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(54) **VEHICLE AIR CONDITIONING IMPROVEMENT**

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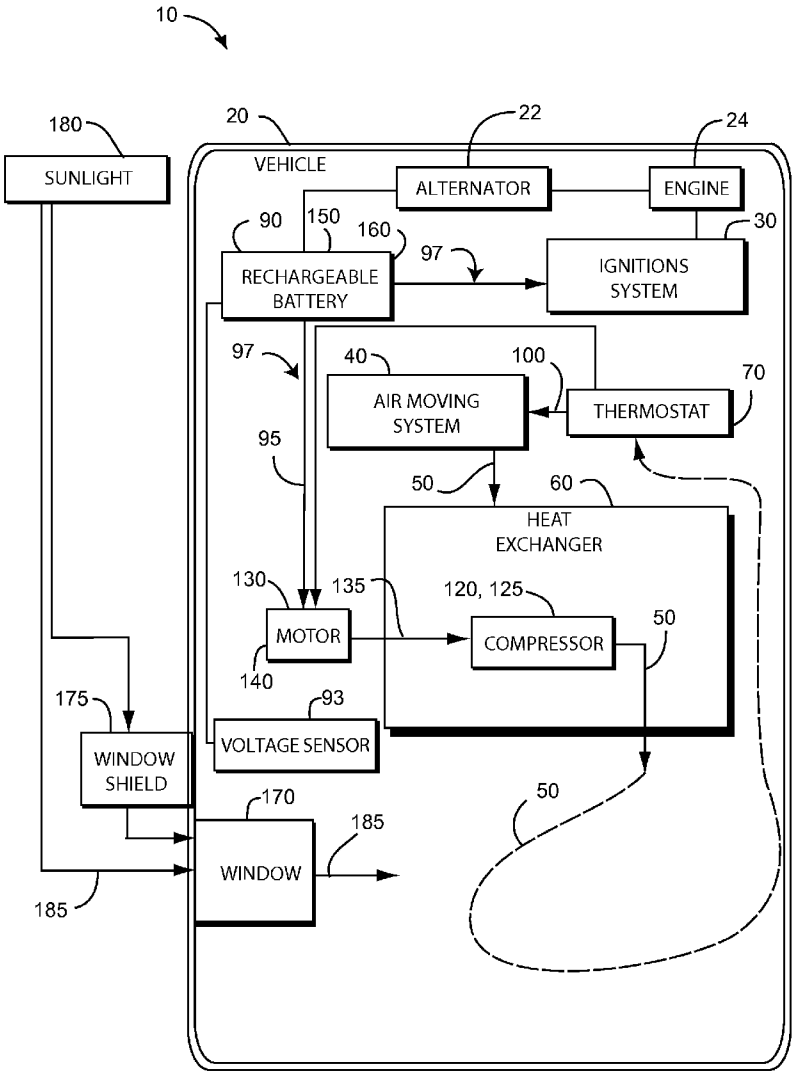
(57) **ABSTRACT**

The present device is a temperature regulation system for a vehicle turned on or off. The temperature regulation system includes a rechargeable battery for supplying power to an air moving system and a heat exchanger in accordance with demand signals from the thermostat, independent of the on/off state of the ignition system. In one embodiment, a DC motor is electrically connected to the rechargeable battery and rotationally coupled to a variable-speed compressor replacing the existing compressor of the vehicle, improving efficiency and extending the use of the rechargeable battery. The temperature regulation system may be used to heat or to cool the vehicle when the temperature of the air in the vehicle exceeds a certain threshold.



