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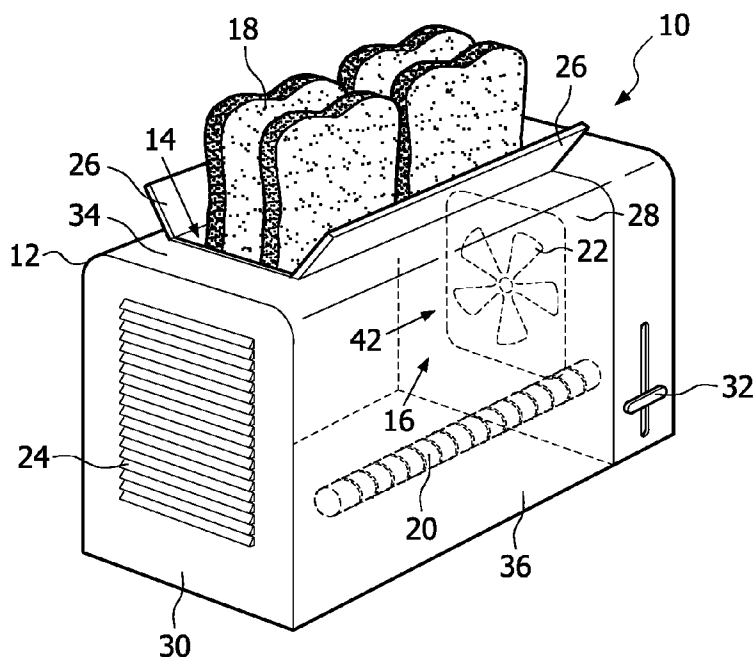
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(54) Title: A TOASTING APPARATUS



(57) Abstract: The present invention relates to an apparatus (10,50) for toasting bread and the like, comprising a housing (12) that comprises an opening (14) which issues into a toasting space (16) for accommodation of products (18) to be toasted, a heating element (20) for heating the products and a control unit for controlling the heating element, wherein the apparatus comprises a cooling device (42) that is adapted to lower a temperature in the toasting space (16). The control unit controls the cooling device and applies an additional drying step to the toasting process by activating the cooling device (42). The cooling device (42) comprises a fan (22) that is adapted to ventilate the toasting space (16).

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A toasting apparatus

The present invention relates to an apparatus for toasting bread and the like, comprising a housing that comprises an opening which issues into a toasting space for accommodation products to be toasted, a heating element for heating the products and a control unit for controlling the heating element.

5 The International Application WO 2004/039224 discloses such an apparatus, which controls the toasting process by repeated switching of the power of the heating element between high and lower levels. In order to obtain bread with a crisp-non moist interior the power level switches for example between 900W and 600W in at least four cycles. US 2003/0075052A1 discloses a toaster, wherein a linear heat source scans the surface of a
10 product to be toasted in two pass rates. The first pass rate is sufficient to drive moisture from the product but is insufficient to darken its surface. After the first pass rate the linear heat source reverses and scans the product at a second pass rate, which is sufficient to darken and toast the surface of the product.

 The problem of these apparatus' from the prior art is that the reduction of the
15 moisture content of the bread during the toasting process is insufficient and uncontrolled. Most people want their toasted products not only to have a nice brown surface but also to have a crisp and dry interior. A well known problem with toasting bread that still exists is that either the surface of the bread does have a nice brown appearance, while the interior of the bread is still quite moist or that the interior of the bread is crisp but its surface is burned
20 or blackened.

 The apparatus' in the prior art are all unsatisfactory with respect to reducing the water content during toasting. The apparatus as disclosed in US 2003/0075052A1 for example dries a product to be toasted in the first step of the toasting process. However during this first step the toasting space will be relatively cold, especially when the apparatus has not
25 been used for a while. During such a step the heat generated by the heat source will be mainly used to heat up the walls defining the toasting space and other nearby components. Only when all these components are sufficiently heated the product reaches a critical temperature that is sufficient for drying it. However this temperature probably will be reached just at the end of the first step, seeing that the first pass rate is insufficient for darken

the surface of the bread and thus the heat source will operate at a low level. This could mean that there is not enough time left for sufficient drying. Moreover depending if the toaster has been used beforehand and thus if the toasting space is still heated or not, the period in which the above-mentioned critical temperature is reached can differ a lot. This will result in an uncontrolled drying process. Indeed the product will also dry during the second pass rate, but the amount of moisture reduction during the first pre-drying step is uncontrolled, which results in an unclear starting position. Another disadvantage is that the heating elements are mounted on a transportation mechanism in order to scan the surface of the bread, which gives a complicated design.

