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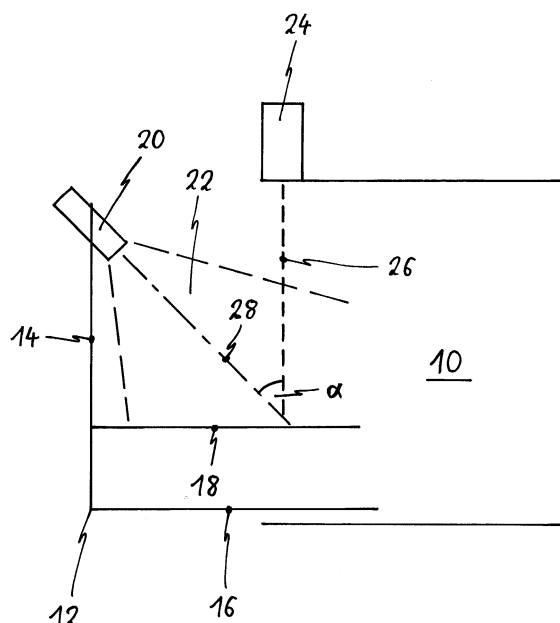
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(54) **A COOKING OVEN INCLUDING AN APPARATUS FOR DETECTING THE THREE-DIMENSIONAL SHAPE OF FOOD STUFF ON A FOOD STUFF CARRIER**

(57) The present invention relates to a cooking oven including an apparatus for detecting the three-dimensional shape of food stuff on a baking tray (18) of said cooking oven. The apparatus includes at least one laser (24) arranged or arrangeable above an oven cavity (10) of the cooking oven. A laser beam (26) from the laser (24) is directional downwardly. The apparatus includes at least one camera (20) arranged or arrangeable above a baking tray (18) of the cooking oven. The camera (20) is arranged or arrangeable in a front portion of the cooking oven. The baking tray (18) and the camera (20) are mechanically coupled, so that the camera (20) and the baking tray (18) are synchronously moveable. An upper side of the baking tray (18) is within a field of vision (22) of the camera (20). An angle between a central axis (28) of a field of vision (22) of the camera (20) and the laser beam (26) is predetermined. Further, the present invention relates to the apparatus for detecting the three-dimensional shape of food stuff on a baking tray (18) of said cooking oven.

FIG 1



Description

[0001] The present invention relates to a cooking oven with an apparatus for detecting the three-dimensional shape of food stuff on a food stuff carrier, in particular baking tray. Further, the present invention relates to an apparatus for detecting the three-dimensional shape of food stuff on a food stuff carrier, in particular baking, tray of a cooking oven.

[0002] The measuring of the three-dimensional shape of food stuff inside the oven cavity can be used for the calculation of the temperature in the core of the food stuff and as an input for an automatic cooking program. The measuring of the three-dimensional shape of food stuff can be realized by a camera and a laser. During the development of the method for the three-dimensional measuring of the shape of food stuff it became clear that the combination of the measuring equipment, i.e. camera and a laser, and the baking tray has several advantages and is the only commercially feasible solution.

[0003] However, there are some problems relating to the combination of the measuring equipment and the cooking oven. The camera and the laser have to be positioned in such places, which are cool enough, in order to insure the function ability and a long lifetime of the camera and laser. The positions of the camera and the laser should result in an angle between the optical axis of the camera and the laser beam, which angle allows a sufficient accuracy of the triangulation between the laser, food stuff and camera. The food stuff should be moved under the laser beam or the laser beam should be moved over the food stuff in a reproducible and smooth way. The changes of the oven structure for installing the measuring equipment should be minimized.

[0004] WO 2010/012340 A1 discloses a cooking oven for automatic heating procedures. The cooking oven comprises a camera and a laser. The camera and the laser are positioned at the upper side of the chamber opening. The laser is inclined by a predefined angle. During inserting the baking tray with food stuff, the laser emits a fan-shaped laser beam and the camera records continuously top views of the baking tray. However, the speed or the shift of positions of the baking tray has to be detected or predetermined, in order to create a three-dimensional model of the food stuff.

