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(54) **DEVICE AND METHOD FOR THERMAL TRANSFER USING AIR AS THE WORKING MEDIUM**
ANLAGE UND VERFAHREN FÜR WÄRMEÜBERTRAGUNG MIT LUFT ALS ARBEITSMEDIUM
DISPOSITIF ET PROCEDE DE TRANSFERT THERMIQUE UTILISANT L'AIR COMME FLUIDE MOTEUR

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Description

TECHNICAL FIELD

[0001] The present invention relates in general to devices for thermal transfer. More particularly, the present invention pertains to devices for heating and cooling employing air as the working medium.

BACKGROUND ART

[0002] The availability of heating and cooling is fundamental to survival and comfort. Thermal transfer devices, including heat pumps and air conditioners, introduce power from an external source to supply or remove heat as desired, and nearly invariably employ a transfer medium to effect this exchange. The transfer medium (also called the working medium or fluid, and often referred to as a refrigerant) that has been found historically to be most cost effective during the ordinary vapor compression refrigeration cycle is that of a group of halogenated hydrocarbons containing one or more fluorine atoms, available under the trademark FREON. In recent years at least such compositions that are chlorinated have been linked to the destruction of the Earth's protective ozone layer, and have been identified as one of humankind's most serious and urgent environmental problems. Consequently, countries throughout the world have mandated that the use of such compositions be significantly reduced and, by the beginning of the next century, eliminated.

[0003] Existing heat transfer devices are subject to a variety of other shortcomings. Commonly such devices employ reciprocating or displacement type engines which have relatively low efficiencies and a large number of parts. For example, vapor compression refrigeration cycle based systems require one or more refrigeration coils, compressors, condensers and expansion valves or other throttling equipment. The number, configuration and complexity of parts and their relative motions result in devices that are expensive to manufacture, are subject to significant wear and require appreciable maintenance. Their size and weight make them undesirable for applications where compactness, low weight and higher efficiency are more critical, such as on aircraft and other vehicles.

[0004] DE-B-1033839 discloses a device for conveying a gaseous working medium. It shows a flow machine for conveying a gaseous working medium in such a manner that the outlet direction of the working medium to be conveyed is opposite to the inlet direction thereof. A blower wheel or an impeller is enclosed in a fixed tubular housing and has an axial inflow and an opposite axial outflow of working medium. The impeller comprises a plurality of blades extending from a central hub radially outwardly. A fixed ring body positioned in front of the blades carries at the inner perimeter thereof a plurality of inlet blades and at the outer perimeter thereof a plurality of outlet blades connecting the ring body with the housing so that the ring body is held in this position in front of the blades whereby during operation of the device a relative motion between the impeller and the ring body is caused.

[0005] This device, however, is not directed to the object of generating a thermal heat transfer is a working medium.

SUMMARY OF THE INVENTION

[0006] It is, therefore, an object of the present invention to provide a device for heat transfer that uses a working medium other than FREON.

[0007] It is another object of the present invention to provide a heat transfer device, as set forth above, that uses air as its working medium.

[0008] It is still another object of the present invention to provide a heat transfer device, as set forth above, that uses other than reciprocating or displacement type engines.

[0009] It is yet another object of the present invention to provide a device, as set forth above, that has higher efficiencies and fewer parts than vapor compression refrigeration cycle based systems, and does not require refrigeration coils, compressors, condensers and expansion valves or other throttling equipment.

[0010] It is a further object of the present invention to provide a device, as set forth above, that is less expensive to manufacture, subject to less significant wear and require less maintenance than vapor compression refrigeration cycle based systems.

[0011] It is still a further object of the present invention to provide a device, as set forth above, whose compactness and low weight make it desirable for applications, such as on aircraft and other vehicles.

[0012] These and other objects and advantages of the present invention over existing prior art forms will become more apparent and fully understood from the following description in conjunction with the accompanying drawings.

[0013] In general, in accordance with the present invention, a device for generating a thermal difference in a working medium includes a fixed housing, an impeller assembly, a substantially annulus-shaped disk having a plurality of outlet vanes along the perimeter thereof, and a substantially circular disk having a plurality of inlet vanes along the perimeter thereof. The impeller assembly includes a plurality of blades extending from a central hub to a casing, defining a like plurality of compartments within the impeller assembly, and is carried coaxially substantially within the housing. The outlet vanes are shaped to allow the annulus-shaped disk to be rotated with and carried coaxially substantially within the impeller assembly, and, the diameter of the inlet vanes allow the substantially circular disk to be rotated with and carried coaxially substantially within the interior of the annulus-shaped disk.

[0014] In general, in accordance with the present invention, a method for generating a thermal difference in a working medium in an enclosure having an inlet and an outlet, includes the steps of applying a force to compress the working medium with decreasing entropy, allowing the working medium to expand with a change in entropy between zero and no greater than the magnitude of the decrease in entropy during the step of compression, whereby a thermal difference will arise in the working medium between the inlet and the outlet, and, transferring the thermal difference.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a partially exploded, perspective view of an exemplary device in accordance with the present invention, in which the device is substantially cylindrical and depicting in exploded form the inlet vane disk and shroud.

Fig. 2 is an exploded, perspective view of the device shown in Fig. 1.

Fig. 3 is a section of the device shown in Fig. 1 taken through any diameter thereof along the longitudinal axis of its shaft.

Fig. 4 is a left side magnified view of a portion of a first configuration of outlet vanes illustrated in the inset shown in Fig. 3 in which the vane thickness is substantially constant but the vane root diameters vary from smallest at their inlet to largest at their outlet.

Fig. 5 is a magnified view of a first configuration of outlet vanes illustrated in the inset shown in Fig. 3 in which the vane thickness is substantially constant but the vane root diameters vary from smallest at their inlet to largest at their outlet.

Fig. 6 is a right side magnified view of a portion of a first configuration of outlet vanes illustrated in the inset shown in Fig. 3 in which the vane thickness is substantially constant but the vane root diameters vary from smallest at their inlet to largest at their outlet.

Fig. 7 is a top, magnified view of a portion of a first configuration of outlet vanes illustrated in the inset shown in Fig. 3 in which the vane thickness is substantially constant but the vane root diameters vary from smallest at their inlet to largest at their outlet.

Fig. 8 is left side magnified view of a portion of a second configuration of outlet vanes illustrated in the inset shown in Fig. 3 in which the vane root diameters remain substantially constant but the vane thicknesses vary from smallest at their inlet to largest at their outlet.

Fig. 9 is a magnified view of a second configuration of outlet vanes illustrated in the inset shown in Fig. 3 in which the vane root diameters remain substantially constant but the vane thicknesses vary from smallest at their inlet to largest at their outlet.

Fig. 10 is a right side magnified view of a portion of a second configuration of outlet vanes illustrated in the inset shown in Fig. 3 in which the vane root diameters remain substantially constant but the vane thicknesses vary from smallest at their inlet to largest at their outlet.

Fig. 11 is a top, magnified view of a portion of a second configuration of outlet vanes illustrated in the inset shown in Fig. 3 in which the vane root diameters remain substantially constant but the vane thicknesses vary from smallest at their inlet to largest at their outlet.

