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(54) **HOUSEHOLD APPLIANCE, PARTICULARLY FOR TREATING TEXTILE ITEMS**

HAUSEHALTGERÄT, INSBESONDERE ZUM BEHANDELN VON TEXTILIEN

APPAREIL MÉNAGER, EN PARTICULIER DE TRAITEMENT DE PRODUITS TEXTILES

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Description

Field of the invention

[0001] The present invention refers to a household appliance.

[0002] More particularly the invention refers to a household appliance having a casing or a cabinet, a rotatable member rotatably mounted in the casing or cabinet, a reversible dynamoelectric machine, operatively coupled to the rotatable member for causing rotation thereof, and control means for driving the reversible dynamoelectric machine during an operation cycle performable by the household appliance, wherein the control means are suitable for driving the reversible dynamoelectric machine to generate a driving torque, with the aim of moving the rotatable member to acquire and/or maintain one or more substantially determined rotational speeds, the control means being further configured for driving the reversible dynamoelectric machine with the aim of performing, during the operation cycle, of one or more steps of controlled braking of the rotation of the rotatable member, where during a step of controlled braking, the reversible dynamoelectric machine generates electric energy.

[0003] The invention has a preferred application in the field of machines for treating textile items, such as household washing machines, drying machines, washing-drying machines, centrifugal driers.

Background of the invention

[0004] Household appliances for treating textile items comprise a basket rotatable within a cabinet, suitable to hold the items to be treated. The basket is rotated by an electric machine, typically an electric motor. The motor that is used is often a variable speed motor given that, especially in case of household appliances such as washing machines and drying-washing machines, there arises the need of rotating the basket at different speeds during different steps of the treatment cycle. For example, referring to a washing machine, during the washing steps in the strict sense and some steps of balancing the load, the basket should rotate at a relatively low speed (for example 40-60 rpm); during some steps of distributing the load, which precede the centrifugal steps, the rotational speed of the basket must be sufficient (for example 90-120 rpm) to allow the items to adhere - due to the centrifugal force - against the peripheral wall of the basket; during the centrifugal steps, which follow the distribution steps, the basket must instead acquire very high rotational speeds (for example 1000 rpm and higher).

[0005] During the execution of a treatment cycle, for example at the end of a centrifugal step, there arises the need of reducing the rotational speeds of the basket, possibly up to stopping it.

[0006] In order to slow or stop the rotation of the basket, one may simply disconnect power supply from the motor,

so that the kinetic energy of the basket is dissipated through simple mechanical friction. Such approach leads to the situation whereby the slowing or stopping of the basket are not controllable and they require relatively long waiting times, due to the rotation inertia, which have an impact on the overall duration of the treatment cycle.

[0007] Another technique useable for slowing and/or stopping the basket is that of providing for a mechanical breaking system, controlled by the control unit of the household appliance to intervene when the power supply is disconnected from the motor itself. The intervention and the operation of such mechanical systems however have the effect of generating noise and/or vibrations.

[0008] A technique that allows slowing and/or stopping the basket in a reliable manner and without generating noise or vibrations is represented by the so-called electric or dynamic braking, which consists in driving the motor in such a manner to progressively reduce the speed thereof. This solution is used for example in the case of machines for treating textile items provided with an induction motor, usually three-phase, controlled through an inverter circuit or inverter. In these machines, the control unit drives the inverter in such a manner that the latter drives the motor dynamically, with the aim of reaching and maintaining the desired operational speed. The inverter may also be driven with the aim of progressively slowing the rotational speeds of the motor, even up to obtaining the stopping thereof. A solution of this type is for example known from JP-A-2001-046777. However, during the electric slowing steps controlled by the inverter, the motor turns into a generator of electric energy. This energy is dissipated due to the Joule effect through the resistance of the motor. Though efficient, this braking technique causes thermal stresses on the motor, which would be desirably avoided and also requires specific installation of heat dissipation systems.

[0009] Document US 3 608 337 A discloses a washing machine provided with a door lock to preclude access to rotating parts until a safety condition is reached. The energy of the rotating drum is recovered when the washing machine is switched off, so that the door lock is retained in its door locking state.

Summary and object of the invention

[0010] An object of the invention is essentially that of providing a household appliance, particularly for treating textile items, of the type indicated in the introduction of the present description, wherein the energy generated during the step of electrically braking the reversible dynamoelectric machine does not cause considerable thermal stresses on the motor itself and on other components of the household appliance, such as the inverter.

[0011] Another object of the invention is essentially that of providing a household appliance, particularly for treating textile items, of the type indicated in the introduction of the present description, which allows reducing electric energy consumptions in the household level.

[0012] Another object of the invention is that of providing such household appliance being easy to manufacture and inexpensive, but safe and reliable in operation.

[0013] One or more of these objects is attained, according to the present invention, by a household appliance, particularly for treating textile items, having the characteristics indicated in the attached claims. Preferred characteristics of the invention are indicated in the sub-claims. The claims form an integral part of the technical disclosure provided herein in relation to the invention.

[0014] In brief, according to the invention, a household appliance of the type described above is characterized in that it is provided with circuit means prearranged for recovering and making the electric energy - generated by the reversible dynamoelectric machine during the controlled braking steps - useable.

[0015] In this manner, the electric energy generated by the dynamoelectric machine during the controlled braking steps should not be dissipated due to the Joule effect but, on the contrary, it may be recovered and become an additional resource, which may contribute to the overall reduction of the household consumptions of electric energy.

[0016] Preferably the control means comprise a microprocessor control unit and the circuit means comprise least one switchable electric device, driven by the control unit with the aim of performing the controlled braking steps.

[0017] In an embodiment, the abovementioned circuit means further comprise a rechargeable accumulator. In this embodiment the switchable electric device is driven by the control unit, substantially upon starting a controlled braking step, to acquire a first switching position, in which the dynamoelectric machine is excluded from the power supply circuit and the accumulator may be charged by the electric energy produced by the dynamoelectric machine. At the end of the step of controlled braking, the control unit drives the switchable electric device to bring it to acquire a second switching position, in which the dynamoelectric machine is once again connected to the power supply circuit, from which the accumulator is excluded instead.

[0018] In an embodiment, the electric energy stored in the accumulator is made available to supply a power supply voltage to one or more electric loads of the household appliance, particularly loads with low electrical absorption, such as for example the control unit, a user interface thereof or components of the latter, or even an internal device for transmitting and/or receiving data. Thus, the overall consumptions of electric energy by the household appliance are lowered. Very advantageously, the accumulator may be used for supplying power to the control system of the household appliance, or to the parts thereof, when it is in stand-by condition. As known, the stand-by - or pre-start - is that operating mode of the household appliances halfway between that of complete OFF condition and that of actual ON condition, which allows

switching ON and using the apparatus itself more rapidly with respect to the OFF mode. According to the invention, the energy stored in the accumulator may thus be advantageously used for reducing the consumption of the household appliance connected to the respective electric power supply, thus supplying - to the control system - the energy required to maintain the stand-by condition (supplying the electronic board, the microprocessor, the timer or a display, when present). Thus, such solution allows covering, partly or totally, the amount of energy absorbed from the power supply socket in stand-by mode, and thus maintain the consumption of the household appliance below a given value, indicatively comprised between about 0.5 and 2 W. Thus for such purpose, another advantage of such application of the invention lies in the fact that the energy stored in the accumulator also contributes to improving energy efficiency class of the household appliance.

[0019] In an embodiment, the household appliance has a voltage output connector, particularly for direct voltage, accessible by a user, which is electrically connected to the rechargeable accumulator. Thus, the electric energy stored in the accumulator may be advantageously drawn and used, through the abovementioned output connector, with the aim of supplying a power supply voltage to electric devices outside the household appliance, particularly devices with low electric absorption. For example, the abovementioned connector may be used to supply voltage to the battery of a mobile phone, or an mp3 reader, or a laptop or palmtop computer, and so on and so forth. This also allows obtaining evident benefits in terms of energy saving within the household environment.

