HEATING/COOLING SYSTEM FOR A BATTERY OF A MOTOR VEHICLE, AND OPERATING METHOD FOR THE SAME

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A motor vehicle and a method for operating the same. The motor vehicle includes a first heating/cooling circuit with a heat source/sink arranged therein and a first pump, and a second heating/cooling circuit with a battery to be heated/cooled arranged therein and a second pump. The heating/cooling circuits can be selectively operatively and/or fluidically connected by way of at least one valve such that the same liquid heat carrier flows through both heating/cooling circuits.
HEATING/COOLING SYSTEM FOR A BATTERY OF A MOTOR VEHICLE, AND OPERATING METHOD FOR THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS


FIELD OF THE INVENTION

[0002] The invention relates to a motor vehicle that includes a first heating/cooling circuit having a heat source/sink arranged therein and a first pump, and a second heating/cooling circuit having a battery to be heated/cooled arranged therein and a second pump, and a method for operating such a motor vehicle.

BACKGROUND OF THE INVENTION

[0003] A heating/cooling circuit for a battery such as, for example, a storage battery of a motor vehicle is known per se. In particular, high-power batteries of electric motor vehicles and hybrid motor vehicles are generally temperature-controlled so as to be operated in a temperature range which is advantageous for power delivery. Therefore, the battery is cooled when outside temperatures are high, and is heated when outside temperatures are low.

[0004] For example, German Patent Publication No. DE 42 39 834 A1 discloses heating of a battery by way of a fuel-operated heater or an internal combustion engine. The heating for the battery can be activated or deactivated by way of a valve. A disadvantage to such a design is that a fuel-operated heater and an internal combustion engine provide a supply temperature of approximately between 75-85°C and between 90-110°C respectively, which, per se, is excessively high for the heating of the battery. The temperature of the heating medium there should specifically be, where possible, no more than approximately 20°C higher than the actual temperature of the battery.

[0005] German Patent Publication DE 101 28 164 A1 furthermore discloses cooling of the battery by way of two separate cooling circuits. A compressor, a condenser and an evaporator are situated in a first circuit, and the battery and a pump are situated in a second circuit. Here, the two circuits are coupled to one another by way of a heat exchanger. To deactivate the cooling of the battery, the heat exchanger can be bridged by a bypass. A disadvantage of this design is the relatively complex construction, which requires a heat exchanger for the coupling of the two cooling circuits.

SUMMARY OF THE INVENTION

[0006] Embodiments of the invention provide an enhanced heating/cooling system for a battery of a motor vehicle and an enhanced operating method for the same. In particular, the battery should be temperature-controlled in as simple a manner as possible, without being damaged.

[0007] In accordance with embodiments of the invention, a motor vehicle includes at least one of the following: a first heating/cooling circuit having a heat source/sink arranged therein and a first pump, and a second heating/cooling circuit having a battery to be heated/cooled arranged therein and a second pump, whereby the heating/cooling circuits operatively and/or fluidically connected to each other by way of at least one valve such that the same liquid heat carrier flows through both heating/cooling circuits.

[0008] In accordance with embodiments of the invention, a method for operating a motor vehicle includes at least one of the following: a first heating/cooling circuit having a heat source/sink arranged therein and a first pump, and a second heating/cooling circuit having a battery to be heated/cooled arranged therein and a second pump, and whereby the heating/cooling circuits are connected to each other by way of at least one valve such that the same liquid heat carrier flows through both heating/cooling circuits.

[0009] In accordance with embodiments, a motor vehicle includes at least one of the following: a first heating/cooling circuit with a heat source/sink arranged therein and a first pump; a second heating/cooling circuit with a battery arranged therein and a second pump; and a valve configured to fluidically connect the first heating/cooling unit and the second heating/cooling circuit to each other such that a same fluid flows through the first heating/cooling unit and the second heating/cooling circuit in order to heat/cool the battery.

[0010] In accordance with embodiments, a motor vehicle includes at least one of the following: a first heating/cooling circuit through which a fluid flows; a heat source/sink provided in the first heating/cooling circuit; a second heating/cooling circuit through which the fluid flows; a battery provided in the second heating/cooling circuit, whereby the second heating/cooling is configured to heat/cool the battery via the fluid; and a valve configured to fluidically connect the first heating/cooling unit and the second heating/cooling circuit such that fluid flows through the first heating/cooling unit and the second heating/cooling circuit.

