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(54) Pump for a dishwashing machine and corresponding pump assembly and dishwashing machine

(57) A pump (2') for dishwashing machines is described, comprising an electric motor (21'), an impeller (23') and electronic motor control circuitry (27'), the electric motor (21') being able to rotate the impeller (23'), the electronic motor control circuitry (27') being able to control the electric motor (21'). Advantageously, the electronic motor control circuitry (27') is structured to control the electric motor (31') of an additional pump (3').

Furthermore, a pump assembly for a dishwashing machine (6') is described, comprising a master pump (2') and at least one slave pump (3'), the master pump (2') being of above said type, the at least one slave pump (3') being electrically connected to the electronic motor control circuitry (27') and being electronically controlled by the electronic motor control circuitry (27').

A dishwashing machine (1') is also described, comprising a pump assembly of above said type, the dishwashing machine (1') being hydraulically connected, on the inlet side, by means of suction, to the water distribution system, through the at least one washing pump (2') and being connected, on the outlet side, to the water distribution system or to a drain, through the at least one discharge pump (3').

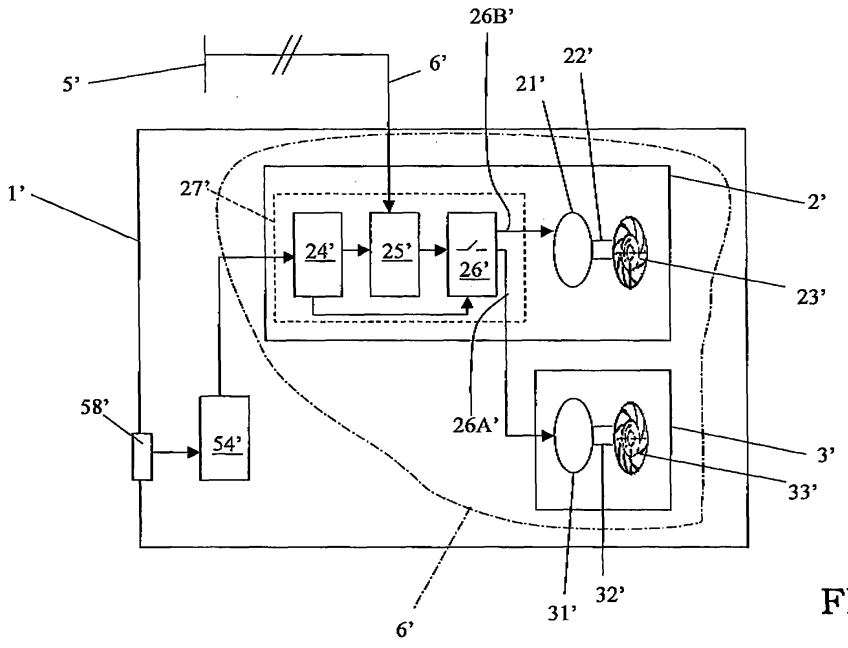

FIG. 4

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Description

Technical field

[0001] The present invention relates to a pump for a dishwashing machine, comprising an electric motor, an impeller and electronic motor control circuitry, said electric motor being able to rotate said impeller, said electronic motor control circuitry being able to control said electric motor.

[0002] Moreover, the present invention relates to a pump assembly for dishwashing machines comprising a master pump of said type.

[0003] Finally, the present invention relates to a dishwashing machine comprising said pump assembly, said dishwashing machine being hydraulically connected, on the inlet side, to a water distribution system, by means of suction, provided by at least one washing pump and, on the outlet side, to the water distribution system by means of at least one discharge pump.

Known art

[0004] As is known, a dishwashing machine is equipped with a suitable pump assembly (or electric pump assembly, since it comprises an electric motor).

[0005] This type of dishwashing machine is connected, on the inlet side, to a water distribution system, by means of conduits, in order to receive clean water, and is connected on the outlet side to a drain in order to drain dirty water.

[0006] Such a dishwashing machine normally comprises at least two pumps, in particular at least a washing pump and a discharge pump.

[0007] By means of the washing pump, water drawn from the water distribution system, combined with a specific detergent, this solution being also called lye, is sprayed onto the dishes.

[0008] The lye and suspended dirt is sucked, by means of the discharge pump, and is expelled towards the waste water system.

[0009] An example of a traditional dishwashing machine is illustrated in figs. 1-2 and one of its discharge pumps is illustrated in fig. 3, said dishwashing machine being generally referenced at 1 and said pump assembly being referenced at 6.

[0010] The dishwashing machine 1 is hydraulically connected, on the inlet side, to the water distribution system, by means of suction provided by the washing pump 2, and, on the outlet side, by means of pressure provided by the discharge pump 3. An electric heater 5, of the resistor type, is such as to heat the lye to be sprayed onto the dishes.