[0020] In a different embodiment, in which the accumulator is not provided for, the abovementioned circuit means comprise a plurality of switchable electric devices belonging to an inverter circuit, particularly a two-phase inverter circuit. During a controlled braking step, the control unit drives the switchable electric devices of the inverter circuit so that the latter produces - starting from the voltage generated by the dynamoelectric machine - a sinusoidal voltage having characteristics compatible with that of the power supply system in alternating current which supplies the household appliance, and which may thus be reintroduced into such system. In this embodiment a filtering stage, configured for treating the alternating voltage generated by the inverter circuit before reintroducing it into the system is also provided for. Furthermore, preferably, at least when the dynamoelectric machine is intended to serve as a motor, i.e. generate a driving torque, the abovementioned inverter circuit is driven by the control unit to serve as a rectifier circuit, with the aim of supplying a substantially direct power supply voltage to the dynamoelectric machine. Thus, also in this embodiment the electric energy produced by the dynamoelectric machine during the controlled braking steps, alongside not causing thermal stresses on the machine itself, becomes a useable resource.

[0021] In a currently preferred embodiment, the reversible dynamoelectric machine is a three-phase motor, particularly an induction motor or a permanent magnets motor, and the control means comprise a respective inverter circuit, particularly a three-phase inverter.

Brief description of the drawings

[0022] Further characteristics and advantages of the present invention shall be clearer from the description that follows, provided with reference to the attached drawings, purely provided by way of non-limiting example, wherein:

- figures 1 and 2 are schematic front view and a schematic partial section, respectively, of a household appliance for treating textile items according to an implementation of the invention;
- figures 3 and 4 are simplified representations of a control circuit of a reversible dynamoelectric machine of the household appliance of figures 1 and 2, in two different operating conditions;
- figure 5 is a simplified representation of a control circuit of a reversible dynamoelectric machine of a household appliance for treating textile items according to a further implementation of the invention.

Description of preferred embodiments of the invention

[0023] Reference to "an embodiment" in this description indicates that a particular configuration, structure or characteristic described regarding the embodiment is included in at least one embodiment. Hence, expressions such as "in an embodiment" and the like, possibly present in various parts of this description do not necessarily refer to the same embodiment. Furthermore, particular configurations, structures or characteristics may be combined in any suitable manner in one or more embodiments. References herein are used for facilitating the reader and thus they do not define the scope of protection or the range of the embodiments.

[0024] Figures 1 and 2 schematically represent a household appliance, according to an embodiment of the present invention. In the exemplified case the household appliance is a machine for treating textile items, and specifically a front loading washing machine, indicated in its entirety with 1. As mentioned, the invention is however suitable for application even in other types of household appliances for treating textile items, distinguished by the presence of a basket for holding the textile items which is rotated by a reversible dynamoelectric machine, such as for example washer-dryers, dryers and centrifugal dryers, even of the top loading type. Furthermore, generally, the invention also finds application in any household appliance having a casing housing a rotatable member which during the operation of the household appliance is suitable to be actuated by at least one electric motor, and in which during one or more steps of the operation

of the household appliance the rotatable member is braked through a suitable control of the motor, in such steps of braking the motor generating electric energy.

[0025] The washing machine 1 comprises a bearing structure or cabinet 2, in which a rotatable member - constituted by a linen-holder basket 3, actuatable through a reversible dynamoelectric machine to rotate around a respective axis - is mounted. In the exemplified case, given that the household appliance is a washing machine, the basket 3 is perforated and the same is mounted to rotate within a tank 4, supported in the cabinet 2. In the case of dryer the tank 4 is not required, the basket 3 is not perforated and a circuit suitable for the circulation of drying air is provided for, all according to the per se known art. The basket 3 and the tank 4 have respective front openings and the basket is accessible to the user by means of an opening, at which a door 5 is provided for.

[0026] In the example considered herein, the above-mentioned reversible dynamoelectric machine is constituted by an electric motor 5 which is operatively coupled to a shaft 3a for actuating the basket 3. In an embodiment the motor 5 is an induction motor or a permanent magnets motor which includes a plurality of phase windings, not represented. In a preferred embodiment, the motor 5 is a three-phase motor, which includes a stator and a rotor, with the phase windings distributed around the stator.

[0027] In the represented example, the washing machine 1 has a system for actuating the basket 3 of the type referred to as "direct drive" according to a term currently used in the field, i.e. with a motor 5 whose stator is fixed directly outside the tank bottom, at a central position, and with the rotor directly associated to the shaft 3a of the basket 3. This type of actuation shall not be deemed as limiting feature given that, alternatively, an electric motor may be provided for at a conventional position, for example associated to the bottom part of the tank 4 and connected to the shaft 3a through suitable transmission, for example a belt and pulley system.

[0028] The household appliance 1 has a control system comprising a control unit 7 which manages, among other things, the operation of the motor 5, so as to rotate the basket 3 according to suitable times and modes (speed, rotation periods, pause periods, possible inversions of rotation, etcetera), depending on the characteristics of the treatment cycle selected by a user. The control unit 7 comprises preferably at least one microcontroller which includes or to which non-volatile memory means - for example comprising one or more ROM and/or EPROM and/or EEPROM and/or Flash memories - are operatively connected. Operating or management programmes which monitor the execution of treatment cycles executable by the washing machine and the instructions regarding the general functionalities thereof are stored in the memory means.

[0029] With particular reference to figure 1, a washing agent dispenser, of the per se known type, for example having a drawer defining several compartments for holding respective washing agents is indicated with 8. A con-

trol panel or user interface of the washing machine, which is part of the control system thereof, is indicated with 9. In the exemplified case, the user interface 9 comprises an ON/OFF button 9a, a rotary selector 9b for selecting the treatment cycles executable by the washing machine 1, program start button 9c, some buttons 9d for selecting possible options associable to a selected cycle (type of linen, centrifuge exclusion, half load, etcetera) and display means 9e, for example an LCD display.

[0030] Furthermore, according to an embodiment of the invention, the household appliance 1 is provided with at least one output connector, particularly in direct voltage, whose function shall be clarified hereinafter; in the represented example, such connector, indicated with 10, is located on the user interface 9, but such positioning shall not be deemed restrictive.

[0031] Lastly, still in figure 1, an electric power supply cable, connected to an alternating voltage source or AC, indicated with Vac, which is assumed to be 230 Volts in this case, is indicated with 11; in the example, the source Vac is represented by a power socket present in the household environment in which the washing machine 1 is installed.

[0032] Obviously the washing machine 1 also comprises all further components required for normal operation thereof (level sensors, water heating resistor, filters, safety components, suspensions, etcetera), which are not represented and described herein in that they are per se known and not strictly inherent to the purposes of the present invention.

[0033] The part of the control system of the washing machine 1 which monitors the operation of the motor 5 is illustrated schematically in figure 3.

[0034] The abovementioned source of AC power supply is indicated with Vac. Reference 20 designates a source of substantially direct current or DC of the washing machine 1, comprising an AC to DC rectifier circuit, which receives an input voltage from Vac, for example a 230 V. In the exemplified embodiment, the DC source 20 includes rectifier diodes, in a bridge configuration.

[0035] The DC source 20 is coupled to a DC-AC inverter indicated with 21, through a line 22 constituting, according to the terminology currently used in the field, a so-called direct current bus or DC bus. A bulk capacitor 23, connected so that the inverter 21 receives a constant DC voltage, for example approximately 320 V DC (for an input voltage at the diode bridge 20 of 230 V AC), is provided for downstream of the DC source 20 on the DC bus 22. Practically, the source 20 rectifies the alternating voltage and pre-loads the capacitor 23, which improves the direct voltage form factor applied to the inverter 21, the latter then inverting the direct voltage into the alternating voltage according to the suitable frequency.

[0036] The inverter 21 includes several branches (inverter legs), where each branch includes respective controllable switch devices, connected in a bridge configuration between the positive and negative lines of the DC bus 22. Three branches, each made up of two bipolar

switches 21a, 21b connected in series, supplied in parallel by the source 20 through the DC bus 22, are provided for in the represented embodiment. Each branch is connected to a terminal of the three-phase load, i.e. of the motor 5, supplied by the control unit between the two switches 21 a, 21 b.

[0037] As known, from a functional point of view, the inverter is a DC/AC converter, capable of transforming, with suitable control of the branch switches 21 a, 21 b, the input direct voltage into a three-phase system of output alternating voltage. In order to avoid the short circuit of the direct input source, the control of the two branch switches 21 a, 21 b is of the complementary type. The switches 21a, 21b may comprise any controllable electronic switch device, such as bipolar devices, triacs, transistors (FET, MOSFET, IGBT, etcetera).

[0038] Each inverter branch is connected to the control unit 7, which is programmed for driving the switch devices 21 a, 21 b so as to connect the power on the lines of the DC bus 22 to the motor phases 5, according to a desired pattern. In practice, the inverter 21 provides for supplying the phase windings of the motor 5 with a desired voltage and frequency, so as to generate - in the motor 5 - the currents required for rotating the rotor. The frequency and the amplitude of the output voltage of the inverter 21 are adjusted by the control unit 7 according to any technique per se known in the sector: the specific modes for driving the inverter, with the aim of controlling the motor, are not part of the objects of the present invention.

