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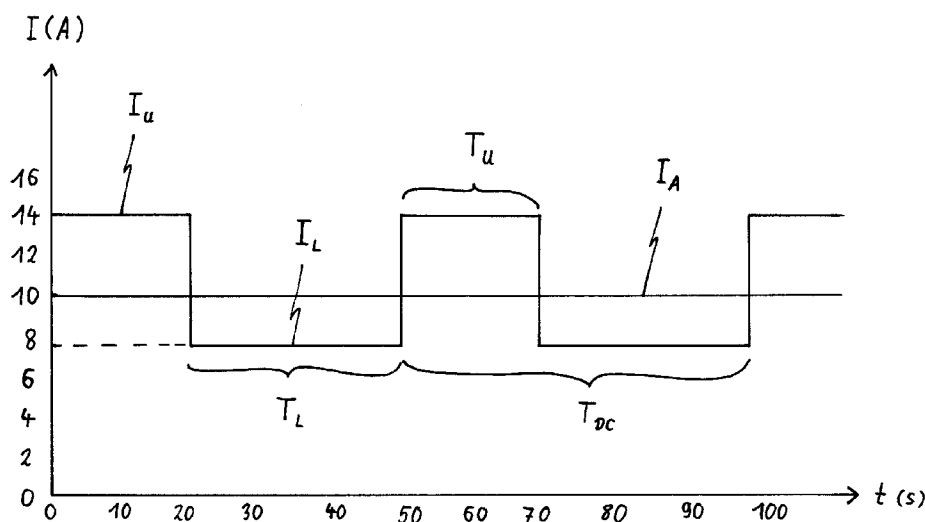
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(54) **A method for controlling a heating-up period of an oven**

(57) The present invention relates to a method for controlling a heating-up period of an oven. The heating-up period of the oven comprises a number of subsequent duty cycles. Each duty cycle includes a first phase with an upper current (I_U) and an upper power (P_U) and a second phase with a lower current (I_L) and a lower power (P_L). The upper current (I_U) and/or the upper power (P_U) exceeds a maximum allowed average current or maximum allowed average power, respectively, during the first phase of the duty cycle. The lower current (I_L) and/or the lower power (P_L) goes below the maximum allowed

average current or maximum allowed average power, respectively, during the second phase of the duty cycle. An average current (I_A) and/or an average power (P_A) goes below or equals the maximum allowed average current or maximum allowed average power, respectively, during the duty cycle. The time (T_U) of the first phase of the duty cycle is shorter than the time (T_L) of the second phase of said duty cycle. Further, the present invention relates to a system for controlling a heating-up period of an oven. Moreover, the present invention relates to a corresponding oven.

FIG 1



Description

[0001] The present invention relates to a method for controlling a heating-up period of an oven. Further, the present invention relates to a system for controlling a heating-up period of an oven. Moreover, the present invention relates to an oven provided for performing said method and/or comprising the system mentioned above.

[0002] In some countries the maximum allowed current for a 230 V power supply is limited. This results in a limited power. For example, in Switzerland the maximum allowed current for a 230 V power supply is limited to 10 A, so that the maximum power is 2300 W. The limitation of the current extends the heating-up period of the oven.

[0003] It is an object of the present invention to provide a method for controlling the heating-up period of an oven, wherein the time for the heating-up period is minimized.

[0004] The object of the present invention is achieved by the method according to claim 1.

[0005] The present invention relates to a method for controlling a heating-up period of an oven, wherein

- the heating-up period of the oven comprises a number of subsequent duty cycles,
- each duty cycle includes a first phase with an upper current and an upper power and a second phase with a lower current and a lower power,
- the upper current and/or the upper power exceeds a maximum allowed average current or maximum allowed average power, respectively, during the first phase of the duty cycle,
- the lower current and/or the lower power goes below the maximum allowed average current or maximum allowed average power, respectively, during the second phase of the duty cycle,
- an average current and/or an average power goes below or equals the maximum allowed average current or maximum allowed average power, respectively, during the duty cycle, and
- the time of the first phase of the duty cycle is shorter than the time of the second phase of said duty cycle.

[0006] The main idea of the present invention is the excess of the maximum allowed average current and power, respectively, for a certain time, and a subsequent undershooting of the maximum allowed average current and power, respectively, wherein the average current and/or average power do not exceed the maximum allowed average current and power, respectively. This method allows a reduction of the time for the heating-up period of the oven by about 30 %.

[0007] Preferably, the average current and/or the average power is equal or marginally smaller than the maximum allowed average current or maximum allowed average power, respectively, during the duty cycle.

[0008] Further, the average current and/or the average power may be equal or marginally smaller than the maximum allowed average current or maximum allowed average power, respectively, during the heating-up period.