[0011] In accordance with embodiments, a method of operating a vehicle includes at least one of the following: providing the motor vehicle with a first heating/cooling circuit with a heat source/sink arranged therein, a second heating/cooling circuit with a battery arranged therein, and a valve configured to fluidically connect the first heating/cooling unit and the second heating/cooling circuit; and selectively switching the valve between an opened position and a closed position such that the battery is heated/cooled via the fluid through the first heating/cooling unit and the second heating/cooling circuit.

[0012] Advantageously, embodiments permit the heating/cooling circuits are operatively and/or fluidically connected to each other without need for a relatively voluminous and heavy heat exchanger. Instead, for the connection of the heating/cooling circuits, a relatively compact and lightweight valve is provided, as a result of which the motor vehicle can also be configured to be more lightweight and more compact.

[0013] The heat source may comprise, for example, a fuel-operated heater. Advantageously, such a fuel-operated heater already forms part of some motor vehicles, for example, as a standstill heater for heating a passenger compartment and/or an internal combustion engine.

[0014] The heat source may also, however, comprise an internal combustion engine. Such an internal combustion engine is advantageously already part of some motor vehicles, for example, as a drive engine or as a range extender in electrically operated vehicles. The waste heat generated during the operation of the internal combustion engine can be used for heating a battery. If both a range extender and also a fuel-operated heater are provided, the range extender need not be activated in order to heat the interior compartment, whereby quieter operation of the vehicle can be attained.
Advantageously, the heating of a battery is done using components which are already provided in the motor vehicle, thereby providing dual usage of the components.

Further advantageous embodiments and refinements of the invention will now emerge from the subclaims and from the description in conjunction with the figures.

It is particularly advantageous if the valve is designed as a mixing valve or as a cyclically operated switching valve, and the heat exchange between the first and second heating/cooling circuits is adjustable by way of the valve. As previously mentioned herein, the supply temperature of a fuel-operated heater (approximately between 75-85°C) or of an internal combustion engine (approximately between 90-110°C) is excessively high to heat a battery without further measures. The temperature of the heating medium at the battery should specifically be, where possible, no more than approximately 20°C higher than the actual temperature of the battery.

In accordance with embodiments, it is now advantageously possible for heat to be extracted from the first heating circuit and supplied to the second heating circuit in a targeted manner via a valve. For this purpose, use is made of a switching valve which is switched between an open position and a closed position in a cyclic manner, that is to say at relatively high frequency. By variation of the duration of the open position in relation to the duration of the closed position, a greater or lesser amount of heat can be extracted from the first heating circuit and supplied to the second heating circuit. Such an operating mode of a switching valve is known per se and is referred to as "pulse width modulation" (PWM).

In accordance with embodiments, advantageously, the switching should take place so quickly that the thereby generated "blocks" of hot heat carrier passing from the first heating/cooling circuit and "blocks" of relatively cool heat carrier circulating in the second heating/cooling circuit arrive at the battery having been adequately mixed. The heat carrier then thus has, at the battery, a homogeneous temperature or only temperature fluctuations that cannot cause damage to the battery. For example, the pump arranged in the second heating circuit can have an assisting action for this purpose. A further advantage in the use of a switching valve is that a controller thereof needs to have only one digital output.

Alternatively, the valve may, however, be designed as a proportional mixing valve. An inflow from the first heating circuit into the second heating circuit is selectively adjustable by way of an actuating motor. A pulse-width-modulated valve actuation device with digital output may then be dispensed with, but in general, for the actuation of a mixing valve, an analogue or PWM output of a controller connected to the mixing valve is necessary. Under some circumstances, mixing valves for the stated application are, however, difficult to obtain, which then makes the use of a cyclically operated switching valve advantageous.

It is further advantageous if a heat exchanger, and/or a reservoir, and/or a turbulence generator, and/or a long fluid line are/is provided in the second heating/cooling circuit between the valve and battery. The heat exchanger serves, among other things, as a thermal mass. As a result, in particular when a cyclically operated switching valve is used, there are considerably smaller temperature fluctuations of the heat carrier at the battery.

