The invention concerns an apparatus for stir-frying discrete pieces or particles of one or more foodstuffs, the apparatus comprising - a heated surface in the form of the interior surface of a substantially circular cylindrical body (14) having a first axis, - stirring means (4) comprising an axle having a second axis extending generally parallel to said first axis and one or more screw elements (5) arranged on said axle for providing a generally helical surface with a generally helical edge (5a), thereby forming a screw arranged for rotation at least partly within and in close proximity to said heated surface such that rotation of said screw transfers said discrete pieces along said cylindrical body substantially parallel to said first axis such that said screw and said heated surface form a screw conveyor, and - scraping elements (27) arranged on said helical edge for scraping said heated surface when said screw rotates so as to remove any layer of material originating from the foodstuffs and adhering to said heated surface, wherein said screw comprises one or more resiliently deformable elements (6a) adapted and arranged for allowing said helical edge with said scraping elements to move in a direction at right angles to said first axis such that if said cylindrical body because of thermal deformation deviates from extending parallel to said first axis, said scraping elements will continue to scrape substantially the entire heated surface when said screw rotates.
Published:

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— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))
Flexible Screw and Scraper Arrangement for a Contact Frying Apparatus

Technical Field

The present invention relates to an apparatus for stir-frying discrete pieces or particles of one or more foodstuffs, the apparatus comprising
- a heated surface in the form of the interior surface of a substantially circular cylindrical body having a first axis,
- stirring means comprising an axle having a second axis extending generally parallel to said first axis and one or more screw elements arranged on said axle for providing a generally helical surface with a generally helical edge, thereby forming a screw arranged for rotation at least partly within and in close proximity to said heated surface such that rotation of said screw transfers said discrete pieces along said cylindrical body such that said screw and said heated surface form a screw conveyor, and
- scraping elements arranged on said helical edge for scraping said heated surface when said screw rotates so as to remove any layer of material originating from the foodstuffs and adhering to said heated surface.

Background Art

Contact frying, i.e. frying the food by contact with a hot surface (pan-frying, stir-frying) is a widespread process in both the kitchen and in the food industry. It is also a desirable process for meeting the increasing demand for industrial ready-made food products of high culinary and nutritional quality. The alternative to contact frying in large industrial scale is deepfat frying, which has its drawbacks by adding significant amounts of low-quality fat to the products and by the risk of toxic compound formation.

In a previous patent, a new continuous contact frying process is disclosed [Adler-Nissen, J., Jensen, J. P. & Dyhr, E. (2001). Method and apparatus for stir-frying. US Patent No. 6331323]. The process was originally developed to reproduce the Asian stir-frying process (wok frying) in large scale, but experience with its industrial use has indicated that it has a wide application as a generally applicable contact frying process for not only the fine cut vegetables and meat so characteristic of Asian cuisines, but that it can also be used for the searing of larger pieces of meat and other contact frying processes.
Disclosure of the Invention

The frying/searing at high temperature results in the formation of a brown crust on the pieces of meat and vegetables. The crust compounds, which result from Maillard reactions and other chemical browning reactions, also tend to stick to the frying surface, and eventually they pyrolyse and form dark deposits. An extensive formation of dark deposits should be avoided, because the burnt deposits may contaminate the food products and also make cleaning difficult. Regular scraping of the surface is therefore needed to prevent this.

The scrapers must be mounted in a way so that they can exert a certain pressure on the frying surface, and this pressure has to be controlled within limits. The scrapers must also fulfil requirements of hygienic design. Because scrapers are subjected to wear and must be replaced, it is also an advantage that they can be mounted and dismounted easily.

Furthermore, when the frying surface constituted by the interior surface of the cylindrical body is heated for implementing the frying process, the body will deform and become curved in a vertical plane containing the axis of the cylindrical body in a manner resembling the shape of a banana.

Thus, although the scraper elements can be elastic and thus compensate for a certain, relatively small deformation of the frying surface, if the "banana" shape becomes too distinct, or other heat related deformations take place, some of the heated surface will not be scraped properly, or at all, with the consequent problems discussed above.

The main object of the present invention is to alleviate or solve this problem, and according to the invention this is achieved by the screw comprising one or more resiliently deformable elements adapted and arranged for allowing the helical edge with the scraping elements to move in a direction at right angles to the first axis such that if the cylindrical body because of thermal deformation deviates from extending parallel to the first axis, the scraping elements will continue to scrape substantially the entire heated surface when the screw rotates.

