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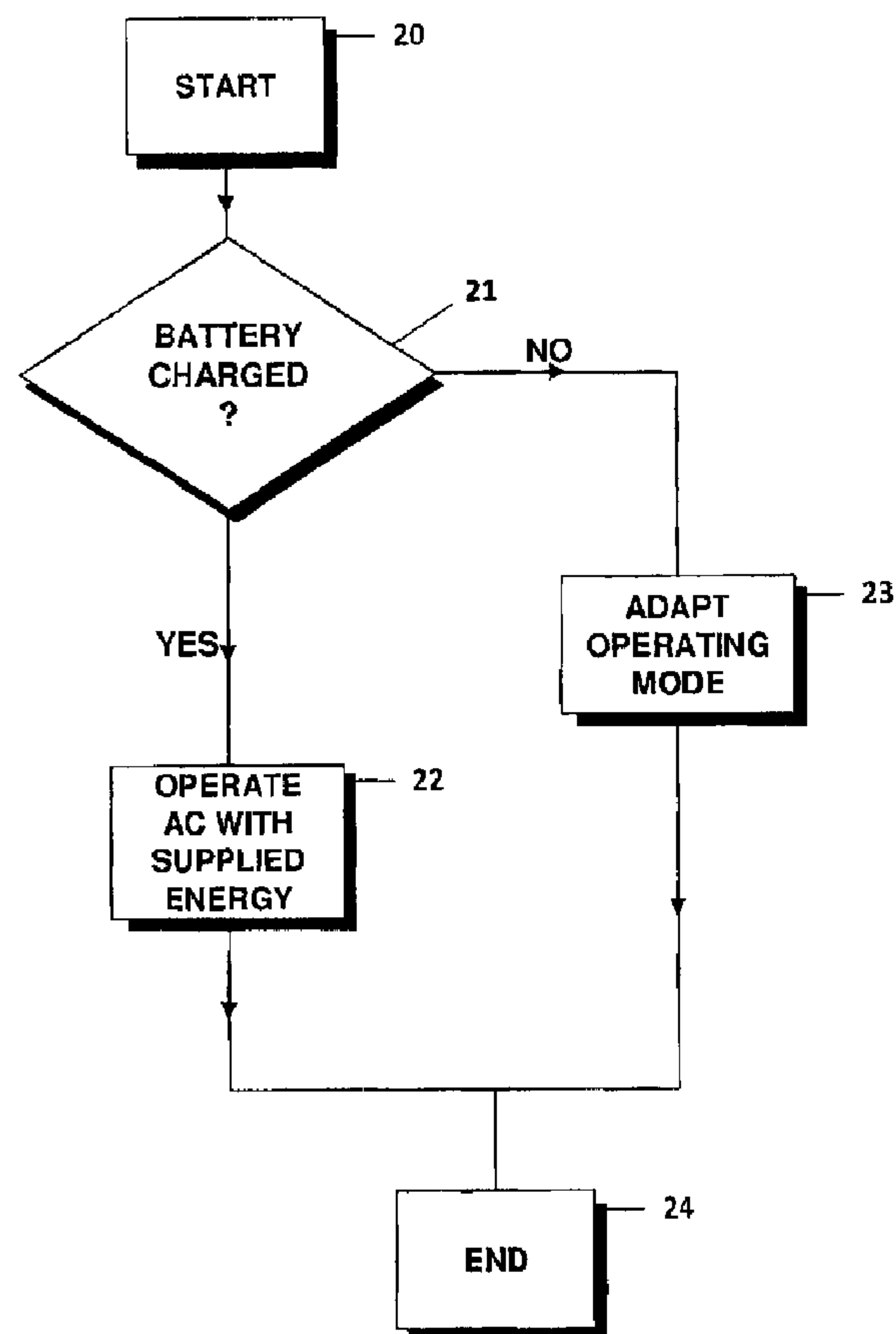
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(54) Titre : CONTROLE EFFICACE DE L'ENERGIE D'UN SYSTEME DE CONDITIONNEMENT DE L'AIR

(54) Title: ENERGY-EFFICIENT CONTROLLING OF AIR CONDITIONING SYSTEM



(57) Abrégé/Abstract:

The invention relates to an air conditioning system of an at least partly electrically driven vehicle. The system comprises: an air conditioning module (10) controlling a temperature inside the vehicle, an air conditioning controller (11) controlling an operation of

(57) **Abrégé(suite)/Abstract(continued):**

the air conditioning module, and a detector (13) configured to detect when a vehicle battery (12) that is used for driving the vehicle is charged by supplied energy. When the detector (13) detects that the vehicle battery (12) is being charged, the air conditioning controller uses the supplied energy directly to drive the air conditioning module.

ABSTRACT**5 Energy-efficient controlling of air conditioning system**

The invention relates to an air conditioning system of an at least partly
electrically driven vehicle. The system comprises: an air conditioning module
10 (10) controlling a temperature inside the vehicle, an air conditioning
controller (11) controlling an operation of the air conditioning module, and a
detector (13) configured to detect when a vehicle battery (12) that is used for
driving the vehicle is charged by supplied energy. When the detector (13)
detects that the vehicle battery (12) is being charged, the air conditioning
15 controller uses the supplied energy directly to drive the air conditioning
module.

Energy-efficient controlling of air conditioning system

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The present application relates to an air conditioning system of at least partly electrically driven vehicle and to a method for operating the air conditioning system.

10 Related Art

An air conditioning system of an electrically driven vehicle also drains the battery regardless of whether it has to warm up or cool down the vehicle interior, especially if the same strategies are used as for vehicles with
15 combustion engines. In the case of at least partly electrically driven vehicles the operating range of the vehicle is an important factor, as the operating range of an at least partly electrically driven vehicle is normally much smaller than the operating range of a vehicle with a combustion engine. The power consumption of modules provided in the vehicle that are not needed to
20 drive the vehicle has to be minimized. An air conditioning system is an element in the vehicle that has a fairly large power consumption compared to other modules provided in the vehicle.