[0011] The washing pump comprises an electric motor, which comprises a rotatable rotor, and a fixed stator. The rotor, which is protected by a sleeve of thermoplastic material, is integral with a shaft, which is force fitted to an impeller. In this way, the rotor is mechanically connected to the impeller. The impeller is of the type with directional vanes.

[0012] The synchronous electric motor of the washing pump is in this case of the so called electronic startup type. The synchronous electric motor is controlled by electronic motor control circuitry, for instance of the vector or PWM type, which is expensive and difficult to implement in small spaces, such as inside a dishwashing pump.

[0013] The discharge pump 3, illustrated in fig. 3, comprises an electric motor 31, of the synchronous type, with permanent magnets, said electric motor 31 comprising a rotatable rotor 310, and a fixed stator 311, of the diapason type.

[0014] The rotor 310, which is protected by the sleeve 312, of thermoplastic material, is integral with a shaft 32, which is forced fitted with an impeller 33. In this way, the rotor 310 is mechanically connected to impeller 33.

[0015] The pump 3 comprises a mechanical joint 39, which facilitates the automatic start up of the synchronous motor, by disengaging it from the load.

[0016] The synchronous electric motor 31 of the discharge pump may be theoretically controlled by the electronic motor control circuits, which is for example of the vector or PWM type. However, such electronic motor control circuitry is expensive and difficult to implement.

[0017] Therefore, in general, the electric synchronous motor of the discharge pump is not electronically controlled. The electric synchronous motor of the discharge pump is directly supplied by the home power supply and rotates at synchronous speed with the electric network, i.e. proportional to 50 Hz or 60 Hz.

[0018] However there are problems, since at startup, the rotor of the electric synchronous motor has to reach synchronous velocity in the shortest time possible, in order to be coupled to the rotational speed of the load at network frequency, and this entails that, for the same load, it has to provide a starting torque higher than the synchronous or regime torque.

[0019] Therefore, in particular if the load inertia is high, a high starting torque has to be applied, so that the electric synchronous motor has to be oversized, for instance by providing a high number of coil turns, and therefore by providing a high quantity of copper, or by increasing the section of magnetic poles, using iron, or by increasing magnet volume, using costly permanent magnets.

[0020] If the disengagement of the motor from the load, during the startup transient, is provided by above said mechanical joint 39, this causes louder noise of motor during synchronous operation, since the transmission of movement between motor and load does not take place through a rigid connection, so that vibration of rotor caused by its oversizing for startup and by a non linear characteristic of the periodic torque, typical of this type of motor, is amplified.

[0021] The absence of an electronic control for the discharge pump entails that the single phase electric synchronous motor is per se of the bidirectional type, since

the rotation direction of the rotor is not predetermined. Moreover, the discharge pump has necessarily to have a straight vane impeller, which is hydraulically less effective than a directional vane impeller, and in this case the use of undesired hydraulic and/or mechanical means is required, for allowing water to flow according to a predetermined direction.

[0022] The technical problem to be solved by the present invention is to provide a dishwashing machine, a pump assembly and pumps, which solve the above said problems, without any further cost with respect to the typical solution of the known art.

Summary of the invention

[0023] The solution concept provided by the present invention is based on the finding, that the use of washing and discharge pumps in a dishwashing machine comprise operation periods which normally are not superimposed.

[0024] Based on this solution, the technical problem is solved by a pump for a dishwashing machine, comprising an electric motor, an impeller and electronic motor control circuitry, said electric motor being able to rotate said impeller, said electronic motor control circuitry being able to control said electric motor, characterized in that said electronic motor control circuitry comprises connections to an additional electric motor of an additional pump, also called slave pump.

[0025] Such a pump may operate as a master for further slave pumps.

[0026] Furthermore, the technical problem is solved by a pump assembly for dishwashing machine, comprising a master pump and at least one slave pump, said master pump being of above said type, said at least one slave pump being electrically connected to said electronic motor control circuitry and being controlled by said electronic motor control circuitry, belonging to the master pump.

[0027] A pump assembly is thus provided, comprising a master pump and a slave pump, the master pump being the only one to have electronic circuits, though being able to also control, by means of said electronic circuitry, the slave pump.

[0028] The master pump may be the washing pump and the slave pump may be the discharge pump.

[0029] Finally, the technical problem is solved by a dishwashing machine comprising above said pump assembly, said dishwashing machine being hydraulically connected on the inlet side to the water distribution system, providing suction by means of said at least one washing pump and on the outlet side to the same water distribution system or to a drain, by means of said at least one discharge pump.

[0030] As will be described later, in this way the slave pump may be as quite, economic, and correctly sized with respect to application requirements, and efficient as the master pump.

