

FRYING APPARATUS AND PROCESS

The present invention relates to a frying apparatus and process.

5 The usual frying methods nowadays are deep fat frying, belt frying (on a teflon or steel belt) and drum frying. The frying of spherical pieces or mixtures of different ingredients is mostly effected by deep fat frying which is
10 not only undesirable from a health point of view but also imparts an oil-like taste to the product.

The frying of meatballs may be carried out in a drum fryer. but this method suffers from the disadvantage of overheated
15 oil occurring at those parts of the drum not covered by the product. For frying a product consisting of different ingredients which require different frying times, it is difficult to add the new ingredients during the frying and although it is possible to use two or more fryers, this
20 adds to the costs and it is also necessary to provide separate mixers between the fryers.

We have devised an apparatus for solving the above problems wherein the product may be fried and mixed simultaneously,
25 new ingredients may be added during frying and overheated frying oil is not formed.

According to the present invention there is provided a fryer comprising

30 a tray for containing a frying oil on its surface and a product to be surface fried, means for conveying and mixing the product horizontally from an inlet position to an outlet position and simultaneously cleaning the frying
35 surface of the tray,

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means for heating the frying oil, and means for controlling the period of time during which the product contacts the frying oil in order to obtain a fried surface of the product.

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The tray may be made of any material suitable for a frying process e.g. a metal such as steel. It is preferably elongated in shape and may be in the form of a shallow trough the frying surface of which is concave in cross section. Preferably, the tray is adapted to remain stationary or substantially stationary during frying of the product.

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The means for rotating the shaft may be provided by a drive motor attached to one end of the shaft.

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The means for heating the frying oil may be achieved by the provision of a double wall in the tray through which hot oil flows. The hot oil may be heated either by a heat exchanger connected to steam under pressure, e.g. 20 bars or directly from an oil burner. Preferably, the double wall does not extend above the level of the product within the tray in order to protect the frying oil from overheating on the surface of the tray which would not be covered by the product.

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One means for conveying and mixing the product may be, for example, provided by a shaft fitted with angled paddles in a helical arrangement extending from an inlet end to an outlet end within the tray and adapted to rotate so that their edges contact and scrape the frying surface of the tray. The paddles are advantageously slightly curved so that their edges which contact the frying surface of the tray will transport the product and clean the frying surface of the tray by scraping. The rotation of the shaft forces the product from the inlet position to the outlet

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position and also enables mixing of the product by the action of the paddles. In addition, the scraping action of the edges of the paddles on the frying surface of the tray enables the frying surface to remain clean.

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The means for controlling the period of time during which the product remains in contact with the frying oil in order to achieve a fried surface of the product may be provided by a discontinuous movement of the rotation of the shaft.

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The discontinuous movement may be achieved, for instance, by a computer connected to the drive motor and may be

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adjusted according to the nature of the product to be fried. The discontinuous rotation helps to achieve a fried surface on the product. The speed of the rotation is not critical but may be chosen according to the mixing capacity and/or the fragility of the product and may be, for instance, from 5 to 100 and preferably from 10 to 50 RPM.

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The duration of each period of discontinuous rotation of the shaft is not critical but is usually from 5 to 60 seconds, e.g. from 10 to 40 seconds. Each period of rotation may be separated by a period of from 10 seconds to 5 minutes, preferably from 30 seconds to 3 minutes during which time the shaft is stationary.

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An alternative means for conveying and mixing the product may be provided by a central axle adapted to rotate extending horizontally from an inlet end to an outlet end fitted with a plurality of plates or wings projecting substantially perpendicularly from the central axle and

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positioned at an angle in the perpendicular plane so that on rotation of the central axle, the movement of a plate or wing transports the product a certain distance

