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(54) **ELECTRONIC CONTROL APPARATUS FOR AN ELECTRIC MOTOR**

(57) Electronic control apparatus (10) for an electric motor (11) associated with a refrigerator unit (12) comprising a central control unit (14) installed in the refrigerator unit (12) and configured to receive at least a control signal (S1) from one or more sensors (15) associated with the refrigerator unit, and to supply on exit a command

signal (S2) able to command a processing unit (16), also considering the characteristics of said refrigerator unit (12), the processing unit being configured to receive and process the command signal (S2) in order to obtain a drive signal (S3) for the electric motor (11).

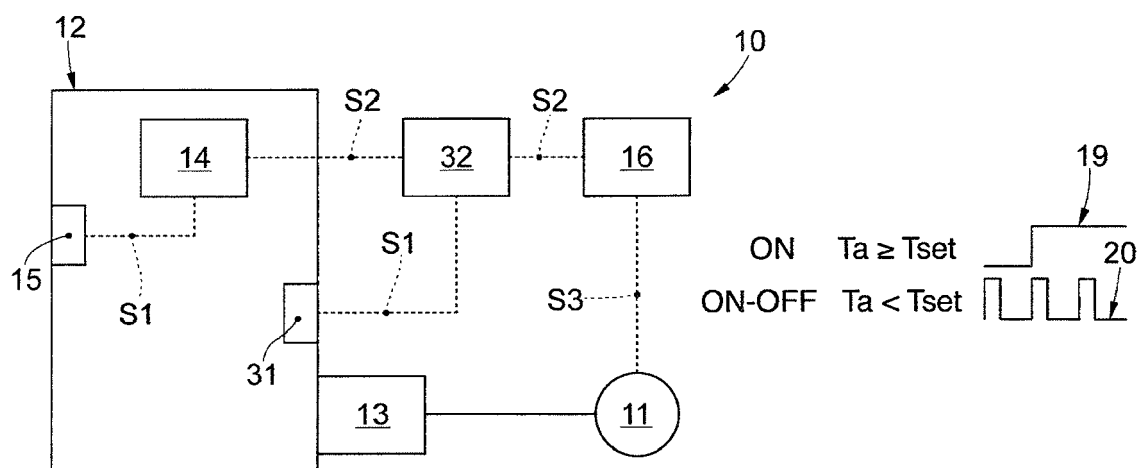


fig. 1

Description

FIELD OF THE INVENTION

[0001] The present invention concerns an electronic control apparatus for an electric motor.

[0002] In particular, the electronic control apparatus associated with the electric motor can be installed to rotate a pumping device, for example an electric pump, applied to refrigerator units.

[0003] The refrigerator units are installed on drink dispensing plants used particularly, but not only, in bars or pubs, pizzerias, discos, restaurants, and in general where cold drinks are consumed.

BACKGROUND OF THE INVENTION

[0004] It is known that in the drink dispensing sector, in order to guarantee an optimal temperature of the drink dispensed, a cooling fluid must be continuously stirred and pumped, in which a part of the dispensing circuit, called the coil, is immersed, which allows the heat exchange between the cooling fluid and the drink to be dispensed.

[0005] The dispensing point can be far from the refrigerator unit and the means used must be constantly cooled along the entire distance between the refrigerator unit and the tap dispensing the drink.

[0006] This function is obtained by means of a pipe in which the drink flows from the refrigerator unit to the dispensing point, in close contact with it; there are two other recirculation pipes, one for delivery and the other for return to and from a tank.

[0007] The two delivery and return pipes transport the cooling fluid put under pressure by an electric pump.

[0008] The electric pump that performs this function consists of an electric motor and a hydraulic unit that houses a pumping impeller attached to its drive shaft.

[0009] A stirring screw is applied at the end of the electric pump.

[0010] The electric motor generates a rotary movement of the shaft and therefore of the hydraulic part which allows the movement of the cooling fluid from a containing tank to the cooling circuit coupled with the drink dispensing circuit.

[0011] It is known that the hydraulic unit is commonly driven by asynchronous single-phase electric motors which rotate at a predetermined speed, or by brushless motors.