Hereby, the scrapers can be displaced in a direction at right angles to the frying surface so as to follow the "banana" shape or other deformations thereof whereby scraping will be much more effective on the deformed portion of the frying surface.
In one embodiment of the apparatus according to the invention, the axle along the length thereof is provided with one or more regions having a smaller cross sectional area than the rest of the axle such that the region or regions serve as the resiliently deformable element or elements allowing the axle to deflect from a rectilinear shape.

Hereby the force of gravity can bend the axle around the region or regions with smaller cross sectional area.

In one embodiment, the screw element is constituted by a continuous helical plate fixedly attached to the axle.

In the currently preferred embodiment of an apparatus according to the invention, the screw elements comprise one or more, preferably three rows of discrete plates each shaped as a generally triangular pie section with one triangle side thereof forming a section of a circle and the other two triangle sides extending from each end of the circular side and intersecting one another at the apex of the triangular pie section, one of the intersecting sides being shorter than the other, the pie section being pivotally attached to the axle at the apex, and wherein the resiliently deformable elements comprise tension springs each having one end attached to the shortest of the sides of a plate and the other end attached to the axle.

Hereby, because of the geometry of the plates and the attachment point of the tension spring to the plate on the shortest side, the individual plates can follow the deformation of the frying surface by pivoting about the apex of the plate whereby the circular side of the pie shaped plate moves in and out relative to the axis of the surface in accordance with the deformation of the frying surface.

Various embodiments of the apparatus according to the invention are specified in the dependent claims 5-16.

Brief Description of the Drawings

In the following detailed part of the present description, the invention will be explained in more detail with reference to the exemplary embodiments of an apparatus according to the invention shown in the drawings, in which
Fig. 1 is a schematic perspective view, partly in section, of a prior art apparatus for continuously stir-frying foodstuffs.

Fig. 2 is a schematic enlarged view of a partial cross section taken along line 11-11 in Fig. 1 with some parts deleted for clarity.

Fig. 3 is a schematic enlarged elevational view of a portion of the helical body of the apparatus of Fig. 1.

Fig. 4 is a diagrammatic lateral elevational view of a stir-frying apparatus according to the invention illustrating the arrangement of a row of scraper elements according to the invention.

Fig. 5 is a diagrammatic view of a portion of the screw of the apparatus in Fig. 4.

Fig. 6 is a diagrammatic sectional view along line X-X in Fig. 5 with the scraper elements removed.

Fig. 7 is a diagrammatic, sectional and cut-off view of a reduced cross section area region of the shaft of the screw shown in Figs. 3-5.

Fig. 8 is a diagrammatic elevational view of the shaft of Figs. 3-7.

Fig. 9 is a schematic lateral elevational view of a scraper element according to the invention.

Fig. 10 is a view corresponding to Fig. 9 of the scraper element mounted in the apparatus and compressed against the heated surface of the screw conveyor.

Fig. 11 is a view corresponding to Fig. 10 illustrating how the scraper compensates for longitudinal curvature of the heated surface.

Fig. 12 is a schematic perspective view of three turns of the screw and a scraper element pivotably attached and guided in a slot in each of the turns.

Fig. 13 is an enlarged view of the releasable and pivotable attachment of the scraper element in a slot in a turn of the screw.
Fig. 14 is an enlarged cross-sectional view seen in the direction of the axis of the screw with three rows of scraper elements.

Fig. 15 is a schematic elevational view of a section of the currently preferred embodiment of the apparatus according to the invention where only one of three rows of screw plates is shown, and

Fig. 16 is a schematic cross-sectional view along line Y-Y in Fig. 15, where all the three rows of screw plates and the entire heated surface or casing are shown.

Referring now to Figs. 1-3, a prior art stir-frying apparatus disclosed in US patent No. 6,331,323 (the disclosure of which is hereby incorporated herein by reference) comprises a housing 1 carried by support legs 2 and associated with two bearing assemblies 3 in which a helical body or screw conveyor 4 is rotatably journalled, the body 4 comprising a helical plate 5 attached to a shaft 6.

The bearing assemblies 3 at either end of the shaft 6 are each supported by a respective piston rod 7 of a hydraulic cylinder and piston assembly 8 pivotally attached by means of pivot 9 to a bracket 10 bolted to a not shown fixed element alongside the housing 1 or a not shown element fixedly attached to the housing 1.