Brief description of drawings

[0031] In these drawings:

- fig. 1 shows a vertical view of a dishwashing machine according to the know art,
- fig. 2 shows a three dimensional view of dishwashing machine of fig. 1,
- fig. 3 shows a discharge pump according to the known art,
- fig. 4 shows a simplified electrical sketch of a dishwashing machine, of a pump assembly and pump according to the invention,
- fig. 5 shows part of the dishwashing machine according to the present invention, with a washing pump.

Detailed description

[0032] Fig. 4 shows a simplified electrical sketch of a dishwashing machine.

[0033] The dishwashing machine 1', according to the invention, comprises a pump assembly 6', comprising a washing pump 2', which represents the master pump, and a discharge pump 3', which is the slave pump.

[0034] The dishwashing machine 1' comprises a dishwashing machine controlling electronic circuitry 57', which includes a user interface 58' (provided for instance with a keyboard for command input by the user) and a dishwashing machine control board 54'. The latter, which is usually a microprocessor, is such as to control the operation of dishwashing machine 1', in particular for controlling the pump assembly 6'.

[0035] The washing pump 2' comprises an electric motor 21'. The electric motor 21' comprises a rotor 210', which is rotatable, and a fixed stator 211'.

[0036] The rotor 210', which is protected by a sleeve 212' of thermoplastic material, is integral with a shaft 22', which is force fitted with an impeller 23'.

[0037] In this way, the rotor 210' is mechanically connected to the impeller 23'. The impeller 23' has directional vanes.

[0038] The washing pump 2' comprises an electronic circuitry 27' comprising, in its present embodiment, a logical unit 24', a power supply unit 25' and a switching unit 26'.

[0039] The logical unit 24', which in this case is formed by a microprocessor board, is structured to control the power supply unit 25'.

[0040] The power supply unit 25', which for example comprises a bridged inverter (in the present case, of single phase type) is controlled by the logical unit 24' and is supplied by means of a power line 5 through the home power supply 5 at 220 V and 50 Hz. The power supply unit 25' is able to supply the synchronous electric motor

21'.

[0041] The switching unit 26' is controlled by the logical unit 24', and has power switches which are controlled by outputs of the logical unit 24.

[0042] An output of switching unit 26' is connected, by means of connection 26B', to the washing pump 2'. In this way, electric power may be supplied to the electric synchronous motor 21' of the washing pump 2' by the inverter 25, in a traditional way, when switching the unit 26', controlled by the logic 24', allows such a connection.

[0043] On the other contrary, electric power cannot be supplied to the motor 21' when the switching unit 26', controlled by the logic 24', does not allow such a connection.

[0044] The discharge pump 3' comprises an electric motor 31', of the synchronous type, with permanent magnets, said electric motor 31' comprising a rotatable rotor and a fixed stator, of the diapason type.

[0045] The rotor of the synchronous electric motor 31', which is protected by a sleeve of thermoplastic material, is integral with a shaft 32', which is force fitted with an impeller 33'. In this way, the rotor of the electric synchronous motor 31' is mechanically connected to the impeller 33. The impeller 33' is of the directional vane type.

[0046] The discharge pump does not comprise electronic motor control circuitry, since the electric motor 31' may be supplied with electric power by the power supply unit 25', which is provided in the electronic motor control circuitry 27' of the washing pump 2'.

[0047] The electronic motor control circuitry 27' is in fact electrically connected, by means of connection 26A', to the motor 31', the power supply unit 25' supplying the motor 31' with electric power, when the switching unit 26', controlled by the logical unit 24', commands such a connection.

[0048] It is to be noted that the switching unit 26', which commands the connection of power supply unit 25' alternatively to the electric synchronous motor 21' or to the electric synchronous motor 31', is controlled by logical unit 24', which is in turn controlled by the electronic dishwashing machine controlling circuitry 54'.

[0049] The logical unit 24' runs software suitable for the electric motor 21' as well as for the electric motor 31'.

[0050] An advantage is that the discharge pump has no electronic motor control circuitry, but benefits of same advantages provided by use of the electronic circuitry typical of washing pumps.

[0051] In fact, during use, the dishwashing machine 1' does not operate the washing and discharge pump at the same time.

[0052] Therefore, instead of using electronic circuits specifically designed for each single pump, it is possible to use a single electronic circuit for controlling the motors, which alternatively runs software for the washing pump and then software for the discharge pump.

[0053] Therefore a pump assembly is provided, with a master pump and a slave pump (or more than one slave pump), wherein the master pump is able to control the operation of the whole pump assembly.

[0054] In this manner it is evident that various advantages may be obtained.

[0055] In fact, the use of electronic motor control circuitry also for the electric synchronous motor of the discharge pump provides the advantage of allowing a controlled startup of motor (for instance by a ramp), so that no mechanical joint for mechanical starting of motor is required. Therefore, the pumps become noiseless.

[0056] Moreover, such a controlled startup of the electric synchronous motor also allows control of rotational direction of rotor: therefore, the single phase electric synchronous motor is no more a bidirectional motor, and, further, the vanes may be of the spoon type, providing a higher hydraulic efficiency.

