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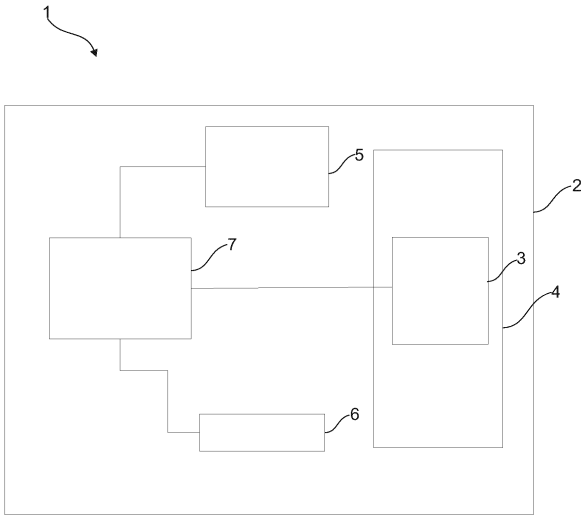
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(54) **AN ELECTRICAL DEVICE COMPRISING A COMPRESSOR WITH IMPROVED ENERGY EFFICIENCY**

(57) The present invention relates to an electrical device (1) comprising a compressor (4) with improved energy efficiency. The electrical device (1) comprises a body (2); a compressor (4) which is disposed in the body (2) and which has at least one electric motor (3); at least one fan (5) which is configured to blow air onto the compressor (4); at least one temperature sensor (6) which is configured to detect the temperature of the electric motor (3) and/or the compressor (4); and at least one control unit (7) which stores a cut-off temperature value at which the operation of the electric motor (3) is stopped and a fan cut-in temperature value at which the operation of the fan (5) is started, and which is configured to control the operation of the electric motor (3) and the fan (5) depending on the temperature information received from the temperature sensor (6), the recorded cut-off temperature value and fan cut-in temperature value.

Figure 1



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Description

[0001] The present invention relates to an electrical device comprising a compressor with improved energy efficiency.

[0002] Compressors are particularly used in cooling cycles performed by means of a refrigerant fluid in devices such as laundry dryer, etc., and compress the refrigerant fluid used in the cooling cycle with the electrical energy supplied from the electricity grid so as to increase the pressure thereof. Therefore, the work done by the compressor depends on the speed of the compressor and the conditions of the evaporator and the condenser used in the cooling cycle of the refrigerant fluid. The decrease in the mains voltage due to various reasons, in other words, the relatively low voltage electricity supplied to the compressor by the mains, does not affect the conditions of the refrigerant fluid used in the cooling cycle, but causes the compressor speed to decrease to a certain level. Taking these two facts into account, in order for the compressor to be properly operated, the electrical power required by the compressor must remain constant at an acceptable level as the voltage decreases. The constant electrical power and the voltage decreases cause the current drawn by the compressor to increase, which in turn increases the temperatures of the windings in the compressor motor. In order to prevent the said increased temperature from damaging the windings, overload protectors are used in the state of the art. Said overload protector is configured to become open circuit and terminate the operation of the compressor such that the windings are not damaged depending on the temperature and current. Depending on the temperature and current drawn, it requires a period of 20-25 minutes for the overload protector, which becomes open circuit, to become closed circuit again, depending on the ambient temperature, and such a period causes the duration of operations performed by electrical devices such as laundry dryers, etc. using said compressor to increase and thus the user satisfaction to decrease.

[0003] Moreover, in order to keep the operation times of such electrical devices wherein compressors are used under control even under abnormal conditions such as the occurrence of a high-temperature environment due to very low voltage electricity supply, the temperature on the negative temperature coefficient thermistor is detected and the compressor is turned off and on depending on this detected temperature; in other words, the operation thereof is terminated and then restarted. In the state of the art, the temperature of the negative temperature coefficient thermistor at which the compressor must be turned off and on, that is, the cut-off temperature, is determined by taking into account the current value formed at the lowest allowed value of the supply voltage. Furthermore, the manufacturer determines a fan cut-in temperature for the compressor lower than the cut-off temperature, and when the said temperature value is reached, the compressor fan is automatically turned on and the compressor is cooled. However, since this forced cooling process causes heat to be released, system efficiency is reduced. In the state of the art, the cut-off temperature and the fan cut-in temperature are defined by the manufacturer according to the current value at the lowest voltage level at which the compressor is required to operate, and this is a relatively high current value compared to normal operating conditions, in other words, conditions under which electrical energy with an acceptable voltage is provided by the mains. Although the cut-off temperature and the fan cut-in temperature determined as fixed by the manufacturer provide protection under abnormal operating conditions, they cause the energy efficiency of the compressor and thus of the electrical device in which the compressor is used to decrease under normal conditions.