The problem with the electric toaster disclosed in WO 2004/039224 is that here the repeated cycles of the toasting process might result in a drier product but there is a considerable risk for a burned or blackened product. In general the opening, being just a small slot for most toasters, is rather small compared to the actual toasting space. This means that the temperature in the toasting space will be slow on responding to a lower power level. Therefore this temperature will not decrease when applying a lower power level, or at least only after some time it will decrease. Regarding the power levels and cycle times mentioned in WO 2004/039224 it is likely that the temperature in the toasting space will not significantly drop during the process steps with lower power level. It might very well be that for each new cycle the temperature in the toasting space further increases, thereby increasing the risk to a blackened product. Therefore it will be difficult to ensure that the temperature in the toasting space is kept under a critical level above which the product starts to burn.

Next to the enhanced risk to blackened products the repeated cycles tend to make the total toasting process rather long. For a non-moist interior for example in total 4 cycles that together take 120 seconds are required.

It is an object of the present invention to provide an apparatus for toasting bread and the like, which allows to effectively lower the moisture content of the bread, while allowing a controlled degree of browning of the surface of the bread. The present invention therefore provides an apparatus according to the first paragraph, wherein the apparatus comprises a cooling device that is adapted to lower a temperature in the toasting space. The cooling device allows lowering the temperature of the toasting space to a level that is sufficient for continued drying of the product without having the risk of burning the surface thereof. Experiments have indicated that by applying such a drying step the water content of the toasted products further decreases. Under certain conditions the amount of water reduction during drying or cooling is even more than during the preceding toasting cycle.

This will be discussed in more detail below. The products dry efficiently by making use of the heat in the toasting space generated in a preceding toasting cycle, while excessive heat is simultaneously removed thereby preventing possible burning or blackening of the products. The product can obtain a sufficient level of browning in a very short period by applying a relatively high power level in the first part of the toasting process. Timely activating the cooling device can prevent any blackening of the products in this case. Furthermore, removing the excessive heat from the apparatus in each toasting process by means of the cooling device will benefit the lifetime of the apparatus. Another advantage is that the cooling device can lower the surface temperature of the toasted products somewhat, making it more convenient to pick them from the toasting apparatus directly after toasting.

According to a preferred embodiment the control unit controls the cooling device. This allows for the control unit applying an additional drying step to the toasting process by activating the cooling device, and thus controlling the additional reduction of moisture content of the toasted products. Varying the duration of such a drying step or varying the amount of temperature reduction in the toasting space by means of varying a power level of the cooling device will vary the amount of water reduction of the product. Since use is made of the heat generated in preceding toasting cycles the additional drying step is very efficient.

According to another preferred embodiment the cooling device comprises a fan that is adapted to ventilate the toasting space. Using a fan allows a very effective removal of the excessive heat in the toasting space and thus to lower the temperature thereof by a relatively simple technical measure. This is especially true when the fan establishes an airflow in the toasting space that is directed towards its opening. An airflow will remove the thin layer of moist that develops around the surface of the bread during the preceding cycle, which considerably enhances the effectiveness of the drying process. It is in particular preferred that the housing comprises a plurality of ventilating holes, which facilitates an efficient ventilation of the toasting space.

According to yet another preferred embodiment the housing comprises a lid, which is movable between an open position uncovering the opening and a closed position covering the opening. The lid can advantageously be kept closed in the first part of the toasting process which will facilitate a rapid temperature increase in the toasting space in the first part of the toasting process. Another advantage is that by opening the lid when switching to the drying step the heat in the toasting space can escape more easily.