[0039] The components of figure 3 indicated up to now are typically provided for, in known solutions, for controlling - through inverters - an induction or permanent magnets three-phase motor.

[0040] In case reduction of the rotational speeds of the motor 5 is required, for example at the end of a centrifugal step, during the deceleration step the motor itself serves as a generator and, thus, the direction of energy flow is inverted, as indicated by the arrow F in figure 4. According to the known art, the solutions that may be used for reducing the speed of the motor are essentially as follows:

- a) disconnecting the motor 5 from the mains, not driving the inverter 21 and thus leaving the switches 21 a, 21 b open; thus, the energy produced by the motor 5 is dissipated by mechanical friction; in practice, there is a free-fall braking and no current flows on the windings of the motor; as explained, such solution requires relatively long times to obtain a considerable deceleration or stop of the basket;
- b) not connecting the motor 5 to the bulk capacitor 23, by closing the switches 21b of the inverter 21: in this case, the energy produced by the motor 5 is dissipated, not only by the mechanical friction, but also due to the Joule effect on the switches 21b of the inverter 21 and on the windings of the motor; this solution leads to thermal stresses on the motor and on the inverter;
- c) imposing a deceleration of the motor 5 operating

through suitable sequence for driving the inverter 21, contrary to the previous cases, where - in practice - the motor 5 is not controlled during the slowing down, in that completely disconnected from the mains (case a) or short-circuited towards ground (case b); through this solution, the energy coming from the motor 5 in part goes to charge the bulk capacitor 23, producing a voltage increase at the ends thereof, and it is partly dissipated due to the Joule effect through the resistors of the motor and of the inverter; it should be observed that through such known solution the voltage increase at the ends of the capacitor 23 must however be somehow controlled, given that it may cause the destruction of the capacitor itself if it exceeds a maximum value (typically about 400 V).

[0041] According to the illustrated embodiment of the present invention, the controlled deceleration of the motor 5 is obtained by driving the inverter 21, similarly to case c) indicated above, and providing the household appliance with circuit means, additionally with respect to the ones conventionally used, prearranged for recovering and making useable the electric energy generated by the motor itself during the controlled braking steps.

[0042] In an embodiment, represented in figures 3 and 4, the abovementioned circuit means comprise means for storing electric energy, selectively connectable to the DC bus 22 between the DC source 20 and the bulk capacitor 23. The abovementioned storage means comprise an accumulator 24, of the rechargeable type, which maybe constituted by a bank of capacitors or super-capacitors. The accumulator 24 is selectively connectable to the inverter 21 alternatively to the DC source 20 and an electric switch device, indicated with 25, driven by the control unit 7 is provided for such purpose. In the represented example, the switch device 25 is constituted by a two-way switch, for example a relay. In operative position thereof, represented in figure 3, the device 25 closes the circuit between the source 20 and the inverter 21, thus excluding the accumulator 24; in the second position, observable in figure 4, the device 25 closes the circuit between the accumulator 24 and the inverter 21, thus excluding the source 20, with the ensuing disconnection of the motor from the power supply mains.

[0043] Figure 3 refers to a condition of the circuit typical of a treatment cycle stage executed by the washing machine 1, when the basket should be rotated at a given speed, with the motor 5 which is required to produce a driving torque.

[0044] The diode bridge which constitutes the DC source 20 substantially converts the alternating voltage coming from the Vac sources into direct voltage, with the capacitor 23 which improves the form factor thereof and keeps it constant. The inverter 21, supplied in direct current through the DC bus 22, inverts the same in alternating current through a sequential modulation of the switches 21a, 21b, up to obtaining a sinusoidal current capable

of rotating the motor 5, according to the required speed and torque. Concretely, the control unit 7 - for example starting from the measurement of the currents and from the measurement or estimation of the speed/position of the rotor detected through known means and methods, and according to the desired speed and the torque load required for executing the treatment cycle stage - imposes a sinusoidal three-phase voltage triplet with variable amplitude and frequency, by suitably operating on the control signals of the six switches 21a, 21b of the inverter 21. In this condition, the mains supplies the power required to maintain the motor 5 rotating and thus the energy flows from the mains towards the motor, as indicated by the arrow F. In the position of figure 3, the switch device 25 prevents the accumulator 24 from being charged from the mains.

[0045] Should the treatment cycle provide for a step of decelerating the motor, the control unit 7 controls the switching of the device 25, to the position of figure 4. The electric energy produced by the motor 5 in the deceleration step controlled by the inverter 21 may thus be stored in the accumulator 24. Thus, alongside preventing heating - due to the Joule effect - of the resistor of the motor and of the switches 21b, any risk of overloading the capacitor 23 is also avoided, given that the energy coming from the motor 5 is used for charging the auxiliary accumulator 24. In the position of figure 4 the accumulator device 25 prevents the accumulator 24 from being loaded even by the mains.

[0046] After completing the braking step, the control unit 7 controls a new switching of the device 25, or the return thereof to the condition of figure 3; in such manner, the auxiliary accumulator 24 is disconnected from the inverter 21 and the mains is reconnected to the inverter itself, for a control of the motor 5 with the aim of a possible new speed rise ramp.

[0047] The energy stored in the accumulator 24 may be used for providing a power supply voltage to one or more electric loads of the household appliance, preferably low absorption loads, in the order of tens of W; suitable power supply means are provided for such purpose, schematically represented by the line indicated with 26, for connecting the accumulator to the load or to the loads of interest. The voltage made available by the accumulator may be possibly transformed through the means 26, depending on the type of load to be made available, through per se known methods and devices.

[0048] In an embodiment the energy stored in the accumulator 24 may be used for supplying the display 9e or other electric components (for example warning lights or LEDs or a timer) of the user interface 9. Additionally or alternatively, the energy of the accumulator may be used for supplying - wholly or partly - the control unit 7, particularly when the latter is in a respective stand-by condition, for example at the end of a completed treatment cycle. For such purpose, as mentioned previously, the energy stored in the accumulator 24 may be used for reducing the consumption of the household appliance 1

connected to the source or socket Vac, supplying to the control system or a parts thereof (electronic board, microcontroller, timer or display if present), the energy required to maintain the stand-by condition. The amount of energy absorbed from the socket Vac in stand-by mode is thus partly or entirely covered, and the consumption of the household appliance may be kept below a given value, indicatively comprised between 0.5 and 2 W, with evident benefits even regarding the improvement of the energy efficiency class of the household appliance.

[0049] In an embodiment, not represented, the household appliance is provided with a communication device, for example a wireless transceiver, with the aim of allowing the transmission and/or reception of information and/or controls on a household bus: such communication device may be supplied through the rechargeable accumulator 24. Obviously, the accumulator 24 may also be used for supplying electric loads of the machine 1 different from those indicated by way of example.

[0050] In an embodiment, such as that exemplified in figure 1, the accumulated electric energy, possibly transformed by the means 26, may be drawn through the output connector in direct voltage 10 present on the user interface 9. The connector 10, of any known type, may for example be used for supplying small electric loads outside the household appliance, such as for example the battery of a mobile phone, a music file reader (such as an mp3 reader), or even a camera, a laptop computer and, generally any electric load or device with low consumption.

[0051] Characteristics and advantages of the invention are clear from the outlined description. The invention allows obtaining considerable advantages, both regarding safeguarding and soundness, in the long term, of active electric devices of the household appliance (such as the motor, the inverter, the bulk capacitor). In addition, there is the undisputable advantage of the possibility of positively exploiting the energy generated by the reversible dynamoelectric machine during the controlled braking steps, thus obtaining energy saving in household electric consumptions.

[0052] Naturally, without prejudice to the principle of the invention, the details and embodiments may vary, even significantly, with respect to what has been described and illustrated purely by way of non-limiting example, without departing from the scope of the invention as defined in the attached claims.

[0053] Figure 5 illustrates a second embodiment of the invention, according to which the electric energy produced by the motor 5 during the controlled braking steps is introduced into the household power supply system Vac. Reference numbers of figures 3 and 4 are used in such figures to indicate elements technically equivalent to those described above.

