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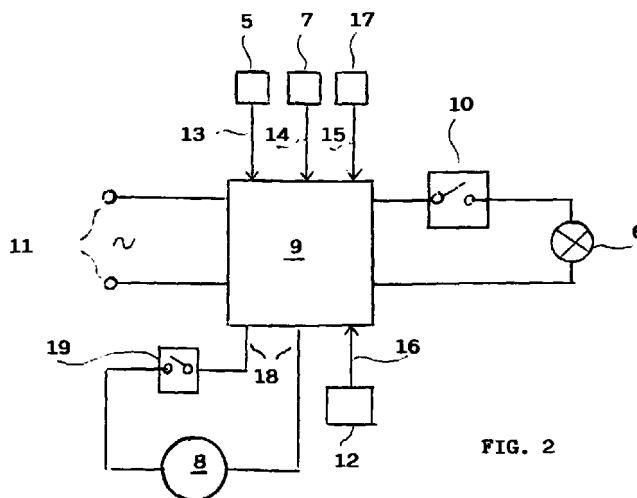
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(57) The refrigeration apparatus comprises a cold storage compartment (3), a freezing compartment (4) and a compressor-driven refrigerating circuit adapted to keep said compartments at respective temperatures by means of cyclic operation phases of the compressor (8). In the cold storage compartment (3) there is provided an internal lighting lamp (6) that is operable also as a temperature balancing device with a variable power according to a pre-set reference temperature (T_r) and the room temperature (T_a).



Description

[0001] The present invention refers to a refrigeration apparatus of the type comprising at least a first compartment and at least a second compartment that are cooled down at different temperatures, as well as a temperature balancing device adapted to ensure a correct operation of the apparatus even in the case of the ambient temperature dropping to an excessive extent.

[0002] Refrigeration apparatuses of this kind are well-known in the art and they generally comprise a refrigerating circuit provided with a single compressor and two evaporators arranged in series and associated to a cold storage compartment and a freezer compartment, respectively. Automatic control means enable the cold storage compartment temperature to be set and the compressor to be caused to operate cyclically in order to keep respective pre-determined temperatures in the two compartments.

[0003] The temperature balancing device is adapted to artificially heat up the cold storage compartment when the ambient temperature is excessively low, in such a manner as to increase the rate of the operation cycles of the compressor, thereby preventing the temperature in the freezer compartment from increasing to a dangerous extent as far as the integrity of the therein stored food articles is concerned.

[0004] In a per se known manner, the temperature balancing device preferably makes use, as a heating element, of the same illuminating lamp which is provided in the cold storage compartment and is normally controlled to light up whenever the access door of said compartment is opened.

[0005] As described for instance in DE-U-297 07 866, a capacitor may be used in view of reducing the power output of the lamp when the latter is operated as a temperature-balancing heating element. In particular, the lamp can be operated at normal power rating by means of a switch adapted to make the connection when the door is opened, or can be operated at a reduced power rating, through said capacitor and an additionally provided switch, in response to an excessive drop in the ambient temperature. In this connection, said additional switch may either be of the manually actuated type or may be provided in the form of an electronic switch that is controllable through a driving circuit adapted to either directly or indirectly detect the ambient temperature.

[0006] In any case, further to said specially provided capacitor, the need arises for also two different switches to be used to accordingly drive the heating and/or illuminating lamp, and this of course undesirably complicates the apparatus.

[0007] The main drawback connected to the above described solution anyway derives from the fact that, when operating as a temperature balancing element, the lamp is operated at a pre-determined fixed power rating, regardless of the actual operating conditions of the

refrigeration apparatus and the actual value of the ambient temperature. Therefore, the resulting "thermally balanced" operation of the apparatus is a rather approximate, imprecise one, ie. the thermal power output of the lamp may be either undesirably excessive or actually insufficient for the operating conditions of the refrigeration apparatus to be able to be controlled automatically in an effective, accurate manner.

[0008] It therefore is a purpose of the present invention to minimize the drawbacks of such prior-art solutions.

[0009] In particular, it is a purpose of the present invention to provide a refrigeration apparatus with a temperature balancing device that is able to operate in an accurate, quick and effective manner in response to the actual temperature and operating conditions.