According to yet another preferred embodiment the apparatus comprises a transport device for holding and transporting the products between a first position wherein the products are located in the toasting space and a second position wherein the products are at least partially located outside the housing, the transportation device moving from the first position to the second position during cooling. The products then are partially located in the toasting space and partially extend outside the housing during the drying step. By bringing the products from the first to the second position lowering the temperature of the toasting space is therefore considerably easier seeing that the total heat capacity of the elements located within the toasting space is reduced. It is in particular preferred that the fan is arranged to generate an airflow that transports heat in a direction from the first position to the second position. This provides a very efficient manner to use the heat generated in the toasting space for drying the products. The products on the one hand will rapidly cool down since they are partially located outside the housing. Simultaneously however the products will be heated in an even manner by means of hot air flowing along their surfaces. This allows imposing a temperature on the products that is sufficient for drying them while avoiding the risk of burning them.

According to the invention it is preferred that the fan is located in one of two opposite sidewalls of the housing and the fan generates an airflow from said one sidewall towards the opposite sidewall. Since the opening issueing in the toasting space are usually disposed at the top surface of conventional toasting apparatus' and most components like the electronic circuitry and the control knobs are disposed in or at its side walls, this is an advantageous location for the fan. Moreover conventional toasting apparatus' are designed to keep their sidewalls relatively cool. This embodiment allows for an efficient removal of heat from the toasting space, especially when both sidewalls concerned comprises ventilating holes.

According to the invention it is preferred that a measurement device is disposed in the toasting space, which device measures the temperature in the toasting space and is coupled to the control unit. This embodiment enables an improved control of the degree of browning of the bread simply by activating the cooling device when the toasting space reaches a critical temperature.

According to a preferred embodiment the heating element is adapted to function at different power levels and that the control unit lowers the power level of the heating element during cooling. Since the cooling device is meant to lower the temperature of the toasting space it is no problem if the heating element operates at lower power during the

drying step. This will save energy. Provided that the temperature in the toasting space does not drop too much, since this would then hinder an effective drying, the power of the heating element can even be switched off.

According to another preferred embodiment an adjustment knob is provided at an outside of the housing, which adjustment knob is coupled to the control unit and controls the drying step by controlling an active period and/or a power level of the cooling device. This enables fine tuning the water content reduction of a product after toasting by means of tuning the adjustment knob.

Aspects mentioned before as well as other aspects, features and advantages of the present invention will be further explained by the following description with reference to the drawings, in which same reference numerals indicate same or similar parts, and in which:

Fig. 1 is a perspective schematic view showing an apparatus for toasting bread and the like according to a first preferred embodiment;

Fig. 2 is a perspective schematic view showing an apparatus for toasting bread and the like according to a second preferred embodiment;

Figs. 3a-c show graphs indicating the power level of the heating element, the power level of the cooling device and the temperature of the toasting space in a toasting apparatus according to the invention as a function of time.

Figs. 1 and 2 show two apparatus' for toasting bread and the like according to preferred embodiments of the invention. Each apparatus comprises a housing 12, which housing comprises an opening 14 that issues in a toasting space 16, a control unit (not shown), and a heating element 20, the latter component shown in Fig. 1 only. Products 18 to be toasted, such as slices of bread, are accommodated in the toasting space and thus accessible through opening 14. The drawings show sidewalls 28,30,36 as well as a top wall 34 of the housing 12. The opening can also be shaped as two parallel slots, which is a common design for many toasting apparatus'.

The sidewall 36 and its opposite wall are preferably provided with transparent glass panels so that the toasting operation may be observed.

The control unit controls the heating element 20, which is adapted to rapidly increase the temperature in the toasting space. This control unit can be any standard control

unit that is commonly available and applied for these types of apparatus'. Preferably it comprises a microprocessor wherein standard programs of the toasting cycle(s) are preprogrammed.