[0054] In such embodiment the circuit means for recovering and using the energy produced by the motor 5 comprise a further inverter 30, controlled by the unit 7, which replaces the diode bridge (20) of the embodiment

of figures 3 and 4. The rechargeable accumulator 24 and the switch device 25 are not provided for in such embodiment. In the illustrated example, the inverter 30 is a two-phase inverter, including two branches or legs, each of which respectively includes controllable switch devices 30a, 30b, connected in a bridge configuration between the positive and negative lines of the DC bus 22.

[0055] When the basket 3 is required to be rotated at a given speed, or the motor is required to generate a driving torque, the unit 7 controls the switch devices 30a, 30b of the two-phase inverter 30, thus essentially performing the same functions as the diode bridge (20) of the embodiment of figures 3-4, with the aim of transforming the alternating voltage coming from the source Vac into direct voltage on the DC bus 22.

[0056] During the controlled braking steps, performed through the inverter 21 similarly to the previous embodiment, the unit 7 also drives the switches 30a, 30b of the inverter 30 so that the latter, starting from the voltage at the ends of the capacitor 23, generates a sinusoidal voltage having characteristics compatible with that available on the supply system Vac. Furthermore, in such embodiment the sinusoidal voltage towards the supply system Vac generated by the two-phase inverter 30 is suitably treated through a filtering stage 31, through per se known means, before being reintroduced into the power supply system.

[0057] As evincible, even in this embodiment the electric energy generated by the motor 5 in the controlled braking steps does not cause thermal stresses on the motor itself or on the switch devices of the inverter 21. Due to the presence of the two-phase inverter 30, such energy may be recovered and reintroduced into the power supply system, so as to be available for other uses, with clear advantage in terms of overall energy saving of the household environment.

[0058] The invention was previously described with reference to a three-phase motor, in particular an induction motor or a three-phase permanent magnet controlled through an inverter. It is however clear to a man skilled in the art that the invention is also applicable in case of other types of reversible dynamoelectric machines useable for the actuation of the basket of machines for treating textile items or household appliances in general.

[0059] In a possible circuit variant of the embodiment of figures 3 and 4, the bulk capacitor 23 is connected to the DC bus 22 upstream of the switchable device 25, or between the source 20 and such device.

Claims

1. A household appliance comprising a casing or a cabinet (2), a rotatable member (3) rotatably mounted within the casing or cabinet (2), a reversible dynamoelectric machine (5), operatively coupled to the rotatable member (3) for causing rotation thereof, and control means (7, 21) for driving the reversible dy-

- namoelectric machine (5) during the operation of the household appliance (1), wherein the control means (7, 21) are suitable for driving the reversible dynamoelectric machine (5) to generate a driving torque, with the aim of bringing the rotatable member (3) to acquire and/or maintain one or more substantially determined rotational speeds, the control means (7, 21) being further configured for driving the reversible dynamoelectric machine (5) with the aim of performing, during the operation of the household appliance, at least one step of controlled braking of the rotation of the rotatable member (3), where during the at least one controlled braking step, the reversible dynamoelectric machine (5) generates electric energy, the household appliance (1) being **characterised in that** it comprises circuit means (10, 24-26; 30) for recovering and making usable the electric energy generated by the reversible dynamoelectric machine (5) during the at least one controlled braking step.
2. The household appliance according to claim 1, wherein the household appliance is a household appliance for treating textile items (1), particularly a washing machine, suitable to perform at least one treatment cycle, the rotatable member comprising a basket for holding the textile items (3) and wherein the control means (7, 21) are configured for
 - driving the reversible dynamoelectric machine (5), during a treatment cycle performable by the household appliance (1), to generate a driving torque with the aim of bringing the basket (3) to acquire and/or maintain one or more substantially determined rotational speeds;
 - driving the reversible dynamoelectric machine (5) with the aim of performing, during the treatment cycle, at least one step of controlled braking of the rotation of the basket (3).
 3. The household appliance according to claim 1 or 2, wherein the control means (7, 21) comprise a control unit including at least one microcontroller (7) and the circuit means (10, 24-26; 30) comprise least one switchable electric device (25; 30a, 30b), driven by the control unit (7).
 4. The household appliance according to claim 3, wherein the circuit means (10, 24-26; 30) comprise rechargeable electric energy storage means (24).
 5. The household appliance according to claim 4, wherein the control unit (7) is prearranged for driving the switchable electric device (25) such that:
 - substantially at the start of the controlled braking step, the switchable electric device (25) acquires a first switching position, in which the reversible dynamoelectric machine (5) is not connected to a relevant power supply circuit (Vac, 20, 22) and it is connected to the storage means (24), so that the latter are charged by the electric energy produced by the reversible dynamoelectric machine (5);
 - substantially at the end of the controlled braking step, the switchable electric device (25) acquires a second switching position, in which the dynamoelectric machine (5) is connected to the relevant power supply circuit (Vac, 20, 22) and it is not connected to the storage means (24).
 6. The household appliance according to any one of claims 4 and 5, wherein the circuit means (10, 24-26; 30) comprise power supply means (26) configured to supply, starting from the energy stored in the storage means (24), a power supply voltage to at least one electric load of the household appliance (1).
 7. The household appliance according to claim 6, wherein the at least one load is selected from among the control unit (7), one or more components (9e) of a user interface (9) of the household appliance (1), a device for transmitting and/or receiving data.
 8. The household appliance according to claim 7, wherein said power supply means (26) are configured for supplying at least part of a control system of the household appliance (1), such as the control unit (7), when the latter is in a stand-by condition, particularly with the aim of maintaining the consumption of the household appliance (1) in the stand-by condition below a given value, preferably comprised between about 0.5 W and about 2 W.
 9. The household appliance according to any one of claims 4 and 5, wherein the circuit means (10, 24-26; 30) comprise power supply means (26) configured to supply, starting from the energy stored in the storage means (24), a power supply voltage to at least one load or electric device outside the household appliance (1).
 10. The household appliance according to claim 9, wherein said power supply means (10, 26) comprise a power socket (10) electrically connected to the storage means (24), the power socket (10) being preferably positioned at a user interface (9) of the household appliance (1).
 11. The household appliance according to claim 1 or 2, wherein the circuit means (10, 24-26; 30) are configured for introducing the electric energy generated by the reversible dynamoelectric machine (5) into an AC electric mains (Vac) which supplies the household appliance (1).
 12. The household appliance according to claim 3,

wherein the circuit means (10, 24-26; 30) comprise a plurality of switchable electric devices (30a, 30b) driven by the control unit (7) and belonging to an inverter circuit (30).

13. The household appliance according to claims 11 and 12, wherein the control unit (7) is configured for driving the switchable electric devices (30a, 30b) of the inverter circuit (30) such that, during the at least one controlled braking step, the inverter circuit (30) produces, starting from a voltage generated by the reversible dynamoelectric machine (5), a sinusoidal voltage having characteristics compatible with that of said electric mains (Vac), with the aim of introduction thereof into said system (Vac).
14. The household appliance according to claim 13, wherein the control unit (7) is configured for driving the switchable electric devices (30a, 30b) of the inverter circuit (30) such that, when the reversible dynamoelectric machine (5) is required to generate a driving torque, the inverter circuit (30) serves as a rectifier circuit, for supplying to the reversible dynamoelectric machine (5) a substantially direct power supply voltage.
15. The household appliance according to any one of preceding claims, wherein the reversible dynamoelectric machine is three-phase motor, particularly an induction motor or a permanent magnet motor (5), including three phase windings and comprising means for generating a substantially direct current (20, 22, 23), including a DC bus (22), and wherein the control means (7, 21) comprise an inverter circuit (21) for controlling the motor (5), including a plurality of switch devices (21a, 21b) coupled to the DC bus (22), the switch devices (21a, 21b) being driven by the control unit (7) for selectively coupling the phase windings of the motor (5) to the DC bus (22), so as to generate said driving torque or perform said at least one controlled braking step.