[0057] This fact, combined with the fact that the electric synchronous motor is correctly sized with respect to startup, avoids the traditional oversizing, with a corresponding saving in terms of copper, iron and permanent magnets.

[0058] An alternative embodiment of the present invention foresees the use of the discharge pump as a master pump and of the washing pump as a slave pump. In this case, the electronic motor control circuitry is provided within the discharge pump and not within the washing pump.

[0059] It is also possible that the pump assembly according to the invention comprises more than one washing pump and more than one discharge pump. In this case, there would be always a master pump and the remaining pumps would be the slave pumps.

[0060] Obviously, in order to increase dependability of the dishwashing machine according to the invention, one could use more than one master pump, for replacing a faulty master pump with a secondary master pump.

[0061] The electronic motor control circuitry 27 is provided only for illustration purposes, being evident that it is possible, by suitably designing its layout, to entirely integrate the same on a single board.

[0062] The electric motors are not necessarily of the synchronous type, although best results are obtained with this type of motor, in terms of global efficiency of washing and discharging operation.

[0063] The only requirements for the software for managing the dishwashing machine controlling circuitry is to indicate, in real time, which pump and which washing program is required. The master pump manages all remaining operations of pump assembly.

[0064] Besides the sensorless control, typical of the known art, another modification is possible, wherein an electric motor feedback is provided, for instance by means of Hall sensors provided inside the stator near the permanent magnet rotor. In this case it is possible to simply mount a very small board with a Hall sensor and corresponding circuitry for processing signals, for providing motor control, by rotor angular variation, according to known algorithms.

Claims

1. Pump (2') for dishwashing machines, comprising an electric motor (21'), an impeller (23') and electronic motor control circuitry (27'), said electric motor (21') being able to rotate said impeller (23'), said electronic motor control circuitry (27') being able to control said electric motor (21'), **characterized in that** said electronic motor control circuitry (27') comprises connections (26B') to an additional electric motor (31') of an additional pump (3').

2. Pump according to claim 1, **characterized in that** said electric motor (21') is of the synchronous single phase type, provided with permanent magnets.

3. Pump according to anyone of preceding claims, **characterized in that** said impeller (23') is of the directional vane type.

4. Pump according to anyone of preceding claims, **characterized in that** said electronic motor control circuitry (27') comprises a logical unit (24'), a power supply unit (25') and a switching unit (26'), **characterized in that** said logical unit runs software for controlling operation of said power supply unit (25') for alternatively supplying power to said electric synchronous motor (21') and said further electric motor (31'), said logical unit being connected to said switching unit (36') in order to allow the connection between said power supply unit (25') and said electric motors (21', 31').

5. Pump according to anyone of preceding claims, **characterized in that** said power supply unit (25') comprises an inverter.

6. Pump assembly for dishwashing machines (6'), **characterized in that** it comprises a master pump (2') and at least one slave pump (3'), said master pump (2') being in accordance with one of preceding claims, said at least one slave pump (3') being electrically connected to said electronic motor control circuitry (27') and being electronically controlled by said electronic motor control circuitry (27').

7. Pump assembly according to claim 6, **characterized in that** said master pump is a washing pump for dishwashing machines (2'), said at least one slave pump being the discharge pump (3') of the dishwashing machine.

8. Pump assembly according to anyone of preceding claims 6 or 7, **characterized in that** said master pump is a first washing pump (2'), said at least one slave pump comprising an additional washing pump.

9. Pump assembly according to anyone of claims 6-8, **characterized in that** at least one among said at least one master pump (2') and at least one slave pump (3') is of the synchronous type.

10. Pump assembly for dishwashing machines according to anyone of claims 5-9, **characterized in that** the at least one of the at least one master pump (2') and at least one slave pump (3') has an electric motor (21', 31') of the permanent magnet type.

11. Pump assembly according to anyone of claims 5-9, **characterized in that** at least one slave pump (3') has an impeller (33') with directional vanes.

12. Dishwashing machine (1') comprising a pump assembly according to anyone of claims 6-11, said dishwashing machine (1') being hydraulically connected, on the inlet side, to the water distribution system, by means of suction, through said at least one washing pump (2') and, on the outlet side, to said water distribution system or to a drain, by means of said at least one discharge pump (3').

13. Dishwashing machine according to claim 12, comprising electronic dishwashing machine control circuitry (57'), connected to said electronic motor control circuitry (27'), said electronic dishwashing machine control circuitry (57') comprising an output connection to said electronic motor control circuitry (27'), for controlling said switching unit (26').

