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United States Patent Application Publication	20250257911
Kind Code	A1
Publication Date	August 14, 2025
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LOOPED CENTRIFUGAL ADSORPTION HEAT PUMP

Abstract

Disclosed is a heat pump that does not have a mechanical compressor, it instead consists of a rotating sealed drum containing working fluid and adsorbent. The working fluid evaporates and transfers energy from a source to the adsorbent where heat is rejected, the centrifuged adsorbent outputs working fluid to continue the cycle.

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Family ID: **92461969**

Appl. No.: **19/034531**

Filed: **January 22, 2025**

Foreign Application Priority Data

AU	AU 2024200773 A1	Feb. 08, 2024

Publication Classification

Int. Cl.: **F25B30/04** (20060101)

U.S. Cl.:

CPC **F25B30/04** (20130101);

Background/Summary

FIELD

[0001] The present invention relates to heat pumps with integrated heat exchange systems. To be more specific this invention pertains to a heat pump that operates by rotation, evaporation, adsorption and centrifugation.

BACKGROUND

[0002] Prior art heat pumps generally can be described as being based on well understood cycles such as Rankine, Sterling, and the Refrigeration cycle, also known as the Air Conditioning cycle. Heat pumps have in common the transfer of thermal energy from a source to a warmer sink, this being the opposite direction to natural thermal energy flow being from hot to cold, and as such generally heat pumps need a power input to do the work required to move thermal energy from a source to a warmer sink. Air conditioning consumes over 10% of global energy consumption and is forecast to increase threefold by 2050. The average efficiency of air conditioners sold today is less than half of what is typically available on the shelves—and one third of best available technology. The existential need is to improve the efficiency of air conditioning, whilst significantly lowering price.

[0003] Any reference herein to known prior art does not, unless the contrary indication appears, constitute an admission that such prior art is commonly known by those skilled in the art to which the invention relates, at the priority date of this application.

SUMMARY

[0004] The present invention provides heat pumping through the evaporation and adsorption of a working fluid, the working fluid is continuously supplied for the said evaporation by the centrifugation of the adsorption media, which itself is continuously adsorbing evaporated working fluid, so creating a continuously looped process.

[0005] The adsorption media can be a solid or a liquid.

[0006] The working fluid is a volatile liquid that is miscible with the liquid adsorbent, or readily adsorbed by a solid adsorbent/desiccant.

[0007] The centrifugation device is a rotating sealed drum, having first been evacuated, then filled with a working fluid and an adsorbent fluid, the two fluids version is later referred to as binary fluids, or a working fluid and a solid adsorbent/desiccant.

[0008] When binary fluids are used the preferred orientation of the drum is for its axis of rotation to be vertical.

[0009] When using a working fluid and a liquid adsorbent the drum can also be loaded with a thermally conductive material which enhances the heat flux from the liquid adsorbent inner radial surface to the drum's skin.

[0010] When using a solid desiccant/adsorbent, such material may be combined with a high thermally conductive additive to enhance heat flux to the drum skin.

[0011] The outer surface of the rotating drum can include integrated fins to enhance the heat exchange flux between the drum's skin and the environment.

[0012] The centrifugation function of the present invention replaces the motor driven compressor found in conventional air conditioners.

[0013] An electric motor powers the rotating drum giving both centrifugation and enhanced heat exchange from the drum to the environment, power is required to keep the drum at its design speed and to overcome air drag and bearing friction.