Patentansprüche

1. Haushaltsgerät, umfassend ein Gehäuse oder einen Schrank (2), ein drehbares Element (3), welches drehbar innerhalb des Gehäuses oder des Schanks (2) montiert ist, eine reversible dynamoelektrische Vorrichtung (5), welche betriebsmäßig mit dem drehbaren Element (3) verbunden ist, um eine Drehung davon zu bewirken, und Regelungs-/Steuerungsmittel (7, 21) zum Antreiben der reversiblen dynamoelektrischen Vorrichtung (5) während des Betriebs des Haushaltsgeräts (1), wobei die Regelungs-/Steuerungsmittel (7, 21) dazu geeignet sind, die reversible dynamoelektrische Vorrichtung (5) anzutreiben, um ein Antriebsdrehmoment mit dem Ziel

zu erzeugen, das drehbare Element (3) dazu zu bringen, eine oder mehrere im Wesentlichen vorgegebene Drehgeschwindigkeiten anzunehmen oder/und beizubehalten, wobei die Regelungs-/Steuerungsmittel (7, 21) ferner dazu eingerichtet sind, die reversible dynamoelektrische Vorrichtung (5) mit dem Ziel anzutreiben, während des Betriebs des Haushaltsgeräts wenigstens einen Schritt eines geregelten/gesteuerten Bremsens der Drehung des drehbaren Elements (3) durchzuführen, wobei während des wenigstens einen geregelten/gesteuerten Bremsschrittes die reversible dynamoelektrische Vorrichtung (5) elektrische Energie erzeugt, wobei das Haushaltsgerät (1) **dadurch gekennzeichnet ist, dass** es Schaltungsmittel (10, 24-26; 30) umfasst zum Wiedergewinnen und Nutzbarmachen der elektrischen Energie, welche von der reversiblen dynamoelektrischen Vorrichtung (5) während des wenigstens einen geregelten/gesteuerten Bremsschrittes erzeugt wird.

2. Haushaltsgerät nach Anspruch 1, wobei das Haushaltsgerät ein Haushaltsgerät zum Behandeln von Textilien (1), insbesondere eine Waschmaschine ist, welche dazu geeignet ist, wenigstens einen Behandlungszyklus durchzuführen, wobei das drehbare Element einen Korb zum Halten der Textilien (3) umfasst und wobei die Regelungs-/Steuerungsmittel (7, 21) eingerichtet sind zum:

- Antreiben der reversiblen dynamoelektrischen Vorrichtung (5) während eines Behandlungszyklus, welcher von dem Haushaltsgerät (1) durchführbar ist, um ein Antriebsdrehmoment mit dem Ziel zu erzeugen, den Korb (3) dazu zu bringen, eine oder mehrere im Wesentlichen vorgegebene Drehgeschwindigkeiten anzunehmen oder/und beizubehalten;
- Antreiben der reversiblen dynamoelektrischen Vorrichtung (5) mit dem Ziel, während des Behandlungszyklus wenigstens einen Schritt eines geregelten/gesteuerten Bremsens der Drehung des Korbs (3) durchzuführen.

3. Haushaltsgerät nach Anspruch 1 oder 2, wobei die Regelungs-/Steuerungsmittel (7, 21) eine Regelungs-/Steuerungseinheit umfassen, welche wenigstens einen Mikrocontroller (7) umfasst, und wobei die Schaltungsmittel (10, 24-26; 30) wenigstens eine schaltbare elektrische Vorrichtung (25; 30a, 30b) umfassen, welche von der Regelungs-/Steuerungseinheit (7) angetrieben wird.
4. Haushaltsgerät nach Anspruch 3, wobei die Schaltungsmittel (10, 24-26; 30) wiederaufladbare Elektrische-Energie-Speichermittel (24) umfassen.

5. Haushaltsgesetz nach Anspruch 4, wobei die Regelungs-/Steuerungseinheit (7) dazu eingerichtet ist, die schaltbare elektrische Vorrichtung (25) derart anzutreiben, dass:

- im Wesentlichen zu Beginn des geregelten/gesteuerten Bremsschrittes, die schaltbare elektrische Vorrichtung (25) eine erste Schaltposition einnimmt, in welcher die reversible dynamoelektrische Vorrichtung (5) mit einem relevanten Leistungszufuhrschaltkreis (Vac, 20, 22) nicht verbunden ist und mit den Speichermitteln (24) verbunden ist, so dass die Letzteren durch die von der reversiblen dynamoelektrischen Vorrichtung (5) erzeugte elektrische Energie aufgeladen werden;

- im Wesentlichen am Ende des geregelten/gesteuerten Bremsschrittes, die schaltbare elektrische Vorrichtung (25) eine zweite Schaltposition einnimmt, in welcher die dynamoelektrische Vorrichtung (5) mit dem relevanten Leistungszufuhrschaltkreis (Vac, 20, 22) verbunden ist und nicht mit den Speichermitteln (24) verbunden ist.

6. Haushaltsgesetz nach einem der Ansprüche 4 und 5, wobei die Schaltungsmittel (10, 24-26; 30) Leistungszufuhrmittel (26) umfassen, welche dazu eingerichtet sind, beginnend mit der in den Speichermitteln (24) gespeicherten Energie eine Leistungszufuhrspannung an wenigstens eine elektrische Last des Haushaltsgesetz (1) zuzuführen.

7. Haushaltsgesetz nach Anspruch 6, wobei die wenigstens eine Last ausgewählt ist, aus der Regelungs-/ Steuerungseinheit (7), einer oder mehreren Komponenten (9e) einer Benutzerschnittstelle (9) des Haushaltsgesetz (1), einer Vorrichtung zum Übertragen oder/und Empfangen von Daten.

8. Haushaltsgesetz nach Anspruch 7, wobei die Leistungszufuhrmittel (26) dazu eingerichtet sind, wenigstens einen Teil eines Regelungs-/Steuerungssystems des Haushaltsgesetz (1) zu versorgen, wie etwa die Regelungs-/Steuerungseinheit (7), wenn sich die Letztere in einem Stand-By-Zustand befindet, insbesondere mit dem Ziel, den Verbrauch des Haushaltsgesetz (1) in dem Stand-By-Zustand unterhalb einem vorgegebenen Wert, welcher vorzugsweise zwischen 0,5 W und ungefähr 2 W liegt, zu halten.

9. Haushaltsgesetz nach einem der Ansprüche 4 und 5, wobei die Schaltungsmittel (10, 24-26; 30) Leistungszufuhrmittel (26) umfassen, welche dazu eingerichtet sind, beginnend mit der in den Speichermitteln (24) gespeicherten Energie, eine Leistungszufuhrspannung an wenigstens eine Last oder eine

elektrische Vorrichtung außerhalb des Haushaltsgesetz (1) zuzuführen.

10. Haushaltsgesetz nach Anspruch 9, wobei die Leistungszufuhrmittel (10, 26) einen Stecker (10) umfassen, welcher mit den Speichermitteln (24) elektrisch verbunden ist, wobei der Stecker (10) vorzugsweise an einer Benutzerschnittstelle (9) des Haushaltsgesetz (1) angeordnet ist.

11. Haushaltsgesetz nach Anspruch 1 oder 2, wobei die Schaltungsmittel (10, 24-26; 30) dazu eingerichtet sind, die von der reversiblen dynamoelektrischen Vorrichtung (5) erzeugte elektrische Energie in ein Wechselstromnetz (Vac) einzuführen, welches das Haushaltsgesetz (1) mit Energie versorgt.

12. Haushaltsgesetz nach Anspruch 3, wobei die Schaltungsmittel (10, 24-26; 30) eine Mehrzahl von schaltbaren elektrischen Vorrichtungen (30a, 30b) umfassen, welche von der Regelungs-/Steuerungseinheit (7) angetrieben werden und zu einem Inverter-Schaltkreis (30) gehören.

13. Haushaltsgesetz nach Anspruch 11 und 12, wobei die Regelungs-/Steuerungseinheit (7) dazu eingerichtet ist, die schaltbaren elektrischen Vorrichtungen (30a, 30b) des Inverter-Schaltkreises (30) derart anzutreiben, dass während wenigstens eines geregelten/gesteuerten Bremsschrittes der Inverter-Schaltkreis (30), beginnend mit einer von der reversiblen dynamoelektrischen Vorrichtung (5) erzeugten Spannung eine sinusförmige Spannung erzeugt, welche mit dem elektrischen Netz (Vac) kompatible Eigenschaften aufweist, mit dem Ziel, diese in das System (Vac) einzuführen.

14. Haushaltsgesetz nach Anspruch 13, wobei die Regelungs-/Steuerungseinheit (7) dazu eingerichtet ist, die schaltbaren elektrischen Vorrichtungen (30a, 30b) des Inverter-Schaltkreises (30) derart anzutreiben, dass, wenn es erforderlich ist, dass die reversible dynamoelektrische Vorrichtung (5) ein Antriebsdrehmoment erzeugt, der Inverter-Schaltkreis (30) als ein Gleichrichterschaltkreis dient, um an die reversible dynamoelektrische Vorrichtung (5) eine im Wesentlichen Leistungszufuhr-gleichspannung zuzuführen.