[0004] In the state of the art Chinese patent document no. CN101776318, a method is disclosed, which ensures that the compressor is operated between 160V and 260V and which automatically terminates the operation of the compressor when electricity is supplied at a voltage outside these values.

[0005] In the state of the art Chinese utility model document no. CN2511029, a protection circuit is disclosed, which is activated at predetermined low and high voltages to protect compressors having asynchronous motors and which is deactivated when the supplied voltage reaches normal levels.

[0006] Therefore, in the state of the art, there is a need for an electrical device comprising a compressor with improved energy efficiency by adaptively changing the cut-off temperature and the fan cut-in temperature depending on the instantaneous voltage supplied by the mains.

[0007] The aim of the present invention is the realization of an electrical device comprising a compressor with improved energy efficiency by adaptively changing the cut-off temperature and the fan cut-in temperature depending on the instantaneous voltage supplied by the mains.

[0008] The electrical device realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises a control unit which stores a cut-off temperature value at which the operation of an electric motor disposed in a compressor positioned in a body is terminated and a fan cut-in temperature value at which a fan positioned in the body is started to operate, which is configured to control the operation of the electric motor and the fan depending on the temperature information provided by a temperature sensor adapted to detect the temperature around the electric motor and the stored cut-off temperature value and fan cut-in temperature value and which is further configured to monitor the voltage of the electricity supplied to the electric motor from the electrical mains in real time and to control and change the cut-off temperature value and/or the fan cut-in temperature value to predetermined values depending on the monitored voltage

value. By means of the control unit updating the cut-off temperature value and/or the fan cut-in temperature value depending on the voltage value, safety is provided under abnormal conditions, in other words, when the electrical voltage supplied from the mains is lower than a certain threshold value and thus the current drawn is relatively high, and in other conditions, the compressor is prevented from operating inefficiently by using the appropriate cut-off temperature value and/or the fan cut-in temperature value.

[0009] In an embodiment of the present invention, the electrical device further comprises the control unit which is configured to store at least one predetermined voltage threshold value, to compare the determined real-time voltage with the said threshold voltage value, and, as a result of the comparison process if it is determined that the real-time voltage value supplied from the mains falls below the said threshold value, to bring the cut-off temperature value and/or the fan cut-in temperature value to a value lower than the current value.

[0010] The present invention also relates to an electrical appliance which is a laundry dryer. By increasing the energy efficiency without too much stopping the operation of the compressor in the laundry dryer for safety purposes, almost all of the operations to be performed by the laundry dryer are performed within the time specified for the said operations, and customer satisfaction is not compromised.

[0011] By means of the present invention, especially in case of high temperatures due to the electric motor drawing excessive current when the electrical energy supplied from the mains is at a low voltage, the cut-off temperature value at which the operation of the electric motor is automatically stopped as a safety precaution and/or the fan cut-in temperature value at which the fan starts operating for more effective cooling of the electric motor is adaptively updated depending on the electrical voltage supplied from the mains such that the electric motor is operated without causing any inefficiency under normal, in other words, acceptable voltage conditions.

[0012] The electrical device comprising a compressor with increased energy efficiency realized in order to attain the aim of the present invention is illustrated in the attached figure, where:

Figure 1 - is the schematic view of the electrical device of the present invention.