[0005] CN 101059338 A discloses a method for measuring the position of a carbonization chamber in a coal coke charring room. A camera, a laser and a reference body are used. However, also in this case the speed or the shift of positions of the moved objects has to be detected or predetermined.

[0006] JP 2001099615 A discloses a three-dimensional object shape measuring instrument. A camera and a laser are moveable inside the oven chamber. The movement of the camera and laser as well as the evaluation require a complex controller.

[0007] CN 101059338 A discloses a cooking oven with a detection part for detecting the position of a food-hold-

ing component, so that the user is informed, if the food-holding component is correctly placed inside the oven chamber. A one-dimensional sensor detects the distance between the top wall of the oven chamber and the food-holding component.

[0008] It is an object of the present invention to provide a cooking oven including an apparatus for detecting the three-dimensional shape of food stuff on a food stuff carrier, in particular a baking tray, wherein said apparatus is realized by low complexity and low costs.

[0009] The object of the present invention is achieved by the cooking oven according to claim 1.

[0010] The present invention relates to a cooking oven including an apparatus for detecting the three-dimensional shape of food stuff on a food stuff carrier, in particular baking tray, of said cooking oven, wherein:

- the apparatus includes at least one laser arranged or arrangeable above an oven cavity of the cooking oven,
- a laser beam from the laser is directional downwardly,
- the apparatus includes at least one camera arranged or arrangeable above the food stuff carrier of the cooking oven,
- the camera is arranged or arrangeable in a front portion of the cooking oven,
- the food stuff carrier and the camera are mechanically coupled, so that the camera and the food stuff carrier are synchronously moveable,
- an upper side of the food stuff carrier is within a range of vision of the camera, and
- an angle between a central axis of a range of vision of the camera and the laser beam is predetermined.

[0011] The main idea of the cooking oven according to the present invention is the moveable camera and the stationary laser, wherein the camera is mechanically coupled to the food stuff carrier, in particular baking tray and the laser is arranged above the oven cavity. Since the camera and the baking tray are coupled, the distance between the camera and the food stuff is constant, so that the detection of the three-dimensional shape of the food stuff is independent of the speed of the food stuff carrier, when said food stuff carrier is moved into the oven cavity. The cooking oven with the apparatus can be realized by low complexity and low costs.

[0012] According to a preferred embodiment of the present invention the cooking oven comprises a drawer, wherein the camera is arranged or arrangeable at a top portion of a vertical part of said drawer, and the food stuff carrier is arranged or arrangeable at the vertical part and/or on a horizontal part of said drawer. The combination of the drawer and the apparatus contributes that the inventive cooking oven may be realized by low complexity and low costs.

[0013] In particular, the vertical part of the drawer is formed as an oven door. The oven door as vertical part

of the drawer contributes also the low complexity of the cooking oven.

[0014] Preferably, the camera is arranged or arrangeable inside a top portion of the oven door. Thus, the camera is protected from heat and dirt.

[0015] Further, the laser may be arranged or arrangeable behind a front frame of the oven cavity. In this position the laser can easily be kept cool.

[0016] In the latter case, the front frame may comprise at least one hole for the laser beam.

[0017] According to a preferred embodiment of the present invention the angle between the central axis of the field or range of vision of the camera and the laser beam is between 30° and 60°, preferably about 45°.

[0018] The object of the present invention is further achieved by the apparatus according to claim 8.

[0019] The present invention relates to an apparatus for detecting the three-dimensional shape of food stuff on a food stuff carrier, in particular baking tray, of a cooking oven, wherein:

- the apparatus includes at least one laser arranged or arrangeable above an oven cavity of the cooking oven,
- a laser beam from the laser is directional downwardly,
- the apparatus includes at least one camera arranged or arrangeable above a food stuff carrier of the cooking oven,
- the camera arranged or arrangeable in a front portion of the cooking oven,
- the camera is mechanically coupled or coupleable with the food stuff carrier, so that the camera is synchronously moveable with the food stuff carrier,
- a range of vision of the camera is directed or directional to an upper side of the food stuff carrier, and
- an angle between a central axis of a field of vision of the camera and the laser beam is predetermined.