Accordingly, a need exists to provide an air conditioning system with which
25 the energy consumption provided by the vehicle battery is minimised.

Summary

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According to a first aspect, an air conditioning system of an at least partly electrically driven vehicle is provided, the system comprising an air conditioning module controlling a temperature inside the vehicle. An air conditioning controller controls an operation of the air conditioning module.

5 Furthermore, a detector is provided configured to detect when a vehicle battery that is used for driving the vehicle is charged by supplied energy. When the detector detects that the vehicle battery is being charged, the air conditioning controller uses the supplied energy directly to drive the air conditioning module. Thus, when the vehicle battery is being charged,

10 instead of charging the vehicle battery and then using the vehicle battery to operate the air conditioning system, the supplied energy is at least partly used to drive the air conditioning module. This does not mean that the complete energy supplied to the battery is used for operating the air conditioning module. However, the energy that is needed to operate the air

15 conditioning module is deduced from the energy supplied to the vehicle battery instead of charging the battery. This part of the supplied energy is used to directly drive the air conditioning module. As buffering of the electrical energy into batteries or super caps results in a loss being imposed, it is more efficient to directly drive the air conditioning module with the

20 supplied energy instead of storing it first in the battery and then using this stored energy in the battery to drive the air conditioning module.

For at least partly electrically driven vehicles energy may be supplied to the battery in two different situations: the energy is either supplied by a

25 charging station when the vehicle is at rest directly before the vehicle is used, or energy is supplied to the battery using the motor as a generator when the vehicle is driving and when a brake of the vehicle is activated. For determining whether energy supplied to a vehicle, when the vehicle is not running, is used to drive the air conditioning module a database may be

30 provided containing a timetable in which information is contained on when the vehicle will be used next. The detector can now be configured to detect if

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the vehicle engine is running or not and when the detector detects that the vehicle engine is not running, the air conditioning controller uses the supplied energy to drive the air conditioning module in dependence on the fact of when the vehicle will be used next. When the vehicle is not running
5 the supplied energy is coming directly from a charging station. When it can be deduced from the timetable that the vehicle will be used in the near future, e.g. within a predetermined period of time, the vehicle interior can be preconditioned as long as it is in the charging mode. The energy that is needed to initially set the interior of the vehicle to a desired temperature does not
10 unload the battery as it comes directly from the charging station.

It should be understood that the term "timetable for containing information on when the vehicle will be used next" is not limited to a timetable physically stored in a database located within the vehicle. The timetable may be rather
15 stored centralized on servers located remotely from the vehicle. Via a data connection, the vehicle may be in contact with such a server. In another embodiment, the vehicle may access schedules or appointments of a user, for example in the form of an organizer, in order to analyze this data to predict when the user is likely to use the vehicle next. Therefore, the term
20 "timetable" may refer to various forms of data stored in different locations within and without the vehicle. In particular, the term "timetable" is not limited to a database located within the vehicle.

During driving the air conditioning controller may be configured to use route
25 information provided by a navigation module in order to determine when and how the air conditioning module will be operated. A navigation module usually contains map data that are used to calculate a route to a desired destination. The map data includes altitude information, speed limits and information about the curvature. As a consequence it can be predicted when
30 the vehicle brake will be activated if the vehicle is driving along the calculated route. Based on the braking events the amount of energy supplied

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to the vehicle battery can be predicted. The amount of energy and the frequency at which energy is supplied to the battery can then be used to determine whether the air conditioning module can be operated only by energy not provided by the battery.

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Route information and details associated thereto provided by the navigation module are commonly referred to as the electronic horizon. The electronic horizon contains information on speed limits, altitude information, and information about the curvature of the route ahead. Based on such
10 information, it is not only possible to calculate the occurrence of braking events in the future. It is furthermore possible to calculate situations where the driver is not actively braking, but is, at the same time, not requiring a drive force. This means, that the driver does not activate the gas pedal. Such a situation is referred to as free-wheeling. There is no need to accelerate the
15 vehicle, rather, a slow deceleration is intended. In such a situation, it is possible to have the clutch engaged, and by the inertia of the moving vehicle drive the motor functioning as a generator via the turning of the wheels. By this, energy is supplied. The amount of supplied energy and the number of occurrences at which this energy is supplied can be used to determine
20 whether the air conditioning module can be operated only by this kinetic energy which is transferred into electrical energy. It should be understood that the term "free-wheeling" does not mean that no kinetic energy is transformed intentionally into electrical energy in order to operate electric consumers within the vehicle. Rather, it can be acceptable to convert a
25 certain amount of kinetic energy per time into electrical energy and therefore reduce the velocity of the vehicle during free-wheeling by a certain amount per time. This means that, during free-wheeling, additionally to the standard decelerating forces such as friction and wind resistance, a further decelerating force may act which is due to the conversion of kinetic energy
30 into electrical energy.

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The amount of kinetic energy provided by the turning of the wheels and the gears of the vehicle and converted into electrical energy via the generator per time unit depends on the amount of electrical loads connected to the generator. Therefore, if the air conditioning module is operated by energy
5 directly from the generator (and not via the battery) and if the air conditioning is running at a level of high power consumption, more kinetic energy per time will be converted into electrical energy. This, at the same time, corresponds to a quicker deceleration of the vehicle.

10 One possible solution to drive the air conditioning system would be that the air conditioning controller only operates the air conditioning module when the detector detects energy being supplied to the battery, this energy being partly used to directly drive the air conditioning module. When energy is not being supplied to the battery, the air conditioning module would not operate
15 at all. In an alternative solution it is also possible to reduce the power of the air conditioning module when no energy is supplied to the battery so that the air conditioning module has to be operated using the energy stored in the battery.