In the heating mode, the heat exchanger acts, as it were, as a damper. It is furthermore possible for the switching valve to be cycled with relatively low frequency (preferably <1 Hz) without a stipulated maximum temperature at the battery being exceeded. The service life of the switching valve can thus be increased considerably. Advantages are however also obtained, owing to the damping by the thermal mass, when an analogue-controlled mixing valve is used. A regulation device for actuating the mixing valve, and the actuating motor of the mixing valve itself, need not exhibit very fast response. It is thus possible to install components which are of relatively simple construction and are thus also inexpensive.

A very similar effect can also be attained with a reservoir and/or a turbulence generator and/or a long fluid line. In a reservoir, the incoming blocks of cool and hot water dwell for a certain period of time, and the temperatures thereof thus equalize. A compensation vessel which is required in any case may, for example, be used for this purpose, which compensation vessel thus serves a dual purpose. With a turbulence generator, mixing of the blocks can be obtained, and a long line acts in turn as a thermal mass, similarly to the heat exchanger. The length of the fluid line is determined on the basis of the temperatures of the blocks of cool and hot water, the mass and flow speed of the blocks, the thermal mass of the line, and the tolerable temperature fluctuation at the battery. It is self-evidently possible for the stated measures to be used individually or in combination.

It is advantageous in this context for the heat exchanger to be designed as a passive water/air heat exchanger. In such an arrangement, it is advantageously the case not only that the thermal mass of the passive heat exchanger has a damping action on temperature fluctuations of the heat carrier in the second cooling/heating circuit, but rather also that excess heat energy is dissipated to the environment. The supply temperature from a fuel-operated heater or an internal combustion engine, which is itself excessively high, can thus be effectively lowered to a level suitable for the battery. Since the heating of the battery takes place predominantly at a standstill, an excess dissipation of heat can be kept within limits by way of a passive heat exchanger.

It is also particularly advantageous for the heat exchanger to be connected to a third cooling/heating circuit. It is preferable if, in a first operating state, the first and the second heating/cooling circuit are operatively and/or fluidically connected by way of the at least one valve, whereby a heat exchanger which is additionally provided in the second heating/cooling circuit and which is operatively and/or fluidically connected to a third heating/cooling circuit is deactivated. In a second operating state, the first and the second heating/cooling circuit are operatively and/or fluidically disconnected from one another by way of the at least one valve, whereby the additionally provided heat exchanger is activated. In this case, the second heating circuit thus not only serves for heating the battery, but also for cooling the battery, and thus performs a dual function. Furthermore, in the heating mode, the heat exchanger acts as a thermal mass, resulting in considerably smaller temperature fluctuations of the heat carrier at the battery in particular when a cyclically operated switching valve is used. In the heating mode, the heat exchanger thus acts as a damper, and thus performs a dual function together with its cooling function.

It is also advantageous if the heat source is formed by an electric motor, and/or a generator, and/or an inverter, because in these cases, the supply temperature is generally considerably lower than the supply temperature of a fuel-operated heater or of an internal combustion engine. The
described problems associated with a relatively high supply temperature can be once again considerably alleviated in this way. Furthermore, waste heat generated in any case by the stated assemblies can be used for heating the battery, without the fuel-operated heater additionally having to be activated.

[0026] It is furthermore particularly advantageous if a charging unit for the battery is arranged in the second heating/cooling circuit between the valve and the battery. A battery charging unit for charging the battery from a fixed electricity network is often provided in a motor vehicle. By way of the stated measure, the battery charging unit can serve for actively heating the battery using the waste heat thereof or can serve as a damping thermal mass when the battery is heated by way of the heat source arranged in the first heating circuit. In this way, the battery charging unit performs multiple functions.

[0027] In accordance with embodiments, the motor vehicle includes a bypass fluid line which is situated parallel to the charging unit and at least one valve which is provided for conducting the heat exchanger selectively via the charging unit or via the bypass line. In this way, the battery charging unit can be coupled out of the heating/cooling circuit, for example, when only the battery is to be cooled.

