

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

APPARATUS AND METHOD FOR REDUCING COOKING TIME

TECHNICAL FIELD

[0001] The present invention relates generally to commercial ovens and particularly to a cooking apparatus and methods to reduce cooking time for food.

BACKGROUND ART

[0002] Commercial ovens can be used to bake and/or cook a wide variety of food products such as pizza, pizza type products, cookies, sandwiches and others.

[0003] One main type of commercial oven is a hot air conveyor oven 10, one form of which is illustrated in Figure 1, which has a conveyor belt which moves the food product through the oven driven by a conveyor drive motor, at least one heat source and a number of blowers which project hot air from the heat source through mechanisms known as air fingers which project streams of hot air onto the food product in order to cook the food product as the food product moves through the oven.

[0004] In this type of oven, the heat transfer from conduction is generally dependent upon the food product and the cooking surface used and heat transfer from radiation is effectively constant because the colour of the oven interior cannot be changed. For these reasons, the most common way of optimising heat transfer within the oven is by regulating the hot air.

[0005] The air fingers of this type of oven direct the heated air from the blowers into substantially vertical jets that are directed at the top and bottom of the conveyor belt. A configuration including an upper air finger 12 and a lower air finger 12 to blow heated air onto a food product 14 on a conveyor 11 is illustrated in Figure 2. In this configuration, the oven 10 uses a number of air fingers, each of which is composed of a manifold 15, an inner plate 16 and an outer plate 17 as illustrated in Figure 3.

[0006] The manufacturers of these types of ovens make it clear that no adjustment is necessary or possible to the air fingers 12, 13.

[0007] The oven specifications or settings generally mean that a particular food product has a particular bake time governed by the temperature of the oven and the time of delivery. Cooking the product more quickly, in other words, decreasing the time of delivery of a particular cooked food product, is not as simple as increasing the oven temperature and reducing the belt speed. This will typically produce food products which are over baked at their edges and under baked in

the middle of the food product.

[0008] There is therefore a complex relationship between the particular food product to be cooked, the temperature of the oven and the belt speed, which is extremely difficult to control in order to achieve a product that is cooked properly, but available more quickly.

[0009] Clearly however, reducing the time of delivery whilst ensuring that the product is properly cooked will provide an important commercial advantage.

[0010] It will be clearly understood that, if a prior art publication is referred to herein, this reference does not constitute an admission that the publication forms part of the common general knowledge in the art in Australia or in any other country.

SUMMARY OF INVENTION

[0011] The present invention is directed to an apparatus and method for reducing cooking time, which may at least partially overcome at least one of the abovementioned disadvantages or provide the consumer with a useful or commercial choice.

[0012] With the foregoing in view, the present invention in one form, resides broadly in an apparatus for reducing cooking time, the apparatus including a conveyor oven with a driven conveyor belt to move food products through the conveyor oven, at least one heating module, at least one air blower, a number of air fingers to project heated air onto the food product whilst on the conveyor belt and at least one hot air diffuser member or assembly positioned between the food product on the conveyor belt and the air fingers allowing increased temperature to be used in the oven and a reduction in cook time.

[0013] In another aspect, the present invention resides broadly in a method for reducing cooking time, the method including providing a conveyor oven with a driven conveyor belt to move food products through the conveyor oven, at least one heating module, at least one air blower, a number of air fingers to project heated air onto the food product whilst on the conveyor belt and at least one hot air diffuser member or assembly positioned between the food product on the conveyor belt and the air fingers, and increasing the air temperature within the oven to above 500°F and increasing the speed of the conveyor belt to achieve a time of delivery of the food product through the conveyor oven of approximately 3 minutes.

[0014] In another aspect, the present invention resides in a hot air diffuser member or assembly for a hot air conveyor oven utilising at least one air finger, the hot air diffuser member

or assembly including an air finger cover positioned at least partially over at least one air finger allowing increased temperature to be used in the oven and a reduction in cook time

[0015] In one form, the apparatus of the present invention includes a hot air conveyor oven with a driven conveyor belt to move food products through the conveyor oven. The conveyor oven may have any configuration and may utilise any power source. For example, the conveyor oven may be a gas oven or electric oven or a combination of both.

[0016] Generally, the at least one air blower will deliver hot air from the at least one heating module to the number of air fingers in order to deliver the heated air to the food product on the conveyor belt.

[0017] The conveyor oven may use any type of conveyor. Normally, the conveyor oven will use a closed loop conveyor belt which is driven by a drive motor. Preferably, the drive motor will be speed adjustable and a controller will normally be provided with the oven in order to control the speed of the conveyor belt to adjust the belt speed or time of delivery of cooked food products.

[0018] The conveyor oven of the present invention includes at least one heating module. Any type of heating module may be used. For example, the heating module may be a gas burner or electric heating element may be used or a combination of both. Further, any number or combination of heating modules may be provided.

[0019] The conveyor oven of the present invention includes at least one air blower. Any type of air blower may be used and any number of air blowers may be used.

[0020] The conveyor oven of the present invention includes a number of air fingers to project heated air onto the food product whilst on the conveyor belt. Each air finger will preferably include a manifold, an inner plate and an outer plate. Typically, the inner plate and the outer plate will be mounted relative to the manifold and the manifold will then preferably be mounted relative to an internal surface of the oven within the baking chamber.

[0021] As mentioned, a number of air fingers will typically be provided in the conveyor oven and preferably, a number of upper air fingers are provided and a number of lower air fingers are provided. The upper air fingers will normally direct heated air downwardly on to a food product on top of the conveyor belt and the lower air fingers will normally direct heated air upwardly onto the base of a food product on top of the conveyor belt.

[0022] Normally, the conveyor belt will be a chain-link belt or similar having openings there through in order to allow air to circulate more or less freely within the oven and through the conveyor belt.

[0023] The preferred manifold of each air finger will typically be manufactured from a robust material suitable for use in the food services industry. A particularly preferred material is stainless steel. The size of the manifold will typically be configured according to the size of the oven. However, the air fingers may be provided in different sizes for the same oven and in particular, different width air fingers may be used in order to optimise the cooking of the food product.

[0024] In the context of this specification, the dimension of “width” of the air fingers is used in relation to the dimension of the air finger from the entry side of the oven to the exit side of the oven and the “width” of the oven or the conveyor belt is the lateral dimension of the oven or conveyor belt across which food products may be spaced for travel through the oven.

[0025] The preferred manifold of each of the air fingers is preferably shaped, with the shape being that of a right-angled triangle when viewed from the end of the oven. The manifold of each of the air fingers will typically be substantially rectangular in plan. Each manifold will therefore preferably have a substantially vertical mounting portion at one end of the manifold with a base wall extending substantially perpendicularly to the substantially vertical mounting portion and a pair of sidewalls extending away from the base wall with a free end edge of each of the pair of sidewalls being angled. The free end of the manifold may be defined by the apex between the free end edge of each of the pair of sidewalls and the base wall or may be truncated, preferably substantially perpendicularly with the base wall. The outlet side of the air finger is preferably substantially parallel to the conveyor belt and spaced therefrom.

[0026] The base wall of the manifold will typically be oriented at an angle to and spaced from the conveyor belt, angling toward the conveyor belt from the mounting side.

[0027] The substantially vertical mounting portion provided at one end of the manifold will typically define an open end of the manifold in order to allow hot air to be projected into the manifold. The free end of the manifold will preferably be closed either by a portion of the manifold and/or by one or more portions provided on the inner plate or outer plate of the air finger.

[0028] The base wall and a pair of sidewalls will preferably provide the manifold with a substantially U-shaped configuration. Both the base wall and each of the pair of sidewalls will

preferably be substantially solid and continuous.

[0029] One or more baffles may be provided within the manifold. The baffle(s) may be solid, perforated, partially perforated or absent. Where provided, a baffle may preferably extend from adjacent to the open end of the manifold towards the closed end of the manifold and may extend at any angle relative to the base wall of the manifold.