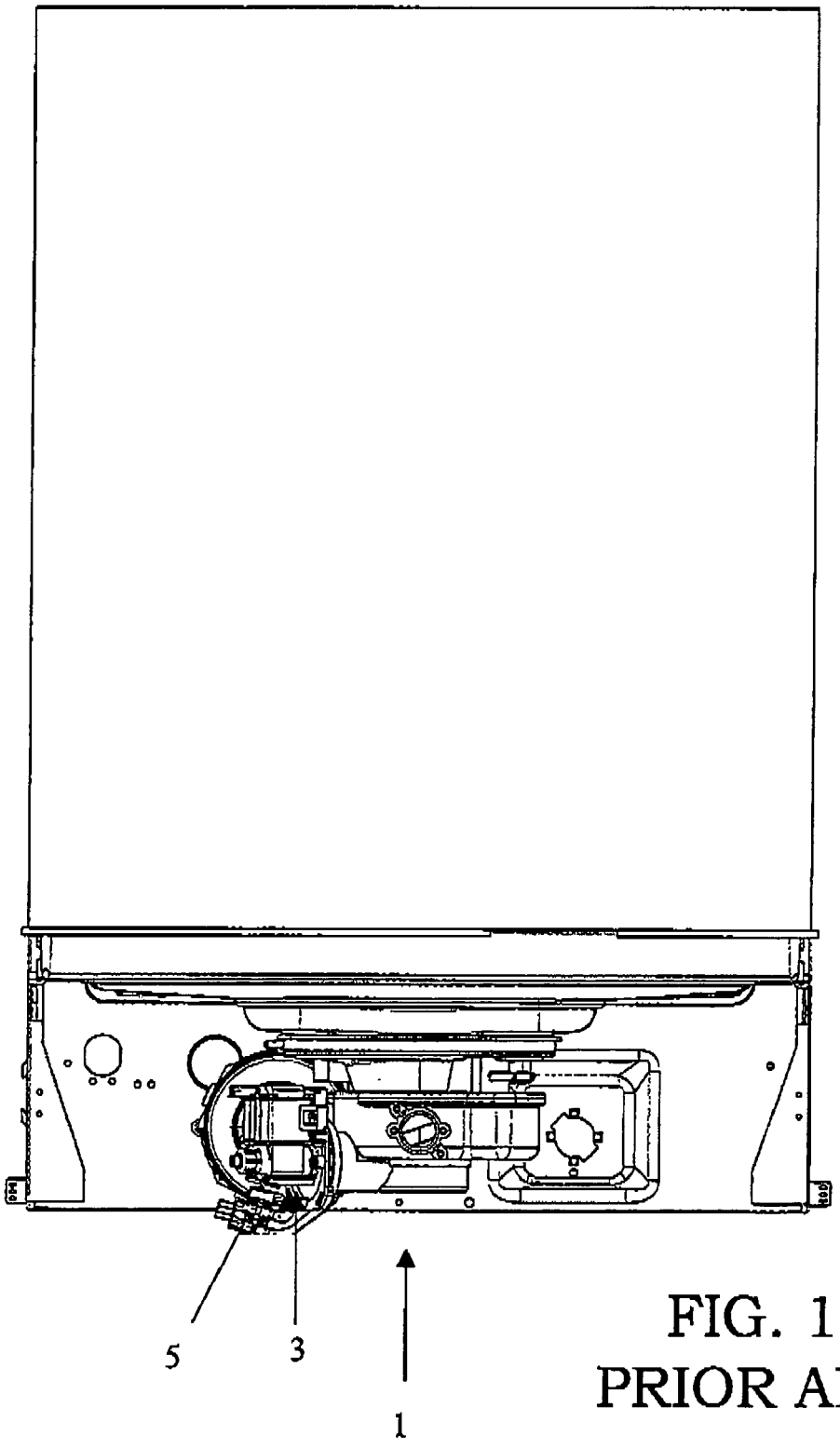

FIG. 1
PRIOR ART