[0028] It is additionally advantageous if the first heating/cooling circuit is provided for heating/cooling and the third cooling/heating circuit is provided for cooling/heating a passenger compartment of the motor vehicle. In this way, the heating/cooling circuits can be used for multiple functions, or already existing heating/cooling circuits for the air conditioning of a passenger compartment can also be utilized for controlling the temperature of the battery. In this way, the embodiments can be implemented in reality with relatively little outlay.

[0029] It is also particularly advantageous if the valve for operatively and/or fluidically connecting the first and the second heating/cooling circuit is arranged in the first heating/cooling circuit between a heat exchanger for heating/cooling the passenger compartment and the heat source. The supply temperature for the second heating circuit can be lowered in this way. The described problems associated with a relatively high supply temperature can be once again considerably alleviated in this way.

[0030] Generally, an advantage of embodiments of the invention is that components already provided in a motor vehicle are used for the temperature control of the battery, and thus, serve a dual purpose. In this way, embodiments of the invention can be implemented in reality with relatively little outlay. At the same time, despite comprehensive functionality, the motor vehicle weight remains substantially constant. The benefit of embodiments of the invention is thus particularly pronounced.

[0031] In the above examples, it has in part been assumed that the first circuit is a heating circuit and the third circuit is a cooling circuit. Embodiments of the invention are, however, self-evidently also applicable analogously to systems in which the first circuit is formed as a cooling circuit and the third circuit is formed as a heating circuit. In general, the boundaries between cooling circuit and heating circuit are loosely defined, because in principle, it is merely the case that heat is transmitted from one location to another, and the designation “heating” or “cooling” is dependent substantially on the viewpoint of the observer.

[0032] The above embodiments and refinements of the invention may be combined with one another in any desired manner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] Embodiments of the invention will be explained in more detail below on the basis of the exemplary embodiments depicted in the schematic figures of the drawing, in which:

[0034] FIG. 1 illustrates a block circuit diagram of an exemplary heating system for a battery of a motor vehicle.

[0035] FIG. 2 illustrates the heating system of FIG. 1, but includes an additional cooling circuit.

[0036] FIG. 3 illustrates the heating system of FIG. 2, but includes an additional cooling system for the drivetrain of the motor vehicle.

[0037] FIG. 4 illustrates the heating system of FIG. 3, but includes a battery charging unit integrated into the heating/cooling circuit of the battery.

DETAILED DESCRIPTION OF EMBODIMENTS

[0038] As illustrated in FIG. 1, embodiments include a first heating/cooling circuit 1 with a heat source 2 arranged therein, and a first pump 3, and a second heating/cooling circuit 4 with a battery 5 to be heated arranged therein and a second pump 6. The first heating circuit 1 and the second heating circuit 4 can be operatively and/or fluidically connected by way of a valve 7 such that the same liquid heat carrier flows through them. Specifically, the valve 7 is designed as a cyclically operated switching valve, whereby the heat exchange between the first and the second heating circuit 1 and 4 can be selectively adjusted. Alternatively, the valve 7 may also be designed as a mixing valve. The first heating circuit 1 further includes a check valve 8 which is arranged between the two connecting lines to the second heating circuit 4, a heat exchanger 10 which is arranged in a passenger compartment 9 of a motor vehicle which includes the arrangement illustrated in FIG. 1, and a compensation vessel 11.

[0039] The function of the arrangement illustrated in FIG. 1 is now explained as follows. By way of the heat source 2, heat is generated and transmitted to a liquid heat carrier, which liquid heat carrier is set in motion by the pump 3 and circulates anticlockwise in the first heating circuit 1. The heat source 2 may, for example, be designed as a fuel-operated heater and operated with a fuel which is also used for driving the motor vehicle, for example, gasoline, diesel or gas. The passenger compartment 9 can now be heated, in a manner known per se, by way of the heat exchanger 10. To be able to compensate for volume fluctuations of the heat carrier, the compensation vessel 11 arranged in the first heating circuit 1 is provided. The first heating circuit 1 thus performs the function of a standstill heater, such as is known per se, for a motor vehicle.