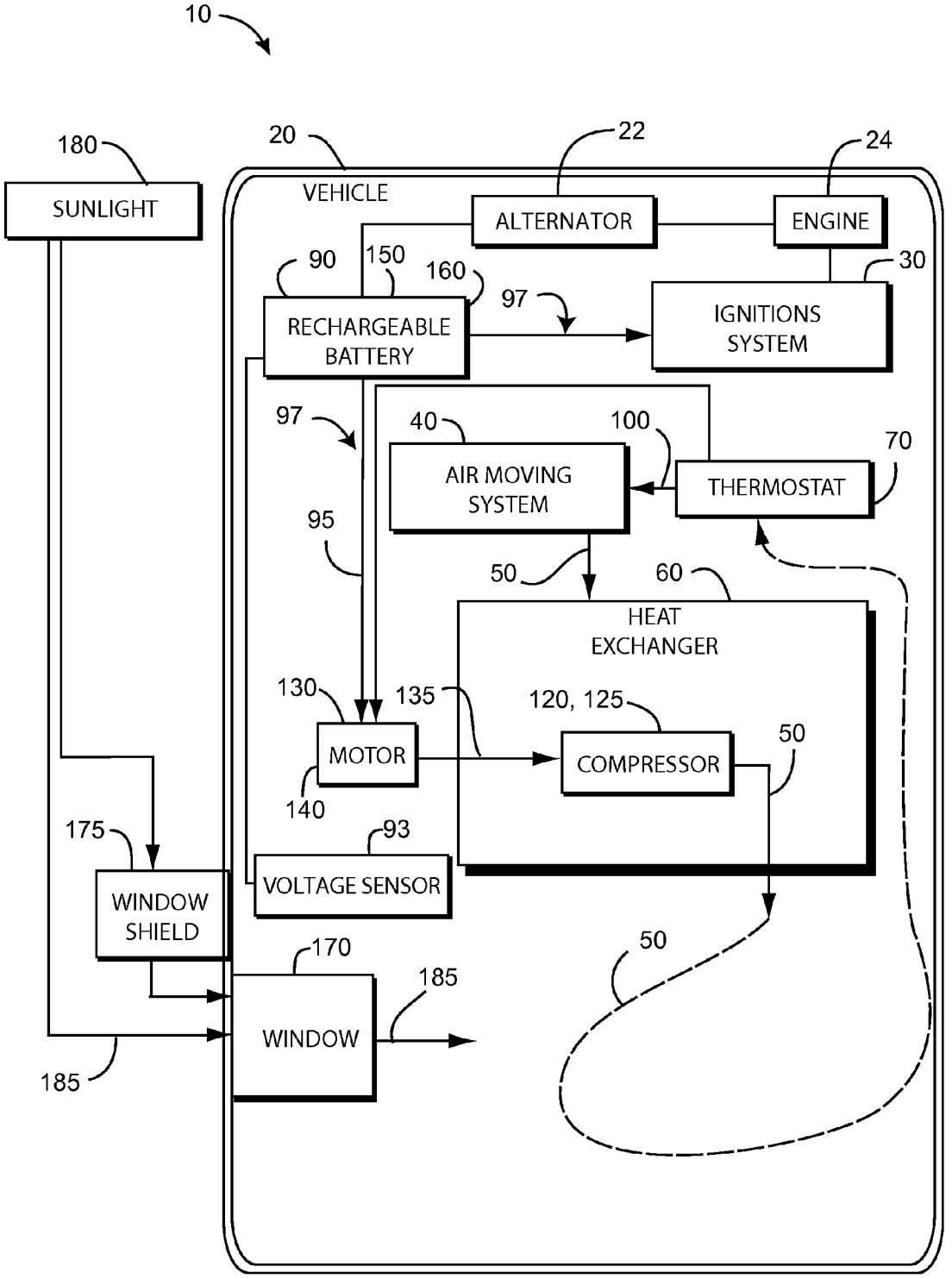

10
180
SUNLIGHT
20
VEHICLE
22
ALTERNATOR
24
ENGINE
90
150
160
97
30
RECHARGEABLE BATTERY
IGNITIONS SYSTEM
97
40
100
70
AIR MOVING SYSTEM
THERMOSTAT
95
50
60
HEAT EXCHANGER
130
135
120, 125
50
MOTOR
COMPRESSOR
140
175
93
WINDOW SHIELD
VOLTAGE SENSOR
50
170
185
WINDOW
185

