A toaster (10) for toasting an article includes a base (12), a plate (14), a low thermal mass heater (16), and an air path. The plate is supported to the base so that a first surface of the plate may be brought into physical contact with the article. The low thermal mass heater is arranged to direct heat toward a second surface of the plate so as to heat the plate to a toasting temperature. The air path is arranged to convey air through openings in the plate to the article so that the air is heated by the low thermal mass heater and so that the heated air is directed onto the article when the first surface of the plate is in physical contact with the article.
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PHYSICAL CONTACT TOASTER WITH AIR IMPINGEMENT

RELATED APPLICATIONS

This application claims the benefit of U. S. Non-Provisional Application No. 09/035,620, filed March 5, 1998.

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates to a toaster for toasting articles such as breads.

Background of the Invention

Current commercial high volume toasters use either a heated platen or an array of medium wave radiant emitters in order to toast breads, buns, rolls, and other food articles, all of which are referred to generically hereinafter as breads. In a heated platen toaster, the toaster’s heated platen is brought into physical contact with the bread to be toasted. The advantage of this physical contact is that the heated platen caramelizes the sugar in the bread so as to seal its surface resulting in pleasing texture, taste, and appearance.

Contact toasting relies on a combination of compression of the bread by the heated platen and conductive heat transfer from the heated platen to the surface of the bread. If the platen of the toaster is heated to approximately 450°F, the surface of the bread in contact with the heated platen usually will brown in about 15 to 20 seconds, depending upon thickness, moisture content, and density of the bread. This browning
time cannot be reduced with current contact toasters because of the time required to heat the bread below the bread surface.

For example, if the platen temperature were increased to 550°F, the time required to brown the surface of the bread could be decreased to approximately 6 to 10 seconds, depending upon thickness, moisture content, and density of the bread. However, there will be bread below the bread surface that will not be heated because the interior of the bread is much slower to heat due to the poor heat conduction of the bread itself. Therefore, in order to achieve acceptable exterior browning and interior heating, the toasting process must be slowed to allow the heat generated on the bread surface to conduct through the interior volume of the bread.

Moreover, contact toasters generally heat up to toasting temperatures very slowly. Therefore, contact toasters are currently left in their on states between toastings, which wastes energy and shortens the useable life of contact toasters.

A radiant emitter toaster, on the other hand, is a non-contact toaster that allows the interior of bread to be heated more quickly. However, such toasters do not acceptably caramelize the surface of the bread.

The present invention solves one or more of the problems noted above.

**Summary of the Invention**

In accordance with one aspect of the present invention, a toaster for toasting an article comprises a heating surface, a heater, and an air path. The heating surface is in
physical contact with the article. The heater is arranged to heat the heating surface to a toasting temperature. The air path is arranged to direct heated air into the article.

In accordance with another aspect of the present invention, a toaster for toasting an article comprises a plate, a low thermal mass heater, and an air path. The plate has first and second surfaces and openings between the first and second surfaces, and the second surface of the plate is in physical contact with the article. The low thermal mass heater is arranged to direct heat toward the first surface of the plate so as to heat the plate to a toasting temperature. The air path is arranged to convey air so that the air is heated by the low thermal mass heater and so that the heated air is directed through the openings between the first and second surfaces into the article.

In accordance with yet another aspect of the present invention, a toaster for toasting an article comprises a base, a plate, a low thermal mass heater, and an air path. The plate is supported to the base so that a first surface of the plate may be brought into physical contact with the article. The low thermal mass heater is arranged to direct heat toward a second surface of the plate so as to heat the plate to a toasting temperature. The air path is arranged to convey air through the plate to the article so that the air is heated by the low thermal mass heater and so that the heated air is directed onto and into the article when the first surface of the plate is in physical contact with the article.
Brief Description of the Drawings

These and other features and advantages of the present invention will become more apparent from a detailed consideration of the invention when taken in conjunction with the drawings in which:

Figure 1 illustrates a first embodiment of a toaster according to the present invention; and,

Figure 2 illustrates a second embodiment of a toaster according to the present invention.