[0012] However, there is a need to modulate the power of the electric motor according to the temperature detected in the cooling fluid to reach a reference temperature set for the specific refrigerator unit.

[0013] In this context, known electric pumps are programmed to manage the variations in temperature according to the specific refrigerator unit and, if the refrigerator unit is changed, the electric pumps require dedicated modifications.

[0014] This entails a high expenditure of resources both from an economic point of view and due to the employment of specialized operators.

[0015] Many of the known solutions do not allow the same electric pump to be used in different refrigerator units even if the electric pump has characteristics suitable for several types of refrigerator units.

[0016] For example, the prior art documents US-A-2010/0043484 and GB-A-2.228.310 describe two solutions that, if applied in two different refrigerator units from those on which the pumps are initially installed, still require dedicated modifications by a specialized operator.

[0017] Other solutions relating to a different cooling technology concern the control of the compressors of the refrigerator unit to maintain the temperature or pressure of the cooling liquid in a desired range.

[0018] WO-A-2011/053347 describes a system that uses a compressor in a refrigerator unit to cool a liquid.

[0019] Document EP-A-0.325.523 describes a steam compression cycle used for the storage and preservation of milk.

[0020] Document EP-A-2.515.060 describes a dispensing plant in which the compressor operates according to the thickness of the ice formed on the walls of the tank containing the liquid.

[0021] However, as well as using indirect detection systems, these known solutions do not consider the possibility of using the same solution in different refrigerator units, without needing to perform specific adaptations.

[0022] JP-A-2001/082848 describes a dispensing plant in which there is a control circuit which drives the stirrer in relation to the difference in the temperature of the motor of the stirrer with respect to the air temperature.

[0023] This known solution is not efficient, it uses parameters that are not directly correlated to the temperature of the liquid in the containing tank and does not take into consideration that the temperature of the motor can be varied by other phenomena, such as for example malfunctioning and/or engine failures.

[0024] Document EP-A-0.436.758 describes a dispensing plant in which there is a control and command unit which drives both the refrigerator unit and the stirrer.

[0025] However, as well as being structurally cumbersome and complex, this known solution does not provide the possibility of using the same control and command unit in another refrigerator system.

[0026] There is therefore a need to perfect and make available an electronic control apparatus for an electric motor which overcomes at least one of the disadvantages of the state of the art.

[0027] The present invention sets itself the purpose of providing an electronic control apparatus for an electric motor that allows it to be installed on refrigerator units with various characteristics, without making changes each time based on the refrigerator unit on which it is installed, as well as significantly reducing energy consumption.

[0028] One purpose of the present invention is to mod-

ulate the on/off cycles according to the temperature detected in the cooling fluid and to the specific characteristics of the refrigerator unit.

[0029] Another purpose is to provide a control apparatus applicable to a wide range of electric pumps and refrigerator units of various formats.

[0030] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0031] The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

[0032] Embodiments described here concern an electronic control apparatus for an electric motor of an electric pump of a refrigerator unit installed in a drink dispensing plant.

[0033] The apparatus comprises two temperature sensors associated with the refrigerator unit.

[0034] The apparatus comprises a central control unit installed in the refrigerator unit and configured to receive at least a control signal from the two temperature sensors.

[0035] The central control unit detects and/or has in its memory the characteristics of the refrigerator unit and can be comprised in the refrigerator unit itself.

[0036] The central control unit is configured to supply on exit a command signal comprising the characteristics of the refrigerator unit.

[0037] The presence of two temperature sensors is advantageous to be able to detect the temperature at different points of the cooling circuit of the drink dispensing plant.

[0038] Indeed, the Applicant has verified that the presence of two temperature sensors significantly improves the functioning of the electronic control apparatus.

[0039] This characteristic allows to acquire more detections of the temperature at different points of the refrigerator unit.

[0040] This allows to eliminate false measurements, to regulate the electric motor of the electric pump with greater precision and render the apparatus more efficient and adaptable when it is associated with another refrigerator unit with different characteristics.

[0041] If two temperature sensors are not present and associated with the refrigerator unit, it is possible to install them in the latter, connecting them to the central control unit.