FIG. 1

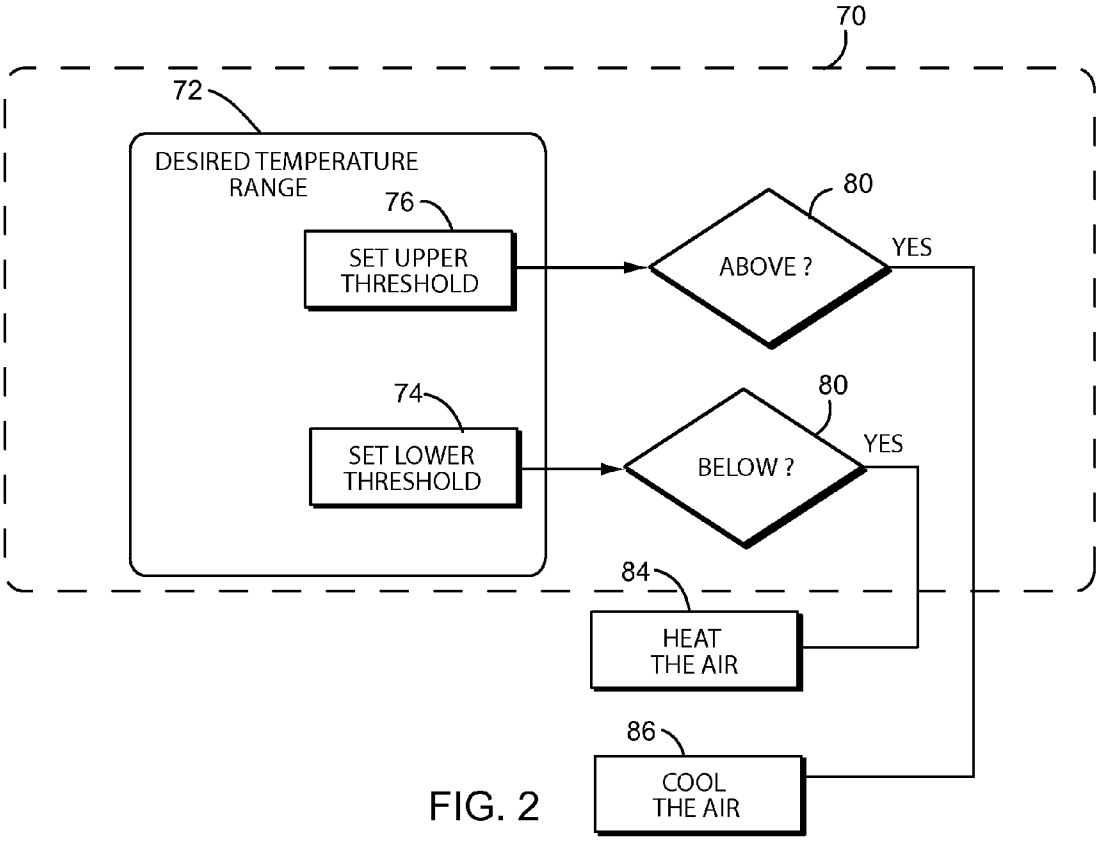

70
72
DESIRED TEMPERATURE RANGE
76
SET UPPER THRESHOLD
80
ABOVE ?
YES
74
SET LOWER THRESHOLD
80
BELOW ?
YES
84
HEAT THE AIR
86
COOL THE AIR

FIG. 2

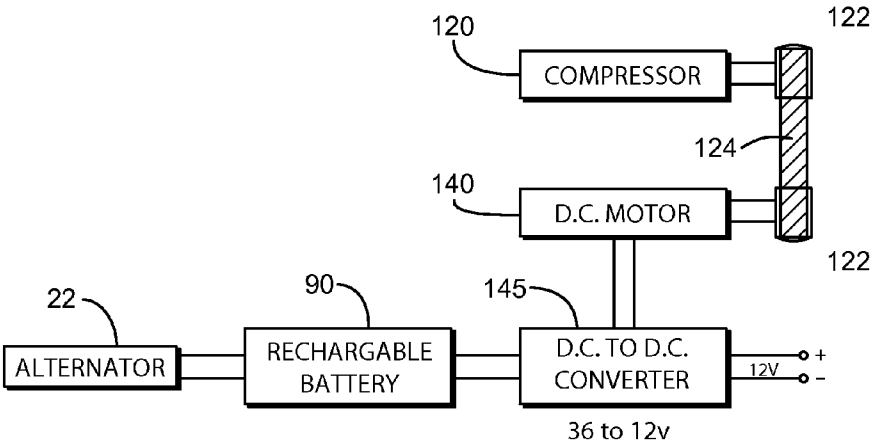

120
122
COMPRESSOR
124
140
D.C. MOTOR
122
145
90
22
ALTERNATOR
RECHARGABLE BATTERY
D.C. TO D.C. CONVERTER
12V
+
-
36 to 12v