[0014] The present invention has far fewer components than existing retail refrigeration cycle air conditioners, has no expensive materials, and has high reliability in that the only items subject to wear are the motor and its bearings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] A detailed description of preferred embodiments will follow, by way of example only, with

reference to the accompanying drawings, in which;
[0016] FIG. **1** shows a sealed rotating drum mounted on an electrical motor.
[0017] FIG. **2** shows a cross section of the drum of FIG. **1**.
[0018] FIG. **3** shows a front view of the invention.
[0019] FIG. **4** shows a top view of the invention with the top cover removed to make visible the key components.
[0020] FIG. **5** is a copy of a graph produced by Professor Tsori* showing the phase separation of 2 miscible fluids of different densities subject to centrifugation. *Cited Paper; Y. Tsori, L. Leibler, C. R. Physique 8 (2007). © 2007 Académie des sciences. Published by Elsevier Masson SAS.
DETAILED DESCRIPTION
[0021] Referring to the drawings;
[0022] FIG. **1** shows a motor **1**, a drum **2**, and a drive shaft **3**.
[0023] FIG. **2** shows the drum **2**, the drive shaft **3**, emitted evaporated vapor **4**, the vapor **4** having travelled to lower region where it is seen as vapor **5**, an absorption surface/medium **6**, a tapered barrier **7**, a liquid flow channel **8**, and an inner surface **18** of the drum **2**.
[0024] FIG. **3** shows the motor **1**, the drum **2**, the drive shaft **3**, the heat exchanger fins **9**, the semicircular air duct **10** floor, the containment wall **11** of the lower semicircular duct (not shown), a thermal insulator and lower semicircular duct floor **19**, the case of the device **17**.
[0025] FIG. **4** shows the drum **2**, the heat exchanger fins **9**, the semicircular duct **10**, the containment wall **11** of the lower semicircular duct (not shown), the containment wall of the **12** of the semicircular duct **10**, the upper duct airflow inwards **13**, the upper duct airflow outwards **14**, the lower duct airflow inwards **15**, the lower duct airflow outwards **16**, and the case **17**.
[0026] FIG. **5** shows a series of plots relating to phase separation of miscible fluids of different densities undergoing centrifugation.
[0027] A preferred embodiment of the invention is an air conditioner using centrifuged binary fluids, one being the working fluid, the other being the adsorbent and where the two fluids are miscible. For example in this preferred embodiment the working fluid is Dichloromethane (DCM) and the adsorbent is Isopropyl alcohol (IPA), and various parameters have been chosen to show typical performance, none of the parameters are limited to the ones chosen for the preferred embodiment, in other words the preferred embodiment can be scaled to suit particular requirements such as size, power input and desired thermal outputs.
[0028] Other working fluids and liquid desiccants/adsorbents, or solid desiccants/adsorbents can be chosen to adapt to other thermodynamic needs. Some of the myriad of alternative solutions include Bromomethane, Iodomethane, N-Butanol, Acetone, Butane and Propane, the key issue whatever combination is chosen is to match the thermodynamic needs, such as inside and outside air temperatures, the preferred RPM of the drum **2**, as higher RPM has noise and drag factors to be considered, the desired efficiency, and particularly the toxicity of chemicals should there be a leak.
[0029] The nominated chemicals in this example of the preferred embodiment, being DCM and IPA are not hazardous given the small quantities used, less than 500 ml in total for 1 HP cooling/heating capacity.
[0030] DCM has a density of 1.35 g/cc and a vapor pressure of 47.4 kPa at 20 C, IPA has a density of 0.786/cc and a vapor pressure of 4.4 kPa at 20 C.
[0031] The key basis for this present invention preferred embodiment is to use two miscible liquids where one has a significantly higher density than the other, and though denser has a significantly higher vapor pressure. This results in a simple fact that vapor will flow from the higher density, higher vapor pressure liquid, to the lower density, lower vapor pressure liquid, and in doing so thermal energy is used to cause the evaporation, and thermal energy is released when those vapors are adsorbed into the lower vapor pressure liquid. Such a simple transfer of heat can continuously occur from a source of DCM in an evaporator to a significantly warmer receiver (condenser) containing IPA if, and only if, the source is continually replenished with near pure DCM, and the