15. Haushaltsgesetz nach einem der vorhergehenden Ansprüche, wobei die reversible dynamoelektrische Vorrichtung ein Drei-Phasen-Motor ist, insbesondere ein Induktionsmotor oder ein Permanentmagnetmotor (5), umfassend Drei-Phasen-Windungen und umfassend Mittel zum Erzeugen eines im Wesentlichen Gleichstroms (20, 22, 23), umfassend einen DC-Bus (22), und wobei die Regelungs-/Steuerungsmittel (7, 21) einen Inverter-Schaltkreis (21)

zum Regeln/Steuern des Motors (5) umfassen, umfassend eine Mehrzahl von Schaltvorrichtungen (21 a, 21 b), welche an den DC-Bus (22) gekoppelt sind, wobei die Schaltvorrichtungen (21 a, 21 b) von der Regelungs-/Steuerungseinheit (7) angetrieben werden, um die Phasen-Windungen des Motors (5) an den DC-Bus (22) selektiv zu koppeln, um das Antriebsdrehmoment zu erzeugen oder den wenigstens einen geregelten/gesteuerten Bremsschritt durchzuführen.

Revendications

1. Appareil électroménager comprenant une enveloppe ou un châssis (2), un organe rotatif (3) monté mobile en rotation à l'intérieur de l'enveloppe ou du châssis (2), une machine dynamoélectrique réversible (5), couplée fonctionnellement à l'organe rotatif (3) pour provoquer une rotation de celui-ci, et des moyens de contrôle (7, 21) pour entraîner la machine dynamoélectrique réversible (5) pendant le fonctionnement de l'appareil électroménager (1), dans lequel les moyens de contrôle (7, 21) sont adaptés pour entraîner la machine dynamoélectrique réversible (5) à générer un couple d'entraînement, dans le but d'amener l'organe rotatif (3) à acquérir et/ou maintenir une ou plusieurs vitesses de rotation sensiblement déterminées, les moyens de contrôle (7, 21) étant en outre configurés pour entraîner la machine dynamoélectrique réversible (5) dans le but de réaliser, pendant le fonctionnement de l'appareil électroménager, au moins une étape de freinage contrôlé de la rotation de l'organe rotatif (3), où pendant la au moins une étape de freinage contrôlé, la machine dynamoélectrique réversible (5) génère de l'énergie électrique, l'appareil électroménager (1) étant **caractérisé en ce qu'il** comprend des moyens de circuit (10, 24-26 ; 30) pour récupérer et rendre utilisable l'énergie électrique générée par la machine dynamoélectrique réversible (5) pendant la au moins une étape de freinage contrôlé.

2. Appareil électroménager selon la revendication 1, dans lequel l'appareil électroménager est un appareil électroménager destiné à traiter des articles textiles (1), en particulier une machine à laver, adapté pour réaliser au moins un cycle de traitement, l'organe rotatif comprenant un panier pour contenir les articles textiles (3) et dans lequel les moyens de contrôle (7, 21) sont configurés pour

- entraîner la machine dynamoélectrique réversible (5), pendant un cycle de traitement pouvant être réalisé par l'appareil électroménager (1), à générer un couple d'entraînement dans le but d'amener le panier (3) à acquérir et/ou maintenir une ou plusieurs vitesses de rotation sensiblement

déterminées ;

- entraîner la machine dynamoélectrique réversible (5) dans le but de réaliser, pendant le cycle de traitement, au moins une étape de freinage contrôlé de la rotation du panier (3).

3. Appareil électroménager selon la revendication 1 ou 2, dans lequel les moyens de contrôle (7, 21) comprennent une unité de contrôle comprenant au moins un microcontrôleur (7) et les moyens de circuit (10, 24-26 ; 30) comprennent au moins un dispositif électrique commutable (25 ; 30a, 30b), entraîné par l'unité de contrôle (7).

4. Appareil électroménager selon la revendication 3, dans lequel les moyens de circuit (10, 24-26 ; 30) comprennent des moyens de stockage d'énergie électrique rechargeables (24).

5. Appareil électroménager selon la revendication 4, dans lequel l'unité de contrôle (7) est prévue pour entraîner le dispositif électrique commutable (25) de sorte que :

- sensiblement au début de l'étape de freinage contrôlé, le dispositif électrique commutable (25) acquiert une première position de commutation, dans laquelle la machine dynamoélectrique réversible (5) n'est pas connectée à un circuit d'alimentation adéquat (Vac, 20, 22) et est connectée aux moyens de stockage (24) de sorte que ces derniers soient chargés par l'énergie électrique produite par la machine dynamoélectrique réversible (5) ;

- sensiblement à la fin de l'étape de freinage contrôlé, le dispositif électrique commutable (25) acquiert une seconde position de commutation, dans laquelle la machine dynamoélectrique (5) est connectée au circuit d'alimentation adéquat (Vac, 20, 22) et n'est pas connectée aux moyens de stockage (24).

6. Appareil électroménager selon l'une quelconque des revendications 4 et 5, dans lequel les moyens de circuit (10, 24-26 ; 30) comprennent des moyens d'alimentation (26) configurés pour fournir, en partant de l'énergie stockée dans les moyens de stockage (24), une tension d'alimentation à au moins une charge électrique de l'appareil électroménager (1).

7. Appareil électroménager selon la revendication 6, dans lequel la au moins une charge est choisie parmi l'unité de contrôle (7), un ou plusieurs composants (9e) d'une interface utilisateur (9) de l'appareil électroménager (1), un dispositif pour transmettre et/ou recevoir des données.

8. Appareil électroménager selon la revendication 7,

dans lequel lesdits moyens d'alimentation (26) sont configurés pour alimenter au moins une partie d'un système de contrôle de l'appareil électroménager (1), telle que l'unité de contrôle (7), lorsque cette dernière est en état de veille, en particulier dans le but de maintenir la consommation de l'appareil électroménager (1) dans l'état de veille en dessous d'une valeur donnée, de préférence comprise entre environ 0,5 W et environ 2 W.

9. Appareil électroménager selon l'une quelconque des revendications 4 et 5, dans lequel les moyens de circuit (10, 24-26 ; 30) comprennent des moyens d'alimentation (26) configurés pour fournir, en partant de l'énergie stockée dans les moyens de stockage (24), une tension d'alimentation à au moins une charge ou un dispositif électrique à l'extérieur de l'appareil électroménager (1).
10. Appareil électroménager selon la revendication 9, dans lequel lesdits moyens d'alimentation (10, 26) comprennent une prise électrique (10) connectée électriquement aux moyens de stockage (24), la prise électrique (10) étant de préférence positionnée au niveau d'une interface utilisateur (9) de l'appareil électroménager (1).
11. Appareil électroménager selon la revendication 1 ou 2, dans lequel les moyens de circuit (10, 24-26 ; 30) sont configurés pour introduire l'énergie électrique générée par la machine dynamoélectrique réversible (5) dans un réseau électrique à courant alternatif (Vac) qui alimente l'appareil électroménager (1).
12. Appareil électroménager selon la revendication 3, dans lequel les moyens de circuit (10, 24-26 ; 30) comprennent une pluralité de dispositifs électriques commutables (30a, 30b) entraînés par l'unité de contrôle (7) et appartenant à un circuit inverseur (30).
13. Appareil électroménager selon les revendications 11 et 12, dans lequel l'unité de contrôle (7) est configurée pour entraîner les dispositifs électriques commutables (30a, 30b) du circuit inverseur (30) de sorte que, pendant la au moins une étape de freinage contrôlé, le circuit inverseur (30) produise, en partant d'une tension générée par la machine dynamoélectrique réversible (5), une tension sinusoïdale ayant des caractéristiques compatibles avec celles dudit réseau électrique (Vac), dans le but d'introduire celle-ci dans ledit système (Vac).
14. Appareil électroménager selon la revendication 13, dans lequel l'unité de contrôle (7) est configurée pour entraîner les dispositifs électriques commutables (30a, 30b) du circuit inverseur (30) de sorte que, lorsque la machine dynamoélectrique réversible (5) est nécessaire pour générer un couple d'entraînement,

le circuit inverseur (30) serve de circuit redresseur, afin de fournir à la machine dynamoélectrique réversible (5) une tension d'alimentation sensiblement continue.