FIG. 4

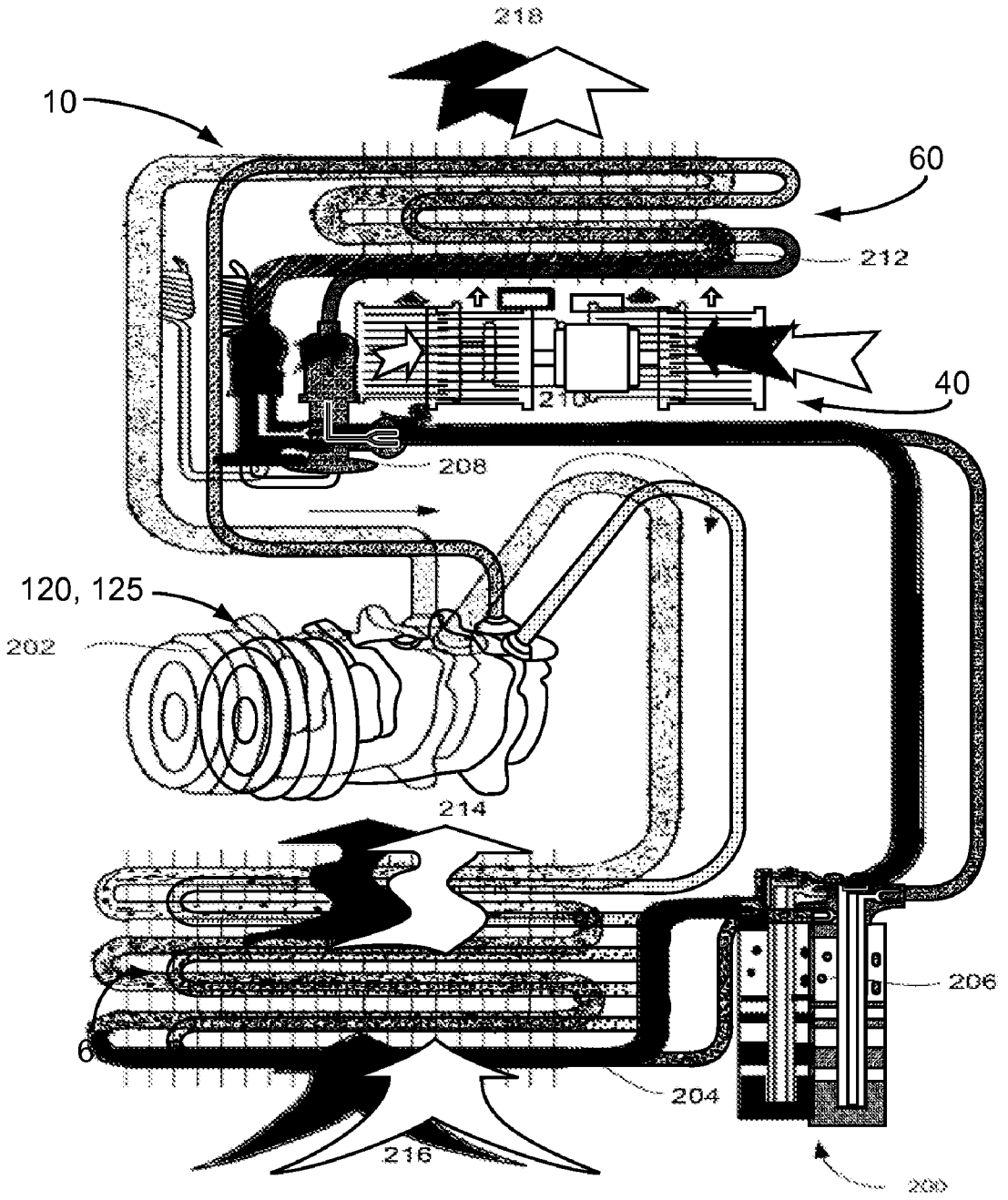


FIG. 3

VEHICLE AIR CONDITIONING IMPROVEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application 61/196,121, filed on Oct. 15, 2008, and incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

[0002] Not Applicable.

FIELD OF THE INVENTION

[0003] This invention relates to environmental heating and cooling systems, and more particularly to an improved such system for a vehicle.

DISCUSSION OF RELATED ART

[0004] One of the most unpleasant experiences an automobilist has to endure is to return to his vehicle parked outside on a hot sunny day, and find the temperature inside quite unbearable and suffocating. The same is the case in winter, in which case the temperature dips to the other extreme once the heater is switched off, and vehicle locked.

[0005] Some of the methods employed at present to solve the abovementioned issues are to roll down the windows slightly, and using window shields or blinds to decrease exposure of the vehicle to direct sunlight. Currently these methods are used to decrease the interior temperature to some extent but not to a comfortable level, not even to the outside ambient temperature when the weather is hot.

[0006] However, the aforementioned attempts are cumbersome to use and inefficient. Attempts like blocking the rays of the sun merely reduce the temperature of the heated air, as opposed to eliminating the heated air from the cabin of the vehicles. Also, the air conditioner can only function if the vehicle's ignition system is in operation. Attempts to keep the temperature inside parked vehicles by insulating the vehicle or using thermoelectric modules is a tested method, but the thermoelectric heating/cooling modules required for such a design are expensive and generally require huge amounts of power for its operation. Therefore, there is a need for a device that can be operated when the ignition system is on or off. Also, there is a need for a temperature regulation system to maintain the temperature of the interior of the vehicle close to ambient so that people entering their vehicle will not experience a furnace-like hot temperature. If the ambient and the interior temperatures are similar, people will not experience any difference. When the ignition is started, the air conditioner need not fight the build up of heat, so the cooler temperature is achieved in a shorter time. Further, in the conventional vehicle, a study of the optimal usage of air conditioner reveals that a high capacity cooling power is needed only for the first few minutes after the person driving the car enters the vehicle. This is to get rid of the excessive built-up heat in the vehicle and let the interior cool down quickly. Once the temperature inside the cabin drops to a desired comfortable level, less power is needed to maintain it. On the other hand, if the weather is too cold, a separate heating system would be required to warm the passenger cabin of the vehicle. Having a separate heating system and cooling system would be inefficient and more expensive. Thus, there is a need for a temperature regulation system that can maintain a desired temperature range in the vehicle. Also, there is a need for a single system that can maintain a desired temperature range in both hot weather and cold weather conditions.

[0007] In the prior art literature, U.S. Pat. No. 4,955,203 issued to Sundhar on Sep. 11, 1990, titled "Air conditioner for parked automotive vehicle," discloses an air conditioning unit. This device discloses for a parked automotive vehicle having a cooling unit comprising a cooling chamber with at least one insulated wall having on opposite sides thereof a heat sink and a cooling block having there between a thermoelectric chip. However, as per the '203 invention, it would require creation of a separate duct system to carry the cold air from trunk to inside the car. Also, in order to implement this design, it is required to drill holes at the metal floor of the trunk for air intake and outflow. Therefore, there is a need for a device that provides the advantage of using the vehicles existing duct system.