IPA at the condenser is also continually processed to remove adsorbed DCM so keeping the IPA near pure. So this present invention is at its core a DCM and IPA purity processor with an evaporator and a condenser, and associated heat exchangers, this can conveniently be described as a “looped heat pump”. This binary fluid centrifugation phase separation, or purity processor, has the important characteristic of being performed without consuming energy form the motor **1**, the motor **1** needs power to get the drum **2** up to speed, and to overcome aerodynamic drag and bearing friction, but the energy powering the purity processor comes from the evaporation of working fluid at **20** which has higher tangential kinetic energy than the same mass of working fluid adsorbed into 6 the inner surface of the adsorbent rich fluid at **6**, the difference in kinetic energy is equal to the energy then required to increase the velocity of the working fluid as it progresses outward through the adsorbent to the drum surface **20**, for example the DCM at a given operation speed may have a velocity of 100 m/s when initially adsorbed, but when it reaches the drum surface **20** it will be for example 120 m/s, so it has in effect increased it kinetic energy by virtue of inducing a torque against the motor **1**, however the working fluid vapor leaving surface **20** in the evaporator has angular kinetic energy that gets reduced when it gets adsorbed as there is drag, and that drag inputs torque to the system, thus negating the torque needed to process the DCM in the purity processor (the centrifugation process at **6**).

[0032] For this example of the preferred embodiment the ratio by volume of DCM to IPA is 1:1. Other ratios can be employed for the purpose of increasing or decreasing the purity of the working fluid injected into the evaporator **18**, the need for purity on the binary fluid preferred embodiment is to ensure that the unwanted adsorbent fluid does not accumulate in the evaporator, however higher purity can also be accomplished by higher RPM causing greater phase separation. The desired ratio of binary fluids is thus dependent on the particular heat pump application, ratios as high as 10:1 or as low as 1:10 could be part of a specified design. the range of RPM is partly determined by the fluids chosen, by the diameter of the drum **2**, and by the thermodynamic performance sought, but the rotational speed be anywhere from 100 RPM to 100,000 RPM.

[0033] The preferred rotational speed range is from 500 RPM to 20,000 RPM, particularly preferred is from 1,000 RPM to 10,000 RPM, and particularly preferred is 2,000 RPM to 6,000 RPM.

[0034] The drum **2** internal diameter for this example is 20 cm, the wall thickness is 1 mm, and the fins **9** have a diameter of 22.2 cm. the drum **2** height is 15 cm. Including the external ducts and frames it would be an air conditioner much smaller than current retailed air conditioners of sub 1 HP. However the application of the invention is suited to various combinations of height, diameter, wall thickness, and wall materials, the diameter can be from as low as 5 cm to as great as many meters, similarly the height can be from a centimeter to meters, the ratio of height to diameter can be from as 1:100 to as high as 100:1, for the consideration of drag, being the 4th power of radius, a height to diameter ratio of 1:5 to 5:1 is preferred, 1:2 to 2:1 is particularly preferred and 2:3 to 3:1 is specifically preferred.

[0035] For drum materials, the preference is for high yield strength and high thermal conductivity, Aluminum alloys are the specifically preferred metals, such as those in the 6000 and 7000 series, for higher thermal performance copper alloys are ideally suited, for higher RPM Copper Beryllium is ideal. Stainless steel alloys are applicable in cases where the internal fluids are corrosive.

[0036] 6 is a zone of the drum **2** where at design RPM the binary fluids will form as a near vertical ring having an outer radius being the drum **2**, and an inner radius dependent on the volume of the binary fluids loaded into the drum **2**. A thermally conductive matrix can be added at **6**, this can be a solid or granular, the purpose of which is to increase the thermal flux from the inner radius to the drum **2** skin. If the thermally conductive material is granular then it can be mixed with the DCM and IPA and sit at the bottom of the drum **2** prior to spin up, upon which by centrifugal action it will distribute evenly to form **6** as drawn which will include the DCM, IPA and the thermally conductive granules, in the alternative a solid but porous thermally conductive ring could be