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corresponding to the width of the angle. The alternative means may also comprise a scraper to clean the frying surface, a mixing plate to lift and turn the product while rotating and a level out system, such as an articulated

level out system positioned on the opposite side of the axle to the plates or wings, to maintain a desired thickness of the product layer on the frying surface of the tray. In this embodiment, the tray preferably consists of two double jacketed tubs in two levels, preferably tightly mounted to each other, each tub being separately heated with thermal oil. The downstream tub is preferably at a lower level to the upstream tub. The central axles in each tub are adapted to rotate clockwise and anti-clockwise and are separately driven, e.g. by two computer controlled servo-motors. Advantageously, the plates or wings in the downstream tub are mounted at a narrower angle in the perpendicular plane than the plates or wings in the upstream tub and therefore one rotation of the central axle transports the product less distance in the downstream tub than in the upstream tub. This arrangement in the downstream tub therefore requires more turns than the arrangement in the upstream tub to transport the food product a specified distance in the tray, e.g. 1.5 to 2.5 turns and preferably 1.75 to 2.25 turns of the central axle in the downstream tub are required to transport the product the same distance as one turn of the central axle in the upstream tub. The reason why the tray is divided into two parts with the plates or wings in the downstream tub mounted at a narrower angle than those in the upstream tub is because it is necessary that the product lies still on the frying surface of the tray for specified periods during frying in order to achieve an attractive browning. During frying the product becomes hotter and therefore the resting time on the frying surface of the tray should preferably be shorter in order to avoid burned and/or destroyed portions.

The plates or wings are each conveniently segments of an ellipsoid plane section, preferably from $1/5$ to $1/2$ and more preferably from $2/9$ to $4/9$ of the ellipsoid plane section.

The plates or wings are preferably connected to one another by means of one or more connecting rods or stay tubes to give stability.

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The present invention also provides a process for surface frying a food product which comprises conveying the food product horizontally from an inlet position to an outlet position in a tray containing frying oil while

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simultaneously mixing the product and cleaning the frying surface of the tray and controlling the period of time during which the product contacts the frying oil in order to obtain a fried surface of the product.

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Generally, the frying oil is added to the tray and heated to the frying temperature before the product is added. The amount of frying oil added to the tray depends on the product but may be from 0.5 to 10%, usually from 1 to 6% and more usually from 1.5 to 4% by weight based on the weight of product being fried.

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Examples of products which may be fried by the apparatus and process of this invention include meat balls, diced potatoes and products containing a mixture of ingredients such as the Swedish "Pyttipanna" or Chinese types of stir fries. When a product containing a mixture of ingredients which require different frying times, it is easy to add the ingredients which require shorter frying times at the appropriate position between the inlet and outlet positions of the tray.

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The process of the present invention may be carried out batchwise or continuously. In both batchwise and continuous processes the product can be added simply by dropping it into the tray. In a batchwise process, the batches may conveniently be weighed manually and added by a semi-

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automatic device such as a screw feeder. In a continuous process, weighing belts may be used to add the product to the tray.

5 The present invention will now be further illustrated by way of example only with reference to the following drawings in which

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Figure 1

represents a perspective view of a fryer according to the present invention.

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Figure 2

represents a diagrammatic side view of a means different to that shown in Figure 1 for conveying and mixing the product in the fryer,

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Figure 3

represents a cross-section through line X-X of Figure 2,

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Figure 4

represents a section along the line A-A of Figure 3 looking in the direction of the arrows.

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Figure 5

represents a side view of an alternative fryer according to the present invention,

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Figure 6

represents a plan view of the fryer shown in Figure 5

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Figure 7

represents a cross-section of the fryer shown in Figure 6, and

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Figure 8

represents a series of cross sections at the dosing point
 5 of potatoes in the fryer to show one cycle during the
 function.

Referring to Figure 1, the fryer, generally designated 10
 comprises an elongated tray 11 having a frying surface 12
 10 which is concave in cross section and provided with a
 heating jacket 13 through which flows heating oil via inlet
 14 and outlet 15, and a heat exchanger 16 connected to
 steam at twenty bar pressure. The tray 11 is provided with
 holes 17, 18 at each end through which passes a shaft 19
 15 adapted to rotate fitted with angled paddles 20 which are
 attached in pairs to the shaft 19 at the mid-point of their
 lengths by means of an axle 21. The outer long edge of each
 paddle facing the frying surface 12 when the shaft rotates
 is curved in a convex manner so that the convex long edge
 20 of the paddle 20 corresponds to the concave frying surface
 12 and is adapted to contact and scrape the frying surface.
 One end 22 of the shaft is connected to a drive motor 23 by
 means of a drive belt 24. The product is fed into the tray
 at an inlet position 25 and is passed out of the tray at an
 25 outlet position 26.