[0030] As mentioned above, each of the preferred air finger manifolds will typically be mounted to an inside portion of the oven. Each air finger will typically extend substantially across the width of the oven. The air fingers provided will preferably extend from the same side of the oven in order that the at least one blower can be provided on one lateral side of the oven rather than both lateral sides but there may be circumstances where air fingers are provided extending inwardly from both lateral sides of the oven.

[0031] The air fingers provided in the oven may have different configurations and/or sizes. In particular, the width of the air fingers may not all be the same. Generally, the particular configurations of the air fingers provided within the oven will be specifically chosen or determined in order to provide optimal cooking of the food products to be cooked.

[0032] The free end of the preferred manifold may be supported on the opposite side of the manifold from the open end. In particular, a U-shaped bracket or similar may be provided within the baking chamber in order to support the free end of the manifold such that all of the weight is not borne by the mounting of the manifold on one end only of the air finger.

[0033] The preferred inner plate of each of the air fingers will typically mount at least partially within the manifold of a respective air finger. Each of the inner plates of the air fingers will preferably be perforated. The particular size and configuration of the holes formed in the perforation of the inner plates may vary.

[0034] It is particularly preferred that the inner plate of each of the air fingers is substantially planar. Preferably, the inner plate will preferably be positioned relative to the manifold to be substantially parallel to the plane of the upper section of the conveyor belt.

[0035] Each of the preferred inner plates will preferably include at least one end flange, typically at the end of the inner plate adapted to be positioned relative to the free end of the manifold. The at least one end flange will preferably extend to the base wall of the manifold and at least partially close the free end of the manifold.

[0036] At least one side flange is preferably provided on each side edge of the inner plate and will preferably extend away from the base wall of the manifold.

[0037] The preferred outer plate preferably mounts relative to the respective manifold of each air finger over the inner plate. The outer plate will preferably be perforated. The perforations of the outer plate may have the same configuration as the inner plate or an alternate configuration may be used. In particular, the size of the holes and/or the hole configuration in the outer plate may have the same configuration as the inner plate or different hole sizes and/or hole configuration may be used on the outer plate.

[0038] The outer plate will preferably be substantially planar. The outer plate will preferably be positioned relative to the manifold to be substantially parallel to the plane of the upper section of the conveyor belt and to the inner plate.

[0039] Each of the preferred outer plates will preferably include at least one end flange, typically at the end of the outer plate adapted to be positioned relative to the free end of the manifold. The at least one end flange will preferably extend to the base wall of the manifold and at least partially close the free end of the manifold.

[0040] At least one side flange is preferably provided on each side edge of the outer plate and will preferably extend toward the base wall of the manifold.

[0041] Once the preferred outer plate is assembled to the manifold with the inner plate positioned between the outer plate and the manifold, the manifold will preferably be substantially closed except for the perforations in the respective inner plates and outer plates allowing air to be injected into the air finger through the open end of the manifold and to exit the air finger substantially at right angles to the angle of injection, either downwardly or upwardly from the air finger depending upon the position of the air finger within the oven.

[0042] The apparatus of the present invention includes at least one hot air diffuser member positioned between the food product on the conveyor belt and the air fingers allowing increased temperature to be used in the oven and a reduction in cook time. There are a number of possible configurations of hot air diffuser member that could be used in order to provide the advantages of the present invention. In particular, possible configurations include:

- a) a perforated basket or similar to be placed over a food product when on the conveyor belt;
- b) a perforated plate or member inserted between at least some of the air fingers and the

food products when on the conveyor belt; and

- c) a perforated finger cover provided for at least some of the air fingers.

[0043] In the first possible configuration of a perforated basket or similar to be placed over a food product when on the conveyor belt, typically, an individual basket will be provided for each food product. However, this configuration is less preferred as it may cause operational issues in the loading and unloading of the food product from the oven.

[0044] The perforated basket may have any shape or configuration and will typically be sized and shaped according to the food product to be cooked. Generally however the size of the basket will preferably be slightly larger in lateral dimension to the outside lateral dimension of the food product to be cooked. It is preferred that the height of the basket will typically allow for a space between the inside of an upper wall of the basket and the top of the food product even when cooked as well as a space between the upper wall of the basket and the roof lowest portion of the baking chamber.

[0045] The perforated basket of the preferred embodiment will preferably have at least one sidewall terminating at a lower edge which can be rested on the conveyor directly (or a portion of the cooking container for the food product) and at least one upper wall extending substantially transversely to the at least one sidewall across the top of the food product to be cooked. A planar upper wall is preferred.

[0046] The perforated basket may be formed in any way. For example, the perforated basket may be formed from one or more wall members formed from perforated stainless steel plate or alternatively, the wall members may be formed from a woven stainless steel wire. In both cases, the perforated basket will typically include a member or assembly with a number of openings in both the at least one sidewall and the at least one other wall. This will typically act to allow the heated air access to the food product but will typically soften or shield the food product on the conveyor belt from a part of the heated air from the air fingers while still allowing sufficient heat through to achieve complete cooking of the product in a shorter time.

[0047] In the second possible configuration of a perforated plate or member inserted between at least some of the air fingers and the food products went on the conveyor belt, one or more perforated plates may be inserted between the upper air fingers and an upper side of the conveyor belt. Provision of a perforated plate or member in this configuration will typically ease the operational problems caused by providing a perforated basket for each of the food products to be cooked.

[0048] In a preferred embodiment, a substantially unitary, preferably stainless steel perforated plate is installed within the oven space between a lower proximity of the upper air fingers and spaced from an upper side of the conveyor belt. Appropriate supports are preferably provided on each side of the oven cavity to support either side of the perforated plate. The perforated plate may extend over the length (the effective cooking length) of the oven cavity on only a portion thereof. Preferably, the perforated plate will extend across the width of the oven.

[0049] In the third possible configuration of providing a perforated finger cover for at least some of the air fingers, it is preferred that at least some, and preferably all of at least the upper air fingers in the conveyor oven are provided with a perforated finger cover. The perforated finger cover will preferably be attached directly to the manifold of the air finger, preferably outside of the outer plate.

[0050] The perforated finger cover may have any configuration, but will typically be sized and shaped to attach directly to the manifold over the outer plate of the air finger. In some configurations, the perforated finger cover will have a substantially planar wall to be located adjacent to but spaced from the upper surface of the conveyor belt and one or more side flanges extending from, preferably substantially perpendicularly to, the substantially planar wall in order to attach the finger cover relative to the manifold of the air finger.

[0051] Preferably each of the finger covers when properly installed on respective air fingers will be substantially coplanar and spaced from the upper side of the conveyor belt.

[0052] Some or all of the air fingers may be provided with preferred perforated finger covers. In a particularly preferred embodiment, all of the upper fingers are preferably provided with a perforated finger cover.

[0053] Regardless of which of the possible configurations is used, the purpose of the hot air diffuser is to soften the heated air blowing on the food. The hot air diffuser is preferably perforated in that it is provided with a number of openings in the diffuser. The particular shape, configuration and size of the openings provided will normally be chosen according to the particular food product to be cooked. This will typically act to allow the heated air access to the food product but will typically soften or shield the food product on the conveyor belt from a part of the heated air from the air fingers while still allowing sufficient heat through to achieve complete cooking of the product in a shorter time.

[0054] The openings are preferably circular but rectangular openings or capsule-shaped openings could be used. The thickness of the wall of the hot air diffuser which faces the

conveyor belt is typically chosen to reduce weight but also to maintain structural integrity in the heated environment of the oven. Therefore, the thickness of material used will typically be between 11 gauge and ¼ inch.

[0055] The opening size is also important. The opening size may be anywhere from 0.0330 up to 1 inch with opening sizes of between 3 and 10 mm preferred and opening sizes of between 4.8 mm and 9 mm being particularly preferred as this provides an optimum amount of heated air through the diffuser whilst providing sufficient diffusion of the air to soften the hot air on the food product.