[0010] A further purpose of the present invention is to provide a refrigeration apparatus of the above cited kind, which, although functionally sophisticated, requires a substantially limited number of component parts.

[0011] According to the present invention, such aims are reached in a refrigeration apparatus with temperature balancing device embodying the features and characteristics as substantially recited in the appended claims.

[0012] The features and advantages of the present invention will anyway be more readily and clearly understood from the description that is given below by way of non-limiting example with reference to the accompanying drawing, in which

- Figure 1 is a schematical view of a refrigeration apparatus provided with a temperature balancing device and illustrated in a representation in which it appears without its access door;
- Figure 2 is the electrical schematics of a preferred embodiment of the temperature balancing device applicable to the apparatus shown in Figure 1.

[0013] With reference to the above cited Figures, the refrigeration apparatus according to the present invention is preferably a refrigerator of the type comprising at least a cold storage compartment 3 and at least a freezer compartment 4. In a per se known (and not shown) manner, the two compartments 3 and 4 are thermally insulated and are adapted to be cooled down by respective evaporators connected in series in a refrigerating circuit that also includes a compressor 8 and a condenser which are both common to both compartments. Through a sequence of switch-on and switch-off cycles of the compressor 8, the compartments 3 and 4 are normally kept at respective temperatures, wherein the cold storage temperature is obviously higher than the freezer temperature.

[0014] The rated temperature of the cold storage compartment 3, and as a consequence also the temper-

ature of the freezer compartment 4, is adjustable by means of a control device 5 to which at least a lamp 6 (preferably of the filament type).

[0015] In a per se known manner, the lamp 6 is adapted to perform the twofold task of illuminating the cold storage compartment 3 (by for instance delivering its full thermal power output) when the associated access door of the refrigerator is opened, and artificially heating the same cold storage compartment 3 (even if the associated access door is closed) when anomalous conditions occur as brought about by an excessive lowering of the ambient temperature T_a . In other words, the lamp 6 is able to perform a temperature balancing task, ie. is capable of heating up the cold storage compartment 3 to a temperature that is detected by an appropriate sensor 7 and used to cause the on/off cycles of the compressor 8 to occur at a faster rate.

[0016] The lamp 6 is anyway supplied at the normal power rating, ie, at the rating at which it operates when performing as an illuminating lamp upon a door opening condition being detected (for instance, by a Reed-type magnetic sensor 12 or the like).

[0017] With particular reference to Figure 2, a preferred embodiment for controlling the operation of the lamp 6 is described below.

[0018] The refrigeration apparatus comprises control means based on a microprocessor 9, for instance of the Motorola P18 type, that are adapted to control at least an electronic switch 10 (for instance, a Triac) so as to deliver to the lamp 6 (as this will be described in greater detail further on) the power supply available at two terminals 11.

[0019] The microprocessor 9 comprises respective inputs 13, 14, 15 and 16 that are driven by the control device 5, the temperature sensor 7 of the cold storage compartment 3, a sensor 17 adapted to detect the ambient temperature T_a , and the door-opening magnetic sensor 12, respectively.

[0020] Furthermore, the microprocessor 9 has two outputs 18 through which it is capable of cyclically energize the compressor 8, via a relay 19 or the like, in accordance with the temperature T_r set on the control device 5 (for instance, 5°C) and the temperature detected by the sensor 7, which preferably detects the temperature of the air in the interior of the cold storage compartment 3. In a per se known manner, the cyclic energizations of the compressor 8 are therefore in this way normally able to keep the temperatures in the compartments 3 and 4 at their respective rated or set values through a sequence of cooling phases alternating with pauses or resting phases of the respective evaporators.

[0021] When the sensor 12 detects an open-door condition, it drives the input 16 of the microprocessor 9 with a control signal in response to which the microprocessor 9 then drives in turn the Triac 10 so as to let the lamp 6 be supplied at the required power rating to illuminate the interior of the cold storage compartment 3.

[0022] The inputs 13 and 15 of the microprocessor

9 are driven by the control device 5 and the sensor 17 with a reference signal and a signal that is indicative of the temperature T_a of the room in which the apparatus is installed, respectively.