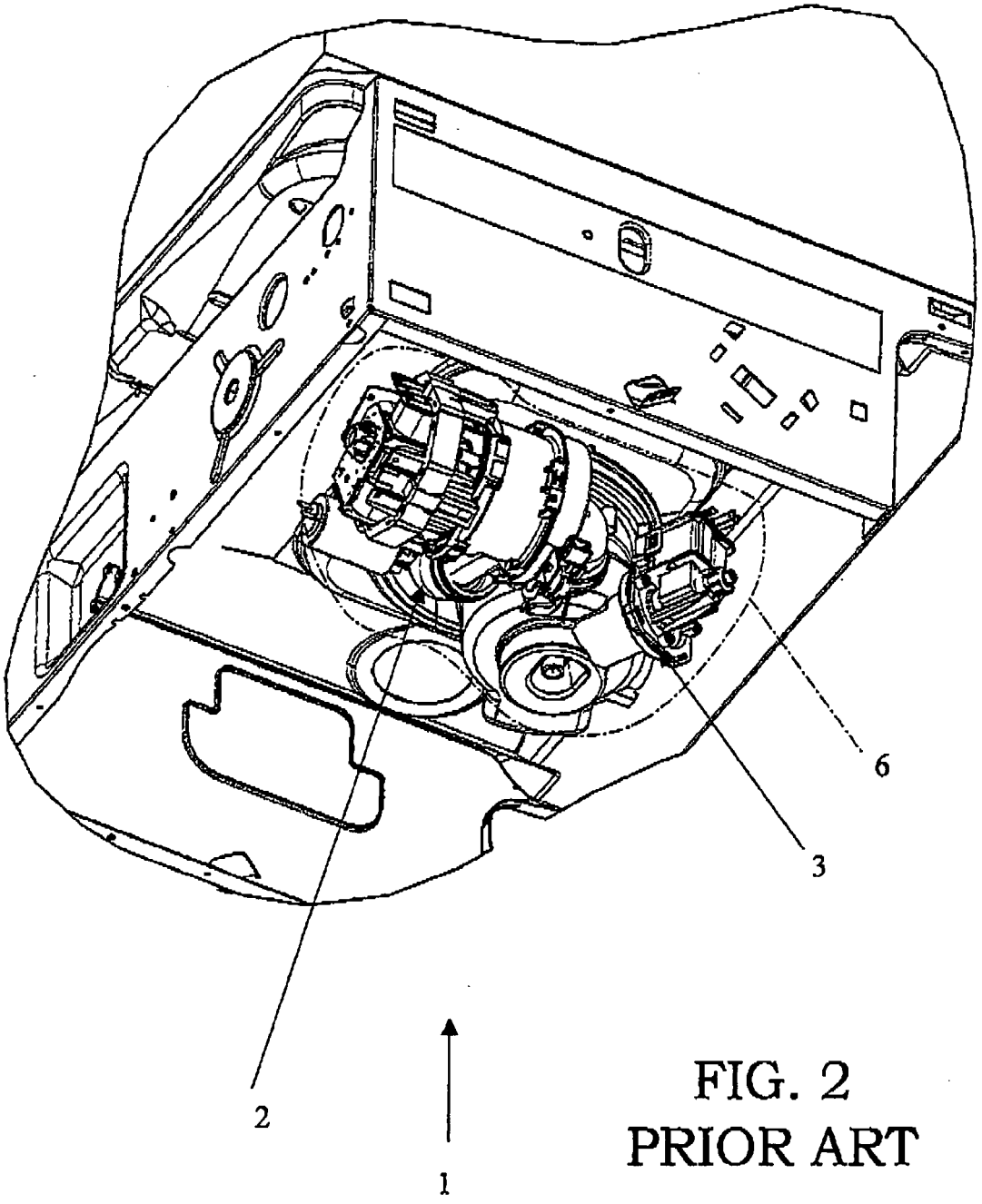

FIG. 2
PRIOR ART