[0042] The control apparatus comprises a processing unit that is distinct and separate from the central control unit, associated with the electric motor, and is configured to receive and process the command signal in order to obtain a drive signal for the electric motor.

[0043] The processing unit can be advantageously in-

tegrated in the electric motor, or installed on it, for example inside the protective casing, or outside of the latter.

[0044] This solution is advantageous because it simplifies the maintenance operations and/or removal/installation of the processing unit on other refrigerator units.

[0045] According to one aspect of the present invention, the command signal is able to command the processing unit, also considering the characteristics of the refrigerator unit, and the drive signal is able to modulate, according to a predefined duty-cycle, the functioning of the electric motor as a function of the command signal arriving from the central command unit.

[0046] In accordance with possible embodiments, the central command unit is configured to supply a command signal to the processing unit that adapts the control signal coming from the sensor/sensors associated with the refrigerator unit, depending on the specific characteristics of the refrigerator unit.

[0047] In this way, the processing unit can regulate the functioning of the electric motor in a manner coordinated with the specific characteristics of the refrigerator unit with which it is associated.

[0048] According to possible embodiments, the electronic control apparatus comprises a selector connected to the processing unit configured to selectively connect to the processing unit the central control unit, or at least one other sensor associated directly with the refrigerator unit.

[0049] Formulations of the present invention provide that the electric motor is connected and coordinates the functioning of an electric pump semi-immersed in a refrigerating fluid of the refrigerator unit of a drink dispensing plant.

[0050] The present invention also concerns a method to electronically control an electric motor associated with the refrigerator motor, which comprises:

- a step of receiving at least a control signal from two temperature sensors associated with the refrigerator unit by means of the central control unit installed in the refrigerator unit;
- a step of supplying a command signal from the central control unit to a processing unit as a function of the control signal and of the characteristics of the specific refrigerator unit, said processing unit being distinct and separate from the central control unit and associated with the electric motor;
- a step of processing the command signal to obtain a drive signal able to modulate, according to a predefined duty-cycle, the functioning of the electric motor, by means of the processing unit, as a function of the command signal coming from the central control unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0051] These and other characteristics of the present invention will become apparent from the following de-

scription of some embodiments, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a schematic representation of an electronic control apparatus associated with a refrigerator unit according to a possible embodiment;
- fig. 2 is a block diagram of one embodiment of a method to electronically control an electric motor associated with a refrigerator unit;
- fig. 3 is a schematic representation of an electric pump associated with a refrigerator unit according to a possible embodiment.

[0052] To facilitate comprehension, the same reference numbers have been used, where possible, to identify identical common elements in the drawings. It is understood that elements and characteristics of one embodiment can conveniently be incorporated into other embodiments without further clarifications.

DETAILED DESCRIPTION OF SOME EMBODIMENTS

[0053] Embodiments described here concern an electronic control apparatus 10 for an electric motor 11 associated with a refrigerator unit 12.

[0054] For example, according to possible embodiments, the electric motor 11 is connected to an electric pump 13 and coordinates its functioning to manage the cooling and maintenance at a pre-set and specific temperature of the refrigerator unit 12 of a drink dispensing plant.

[0055] As will be clear from the description, the present invention allows to electronically control the electric motor 11 connected to an electric pump 13 associated with a refrigerator unit 12, at the same time considering the specific characteristics of the refrigerator unit 12.

[0056] In this way, it is no longer necessary to reprogram the electronic control apparatus 10 according to the specific refrigerator unit 12.

[0057] In fact, the present invention provides that the electronic control apparatus 10 is able to interpret a command signal that emulates the signal coming from the sensors associated with the refrigerator unit 12, adapting it according to the specific characteristics of the refrigerator unit 12.

[0058] This allows the electronic control apparatus 10 to adapt the power of the electric motor 11, not only on the basis of the values measured by the sensors associated with the refrigerator unit 12, but also on the basis of the specific characteristics of the refrigerator unit 12 itself.