installed that will be saturated by the binary fluids upon reaching the desired operational RPM.
[0037] When the drum **2** is spun up to speed the binary fluids at **6** undergo phase separation, the DCM will concentrate at the outer radius being the drum **2** interior surface, the IPA will concentrate at the inner radial surface of the binary fluids.
[0038] FIG. **5** shows an example of phase separation provided in the peer reviewed paper; Y. Tsori, L. Leibler, C. R. Physique 8 (2007). © 2007 Académie des sciences. Published by Elsevier Masson SAS.
[0039] In this example the operational RPM of the drum **2** is 3,000 RPM which is determined by the electric motor **1**, at 3,000 RPM the inner surface of 6 is almost perpendicular (>89.9 Deg), and so the inner surface of the drum **2** has not been machined away from perpendicular, however at lower RPM the inner surface of drum **2** could be modified minutely as needed to ensure proper operation of the Working fluid in contact with the drum **2** at the upper section of 2 (further explained later).
[0040] In this example the ratio of DCM:IPA at the drum **2** inner surface exceeds 20:1 where the radial depth of 6 is 2 cm, and the ratio of IPA to DCM exceeds 20:1 at the inner radius surface of the binary fluids.
[0041] At the operational speed the binary fluid being 95% DCM is fed to the upper part of drum **2** and the surface **18** through the feed hole **8**, being one of many distributed around the drum in the tapered barrier **7**. At operational RPM the diameter of the holes **8**, taking into account the length of the hole **8**, the centrifugal pressure created by rotation of binary fluids and the viscosity of the fluid mix result in a feed rate, at a set RPM that feed rate is determined therefore primarily by the hole **8** diameter and the number of holes **8**.
[0042] The tapered barrier **7** is sloped such that when the drum **2** is stationary, and so the binary fluid mix rests at the bottom of the drum **2**, any vapor condensing on the surface **18** will readily flow back to the bottom of the drum **2**.
[0043] For a desired cooling output of say 500 W (⅔ HP) the working fluid supplied to the upper section of the drum **2**, where there is the inner surface **18** called the Evaporator, needs to be approximately 1.2 cc per second, so for example if there are ten holes **8**, each will need to feed 0.12 cc per second.
[0044] The surface **18** may be micro patterned to enhance heat transfer and or surface wetting.
[0045] Given the ratio of at least 20:1 DCM to IPA, the fluid fed through hole **8** into the Evaporator will evaporate as a result of thermal energy supplied to the drum by external air and thermal flux through the fins **9** and the drum **2**, the DCM component will completely evaporate, and the IPA at a low concentration will also fully evaporate. This is of course subject to the external environmental temperature, but for sensible room and outside temperatures it is easily designed to do such. The evaporation of the fluids from the surface **20** draws heat from the drum **2** skin, this is the heat of vaporization, which is endothermic. Vapor **4** at a much higher pressure than the vapor pressure at **6** flows towards **6**, at **6** the vapor **5** is adsorbed, which releases the heat of condensation, which is exothermic. Having thus been adsorbed the centrifugation rapidly causes the DCM to progress back to the drum **2** inner surface **18**, thus completing the cycle.
[0046] In this example of the preferred embodiment, the fins **9** in the upper section as shown in FIG. **3** have an associated air volume (the air between the fins **9**) of approximately 950 cc, with an RPM of 3,000 this means that volume is replaced 50× per second, accordingly the air volume drawn in and output to the room is at least 50 liters per second, more in fact as there is entrainment. 50 liters per second is an acceptable volume output for an air conditioner.
[0047] As shown in FIG. **4** room air enters the semicircular duct drawn in by the fins **9** at **13**, the air introduced to the fins **9** at **13** has a large velocity mismatch, accordingly airflow at the fins **9** surface is turbulent, thus providing high thermal exchange, as the air between the fins **9** progresses towards the **11** output at **14** the mismatch decreases and the air between the fins is subject to centrifugal force and so spills out of the fins **9** to create the airflow **14** to the room being air

conditioned. The spacing and number of fins **9** can be designed by inputting the parameters of required airflow, and required thermal transfer to and from the drum **2** to the environment, if too many fins are used then drag may become excessive, if too few fins **9** are used then thermal flux from the drum **2** to the environment, or from the environment to the drum **2**, may limit the thermodynamic performance.