[0008] Another U.S. Pat. No. 6,453,678 issued to Sundhar on Sep. 24, 2002, titled "Direct current mini air conditioning system," discloses an air conditioning unit which is provided for a parked truck/boat to cool the sleeping cabin. However, the mechanism is not efficient in its operation. Therefore, there is a strong need for a device that operates more efficiently to extend battery usage.

[0009] From the foregoing, it becomes apparent that there is a need for a system that optimally conditions the air inside the cabin of a parked vehicle, and also during the times when the vehicle is being driven, such that the temperature in the vehicle compartment remains within a desired range. The present invention attempts to bridge the shortcomings in the state of the art literature by proposing an air-conditioning system for vehicles.

[0010] Therefore, there is a need for a temperature regulation system that can be operated when the ignition system is on or off. The needed temperature regulation system would maintain comfortable desired temperatures in the vehicle. Further, there is a need for a single system that can maintain comfortable temperatures in both hot weather and cold weather conditions. Also, the needed device would provide the advantage of using the vehicles existing duct and ventilation system. Finally, such a need system would operate more efficiently to extend battery usage. The present invention accomplishes these objectives.

SUMMARY OF THE INVENTION

[0011] The present device is a temperature regulation system for a vehicle having an ignition system and an air moving system. The air moving system circulates air inside of the vehicle across a heat exchanger to maintain a desired temperature range within the vehicle with a thermostat. The temperature regulation system includes a rechargeable battery for supplying power to the air moving system and the heat exchanger in accordance with demand signals from the thermostat and independent from an on/off state of the ignition system.

[0012] The temperature regulation system further includes a brushless DC motor for driving a variable-speed compressor. The DC motor is electrically connected to the rechargeable battery and rotationally coupled to the variable-speed compressor which is connected to the heat exchanger. The variable-speed compressor acts in place of the existing compressor of the vehicle.

[0013] The rechargeable battery may be at least one lithium ion battery or, as desired, may be at least one lithium-phosphate battery. The rechargeable battery is adapted to electrically power the ignition system of the vehicle when the thermostat detects the temperature of the air inside the vehicle has exceeded the desired temperature range. The heat exchanger may be used to heat the air when the temperature of the air in the vehicle drops below a set lower threshold or to cool the air when the temperature of the air in the vehicle rises above a set upper threshold.

[0014] In another embodiment, the system further includes at least one heat-reflecting window shield, which has a heat-reflecting coating for example, for reflecting heat away from the at least one window.

[0015] The present invention is a temperature regulation system that can be operated when the ignition system is on or off. Further, the invention is a system that can maintain desired temperature ranges in both hot weather and cold weather conditions. Also, the device provides the advantage of using the vehicles existing duct and ventilation system. In addition in hot weather, the fan of the air conditioning can be operated continuously when parked to lower interior temperature, using less power than the air conditioning system. Finally, the invention operates more efficiently to extend battery usage. Other features and advantages of the present invention will become apparent from the following more detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention.

DESCRIPTION OF THE DRAWINGS

[0016] FIG. **1** is a functional block diagram of a temperature regulation system;

[0017] FIG. **2** is a functional block diagram of a thermostat;

[0018] FIG. **3** is a functional diagram showing how components of the invention are connected; and

[0019] FIG. **4** is a is functional block diagram of another embodiment of the invention, illustrating a DC motor connected to an existing compressor via a belt.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0020] Illustrative embodiments of the invention are described below. The following explanation provides specific details for a thorough understanding of and enabling description for these embodiments. One skilled in the art will understand that the invention may be practiced without such details. In other instances, well-known structures and functions have not been shown or described in detail to avoid unnecessarily obscuring the description of the embodiments.

[0021] Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise," "comprising," and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to." Words using the singular or plural number also include the plural or singular number respectively. Additionally, the words "herein," "above," "below" and words of similar import, when used in this application, shall refer to this application as a whole and not to any particular portions of this application. When the claims use the word "or" in reference to a list of two or more items, that word covers all of the following interpretations of the word: any of the items in the list, all of the items in the list and any combination of the items in the list.

[0022] With respect to the drawings, FIGS. **1** and **3** illustrate a temperature regulation system **10** for a vehicle **20** having an ignition system **30** and an air moving system **40**. The air moving system **40** circulates air **50** inside of the vehicle **20** across a heat exchanger **60** to maintain a desired temperature range **72** within the vehicle **20** with a thermostat **70**. The temperature regulation system **10** includes a rechargeable battery **90** for supplying power **95** to the air moving system **40** and the heat exchanger **60** in accordance with demand signals **100** from the thermostat **70** and independent from an on/off state of the ignition system **30**.