Fig. 12 is a graph of the volume versus pressure of the working medium as it undergoes compression (depicted as line A) and expansion (depicted as line B) in accordance with the present invention.

Fig. 13 is a graph of the temperature versus entropy of a complete heat transfer cycle in accordance with the present invention.

PREFERRED EMBODIMENT FOR CARRYING OUT THE INVENTION

[0016] Fig. 1 presents in partial exploded perspective an exemplary device in accordance with the present invention, generally indicated by the numeral 10, for heat transfer using air as the working medium. In order to more fully appreciate the construction and operation of device 10, it is helpful to first set forth certain underlying principles upon which the construction and operation is believed to be founded.

[0017] All matter and energy have some form of disordered energy inherent in them, and this disordered energy is the energy of the units of the working medium (that is, the matter or energy) which have their energies divided among various energy levels. The method of the present invention adds or subtracts potential energy to a particular group of units of the working medium or their energy levels. This may be accomplished by introducing the working medium into a potential energy field whose effective dimensions are less than the dimensions encompassed by the working medium.

[0018] The potential energy fields in which the working medium may be introduced include any acceleration force field such as a gravitational field, a centrifugal field, a centripetal field, a linear acceleration field, an electromagnetic field, an electric field, a magnetic field and a nuclear field. If the working medium has a component of displacement aligned with the direction of the potential energy field, the kinetic energy of the working medium is altered. If a component of the displacement is in the direction of increasing kinetic energy, then potential energy is decreased; if a component of displacement is in the direction of decreasing kinetic energy, then potential energy is increased; and, if the component of displacement in both directions are equal, then the average total energy of the working medium remains constant. Inasmuch as the working medium is made up of units whose energies are distributed in various energy levels, the same effect on kinetic energy occurs for both the units and their energy levels. Thus, the addition and subtraction of potential energy may be achieved by controlling a component of the displacement of the working medium or its energy levels.

[0019] By Einstein's principle of Equivalence, acceleration is equivalent to gravitation. A gravitational field acts in one dimension toward the source of the field. Therefor, if the working medium is introduced into a gravitational field with at least one, but not all of its dimensions aligned with the direction of the force field, the energy of the units having a component of displacement aligned with the direction of the force field will differ from the energy of the units whose component of displacement is in other dimensions.

[0020] By conventional processes, the addition of energy to the working medium also divides the energy randomly among all the units and their energy levels. But in the method of the present invention energy is added only to a select number of units and energy levels. This decreases the randomness in the distribution of energy among the units of the working medium and results in an ordering of the distribution of energy. Entropy is a variable universally used in defining the thermodynamic state of matter by relating its energy to absolute temperature and to its state of order (more particularly, the probability of a given distribution of momentum among its units). Thus, an ordering of the distribution of energy is also commonly referred to as a decrease in entropy. I have appreciated that the selective variation in the entropy of a system of matter or energy (in other words, the selective introduction of order in a portion of a disordered system) may be used to transfer heat efficiently and without the use of FREON working mediums.

[0021] There are a variety of mechanisms to effect such selective introduction of order in a disordered system. For example, the working medium may be: introduced into a gravitational field with at least one dimension aligned with the direction of the gravitational force; rotated with at least one dimension aligned with the radius of rotation; accelerated (at a positive, negative or constant rate) with at least one dimension aligned with the direction of acceleration; or, introduced into an electromagnetic, electric, magnetic, or nuclear force field with at least one dimension aligned with the direction of the force field.

[0022] Device 10 uses air as its working medium and applies a centrifugal force along the radius of rotation. This increases the kinetic energy of, and compresses the working medium, raising its temperature, pressure and density, and thereby reducing the entropy of the enclosed air and creating a significant thermal difference in the air between its inlet and outlet.

[0023] Device 10 may be seen in the exploded, perspective view of Fig. 2, the partially exploded, perspective view of Fig. 1, and the sectional view of Fig. 3, to include a housing 20, drag rotor 30, impeller 40, outlet vanes annulus 50, inlet vanes disk 60 and shroud 70, all coaxially carried about a drive shaft 80 from motor 81 having a threaded end 82 for receiving washer 83 and retaining nut 84. The rotational force output from motor 81 may be coupled to drive shaft 80 by any suitable means including collet 88 (as shown in Fig. 3).

[0024] Housing 20 may be made of aluminum or other lightweight, strong, heat conductive material, and is substantially cylindrical having a open front end and a closed rear plate 21 with a circular aperture 22 in the center thereof to receive the flanged end 86 of cylindrical bridge 87 to motor 81.

[0025] One or more substantially cylindrical drag rotors 30 of progressively smaller diameters, each of which drag rotors 30 has its own bearing 31 to carry its respective drag rotor 30 upon drive shaft 80, may be mounted coaxially within housing 20. Drag rotors 30 rotate in the same direction with and at a reduced rotational velocity from that of impeller 40, thereby reducing drag power.

[0026] Impeller 40 is made of Delrin® or other lightweight, strong, heat insulative material, and is substantially cylindrical having a casing 41, a closed rear plate 42 and a central hub 43 through which drive shaft 80 passes. A plurality of radial blades 44 extend from central hub 43 to the inside of impeller 40, defining a plurality (in this exemplary embodiment, twelve) of radial compartments 45 through which the working medium (air) passes. Radial blades 44 extending out from central hub 43 at a height (dimension from front to back of impeller) of substantially the height of cylindrical impeller 40 itself. At a radial distance that substantially equals the inner diameter of the annulus of outlet vanes annulus 50, the height of blades 44 is reduced to receive outlet vanes annulus 50 as noted hereinbelow. Impeller 40 rotates with drive shaft 80 by forming in the back of rear plate 42 an engagement recess 47 (as shown in Fig. 3) to matingly receive a corresponding collar 85 (as shown in Figs. 2 and 3) that may be integrally formed with drive shaft 80.

[0027] Outlet vanes annulus 50 is made of Delrin® or other lightweight, strong, heat insulative material, and includes a plurality of individual outlet vanes 51 along its perimeter (one for each radial compartment 45), a cylindrical sleeve 52, and an annulus portion 53 integrally formed with outlet vanes 51 and sleeve 52. As best illustrated in Fig. 1, the outer and inner radii of outlet vanes annulus 50, and its height (that is, its dimension from front to back) are sized such that outlet vanes annulus 50 is received snugly-within impeller 40 and acts to substantially close radial compartments 45 to fluid flow except for an axial fluid inlet 55 to each radial compartment 45 near drive shaft 80, and a fluid outlet 56 to each radial compartment 45 at the perimeter of outlet vanes annulus 50.

[0028] Inlet vanes disk 60 is made of Delrin® or other lightweight, strong, heat insulative material, and includes a plurality of individual inlet vanes 61 along its perimeter (one for each radial compartment 45) emanating from a hub 62 integrally formed therewith. The radius of inlet vanes disk 60 to its outer perimeter, and its height (that is, its dimension from front to back) are sized such that inlet vanes disk 60 is received snugly within cylindrical sleeve 52 and acts to receive the working medium (air), and direct the same into radial compartment 45 near drive shaft 80.