[0059] According to one aspect of the present invention, the electronic control apparatus 10 for an electric motor 11 associated with a refrigerator unit 12 comprises:

- a central control unit 14 installed in the refrigerator unit 12 and configured to receive at least one control

signal S1 from one or more sensors 15 associated with the refrigerator unit 12 and to provide a command signal S2 at exit;

- a processing unit 16 configured to receive and process the command signal S2 coming from the central control unit 14 to obtain at exit a drive signal S3 for the electric motor 11;

said command signal S2 being able to command the processing unit also considering the characteristics of the refrigerator unit 12, and said drive signal S3 being able to modulate according to a predefined duty-cycle the functioning of the electric motor 11 as a function of the signal command S2.

[0060] According to possible embodiments, the central control unit 14 is also used for other functions relating to the functioning of the refrigerator unit 12 itself.

[0061] According to possible embodiments, the control signal S1 is a temperature value of the cooling liquid of the refrigerator unit 12.

[0062] According to possible embodiments, the one or more sensors 15 can comprise two temperature sensors able, for example, to detect a temperature value T_a at the point where they are installed.

[0063] The two temperature values detected by the two temperature sensors 15 can be the same, or different, according to the position of the temperature sensors, the specific operating conditions of the refrigerator unit, the specific temperature sensor used, or other.

[0064] For example, the temperature sensors can be thermocouples, thermo-resistors, integrated circuit sensors, or suchlike.

[0065] According to possible embodiments, the central control unit 14 processes the control signal S1 and, by means of the information correlated to the characteristics of the specific refrigerator unit 12, provides a command signal S2.

[0066] For example, the characteristics of the refrigerator unit 12 can be the volume of the refrigerator unit to be cooled, the equilibrium temperature of the refrigerator unit, the sizes of the refrigeration pipes, the power supply, and the format of the refrigerator unit or other specific characteristics of a refrigerator unit.

[0067] The command signal S2 can be a signal of electric current, electric voltage, or resistance connected to the processing unit 16.

[0068] The command signal S2 considers the data relating to the characteristics of the specific refrigerator unit 12 contained in the central control unit 14.

[0069] According to possible embodiments, the processing unit 16 is configured to interpret the command signal S2 independently of the refrigerator unit 12, the central control unit 14 being configured to process the characteristics of the refrigerator unit 12 before transmitting the command signal S2 to the processing unit 16.

[0070] This means that it is not necessary to reprogram the processing unit 16 when it is installed on another refrigerator unit 12, since it is commanded directly by the

central control unit 14 of the refrigerator unit 12.

[0071] In possible implementations, the processing unit 16 can comprise a bidirectional triode thyristor, or triac, by means of which the delivery of a determinate intensity of electric current which supplies the electric motor 11 is commanded.

[0072] In particular, this can be done with a series of high frequency drive/shutdown cycles which allow to implement a substantially linear performance of the power of the electric motor 11.

[0073] In particular, the processing unit 16 is configured to command the electric motor 13 by means of pulse modulation, for example, using the PWM (Pulse Width Modulation) technique. Advantageously, the operating frequency of the electric motor 13 and therefore the selected duty cycle.

[0074] According to possible embodiments, the central control unit 14 can comprise an amplification and stabilization element able to modulate the control signal S1 received by one or more sensors 15 to obtain a stable command signal S2 of current and voltage to be supplied to the processing unit 16.

[0075] According to possible embodiments, according to the command signal S2 coming from the central control unit 14, the processing unit 16 emits a voltage, current or electrical resistance value to the electric motor 11 to determine the drive or shutdown thereof.

[0076] According to possible embodiments, the electric motor 11 is of the single-phase asynchronous type and its power can develop as a function of the time comparable in quality to that of a brushless electric motor with the addition of greater reactivity in the starting times, which is typical of single-phase asynchronous motors.

[0077] The electric motor 11 can be the single-phase asynchronous, brushless or other type.

[0078] The electric motor 11 can be protected by an external cover 17 which can include the electric motor 11 in an integrated and watertight manner.

[0079] The processing unit 16 can be associated externally with the external cover 17 and be provided with a protection element 18.

[0080] According to a characteristic aspect of the present invention, the processing unit 16 can be installed in any type whatsoever of refrigerator unit 12 in production, therefore without costs of re-engineering of the production process, or already present on the market, or sold.