[0056] Any opening pattern can be used. For example, the openings provided in different rows may be staggered or straight with staggered being the preferred configuration.

[0057] Another important parameter when choosing the particular shape, configuration and size of the openings in the hot air diffuser is the percentage open area. Normally, the percentage open area will be between 5% and 63% of the area of the wall of the diffuser which is located adjacent to the conveyor belt. Generally, the percentage open area will be between 30% and 55% and particularly preferred is between 37% and 50%. A 45% to 50% open area is the most optimal.

[0058] According to the method of the present invention, the provision of the hot air diffuser allows an operator to increase the temperature of the oven and increase the speed of the conveyor through the oven while still maintaining quality of the cooked product and ensuring that the food product is cooked whilst minimising the chance that any portion of the food product will be overcooked.

[0059] The provision of the diffuser, particularly in relation to the upper air fingers is important to achieving this particular object. The finger covers a particularly preferred as the provision of the finger covers allows the air fingers to be removed with the finger covers in position making maintenance more simple and time effective.

[0060] Without wishing to be limited by theory, the provision of the diffuser not only shields the food product from the increased heat being provided into the oven as a result of the increased setpoint temperature but the diffuser also heats up in order to assist with radiant heat transfer from the solid portions of the diffuser whilst allowing hot air to access the food product through the openings in the diffuser. This provides more than one type of heat transfer to the food product and the provision of the diffuser allows an increase in temperature with a decrease in time of delivery whilst maintaining optimal quality of the cooked food product.

[0061] Any of the features described herein can be combined in any combination with any one or more of the other features described herein within the scope of the invention.

[0062] The reference to any prior art in this specification is not, and should not be taken as an acknowledgement or any form of suggestion that the prior art forms part of the common general knowledge.

BRIEF DESCRIPTION OF DRAWINGS

[0063] Preferred features, embodiments and variations of the invention may be discerned from the following Detailed Description which provides sufficient information for those skilled in the art to perform the invention. The Detailed Description is not to be regarded as limiting the scope of the preceding Summary of the Invention in any way. The Detailed Description will make reference to a number of drawings as follows:

[0064] Figure 1 is a schematic view of a conventional conveyor oven which will also find use in the apparatus of the present invention..

[0065] Figure 2 is a schematic view of a pair of opposed air fingers from a conventional conveyor oven showing the operational principles.

[0066] Figure 3 is an exploded isometric view of a conventional oven finger.

[0067] Figure 4 is an isometric view of a perforated basket according to an embodiment of the present invention.

[0068] Figure 5 is an isometric view of a woven metal basket according to an embodiment of the present invention.

[0069] Figure 6 is an isometric view of an entry end of a conventional conveyor oven and a diffuser member according to an embodiment of the present invention.

[0070] Figure 7 is a detailed isometric view of a diffuser member according to an embodiment of the present invention.

[0071] Figure 8 is a view of an oven finger removed from the oven and with a finger cover diffuser according to an embodiment of the present invention.

[0072] Figure 9 is an end view of the entry end of an oven fitted with the oven finger illustrated in Figure 8 with a finger cover diffuser.

[0073] Figure 10 is a side view of an interior portion of an oven showing a pair of upper air fingers each fitted with a finger cover diffuser.

DESCRIPTION OF EMBODIMENTS

[0074] According to a particularly preferred embodiment of the present invention, an apparatus for reducing cooking time is provided.

[0075] The apparatus of the preferred embodiment includes a conveyor oven 10 with a driven conveyor belt 11 to move food products 14 through the conveyor oven 10.

[0076] The oven illustrated in Figure 1 is a Middleby Marshall PS640 Series Oven. This top of oven includes a conveyor drive motor 18 which is responsible for driving the conveyor belt. The conveyor belt 11 has a crumb pan 19 located beneath the entry and exit site of the conveyor belt 11 in order to catch crumbs and other materials to drop through the conveyor belt. Located above the conveyor belt at both the entry and exit and is an end plug 20 which allows access to the ovens interior. The end plug is associated with an eyebrow 21 at either end which when removed and together with the end plug provides the access to the interior of the oven. The eyebrow 21 can also be adjusted to various heights to partially control heat loss into the environment.

[0077] A window 22 is provided approximately centrally along the length of the oven and this can be opened to allow an operator to access food products inside the baking chamber. The view provided in Figure 9 is taken through the window 22.

[0078] The controls for the oven provided in the housing 23 with an access panel. This allows access to the ovens interior and control components. The access panel is typically provided with a serial plate 24 providing specifications for the oven that affect installation and operation. A control panel 25 is provided for the operating controls of the oven. A photocell 26 is provided which turns the oven on when the beam is interrupted.

[0079] Not shown or obscured by the oven housing in Figure 1 is a gas burner, a number of air blowers, and a number of air fingers to project heated air onto the food product whilst on the conveyor belt. Generally, the air blowers will deliver hot air from the gas burner to the number of air fingers in order to deliver the heated air to the food product on the conveyor belt.

[0080] The conveyor oven may use any type of conveyor. Normally, the conveyor oven will use a closed loop conveyor belt 11 as seen in Figures 4, 5 and 8 in particular. The drive motor 18

is speed adjustable and a controller will normally be provided with the oven in order to control the speed of the conveyor belt 11.

[0081] Any type of heating module may be used. For example, the heating module may be a gas burner or electric heating element may be used or a combination of both. Further, any number of heating modules may be provided.

[0082] The conveyor oven of the present invention includes at least one air blower. Any type of air blower may be used in any number of air blowers may be used.

[0083] The conveyor oven 10 of the present invention includes a number of air fingers 12 such as those illustrated in Figures 3 and 3 to project heated air onto the food product whilst on the conveyor belt 11. Each air finger 12 of the preferred embodiment includes a manifold 15, an inner plate 16 and an outer plate 17. Typically, the inner plate 16 and the outer plate 17 will be mounted relative to the manifold 15 and the manifold 15 will then normally be mounted relative to an internal surface of the oven 10 within the baking chamber.

[0084] As mentioned, a number of air fingers will typically be provided in the conveyor oven and preferably, a number of upper air fingers are provided in a number of lower air fingers are provided. The upper air fingers will normally direct heated air downwardly on to a food product on top of the conveyor belt and the lower air fingers will normally direct heated air upwardly onto the base of a food product on top of the conveyor belt. Normally, the conveyor belt will be a chain-link belt or similar having openings there through in order to allow air to circulate more or less freely within the oven.

[0085] As illustrated in Figure 3, the manifold 15 of each air finger 12 is manufactured from a robust material suitable for use in the food services industry. A particularly preferred material is stainless steel. The size of the manifold 15 will typically be configured according to the size of the oven.

[0086] As illustrated, the preferred manifold 15 of each of the air fingers 12 is preferably shaped, with the shape being that of a right-angled triangle when viewed from the end of the oven. The manifold 15 of each of the air fingers will typically be substantially rectangular in plan. Each manifold 15 will therefore have a substantially vertical mounting portion 28 at one end of the manifold 15 with a base wall 27 extending substantially perpendicularly to the substantially vertical mounting portion 28 and a pair of sidewalls 29 extending away from the base wall 27 with a free end edge of each of the pair of sidewalls 29 being angled. The free end of the manifold may be defined by the apex between the free end edge of each of the pair of

sidewalls and the base wall or may be truncated, preferably substantially perpendicularly with the base wall.

[0087] The base wall 27 will typically be oriented at an angle to the conveyor belt and spaced from the conveyor belt 11.

[0088] The substantially vertical mounting portion 28 provided at one end of the manifold 15 will typically define an opening 30 of the manifold 15 in order to allow hot air to be projected into the manifold 15. The free end of the manifold 15 will preferably be closed either by a portion of the manifold 15 and/or by one or more portions provided on the inner plate 16 or outer plate 17 of the air finger 12.