[0029] Shroud 70 is made of Delrin or other lightweight, strong, heat insulative material, and includes a closure ring 71 and a shroud annulus 72 that may be made integrally therewith. Closure ring 71 has an outer diameter that engages the outside of the open end of housing 20 by interference fit, and a reduced inner diameter. A plurality of radial spacing ribs 73 extend from the inner diameter of closure ring 71 to the outer edge of shroud annulus 72, thereby integrally carrying the latter and defining a restricted nozzle 74 for the output from outlet vanes 51. The inner diameter of shroud annulus 72 should substantially equal that of the inner diameter of cylindrical sleeve 52, defining a cylindrical channel 76 for the input to inlet vanes 61. Thus, shroud 70 insures the outlet vanes annulus 50 remains securely within impeller 40 and provides a nozzle from outlet vanes 51 and an input channel into inlet vanes 61. Shroud annulus 72 may be formed as a solid or, as shown in Figs. 1-3, to reduce weight with substantially equal structural integrity, may be formed with ribs 73 extended radially inwardly from the outer diameter of shroud annulus 72 to its inner diameter, and at least a portion of shroud annulus 72 extending radially between its inner and outer diameters and circumferentially between ribs 73 removed.

[0030] Air flow through device 10 is most effectively seen in Fig. 3 where it is pictorially represented by multiple lines with arrowheads. Air in the vicinity of cylindrical channel 76 is smoothly drawn therethrough by inlet vanes 61 and directed into the radially innermost portion of radial compartments 45. Once inside compartments 45, the rotation of radial blades 44 impart centrifugal energy from drive shaft 80 to the air, effecting a compression of the air within radial compartments 45, and producing a pressure, temperature and density increase within radial compartment 45. In this manner the centrifugal force is applied to and compresses the working medium, air, increasing its state of order (i.e., decreasing its entropy).

[0031] The compressed air is allowed to expand as it exits the radially outwardmost portion of radial compartments 45 through outlet vanes 51 and nozzle 74. The expansion must proceed with a change in entropy between zero and no greater than the magnitude of the decrease in entropy accomplished during compression. This may be realized by configuring outlet vanes 51 to insure that as the compressed air is allowed to expand, its potential energy is simultaneously converted to kinetic energy and a component of the thrust produced by the ejection of the working medium (air) is converted to torque at drive shaft 80, and more preferably the velocity of outlet vanes 51 is substantially equal to the tangential component of the working medium ejection velocity.

[0032] Two acceptable configurations of outlet vanes 51 that achieve expansion in the necessary manner may be best viewed in the enlargements of Figs. 4-7, on one hand, and 8-11 on the other. In Figs. 4-7 (and particularly Fig. 7) a first configuration of outlet vanes 51 illustrated in the inset shown in Fig. 3 may be seen to posses vane thicknesses that are substantially constant but have vane root diameters that vary from smallest at their inlet 55 to largest at their outlet 56. In Figs. 8-11 (and particularly Fig. 11), a second configuration of outlet vanes 51 illustrated in the inset shown in Fig. 3 may be seen to posses vane root diameters that remain substantially constant but have vane thicknesses that vary from smallest at their inlet 55 to largest at their outlet 56. The passageway between the inlet 55 and the outlet 56 forms a venturi. The ratio of the area of inlet 55 to the area of the outlet 56 determines the extent of conversion of potential energy of the working medium to kinetic energy, and is preferably chosen to convert all the potential energy increase resulting from compression of the working medium (air) at inlet 55 to kinetic energy in the form of the ejection velocity of the working medium (air) at outlet 56.

[0033] An understanding of the thermodynamic processes implemented by device 10 and the method of the present invention may be more readily discerned from Figs 12 and 13. Fig. 12 is a depicts graphically the volume versus pressure of the working medium as it undergoes compression (depicted as line A) and expansion (depicted as line B). Device 10 begins operation by drawing the working medium, in this instance air, into radial compartments 45 and rotating the same to apply a centrifugal force and compress the air within the radial compartment 45 with deceasing entropy. This compression produces an increase in pressure and a decrease in volume as seen with line A (1-2) in Fig. 12, and an increase in the order of the air molecules (i.e., the units of this system), reflected as a decrease in entropy as seen with line 1-2 in Fig. 13. This compression with decreasing entropy may be referred to as the Amin compression process, and its magnitude of work characterized by the area of the graph of Fig. 13 between the numerals 1-2-2'-l'.

[0034] When the air or other working medium within radial compartment 45 is allowed to exit and expand, the pressure decreases and volume increases as seen in line B (2-1) of Fig. 12, and the temperature is reduced with substantially no change in entropy (isentropic expansion line 2-3 in Fig. 13). The magnitude of the work of expansion is characterized by the area of the graph of Fig. 13 between the numerals 2-2'-3'-3', and the net work of the entire cycle is the difference between the magnitude of work for compression and magnitude of work for expansion.

[0035] The preferred embodiment contemplates variation of potential energy in the working medium by displacement of less than all the components of the units of the working medium or its energy levels. The skilled artisan should now appreciate that the concept of the present invention may be realized with force applied in any manner that does not uniformly alter the entropy of the working medium.

[0036] Inasmuch as the present invention is subject to variations, modifications and changes in detail, some of which have been expressly stated herein, it is intended that all matter described throughout this entire specification or shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense. It should thus be evident that a device constructed according to the concept of the present invention, and reasonably equivalent thereto, will accomplish the objects of the present invention and otherwise substantially improve the art of thermal transfer devices and methods therefor.

Claims

1. A device (10) for generating a thermal difference in a working medium such as air, comprising:

   a fixed housing (20);

   an impeller assembly (40) having a plurality of blades (44) extending from a central hub (43) to a casing (41), defining a like plurality of compartments (45) within said impeller assembly, said impeller assembly (40) carried coaxially substantially within said housing (20);

   a substantially annulus-shaped disk (50) having a plurality of outlet vanes (51) along the perimeter thereof, said blades (44) being shaped to allow said annulus-shaped disk (50) to be rotated with and carried coaxially substantially within said impeller assembly (40); and

   a substantially circular disk (60) having a plurality of inlet vanes (61) along the perimeter thereof and a diameter to allow the same to be rotated with and carried coaxially substantially within the interior of said annulus-shaped disk (50).

2. A device (10), as set forth in claim 1, wherein said blades (44) extend radially from said central hub (43) to said casing (41), and said compartments (45) are radial compartments.

3. A device (10), as set forth in claim 2, wherein said outlet vanes (51) include a plurality of passageways therebetween in the form of a like plurality of venturi through which said working medium is ejected.

4. A device (10), as set forth in claim 3, wherein said outlet vanes (51) have an inlet (55), an outlet (56), a substantially constant thickness, and root diameters varying from substantially smallest at said inlet (55) to substantially largest at said outlet (56).

5. A device (10), as set forth in claim 3, wherein said outlet vanes (51) have an inlet (55), an outlet (56), a substantially constant root diameters, and thicknesses varying from substantially smallest at said inlet (55) to substantially largest at said outlet (56).

6. A device (10), as set forth in claim 3, further including a shroud (70) at least partially covering said housing (20) and defining an outlet nozzle (74) in operational association with said outlet vanes (51).

7. A device (10), as set forth in claim 6, including at least one drag rotor (30) carried coaxially substantially within said housing (20) on said drive shaft (80), said impeller assembly (40) carried coaxially substantially within said drag rotor (30).