In operation, heating oil is passed through the heating
 jacket 13, frying oil is placed in the tray to cover the
 frying surface 12, the drive motor 23 rotates the shaft 19
 30 at 20 RPM discontinuously for 10 seconds with a one or two
 minutes rest period in between and meat balls are fed into
 the tray at the inlet position 25. The rotation of the
 shaft 19 and the paddles 20 forces the meat balls along the
 tray from the inlet position 25 to the outlet position 26
 35 while they are mixed and fried by the frying oil and
 simultaneously, the curved outer long edges of the paddles

20 scrape and clean the frying surface 12. The
discontinuous rotation of the shaft is controlled by a
computer (not shown) and ensures that the meat balls are
fried for the desired length of time before exiting the
5 tray 11 at the outlet position 26.

For frying a mixed product such as the Swedish dish
Pyttipanna (a mixture of diced potatoes, meat, onions and
spices), the frying oil is first added to the tray and
10 heated to the frying temperature. The potatoes are added
and the shaft 19 is rotated at 20 RPM for 10 seconds with a
one or two minutes rest period in between. The potatoes are
fried for 6 minutes during which time they are transported
to a position nearly half way along the tray. At this
15 position, the onions, meat and spices are added and fried
together with the potatoes for a further 8 minutes. On
reaching the outlet position 26, each ingredient has been
fried for the desired length of time.

20 The frying oil does not become overheated as in a drum
fryer and the fryer is more efficient and energy saving
than conventional fryers.

Referring to Figures 2, 3 and 4, the centre shaft 27
25 adapted to rotate is fitted with curved angled paddles 28
each consisting of an anchor shaft 29, an anchor plate 30
and a scraping plate 31. Each paddle is attached to the
centre shaft 27 by means of the anchor shaft 29.

30 Referring to Figures 5 to 8 of the drawings, the fryer
comprises two trays 32, 33 each having a frying surface 34,
35 which is concave in cross-section and provided with a
heating jacket (not shown) through which flows heating oil
via an inlet and an outlet (not shown), and a heat
35 exchanger (also not shown) connected to steam at 20 bar
pressure. Each tray is provided with a central axle 36, 37

one end of each of which 38, 39 is separately connected to a computer controlled servo-motor (not shown) which is adapted to rotate the central axles both clockwise and anti-clockwise.

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Mounted on each central axle 36, 37 are a plurality of wings 40, 41 for transportation each wing being a $1/3$ segment of an ellipsoid plane section, each wing projecting perpendicularly from the central axle and positioned at an angle in the perpendicular plane, the angle of the wings 40 being wider than that of the wings 41 so that on rotation of the respective central axles two turns of axle 37 are required to transport the product the same distance as only one turn of axle 36.

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The wings 40, 41 are connected to each other by four stay tubes 42, 43 respectively. Each wing is provided with a scraper 44 to clean the frying surface and a mixing plate 45 to lift and turn the product. An articulated level out system 46 is mounted on each central axle on the opposite side to the wings. Dosing points for potatoes, onions and meat are shown at 47, 48, 49, the product is shown at 50 and the final fried product outlet is shown at 51.

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In operation, heating oil is passed through the heating jacket, frying oil is placed in each of the trays 32, 33 to cover the frying surfaces 34, 35 and the servo-motors rotate the central axles in accordance with the function illustrated in Figure 8.

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The fryer can be divided into sections where each section is the distance between an adjacent pair of wings 40, 41. The product is transported stepwise from section to section by an intermittent rotation of the central axles, in the direction of the arrows to the right in the drawings, the

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distance travelled by the product during one whole turn of the axle (360°) depending on the angle of the wings.

The function shown in Figure 8 illustrates five steps as follows:

1. Dosing

The bottom of the fryer is "free". The axle 36 is in its zero position

2. Level out

The axles 36, 37 turn clockwise 105° and return thereafter to zero position to level out the product, the thickness of the product layer 50 being reduced by increasing the length of the articulated level out system 46.

3. Frying

The product 50 is lying stationary at the bottom of the fryer. Resting time for "pyttipanna" is 120 s in the first part and 60 s in the second part in the fryer.

4. Transport and mixing

The axles 36, 37 turn counter clockwise 360° and the wings 40, 41 transport the product one section. The rotation speed is 60° per second, i.e. a complete revolution takes 6 seconds. When rotating counter clockwise, the level out system glides over the product and thus does not affect the thickness. Since the wings 40, 41 are mounted at an angle in the perpendicular plane, the product is pushed to the side of the fryer at the same time as it is transported forward.