20 The air conditioning system may consider the temperature inside the vehicle at the current moment in time, the temperature outside the vehicle at the current moment in time, as well as a desired set temperature range. The set temperature range may be specified by a minimum and a maximum temperature. An air conditioning controller system may be configured to
25 calculate the operating state of the air conditioning based on these three temperature parameters, as well as the electronic horizon. For example, the air conditioning controller can calculate the positions along the route where the air conditioning module is not operating at all, for example, because at these positions the temperature inside the car is within the set temperature
30 range. Another possibility why the air conditioning module is not operating, would be that there is no electrical energy provided from, e.g. braking or

free-wheeling. It could be more energy-efficient to postpone the operating of the air conditioning module to a later moment in time, when energy is provided to the system from, e.g. braking or free-wheeling.

5 Moreover, the calculation of the operating strength of the air conditioning module may include calculation of the power consumption of the air conditioning module when operating. For example, by adjusting the temperature of the cooled air and adjusting the number of used outlets, this means adjusting the volume of the cooled air per time, the power
10 consumption can be either increased or decreased. By calculation of the power consumption, the air conditioning controller is able to calculate an equivalent load of the air conditioning module. For example, if the cooled air has a very low temperature if compared to the ambient temperature, this corresponds to a high load of the air conditioning module, which, in turn,
15 results in a large power drain from the generator. In case of free-wheeling, this corresponds to a larger deceleration value of the vehicle, because the rate of conversion of kinetic energy into electrical energy is larger. Therefore, for a fixed decrease in temperature, the time period where energy is provided to the system from, e.g. free-wheeling, is reduced. Therefore, once a strength
20 of air conditioning operation has been calculated, this can be iteratively used to calculate the time spans during which energy is provided to the system which can be used to directly drive the air conditioning module.

Using such an approach to drive the air conditioning module may be
25 accompanied by calculating a temperature profile of the temperature inside the vehicle over the entire planned route. For every moment in time between the origin and the destination of the route, the system may calculate whether energy is supplied to the system via braking or free-wheeling, may calculate the operating state of the air conditioning module, and, based on
30 this information, may calculate the inside temperature of the vehicle. Depending on the set temperature range, which can be selected, or example

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by a user, the system may operate the air conditioning module only during periods where energy is provided to the system or also operate the air conditioning module during times where no energy is supplied to the system, this means operate the air conditioning module by energy provided from the
5 battery.

In particular, it is possible to adapt the operation state of the air conditioning module such that the amount of energy withdrawn from the battery is minimized. From the calculated temperature profile, it can be
10 estimated when the temperature rises above the maximum temperature specified for example by the user. In order to minimize the amount of energy withdrawn from the battery, it can be possible to operate the air conditioning at times where energy is provided to the system from, e.g. free-wheeling or braking, at a high level of operating strength. Then the temperature inside
15 the car may drop towards the minimum temperature of the set temperature range and later on, during times when no energy is provided to the system from braking or free-wheeling, rise within the set temperature range. The system can calculate based on the calculated temperature profile when it becomes necessary to operate the air conditioning module by energy
20 withdrawn from the battery. Based on this, points in time or time periods of operation of the air-conditioning module as well as the operation strength of the air conditioning module can be chosen such that the amount of energy withdrawn from the battery is minimized.

25 The invention furthermore relates to a method for operating the air conditioning system on which a charging of the vehicle battery by supplied energy is detected, and when it is detected that the vehicle is being charged, the supplied energy is used directly to drive the air conditioning module.

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Brief description of the drawings

The invention will be described in further detail with reference to the accompanying drawings, in which

5 Fig. 1 is a systematic view of an air conditioning system that can be operated with minimized energy provided by a vehicle battery,

Fig. 2 shows a flow-chart containing steps carried out in operating the air conditioning system of Fig. 1,

10 Fig. 3 shows a flow-chart containing the steps of an alternative way how to operate the air conditioning system, and

Fig. 4 is a systematic view of an air conditioning system that allows to be operated with minimized energy provided from the vehicle battery.

Detailed description

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In Fig. 1 a system is shown allowing an energy-efficient controlling of an air conditioning system. The system comprises an air conditioning module 10 that is used to warm up or cool down a vehicle interior (not shown). The air conditioning module is controlled by an air conditioning controller 11 that
20 controls the operating of the air conditioning module 10. A user of the air conditioning system shown in Fig. 1 can set a desired temperature using an input unit (not shown), the air conditioning controller controlling the air conditioning module in such a way that the temperature desired by the user inside the vehicle will be reached.

25

Furthermore, a vehicle battery 12 is shown, the battery being the battery that is used to at least partly drive the vehicle. The vehicle may be a purely electrically driven vehicle or a hybrid vehicle that is driven by a combustion engine and at least partly by the battery 12. The battery 12 is charged either
30 by a charging station 16 when the vehicle is not moving using a wired connection between the charging station and the vehicle battery. The vehicle

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can furthermore be charged during driving by a generator 17 provided in the vehicle that generates power when the vehicle is running, e.g. during braking or in other driving situations such as downhill driving. The supplied energy is symbolized by the arrow shown in Fig. 1. The air conditioning system
5 furthermore comprises a charging control unit/detector 13 that is configured to detect when energy is being supplied to the vehicle battery. In the example shown the detector is provided as a separate unit. However, it should be understood that the detector 13 may also be provided in the air conditioning controller 11 and may be designed as a separate entity or may be part of
10 another entity provided in the vehicle. When the detector detects that energy is being supplied to the battery the air conditioning controller is configured such as to use part of the supplied energy to directly operate the air conditioning module 10 instead of storing it in the battery first and then using the stored energy to operate the air conditioning module.

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The detector 13 can furthermore detect whether the vehicle engine is running or not. When the vehicle is not running and energy is being supplied to the battery, the supplied energy is transmitted from a charging station. The system shown in Fig. 1 can furthermore comprise a database
20 with a timetable 14 from which the operating times of the vehicle can be deduced. The timetable 14 can be part of a personal digital assistant, PDA, of the driver or of a mobile phone of the driver from where it can be deduced when the vehicle will be probably be used next. The timetable can further include information about the usual driving behaviour in the past. By way of
25 example the timetable can contain information that the vehicle is usually used in the morning to drive to work and in the afternoon to drive back.