[0023] In one embodiment, the heat exchanger **60** of the vehicle **20** includes a compressor **120**. The temperature regulation system **10** further includes a motor **130** for driving the compressor **120**. The motor **130** is electrically connected **97** to the rechargeable battery **90** and rotationally coupled **135** to the compressor **120**. In a preferred embodiment, the motor **130** is a brushless DC motor **140**. Preferably, the DC motor **140** operating voltage ranges from 12 VDC to 300 VDC

[0024] In another embodiment, the temperature regulation system **10** further includes a variable-speed compressor **125**. In this embodiment, the variable-speed compressor **125** acts in place of the existing compressor **120** of the vehicle **20**. In a preferred embodiment, the DC motor **140** is rotationally coupled **135** to the variable-speed compressor **125** which is connected to the heat exchanger **60**. The variable-speed compressor **125** can be made by deploying a rotary pump or a piston pump or a scroll pump (not shown).

[0025] In one embodiment, the rechargeable battery **90** may be at least one lithium ion battery **150**. In another embodiment, the rechargeable battery **90** may be at least one lithium-phosphate battery **160**. The temperature regulation system **10** may also include a bank (not shown) of rechargeable batteries **90**. The rechargeable battery **90** is adapted to electrically power the ignition system **30** of the vehicle **20** when the thermostat **70** detects the temperature of the air **40** inside the vehicle **20** has exceeded the desired temperature range **72**. The rechargeable battery **90** may be placed under the hood or under the front passenger seat (not shown) or other suitable locations in the vehicle **20**. The motor **130** is preferably located under the hood (not shown) of the vehicle **20**. In one embodiment, the rechargeable battery **90** is adapted to electrically power the temperature regulation system **10** when the thermostat **70** detects the temperature of the air **40** inside the vehicle **20** has exceeded the desired temperature range **72**, the temperature regulation system **10** being able to power the air moving system **40** of the vehicle independent of the vehicle's on/off state.

[0026] In one embodiment, as illustrated in FIG. **2**, the heat exchanger **60** may be used to heat **84** the air **40** when the temperature of the air **40** in the vehicle **20** drops below a set lower threshold **74**, or to cool **86** the air **40** when the temperature of the air **40** in the vehicle **20** rises above a set upper threshold **76**.

[0027] In another embodiment, the vehicle **20** includes at least one window **170**, the system **10** further including at least one heat-reflecting window shield **175** for reflecting heat **185** away from the at least one window **170**. The shield **175** is preferably easy to deploy and retrieve.

[0028] In another embodiment, the rechargeable battery **90** is preferably a Lithium-Ion battery **150** of about 3.0 KWH. If

temperature regulation system **10** is installed in a hybrid vehicle (not shown) then the rechargeable battery **90** storage capacity should be increased up to 3 KWH. In a pure electric vehicle (not shown) there will be no onboard engine **24** to charge the rechargeable battery **90**. Therefore, the storage capacity of the rechargeable battery **90** of an electric vehicle will be much higher than a hybrid vehicle, typically 16 KWH, and the storage capacity is enough for the functioning of the temperature regulation system **10**.

[0029] When the vehicle **20** is parked, the input power to the temperature regulation system **10** comes from the high capacity rechargeable battery **90**, wherein preferably up to 80% of its stored energy is sufficient to power the temperature regulation system **10** for at least 8 hours. When the vehicle **20** is in motion, an alternator **22** connected to an engine **24** of the vehicle **20** charges the rechargeable battery **90** in addition to supplying electrical power to run temperature regulation system **10**. In one embodiment, the rechargeable battery **90** is recharged using a high power-high voltage alternator **22**. The alternator **22** may be selected with an output voltage that matches the DC motor **140** used in the temperature regulation system **10**. It can be noted that a D.C. to D.C. step down solid state transformer **145** may be used if 12 Volts D.C. is required.

[0030] When the vehicle **20** is parked under the hot sun, the D.C. temperature regulation system **10** operates intermittently (not the engine **24** of the vehicle **20**) to cool down the temperature inside the vehicle **20**. A thermostat **70** located in the interior of the vehicle **20** will sense the rise in temperature. When the temperature of the air **50** inside the vehicle **20** goes outside of the desired temperature range **72**, then the temperature regulation system **10** turns on the variable-speed compressor **125**. The stored energy in the rechargeable battery **90** energizes the temperature regulation system **10**. The existing air moving system **40** in the vehicle **20** is also turned on and powered by the rechargeable battery **90**. The air moving system **40** operates at much less power than the variable-speed compressor **125** and has a smaller effect on the temperature regulation system's **10** overall performance.

[0031] In order to minimize the current drain of the rechargeable battery **90**, the variable-speed compressor **125** may be operated intermittently at low speed. That is, the variable-speed compressor's **125** volumetric displacement can be made variable, thereby decreasing the energy used. Thus, the rechargeable battery **90** may be used more economically. Also, it is to be noted that the operation of the temperature regulation system **10** is reversible. That is, the temperature regulation system **10** can be made to either heat or cool the air **50** in the vehicle **20**.