The heating element 20 comprises a ceramic rod, wound with a resistance wire. It is also possible to apply wires wound on an insulator plate, such as a mica plate. Other possible heating elements are halogen lamps, infrared emitters, induction heaters and microwave heaters. Although Fig. 1 shows just one heating element, usually the housing accommodates a number of heating elements. These elements are arranged in the housing so as to have an even distribution in temperature in the toasting space. Furthermore a number of aluminum plates (not shown) are usually disposed nearby the heating elements to reflect the heat towards the interior of the toasting space while preventing excessive heating of the sidewalls. The heating elements preferably functions within a certain range of power levels and/or can be separately operated.

Both apparatus' comprise a cooling device 42 that preferably comprises a fan 22, which is arranged in one of the walls of the housing so as to lower the temperature in the toasting space when it is activated. The control unit controls the fan. By activating the fan the control unit applies an additional drying or cooling step to the toasting process. The fan will ventilate the toasting space and consequently lower the temperature around the products 18. This temperature decreases to a level that is sufficiently high to further dry the products, but at the same time is sufficiently low to avoid blackening or burning their surfaces. By removing the moist air that surrounds the products the drying thereof improves considerably.

To facilitate the ventilation of the toasting space ventilation holes 24 or a wall ventilator are arranged in one or more of the side-, top- or bottom-walls of the housing 12. Preferably the ventilation holes are disposed in the wall that accommodates the fan and the wall opposite to it. In Fig. 1 for example ventilation holes are provided in the sidewalls 28 and 30. In sidewall 28 the ventilation holes are provided in the back side and thus not visible in Fig. 1. The fan is preferably driven by an electromotor. The fan 22 can be any fan that is commonly available provided it fits in one of the housing walls.

Preferably the heating element 20 is switched to a much lower power level during the drying step in order to save energy or can even be switched off. It is also possible to lower the output of one or more heating elements during the heating cycle in order to avoid the temperature in the heating space reaching a critical level with respect to burning of the products. This is discussed in more detail below.

The first preferred embodiment from Fig. 1 comprises two lids 26, which can be folded in and out to respectively cover and uncover opening 14. Preferably lids 26 are closed during the first cycle or cycles of the toasting process in order to facilitate a rapid increase of the toasting space' temperature. When the control unit switches to the additional drying step the lids 26 are opened to facilitate transportation of heat in the toasting space to the outside world. Therefore the control unit controls the opening and closing of the lid.

The second preferred embodiment from Fig. 2 comprises a transportation device 54, which device is adapted to hold the products 18 and to transport them between a first position wherein the products are located in the toasting space 16 and a second position (shown in Fig. 2) wherein the products are at least partially located outside the housing.

The embodiment in Fig 1 preferably also has a transportation device (not shown) similar to device 54. The difference is that in the first embodiment the products extend outside the housing from the top wall 34 while in the second embodiment the products extend from the side wall 36. The advantage with the second embodiment is that slices of bread can be covered with additional food products or sandwich fillings prior to the toasting process, which foods are toasted together with the bread. Fig. 1 show the products in their second position, the products being partially located in the toasting space and partially extending outside the housing.

Preferably the fan is arranged so as to generate an airflow that transports the heat in a direction from the first position to the second position. In the case of the second preferred embodiment this could mean that guiding plates (not shown) are disposed in the toasting space 16 in order to direct the airflow towards sidewall 36. This could be ceramic plates that for example are mounted between the transportation device 54 and the sidewall opposite to sidewall 36 and hinge in relation to these components when the transportation device moves. These plates can then advantageously also be used to reflect the heat generated by the heating elements and protect the sidewall opposite to sidewall 36 from getting overheated.

The transportation device preferably is adapted to transport the products to a third position also, wherein the products extend outside the housing somewhat further as compared to the second position. The third position can then advantageously be used to indicated the end of the complete toasting process; when this happens the transportation device moves from the second to the third position. The apparatus can also indicate the end of the toasting cycle with other signals like an audio or a light signal.

It is possible to carry out the drying step while keeping the lids closed and/or keeping the transportation device in its first position. In this case the fan will function at higher power.