If it is possible to deduce from the timetable that the vehicle will be used in a predetermined period of time, e.g. within the next hour, the air conditioning
30 controller 11 can use the amount of supplied energy needed to operate the air conditioning module 10 directly from the charging station. The vehicle

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may furthermore contain a navigation module 15 that is used to calculate a route to a desired destination. As it is known to those skilled in the art the navigation module 15 uses map data to calculate the best route to a destination provided by the user. When a route has been calculated by the navigation module or when the driving direction is clear as there are no possibilities to branch away from the present route, the map data can be used to determine when energy will be supplied to the battery with a high likelihood. The map data can be used to predict braking situations, the braking allowing the generator of the at least partly electrically driven vehicle to generate energy supplied to the battery. The map data allows a consideration of altitude profiles and up-coming speed limits. By way of example when it can be deduced from the map data that an urban agglomeration will be reached at a certain part of the route where the vehicle velocity has to be drastically reduced, the braking induced energy can be used to drive the air conditioning module 10.

The air conditioning controller can operate the air conditioning module in different operating modes. In one operating mode the air conditioning module is only used when energy is being supplied to the battery. If the vehicle cabin should be kept at a predetermined temperature level, the air conditioning module need not be operated continuously. It might be sufficient to only temporarily operate the air conditioning module to obtain a certain temperature level. In another embodiment, if it is detected that the desired temperature will not be obtained when the air conditioning module is only used where energy is being supplied to the battery, another operating mode can be selected where a reduced energy consumption mode is used when energy is not being supplied to the battery, a higher energy consumption mode being used when energy is being supplied to the battery.

In connection with Fig. 2 the basic operating mode of the air conditioning system shown in Fig. 1 is summarized. The method starts in step 20 and in

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step 21 it is detected whether the battery 12 is being charged by supplied energy. If the supplied energy is detected in step 21 the air conditioning module can be operated using some of the supplied energy directly to drive the air conditioning module (step 22). If it is detected that energy is not being
5 supplied to the battery the operating mode can be adapted accordingly in step 23. This can mean that the air conditioning module is turned off when energy is not being supplied to the battery, or this can mean that energy supplied by the battery is used to drive the air conditioning module. The air conditioning module can then be operated using the same amount of energy
10 as provided in the operating mode 22, or another operating mode may be selected in which the air conditioning module works in an operating mode with reduced energy consumption. The method ends in step 24.

A more detailed view of the operation of the air conditioning module is shown
15 in Fig. 3. Fig. 3 shows in more detail what happens when it has been detected in step 21 of Fig. 2 that the battery is being charged by supplied energy. Thus, when the supply of energy is confirmed in step 21 the air conditioning controller may ask in step 31 whether the vehicle is running or not. If the vehicle is not running, it can be concluded that the supplied
20 energy is coming directly from a charging station and that the vehicle is presently not being used. In this situation the timetable 14 can be queried in step 32 and it can be asked in step 33 whether the vehicle will be used in the near future. If it can deduce from the timetable that the vehicle will be used in the near future, the air conditioning module can be operated with
25 the supplied energy in step 34 without storing the supplied energy that is used for the air conditioning module in the battery. If it is detected in step 33 that the vehicle will not be used, the air conditioning module will not be operated.

30 If it is detected in step 31 that the vehicle is running, it can be asked in step 35 whether a route has been calculated in the navigation module 15 or

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whether the navigation module is able to predict the driving route. If a route has been calculated or the route can be predicted, optimized air conditioning operation can be calculated in step 36. One example of the optimized air conditioning operation can be that the air conditioning module is only used
5 when energy is being supplied to the vehicle. In step 37 the air conditioning module can then be operated using the supplied energy. When no route has been determined in step 35 the air conditioning module can also be operated only when energy is being supplied to the battery. In another embodiment it is also possible to additionally operate the air conditioning module when
10 energy is not being supplied to the vehicle battery. The method ends in step 38. Summarizing as discussed above, the invention provides an alternative air conditioning strategy for at least partly electrically driven vehicles. Especially the use of energy stored in the vehicle battery used for driving the vehicle is either minimized or even completely avoided.

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In connection with Fig. 4, a further embodiment of the present invention is schematically illustrated. In this embodiment, the operation mode of the air conditioning system is adapted during running of the vehicle according to an electronic horizon 45. Information on the planned route comprising
20 information on speed limits, altitude profiles, curvature of the road is obtained from a navigation system 45. Together with information on the present temperature inside the vehicle 42, a target temperature range inside the vehicle 43, i.e. a set temperature range, and a temperature outside the vehicle 44, this information is used by the air conditioning controller 41 to
25 calculate a planned operation timetable for the air conditioning module 40. Based on the information on desired temperature 43 and current temperatures 42, 44, it is possible to estimate a necessary operation mode for the air conditioning module 40 in order to cool down the vehicle to the target temperature range 43. For example, it can be estimated that the air
30 conditioning module 40 needs to be operated for a certain amount of time cooling down a certain volume of air to a certain temperature. Operating the

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air conditioning module in such a manner will result in a vehicle ambient temperature which lies within the target temperature range 43. Based on such an operation schedule, it is furthermore possible to estimate the amount of electrical power needed to operate the air conditioning module 40.

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On the other hand, based on the information referred to as the electronic horizon 45, it is possible to estimate the amount of power which is available directly from the charging control unit 46. In particular, energy which is available directly from the charging control unit 46, does not need to be withdrawn from the battery 47. A generator 48 inside the vehicle can provide this amount of energy directly via the charging control unit 46 to the air conditioning controller 41. This amount of energy can be used to operate the air conditioning module 40 according to the calculated air conditioning schedule.