[0009] For example, the upper current and/or the upper power exceed the maximum allowed average current or maximum allowed average power, respectively, by 30 % to 50 %, in particular by about 40 %.

[0010] In a similar way, the lower current and/or the lower power is about 60 % to 90 % of the maximum allowed average current or maximum allowed average power, respectively, in particular about 75 %.

[0011] Preferably, the time of the first phase of the duty cycle is about 30 % to 45 % of the time of the duty cycle. Further, the time of the second phase of the duty cycle may be about 55 % to 70 % of the time of the duty cycle.

[0012] The time of the first phase of the duty cycle may be determined by the equation

$$T_U = T_{DC} * (P_A - P_L) / (P_U - P_L),$$

wherein T_U is the time of the first phase of the duty cycle, T_{DC} is the time of the duty cycle, P_U is the upper power, P_L is the lower power and P_A is the average power.

[0013] In a similar way, the time of the first phase of the duty cycle is determined by the equivalent equation

$$T_U = T_{DC} * (I_A - I_L) / (I_U - I_L),$$

wherein T_U is the time of the first phase of the duty cycle, T_{DC} is the time of the duty cycle, I_U is the upper current, I_L is the lower current and I_A is the average current.

[0014] For example, the upper current corresponds with a higher number of activated heating elements of the oven,

and the lower current corresponds with a lower number of activated heating elements of the oven.

[0015] Preferably, the heating elements are switched in parallel

[0016] In particular, the method is performed by an electronic control circuit.

[0017] The method may be also performed by a computer program.

[0018] Moreover, the method may be performed by a combination of an electronic control circuit and a computer program.

[0019] The present invention relates further to a system for controlling a heating-up period of an oven, wherein the system is provided for performing the method mentioned above.

[0020] Additionally, the present invention relates to an oven, in particular a cooking oven, wherein the oven is provided for the method described above and/or the oven comprises the system mentioned above.

[0021] At last, the present invention relates to a computer program product stored on a computer usable medium, comprising computer readable program means for causing a computer to perform a method mentioned above.

[0022] Novel and inventive features of the present invention are set forth in the appended claims.

[0023] The present invention will be described in further detail with reference to the drawing, in which

FIG 1 illustrates a schematic diagram of a current during a heating-up period of an oven as a function of the time according to a preferred embodiment of the present invention.

[0024] FIG 1 illustrates a schematic diagram of a current I during a heating-up period of an oven as function of the time t according to a preferred embodiment of the present invention. The diagram shows a time slot of the beginning of the heating-up period. Said time slot takes about two minutes. Usually the heating-up period takes a time less than 10 minutes.

[0025] The diagram illustrates three current levels. An upper current I_U occurs, when two heating elements of the oven are activated. A lower current I_L occurs, when only one of the heating elements of the oven is activated. The heating elements are switched in parallel. In general, the upper current I_U corresponds with a higher number of activated heating elements of the oven, and the lower current I_L corresponds with a lower number of activated heating elements of the oven. An average current I_A defines an average value of the upper current I_U and the lower current I_L , wherein the calculation of said average current I_A is weighted by the time T_U of the upper current I_U and the time T_L of the lower current I_L . The current I alternates between the upper current I_U and the lower current I_L , so that the current I forms a rectangular signal.

[0026] The heating-up period of the oven comprises a number of subsequent duty cycles. Each duty cycle includes one phase with the upper current I_U and one phase with the lower current I_L . In this example, the time T_U of the upper current I_U is about 18 s, and the time T_L of the lower current I_L is about 30 s. Thus, the time T_{DC} of the duty cycle is about 48 s in this special example. The time T_U of the upper current I_U is about 38 % of the time T_{DC} of the duty cycle. The time T_L of the lower current I_L is about 62 % of the time T_{DC} of the duty cycle.

[0027] In this preferred embodiment, the upper current I_U is about 14 A, and the lower current I_L is about 7.5 A. Thus, the average current I_A weighted by the times T_U and T_L of the upper current I_U and lower current I_L , respectively, is about 10 A. The heating-up period with said current values can be used, if a maximum average current of 10 A is allowed. For 38 % of the heating-up period the upper current I_U of about 14 A exceeds the maximum allowed average current of 10 A. For 62 % of the heating-up period the lower current I_L of about 7.5 A goes below the maximum allowed average current of 10 A. In this example, the average current I_A corresponds with the maximum allowed average current of 10 A. In general, the average current I_A may not exceed the maximum allowed average current.

[0028] For a 230 V power supply the upper current I_U of about 14 A corresponds with an upper power P_U of about 3220 W. The lower current I_L of about 7.5 A corresponds with a lower power P_L of about 1725 W. The average current I_A of about 10 A corresponds with an average power P_A of about 2300 W. In a similar way, the maximum allowed average current of 10 A corresponds with a maximum allowed average power of about 2300 W.