[0040] In electrically driven vehicles, the traction battery 5 should, for optimum functioning, be at a specific temperature. In particular, in the presence of low outside temperatures, the battery 5 can be heated for this purpose. It is a problem here that the fuel-operated heater 2 generally delivers a temperature too high for heating the battery 5. For example, a fuel-operated heater 2 delivers a temperature of approximately between 75-85° C, whereas the temperature of the heating medium at the battery 5 should be, where possible, no more than approximately 20° C, higher than the battery tempera-
The battery 5, therefore, cannot be incorporated directly into the first heating circuit 1. Instead, heat is extracted from the first heating circuit 1 and supplied to the second heating circuit 4 in a targeted manner by way of the valve 7. For this purpose, the switching valve 7 is switched in a cyclic manner, that is to say at a relatively high frequency, between the illustrated first valve position and the second valve position (not illustrated position). By varying the duration of the first valve position in relation to the duration of second valve position, a greater or lesser amount of heat can be extracted from the first heating circuit 1 and supplied to the second heating circuit 4. Such an operating mode of the switching valve 7 is known per se and is referred to as "pulse width modulation" (PWM). Furthermore, the supply of heat into the second heating circuit 4 can be influenced through corresponding actuation of the pump 3 and/or of the pump 6.

In the first valve position, the heat carrier, driven by the pump 6, circulates counter-clockwise in the second heating circuit 4 and is isolated from the first heating circuit 1. In the second valve position, the first heating circuit 1 and the second heating circuit 4 are operatively and/or fluidically connected. Accordingly, the first valve position and the second valve position alternate with one another during operation. When the valve 7 is in valve position 2, the check valve 8 prevents the heat carrier from being forced by the pump 6 counter to the actual flow direction in the first heating circuit 1. With suitable arrangement of the branching points, the check valve 8 may also be dispensed with if a backward flow can be prevented by the pressure conditions prevailing here.

The switching of the valve 7 occurs so quickly that, in a manner of speaking, "blocks" or volumes of the hot heat carrier passing from the first heating circuit 1 and "blocks" or volumes of the relatively cool heat carrier circulating in the second heating circuit 4 arrive in an alternating manner at the pump 6, and are swirled or otherwise mixed by the pump. The heat carrier thus arrives at the battery 5 with a homogeneous temperature, or has only temperature fluctuations that cannot cause damage to the battery 5.

In FIG. 1, the valve 7 is designed as a cyclically operated switching valve 7. It is, however, likewise possible for a mixing valve to be provided instead of the cyclically operated switching valve 7. A pulse-width-modulated (PWM) valve actuation device with digital output may then be dispensed with, but in general, for the actuation of a mixing valve, an analogue or PWM output of a controller operatively and/or fluidically connected to the mixing valve is necessary.

In FIG. 1, the valve 7 is still arranged upstream of the heat exchanger 10. It is, however, also alternatively possible for the valve 7 to be arranged downstream of the heat exchanger 10. The heat exchanger is then advantageously already cooled slightly, as a result of which the switching frequency of the switching valve 7 can be reduced. The two connecting lines between the first heating circuit 1 and the second heating circuit 4 respectively, and the check valve 8 should in this case be arranged in the line portion A between the heat exchanger 10 and the fuel-operated heater 2.

FIG. 2 illustrates an embodiment of an arrangement which includes a heat exchanger 12 is provided in the second heating circuit 4 between the valve 7 and the battery 5, which heat exchanger is operatively and/or fluidically connected to a third cooling circuit 13. The third cooling circuit 13 includes a compressor 14, a condenser 15, a dryer 16, a shut-off valve 17, a thermostatic expansion valve 18, and an evaporator 19.
[0054] A long line may be provided upstream of the battery 5, which long line has a similar action to the heat exchanger 12. The long line acts as a thermal mass, whereby likewise an equalization of the different temperatures of the heat carrier is attained. It is self-evidently possible for the stated measures to be used individually or in combination.

[0055] FIG. 3 illustrates an embodiment of an arrangement which includes a fourth cooling circuit 22, in which a coolant circulates counter-clockwise and which is driven by a pump 23. In the cooling circuit 22 there are arranged a DC/DC converter 24, a DC/AC converter 25, an electric motor 26 and a heat exchanger 27. In a branch situated parallel to the DC/AC converter 25 and electric motor 26, there are arranged a further DC/AC converter 28 and a generator 29. A compensation vessel 30 is additionally provided in the cooling circuit 22.