[0048] The thickness and radial width of the fins **9** depends on the thermal conductivity of the fins **9**, aluminum fins **9** have a specifically desired ratio not exceeding 1:20, for copper the ratio would increase to 1:30. The optimum spacing of the fins **9** is also subject to calculated design, the thermal transfer from fin **9** to the environment occurs in the surface boundary, and so spacing between fins **9** of more than 100 μm is sufficient such that each fin **9** does not interfere with its neighbors thermal transfer efficiency.

[0049] To enhance thermal flux from fins **9** to air, or from air to fins **9**, the surface can be textured, or coated, or both.

[0050] 500 W of desired cooling as per the example, though the same would apply if the air conditioners was used as a heater but with the room connected to the lower duct (not seen) drawn from 50 liters of air per second results in a 10 C temperature depression, with semicircular duct **10** and fin **9** entrainment to say 100 liters per second output at **14** then the air output would be −5 C lower temperature than the air input at **13**.

[0051] For the given example the Drum **2** inner surface **18** is fed DCM rich fluid which due to the centrifugal forces rapidly distributes over the surface, so the evaporation of fluid resulting in 500 W of latent heat of vaporization requires that a continuous supply of thermal energy enters the fins **9** and conduct through the drum **2** to the evaporation surface **20**. Given that the radius of 18 is 10 cm, and the height of the evaporator is say 7 cm, then the surface area of 18 is 439 cm2, therefore as per the example the heat flux per cm2 will be just 1.13 W per cm2. This is a reasonable heat flux given the fins **9** and the drum **2** are made from Aluminum. The inner surface **20** of the drum **6** can be textured to enhance working fluid flow/spreading, and to enhance heat transfer.

[0052] At the condenser, being the inner surface of 6, a similar heat flux must exist, given the low thermal conductivity of the binary fluids, and the desire to not have a high Delta Temperature at the inner surface of the fluids and the drum **2**, the introduction of the thermally conductive matrix is desirable for high performance operation. Given the 1.2 W per cm2 desired flux, and given the radial depth at 6 of 2 cm for this example, if a maximum Delta Temperature of 2 C is desired then the thermal conductivity of the region **6** will need to be about 1.2 W/cm/C, this can be easily achieved by a number of inert high thermal conductivity materials.

[0053] Paragraphs (0016) to (0042) thus provide instructions for the invention in this preferred embodiment to be applied as an air conditioner having useful output for cooling or heating of a room, and for sensible rates of heat transfer and airflow output.

[0054] In a further preferred embodiment of the invention the heat pump employs a solid desiccant at **6** such as activated charcoal, and a working fluid that can include DCM, water or other suitable fluids. Centrifugal drying of desiccants is a known process, but the present invention make this an evacuated, sealed and then dosed process that is looped making the power consumption low enough to provide useful heat pumping/air conditioning at high efficiency.

[0055] Because the working fluid is pure and the desiccant is inert, then the required operation speed (RPM) is determined by the atomic forces between the working fluid and the desiccant. Water has a high polarity and so with activated charcoal, and with the same drum **2** dimensions as given in the binary fluids example, the required RPM to make the activated charcoal produce water at inner surface of the drum **2**, is much higher than that of the binary fluid embodiment, and in fact for satisfactory operation (producing enough water) the rotation speed is at least 10,000 RPM. If DCM is used with activated charcoal the speed can be reduced to 3,000 RPM.

[0056] Water with activated charcoal is a very appealing combination as there are no risks to humans even if leaked from the drum **2**, however for typical air conditioning operation the vapor density of water at say 25 C is low, and so to move a mass of grams per second the vapor velocity is very high, unless the device diameter is of the order of 40 cm. Water with activated charcoal at a drum **2** diameter of 20 cm is therefore more suited for lower output air conditioners, perhaps ½ HP or less. DCM and activated charcoal at 20 cm drum **2** diameter can be used for 1 HP.