8. A device (10), as set forth in claim 7, wherein the diameter of said circular disk (60) substantially equals the diameter of the interior of said annulus-shaped disk (50).

9. A method for generating a thermal difference in a working medium in an enclosure having an inlet and an outlet comprising the steps of:

   applying a force to compress the working medium, with decreasing entropy;

   allowing the working medium to expand with a change in entropy between zero and no greater than the magnitude of the decrease in entropy during the step of compression, whereby a thermal difference will arise in the working medium between the inlet and the outlet; and

   transferring the thermal difference.

10. A method, as set forth in claim 9, wherein said step of applying a force includes the step of applying an acceleration force selected from the group including at least one of gravitation, centrifugal, centripetal, electromagnetic, electric and magnetic.

11. A method, as set forth in claim 10, wherein the working medium exists in a plurality of dimensions and said step of applying an acceleration force includes the step of applying an acceleration force

in less than the plurality of dimensions in which the working medium exists.

12. A method, as set forth in claim 9, wherein said step of applying an acceleration force in less than the plurality of dimensions in which the working medium exists includes the step of imparting a change in potential energy of the working medium in less than the plurality of dimensions in which the working medium exists.

13. A method, as set forth in claim 9, wherein said step of applying a force to compress the working medium includes the step of applying a force to compress a fluid having no FREON.

14. A method, as set forth in claim 13, wherein said step of applying a force to compress a fluid having no FREON includes the step of applying a force to compress air.

15. A method, as set forth in claim 9, wherein said step of applying a force includes the step of decreasing the disorder of selected portions of the working medium.

16. A method, as set forth in claim 9, wherein said step of applying a force includes the step of rotating the impeller assembly (40), and the step of allowing the working medium to expand includes the step of increasing the torque on the rotating impeller assembly by ejecting the working medium from the impeller assembly.

17. A method, as set forth in claim 9, wherein the working medium is a fluid, said step of applying a force includes the step of rotating the impeller assembly about a center of rotation, and the step of allowing the working medium to expand includes the step of allowing a phase change in said fluid and increasing the torque on the rotating impeller assembly by returning said phase changed fluid to said center of rotation.

18. A method, as set forth in claim 9, wherein said step of transferring the thermal difference includes the step of converting the thermal difference to work.

Patentansprüche

1. Vorrichtung (10) zum Erzeugen einer Wärmedifferenz in einem Arbeitsmedium, wie zum Beispiel Luft, mit:

einem festangeordneten Gehäuse (20);

einer Laufradanordnung (40) mit einer Vielzahl von Schaufeln (44), die sich von einer mittigen Nabe (43) zu einem Gehäuse (41) erstrecken und in der Laufradanordnung eine gleiche Vielzahl von Abteilen (45) ausbilden, wobei die Laufradanordnung (40) im wesentlichen in dem Gehäuse (20) koaxial angeordnet ist;

einer im wesentlichen ringförmigen Scheibe (50) mit einer Vielzahl von Auslassschaufeln (51) entlang ihres Umfangs, wobei die Schaufeln (44) derart ausgeformt sind, dass zugelassen wird, dass die ringförmige Scheibe (50) mit der Laufradanordnung (40) gedreht wird und im wesentlichen in dieser koaxial angeordnet ist; und

einer im wesentlichen kreisförmigen Scheibe (60) mit einer Vielzahl von Einlassschaufeln (61) entlang ihres Umfangs und einem Durchmesser, der es zuläßt, dass die Scheibe (60) in der ringsförmigen Scheibe (50) gedreht wird und im wesentlichen in derem Inneren koaxial angeordnet ist.

2. Vorrichtung (10) nach Anspruch 1, worin sich die Schaufeln (44) von der mittigen Nabe (43) zu dem Gehäuse (41) radial erstrecken und die Abteile (45) radiale Abteile sind.

3. Vorrichtung (10) nach Anspruch 2, worin die Auslassschaufeln (51) zwischen sich eine Vielzahl von Durchgängen in der Form von einer gleichen Vielzahl von Venturi-Kanälen aufweist, durch die das Arbeitsmedium ausgestoßen wird.

4. Vorrichtung (10) nach Anspruch 3, worin die Auslassschaufeln (51) einen Einlass (55), einen Auslass (56), eine im wesentlichen konstante Dicke und Fußkreisdurchmesser, die sich im wesentlichen von einem kleinsten Durchmesser an dem Einlass (55) in einen größten Durchmesser an dem Auslass (56) ändern, aufweisen.

5. Vorrichtung (10) nach Anspruch 3, worin die Auslassschaufeln (51) einen Einlass (55), einen Auslass (56), im wesentlichen konstante Fußkreisdurchmesser und Dicken, die sich von einer im wesentlichen geringsten Dicke an dem Einlass (55) in eine im wesentlichen größte Dicke an dem Auslass (56) ändern, aufweisen.

6. Vorrichtung (10) nach Anspruch 3, die außerdem eine Abdeckung (70) aufweist, die das Gehäuse (20) wenigstens teilweise bedeckt und eine Auslassdüse (74) bildet, die mit den Auslassschaufeln (51) in Betriebsverbindung steht.

7. Vorrichtung (10) nach Anspruch 6, die wenigstens einen Schlepprotor (30) aufweist, der im wesentlichen in dem Gehäuse (20) auf der Antriebswelle (80) koaxial angeordnet ist, wobei die Laufradanordnung (40) im wesentlichen in dem Schlepprotor (30) koaxial angeordnet ist.

8. Vorrichtung (10) nach Anspruch 7, worin der Durchmesser der kreisförmigen Scheibe (60) im wesentlichen gleich dem Durchmesser des Inneren der ringförmigen Scheibe (50) ist.

9. Verfahren zum Erzeugen einer Wärmedifferenz in einem Arbeitsmedium in einem Gehäuse mit einem Einlass und einem Auslass, mit den folgenden Schritten:

Aufbringen einer Kraft, um das Arbeitsmedium zu komprimieren, wobei die Entropie verringert wird;

Zulassen, dass sich das Arbeitsmedium ausdehnt, wobei sich die Entropie zwischen Null und einem Wert, der nicht größer ist als der Betrag der Entropieverringerung während des Komprimierschrittes, ändert, wodurch in dem Arbeitsmedium zwischen dem Einlass und dem Auslass eine Wärmedifferenz entsteht; und

Übertragen der Wärmedifferenz.

10. Verfahren nach Anspruch 9, worin der Schritt, bei dem eine Kraft aufgebracht wird, den Schritt aufweist, bei dem eine Beschleunigungskraft aufgebracht wird, die aus der Gruppe ausgewählt wird, welche wenigstens die Gravitationskraft, die Zentrifugalkraft, die Zentripetalkraft, die elektromagnetische Kraft, die elektrische Kraft oder die Magnetkraft aufweist.

11. Verfahren nach Anspruch 10, worin das Arbeitsmedium in einer Vielzahl von Dimensionen vorhanden ist und worin der Schritt, bei dem eine Beschleunigungskraft aufgebracht wird, den Schritt aufweist, bei dem eine Beschleunigungskraft in weniger Dimensionen als der Vielzahl von Dimensionen, in welchen das Arbeitsmedium vorhanden ist, aufgebracht wird.