[0020] The main idea of the cooking oven according to the present invention is the moveable camera and the stationary laser, wherein the camera is mechanically coupled to the food stuff carrier, in particular baking tray and the laser is arranged above the oven cavity. Since the camera and the baking tray are coupled, the distance between the camera and the food stuff is constant, so that the detection of the three-dimensional shape of the food stuff is independent of the speed of the food stuff carrier, when said food stuff carrier is moved into the oven cavity. The cooking oven with the apparatus can be realized by low complexity and low costs.

[0021] In particular, the apparatus is provided for the cooking oven 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 sectional side view of a drawer oven with an apparatus for detecting the three-dimensional shape of food stuff according to a preferred embodiment of the present invention.

[0024] FIG 1 illustrates a schematic sectional side view of a drawer oven with an apparatus for detecting the three-dimensional shape of food stuff according to a preferred embodiment of the present invention.

[0025] The drawer oven comprises a stationary oven cavity 10 and a moveable drawer 12. The drawer 12 is moveable into the oven cavity 10 along a horizontal direction. The drawer 12 includes a vertical part 14 and a horizontal part 16. The vertical part 14 of the drawer 12 forms an oven door. The horizontal part 16 of the drawer 12 is movably arranged within a lower portion of the oven cavity 10. The drawer 12 comprises a baking tray 18 for receiving food stuff. In this example the baking tray 18 is attached at the vertical part 14 of the drawer 12. In general, the baking tray 18 may be attached at the vertical part 14 of the drawer 12 and/or on the horizontal part 16 of the drawer 12. The baking tray 18 extends substantially within a horizontal plane.

[0026] A camera 20 is arranged at a top portion of the horizontal part 16 of the drawer 12. A field of vision 22 of the camera 20 is directed onto an upper side of the baking tray 18. The field of vision 22 of the camera 20 covers substantially the whole upper side of the baking tray 18. In this example, the camera 20 is arranged inside the vertical part 14 of the drawer 12, i.e. inside the oven door. Thus, the place of the camera 20 can be kept cool enough without high complexity. There are no additional costs for positioning the camera 20 inside the oven door. Inside the vertical part 14 of the drawer 12 there is no danger of damaging said camera 20.

[0027] A laser 24 is arranged upon an upper front portion of the oven cavity 10. The laser 24 is arranged behind a front frame of the oven cavity 10. In this position the laser 24 can be kept cool by low complexity. Since the laser 24 is arranged outside the oven cavity 10, it is protected from heat and dirt. Further, the laser 24 can be cleaned easily. A laser beam 26 from the laser 24 is directed downwardly. Through a hole in the front frame of the oven cavity 10 the laser beam 26 can be projected over the whole width of the baking tray 18.

[0028] There is an angle α of about 45° between a central axis 28 of the field of vision 22 of the camera 20 on the one hand and the direction of the laser beam 26 on the other hand. The angle α of about 45° between the laser beam 26 and the central axis 28 allows a good resolution of the triangulation measurement between the camera 20, the laser 26 and the foodstuff.

[0029] The laser 24 forms the stationary part of the apparatus for detecting the three-dimensional shape of food stuff. The camera 20 and the baking tray 18 form the mobile part of the apparatus for detecting the three-dimensional shape of food stuff. Since the camera 20

and the baking tray 18 are fixed at the drawer 12, the distance between the camera 20 and the food stuff is constant. Thus, the detection of the three-dimensional shape of the food stuff is independent of the speed of inserting the drawer 12 into the oven cavity.