[0089] The base wall 27 and a pair of sidewalls 29 will preferably provide the manifold 15 with a substantially U-shaped configuration. Both the base wall 27 and each of the pair of sidewalls 29 will preferably be substantially solid and continuous.

[0090] One or more baffles 31 may be provided within the manifold. The baffle 31 may be solid, perforated, partially perforated or absent. Where provided, such as in Figure 3, a baffle 31 may extend from adjacent to the open end of the manifold 15 towards the closed end of the manifold and may extend at any angle relative to the base wall 27 of the manifold 15.

[0091] As mentioned above, each of the preferred air finger manifolds 15 will typically be mounted to an inside portion of the oven. Each air finger 12 will typically extend substantially across the width of the oven. The air fingers 12 provided will preferably extend from the same side of the oven in order that the blowers can be provided on one side of the oven rather than both sides but there may be circumstances where air fingers 12 are provided from both sides of the oven.

[0092] The air fingers 12 provided in the oven may have different configurations and/or sizes. In particular, the width of the air fingers may not all be the same. Generally, the particular configurations of the air fingers 12 provided within the oven will be specifically chosen or determined in order to provide optimal cooking of the food products to be cooked.

[0093] The free end of the preferred manifold 15 may be supported on the opposite side of the manifold from the open end. In particular, a U-shaped bracket or similar may be provided within the oven space in order to support the free end of the manifold such that all of the weight is not born by the mounting of the manifold on one end only of the air finger.

[0094] The preferred inner plate 16 of each of the air fingers 12 will typically mount at least partially within the manifold 15 of a respective air finger 12. Each of the inner plates 16 of the air fingers 15 will preferably be perforated. The particular size and configuration of the holes formed in the perforation of the inner plates 16 may vary.

[0095] It is particularly preferred that the inner plate 16 of each of the air fingers 12 is substantially planar. Preferably, the inner plate 15 will preferably be positioned relative to the manifold 15 to be substantially parallel to the plane of the upper section of the conveyor belt 11 upon which the food products are placed.

[0096] Each of the preferred inner plates 16 preferably include an end flange 32, typically at the end of the inner plate 16 adapted to be positioned relative to the free end of the manifold 15. The end flange 32 will preferably extend to the base wall 27 of the manifold 15 and at least partially close the free end of the manifold 15.

[0097] A side flange 33 is provided on each side edge of the inner plate 15 and extends away from the base wall 27 of the manifold.

[0098] The preferred outer plate 17 preferably mounts relative to the respective manifold 15 of each air finger 12 over the inner plate 16. The outer plate 17 will preferably be perforated. The perforations of the outer plate 17 may have the same configuration as the inner plate 16 or an alternate configuration may be used. In particular, the size of the holes and/or the hole configuration in the outer plate 17 may have the same configuration as the inner plate 16 or different hole sizes and/or hole configuration may be used on the outer plate 17.

[0099] The outer plate 17 will preferably be substantially planar. The outer plate 17 will preferably be positioned relative to the manifold 15 to be substantially parallel to the plane of the upper section of the conveyor belt 11 upon which the food products are placed.

[00100] Each of the preferred outer plates 17 include an end flange 34, typically at the end of the outer plate 17 adapted to be positioned relative to the free end of the manifold 15. The end flange 34 will preferably extend to the base wall 27 of the manifold 15 and at least partially close the free end of the manifold 15.

[00101] A side flange 35 is preferably provided on each side edge of the outer plate 17 and will preferably extend toward the base wall 27 of the manifold 15.

[00102] Once the preferred outer plate 17 is assembled to the manifold 15 with the inner plate

16 positioned between the outer plate 17 and the manifold 15, the manifold 15 will preferably be substantially closed except for the perforations in the respective inner plates 16 and outer plates 17 allowing air to be injected into the air finger 12 through the open end of the manifold 15 and to exit the air finger 12 substantially right angles to the angle of injection, either downwardly or upwardly from the air finger 12 depending upon the position of the air finger 12 within the oven as illustrated in Figure 2.

[00103] The apparatus of the present invention includes at least one hot air diffuser member positioned between the food product on the conveyor belt and the air fingers allowing increased temperature to be used in the oven and a reduction in cook time. There are a number of possible configurations of hot air diffuser member that could be used in order to provide the advantages of the present invention. In particular, possible configurations include

- a) a perforated basket or similar to be placed over a food product when on the conveyor belt, examples of which are illustrated in Figures 4 and 5;
- b) a perforated plate or member inserted between at least some of the air fingers and the food products when on the conveyor belt such as that illustrated in Figures 6 and 7; and
- c) a perforated finger cover provided for at least some of the air fingers, such as that illustrated in Figure 8 to 10.

[0100] In the first possible configuration of a perforated basket 36 or similar to be placed over a food product when on the conveyor belt 11, typically, an individual basket 36 will be provided for each food product. This may cause operational issues in the loading and unloading the food product.

[0101] The perforated basket 36 may have any shape or configuration and will typically be sized and shaped according to the food product to be cooked. Generally however the size of the basket will preferably be slightly larger in lateral dimension to the outside lateral dimension of the food product to be cooked. It is preferred that the height of the basket will typically allow for space between the inside of an upper wall of the basket 36 and the top of the food product even when cooked but still have the upper side of the basket spaced from the air fingers of the oven.

[0102] The perforated basket illustrated in Figures 4 and 5 have a sidewall terminating at a lower edge which can be rested on the conveyor belt 11 directly (or a portion of the cooking container for the food product) and an upper wall extending substantially transversely to the sidewall across the top of the food product to be cooked.

[0103] The perforated basket 36 may be formed in any way. For example, the perforated

basket may be formed from one or more wall members which are formed from perforated stainless steel plate, such as that illustrated in Figure 4 or alternatively, the wall members may be formed from a woven stainless steel wire as that illustrated in Figure 5. In both cases, the perforated basket will typically include a member or assembly with a number of openings in both the at least one sidewall and the at least one upper wall. This will typically act to allow the heated air access to the food product but will typically soften or shield the food product on the conveyor belt from a part of the heat from the air fingers while still allowing sufficient heated air through to achieve complete cooking of the product in a shorter time.

[0104] In the second possible configuration of a perforated plate or member 37 inserted between at least some of the air fingers and the food products went on the conveyor belt, one or more perforated plates 37 may be inserted between the upper air fingers and an upper side of the conveyor belt 11. The perforated plate 37 is illustrated in Figures 6 and 7 but out of position in order to illustrate the plate 37. Provision of a perforated plate or member in this configuration will typically ease the operational problems caused by providing a perforated basket for each of the food products to be cooked.

[0105] In a preferred embodiment, a substantially unitary, preferably stainless steel perforated plate 37 is installed within the oven space between a lower proximity of the upper air fingers and spaced from an upper side of the conveyor belt 11. Appropriate supports are preferably provided on each side of the oven cavity to support either side of the perforated plate. The perforated plate may extend over the length (the effective cooking length) of the oven cavity already a portion thereof. Preferably, the perforated plate 37 will extend across the width of the oven.

[0106] In the third possible configuration of providing a perforated finger cover 38 for at least some of the air fingers, it is preferred that at least some, and preferably all of at least the upper air fingers in the conveyor oven are provided with a perforated finger cover 38. The perforated finger cover 38 will preferably be attached directly to the manifold 15 of the air finger 12, preferably outside of the outer plate 17 as illustrated in Figure 8.

[0107] The perforated finger cover 38 may have any configuration, but will typically be sized and shaped to attach directly to the manifold 15 over the outer plate 17 of the air finger 12. In some configurations, the perforated finger cover 38 will have a substantially planar wall 40 to be located adjacent to but spaced from the upper surface of the conveyor belt 11 and one or more side flanges 39 extending, preferably substantially perpendicularly to the substantially planar wall 40 in order to attach the finger cover 38 relative to the manifold 15 of the air finger 12.