12. Verfahren nach Anspruch 9, worin der Schritt, bei dem eine Beschleunigungskraft in weniger Dimensionen als der Vielzahl von Dimensionen, in welchen das Arbeitsmedium vorhanden ist, aufgebracht wird, den Schritt aufweist, bei dem eine Änderung einer potentiellen Energie des Arbeitsmediums in weniger Dimensionen als der Vielzahl von Dimensionen, in welchen das Arbeitsmedium vorhanden ist, verliehen wird.

13. Verfahren nach Anspruch 9, worin der Schritt, bei dem eine Kraft zum Komprimieren des Arbeitsmediums aufgebracht wird, den Schritt aufweist, bei dem eine Kraft zum Komprimieren eines Fluids, das kein FREON aufweist, aufgebracht wird.

14. Verfahren nach Anspruch 13, worin der Schritt, bei dem eine Kraft zum Komprimieren eines Fluids, das kein FREON aufweist, aufgebracht wird, den Schritt aufweist, bei dem eine Kraft zum Komprimieren von Luft aufgebracht wird.

15. Verfahren nach Anspruch 9, worin der Schritt, bei dem eine Kraft aufgebracht wird, den Schritt aufweist, bei dem die Fehlordnung von ausgewählten Teilen des Arbeitsmediums verringert wird.

16. Verfahren nach Anspruch 9, worin der Schritt, bei dem eine Kraft aufgebracht wird, den Schritt aufweist, bei dem die Laufradanordnung (10) gedreht wird, und worin der Schritt, bei dem zugelassen wird, dass sich das Arbeitsmedium ausdehnt, den Schritt aufweist, bei dem das Drehmoment an der sich drehenden Laufradanordnung erhöht wird, wobei das Arbeitsmedium von der Laufradanordnung ausgestoßen wird.

17. Verfahren nach Anspruch 9, worin das Arbeitsmedium ein Fluid ist, worin der Schritt, bei dem eine Kraft aufgebracht wird, den Schritt aufweist, bei dem die Laufradanordnung um eine Drehmitte gedreht wird, und worin der Schritt, bei dem zugelassen wird, dass sich das Arbeitsmedium ausdehnt, den Schritt aufweist, bei dem eine Phasenänderung in dem Fluid zugelassen ist und bei dem sich das Drehmoment an der sich drehenden Laufradanordnung erhöht, wobei das in der Phase geänderte Fluid zu der Drehmitte zurückgeführt wird.

18. Verfahren nach Anspruch 9, worin der Schritt, bei dem die Wärmedifferenz übertragen wird, den Schritt aufweist, bei dem die Wärmedifferenz in Arbeit umgewandelt wird.

Revendications

1. Dispositif (10) pour créer une différence thermique dans un milieu de travail tel que l'air, comprenant :

un carter fixe (20) ;
un ensemble de roue rotative (40) ayant une pluralité de pales (44) qui s'étendent d'un moyeu central (43) à une jante (41) de manière à définir une même pluralité de compartiments (45) à l'intérieur dudit ensemble de roue, ledit ensemble de roue (40) étant supporté coaxialement sensiblement à l'intérieur dudit carter

(20) ;

un disque sensiblement annulaire (50) comportant une pluralité d'ailettes de sortie (51) le long de son périmètre, lesdites pales (44) étant configurées pour permettre audit disque annulaire (50) de tourner avec ledit ensemble de roue (40) et d'être supporté coaxialement sensiblement à l'intérieur dudit ensemble de roue (40) ; et

un disque sensiblement circulaire (60) comportant une pluralité d'ailettes d'entrée (61) le long de son périmètre et ayant un diamètre qui permet à ce disque de tourner avec ledit disque annulaire (50) et d'être supporté coaxialement sensiblement à l'intérieur de ce dernier.

2. Dispositif (10) selon la revendication 1, dans lequel lesdites pales (44) s'étendent radialement à partir dudit moyeu central (43) jusqu'à ladite jante (41), et lesdits compartiments (45) sont des compartiments radiaux.

3. Dispositif (10) selon la revendication 2, dans lequel lesdites ailette de sortie (51) définissent entre elles une pluralité de passages sous la forme d'une même pluralité de venturis à travers lesquels ledit fluide de travail est éjecté.

4. Dispositif (10) selon la revendication 3, dans lequel lesdites ailettes de sortie (51) ont une entrée (55), une sortie (56), une épaisseur sensiblement constante et des diamètres de racine qui varient d'une valeur sensiblement la plus petite à ladite entrée (55) à une valeur sensiblement la plus grande à ladite sortie (56).

5. Dispositif (10) selon la revendication 3, dans lequel lesdites ailettes de sortie (51) ont une entrée (55), une sortie (56), un diamètre de racine sensiblement constant et des épaisseurs qui varient d'une valeur sensiblement la plus petite à ladite entrée (55) à une valeur sensiblement la plus grande à ladite sortie (56).

6. Dispositif (10) selon la revendication 3, comprenant en outre une joue (70) qui couvre au moins en partie ledit carter (20) et définit une buse de sortie (74) en association fonctionnelle avec lesdites ailettes de sortie (51).

7. Dispositif (10) selon la revendication 6, incluant au moins un rotor de traînée (30) supporté coaxialement sensiblement à l'intérieur dudit carter (20) sur ledit arbre d'entraînement (80), ledit ensemble de roue (40) étant supporté coaxialement sensiblement à l'intérieur dudit rotor de traînée (30).

8. Dispositif (10) selon la revendication 7, dans lequel le diamètre dudit disque circulaire (60) est sensiblement égal au diamètre de l'intérieur dudit disque annulaire (50).

9. Procédé de génération d'une différence thermique dans un fluide de travail dans une enceinte ayant une entrée et une sortie, comprenant les étapes de :

application d'une force pour comprimer le fluide de travail, avec diminution d'entropie ;

création d'une détente du fluide de travail avec un changement d'entropie compris entre zéro et une valeur non supérieure à la valeur de la diminution d'entropie pendant l'étape de compression, de sorte qu'une différence thermique apparaît dans le fluide de travail, entre l'entrée et la sortie ; et

transfert de la différence thermique.

10. Procédé selon la revendication 9, dans lequel ladite étape d'application d'une force comprend l'étape d'application d'une force d'accélération choisie dans le groupe incluant au moins une des forces de gravitation, centrifuge, centripète, électromagnétique, électrique et magnétique.

11. Procédé selon la revendication 10, dans lequel le fluide de travail existe dans une pluralité de dimensions et ladite étape d'application d'une force d'accélération inclut l'étape d'application d'une force d'accélération dans moins que la pluralité de dimensions dans lesquelles le fluide de travail existe.

12. Procédé selon la revendication 9, dans lequel ladite étape d'application d'une force d'accélération dans moins que la pluralité de dimensions dans lesquelles le fluide de travail existe inclut l'étape de communication d'un changement d'énergie potentielle du fluide de travail dans moins que la pluralité de dimensions dans lesquelles le fluide de travail existe.

13. Procédé selon la revendication 9, dans lequel ladite étape d'application d'une force pour comprimer le fluide de travail inclut l'étape d'application d'une force pour comprimer un fluide ne contenant pas de FREON.