[0030] In an alternative embodiment of the present invention a coupling between the baking tray 18 and the camera 20 is provided, wherein the drawer 12 is not necessary. The coupling between the baking tray 18 and the camera 20 may be realized by arbitrary mechanical equipment, so that the movement of the camera 20 depends on the movement of the baking tray 18. Further, the movement of the camera 20 may be driven by a motor in dependence of the position of the baking tray 18.

[0031] 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.

[0032] For instance, another food stuff carrier can be used instead of a baking tray for instance a grid or plate.

List of reference numerals

[0033]

10	oven cavity
12	drawer
14	vertical part, oven door
16	horizontal part
18	baking tray
20	camera
22	field of vision
24	laser
26	laser beam
28	central axis of the field of vision 22
α	angle between laser beam 28 and central axis 28

Claims

1. A cooking oven including an apparatus for detecting the three-dimensional shape of food stuff on a food stuff carrier, in particular a baking tray (18), of said cooking oven, wherein:

- the apparatus includes at least one laser (24) arranged or arrangeable above an oven cavity (10) of the cooking oven,
- a laser beam (26) from the laser (24) is directional downwardly,
- the apparatus includes at least one camera

(20) arranged or arrangeable above a food stuff carrier of the cooking oven,

- the camera (20) is arranged or arrangeable in a front portion of the cooking oven,
- the food stuff carrier (18) and the camera (20) are mechanically coupled, so that the camera (20) and the food stuff carrier (18) are synchronously moveable,
- an upper side of the food stuff carrier (18) is within a range of vision (22) of the camera (20), and
- an angle between a central axis (28) of a range of vision (22) of the camera (20) and the laser beam (26) is predetermined.

2. The cooking oven according to claim 1, **characterized in, that** the cooking oven comprises a drawer (12), wherein the camera (20) is arranged or arrangeable at a top portion of an vertical part (14) of said drawer (12), and the food stuff carrier (18) is arranged or arrangeable at the vertical part (14) and/or on a horizontal part (16) of said drawer (12).

3. The cooking oven according to claim 2, **characterized in, that** the vertical part (14) of the drawer (12) is formed as an oven door.

4. The cooking oven according to claim 3, **characterized in, that** the camera (20) is arranged or arrangeable inside a top portion of the oven door.

5. The cooking oven according to any one of the preceding claims, **characterized in, that** the laser (24) is arranged or arrangeable behind a front frame of the oven cavity (10).

6. The cooking oven according to claim 5, **characterized in, that** the front frame comprises at least one hole for the laser beam (16).

7. The cooking oven according to any one of the preceding claims, **characterized in, that** the angle between the central axis (28) of the range of vision (22) of the camera (20) and the laser beam (26) is between 30° and 60°, preferably about 45°.

8. An apparatus for detecting the three-dimensional shape of food stuff on a food stuff carrier, in particular a baking tray (18), of a cooking oven, wherein:

- the apparatus includes at least one laser (24) arranged or arrangeable above an oven cavity

(10) of the cooking oven,
- a laser beam (26) from the laser (24) is directional downwardly,
- the apparatus includes at least one camera (20) arranged or arrangeable above the food stuff carrier (18) of the cooking oven, 5
- the camera (20) arranged or arrangeable in a front portion of the cooking oven,
- the camera (20) is mechanically coupled or coupleable with the food stuff carrier (18), so that the camera (20) is synchronously moveable with the food stuff carrier (18), 10
- a range of vision (22) of the camera (20) is directed or directional to an upper side of the food stuff carrier (18), and 15
- an angle between a central axis (28) of a field of vision (22) of the camera (20) and the laser beam (26) is predetermined.

9. The apparatus according to claim 8, 20
characterized in, that
the apparatus is provided for a cooking oven according to any one of the claims 1 to 7.