[0081] In another variant embodiment, the processing unit 16 can be integrated with the electric motor 11. In this way the electric motor 11 and the processing unit can be enclosed inside the external cover 17.

[0082] The processing unit 16 is directly connected to the electric motor 11 by means of a terminal board.

[0083] According to the command signal S2 interpreted by the processing unit 16, the latter allows to command the electric motor 11 for different operating modes. In particular, the processing unit 16 allows to command the electric motor 11 for a full-power operation in a continu-

ous and extended operation cycle 19.

[0084] Moreover, the processing unit 16 allows to command the electric motor 11 with a sequential on/off cycle 20 and immediately reaching maximum power.

[0085] The processing unit 16 can be associated with an electric motor 11 to drive an electric pump 13.

[0086] The electric pump 13 is the type semi-immersed in a cooling fluid 21.

[0087] By cooling fluid 21 we mean, for example, a liquid such as water or water enriched with additives.

[0088] The cooling fluid 21 is collected in a containing tank 22.

[0089] The electric pump 13 is installed to allow the hydraulic circulation of the cooling fluid 22 delivered from the cooling unit 12 to the drink dispensing service.

[0090] The electric pump 13 is coupled with the electric motor 11 which can function at full power.

[0091] The electric pump 13 comprises a rotation shaft 23 with an axis of rotation X coaxial with the rotation shaft of the electric motor 11.

[0092] A hydraulic impeller 24 is associated with the rotation shaft 23 to collect the cooling fluid 21 from the refrigerator unit 12 toward the drink dispensing service.

[0093] In a variant embodiment, in correspondence with the end of the hydraulic impeller 24, facing toward the bottom of the containing tank 22, a stirring element 25 is associated, coaxial and integrated with the rotation shaft 23.

[0094] The stirring element 25 is immersed in the cooling fluid 21 and allows it to be mixed to make its temperature uniform in the entire volume of the containing tank 22.

[0095] The refrigerator unit 12 comprises a cooling circuit 26 made along the internal lateral wall of the containing tank 22.

[0096] The cooling circuit 26 is made of a plurality of pipes inside which a process fluid flows in order to cool the cooling fluid 21.

[0097] The plurality of pipes is lapped by the cooling fluid 21 so as to allow the heat exchange between the latter and the process fluid.

[0098] The refrigerator unit 12 comprises a compressor 27 which, associated with the cooling circuit 26, keeps the temperature of the cooling fluid 21 constant.

[0099] A delivery pipe 28 is associated with the electric pump 13, which allows the hydraulic transfer of at least a part of the cooling fluid 21 from the refrigerator unit 12 to the drink dispensing service.

[0100] Moreover, a return pipe 29 is also associated with the electric pump 13, which allows to transfer at least a part of the cooling fluid 21 from the drink dispensing service to the refrigerator unit 12.

[0101] The cold cooling fluid 21 is removed from the containing tank 22 thanks to the drive of the electric motor 11 of the electric pump 13.

[0102] The rotation shaft 23 transfers the movement to the hydraulic impeller 24 which sucks in the cooling fluid 21 from the containing tank 22 toward the delivery

pipe 28 through a suction nozzle 30.

[0103] Once the cooling fluid 21 has fulfilled the function of cooling the drink, it returns, now warm, to the containing tank 22 through the return pipe 29.

[0104] The term "warm" means that the detected temperature T_a of the cooling fluid 21 is higher than the set reference temperature T_{set} specific for the refrigerator unit 12, therefore it is no longer effective for cooling the drinks and needs to return to the refrigerator unit 12.

[0105] In possible variant embodiments, which can be combined with all the embodiments described here, the refrigerator unit 12 can be associated with other sensors 31 that can be connected directly to the processing unit 16.

[0106] For example, the other sensors 31 can be temperature sensors and can be located in correspondence with the exit of the return pipe 29. In this way, the other sensor 31 is able to detect the temperature of the cooling fluid 21 arriving from the drink dispensing service.

[0107] The one or more other sensors 31 can control the temperature of the cooling fluid 21 in different positions inside or outside the containing tank 22 of the refrigerator unit 12.