[0013] The elements illustrated in the figure are numbered as follows:

1- Electrical device
2- Body
3- Electric motor
4- Compressor
5- Fan
6- Temperature sensor
7- Control unit

[0014] The electrical device (1) comprises a body (2); a compressor (4) which is disposed in the body (2) and which has at least one electric motor (3); at least one fan (5) which is configured to blow air onto the compressor (4); at least one temperature sensor (6) which is configured to detect the temperature of the electric motor (3) and/or the compressor (4); and at least one control unit (7) which stores a cut-off temperature value at which the operation of the electric motor (3) is stopped and a fan cut-in temperature value at which the operation of the fan (5) is started, and which is configured to control the operation of the electric motor (3) and the fan (5) depending on the temperature information received from the temperature sensor (6), the stored cut-off temperature value and fan cut-in temperature value. In the compressor (4), for example, in case of a decrease in the electrical voltage supplied from the mains, the current drawn by the electric motor (3), which is preferably of asynchronous type, increases in order to prevent any decrease in the operating power, which in turn causes the temperature of the electric motor (3) to increase over time. Therefore, the control unit (7) periodically reads the temperature value sensed by the temperature sensor (6) and compares the said temperature value with the cut-off temperature value and the fan cut-in temperature value stored therein. The fan cut-in temperature value is a value lower than the cut-off temperature value, and when the temperature read by the control unit (7) on the temperature sensor (6) is equal to the fan cut-in temperature value, the control unit (7) controls the fan (5) to start the operation. While the aim is to directly or indirectly reduce the temperature of the electric motor (3) with the air blown by the fan (5) towards the compressor (4), depending on the amount of current drawn, the temperature of the electric motor (3) may continue to increase despite the operation of the fan (5). In such a case, when the temperature read by the control unit (7) on the temperature sensor (6) is equal to the cut-off temperature value, the control unit (7) controls the electric motor (3) to stop the operation. Thus, the electric motor (3) is prevented from being damaged due to high temperature.

[0015] The electrical device (1) of the present invention comprises the control unit (7) which is configured to instantly monitor the voltage supplied from the mains and to update the cut-off temperature value and/or the fan cut-in temperature value to a predetermined appropriate value depending on the said voltage value. By means of the control unit (7) updating the cut-off temperature value and/or the fan cut-in temperature value depending on the voltage value, the safety of the electric motor (3) is provided under abnormal conditions, in other words, when the electrical voltage supplied from the mains is lower than a certain threshold value and thus the current drawn by the electric motor (3) is relatively high, and in other conditions, the compressor (4), and hence, the electrical device (1), are prevented from operating inefficiently by using the appropriate cut-off temperature value and/or the fan cut-in temperature value.

[0016] In an embodiment of the present invention, the

electrical device (1) comprises the control unit (7) which is configured to store at least one predefined voltage threshold value and to update the cut-off temperature value and/or the fan cut-in temperature value to a value which is lower than the current value when the instantaneous voltage falls below the threshold value. Thus, the cut-off temperature value and/or the fan cut-in temperature value defined for safety purposes is brought to a lower value in abnormal conditions, and protective actions such as starting the fan (5) or terminating the operation of the electric motor (3) without being damaged by high temperatures are taken.

[0017] The present invention relates to an electrical device (1) which is a laundry dryer. By means of the dynamic updating of the cut-off temperature value and/or the fan cut-in temperature value in the laundry dryer, the compressor (4) is operated without the need for being stopped for too long for safety purposes, and almost all of the operations to be performed by the laundry dryer are performed within the specified time for the said operations, and customer satisfaction is not compromised.

[0018] By means of the present invention, an electrical device (1) is realized, comprising a compressor (4) which operates safely in the abnormal operating conditions where high current is drawn due to the decreasing mains voltage and in the normal conditions where the voltage level is safe, without causing any inefficiency by adaptively updating the cut-off temperature value and/or the fan cut-in temperature value depending on the electrical voltage supplied from the mains by the control unit (7).