Detailed Description

A toaster 10 according to the present invention is shown in Figure 1. The toaster 10 includes a base 12, a platen 14, and a heating unit 16. A hinge 18 is provided between the base 12 and the platen 14 so that the platen 14 can be moved into and out of contact with bread 20. The heating unit 16 may be suitably mounted to the platen 14. Accordingly, the weight of the heating unit 16 and the platen 14 applies pressure to the surface of the bread 20 which facilitates the caramelizing effect during toasting.

The heating unit 16 includes a plurality of heating elements 22. Although four such heating elements 22 are shown in Figure 1, any number greater or smaller than four may be used in the heating unit 16. The heating elements 22, for example, may be low thermal mass heating elements such as quartz halogen lamps that emit radiant energy when energized. Each of the heating elements 22 has a corresponding
reflector 24. The reflectors 24 may be generally parabolic and are arranged to cooperate with one another and with the heating elements 22 in order to uniformly distribute the radiant energy emitted by the heating elements 22 over the surface of the platen 14 that faces the heating elements 22.

The advantage of using low thermal mass heating elements for the heating elements 22 is that such heating elements are substantially instant on and instant off heating elements. Accordingly, as soon as the heating elements 22 of the toaster 10 are energized in order to toast the bread 20, they emit a substantial amount of radiant energy in order to quickly heat the platen 14. Thus, the toaster 10 need not be left in the on state between toastings.

By contrast, high thermal mass heating elements must themselves first heat up before they can emit substantial amounts of energy in order to heat a platen. Accordingly, there has been a tendency to leave Toasters employing such high thermal mass heating elements in the on state between toastings.

The surface of the platen 14 that faces the heating elements 22 is preferably arranged to have an emissivity of about 1. For example, this surface may be a black anodized surface which generally has an emissivity of about 0.9. However, the surface of the platen 14 that faces the heating elements 22 may be coated or formed with any other material, such as carbon black, and may be ruled or roughened in order to increase the amount of energy that the platen 14 absorbs from the heating elements 22.
The heating unit 16 includes a convection blower 30 that takes in air through an intake filter 32 and circulates this air within the portion of the heating unit 16 that is behind the reflectors 24. As shown in Figure 1, each of the reflectors 24 is provided with a plurality of openings 34 therethrough. Accordingly, the convection blower 30 forces the air from behind the reflectors 24 out through the openings 34 toward the platen 14. This air picks up heat from the heating elements 22, the reflectors 24, and other structures of the heating unit 16.

Also as shown in Figure 1, the platen 14 is itself provided with a plurality of openings 36. Accordingly, the air that is forced toward the platen 14 impinges generally in a perpendicular direction on the surface of the platen 14 facing the heating elements 22, passes through the platen 14 by way of the openings 36, and is directed to the bread 20. As the air passes through the platen 14, it picks up additional heat. At this point, this air may have a temperature of 250°F.

With the arrangement as described above, when the heating elements 22 are energized in order to heat the platen 14, the convection blower 30 is energized to begin circulating air, and the platen 14 is moved into physical contact with the bread 20, the heat of the platen 14 caramelizes the surface of the bread 20. At the same time, the air moved by the convection blower 30 picks up heat, and this heated air is directed by the openings 36 in the platen 14 into the bread 20. The air passing through the openings 36 in the platen 14 penetrates the surface of the bread 20 in order to more quickly heat its interior. With this combination of a platen 14 and air directed to impinge on the bread 20, the toasting time of the bread 20 can be reduced.
to the range of about 6 to 10 seconds, depending upon thickness, moisture content, and density of the bread.

The base 12 may be stationary so that, when the bread 20 is to be toasted, the heating elements 22 are energized in order to heat the platen 14, the convection blower 30 is energized to begin circulating air, the bread 20 is placed under the platen 14, and the platen 14 is moved into physical contact with the bread 20. Alternatively, the base 12 may be provided with a conveyor 40 which is arranged to move the bread 20 under the platen 14. The conveyor 40, for example, may be a belt type conveyor. The platen 14 may be provided with a handle to facilitate its movement into and out of engagement with the bread 20.

