CLAIMS

1. Method of roasting coffee beans with a roasting apparatus (X), said roasting apparatus (X) comprising :

- a chamber (1) to contain coffee beans,
- a heating device (2) configured to supply hot air to the chamber,
- at least one temperature probe (5) to measure the temperature of air supplied by the heating device,
- a control system (80) configured to control the heating device (2) and configured to reproduce roasting recipes, said roasting recipes representing the temperature to be applied at discrete successive times t_i, respectively, said control of the heating device (2) implementing a feedback loop regulation based on the temperature T_{reg} measured by the at least one temperature probe (5),

wherein, before implementing a new operation of roasting coffee beans with the roasting apparatus (X) by reproducing coffee beans roasting recipes R_{set}, said roasting recipes R_{set} providing at least a set of points ($T_{set@ti}$; t_i) defined with one specific master roasting apparatus (M), the feedback loop regulation is adjusted in the roasting apparatus (X),

said operation of adjustment comprising the steps of :

- supplying at least one of the conditions Ci of the new operation of roasting in the roasting apparatus (X),
- comparing each supplied condition Ci of the new operation of roasting with the corresponding condition of reference Ci_{-ref} originally applied during the definition of the roasting recipes R_{set} with said master roasting apparatus (M),
- if a difference is identified between said supplied condition Ci of the new operation of roasting in the roasting apparatus (X) and the corresponding condition of reference Ci_{Ref} in the master roasting apparatus (M) then :
  - based on said identified difference, getting access to a corresponding pre-determined correction K_{Ci} specific to the nature and the difference with Ci_{Ref} of said condition of roasting, and
  - applying said corresponding pre-determined correction K_{Ci} directly or indirectly to at least one of the temperatures $T_{set@ti}$ of the roasting recipes to be reproduced by the roasting apparatus (X).

2. Method of roasting coffee beans according to the precedent claim, wherein the at least one temperature probe (5) is positioned outside the chamber (1).

3. Method of roasting coffee beans according to Claim 1 or 2, wherein the coffee beans roasting recipes R_{set} defined with the specific master roasting apparatus (M) are roasting recipes R_{Mn} adapted to the roasting of one pre-determined quantity M_n of beans of same type C_n and providing the temperatures $T_{Mn}@t_i$ to be applied at discrete successive times t_i respectively.

4. Method of roasting coffee beans according to any one of the precedent claims, wherein the at least one of the conditions Ci of roasting relates at least to one of the following features :
- the external ambient conditions such as : the ambient temperature, the ambient humidity, the pressure, the altitude,
- the type of roasting apparatus used,
- if the heating device is electrically powered, the type of source of power, the frequency or the voltage,
- if the heating device is powered by at least one gas burners, the parameters of supply of the gas, such as the type of used gas, the pressure of said used gas and/or the flow of said used gas,
- the characteristics of the coffee beans to be roasted such as : the quantity m of coffee beans used, the moisture level of the coffee beans, a variation in the characteristics of the type of coffee beans,
- the characteristics of the desired aroma profile such as the level of roasting.

5. Method of roasting coffee beans according to any one of the precedent claims wherein, depending on the type of correction, the feedback loop regulation is adjusted at installation, periodically and/or before each roasting operation.

6. Method of roasting coffee beans according to any one of the precedent claims wherein, during the new operation of roasting coffee beans with the roasting apparatus (X), at least one of the conditions Ci of the new operation of roasting is monitored, preferably the external ambient conditions, and
if said at least one monitored condition Ci changes during the new operation of roasting coffee beans, then the steps of the operation of adjustment are implemented again.

7. Method of roasting coffee beans according to any one of the precedent claims wherein the pre-determined correction K_{ci} specific to one condition Ci of the new roasting operation is defined by coefficient a_{ci} , and

- said coefficient is directly applied to the temperatures T_{set} provided by the roasting recipes defined with the specific master roasting apparatus (M) and to be reproduced, said correction comprising replacing T_{set} by $a_{ci}\ T_{set}$ in the feedback loop regulation,
or
- said correction is applied to the temperatures T_{reg} measured by the at least one temperature probe 5, said correction comprising replacing T_{reg} by $\frac{T_{reg}}{a_{ci}}$ in the feedback loop regulation,

wherein a_{ci} is a pre-determined factor specifically pre-determined for said condition Ci and the identified difference, or is equal to 1 by default.