[0108] In this way, the one or more other sensors 31 constantly detect the temperature of the cooling liquid 21.

[0109] It should be noted that what we have described for these sensors 31 can be transferred to the sensors 15 connected to the central control unit 14.

[0110] According to possible embodiments, the electronic control apparatus 10 comprises a selector 32 connected to the processing unit 16 configured to selectively connect to the processing unit 16 the central control unit 14, or one or more other sensors 31 associated with the refrigerator unit 12, said selector 32 being configured to pass from a first control mode, in which the central control unit 14 commands the processing unit 16 according to the characteristics of the refrigerator unit 12, to a second direct control mode, in which the processing unit 16 is commanded by the other sensors 31 directly associated with the refrigerator unit 12.

[0111] In the case where the selector 32 connects the central control unit 14 to the processing unit 16, according to the command signal S2 sent by the central control unit 14, the processing unit 16 controls the power supply of the electric motor 11 according to the set reference temperature value T_{set} and specific to the refrigerator unit 12.

[0112] In particular, the detected temperature T_a of the cooling fluid 21 exiting from the return pipe 30 must not exceed the set reference temperature T_{set} .

[0113] If the detected temperature T_a of the cooling fluid 21 is higher than or equal to the set reference temperature T_{set} , the electric motor 11 is driven with a continuous functioning cycle 19 at full power and maximum speed.

[0114] If the detected temperature T_a of the cooling fluid 21 is lower than the set reference temperature T_{set} , the electric motor 11 is driven with an on/off cycle 20.

[0115] In this case, the processing unit 16 induces a

reduction in the average power delivered by the electric motor 11 and, consequently, also reduces the stirring of the cooling fluid 21 caused by the stirring element 25.

[0116] Advantageously, the electric motor 11 thus passes from the full power function to the energy saving function while maintaining the nominal performances guaranteed by the electric pump 13 unchanged.

[0117] A further advantage is given by the fact that the reduced stirring of the cooling fluid 21 allows an energy saving connected to the cooling circuit 26. In fact, the processing unit 16 of the electronic control apparatus 10 allows to reduce the stirring of the cooling fluid 21, thanks to the PWM, and prevents the erosion of a band of ice which is formed, for example, starting from the lateral walls close to the pipes of the cooling circuit 26 of the containing tank 22.

[0118] Moreover, by exploiting the inertia of the hydraulic impeller 25, before it stops due to friction with the cooling fluid 21, it is possible to reactivate the electric motor 11 to obtain a high-frequency duty cycle and thus implement a substantially linear development of the power of the electric motor 11.

[0119] In one embodiment, the development of the power of the electric motor 11 can be controlled by varying, or modulating, the phase shift angle, or trigger, ϕ of the electronic drive/shutdown element, or triac, with which the electric power supply of the electric motor 11 is commanded.

[0120] In this way, if the erosion of the band of ice by the stirring element 25 is minimal, the compressor 27 does not come into operation and thus saves energy in addition to that obtained with the control of the electric motor 11 of the electric pump 13.

[0121] Furthermore, the present invention defines an electronic control method of the electric motor 11 which comprises:

- a reception step (f1) of at least one control signal S1 from one or more sensors 15 associated with the refrigerator unit 12 by means of the central control unit 14 of the refrigerator unit 12;
- a supply step (f2) of a command signal S2 from the central control unit 14 to a processing unit 16 as a function of the control signal S1 and the characteristics of the specific refrigerator unit 12;
- a processing step (f3) of the command signal S2 to obtain at exit a drive signal S3 able to modulate, according to a predefined duty-cycle, the functioning of the electric motor 11, by means of the processing unit 16, as a function of the command signal S2 coming from the central control unit 14.

[0122] It is clear that modifications and/or additions of parts can be made to the electronic control apparatus 10 for an electric motor 11 as described heretofore, without departing from the field and scope of the present invention.