An adjustment knob 32 is mounted in one of the sidewalls of the housing. It can be a rotating knob (Fig. 2) or a sliding knob (Fig. 1). The knob is coupled to the control unit and controls the drying step by controlling an active period and/or a power level of the cooling device and/or a power level of the heating elements. In this way the amount of moisture reduction during the drying step can be tuned by means of tuning the adjustment knob. An alternative is to provide a selection switch that switches between several toasting programs that are preprogrammed in the control unit. These programs for example range from programs resulting in very dry and crisp bread with a hard interior to programs resulting in more moist bread with a softer interior.

Preferably a sensor or measuring device (not shown) is arranged in the housing. This can for example be a color sensor that can measure the degree of browning of the surface of the products to be toasted. Other useful sensor types are Infrared sensors or smell sensors. Another possibility is to apply a temperature device, such as a thermocouple or a thermostat, to measure a temperature in the toasting space. Such devices send an input signal corresponding to the measured quantity to the control unit. The control unit uses this signal to activate the cooling device and/or to lower the power level of the heating elements.

Figs 3a-c show graphs that respectively indicate the power level of the heating element, the power level of the cooling device and the temperature of the toasting space as a function of time. The corresponding experiments have been done with an apparatus similar to the embodiment shown in Fig. 1. It shows that at the beginning of the toasting cycle the heating elements operate at a relatively high level in order to obtain a rapid increase of the temperature of the toasting space and have a quick browning of the surfaces of the products to be toasted. In order to avoid that the temperature exceeds a critical temperature T_1 the power of the heating elements decreases considerably at time t_1 .

When the surface of the bread is sufficiently brown and crisp at time t_2 the additional drying step starts, by activating the fan at a relatively high power level.

Consequently the temperature in the toasting space decreases (see Fig. 3c). The power level of the heating element during the drying step is further reduced or even switched off during the drying step. At time t_3 the drying step stops and with that the toasting cycle ends.

Next to the schemes as shown in Figs. 3a-c it is also possible to operate the fan at different power levels during the drying step, for example starting at high power to

immediately remove most of the heat in the toasting space and then switch back to lower power to avoid cooling the toasting space too much. Furthermore it is possible to have more frequent switches in power level of the heating elements prior to the drying step. If one wants to considerably enhance the speed of the drying process it is needed to operate both the heating element and the fan at high power during this process.

Preferably t_2 is at 45-60 seconds after starting the toasting process, while the time period between t_2 and t_3 takes 0-45 seconds. The heating elements operate at power levels ranging between 800-2400W during the first cycle prior to the drying step. The temperature in the toasting space preferably does not exceed 500 °C, which temperature is measured on the ceramic rod or insulator plate. The corresponding average air temperature in the toasting space is approximately 300 °C. Experiments have shown that the water content in the bread is further reduced during the additional drying step by 10-20 % per minute with a maximum water loss of 25% (percentages related to the total weight of the product). In the initial toasting process prior to drying the water content decreases with approximately 10% depending on the power of the heating elements. Thus the water content decreases more in the additional drying step than in the preceding toasting cycle.

As mentioned before the housing preferably accommodates a temperature sensor measuring the temperature in the toasting space. In this way it is possible that a pre-programmed or a pre-selected level of maximum temperature in the toasting space T_1 together with the selected power level(s) of the heating elements determine time t_2 . Furthermore it is also possible to let time t_3 be determined by a pre-programmed or a pre-selected level of the minimum temperature in the toasting space T_2 together with the activity of the cooling device. It will be clear that this ensures that the temperature that is experienced by the products to be toasted is always kept within a fixed and pre-determined range. This in contrast to the apparatus disclosed in WO 2004/039224 and US 2003/0075052A1, in which case the power level of the heating elements and the times t_1 - t_3 are pre-programmed or pre-selected, which together determine the level of T_1 .

By carefully pre-selecting the power levels of heating elements and the fan and the temperature range within the toasting space T_1 - T_2 with the apparatus according to the invention, the degree of browning on the one hand and the total reduction in water content on the other can be pre-selected more or less independently.