[0056] The arrangement also includes a fifth cooling circuit 31 in which a pump 32, an internal combustion engine 33, a switching valve 34 and a heat exchanger 35 are arranged. In the region of the heat exchangers 27 and 35, there is also provided a fan 36. The arrangement finally comprises a battery charging unit 37 with installed cooling fan.

[0057] The function of the arrangement illustrated in FIG. 3, in particular of the assemblies provided in addition to FIG. 2, is explained as follows. The DC/DC converter 24, the DC/AC converter 25 and the electric motor 26 serve for the drive of the vehicle, whereby the DC/AC converter 25 transforms, in a manner known per se, the direct-current voltage of the battery 5 into an alternating-current voltage required for the electric motor 26 which is usually in the form of a synchronous motor or asynchronous motor. The DC/DC converter 24 converts the voltage of the battery 5, which is generally a few hundred volts, into a low voltage (for example 12V) which is required for peripheral units such as actuating motors, entertainment systems, navigation systems, illumination and the like. It is pointed out at this juncture that, for improved clarity, the electrical connections are not shown in the figures.

[0058] The internal combustion engine 33 is operatively and/or mechanically coupled to the generator 29, which charges the battery 5 by way of the DC/AC converter 28 when required, or supplies electrical energy to the electric motor 26. The internal combustion engine 33 thus forms a "range extender" such as is known per se. Finally, the battery charging unit 37 is provided for charging the battery 5 from a fixed electricity network.

[0059] To keep the stated assemblies at an optimum operating temperature, the assemblies are cooled, i.e., there temperature is reduced, to prevent overheating. The DC/DC converter 24, the DC/AC converter 25, the electric motor 26, the DC/AC converter 28 and the generator 29 are cooled by way of the heat exchanger 27 (cooling circuit 22). The fan 36 may be activated for enhanced cooling power as required.

[0060] The internal combustion engine 33 is cooled by way of the heat exchanger 35 (cooling circuit 31), whereby likewise, the fan 36 may be activated for improved cooling power. In order that the internal combustion engine 33 can warm up until it reaches its optimum operating temperature, the switching valve 34 is provided which conducts the heat carrier initially only via the pump 32 and the internal combustion engine 33 and then later also via the heat exchanger 35.

[0061] In accordance with embodiments, the waste heat of the internal combustion engine 33 is also conducted via the heat exchanger 10, whereby the passenger compartment 9 can be heated, in a manner known per se, by way of the internal combustion engine 33. Likewise, the waste heat of the internal combustion engine 33 may also be conducted via the battery 5 in order to heat the battery 5 as required. The heat source for heating the battery 5 is thus in this case formed by the internal combustion engine 33. In order that the pumps 3, 6 and 32 do not have an adverse influence upon the coupling of the heating circuits 1, 4 and 31, that is to say in order that the heat carrier cannot be forced counter to its intended flow direction, additional check valves 38 and 39 are also provided in the arrangement illustrated in FIG. 3. With suitable arrangement of the branching points, the check valves 38 and/or 39 may be dispensed with if a backward flow can be prevented by the pressure conditions prevailing here.

[0062] In FIG. 3, the fuel-operated heater 2 and the internal combustion engine 33 are provided as heat sources for the heating of the passenger compartment 9 and the battery 5. It is self-evidently also conceivable for the heat source to alternatively or additionally be formed by the electric motor 26, and/or the generator 29, and/or by one or more of the inverters 24, 25 and 28. In this case, the cooling/heating circuit 22 would have to be operatively and/or fluidically connected to the heating circuit 1 or 4 respectively.

[0063] FIG. 4 illustrates an embodiment of an arrangement in which the battery charging unit 37 does not have an installed fan but rather is integrated into the second heating/cooling circuit 4. Specifically, the battery charging unit 37 is arranged between the valve 7 and the battery 5. Additionally provided are a bypass line, which is situated parallel to the charging unit 37, and a valve 40, which is provided for conducting the heat carrier selectively via the charging unit 37 or via the bypass line.