5. Level out

5 The axles 36, 37 turn clockwise 105° (this takes slightly less than 2 seconds) and return thereafter to zero position to level out the product by means of the level out system 46 to maintain a specified thickness of the product layer on the bottom of the fryer.

10 The whole cycle is repeated.

Points 1-5 can be described as one cycle, total frying time for the product is 12 cycles (four cycles x 128 s in the first part and eight cycles x 68 sec in the second part).

15 In Figure 6, in the "Pyttipanna" production the potatoes are dosed at position 47, the onions are dosed at position 48 and the meat is dosed at position 49. By the end of the process all ingredients are mixed together.

20 In order to achieve an attractive browning it is necessary that the product lies stationary on the frying surface for specified periods during the frying. As the product while frying gets warmer, the resting time by the end of the
25 process needs to be shorter to avoid burned and/or destroyed pieces. This is the reason why the fryer is divided into two parts with different angles on the transport wings. The ratio is $1/2$, e.g. 1 turn in the first part is equal to 2 turns in the second.

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**CLAIMS**

1. A fryer comprising
 - 5 a tray for containing a frying oil on its surface and a product to be surface fried, means for conveying and mixing the product horizontally from an inlet position to an outlet position and simultaneously cleaning the frying surface of the tray,
 - 10 means for heating the frying oil, and means for controlling the period of time during which the product contacts the frying oil in order to obtain a fried surface of the product.
- 15 2. A fryer according to claim 1 wherein the tray is an elongated shallow trough whose frying surface is concave in cross section.
- 20 3. A fryer according to claim 1 wherein the tray is adapted to remain stationary or substantially stationary during frying of the product.
- 25 4. A fryer according to claim 1 wherein the means for heating the frying oil is achieved by the provision of a double wall in the tray through which hot oil flows.
5. A fryer according to claim 4 wherein the double wall does not extend above the level of the product in the tray.
- 30 6. A fryer according to claim 1 wherein the means for controlling the period of time during which the product remains in contact with the frying oil in order to achieve a fried surface of the product is provided by a
- 35 discontinuous movement of the rotation of the shaft.



7. A fryer according to claim 1 wherein the means for conveying and mixing the product is provided by a shaft fitted with angled paddles in a helical arrangement extending from an inlet end to an outlet end within the tray and adapted to rotate so that their edges contact and scrape the frying surface of the tray.

8. A fryer according to claim 7 wherein the paddles are slightly curved so that their edges which contact the frying surface of the tray will transport the product and clean the frying surface of the tray by scraping.

9. A fryer according to claim 1 wherein the means for conveying and mixing the product is provided by a central axle adapted to rotate extending horizontally from an inlet end to an outlet end fitted with a plurality of plates or wings projecting substantially perpendicularly from the central axle and positioned at an angle in the perpendicular plane so that on rotation of the central axle, the movement of a plate or wing transports the product a certain distance corresponding to the width of the angle.

10. A fryer according to claim 9, wherein the means for conveying and mixing the product also comprises a scraper for cleaning the frying surface.

11. A fryer according to claim 9 wherein the means for conveying and mixing the product also comprises a mixing plate to lift and turn the product while rotating.

12. A fryer according to claim 9 wherein the means for conveying and mixing the product also comprises a level out system to maintain a desired thickness of the product layer on the surface of the tray.



13. A fryer according to claim 12 wherein the level out system is an articulated level out system positioned on the opposite side of the central axle to the plates or wings.

5 14. A fryer according to claim 9 wherein the tray consists of two double jacketed tubs in two levels, each tub being separately heated with thermal oil and the central axles in each tub being separately driven.

10 15. A fryer according to claim 9 wherein the plates or wings in the downstream tub are mounted at a narrower angle in the perpendicular plane than the plates or wings in the upstream tub.

15 16. A fryer according to claim 9 wherein the plates or wings are $1/5$ to $1/2$ segments of an ellipsoid plane section.

20 17. A process for surface frying a food product which comprises conveying the food product horizontally from an inlet position to an outlet position in a tray whose surface is coated with frying oil while simultaneously mixing the product and cleaning the frying surface of the tray and controlling the period of time during which the
25 product contacts the frying oil in order to obtain a fried surface of the product.

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