It should be clear to a person skilled in the art that the present invention is not limited to the exemplary embodiments discussed above, but that several variations and

modifications are possible within the protective scope of the invention as defined in the appending claims.

CLAIMS:

1. An apparatus (10,50) for toasting bread and the like, comprising a housing (12) that comprises an opening (14) which issues into a toasting space (16) for accommodation of products (18) to be toasted, a heating element (20) for heating the products and a control unit for controlling the heating element, characterized in that the apparatus comprises a cooling device (42) that is adapted to lower a temperature in the toasting space (16).

2. An apparatus (10,50) as claimed in claim 1, characterized in that the control unit controls the cooling device (42).

3. An apparatus (10,50) as claimed in claim 1, characterized in that the cooling device (42) comprises a fan (22) that is adapted to ventilate the toasting space (16).

4. An apparatus (10,50) as claimed in claim 3, characterized in that the housing (12) comprises a plurality of ventilating holes (24).

5. An apparatus (10,50) as claimed in claim 1, characterized in that the housing (12) comprises a lid (26), which is movable between an open position uncovering the opening (14) and a closed position covering the opening.

6. An apparatus (10,50) as claimed in claim 3, characterized in that the apparatus comprises a transport device (54) for holding and transporting the products (18) between a first position wherein the products are located in the toasting space and a second position wherein the products are at least partially located outside the housing, the transport device moving from the first to the second position during cooling.

7. An apparatus (10,50) as claimed in claim 6, characterized in that the fan (22) is arranged to generate an airflow that transports heat in a direction from the first position to the second position.

8. An apparatus (10,50) as claimed in claim 3, characterized in that the fan (22) is located in one of two opposite sidewalls (24,28, 30, 36) of the housing (12) and that the fan generates an airflow from said one sidewall (28) towards the opposite sidewall (30).

5

9. An apparatus (10,50) as claimed in claim 1, characterized in that a measurement device is disposed in the toasting space (16), which device measures the temperature in the toasting space and is coupled to the control unit.

10 10. An apparatus (10,50) as claimed in claim 1, characterized in that the heating element (20) is adapted to function at different power levels and that the control unit lowers the power level of the heating element during cooling.

11. An apparatus (10,50) as claimed in claim 2, characterized in that an
15 adjustment knob (32) is provided at an outside of the housing (12), which adjustment knob is coupled to the control unit and controls the drying step by controlling an active period and/or a power level of the cooling device (42).