[0123] It is also clear that, although the present inven-

tion has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of electronic control apparatus 10 for an electric motor 11, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

Claims

1. Electronic control apparatus for an electric motor (11) of an electric pump (13) of a refrigerator unit (12) installed in a drink dispensing plant, **characterized in that** said apparatus comprises:

- two temperature sensors (15) associated with said refrigerator unit (12),
- a central control unit (14) installed in said refrigerator unit (12) and configured to receive at least a control signal (S1) from said temperature sensors (15) and to supply a command signal (S2) comprising the characteristics of said refrigerator unit (12),
- a processing unit (16) distinct and separate from said central control unit (14), associated with said electric motor (11) and configured to receive and process said command signal (S2) in order to obtain a drive signal (S3) for said electric motor (11);

said command signal (S2) being able to command said processing unit (16), also considering said characteristics of said refrigerator unit (12), and said drive signal (S3) being able to modulate, according to a predefined duty-cycle, the functioning of said electric motor (11) as a function of said command signal (S2).

2. Electronic control apparatus as in claim 1, **characterized in that** said processing unit (16) is integrated in said electric motor (11).
3. Electronic control apparatus as in claim 1 or 2, **characterized in that** said characteristics of said refrigerator unit (12) are chosen from a group of characteristics consisting of: volume of the refrigerator unit to be cooled, equilibrium temperature of the refrigerator unit, size of the refrigeration pipes, feed power, and format of the refrigerator unit.
4. Electronic control apparatus as in any claim hereinbefore, **characterized in that** said processing unit (16) is configured to interpret said command signal (S2) independently of said refrigerator unit (12), said central control unit (14) being configured to process said characteristics of said refrigerator unit (12) before transmitting said command signal (S2) to said processing unit (16).

5. Electronic control apparatus as in any claim hereinbefore, **characterized in that** it comprises a selector (32) connected to said processing unit (16) configured to selectively connect to said processing unit (16) said central control unit (14), or one or more other sensors (31) associated with said refrigerator unit (12), said selector (32) being configured to pass from a first control mode, in which said central control unit (14) commands said processing unit (16) on the basis of said characteristics of said refrigerator unit (12), to a second direct control mode, in which said processing unit (16) is commanded by said other sensors (31) directly associated with said refrigerator unit (12).

6. Electronic control apparatus as in claim 5, **characterized in that** said further sensor (31) comprises a temperature sensor.

7. Electronic control apparatus as in any claim hereinbefore, **characterized in that** said electric motor (11) is a single-phase asynchronous motor, or a brushless motor.

8. Electronic control apparatus as in any claim hereinbefore, **characterized in that** said electric motor (11) is associated with an electric pump (13) able to be semi-immersed in a refrigerating fluid (21) of said refrigerator unit (12).

9. Electronic control apparatus as in any claim hereinbefore, **characterized in that** said processing unit (16) comprises a bidirectional triode thyristor, or TRI-AC, able to command said electric motor (11).

10. Method to electronically control an electric motor (11) of an electric pump (13) of a refrigerator unit (12) installed in a drink dispensing plant, **characterized in that** said method comprises:

- a step of receiving (f1) at least a control signal (S1) from two temperature sensors (15) associated with said refrigerator unit (12) by means of a central control unit (14) installed in said refrigerator unit (12);
- a step of supplying (f2) a command signal (S2) from said central control unit (14) to a processing unit (16) as a function of said control signal (S1) and of the characteristics of said refrigerator unit (12), said processing unit (16) being distinct and separate from said central control unit (14) and associated with said electric motor (11);
- a step of processing (f3) said command signal (S2) to obtain a drive signal (S3) able to modulate, according to a predefined duty-cycle, the functioning of said electric motor (11), by means of said processing unit (16), as a function of said command signal (S2).