15

In one embodiment, generator 48 can be the electric motor of the electrically driven vehicle according to the present invention. In one mode of operation, the electric motor of the electrically driven vehicle may be operated as generator 48 when no driving power is needed in order to accelerate or at least maintain the velocity of the vehicle. Situations when no driving power is needed are, for example, situations of braking 49a or free-wheeling 49b. During braking, the vehicle is decelerated. Kinetic energy needs to be removed from the system of the vehicle and transformed into other forms of energy. Instead of transforming the kinetic energy only into heat as in conventional brakes, it is possible to operate the electric motor of the vehicle as a generator 48 and convert at least some of the kinetic energy into electrical energy.

25

Another situation where the electrical motor of the vehicle could be operated as a generator 48 is free-wheeling 49b. During free-wheeling, it is not desired that the vehicle accelerates. A slow deceleration of the vehicle may be

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acceptable. Another situation of free-wheeling could be downhill driving, where an additional downhill slope accelerates the vehicle. In such situations, it is acceptable that a certain amount of kinetic energy is transformed into electrical energy via generator 48. The amount of energy withdrawn from generator 48 depends on the mode of operation of the air conditioning module 40. The mode of operation of the air conditioning module 40 is determined by the operation schedule provided within air conditioning controller 41 based on the information of the electronic horizon 45. For example, if the air conditioning module 40 is working heavily, this means that a large volume of air is cooled down to a low temperature per time, a large amount of electrical energy is withdrawn from generator 48 via charging controller 46. This means that, during a situation of free-wheeling 49b, the vehicle is decelerated comparably quickly. There are driving situations where this could be acceptable. Such a driving situation could be the approach of a speed limit. If the distance to the speed limit is such that the deceleration value based on the mode of operation of the air conditioning module 40 is suitable to reduce the speed accordingly, then such a mode of free-wheeling 49b is acceptable. On the other hand, if, based on the information from the electronic horizon 45, it is evident that the high level of operation of the air conditioning module 40 would decrease the velocity of the vehicle too quickly in the case of free-wheeling 49b, it could be more favourable to lower the power consumption of the air conditioning module 40 by changing the mode of operation.

When, based on the planned route and the electronic horizon 45, the properties of the entire route ahead are available as information to the air conditioning controller 41, it is possible to calculate a temperature profile of the inside temperature of the vehicle along the entire route. This can be favourable, because for example during some parts of the route there may be an excess of kinetic energy, while, during other periods of the route, there may be no excess of kinetic energy. Then, during the periods of an excess of

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kinetic energy, it may be favourable to operate air conditioning module 40 at a high level of operation and cool down the inside temperature of the vehicle, for example to the minimum temperature of the target temperature range 43. Then, during the periods when no excess of kinetic energy exists, the inside
5 temperature of the vehicle can rise within the target temperature range. Because the temperature was cooled down sufficiently initially, it is then possible to refrain from using the air conditioning module 40 at all.

In particular, it is possible by calculating a temperature profile of the inside
10 temperature along the entire route, to optimize the operation mode of the air conditioning module such that the amount of energy withdrawn from the battery in order to drive the air conditioning module is minimized. By cooling down the inside temperature to the minimum possible temperature when an excess of kinetic energy to be transformed into electrical energy to drive the
15 air conditioning module via a generator is available, it is possible to refrain from withdrawing energy from the battery as much as possible. The time periods at which the air conditioning module is operated as well as the strength of operation of the air conditioning module can be chosen such that the temperature remains within the target temperature range but at the
20 same time the amount of energy withdrawn from the battery to operate the air conditioning module is minimized.

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CLAIMS

- 5 1. An air conditioning system of an at least partly electrically driven vehicle, the system comprising:
- an air conditioning module (10) controlling a temperature inside the vehicle,
 - an air conditioning controller (11) controlling an operation of the air conditioning module,
 - a detector (13) configured to detect when a vehicle battery (12) that is used for driving the vehicle is being charged by supplied energy, wherein when the detector (13) detects that the vehicle battery (12) is being charged, the air conditioning controller uses the supplied energy directly to drive the air conditioning module,
- 10 wherein the air conditioning controller (11) is configured to use route information provided by a navigation module (15) in order to determine when and how the air conditioning module will be operated during driving as an operation schedule.
- 15
- 20 2. The air conditioning system according to claim 1, further comprising a database containing a timetable (14) in which information is provided on when the vehicle will be used next, wherein the detector (13) is further configured to detect if a vehicle engine is running or not,
- 25 wherein when the detector (13) detects that the vehicle engine is not running, the air conditioning controller (11) uses the supplied energy to drive the air conditioning module in dependence on the fact of when the vehicle will be used next.

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3. The air conditioning system according to claim 1 or 2, wherein the air conditioning controller (11) is configured to calculate a temperature profile along the route of a first temperature inside the vehicle based on the operation schedule.
- 5 4. The air conditioning system according to any one of claims 1 to 3, wherein a motor of the vehicle is used as a generator to supply energy when no acceleration of the vehicle is required.
- 10 5. The air conditioning system according to claim 4, wherein the generator is configured to transform kinetic energy of the vehicle into supplied energy during braking or free-wheeling of the vehicle.
- 15 6. The air conditioning system according to claim 3, wherein the air conditioning controller is configured to determine the operation schedule such that the first temperature remains within a target temperature range.
- 20 7. The air conditioning system according to claim 6, wherein the air conditioning controller is configured to only drive the air conditioning module using energy withdrawn from the vehicle battery if the first temperature is not within the target temperature range.
- 25 8. The air conditioning system according to any one of claims 1 to 7, wherein the air conditioning controller is configured to minimize the energy withdrawn from the battery to drive the air conditioning module.
- 30 9. The air conditioning system according to claim 4 or 5, wherein the air conditioning controller is configured to determine the operation

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schedule in such a way that it only uses the supplied energy from the generator to drive the air conditioning module.