1/2

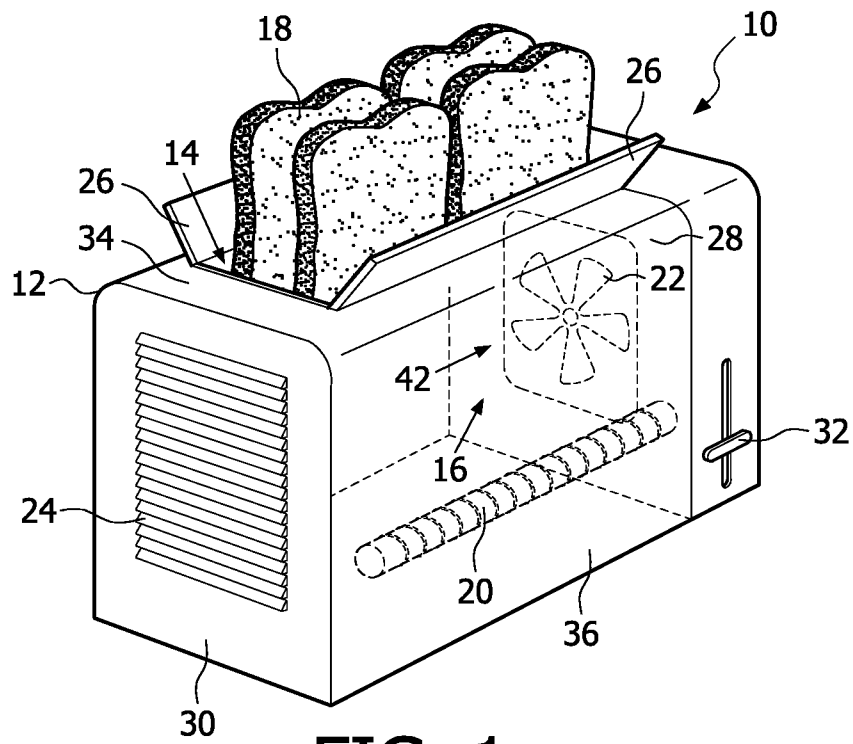


FIG. 1

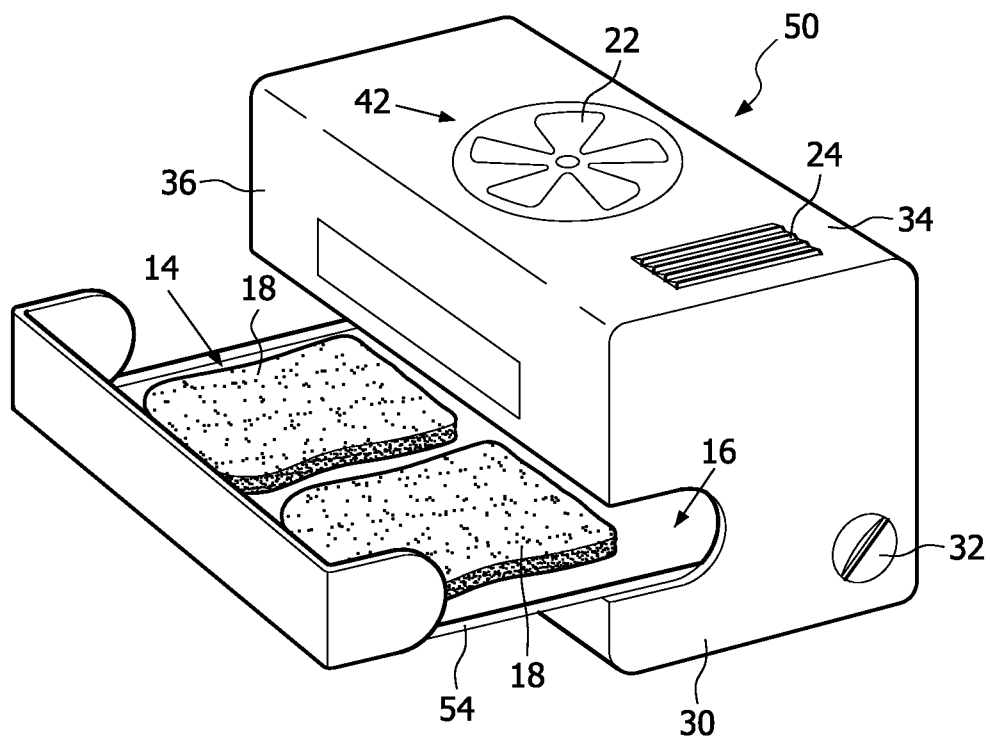


FIG. 2

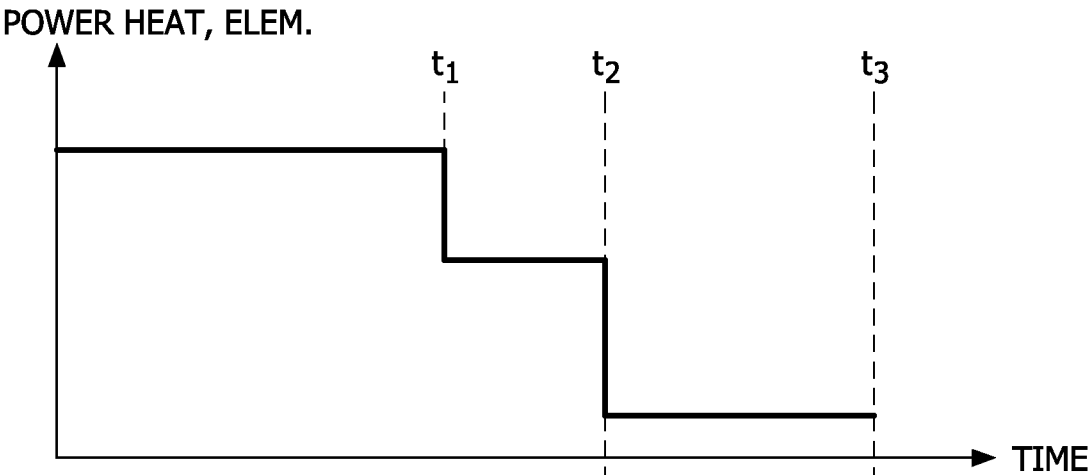