[0064] In the illustrated position of the valve 40, the charging unit 37 can be cooled by way of the heat exchanger 12 (or by way of an air/coolant heat exchanger which is arranged in the second heating/cooling circuit 4 but which is not illustrated in FIG. 4). The charging unit 37 may additionally also serve as a heat source for heating the battery 5 and also the passenger compartment 9. Finally, the charging unit also serves as a thermal mass when the battery 5 is heated by way of the fuel-operated heater 2 or the internal combustion engine 33, such that the temperature fluctuations of the heat exchanger caused by the switching of the valve 7 are substantially compensated. In this way, the battery charging unit 37 performs multiple functions. By actuation of the valve 40, the battery charging unit 37 can be operatively and/or fluidically disconnected from the second heating/cooling circuit 4, for example, if only the battery 5 but not the battery charging unit 37 is to be cooled.

[0065] By utilizing the thermal mass of the heat exchanger ("chiller") 12, which is often provided in any case in a cooling circuit 4 for cooling the battery 5, and/or by utilizing the thermal mass of a battery charging unit 37, which is generally likewise provided on board a vehicle, it is possible for the temperature fluctuations of the heat carrier caused by a switching valve 7 to be considerably reduced. Furthermore, it is possible for the switching valve 7 to be cycled at a relatively low frequency without a stipulated maximum temperature of the battery 5 being exceeded. The service life of the switching valve 7 can thus be extended considerably.

[0066] Advantages of embodiments are, however, also attained due to the damping by the thermal masses, when an analogue-controlled mixing valve is used. A regulation device for actuating the mixing valve, and the actuating motor
of the mixing valve itself, need not exhibit very fast response. It is thus possible to install components which are of relatively simple construction and are thus also inexpensive.

[0067] In accordance with embodiments, it has been assumed that the first circuit 1 is a heating circuit and the third circuit 13 is a cooling circuit. Such embodiments, however, are not limited to such a design, and thus, are also applicable analogously to systems in which the first circuit 1 is formed as a cooling circuit and the third circuit 13 is formed as a heating circuit. In general, the boundaries between cooling circuit and heating circuit are loosely defined, because for example, the circuit 31 cools the internal combustion engine 33 but heats the heat exchanger 10 and the battery 5. In this respect, the expression “cooling/heating circuit” can generally be used for the circuits 1, 4, 13, 22 and 31.

[0068] In general, the amount of heat or thermal power transferred can also be influenced, in a manner known per se, by variation of the power of the pumps 3, 6 and 32 that are used, of the compressor 14, and of the fan 36. For example, virtually all of the waste heat of the internal combustion engine 33 can be used if the fan 36 is deactivated and the pump 32 runs at full power, etc.

[0069] In accordance with embodiments, it has furthermore been assumed that the heat exchanger 12 is an evaporator/chiller. Embodiments are not, however, limited to such a design. For example, the heat exchanger 12 may also be a passive heat exchanger, in particular, a water/air heat exchanger with cooling fins exposed to the environment. The heat exchanger 27 and/or 35 can also be operatively and/or fluidically connected to the second cooling/heating circuit 4, preferably by way of a switching valve analogous to the valve 40. In such an arrangement, it is advantageously the case not only that the thermal mass of the passive heat exchanger has a damping action on temperature fluctuations of the heat carrier in the second cooling/heating circuit 4, but also that excess energy is discharged to the environment. The excessively high supply temperatures of, for example, between 90 to 110° C. of the internal combustion engine 33 can thus be lowered in an effective manner to a level suitable for the battery 5. Since the heating of the battery 5 takes place predominantly at a standstill, an excessive dissipation of heat by a passive heat exchanger can however be kept within limits.

[0070] It is stated finally that the components in the figures are not necessarily illustrated true to scale, and that the individual variants illustrated in the figures may also form the subject matter of an independent invention. Spatial definitions such as “right”, “left”, “top”, “bottom” and the like relate to the illustrated position of the respective component, and should be appropriately mentally adapted in the event of a change to the specified position. It is also pointed out that the individual cooling/heating circuits may also have more components than illustrated or fewer components than illustrated, without thereby departing from the basic concept of the present invention.