10. The air conditioning system according to any one of claims 1 to 9,
5 wherein the operation schedule contains information on a temperature of the air which is cooled by the air conditioning module and on the amount of air per time which is cooled by the air conditioning module.
11. The air conditioning system according to any one of claims 1 to 10,
10 wherein the air conditioning controller (11) is configured to only operate the air conditioning module (10) when the detector (13) detects that energy is supplied to the battery.
12. A method for operating an air conditioning module provided in an at
15 least partly electrically driven vehicle and used for controlling a temperature inside the vehicle, the method comprising the steps of:
 - detecting a charging of a vehicle battery (12) by supplied energy, the battery being used to drive the vehicle, wherein when it is detected that the vehicle battery is being charged, the supplied energy is used
20 directly to drive the air conditioning module, and
 - using route information provided by a navigation module (15) in order to determine when and how the air conditioning module will be operated during driving in the form of an operation schedule.
- 25 13. The method according to claim 12, further comprising the step of detecting whether a vehicle engine is running or not, wherein when it is detected that the vehicle engine is not running, information is retrieved from a timetable (14) allowing a determination of when the vehicle will be used next, wherein the supplied energy is used to drive
30 the air conditioning module (11) in dependence on the retrieved information.

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14. The method according to claim 13, wherein when the retrieved information allows a determination that the vehicle will be started within a predetermined time period the air conditioning module (10) will be started.
15. The method according to any one of claims 12 to 14, further comprising the step of calculating a temperature profile of a first temperature inside the vehicle based on the operation schedule.
16. The method according to any one of claims 12 to 15, wherein energy is supplied to the battery during braking or free-wheeling of the vehicle.
17. The method according to claim 16, wherein the operation schedule is determined in such a way that it only uses the supplied energy during braking or free-wheeling of the vehicle to drive the air conditioning module.
18. The method according to claim 15, wherein the operation schedule is determined such that the first temperature remains within a target temperature range.
19. The method according to claim 18, wherein the air conditioning module is only driven using energy withdrawn from the vehicle battery if the first temperature is not within the target temperature range.
20. The method according to any one of claims 12 to 19, wherein the operation schedule is determined such that the energy withdrawn from the battery to drive the air conditioning module is minimized.

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21. The method according to any one of claims 12 to 20, wherein the air conditioning module (10) will only be operated when energy is supplied to the battery.

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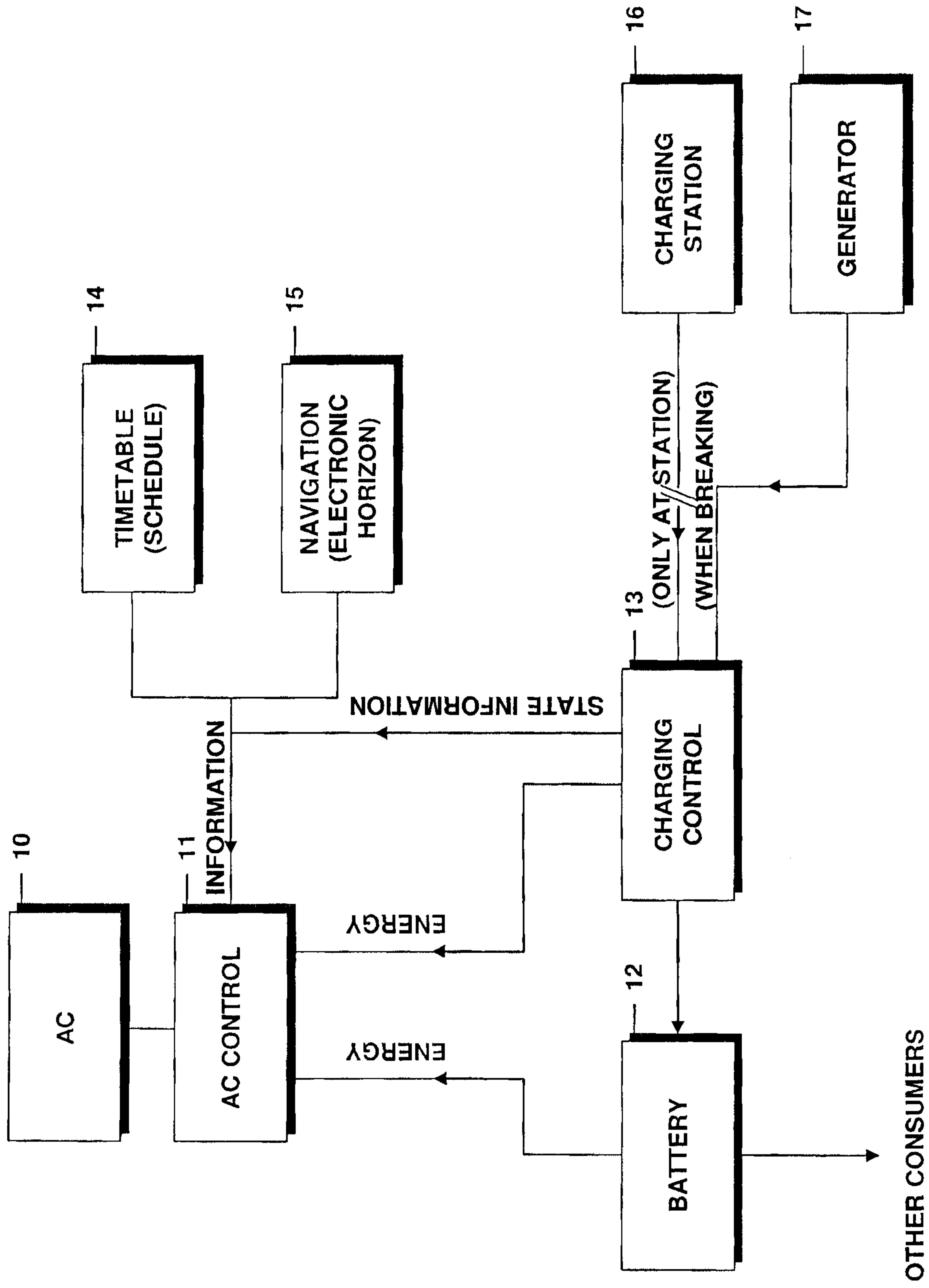