[0057] Where higher outputs are desired the design choices are to increase the diameter, height, or both of drum **2**, or to stack multiple drums on top of each other but driven by just one motor **1**. Such a variation of multiple stacked drums **2** applies equally to both of the preferred embodiments given here.

[0058] With both preferred embodiments having the same dimensions, and with low component costs, and high reliability, a significantly lower retail price is possible, thus making these versions of high efficiency air conditioners the preferred purchase, even for the poor. Thus the present invention has the potential to reduce global power consumption in a World needing more and more air conditioners as we head towards 2050 and a hotter future.

[0059] The preferred embodiments so described are not exhaustive of the possibilities and variation that can employ the core invention of the looped heat pump, the outer drum could be in contact with a liquid such as water, or in the presence of super critical CO_2 or other substances that could exchange heat with the drum.

[0060] The orientation of the rotating drum, and the relative diameters and heights of the evaporator and condenser are all parameters that can be modified to suit applications, in the case of the liquid with solid desiccant version of the heat pump the orientation is not limited to vertical, and in the case of the binary fluid version of the heat pump the outer radius of the condenser can be far greater than that of the evaporator provided that there is a flow path back to the evaporator radius of purified working fluid from the condensers outer radius, such an arrangement can dramatically reduce the needed operation RPM as phase separation is effected by the inner and outer radius difference.

[0061] Given the fact that vapor travels rapidly from one chamber to the other, there exists a source of kinetic energy that could be harnessed inside the drum that could of itself generate, by a micro turbine and dynamo, a small amount of energy, that energy could be applied to the motor **1** so as to reduce the power consumption required from external sources such as the grid, alternatively such a turbine arrangement could be coupled magnetically to an external stator to provide some torque to the drum in the direction of rotation, and in so doing reduce the power consumption required for the motor **1** to maintain operational RPM.

[0062] Such a feasible additional embodiment variations may have some utility for reducing power input, however inherently they increase the device complexity and would increase the cost, so at this stage they have not been proposed as the preferred embodiment or included in the preferred embodiments described in this specification.

[0063] As an alternative to conduction or convection transferring energy into and out of the drum to the environment, the drum could be coupled by thermal radiation, this could be implemented by the drum spinning in a vacuum and the drum having high emissivity, and by the vacuum containment vessel having high thermal emissivity. Such a radiative version could have its total radiative transfer increased by having fins on the drum with high emissivity, interleaved by fins attached to the containment vessel, also of high emissivity, such an arrangement could be envisaged as a Space based heat pump, either actually in Space (beyond a planet's atmosphere) or on a planet or moon having little to no atmosphere, such as the Earth's own Moon.

[0064] The preferred embodiments have been ones that can provide air conditioning for the human environment, however by choosing the right combinations of chemicals and desiccant, liquid or solid, higher or lower temperature applications could be serviced, for instance recovering waste heat from spent steam at a thermal power station, or for low temperature applications such as cryogenics, or gas production. The upper limit of the looped heat pump could be some hundreds of degrees C., to perhaps as low as is scientifically or industrially desired.