[0023] According to a feature of the present invention, the microprocessor 9 is adapted to supply the lamp 6 also when the sensor 12 actually detects a closed-door condition, preferably when the compressor 8 is in a de-energization phase, in the case that the temperature T_a detected by the sensor 17 is lower than a pre-determined value (for instance, 20°C).

[0024] Under such conditions, however, according to the present invention the microprocessor 9 is set so as to supply the lamp 6 at a power rating that is variable (in a linear manner or at discrete levels, from a minimum value to a maximum value) in accordance with the above cited temperatures T_r and T_a .

[0025] Preferably, the microprocessor 9 is adapted to let the lamp 6 operate as a temperature balancing device at a power rating that is variable according to a pre-determined correlation (built into the same microprocessor 9) between the temperatures T_r and T_a . For instance, such a correlation may be of the matrix type and can be most easily set in the microprocessor 9 by anyone skilled in the art.

[0026] Generally, the higher the set temperature T_r and the lower the ambient temperature T_a , the higher will be the power rating at which the lamp 6 is supplied.

[0027] Such a power adjustment can for instance be easily obtained through a phase control of the gate signal of the Triac 10, in a per se known manner, in accordance with the outcome of the correlation between the above cited parameters.

[0028] In this connection, the above cited correlation of the temperatures T_r and T_a is preferably determined by the microprocessor 9 by identifying the values of said temperatures based on the signals it receives at its inputs 13 and 15, as described afore in greater detail. It can however be easily appreciated that, as an alternative solution, the above cited correlation may be determined by the microprocessor 9 in an indirect manner, for instance by identifying the ratio of the operation times to the pause times of the compressor 8. Such a time ratio is in fact indicative of the temperatures T_r and T_a according to determined parameters that can be easily calculated by those skilled in the art.

[0029] In any case, the lamp 6 is in this way able to operate as a temperature balancing heating element at a power rating that is each time correlated to the actual requirements of the refrigeration apparatus. In other words, the risk is in this way advantageously avoided of a thermal power of the lamp 6 proving insufficient under conditions of particularly low ambient temperature T_a or, conversely, of a thermal power of said lamp 6 being excessively high when said ambient temperature is not particularly low.

[0030] Furthermore, a single switch 10 controlled by the microprocessor 9 is capable of supplying the

lamp 6 for it to operate both as an illumination element and temperature balancing heating element. The corresponding advantages in terms of simplicity and reliability, owing to the low number of component parts used, emerge therefore in a fully clear manner.

[0031] It will be of course appreciated that the above described refrigeration apparatus can undergo any of a number of modifications without departing from the scope of the present invention.

[0032] For example, the refrigeration apparatus according to the present invention may be of a more traditional type, ie. of the type using temperature balancing heating means that are distinct from the illumination lamp 6. Also in this case, in fact, the operation of the apparatus will be improved by letting the temperature balancing means operate at a power rating that is correlated to the afore cited parameters, in particular the ambient temperature T_a and the set temperature T_r .

Claims

1. Refrigeration apparatus comprising at least a cold storage compartment (3) and a freezer compartment (4) that are accessible through at least a door, a compressor-driven refrigerating circuit adapted to normally keep said compartments at respective temperatures through a sequence of cyclic energization and de-energization phases of the compressor (8) on the basis of a reference temperature (T_r) that is capable of being set by means of control means (5), temperature balancing heating means (6) controlled by control means (9) being provided in said cold storage compartment, **characterized in that** said control means (9) are adapted to operate said temperature balancing means (6) at a power rating that is variable in accordance with said reference temperature (T_r) and the temperature (T_a) of the room in which the apparatus is installed.
2. Refrigeration apparatus according to claim 1, **characterized in that** said control means (9) are adapted to operate said temperature balancing means (6) at a power rating that is variable in accordance with a pre-determined correlation, which is built into the same control means (9), between said temperatures (T_r , T_a).
3. Refrigeration apparatus according to claim 1, **characterized in that** said temperature balancing means comprise at least a lamp (6) adapted to illuminate the cold storage compartment (3) when said access door is open, said control means (9) being adapted to operate the lamp (6) even with said door in its closed condition when said ambient temperature (T_a) is lower than a pre-determined value.
4. Refrigeration apparatus according to claim 3, **characterized in that** said lamp (6) is actuatable by said control means (9) through at least an electronic switch (10) that is controlled so as to supply the lamp at its highest illumination power rating and at said temperature balancing variable power rating when said door is open and closed, respectively..
5. Refrigeration apparatus according to claim 4, **characterized in that** said electronic switch (10) comprises a Triac operable by phase control of the gate signal by said control means (9).