The base 20 supports a control panel 42 which may be used to select the temperature of the platen 14. A resistive temperature device or other temperature sensor (not shown) may be provided in order to sense the temperature of the platen 14. A controller (also not shown) responds to the sensed temperature of the platen 14, compares the sensed temperature of the platen 14 with a reference temperature as selected through use of the control panel 42, and controls the heating elements 22 in response to this comparison. The reference temperature may be set at around 550°F so that the platen 14 is controlled at this temperature. The controller, for example, may pulse the heating elements 22 such that the pulse on-time of the heating elements 22 is controlled in order to control the average amount of energy supplied by the heating elements 22 to the platen 14. This controller may be a PID (proportional, integral, derivative) controller. In addition the surface of the platen may be coated
with a non-stick material such as PTFE (teflon) in order to facilitate the release of the bread product after the toasting process.

An alternative embodiment in the form of a toaster 100 is shown in Figure 2, the toaster 100 may have a base 102, a platen 104, and a heating unit 106. The platen 104 and the heating unit 106 may be similar to the platen 14 and the heating unit 16 of the toaster 10. The base 102, however, is arranged to index a bread tray 108 under the platen 104 for toasting and then to index the bread tray 108 away from the platen 104 after toasting. A motor 110 is provided with a screw shaft 112 that engages a gear 114. The gear 114 is attached to the bread tray 108. Accordingly, as the screw shaft 112 is rotated by the motor 110, the gear 114 linearly moves the bread tray 108 under the platen 104 for toasting and then away from the platen 104 following toasting. The motor 110 can be controlled in cooperation with the heating elements of the heating unit 106.

The toasters 10 and 100 provide both conductive and convective heat transfers in order to simultaneously toast the exterior surface, and heat the interior volume, of bread. The platens 14 and 104 may be low thermal mass platens which responds to rapid response heating elements.

Certain modifications of the present invention have been discussed above. Other modifications will occur to those practicing in the art of the present invention. For example, as described above, the heating elements 22 may be low thermal mass heating elements such as quartz halogen lamps. Alternatively, calrods or nickel
chrome ribbon heaters may be used for the heating elements 22. However, it should be noted that calrods typically are not instant on and off heaters.

Moreover, the platen 14 as described above may be provided with a handle to facilitate its movement into and out of engagement with the bread 20. Alternatively, the platen 14 may be driven by a motor controlled in synchronism with the movement of the conveyor 40, or controlled in response to the temperature state of the platen, the temperature of the heated air, and the presence of bread under the platen, or controlled in any other desired manner.

Accordingly, the description of the present invention is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the best mode of carrying out the invention. The details may be varied substantially without departing from the spirit of the invention, and the exclusive use of all modifications which are within the scope of the appended claims is reserved.
WHAT IS CLAIMED IS:

1. A toaster for toasting an article comprising:
   a heating surface in physical contact with the article;
   a heater arranged to heat the heating surface to a toasting temperature; and,
   an air path arranged to direct heated air into the article.

2. The toaster of claim 1 wherein the heater comprises a low thermal mass heater.

3. The toaster of claim 1 wherein the heater comprises a quartz halogen lamp.

4. The toaster of claim 1 wherein the air path includes a fan, and wherein the fan is arranged to force heated air through the air path to the article.

5. The toaster of claim 4 wherein the air path includes an opening through the heating surface.

6. The toaster of claim 4 wherein the air path includes the heater so that air moving through the air path picks up heat from the heater in order to heat the air that is directed to the article.
7. The toaster of claim 6 wherein the air path includes an opening through the heating surface.

8. The toaster of claim 4 wherein the heater comprises a heating element and a reflector, wherein the air path includes a reflector opening through the reflector so that air moving through the air path picks up heat from the heater in order to heat the air that is directed to the article.

9. The toaster of claim 8 wherein the air path includes an opening through the heating surface.

10. The toaster of claim 8 wherein the air path includes the heater so that air moving through the air path picks up heat from the heater in order to heat the air that is directed to the article.