[0065] The acceleration of binary fluids in the centrifugation process is governed by physics, as stated in the preferred embodiment 3,000 RPM is sufficient to produce 95:5 ratio of the working fluid DCM entering the evaporator through hole **8**. The required RPM for purity is also governed by the density difference between the binary fluids, and by the temperatures of the fluids.
[0066] There are a series of equations given by Y. Tsori, L. Leibler, these equations are very complicated but have been confirmed in experimentation by the authors and peer reviewed.
[0067] So far the device has been centered on chemicals, it is envisaged that electrons or ions could be an alternative working fluid, and that the evaporator of the looped heat pump could in fact be an electron emitter equivalent to a Cathode, and that the desiccant/adsorber zone could become an Anode, and that the centrifugation zone currently producing purified or pure working fluid could be modified to produce an electron output as proposed by Professor Richard Tolman (1881 to 1948) in his experiments of accelerated conductors and the production of an EMF. It was precisely his deep understanding of the kinetic mechanism of the phenomenon that suggested to Tolman that not only the centrifugal acceleration of rotating conductors can produce an electromotive force (this fact was not new) but also the angular acceleration. In this way was discovered a new and more powerful method for measuring the inertia of the carrier particles of the electric current. Such background physics thus leaves open for further experimentation and adaptation the likely use of electrons as alternative to the chemicals and desiccants detailed in the preferred embodiments.
[0068] Wherever it is used, the word “comprising” is to be understood in its “open” sense, that is, in the sense of “including”, and thus not limited to its “closed” sense, that is the sense of “consisting only of”. A corresponding meaning is to be attributed to the corresponding words “comprise”, “comprised” and “comprises” where they appear. A corresponding meaning is to be attributed to the corresponding words “adsorbed”, “adsorbed” and “condensed”.
[0069] A corresponding meaning is to be attributed to the corresponding words adsorbent and desiccant. It will be understood that the invention disclosed and defined herein extends to all alternative combinations of two or more of the individual features mentioned or evident from the text. All of these different combinations constitute various alternative aspects of the invention.
[0070] While particular embodiments of this invention have been described, it will be evident to those skilled in the art that the present invention may be embodied in other specific forms without departing from the essential characteristics thereof. The present embodiments and examples are therefore to be considered in all respects as illustrative and not restrictive, and all modifications which would be obvious to those skilled in the art are therefore intended to be embraced therein.

Claims

1. A heat pump comprised of; a motor, a sealed drum, a divider with fluid channels, the sealed rotating drum divided into a rotating evaporator and a rotating condenser, a working fluid within the sealed rotating drum, the bulk of which is present at the outer radius of the condenser in a pure form, an adsorbent within the sealed rotating drum located at the inner radius of the rotating condenser in a pure form, the working fluid in the rotating evaporator is vaporized into a working fluid vapor and the working fluid vapor flows from the rotating evaporator to the rotating condenser whereby the rotation of the sealed rotating drum creates a centrifugation force to desorb/phase separate the working fluid from the adsorbent, whereby the purified working fluid from the rotating condenser is forced outward towards the drum and is supplied back to the rotating evaporator through at least one feed path at the divider with fluid channels creating a continuous looped process.
2. The heat pump as claimed in claim 1 whereby the sealed rotating drum, when stationary, is evacuated of all gases, whereby the stationary rotating drum is then loaded with measured amounts of two fluids that are miscible with each other, whereby the working fluid is at least 5% more dense than the other fluid, and is at least 5% more volatile, the stationary drum is then sealed.