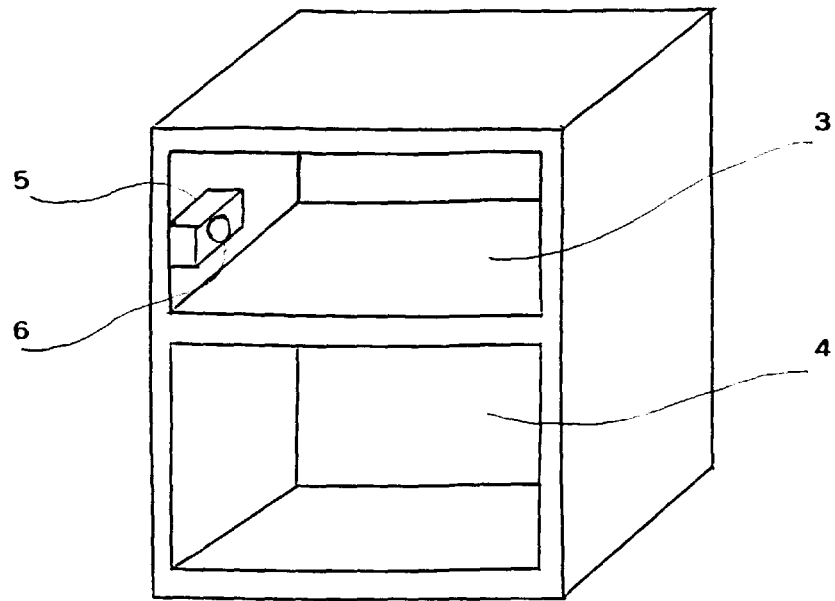


FIG. 1

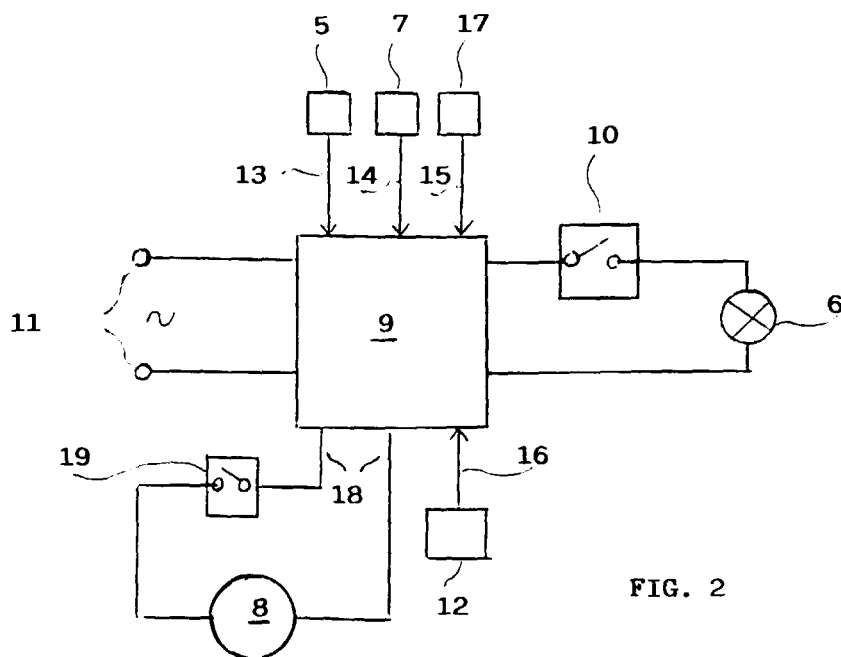


FIG. 2