FIG. 1

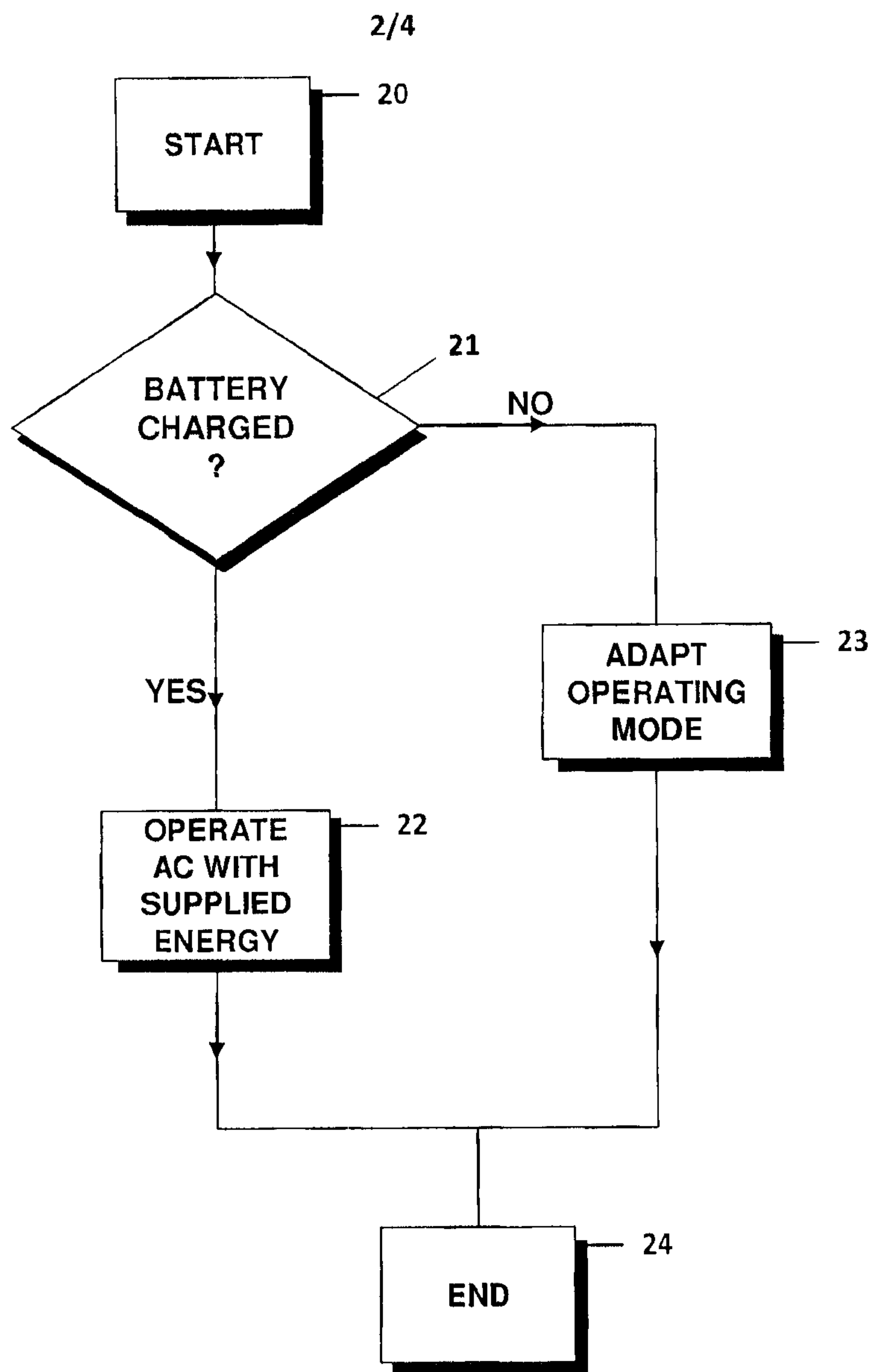


FIG. 2

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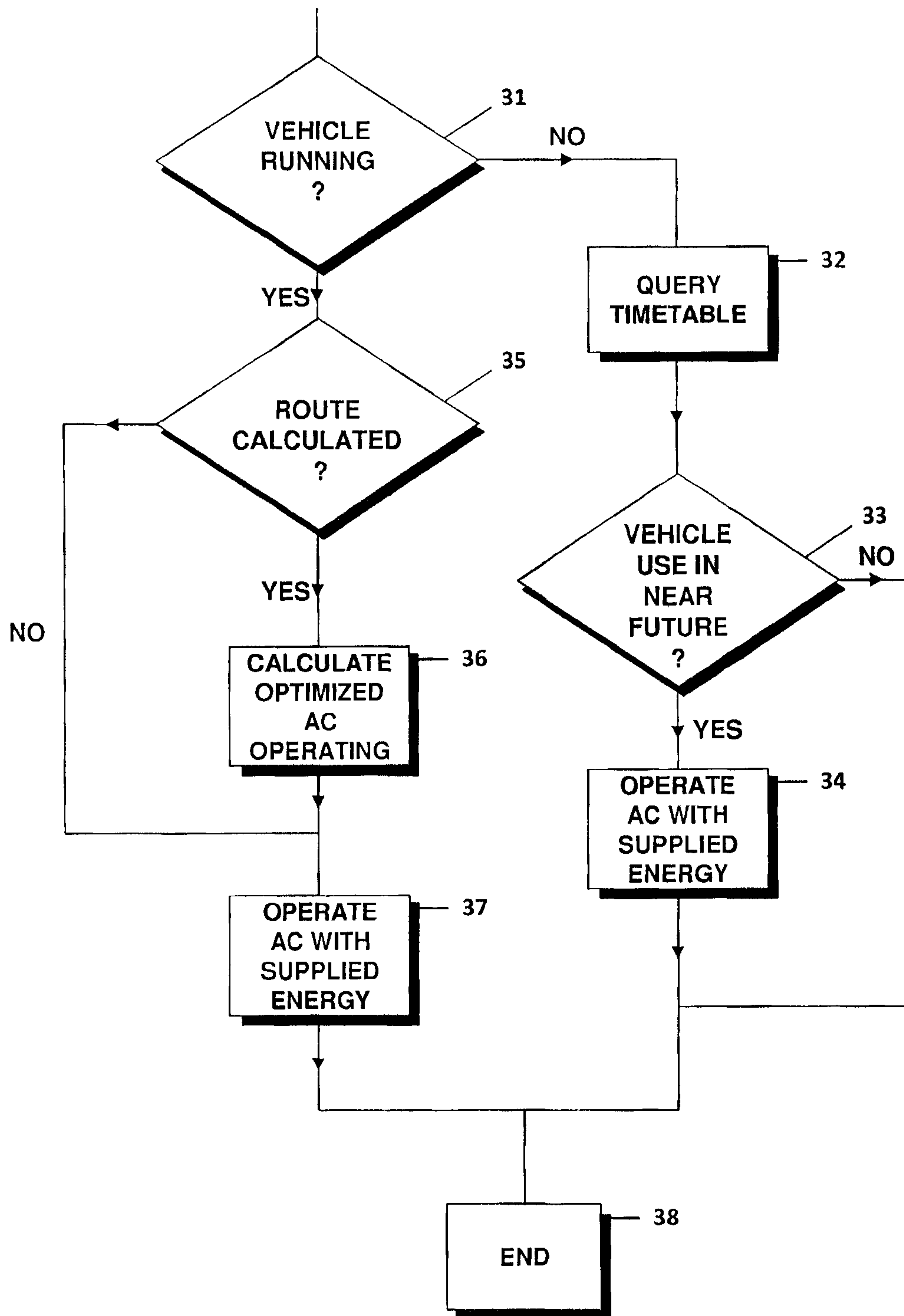