8. Method of roasting coffee beans according to the precedent claim wherein the operation of adjustment comprises the steps of :
- supplying several specific conditions of roasting Ci,
- comparing each one of the specific conditions of roasting Ci with the corresponding condition of reference used during the definition of the roasting recipes defined with said specific master roasting apparatus (M),
- if for more than one of the specific conditions Ci of roasting, a difference is identified between the specific condition of roasting and the corresponding condition of reference, then :
  - based on each of the identified differences, getting access to the corresponding pre-determined corrections Kci specific to conditions Ci of roasting,
  - based on the selection of said corresponding pre-determined corrections Kci, applying the correction K to the feedback loop regulation, said correction K being defined by the coefficient A wherein $A = \prod_i a_{Ci}$.

9. Method of roasting coffee beans according to the precedent claim, wherein the coffee beans are a blend of at least two different coffee beans (coffee A, coffee B, … , coffee N) introduced inside the chamber, and
wherein the control system is configured to obtain for each type of coffee beans coffee n comprised in said blend at least the type coffee n of said coffee beans and the quantity m_n of said type of coffee N introduced in the chamber,
and
if for at least one type of said coffee n part of the blend, at least one difference is identified between the specific condition $C_{coffee\ i}$ of roasting related to a characteristic of said coffee n and the corresponding condition of reference $C_{coffee\ i\ Ref}$ of roasting related to said characteristic of said coffee n
then a global coefficient $a_{C\ coffee\ i\ \ blend}$ for the correction $Kc_{coffee\ i}$ specific to the condition $C_{\ coffee\ i}$ of roasting for the blend is calculated, said global coefficient being calculated as follows :

$$a_{Ccoffee\ i\ blend} = \sum_{n=A}^{N} f_n \cdot a_{Ccoffee\ i\ n}$$

wherein n corresponds to all the types of coffee beans C_A to C_N present in the blend and f_n represents the fraction in weight of coffee beans of type C_n in the blend of coffee beans.

10. Method according to any one of claims 7 to 9 wherein the pre-determined correction K_{ci} specific to one condition Ci of roasting applied to the feedback loop regulation is defined by an additional coefficient (b_{ci}), and

- said correction is applied to the temperatures T_{set} provided by the roasting recipes to be reproduced, said correction comprising replacing T_{set} by $a_{ci}\ T_{set} + b_{ci}$ in the feedback loop regulation,

or

- said correction is applied to the temperatures T_{reg} measured by the at least one temperature probe (5), said correction comprising replacing Treg by $\frac{1}{a_{ci}}\ (T_{reg} - b_{ci})$ in the feedback loop regulation,

wherein b_{ci} is a pre-determined offset specifically pre-determined for said condition Ci and the identified difference or is equal to 0 by default.

11. Method according to the precedent claim wherein in the operation of adjustment comprises the steps of :

- supplying several specific conditions of roasting Ci,
- comparing each one of the specific conditions of roasting Ci with the corresponding condition of reference Ci_{-ref}, used during the definition of the roasting recipes defined with said specific master roasting apparatus (M),
- if for more than one of the specific conditions Ci of roasting, a difference is identified between the specific condition of roasting and the corresponding condition of reference, then :
  - based on each of the identified differences, getting access to the corresponding pre-determined corrections Kci specific to conditions Ci of roasting,
  - based on the selection of said corresponding pre-determined corrections Kci, applying the correction K to the feedback loop regulation, said correction K being defined by the couple of coefficients (A, B), wherein :

  $A = \prod_i a_{Ci}$

  and

  $B = \sum_i b_{Ci}$.

12. Method according to any one of the claims 7 to 11, wherein, in the coefficients a_{ci} , and optionally b_{ci}, defining a correction K_{ci}, at least one of the coefficient varies with time during the reproduction of roasting recipes, optionally the coefficients are constant over different time intervals.

13. Method according to any one of the claims 7 to 12, wherein, in the coefficients a_{ci} , and optionally b_{ci}, defining a correction K_{ci}, at least one of the coefficients varies with temperature during the reproduction of roasting recipes.