[0108] Preferably each of the finger covers 38 when properly installed on respective air fingers 12 will be substantially coplanar and spaced from the upper side of the conveyor belt 11.

[0109] Some or all of the air fingers may be provided with preferred perforated finger covers. In a particularly preferred embodiment, all of the upper fingers are preferably provided with a perforated finger cover.

[0110] Regardless of which of the possible configurations is used, the purpose of the hot air diffuser is to soften the heated air blowing on the food. The hot air diffuser is preferably perforated in that it is provided with a number of openings in the diffuser. The particular shape, configuration and size of the openings provided will normally be chosen according to the particular food product to be cooked.

[0111] The openings are preferably circular but rectangular openings or capsule-shaped openings could be used. The thickness of the wall of the hot air diffuser which faces the conveyor belt is typically chosen to reduce weight but also to maintain structural integrity in the heated environment of the oven. Therefore, the thickness of material used will typically be between 11 gauge and ¼ inch.

[0112] The opening size is also important. The opening size may be anywhere from 0.0330 up to 1 inch with opening sizes of between 3 and 10 mm preferred and opening sizes of between 4.8 mm and 9 mm being particularly preferred as this provides an optimum amount of heated air through the diffuser whilst providing sufficient diffusion of the air to soften the hot air on the food product.

[0113] Any opening pattern can be used. For example, the openings provided in different rows may be staggered or straight with staggered being the preferred configuration.

[0114] Another important parameter when choosing the particular shape, configuration and size of the openings in the hot air diffuser is the percentage open area. Normally, the percentage open area will be between 5% and 63% of the area of the wall of the diffuser which is located adjacent to the conveyor belt. Generally, the percentage open area will be between 30% and 55% and particularly preferred is between 37% and 50%. A 45% to 50% open area is the most optimal.

[0115] According to the method of the present invention, the provision of the hot air diffuser allows an operator to increase the temperature of the oven and increase the speed of the conveyor through the oven while still maintaining quality of the cooked product and ensuring that the food

product is cooked whilst minimising the chance that any portion of the food product will be overcooked.

[0116] The provision of the diffuser, particularly in relation to the upper air fingers is important to achieving this particular object. The finger covers are particularly preferred as the provision of the finger covers allows the air fingers to be removed from the oven with the finger covers in position making maintenance more simple and time effective.

[0117] Without wishing to be limited by theory, the provision of the diffuser not only shields the food product from the increased heat being provided into the oven as a result of the increased setpoint temperature but the diffuser also heats up in order to assist with radiant heat transfer from the solid portions of the diffuser whilst allowing hot air to access the food product through the openings in the diffuser. This provides more than one type of heat transfer to the food product and the provision of the diffuser allows an increase in temperature with a decrease in time of delivery whilst maintaining optimal quality of the cooked food product.

[0118] In the present specification and claims (if any), the word ‘comprising’ and its derivatives including ‘comprises’ and ‘comprise’ include each of the stated integers but does not exclude the inclusion of one or more further integers.

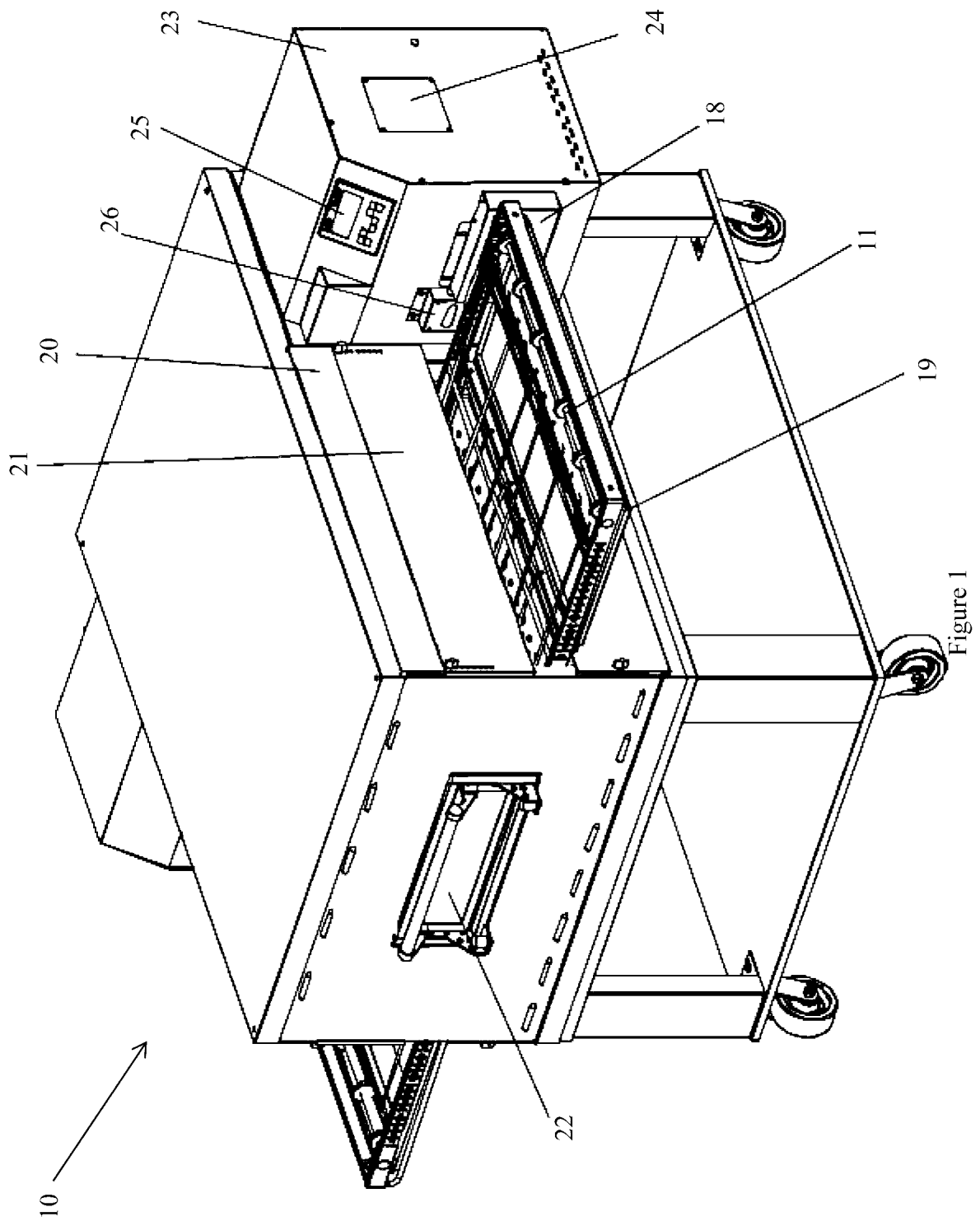
[0119] Reference throughout this specification to ‘one embodiment’ or ‘an embodiment’ means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the appearance of the phrases ‘in one embodiment’ or ‘in an embodiment’ in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more combinations.