[0032] Even though the BTU/Hour cooling power of the variable-speed compressor **125** is smaller compared to a conventional mechanical driven system (not shown), the total displacement rate can be increased by increasing the speed of the variable-speed compressor **125**. Another advantage with small volumetric displacement is that the starting torque is lower as the torque is dependent on the variable-speed compressor's **125** pressure and surface area. So the smaller the surface area of the variable-speed compressor **125**, the smaller will be the force, and hence the required torque. A highly efficient variable-speed compressor **125** will keep the vehicle **20** temperature within the desired range. Thus, there is no need to idle the vehicle engine **24** to maintain the desired temperature range **72** and when the engine **24** is running the alternator **22** charges the rechargeable battery **90**. In another embodiment, the vehicle **20** is made to "breathe" by operating the air moving system **40** continuously when parked, and when the vehicle's ignition system **30** and/or engine **24** are in an off state, which can reduce about 25% of the built-up heat depending upon air flow.

[0033] To preserve the rechargeable battery power when the engine **24** is off, the thermostat **70** controls turning on and off the temperature regulation system **10**. Preferably in one embodiment for hot weather, the air moving system **40** of the vehicle **20** is running all the time while the vehicle **20** is parked and the engine **24** is off. In hot weather, running the air moving system **40** continuously, drawing in ambient air from outside of the vehicle **20**, lowers the interior temperature and consumes less power than continuously operating the entire temperature regulation system **10**.

[0034] In hot weather, when the vehicle **20** is unoccupied, the thermostat **70** is preferably set to a temperature equal or very close to the outside ambient temperature. In this way, people entering the vehicle **20** will not feel a strong difference in temperature from outside of the vehicle **20** and inside the vehicle **20**. In hot weather, by maintaining ambient temperature when the vehicle **20** is unoccupied, the temperature regulation system **10** preserves the rechargeable battery **90**. In another preferred embodiment, a voltage sensor **93** will keep sensing the voltage of the rechargeable battery **90**. When the voltage reaches approximately just above 12 volts, the voltage sensor **93** will shut off the temperature regulation system **10**. In this way, the rechargeable battery **90** will have enough power to start the vehicle **20**.

[0035] In a preferred embodiment, the temperature regulation system **10** has a high COP of 3.00 which means that for every unit of power input to the variable-speed compressor **125** will result in moving 3 units. The input electrical power needed to move 1,148.4 Watts of heat will be equal to 382.8 Watts (1,148.4/3). For continuous 8 hours of operation, the required energy would be 382.8 watts multiplied into 8 hours, which adds up to 3,063 Watt hours or 3.063 kWh. A high energy density rechargeable lithium ion battery is preferably used which will have a 90 AH at 42 Volts (slightly less than 4 kWH).

[0036] FIG. **4** illustrates another embodiment of the temperature regulation system **10** wherein the brushless DC motor **140** for driving the compressor **120** is variable speed and the brushless DC motor **140** is electrically connected to the rechargeable battery **90** and mechanically coupled to the existing compressor **120** by pulleys **122** and a belt **124**. This embodiment provides the advantage and convenience of using the vehicle's existing compressor **120**.

[0037] While a particular form of the invention has been illustrated and described, it will be apparent that various modifications can be made without departing from the spirit and scope of the invention. For example, though in a preferred embodiment, only one rechargeable battery **90** is used, additional rechargeable batteries **90** may be added to the vehicle **20** if desired. Accordingly, it is not intended that the invention be limited, except as by the appended claims.

[0038] The teachings provided herein can be applied to other systems, not necessarily the system described herein. The elements and acts of the various embodiments described above can be combined to provide further embodiments. All of the above patents and applications and other references, including any that may be listed in accompanying filing papers, are incorporated herein by reference. Aspects of the invention can be modified, if necessary, to employ the sys-

tems, functions, and concepts of the various references described above to provide yet further embodiments of the invention.

[0039] These and other changes can be made to the invention in light of the above Detailed Description. While the above description details certain embodiments of the invention and describes the best mode contemplated, no matter how detailed the above appears in text, the invention can be practiced in many ways. Details of the system may vary considerably in its implementation details, while still being encompassed by the invention disclosed herein.

[0040] Particular terminology used when describing certain features or aspects of the invention should not be taken to imply that the terminology is being redefined herein to be restricted to any specific characteristics, features, or aspects of the invention with which that terminology is associated. In general, the terms used in the following claims should not be construed to limit the invention to the specific embodiments disclosed in the specification, unless the above Detailed Description section explicitly defines such terms. Accordingly, the actual scope of the invention encompasses not only the disclosed embodiments, but also all equivalent ways of practicing or implementing the invention.

[0041] The above detailed description of the embodiments of the invention is not intended to be exhaustive or to limit the invention to the precise form disclosed above or to the particular field of usage mentioned in this disclosure. While specific embodiments of, and examples for, the invention are described above for illustrative purposes, various equivalent modifications are possible within the scope of the invention, as those skilled in the relevant art will recognize. Also, the teachings of the invention provided herein can be applied to other systems, not necessarily the system described above. The elements and acts of the various embodiments described above can be combined to provide further embodiments.