15. Appareil électroménager selon l'une quelconque des revendications précédentes, dans lequel la machine dynamoélectrique réversible est un moteur triphasé, en particulier un moteur à induction ou un moteur à aimant permanent (5), comprenant des enroulements triphasés et comprenant des moyens de génération d'un courant sensiblement continu (20, 22, 23), comprenant un bus CC (22), et dans lequel les moyens de commande (7, 21) comprennent un circuit inverseur (21) pour contrôler le moteur (5), comprenant une pluralité de dispositifs de commutation (21a, 21b) couplés au bus CC (22), les dispositifs de commutation (21a, 21b) étant entraînés par l'unité de contrôle (7) pour coupler sélectivement les enroulements de phase du moteur (5) au bus CC (22), de façon à générer ledit couple d'entraînement ou à réaliser ladite au moins une étape de freinage contrôlé.

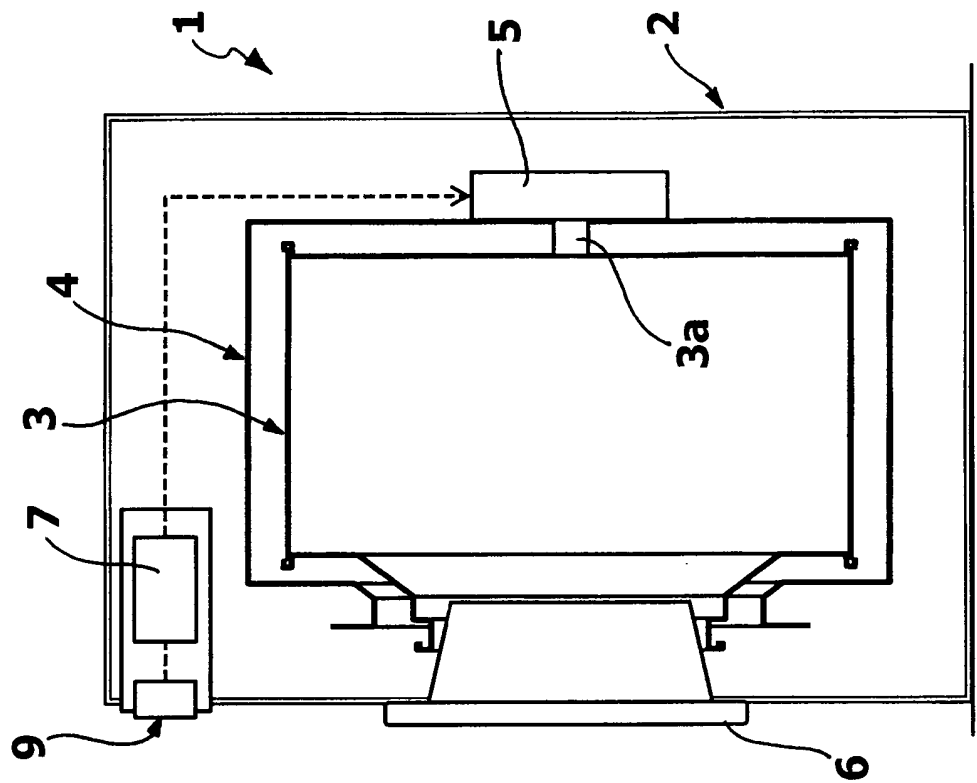


Fig. 1

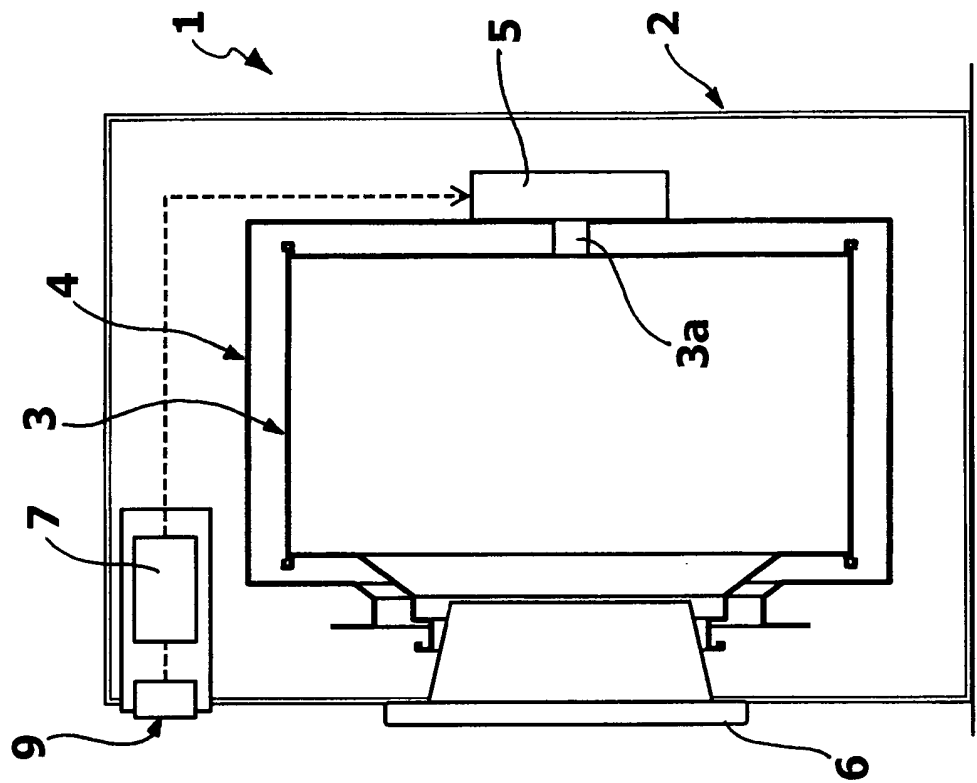


Fig. 2

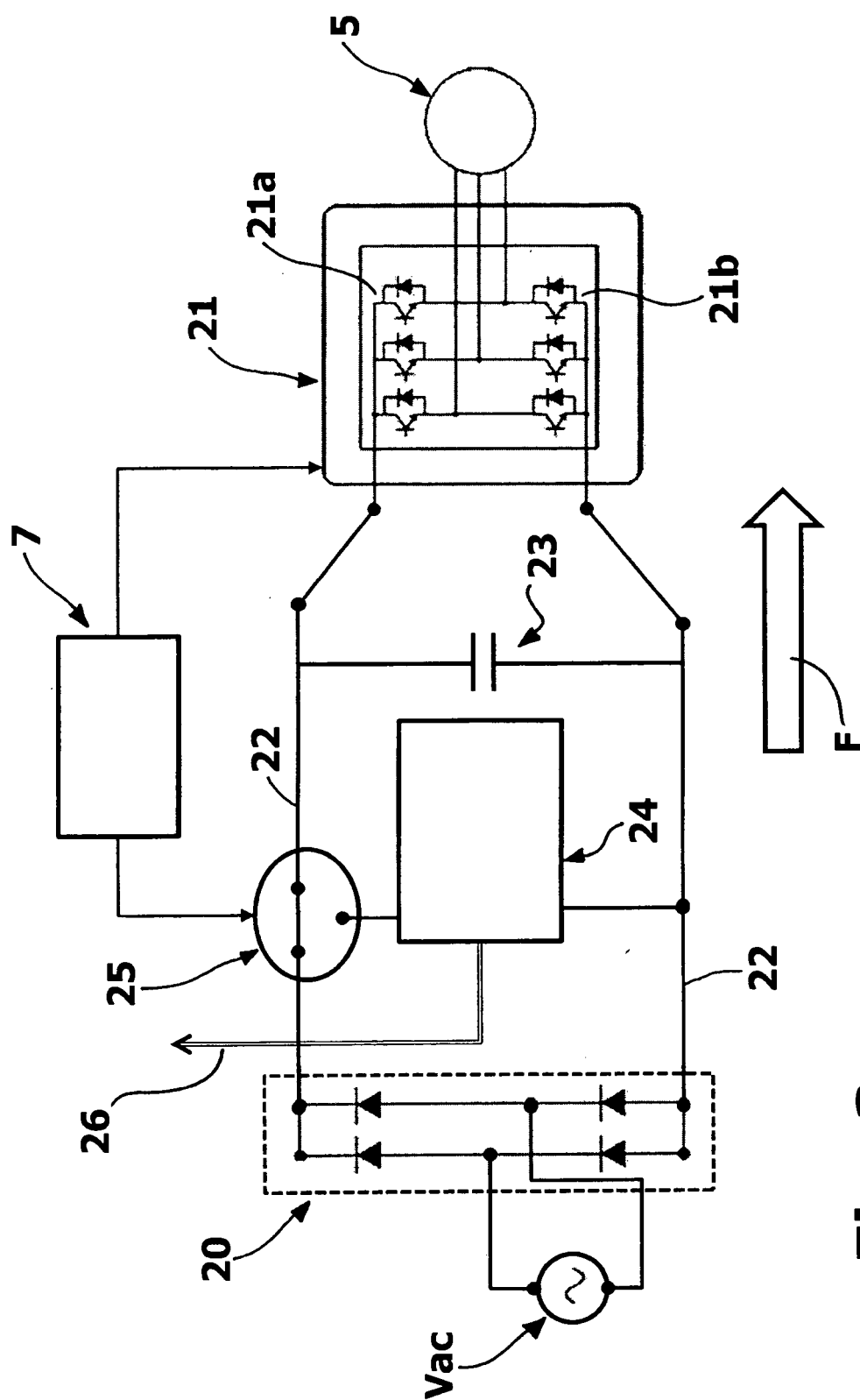


Fig. 3

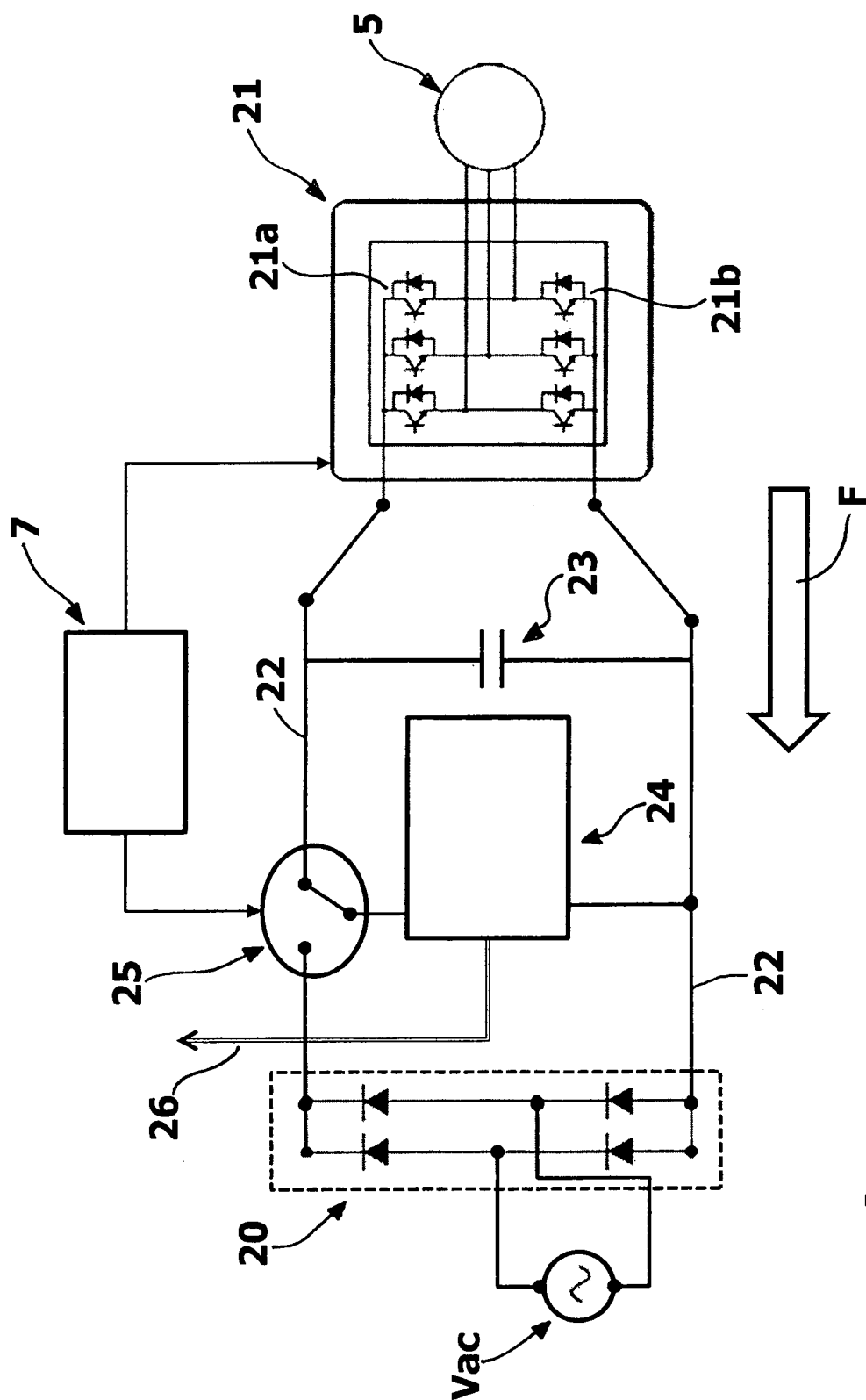


Fig. 4

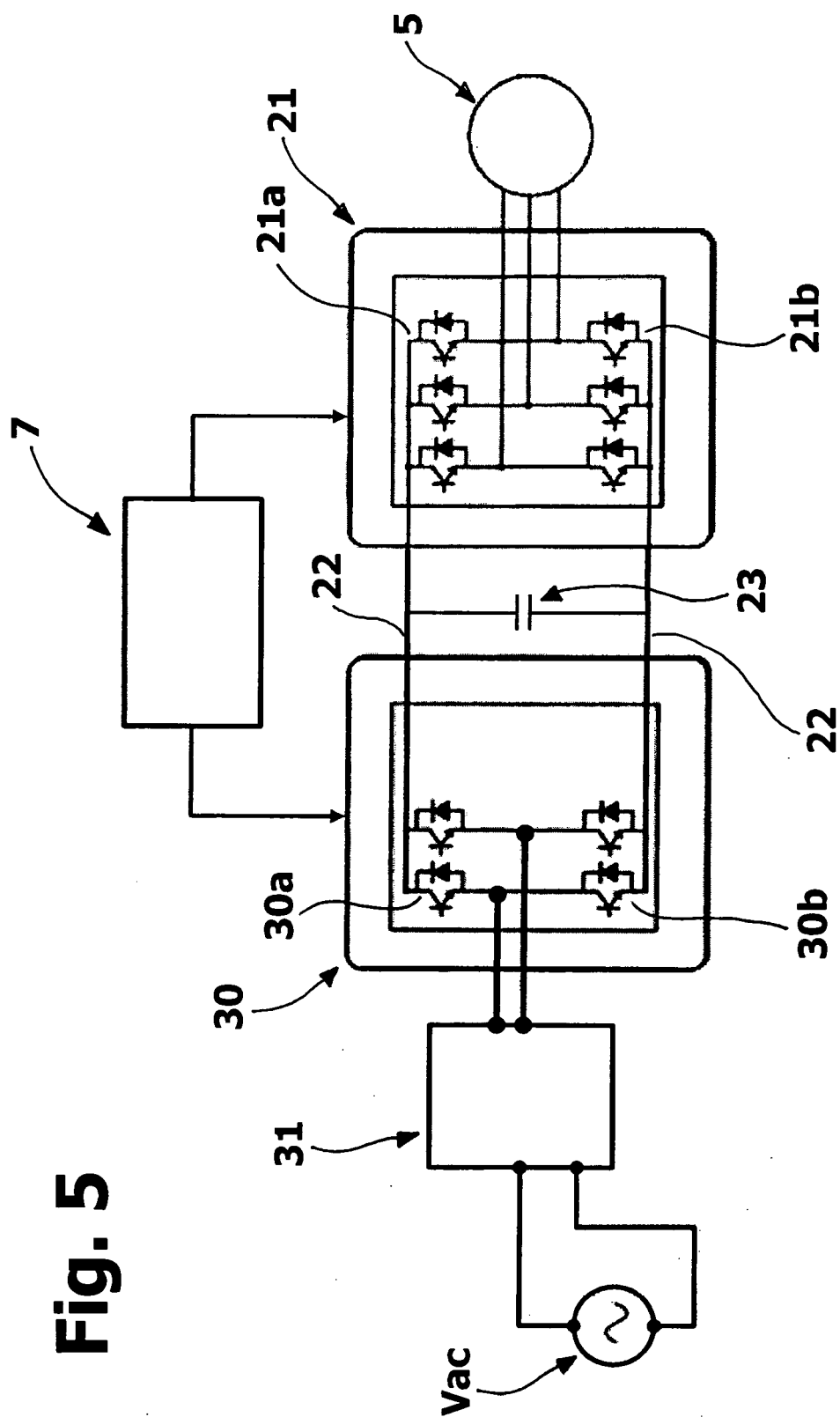


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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