CLAIMS

1. An apparatus for reducing cooking time, the apparatus including a conveyor oven with a driven conveyor belt to move food products through the conveyor oven, at least one heating module, at least one air blower, a number of air fingers to project heated air onto the food product whilst on the conveyor belt and at least one hot air diffuser member positioned between the food product on the conveyor belt and the air fingers allowing increased temperature to be used in the oven and a reduction in cook time.
2. An apparatus for reducing cooking time as claimed in claim 1 wherein each air finger includes a manifold, an inner plate and an outer plate.
3. An apparatus for reducing cooking time as claimed in claim 1 or claim 2 wherein a perforated basket is placed over a food product when on the conveyor belt between the air fingers and the food product.
4. An apparatus for reducing cooking time as claimed in claim 3 wherein a perforated basket is provided for each food product.
5. An apparatus for reducing cooking time as claimed in claim 3 or claim 4 wherein the perforated basket includes at least one sidewall terminating at a lower edge to be rested on the conveyor directly and at least one upper wall extending substantially transversely to the at least one sidewall across the top of the food product to be cooked.
6. An apparatus for reducing cooking time as claimed in any one of claims 3 to 5 wherein the perforated basket is formed from perforated stainless steel plate.
7. An apparatus for reducing cooking time as claimed in claim 1 or claim 2 wherein a perforated plate or member is inserted between at least some of the air fingers and the food product when on the conveyor belt.
8. An apparatus for reducing cooking time as claimed in claim 7 wherein one or more perforated plates are inserted between the air fingers on an upper side of the conveyor and an upper side of the conveyor belt.
9. An apparatus for reducing cooking time as claimed in claim 7 or claim 8 wherein a substantially unitary perforated plate is installed within an oven space between a lower proximity of the air fingers on an upper side of the conveyor and spaced from an upper side of the conveyor belt.
10. An apparatus for reducing cooking time as claimed in claim 9 wherein at least one support is provided on each side of the oven space to support either side of the perforated plate.
11. An apparatus for reducing cooking time as claimed in claim 9 or claim 10 wherein the perforated plate extends over an effective cooking length of the oven space and across the

width of the oven.

12. An apparatus for reducing cooking time as claimed in claim 1 or claim 2 wherein a perforated finger cover is provided for at least some of the air fingers located between at least some of the air fingers and the food product.
13. An apparatus for reducing cooking time as claimed in claim 12 wherein each of at least the upper air fingers in the conveyor oven are provided with a perforated finger cover.
14. An apparatus for reducing cooking time as claimed in claim 13 wherein the perforated finger cover is attached directly to the air finger.
15. An apparatus for reducing cooking time as claimed in claim 13 or claim 14 wherein each of the finger covers, when properly installed on respective air fingers, have a lower surface which is substantially coplanar and spaced from an upper side of the conveyor belt.
16. An apparatus for reducing cooking time as claimed in any one of the preceding claims wherein the hot air diffuser is perforated in that it is provided with a number of openings to allow the heated air access to the food product but to soften or shield the food product on the conveyor belt from a part of the heated air from the air fingers while still allowing sufficient heat through to achieve complete cooking of the product in a shorter time.
17. An apparatus for reducing cooking time as claimed in any one of the preceding claims wherein the hot air diffuser has a number of openings each between 4.8 mm and 9 mm in dimension.
18. An apparatus for reducing cooking time as claimed in any one of the preceding claims wherein the hot air diffuser has a open area of between 45% to 50% of a lower surface.
19. A method for reducing cooking time, the method including providing a conveyor oven with a driven conveyor belt to move food products through the conveyor oven, at least one heating module, at least one air blower, a number of air fingers to project heated air onto the food product whilst on the conveyor belt and at least one hot air diffuser member positioned between the food product on the conveyor belt and the air fingers, and increasing the air temperature within the oven to above 500°F and increasing the speed of the conveyor belt to achieve a time of delivery of the food product through the conveyor oven of approximately 3 minutes.
20. A hot air diffuser member or assembly for a hot air conveyer oven utilising at least one air finger, the hot air diffuser member or assembly including an air finger cover positioned at least partially over at least one air finger allowing increased temperature to be used in the oven and a reduction in cook time