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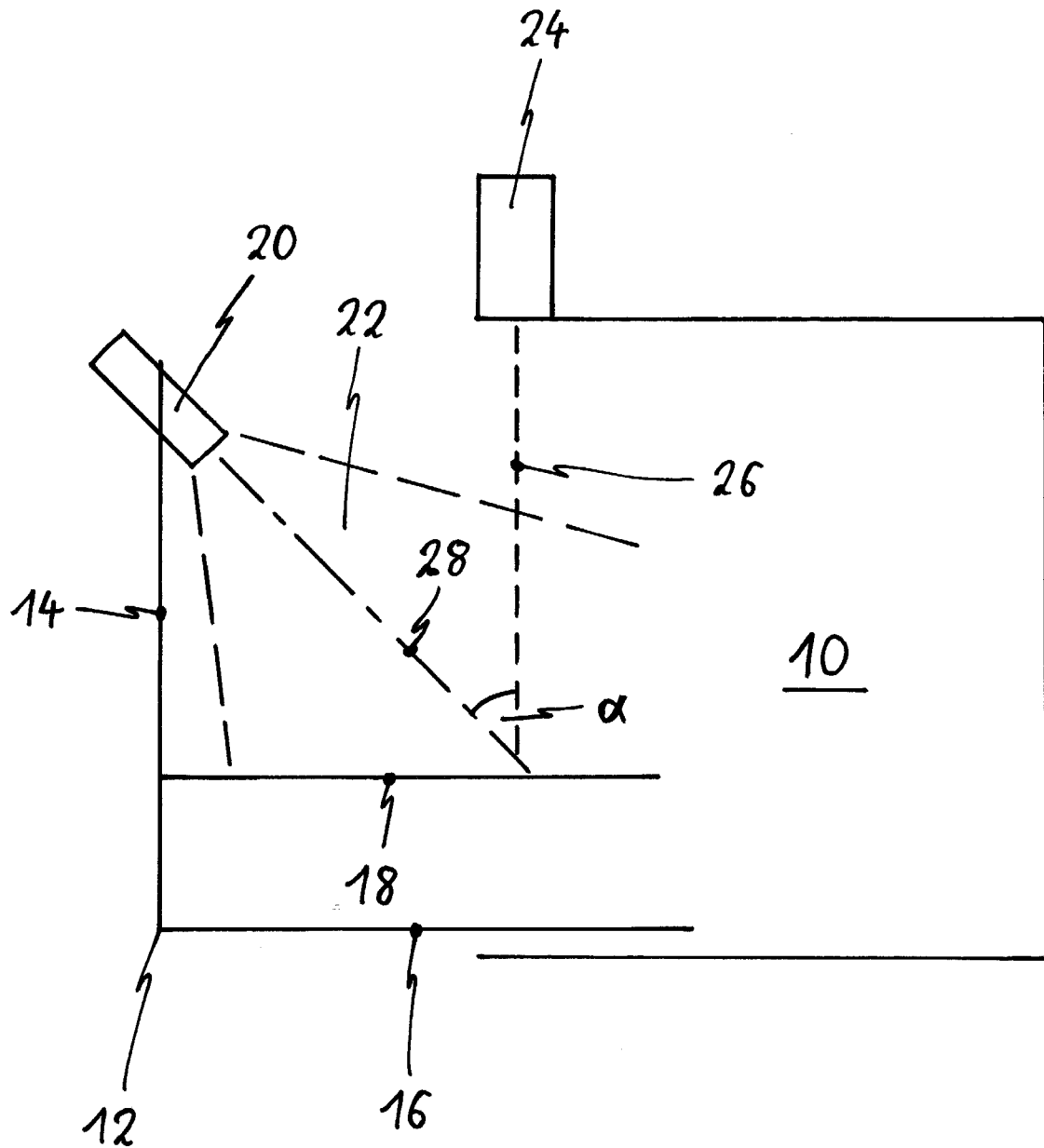
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FIG 1





EUROPEAN SEARCH REPORT

Application Number
EP 17 16 5684

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Place of search		Date of completion of the search	Examiner
The Hague		11 August 2017	Meyers, Jerry
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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 17 16 5684

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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