either of the mediums in chambers **130** and **132**, to thereby form a gas barrier between the chambers similar to that earlier described. Similarly, the gas introduced through manifolds **134** may be one of the gases involved in the heat exchange process. The shape of manifolds **134** is like that of manifolds **68** earlier described, being marginally notched to complement the matrix passing in rotation closely adjacent thereto and equatorially secured to the walls of housing **78**. As in the embodiment first described, there are here provided manifolds **134** and baffles **38**, complementally notched to accommodate the matrix and positioned at the exterior and interior margins of the matrix periphery to effect its close straddling and integrity of the two chambers.

Operationally, the cool gas to be heated is directed through port **84** into housing chamber **130** or the cold side of the housing **78**, with the air being heated as it passes through the heat-charged porous material **110** of rotating matrix **100**, earlier heated by rotation through hot side chamber **132**. The cool gas passes over the matrix support means, cooling the rollers **118** and the associated support means assembly. After its passage through the matrix, the heated medium, directed by the baffle **38** is expelled through port **80** at a reduced pressure. The action in the hot side chamber **132** is just the reverse of that in chamber **130**, i.e., the portions of the matrix **100** rotating therethrough are recharged or heated by the hot gas entering port **82** and passing through the matrix sintered screen portion **110**. The gas is thence directed by the baffle **38** to pass outwardly of chamber **132** through port **86** at a substantially reduced temperature and a reduced pressure.

From the above, it will be observed that this invention provides new and novel apparatus for the efficient heat transfer of gases which are particularly well adapted for installations demanding apparatus of minimum weight and volume, and a maximum reliability. Although the invention has been described with respect to two embodiments, it is to be understood that the invention is not limited thereto but contemplates any and all apparatus fairly falling within the scope of the appended claims.

What I claim is:

1. A cyclic radial flow heat exchanger for effecting heat exchange between fluids comprising, in combination,

a hollow housing having means for passing one of said fluids through a first hot side of the interior of said housing and another of said fluids through a second cold side of the interior of said housing,

an imperforate baffle having notched side margins and traversing said housing interior to separate said hot and said cold sides one from the other,

a porous heat-exchanging matrix of bellows shape cooperable with said notched side margins and interposed in the paths of travel of said fluids through said hot and said cold sides and driveable in rotation about its longitudinal axis, and

means supporting said matrix in said rotation within said housing interior to expose portions of the matrix alternately to passage through said hot and said cold housing sides to thereby effect its periodic heating and cooling responsive to heat differentials existing between said fluids and heat exchange between said fluids.

2. A cyclic radial flow heat exchanger for effecting heat exchange between fluids comprising, in combination,

a hollow housing have means for passing one of said fluids through a first hot side of the interior of said housing and another of said fluids through a second cold side of the interior of said housing,

an imperforate baffle having notched side margins traversing the housing interior to separate said hot and said cold sides one from the other,

a porous heat-exchanging matrix of bellows shape cooperable with said notched side margins and interposed in the paths of travel of said fluids through said hot and said cold sides and driveable in rotation about its longitudinal axis, and

means for supporting said matrix in said rotation within said housing interior to embrace said baffle such that the interior surface of said matrix closely bounds in complemental fashion the said baffle notched side margins, said means in supporting said matrix for rotation serving to expose portions of the matrix alternately to passage through said hot and said cold housing sides to thereby effect its periodic heating and cooling responsive to heat differentials existing between said fluid and heat exchange between said fluids.

3. A cyclic radial flow heat exchanger for effecting heat exchange between fluids comprising, in combination,

a hollow housing having means for passing one of said fluids through a first hot side of the interior of said housing and another of said fluids through a second cold side of the interior of said housing,

an imperforate baffle having notched side margins traversing the housing interior to separate said hot and said cold sides one from the other,

a porous heat-exchanging matrix of bellows shape cooperable with said notched side margins and interposed in the paths of travel of said fluid through said hot and said cold sides and driveable in rotation about its longitudinal axis,

means for supporting said matrix in said rotation within said housing interior to embrace said baffle such that the interior surface of said matrix closely bounds in complemental fashion the said baffle notched side margins, said means in supporting said matrix for rotation serving to expose portions of the matrix alternately to passage through said hot and said cold housing sides to thereby effect its periodic heating and cooling responsive to heat differentials existing between said fluids and heat exchange between said fluids, and

means cooperable with said matrix for sealing said hot side and said cold side against passage of said fluids therebetween including means communicable with a source of pressurized fluid for distributing same over surface portions of the matrix rotating into positions intermediate the said hot side and said cold side of the housing.