3. The heat pump as claimed in claim 2 whereby the total volume of the liquids when the drum is rotating shall be contained at the condenser without overflowing the barrier and spilling into the evaporator.
4. The heat pump as claimed in claim 2 where the evaporator is above the condenser so allowing fluid to drain by gravity from the evaporator to the condenser by spilling over the tapered divider, when the drum is stationary.
5. The heat pump as claimed in claim 1 whereby the binary fluid mix in the condenser is subject to centrifugation and phase separates the denser working fluid from the less dense adsorber, and that once the drum is at its operational speed no torque is required from the motor to phase separate the binary liquids.
6. The heat pump as claimed in claim 5 whereby the phase separation energy input, in the form of motor torque, is totally offset by the rotational kinetic energy of the working fluid vapor as it travels from the evaporator to the condenser, such rotational kinetic energy is transferred back to the drum by drag between the working fluid vapor and the internal parts of the drum, and finally by molecular capture at the condenser, thus for the phase separation process no motor torque is required, therefore phase separation is a zero power input alternative to traditional power consuming compressors.
7. The heat pump claimed in claim 6 whereby motor power, energy input, is still required to overcome external aerodynamic drag and bearing friction.
8. The heat pump as claimed in claim 1 is further comprised of at least one attached or integrated fins at the outer drum surface with the dual purpose of increasing thermal flux between the heat pump and external air, and increasing the amount of air dragged by the device so creating an airflow to the air conditioned space.
9. The heat pump as claimed in claim 8 whereby the spacing and number of attached fins is engineered to optimize heat flux, heat transfer, and airflow volume, whilst avoiding excessive aerodynamic drag.
10. A heat pump as claimed in claim 8 whereby the addition of a semicircular duct surrounding the rotating drum with attached fins creates an air induction zone where the difference of velocities between the air and the rotating fins creates turbulence at the fin surface which increases thermal transfer at the fin boundary layer, whilst at the same time the turbulence increases drag so pulling air into the inter fin volume, the air then is dragged towards the air output duct where it is accelerated by the drag, and so at the output end of the semicircular duct the air is centrifugally flung from the inter fin volume into the air conditioned void, or in the case of the heat rejection duct to the external environment, the loss of the air by centrifugal force leaves a partial vacuum that inducts stationary air at the inlet end(s) of the circular duct(s), the plural is used as there are two semicircular ducts, one involved with the evaporator heat input, and one with the condenser heat rejection.
11. The heat pump as claimed in claim 8 whereby the outgoing temperature exists downstream of the induction zone, whereby an incoming temperature exists upstream of the sealed rotating drum, and whereby a temperature differential exists of at least 10 degrees Celsius between the incoming temperature and the outgoing temperature.
12. The heat pump as claimed in claim 1 whereby the liquid adsorbent is replaced with a solid desiccant/adsorber, the solid residing in the condenser sitting against the inner drum surface thus forming a ring, the solid can take the form of a cast solid or of a powder that upon centrifugation naturally forms an even and balanced ring contained in the condenser. The centrifugation of the solid adsorbent/desiccant under sufficient g force will cause water, or other working fluid, within the adsorbent/desiccant to fully condense such that the radial depth of the adsorbent/desiccant will come into effect essentially increasing the internal pressure of the adsorbent/desiccant as a function of increasing radius, and as such the required RPM to achieve working fluid production decreases with adsorbent/desiccant radial thickness, and furthermore the needed RPM needed to produce

working fluid at the outer radius of the adsorbent/desiccant lessens if a working fluid of lower polarity is chosen, for example DCM has about ⅓ the polarity of water, and in combination with its increased density the required RPM will be approximately half that of when water is the working fluid.

13. The heat pump as claimed in claim 1 whereby a thermally conductive matrix is added and resides in the condenser to enhance the heat transfer flux to the drum skin from the condenser inner radial surface, the matrix can be added to the solid desiccant or in the case of binary fluids is porous to the binary fluids.

14. A heat pump as claimed in claim 1 whereby the efficiency of motor power input to air conditioning output is potentially higher than air conditioners that employ a compressor and an expansion valve.

15. A heat pump as claimed in claim 1 whereby the component count is very low and significantly lower than conventional air conditioners.

16. A heat pump as claimed in claim 1 whereby the external fluids can be liquid, or supercritical fluids, or gases, and not just limited to air.

17. A heat pump as claimed in claim 1 whereby the transfer of energy from the environment to the drum and from the drum to the environment could be done by radiations, and that in such a manner there would be no aerodynamic drag on the drum.

18. A heat pump as claimed in claim 1 whereby some of the kinetic energy contained in the evaporated working fluid could be used to do work through a turbine or fan, and that work could be converted to electrical power by a dynamo, or could be output as torque via a magnetic coupling to an external stator, wherein the drum would experience a torque in the direction of operational rotation thus reducing the motor power input, thus improving the heat pump efficiency.

19. A heat pump as claimed in claim 18 where the power generated by a dynamo, or the torque produced and transferred to an external stator, is sufficient to fully overcome the aerodynamic drag on the drum and the friction in the motor or other supporting bearings.