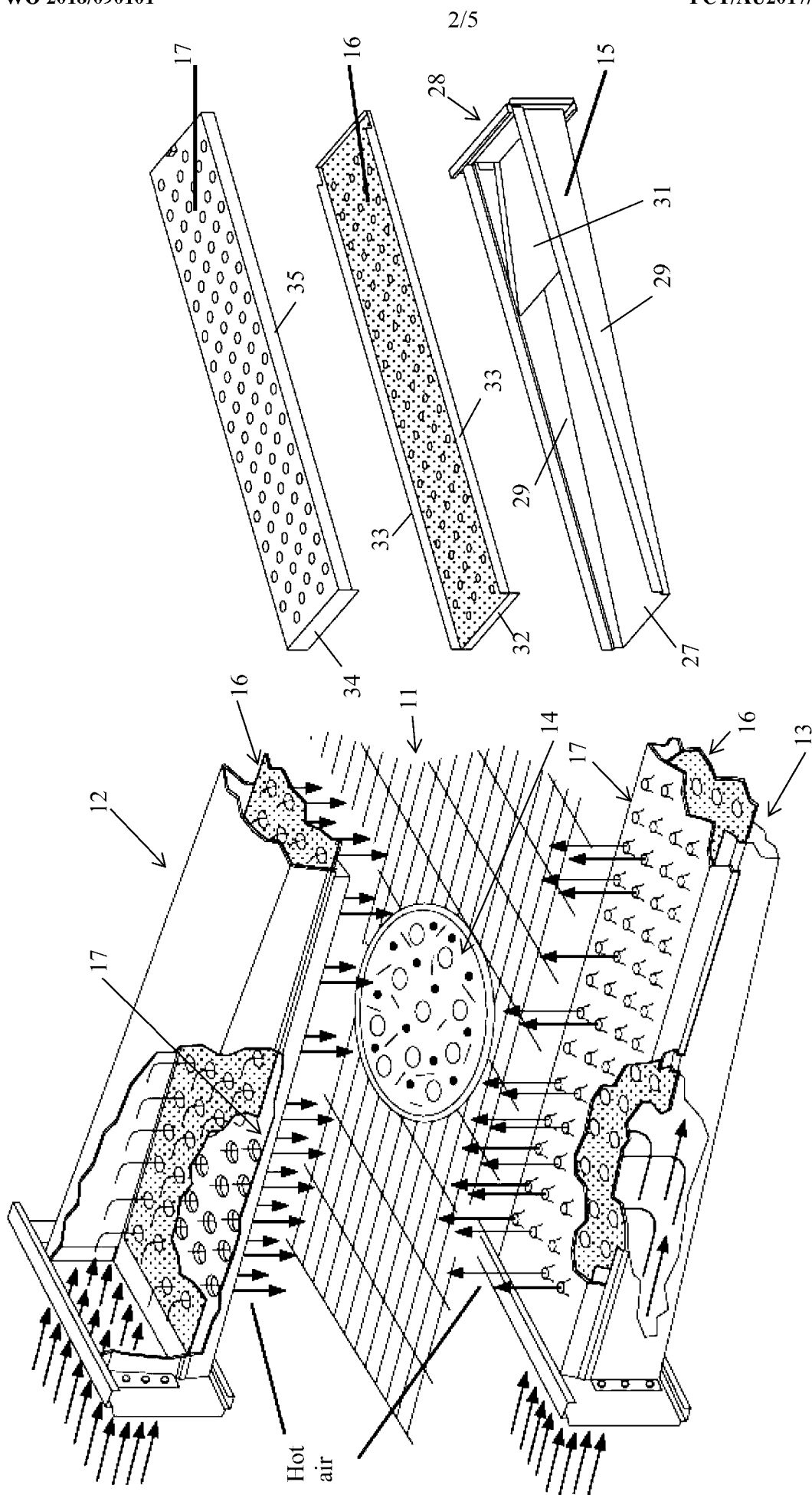


Figure 3

Figure 2

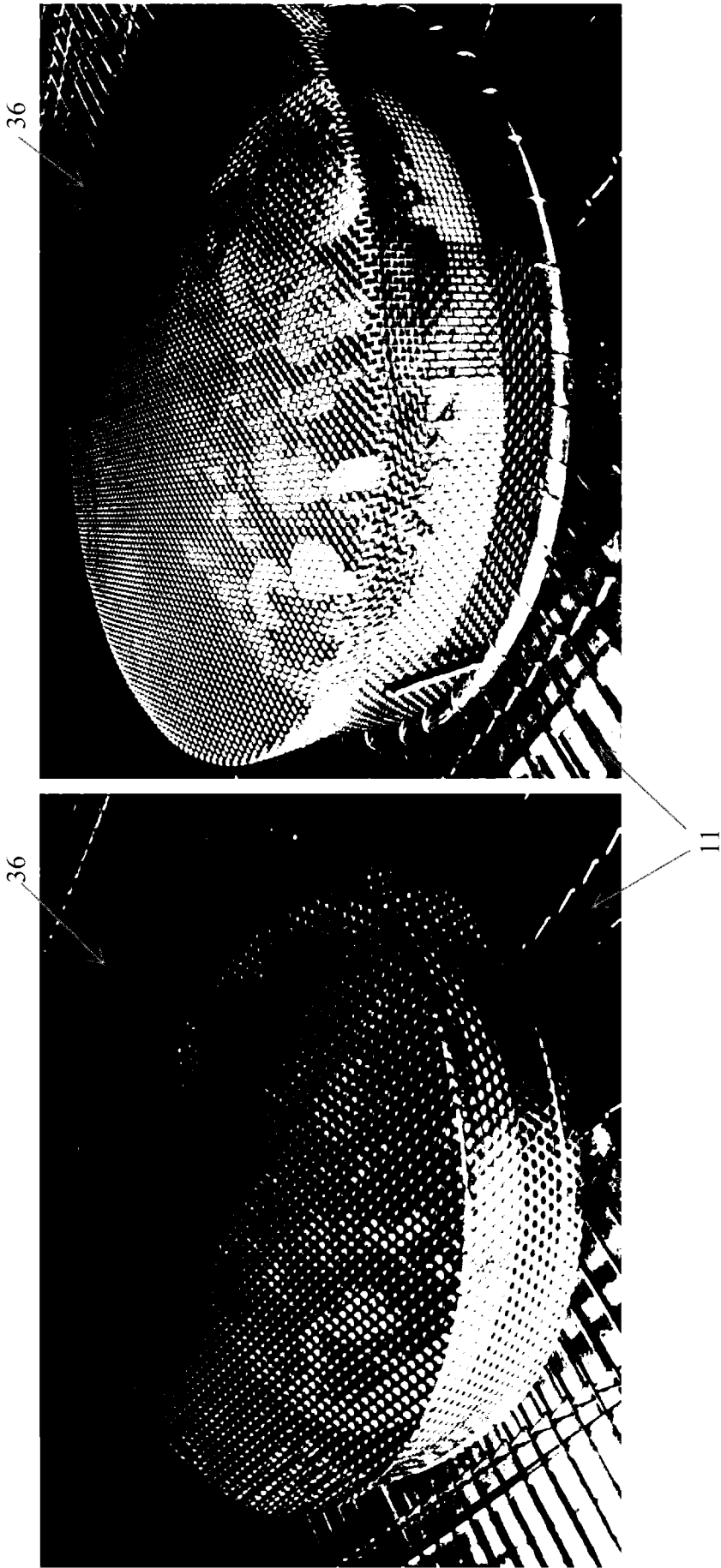
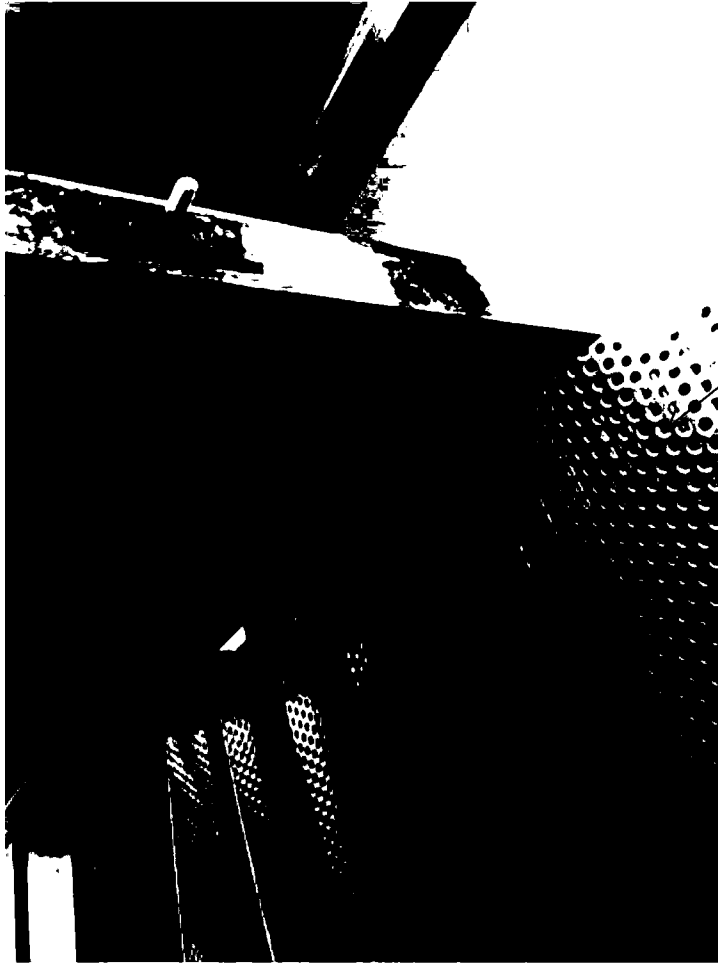


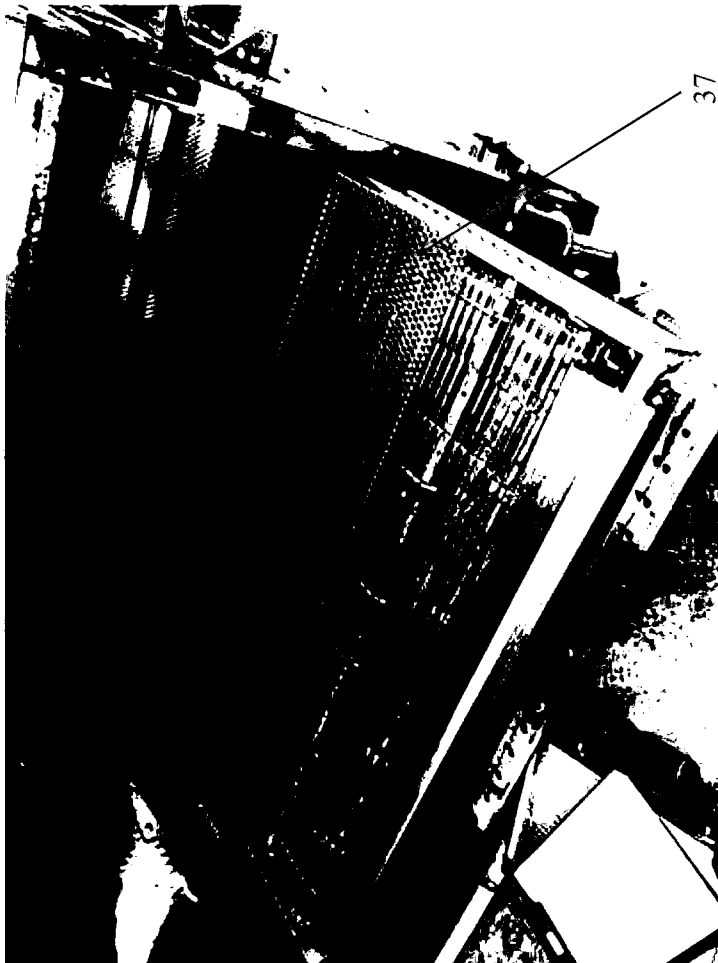
Figure 5

Figure 4



37

Figure 7



37

Figure 6



38

38

Figure 10

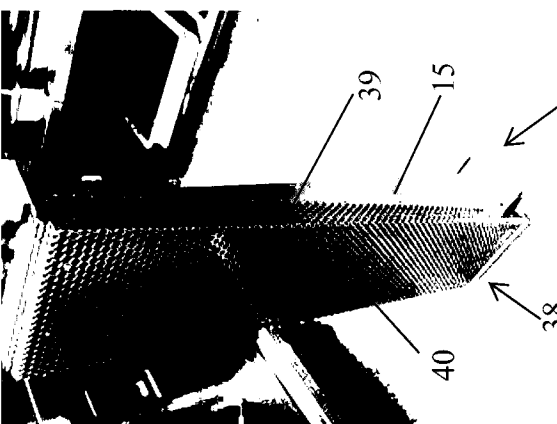


11

21

38

Figure 9



12

38

40

39

15

Figure 8

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/AU2017/051272

A. CLASSIFICATION OF SUBJECT MATTER

A21B 1/26 (2006.01) A21B 1/48 (2006.01)