[0042] All of the above patents and applications and other references, including any that may be listed in accompanying filing papers, are incorporated herein by reference. Aspects of the invention can be modified, if necessary, to employ the systems, functions, and concepts of the various references described above to provide yet further embodiments of the invention.

[0043] Changes can be made to the invention in light of the above "Detailed Description." While the above description details certain embodiments of the invention and describes the best mode contemplated, no matter how detailed the above appears in text, the invention can be practiced in many ways. Therefore, implementation details may vary considerably while still being encompassed by the invention disclosed herein. As noted above, particular terminology used when describing certain features or aspects of the invention should not be taken to imply that the terminology is being redefined herein to be restricted to any specific characteristics, features, or aspects of the invention with which that terminology is associated.

[0044] In general, the terms used in the following claims should not be construed to limit the invention to the specific embodiments disclosed in the specification, unless the above Detailed Description section explicitly defines such terms. Accordingly, the actual scope of the invention encompasses not only the disclosed embodiments, but also all equivalent ways of practicing or implementing the invention under the claims.

[0045] While certain aspects of the invention are presented below in certain claim forms, the inventor contemplates the various aspects of the invention in any number of claim forms.

[0046] Accordingly, the inventor reserves the right to add additional claims after filing the application to pursue such additional claim forms for other aspects of the invention.

What is claimed is:

1. A temperature regulation system for a vehicle having an ignition system and an air moving system that circulates air inside of the vehicle across a heat exchanger to maintain a desired temperature range within the vehicle with a thermostat, the system comprising:

a rechargeable battery for supplying power to the air moving system and the heat exchanger in accordance with demand signals from the thermostat and independent from an on/off state of the ignition system.

2. The temperature regulation system of claim **1** wherein the heat exchanger of the vehicle includes a compressor, and wherein the temperature regulation system further includes a motor for driving the compressor, the motor electrically connected to the rechargeable battery and rotationally coupled to the compressor.

3. The temperature regulation system of claim **2** wherein the motor is a brushless DC motor.

4. The temperature regulation system of claim **3** wherein the rechargeable battery is at least one lithium ion battery.

5. The temperature regulation system of claim **3** wherein the rechargeable battery is at least one lithium-phosphate battery.

6. The temperature regulation system of claim **1** wherein the rechargeable battery is adapted to electrically power the ignition system of the vehicle when the thermostat detects the temperature of the air inside the vehicle has exceeded the desired temperature range.

7. The temperature regulation system of claim **1** wherein the heat exchanger may be used to heat the air when the temperature of the air in the vehicle drops below a set lower threshold, or to cool the air when the temperature of the air in the vehicle rises above a set upper threshold.

8. The temperature regulation system of claim **2** further including a variable-speed compressor.

9. The temperature regulation system of claim **1** wherein the vehicle includes at least one window, the system further including at least one heat-reflecting window shield for reflecting heat away from the at least one window.

10. The temperature regulation system of claim **1** further including a high power-high voltage alternator to charge the rechargeable battery.

11. The temperature regulation system of claim **1** wherein the air moving system wherein the rechargeable battery supplies power to the air moving system when the ignition system is in the off state, whereby air is circulated inside the vehicle continuously when the ignition system is in the off state.

12. A temperature regulation system for a vehicle having an ignition system and an air moving system that circulates air inside of the vehicle across a heat exchanger, having a compressor, to maintain a desired temperature range within the vehicle with a thermostat, the system comprising:

a rechargeable battery for supplying power to the air moving system and the heat exchanger in accordance with demand signals from the thermostat and independent from an on/off state of the ignition system;

a variable speed brushless DC motor for driving the compressor, the motor electrically connected to the rechargeable battery and mechanically coupled to the compressor by pulleys and a belt.

13. The temperature regulation system of claim **12** further including a high power-high voltage alternator to charge a rechargeable battery.

14. The temperature regulation system of claim **12** wherein the rechargeable battery is at least one lithium ion battery.

15. The temperature regulation system of claim **12** wherein the rechargeable battery is at least one lithium-phosphate battery.

16. The temperature regulation system of claim **12** further including a heat reflecting window shield to lower the heat of the interior when the vehicle is turned off.

17. The temperature regulation system of claim **12** wherein the air moving system continuously operates when the vehicle is turned off to lower the interior temperature.

18. The temperature regulation system of claim **12** wherein the air moving system wherein the rechargeable battery supplies power to the air moving system when the ignition system is in the off state, whereby air is circulated inside the vehicle continuously when the ignition system is in the off state.

19. The temperature regulation system of claim **1** wherein the rechargeable battery is adapted to electrically power the temperature regulation system when the thermostat detects the temperature of the air inside the vehicle has exceeded the desired temperature range.

20. The temperature regulation system of claim **12** wherein the rechargeable battery is adapted to electrically power the temperature regulation system when the thermostat detects the temperature of the air inside the vehicle has exceeded the desired temperature range.

* * * * *