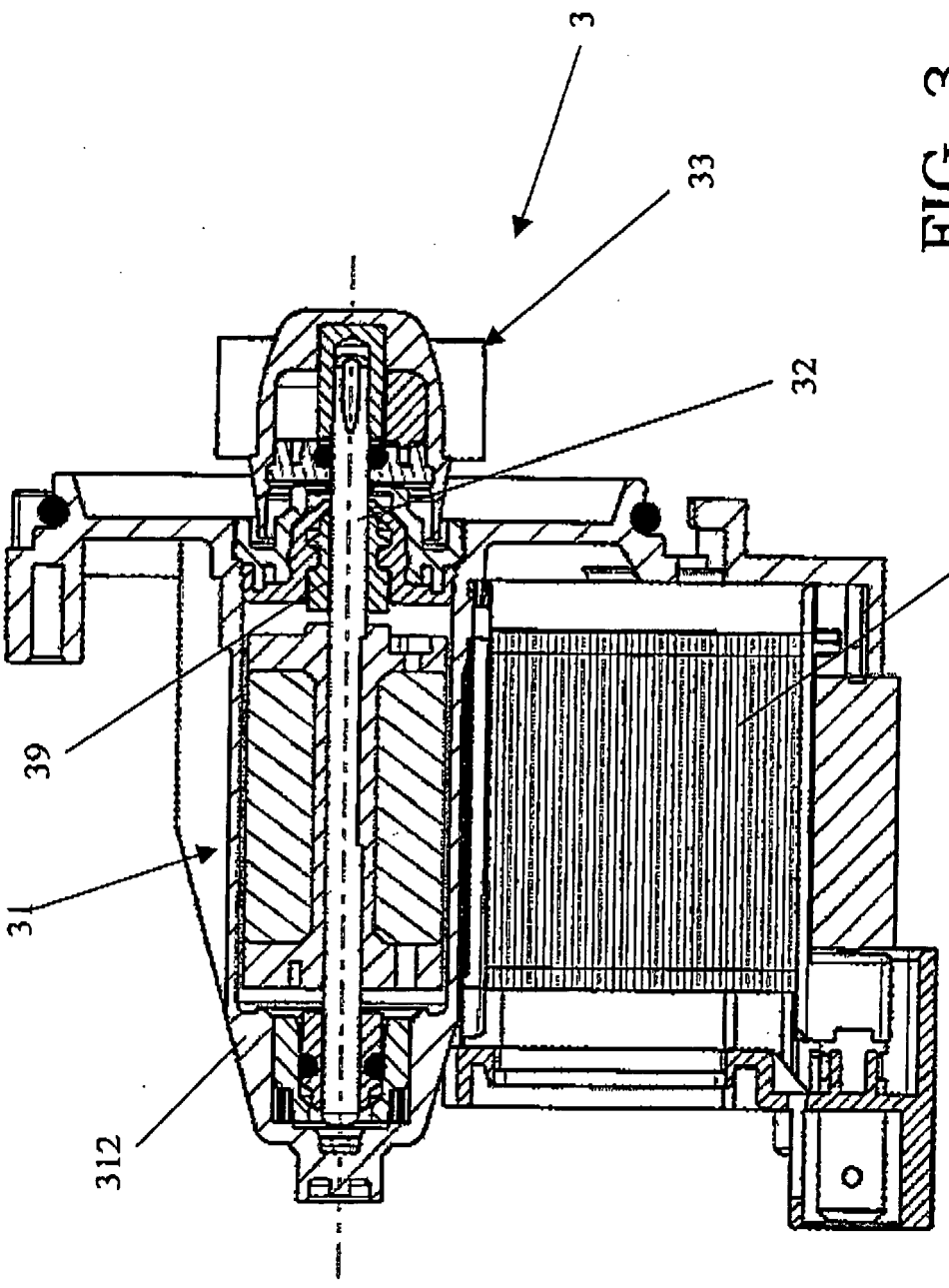

FIG. 3
PRIOR ART

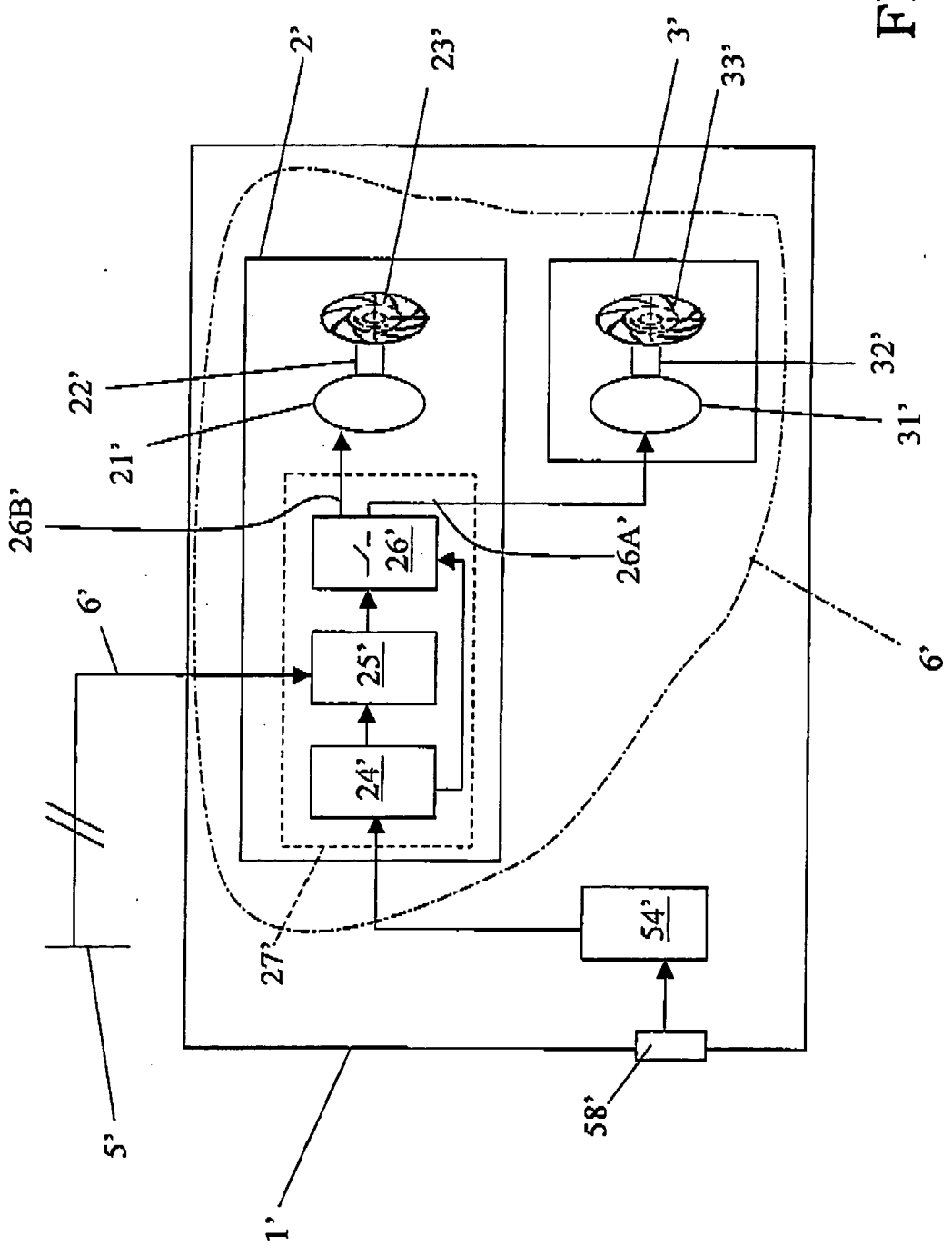