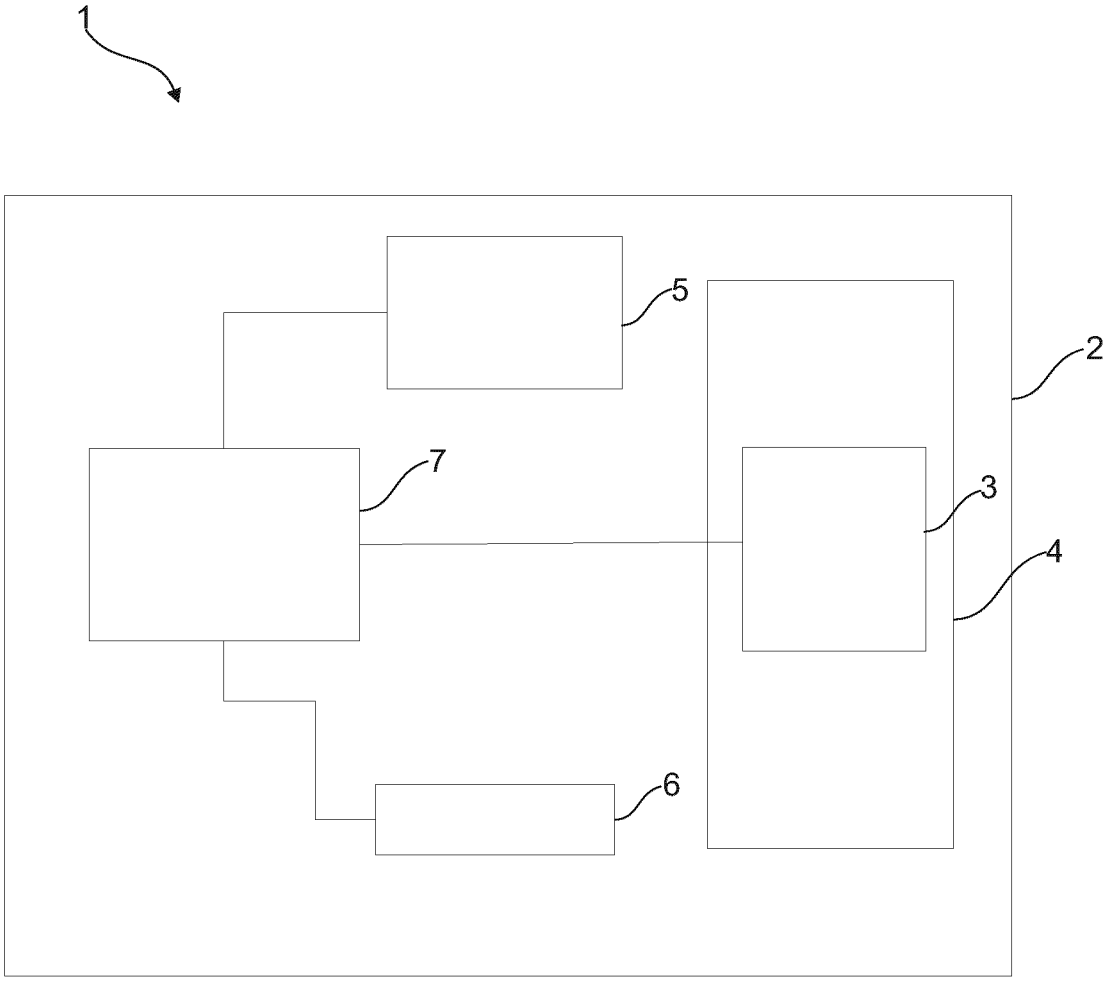
Claims

1. An electrical device (1) **comprising** a body (2); a compressor (4) which is disposed in the body (2) and which has at least one electric motor (3); at least one fan (5) which is configured to blow air onto the compressor (4); at least one temperature sensor (6) which is configured to sense the temperature of the electric motor (3) and/or the compressor (4); and at least one control unit (7) which stores a cut-off temperature value at which the operation of the electric motor (3) is stopped and a fan cut-in temperature value at which the operation of the fan (5) is started, and which is configured to control the operation of the electric motor (3) and the fan (5) depending on the temperature information received from the temperature sensor (6), the stored cut-off temperature value and fan cut-in temperature value, **characterized by** the control unit (7) which is configured to instantly monitor the voltage supplied from the mains and to update the cut-off temperature value and/or the fan cut-in temperature value to a predetermined appropriate value depending on the said voltage value.

2. An electrical device (1) as in Claim 1, **characterized by** the control unit (7) which is configured to store at least one predefined voltage threshold value and to update the cut-off temperature value and/or the fan cut-in temperature value to be lower than the current value when the instantaneous voltage falls below the threshold value.

3. An electrical device (1) as in any one of the above claims, which is a laundry dryer.

Figure 1



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EUROPEAN SEARCH REPORT

Application Number
EP 24 21 5090

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 3 919 671 A1 (ELECTROLUX APPLIANCES AB [SE]) 8 December 2021 (2021-12-08) * paragraphs [0002], [0018], [0024], [0095], [0105], [0110] *	1-3	INV. F04D27/00 F04D29/58
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TECHNICAL FIELDS SEARCHED (IPC)

F04D
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 April 2025	Morales Gonzalez, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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