11. The toaster of claim 10 wherein the air path includes an opening through the heating surface.

12. The toaster of claim 8 wherein the heating element comprises a low thermal mass heater.
13. The toaster of claim 1 wherein the heating surface has first and second
walls, wherein the first wall faces the heater, wherein the second wall is in physical
contact with the article, and wherein the first wall is comprised of a material to absorb
heat from the heater.

14. The toaster of claim 13 wherein the air path includes an opening through
the heating surface.

15. The toaster of claim 13 wherein the air path includes a fan, and wherein
the fan is arranged to force heated air through the air path to the article.

16. The toaster of claim 15 wherein the air path includes an opening through
the heating surface.

17. The toaster of claim 15 wherein the air path includes the heater so that air
moving through the air path picks up heat from the heater in order to heat the air that
is directed to the article.

18. The toaster of claim 17 wherein the air path includes an opening through
the heating surface.
19. The toaster of claim 15 wherein the heater comprises a heating element
and a reflector, and wherein the air path includes a reflector opening through the
reflector so that air moving through the air path picks up heat from the heater in order
to heat the air that is directed to the article.

20. The toaster of claim 19 wherein the air path includes an opening through
the heating surface.

21. The toaster of claim 19 wherein the air path includes the heater so that air
moving through the air path picks up heat from the heater in order to heat the air that
is directed to the article.

22. The toaster of claim 13 wherein the heater comprises a low thermal mass
heater.

23. A toaster for toasting an article comprising:
a plate having first and second surfaces and openings between the first and
second surfaces, wherein the second surface of the plate is in physical contact with the
article;
a low thermal mass heater arranged to direct heat toward the first surface of
the plate so as to heat the plate to a toasting temperature; and,
an air path arranged to convey air so that the air is heated by the low thermal
mass heater and so that the heated air is directed through the openings between the
first and second surfaces into the article.

24. The toaster of claim 23 wherein the air path includes openings through the
plate.

25. The toaster of claim 24 wherein the low thermal mass heater is a quartz
halogen lamp.

26. The toaster of claim 23 wherein the low thermal mass heater comprises a
reflector arranged to direct reflected heat to the first surface of the plate.

27. A toaster for toasting an article comprising:
   a base;
   a plate supported to the base so that a first surface of the plate may be brought
   into physical contact with the article;
   a low thermal mass heater arranged to direct heat toward a second surface of
   the plate so as to heat the plate to a toasting temperature; and,
   an air path arranged to convey air through the plate to the article so that the air
   is heated by the low thermal mass heater and so that the heated air is directed onto and
   into the article when the first surface of the plate is in physical contact with the article.
28. The toaster of claim 27 wherein the low thermal mass heater is a quartz halogen lamp.

29. The toaster of claim 28 wherein the low thermal mass heater comprises a reflector arranged to direct reflected heat to the second surface of the plate.

30. The toaster of claim 27 further comprising a conveyor arranged to convey the article into a position whereat the first surface of the plate may be moved into physical contact with the article.

31. The toaster of claim 30 further comprising a motor arranged to move the conveyor.

32. The toaster of claim 31 wherein the motor is also arranged to move the plate into and out of physical contact with the article.
# INTERNATIONAL SEARCH REPORT

## A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC.

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Minimum documentation searched (classification system followed by classification symbols).

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

Electronic data base consulted during the international search (name of data base and, where practical, search terms used).

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of box C.

Special categories of cited documents:

- **A** document defining the general state of the art which is not considered to be of particular relevance
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- **O** document referring to an oral disclosure, use, exhibition or other means
- **P** document published prior to the international filing date but later than the priority date claimed
- **T** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- **X** document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- **Y** document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search: 6 May 1999

Date of mailing of the international search report: 14/05/1999

Name and mailing address of the ISA:
European Patent Office, P. B. 5818 Patentlaan 2 NL - 2380 HV Rijswijk, Tel. (+31-70) 340-2040, Tx. 31 651 eos - nl, Fax: (+31-70) 340-3016

Authorized officer: Bodart, P.
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**INTERNATIONAL SEARCH REPORT**

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