14. Procédé selon la revendication 13, dans lequel ladite étape d'application d'une force pour comprimer un fluide ne contenant pas de FREON inclut l'étape d'application d'une force pour comprimer de l'air.

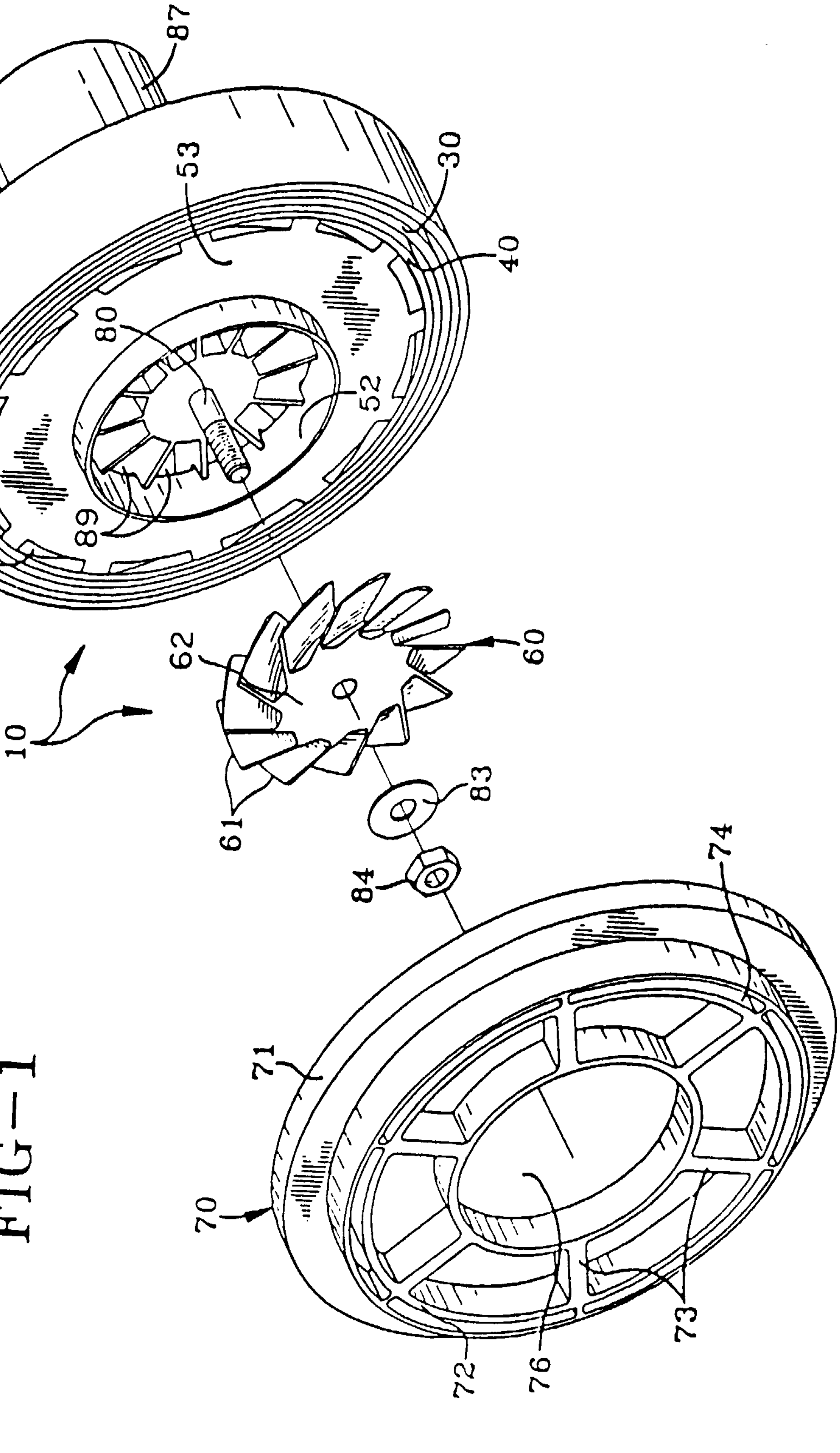
15. Procédé selon la revendication 9, dans lequel ladite étape d'application d'une force inclut l'étape de

diminution du désordre de parties choisies du fluide de travail.

16. Procédé selon la revendication 9, dans lequel ladite étape d'application d'une force inclut l'étape de mise en rotation de l'ensemble de roue (40), et l'étape de création d'une détente du fluide de travail inclut l'étape d'augmentation du couple sur l'ensemble de roue rotative par éjection du fluide de travail à partir de l'ensemble de roue.

17. Procédé selon la revendication 9, dans lequel le milieu de travail est un fluide, ladite étape d'application d'une force inclut l'étape de mise en rotation de l'ensemble de roue autour d'un centre de rotation, et l'étape de création d'une détente du fluide de travail inclut l'étape de création d'un changement de phase dans ledit fluide et d'augmentation du couple sur l'ensemble de roue rotative par retour dudit fluide changé de phase vers ledit centre de rotation.

18. Procédé selon la revendication 9, dans lequel ladite étape de transfert de la différence thermique inclut l'étape de conversion de la différence thermique en travail.