[0029] According to the present invention the upper current I_U or the upper power P_U may exceed the maximum allowed average current or maximum allowed average power, respectively. However, the average current I_A or the average power P_A may not exceed the maximum allowed average current or maximum allowed average power, respectively. This method results in a decreased heating-up period of the oven.

[0030] The time T_U for the upper current I_U and upper power P_U is determined by the equation

$$T_U = T_{DC} * (P_A - P_L) / (P_U - P_L)$$

or by the equivalent equation

$$T_U = T_{DC} * (I_A - I_L) / (I_U - I_L) .$$

[0031] The upper current I_U , the lower current I_L , the upper power P_U and the lower power P_L are given by the electric properties of the heating elements of the oven and by the voltage of the power supply. The average current I_A and the average power P_A can be elected by the user, wherein the average current I_A and the average power P_A may not exceed the maximum allowed average current and maximum allowed average power, respectively. The time of one duty cycle T_{DC} is given by the oven, wherein the user can optionally vary the time of one duty cycle T_{DC} within a predetermined range.

[0032] The method according to the present invention can be performed by an electronic control circuit. Further, the method according to the present invention can be performed by a computer program. At last, the method according to the present invention can be performed by a combination of an electronic control circuit and a computer program.

[0033] The present invention can also be embedded in a computer program product which comprises all the features enabling the implementation of the method described herein. Further, when loaded in computer system, said computer program product is able to carry out these methods.

[0034] Although an illustrative embodiment of the present invention has been described herein with reference to the accompanying drawing, it is to be understood that the present invention is not limited to that precise embodiment, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

List of reference numerals

[0035]

I current
 I_U upper current
 I_L lower current
 I_A average current

P_U upper power
 P_L lower power
 P_A average power

t time
 T_U time of the upper current I_U and upper power P_U
 T_L time of the lower current I_L and lower power P_L
 T_{DC} time of one duty cycle

Claims

1. A method for controlling a heating-up period of an oven, wherein

- the heating-up period of the oven comprises a number of subsequent duty cycles,
- each duty cycle includes a first phase with an upper current (I_U) and an upper power (P_U) and a second phase with a lower current (I_L) and a lower power (P_L),
- the upper current (I_U) and/or the upper power (P_U) exceeds a maximum allowed average current or maximum allowed average power, respectively, during the first phase of the duty cycle,
- the lower current (I_L) and/or the lower power (P_L) goes below the maximum allowed average current or maximum allowed average power, respectively, during the second phase of the duty cycle,
- an average current (I_A) and/or an average power (P_A) goes below or equals the maximum allowed average current or maximum allowed average power, respectively, during the duty cycle, and
- the time (T_U) of the first phase of the duty cycle is shorter than the time (T_L) of the second phase of said duty cycle.

2. The method according to claim 1,
characterized in, that
the average current (I_A) and/or the average power (P_A) is equal or marginally smaller than the maximum allowed average current or maximum allowed average power, respectively, during the duty cycle.
3. The method according to claim 1 or 2,
characterized in, that
the average current (I_A) and/or the average power (P_A) is equal or marginally smaller than the maximum allowed average current or maximum allowed average power, respectively, during the heating-up period.
4. The method according to any one of the preceding claims, **characterized in, that**
the upper current (I_U) and/or the upper power (P_U) exceeds the maximum allowed average current or maximum allowed average power, respectively, by 30 % to 50 %, in particular by about 40 %.
5. The method according to any one of the preceding claims, **characterized in, that**
the lower current (I_L) and/or the lower power (P_L) is about 60 % to 90 % of the maximum allowed average current or maximum allowed average power, respectively, in particular about 75 %.
6. The method according to any one of the preceding claims, **characterized in, that**
the time (T_U) of the first phase of the duty cycle is about 30 % to 45 % of the time (T_{DC}) of the duty cycle.
7. The method according to any one of the preceding claims, **characterized in, that**
the time (T_L) of the second phase of the duty cycle is about 55 % to 70 % of the time (T_{DC}) of the duty cycle.
8. The method according to any one of the preceding claims, **characterized in, that**
the time (T_U) of the first phase of the duty cycle is determined by the equation

$$T_U = T_{DC} * (P_A - P_L) / (P_U - P_L),$$

wherein T_U is the time of the first phase of the duty cycle, T_{DC} is the time of the duty cycle, P_U is the upper power, P_L is the lower power and P_A is the average power.

9. The method according to any one of the preceding claims, **characterized in, that**
the time (T_U) of the first phase of the duty cycle is determined by the equation

$$T_U = T_{DC} * (I_A - I_L) / (I_U - I_L),$$

wherein T_U is the time of the first phase of the duty cycle, T_{DC} is the time of the duty cycle, I_U is the upper current, I_L is the lower current and I_A is the average current.