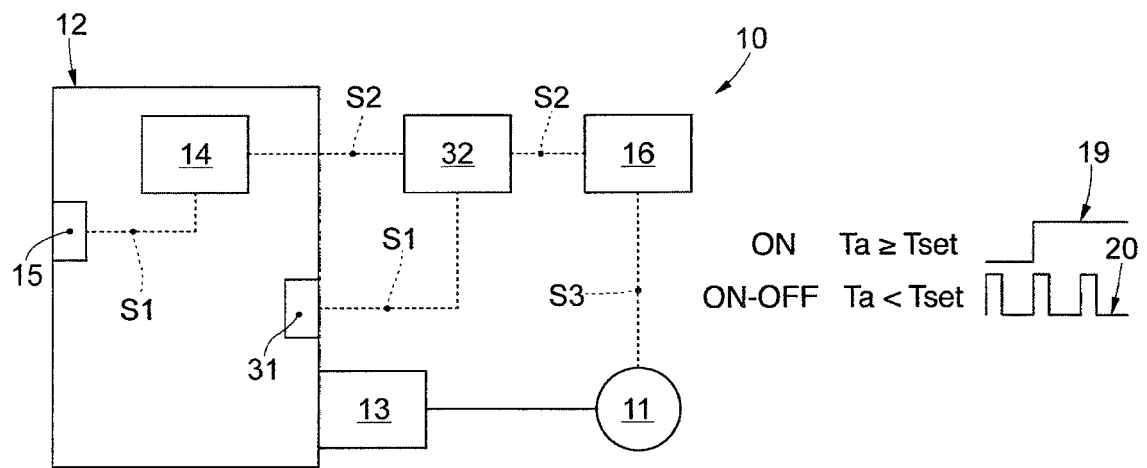


fig. 1

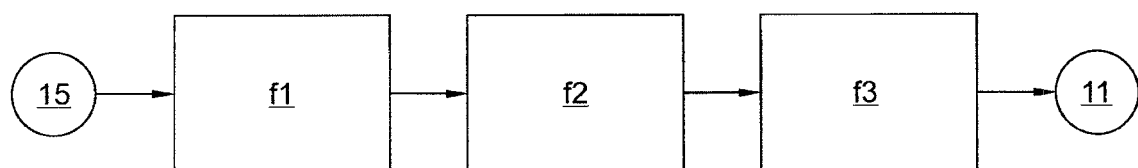


fig. 2

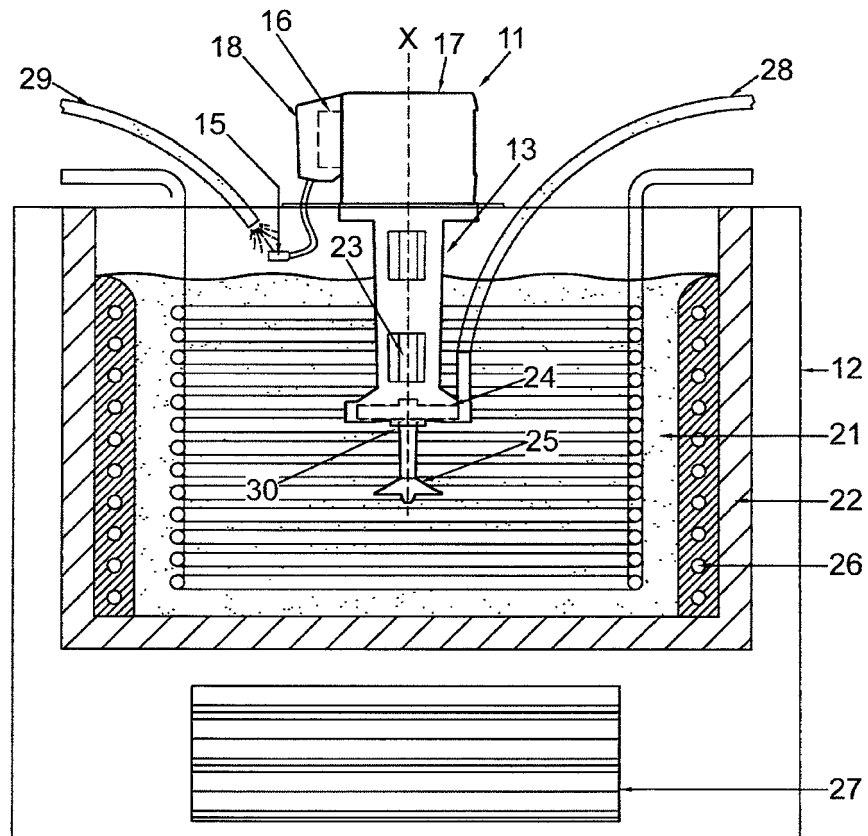


fig. 3



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 20 0958

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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