FIG—1

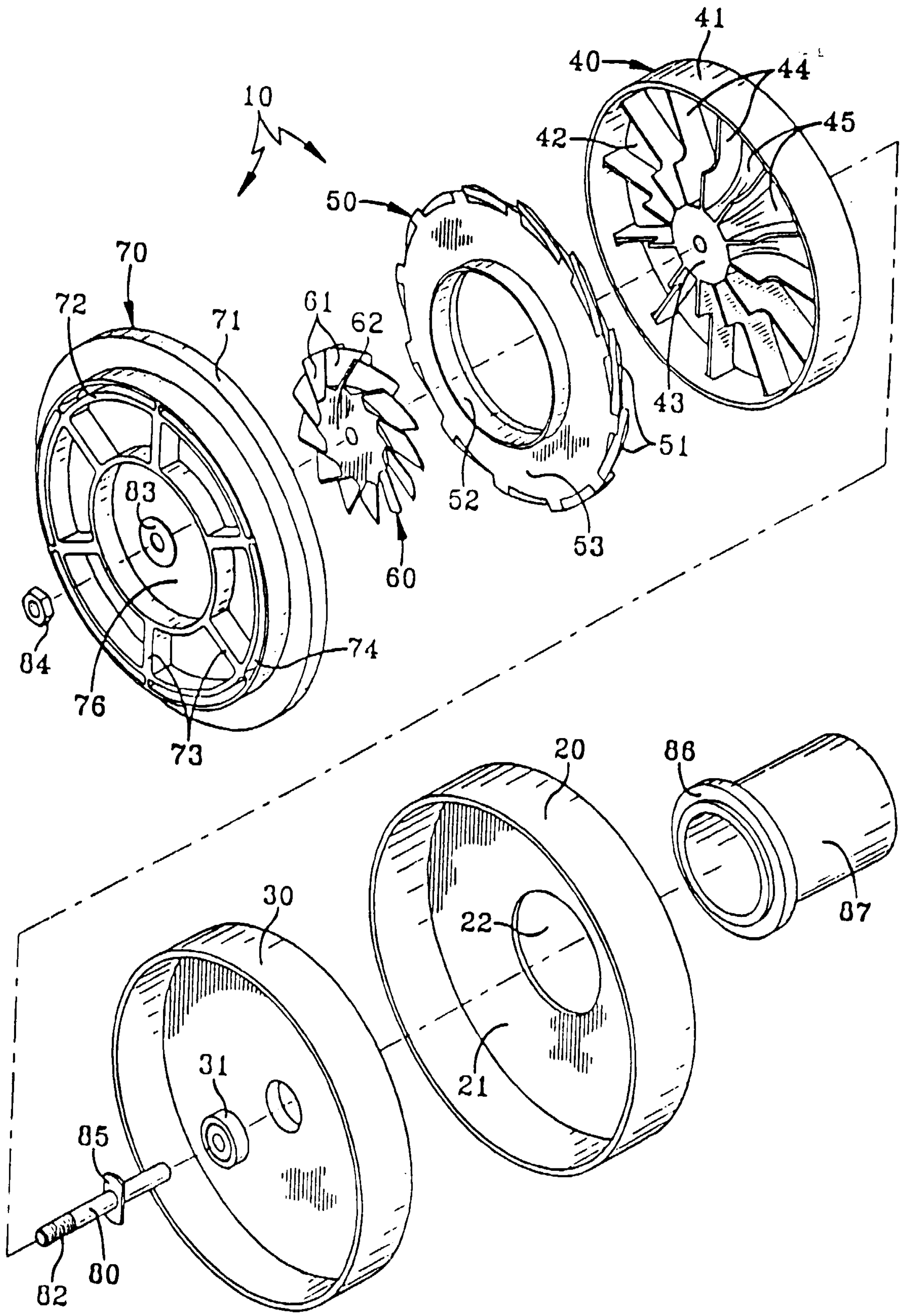

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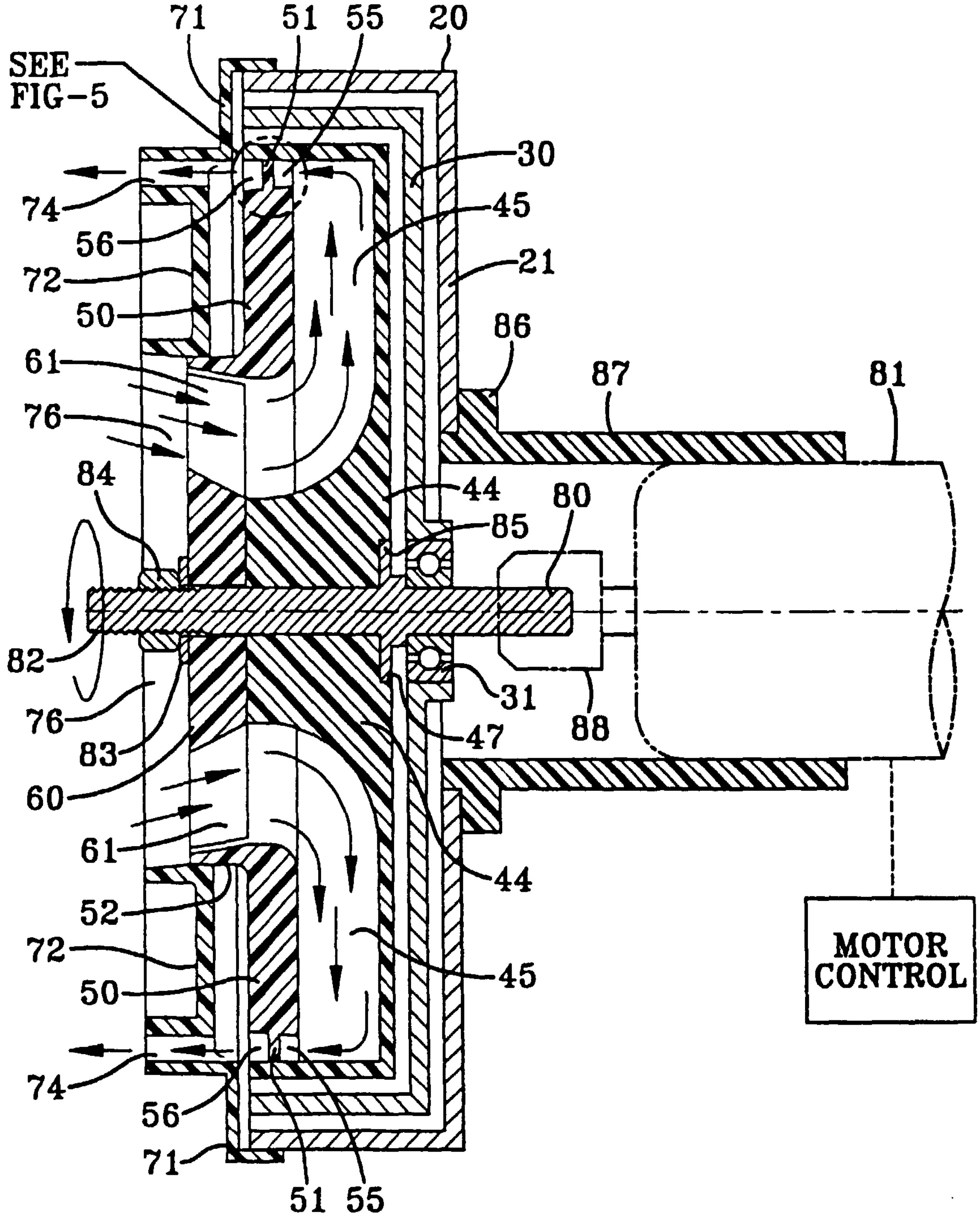
FIG-2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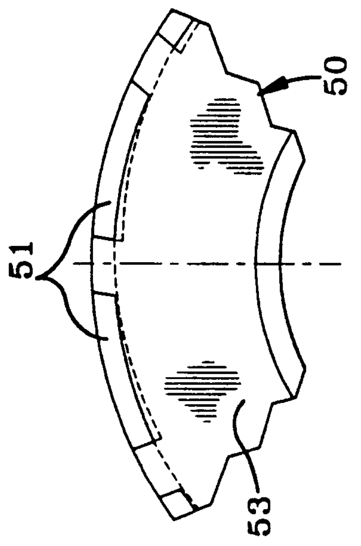
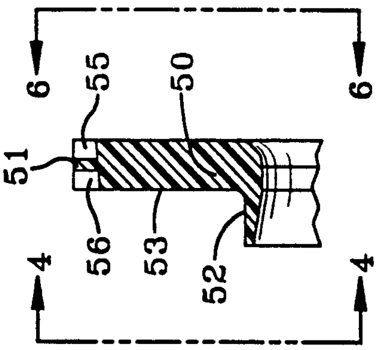
MOTOR CONTROL