10. The method according to any one of the preceding claims, **characterized in, that**
the upper current (I_U) corresponds with a higher number of activated heating elements of the oven, and the lower current (I_L) corresponds with a lower number of activated heating elements of the oven.
11. The method according to claim 10,
characterized in, that
the heating elements are switched in parallel.
12. The method according to any one of the preceding claims, **characterized in, that**
the method is performed by an electronic control circuit, or by a computer program, or by a combination of an electronic control circuit and a computer program.

13. A system for controlling a heating-up period of an oven, **characterized in, that**
the system is provided for performing the method according to any one of the claims 1 to 12.

5 14. An oven, in particular a cooking oven,
characterized in, that
the oven is provided for a method according to any one of the claims 1 to 12 and/or the oven comprises a system
according to claim 13.

10 15. A computer program product stored on a computer usable medium, comprising computer readable program means
for causing a computer to perform a method according to any one of the claims 1 to 12.

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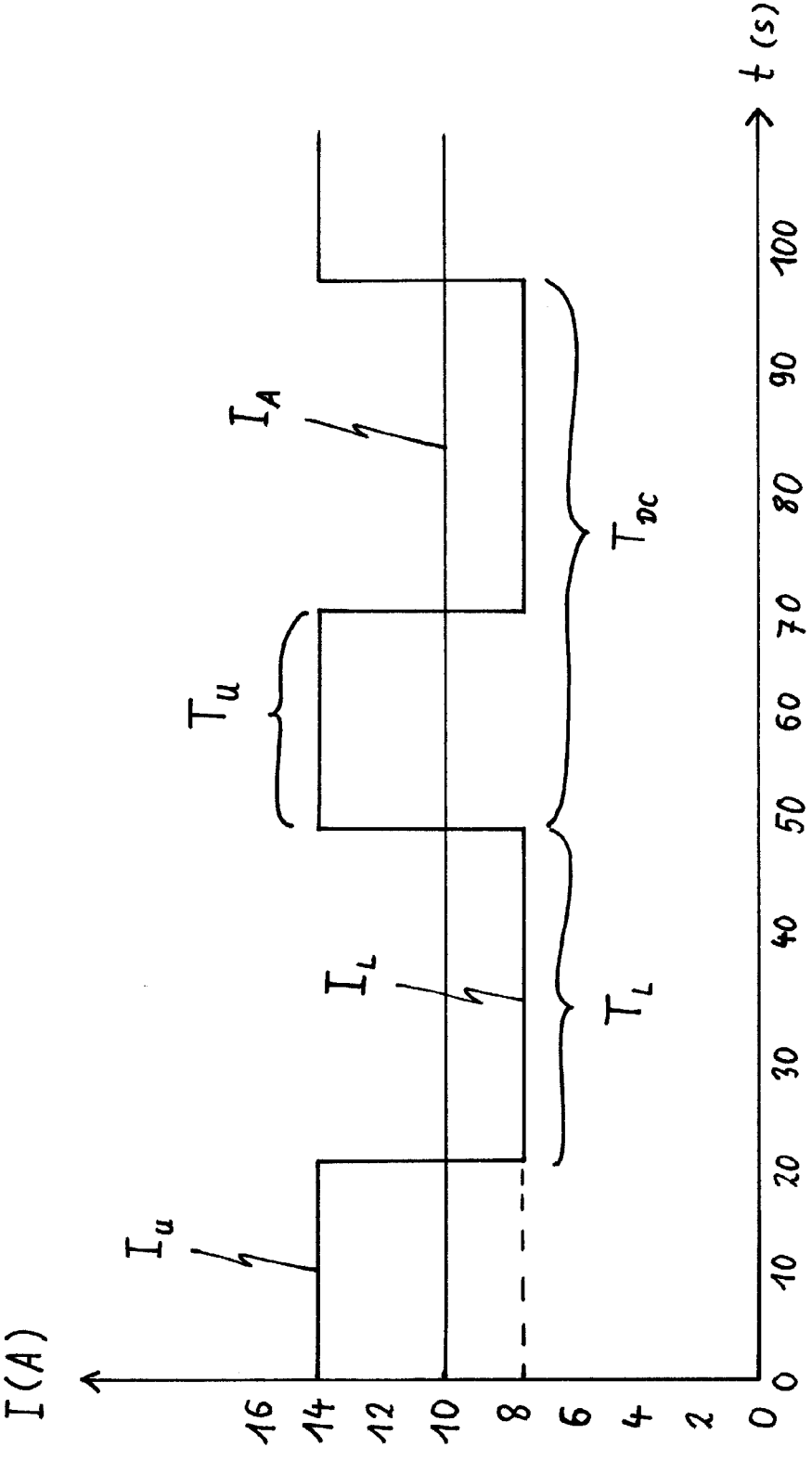
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FIG 1





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