FIG. 3

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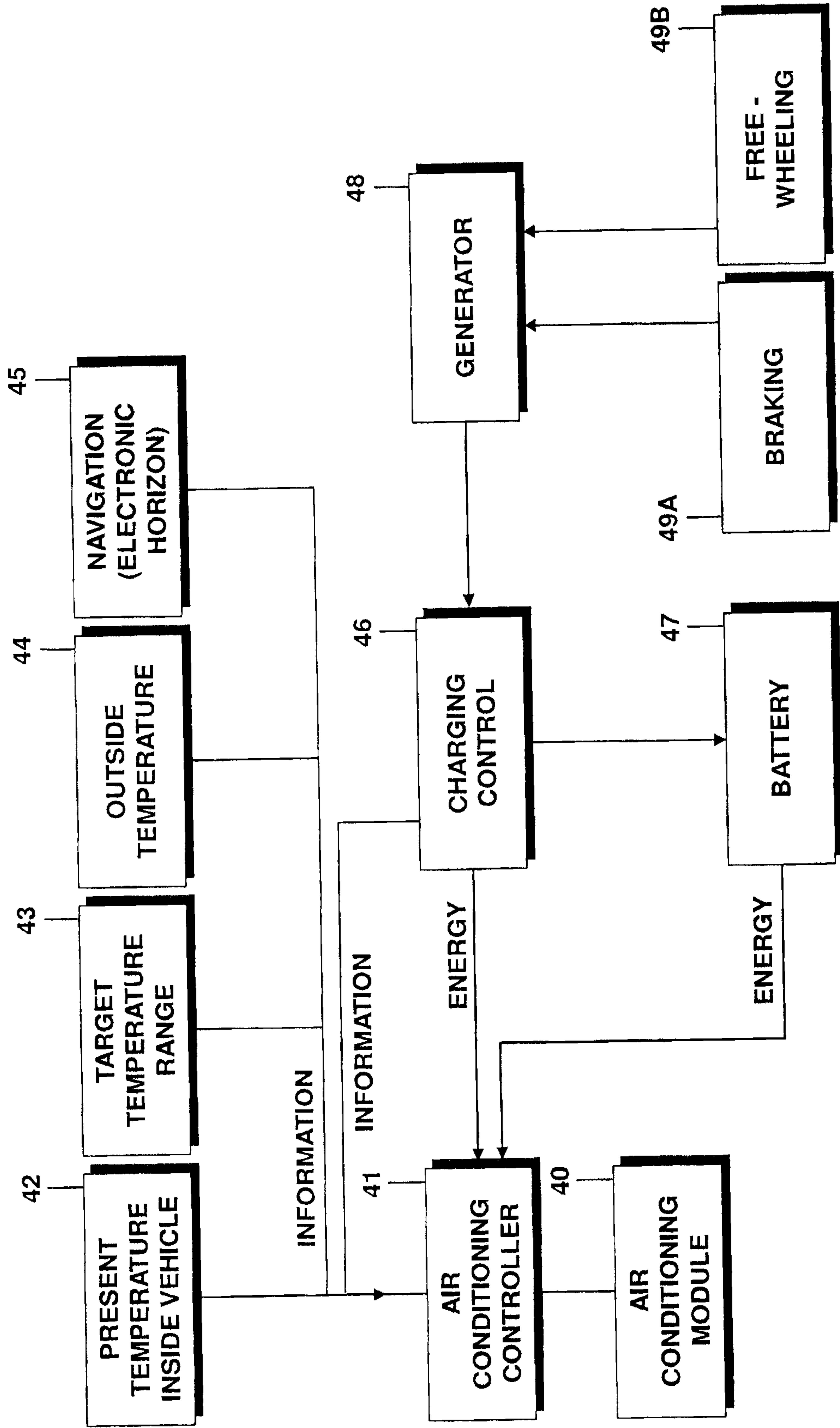


FIG. 4