[0071] Although embodiments have been described herein, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. A motor vehicle comprising:
   a first heating/cooling circuit with a heat source/sink arranged therein and a first pump;
   a second heating/cooling circuit with a battery arranged therein and a second pump; and
   a valve configured to selectively fluidically connect the first heating/cooling unit and the second heating/cooling circuit to each other such that a same fluid flows through the first heating/cooling unit and the second heating/cooling circuit in order to heat/cool the battery.

2. The motor vehicle of claim 1, wherein:
   the valve comprises a mixing valve; and
   heat exchange between the first heating/cooling unit and the second heating/cooling circuit is selectively adjustable by way of the mixing valve.

3. The motor vehicle of claim 1, wherein:
   the valve comprises a cyclically operated switching valve; and
   heat exchange between the first heating/cooling unit and the second heating/cooling circuit is selectively adjustable by way of the cyclically operated switching valve.

4. The motor vehicle of claim 1, further comprising:
   at least one of a heat exchanger, a reservoir, a fluid turbulence generator, and a fluid line provided in the second heating/cooling circuit between the valve and the battery.

5. The motor vehicle of claim 1, further comprising a heat exchanger, a reservoir, a fluid turbulence generator, and a fluid line provided in the second heating/cooling circuit between the valve and the battery.

6. The motor vehicle of claim 5, wherein the heat exchanger comprises a passive water/air heat exchanger.

7. The motor vehicle of claim 5, further comprising a third cooling/heating circuit fluidically connected to the heat exchanger.

8. The motor vehicle of claim 1, wherein the heat source/sink comprises a fuel-operated heater.

9. The motor vehicle of claim 1, wherein the heat source/sink comprises the internal combustion engine of the motor vehicle.

10. The motor vehicle of claim 1, wherein the heat source/sink comprises at least one of an electric motor, a generator, and an inverter.

11. The motor vehicle of claim 1, further comprising a charging unit for the battery, the charging unit being arranged in the second heating/cooling circuit between the valve and the battery.

12. The motor vehicle of claim 11, further comprising a bypass fluid line which is situated parallel to the charging unit and by at least one second valve which is provided for conducting the heat carrier selectivity via the charging unit or via the bypass fluid line.

13. The motor vehicle of claim 7, wherein:
   the first heating/cooling circuit is configured to heat/cool; and
   the third cooling/heating circuit is configured to cool/heat a passenger compartment of the motor vehicle.

14. The motor vehicle of claim 13, further comprising a heat exchanger for heating/cooling the passenger compartment, wherein the valve is provided in the first heating/cooling circuit between the heat exchanger and the heat source.
15. A method of operating a motor vehicle comprising: providing the motor vehicle with a first heating/cooling circuit with a heat source/sink arranged therein, a second heating/cooling circuit with a battery arranged therein, and a valve configured to fluidically connect the first heating/cooling unit and the second heating/cooling circuit; and selectively switching the valve between an opened position and a closed position such that the battery is heated/ cooled via the fluid through the first heating/cooling unit and the second heating/cooling circuit.

16. The method of claim 15, wherein: in a first operating state, the first heating/cooling circuit and the second heating/cooling circuit are fluidically connected by way of the valve; and in a second operating state, the fluidic connection between the first heating/cooling circuit and the second heating/cooling circuit is disconnected by way of the valve.

17. The method of claim 16, further comprising: providing a heat exchanger provided in the second heating/cooling circuit; and providing a third cooling/heating circuit fluidically connected to the heat exchanger.

18. The method of claim 17, wherein: in the first operating state, the heat exchanger is deactivated; and in the second operating state, the heat exchanger is activated.

19. A motor vehicle comprising: a first heating/cooling circuit through which a fluid flows; a heat source/sink provided in the first heating/cooling circuit; a second heating/cooling circuit through which the fluid flows; a battery provided in the second heating/cooling circuit; and a valve configured to fluidically connect the first heating/cooling unit and the second heating/cooling circuit such that fluid flows through the first heating/cooling unit and the second heating/cooling circuit such that the battery is heated/cooled via the fluid.