FIG. 4

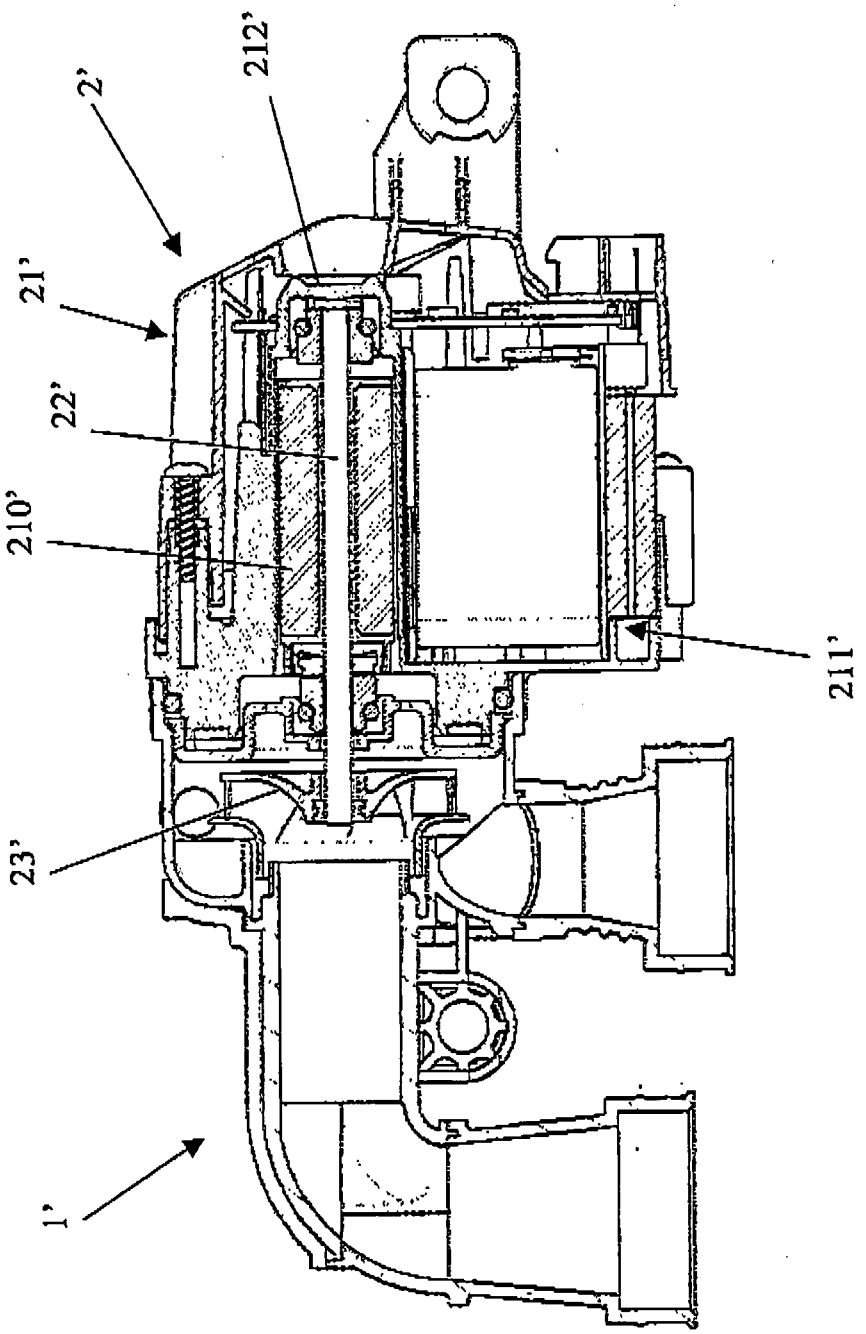

FIG. 5