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

B. FIELDS SEARCHED

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 practicable, search terms used)

Database: PATENW IPC/CPC symbol:A21B1/24/LOW, A21B1/48/LOW, A23L5/17/LOW, A21B1/40/LOW, F24C3/128, F24C15/32/LOW, F24C15/08, F24C15/12, B65D81/343, A47J39/003, A21B1. keywords: PAN, COVER, FINGER, PLATE, COVER, PIZZA and similar terms. Google Patents and Espacenet search: IPC/CPC symbols: A21B1, A23L5, F24C3, F24C15, B65D81/343, A23L3/04, A47J39/003 and keywords: conveyor, food, oven, heat, blower, finger, diffuser, increase temperature, reduce time, perforated plate, cover, finger cover, speed, belt, conveyor, belt and similar terms. Google search: keywords: conveyor, food, oven, heat, blower, finger, diffuser, increase temperature, reduce time, perforated plate, cover, finger cover, speed, belt and similar terms. Applicant & Inventor search done in AUSPAT, EPOQUE and IP Australia's internal database.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"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
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 2 March 2018		Date of mailing of the international search report 02 March 2018	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au		Authorised officer Ashish Tayshetye AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262832535	

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2017/051272
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5454295 A (COX et al.) 03 October 1995 Abstract, Figure 1-4 and 9-10, column 1 lines 50 - column 2 line 37, column 4 line 55 - column 8 line 45, Examples, Table1	1 - 20
X	US 2008/0087175 A1 (HENKE et al.) 17 April 2008 Abstract, Figures 1 - 5, [0013] - [0015], [0031] - [0038], [0042]- [0045]	1-2, 7- 9, 12- 16 and 19 - 20
A	WO 2004/014139 A2 (GLOBAL APPLIANCE TECHNOLOGIES, INC.) 19 February 2004 Whole Document	

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2017/051272	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
US 5454295 A	03 October 1995	US 5454295 A	03 Oct 1995
		AU 3436289 A	05 Oct 1989
		EP 0366738 A1	09 May 1990
		JP H02503386 A	18 Oct 1990
		WO 8908402 A1	21 Sep 1989
US 2008/0087175 A1	17 April 2008	US 2008087175 A1	17 Apr 2008
		US 9089142 B2	28 Jul 2015
		AU 2007313345 A1	24 Apr 2008
		AU 2007313345 B2	08 Dec 2011
		CA 2665822 A1	24 Apr 2008
		CN 101589283 A	25 Nov 2009
		CN 101589283 B	16 Nov 2011
		EP 2074369 A2	01 Jul 2009
		EP 2074369 B1	23 Dec 2015
		HK 1135171 A1	07 Sep 2012
		JP 2010506565 A	04 Mar 2010
		KR 20090067206 A	24 Jun 2009
		SG 175613 A1	28 Nov 2011
		WO 2008048497 A2	24 Apr 2008
		ZA 200902418 B	28 Jul 2010
WO 2004/014139 A2	19 February 2004	WO 2004014139 A2	19 Feb 2004
		WO 2004014139 B1	07 Oct 2004
		AU 2003274896 A1	25 Feb 2004
		AU 2003274896 A2	25 Feb 2004
		AU 2003274896 B2	05 Feb 2009
		AU 2004285500 A1	12 May 2005
		AU 2004285500 B2	30 Oct 2008
		AU 2005220809 A1	22 Sep 2005
		AU 2005294523 A1	20 Apr 2006
		AU 2006223084 A1	21 Sep 2006
		BR PI0309916 A2	11 Oct 2016
		BR PI0415705 A	19 Dec 2006
		BR PI0508492 A	31 Jul 2007
		BR PI0516534 A	09 Sep 2008
		BR PI0608640 A2	19 Jan 2010
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			
Form PCT/ISA/210 (Family Annex)(July 2009)			

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2017/051272	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
		CA 2543060 A1	12 May 2005
		CA 2558409 A1	22 Sep 2005
		CA 2583001 A1	20 Apr 2006
		CA 2601091 A1	21 Sep 2006
		CN 1666067 A	07 Sep 2005
		CN 1871875 A	29 Nov 2006
		CN 1968609 A	23 May 2007
		CN 101036025 A	12 Sep 2007
		CN 101036025 B	23 Jun 2010
		CN 101142448 A	12 Mar 2008
		EP 1534999 A2	01 Jun 2005
		EP 1534999 B1	01 Nov 2017
		EP 1676465 A2	05 Jul 2006
		EP 1676465 B1	29 Sep 2010
		EP 1729583 A1	13 Dec 2006
		EP 1797372 A1	20 Jun 2007
		EP 1797372 B1	22 Nov 2017
		EP 1866573 A1	19 Dec 2007
		EP 2208254 A1	21 Jul 2010
		EP 2208254 B1	11 May 2016
		JP 2007527299 A	27 Sep 2007
		JP 2008538807 A	06 Nov 2008
		KR 20070034452 A	28 Mar 2007
		KR 20070120529 A	24 Dec 2007
		MX PA05000300 A	19 Aug 2005
		MX PA06004385 A	26 Jan 2007
		MX PA06010098 A	25 Apr 2007
		MX 2007004152 A	15 Jun 2007
		MX 2007011209 A	17 Oct 2007
		US 2004123858 A1	01 Jul 2004
		US 6874495 B2	05 Apr 2005
		US 2004118392 A1	24 Jun 2004
		US 7055518 B2	06 Jun 2006
		US 2005217503 A1	06 Oct 2005
		US 7360533 B2	22 Apr 2008
		US 2007194011 A1	23 Aug 2007
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2017/051272	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
		US 7507938 B2	24 Mar 2009
		US 2004211765 A1	28 Oct 2004
		US 7836874 B2	23 Nov 2010
		US 2006169272 A1	03 Aug 2006
		US 7836875 B2	23 Nov 2010
		US 2008105133 A1	08 May 2008
		US 7886658 B2	15 Feb 2011
		US 2008105136 A1	08 May 2008
		US 7946224 B2	24 May 2011
		US 2008099008 A1	01 May 2008
		US 8006685 B2	30 Aug 2011
		US 2008105135 A1	08 May 2008
		US 8011293 B2	06 Sep 2011
		US 2008296284 A1	04 Dec 2008
		US 8035062 B2	11 Oct 2011
		US 2004216732 A1	04 Nov 2004
		US 8297270 B2	30 Oct 2012
		US 2008106483 A1	08 May 2008
		US 8658953 B2	25 Feb 2014
		US 2013004630 A1	03 Jan 2013
		US 8893705 B2	25 Nov 2014
		US 2008206420 A1	28 Aug 2008
		US 9351495 B2	31 May 2016
		US 2007137633 A1	21 Jun 2007
		US 2008105249 A1	08 May 2008
		WO 2005041672 A2	12 May 2005
		WO 2005087009 A1	22 Sep 2005
		WO 2006041814 A1	20 Apr 2006
		WO 2006099394 A1	21 Sep 2006
		WO 2009058934 A1	07 May 2009
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			