FIG. 3a

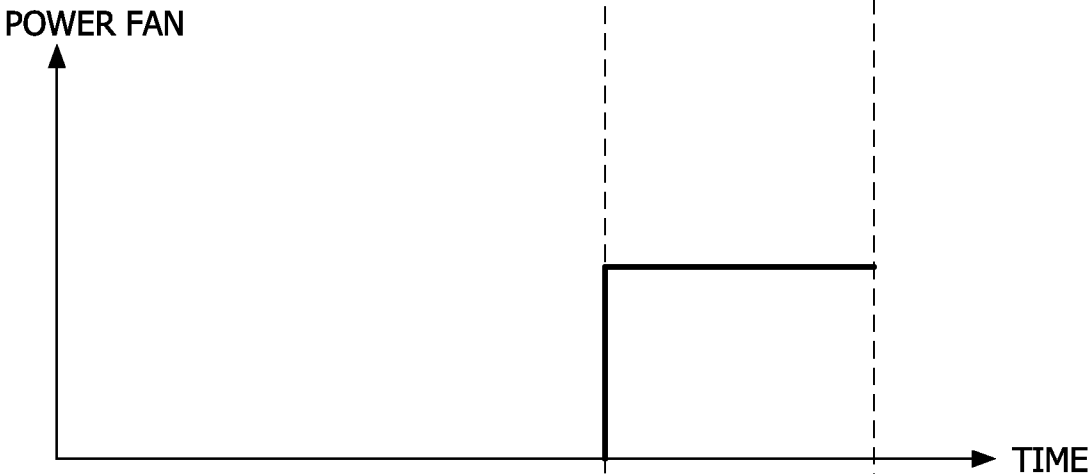


FIG. 3b

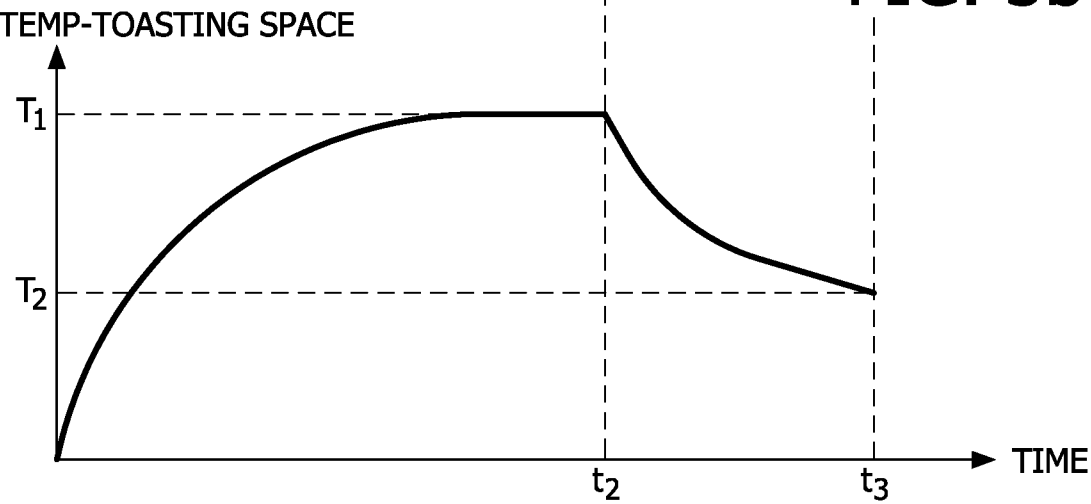


FIG. 3c