4. The combination of claim 3, wherein the distribution means of the sealing means includes a pair of manfolds notched like said baffle side margins and complementally disposed opposite same to closely straddle the matrix and define with said baffle the outer portions of the boundary separating said first and said second housing sides.

5. A cyclic radial flow heat exchanger for effecting heat exchange between fluids comprising, in combination,

a hollow housing having means for passing one of said fluids through a first hot side of the interior of said housing and another of said fluids through a second cold side of the interior of said housing,

an imperforate baffle having notched side margins traversing the housing interior to separate said hot and said cold sides one from the other,

a porous heat-exchanging matrix of bellows shape cooperable with said notched side margins and interposed in the paths of travel of said fluids through said hot and said cold sides and driveable in rotation about its longitudinal axis,

means for supporting said matrix in said rotation within said housing interior to embrace said baffle such that the interior surface of said matrix closely bounds in complemental fashion the said baffle notched side margins, said means in supporting said matrix for rotation serving to expose portions of the matrix alternately to passage through said hot and said cold housing sides to thereby effect its periodic heating and cooling responsive to heat differentials existing between said fluids and heat exchange between said fluids,

and sealing means cooperable with said matrix and disposed within the housing including conduit means for conveying pressurized fluid, and manifold means in communication with said conduit means for receiving therefrom and distributing said pressurized fluid over surface portions of the matrix rotated into positions intermediate the said hot side and said cold side of the housing thereby to prevent passage of the said fluids between said hot and said cold sides of the housing.

6. A cyclic radial flow heat exchanger for effecting heat exchange between fluids comprising, in combination,

a hollow housing having means for passing one of said fluids through a first hot side of the interior of said housing and another of said fluids through a second cold side of the interior of said housing, said means including a pair of oppositely disposed ports defined by cylindrical elements extending interiorly of the housing,

an imperforate baffle traversing the housing interior to separate said hot and said cold sides from each other, said baffle having notched apron members extending laterally outward from either side of a curvilinear central portion the ends of which are concave in opposite directions and are secured to said cylindrical elements,

a porous heat-exchanging matrix of bellows shape, cooperable with said notched apron members and interposed in the paths of travel of said fluids through said hot and said cold sides and driveable in rotation about its longitudinal axis,

means for supporting said matrix in said rotation within said housing interior to embrace said baffle from end to end such that the interior surface of said matrix closely bounds in complemental fashion the said baffle apron members, said means in supporting said matrix for rotation serving to expose portions of the matrix alternately to passage through said hot and said cold housing sides to thereby effect its periodic heating and cooling responsive to heat differentials existing between said fluids and heat exchange between said fluids, and

sealing means cooperable with said matrix and disposed within the housing communicable with a source of pressurized fluid for distributing same over the portions of the matrix positioned adjacent said baffle apron members to seal said hot side and said cold side of the housing against passage of said fluids therebetween.

7. A cyclic radial flow heat exchanger for effecting heat exchange between fluids comprising, in combination,

a hollow housing having means for passing one of said fluids through a first hot side of the interior of said housing and another of said fluids through a second cold side of the interior of said housing, said means including a pair of oppositely disposed ports defined by cylindrical elements extending interiorly of the housing,

an imperforate baffle traversing the housing interior to separate said hot and said cold sides from each other, said baffle having notched apron members extending laterally outward from either side of a curvilinear central portion the ends of which are concave in opposite directions and are secured to said cylindrical elements,

a porous heat-exchanging matrix of bellows shape cooperable with said notched apron members and interposed in the paths of travel of said fluids through said hot and said cold sides and driveable in rotation about its longitudinal axis,