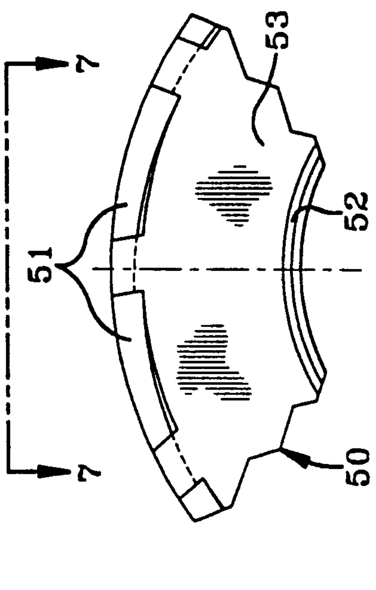
FIG-3



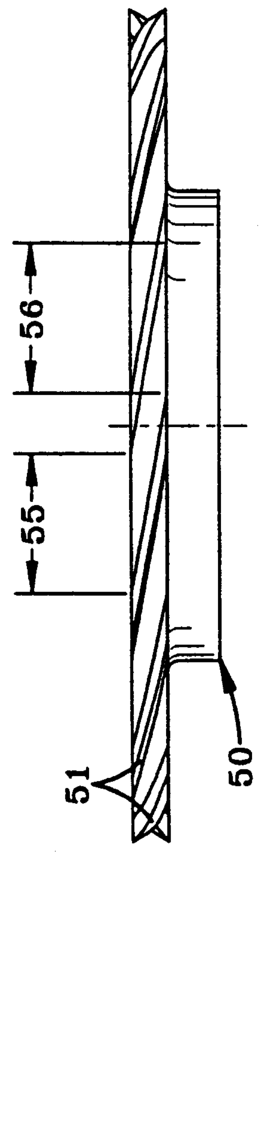
FIG—6



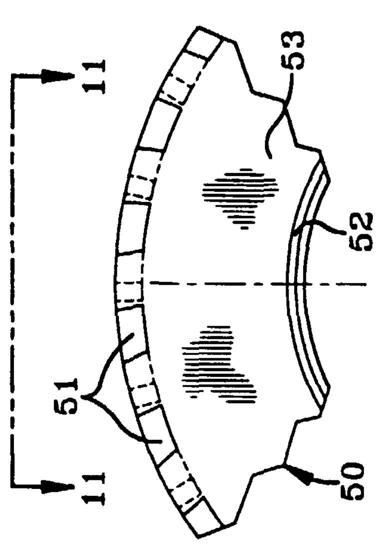
FIG—5



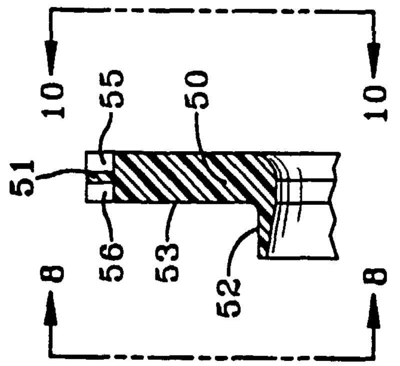
FIG—4



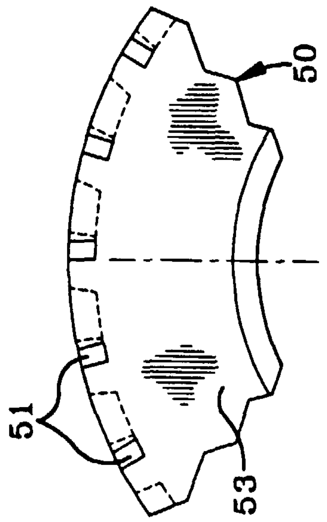
FIG—7



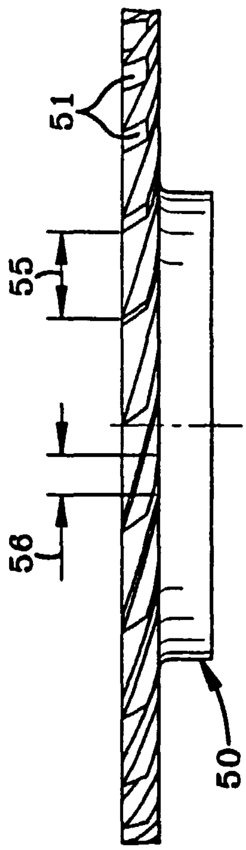
FIG—8



FIG—9



FIG—10



FIG—11

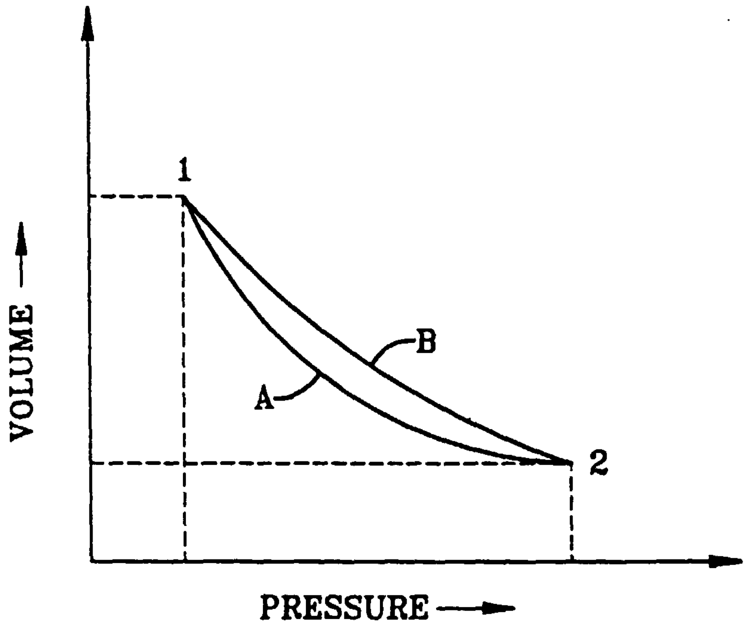


FIG-12

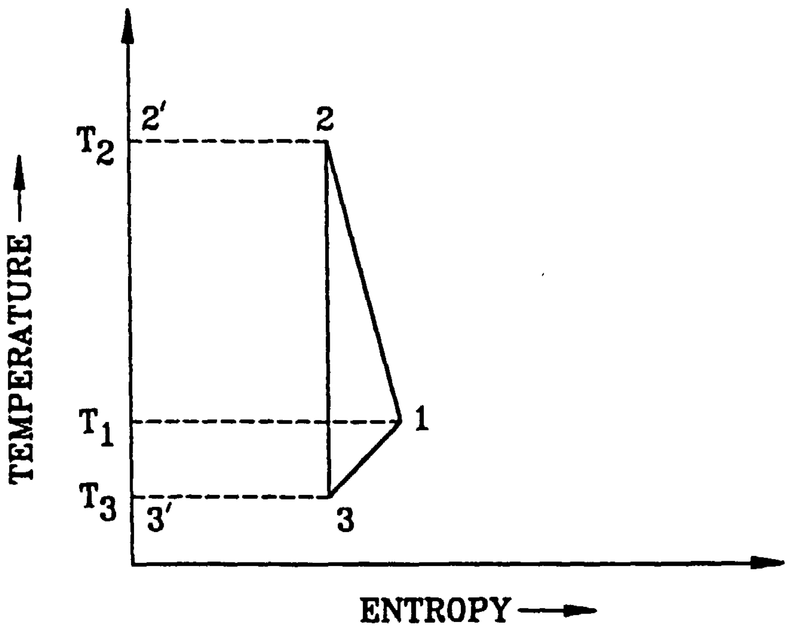


FIG-13