14. Method of roasting coffee beans according to any one of Claim 1 to 6, wherein the pre-determined correction K_{ci} specific to one condition Ci of the new roasting operation is defined by the coefficient D_{ci} A_{ci}, and B_{ci} and
- said coefficients are directly applied to the temperatures T_{set} provided by the roasting recipes defined with the specific master roasting apparatus (M) and to be reproduced, said correction comprising replacing T_{set} by $D_{ci}T_{set}^{\ 2} + A_{ci}T_{set} + B_{ci}$ in the feedback loop regulation,
wherein D_{ci} is a pre-determined factor specifically pre-determined for said condition Ci and the identified difference, or is equal to 0 by default,
wherein A_{ci} is a pre-determined factor specifically pre-determined for said condition Ci and the identified difference, or is equal to 1 by default,
wherein B_{ci} is a pre-determined factor specifically pre-determined for said condition Ci and the identified difference, or is equal to 0 by default,

15. Method according to any one of the precedent claims wherein in the roasting apparatus, the at least one temperature probe (5) is positioned outside the chamber (1) and each pre-determined correction specific to one condition of roasting and one identified difference is pre-determined by :

a_0 - applying the specific difference of condition to the master roasting apparatus M without modifying the other conditions of reference,

a - introducing at least one temporary temperature probe (3) inside the chamber of the master roasting apparatus M,

b - controlling the heating device to reproduce a preset curve R_{set}, said preset curve providing a series of points ($T_{set@ti}$; t_i) representing the temperature $T_{set@t1}$, $T_{set@t2}$, … $T_{set@tfinal}$ to be applied at preset corresponding successive times t_1, t_2, …, t_{final} respectively, said control being based on the temperature T_{reg} measured by the temperature probe (5),

c - during the reproduction of the preset curve R_{set}, measuring the temperature T_{cal} in function of time inside the chamber at the temporary temperature probe (3) enabling the determination of at least a set of points ($T_{cal@ti}$; t_i),

d - comparing the temperature $T_{cal@ti}$ measured at at least one time t_i with the temperature $T_{ref@ti}$ at said same time t_i of a pre-determined reference curve R_{ref} obtained with the master roasting apparatus (M), said reference curve R_{ref} representing the temperature T_{ref} measured in the chamber of the specific master apparatus (M) in the conditions of reference while controlling the heating device of the master apparatus to reproduce said preset curve R_{set},

based on the comparison, determining the correction specific to said condition of roasting and said difference.

16. Method according to any one of the precedent claims wherein the heating device (12) comprises an air flow driver (121) and the control system (180) is operable to control said air flow driver (121) and is configured to apply a roasting recipe ($R_{Flow-set}$) providing setpoints ($F_{@ti}$; t_i) of an air flow $F_{@t1}$, $F_{@t2}$, … to be applied at discrete successive times t_1, t_2, …, respectively,
and the operation of adjustment comprises the steps of :
if a difference is identified between said supplied condition Ci of the new operation of roasting and the corresponding condition of reference C_{iRef}, then :

- based on said identified difference, getting access to a corresponding pre-determined correction $K_{Flow\ Ci}$ specific to the nature and the difference with C_{iRef} of said condition of roasting, and
- applying said corresponding pre-determined correction $K_{Flow\ Ci}$ directly or indirectly to at least one of the air flow $F_{set@ti}$ of the roasting recipes to be reproduced by the roasting apparatus (X)

17. Roasting apparatus comprising :
- a chamber (1) to contain coffee beans,
- a heating device (2) configured to supply hot air to the chamber,
- at least one temperature probe (5) to measure the temperature of air supplied by the heating device,
- a control system (80) configured to control the heating device (2) and configured to reproduce roasting recipes, said roasting recipes providing at least a set of points ($T_{@ti}$; t_i) representing the temperature to be applied at discrete successive times t_i, respectively, said control of the

heating device (2) implementing a feedback loop regulation based on the temperature T_{reg} measured by the at least one temperature probe (5),

wherein the control system is operable to implement the method of any one of Claims 1 to 16.

18. Apparatus according to the precedent claim, wherein the at least one temperature probe (5) is positioned outside the chamber (1).