means for supporting said matrix in said rotation within said housing interior to embrace said baffle from end to end such that the interior surface of said matrix closely bounds in complemental fashion the said baffle side margins, said means in supporting said matrix for rotation serving to expose portions of the matrix alternately to passage through said hot and said cold housing sides to thereby effect its periodic heating and cooling responsive to heat differentials existing between said fluids and heat exchange between said fluids, and

sealing means cooperable with said matrix and disposed within the housing including conduit means for conveying pressurized fluid, manifolds in communication with said conduit means for receiving therefrom and distributing said pressurized fluid to seal said hot side and said cold side against passage of said fluids therebetween, said manifolds being notched like the baffle apron members to straddle therewith said matrix in its rotation and to define thereat the boundary between said hot side and said cold side of the housing, and labyrinth seals at either end of said matrix encircling each of said cylindrical elements.

8. A cyclic radial flow heat exchanger for effecting heat exchange between fluids comprising, in combination,

a hollow housing having means for passing one of said fluids through a first hot side of the interior of said housing and another of said fluids through a second cold side of the interior of said housing,

an imperforate baffle having notched side margins and traversing said housing interior to separate said hot and said cold sides one from the other,

a porous heat exchanging matrix of bellows shape cooperable with said notched side margins and interposed in the paths of travel of said fluids through said hot and said cold sides having major and minor diameters and driveable in rotation about its longitudinal axis, and

means supporting said matrix in said rotation within said housing interior including a plurality of spaced apart members positioned within the housing and curved for receipt and cradling of the matrix at its major diameters, said support means serving to expose portions of the matrix alternately to passage through said hot and said cold housing sides to thereby effect its periodic heating and cooling responsive to heat differentials existing between said fluids and heat exchange between said fluids.

9. A cyclic radial flow heat exchanger for effecting heat exchange between fluids comprising, in combination,

a hollow housing having means for passing one of said fluids through a first hot side of the interior of said

housing and another of said fluids through a second cold side of the interior of said housing, said means including a pair of oppositely disposed ports defined by cylindrical elements extending interiorly of the housing,

an imperforate baffle traversing the housing interior to separate said hot and said cold sides from each other, said baffle having notched apron members extending laterally outward from either side of a curvilinear central portion the ends of which are concave in opposite directions and are secured to said cylindrical elements,

a porous heat-exchanging matrix of bellows shape cooperable with said notched apron members and interposed in the paths of travel of said fluids through said hot and said cold sides having major and minor diameters and driveable in rotation about its longitudinal axis,

means for supporting said matrix in said rotation within said housing interior to embrace said baffle from end to end such that the interior surface of said matrix closely bounds in complemental fashion the said baffle side margins, said means including a plurality of spaced apart members carried by said baffle and curved for receipt and cradling of the bellows at its minor diameters, said means in supporting said matrix for rotation serving to expose portions of the matrix alternately to passage through said hot and said cold housing sides to thereby effect its periodic heating and cooling responsive to heat differentials existing between said fluids and heat exchange between said fluids.

10. In a cyclic radial flow heat exchanger for effecting heat exchange between fluids having in combination a hollow housing with a means for passing one of said fluids through a first hot side of the interior of said housing and another of said fluids through a second cold side of the interior of said housing, an imperforate baffle traversing said housing interior to separate said hot and said cold sides from each other, a porous heat-exchanging matrix of bellows shape interposed in the paths of travel of said fluids through said hot and said cold sides and driveable in rotation about its longitudinal axis, and means supporting said matrix in said rotation within said housing interor to expose portions of said matrix alternately to passage through said hot and said cold housing sides,

the improvement comprising means cooperable with said matrix for sealing said hot side and said cold side against passage of said fluids therebetween including conduit means for conveying pressurized fluid and fluid distribution means in communication therewith disposed closely adjacent the periphery of the matrix for receiving from said conduit means and distributing over said periphery said pressurized fluid.

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SAMUEL W. ENGLE, *Primary Examiner.*

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