The helical body 4 is thus suspended movable in a generally vertical direction because of the possibility of pivoting around the pivots 9. The helical body 4 may also be moved substantially horizontally to and fro in a direction transverse to the axis of the shaft 6 by means of the reciprocating action of the piston rods 7 of the cylinder and piston assemblies 8. The assemblies 8 are activated by means of hydraulic fluid supplied through conduits 8a communicating with a hydraulic fluid pump (not shown) controlled by a conventional controlling means (not shown) arranged in a control cabinet 11.

The shaft 6 is at one end connected to a an electrical drive unit comprising an electrical motor 12 and a gear box 13 by means of a double universal joint 13a allowing movement of the shaft 6 in all directions transverse to the axis of the shaft relative to the drive unit 12, 13. The drive unit 12, 13 is fixedly arranged relative to the housing 1, and the speed of rotation of the electrical motor 12 is controlled by a conventional controlling means (not shown) in the control cabinet 11.
A cylindrical body having a thick-walled portion 14 and a thin-walled portion 15 is arranged in the housing 1 substantially coaxially with the helical body 4. The thin walled portion is peripherally somewhat longer at one side than the other so that discrete pieces of foodstuff transported by the helical body 4 as indicated by the arrow T in Fig. 7 will not be pushed out of the cylindrical body. The portion 14 is heated by means of an elongate gas burner assembly 16 arranged in the housing 1 below the cylindrical body 14, 15.

Gas for the gas burner assembly 16 is supplied through a gas conduit 17, and air for combustion as well as odour removing ventilation is supplied by a fan 18 communicating with a combustion chamber 19 arranged in the lower part of the housing 1 and accommodating the gas burner assembly 16. Exhaust gases from the combustion and ventilating air are removed from the housing through a venting portion 20 of the housing 1. The portion 15 may also have the same thickness as the portion 14.

A protecting wire mesh 21 is arranged over the helical body 4, 5 and the cylindrical body 14, 15 to avoid accidents caused by introduction of any object or a hand into the elongate aperture 21 at the top of the cylindrical body 14, 15. Foodstuff introduction funnels 22-24 are arranged on the housing 1 for introducing finely cut or diced foodstuffs through the aperture 21 into the cylindrical body 14, 15 at different points along the length thereof. The funnels 22-24 penetrate apertures therefor in the wire mesh 21.

At the outlet end of the cylindrical body 14, 15 opposite the inlet end thereof adjacent the drive unit 13, 14 an outlet aperture (not shown) in the bottom of the portion 14 communicates with a ramp member 25 for transferring stir-fried foodstuffs from the cylindrical body to a conveyor 26 for transferring the foodstuffs to further processing apparatus or storage means (not shown).

The axis of the helical body 4, 5 and the cylindrical body 14, 15 is inclined slightly upwards from the inlet end to the outlet end. The inclination is adjustable by means of adjustment elements (not shown) that allow tilting the apparatus or part of same to adjust the inclination of said axis so that the axis also may be horizontal or inclined downwards from the inlet end towards then outlet end.

The helical rim 5a of the helical plate 5 is along the entire length thereof provided with a series of equally spaced scraping and stirring elements 27, some solely comprising a scraping portion 27a and the rest additionally a stirring/scraping portion 27b, the elements 27 being firmly and removably attached to the helical rim by locking engagement of a locking projection 27c of the
element 27 in a corresponding locking recess 5b in the rim 5a of the plate (shown with broken lines in Fig. 2) or alternatively or additionally, for instance, by frictional clamping engagement between the element 27 and the rim 5a.

5 The elements 27 are made of a suitable material having good wear properties such as a suitable plastic material such as Teflon, stainless steel, nylon or PEEK.

In use, discrete pieces 28 (Fig. 7) of finely cut or diced foodstuffs such as vegetables or meat are introduced through the funnel 22 together with an optional frying substance such as oil or fat, and further discrete pieces and optionally further frying substance may be introduced through funnels 23 and 24.

The cylindrical portion 14 is heated to a predetermined temperature controlled by conventional controlling means (not shown) controlling the gas burner gas consumption in dependency of temperature measurements via not shown conventional thermometer means arranged for measuring the temperature of the portion 14.

The helical body 4, 5 is rotated at a predetermined and variable speed of rotation depending on the foodstuffs to be fried and the temperature of the cylindrical portion 14. The co-operation between the helical body 4, 5, the scraping/stirring elements 27 and the interior surface of the cylindrical portion 14 serves to move the discrete pieces 28 forward along the inner surface of the cylindrical portion 14 substantially parallel to the axis thereof, while at the same time stirring them so as to continuously bring new surface portions of the discrete pieces 28 into heat conducting contact with the heated inner surface of the cylindrical portion 14.

Any excess fluid frying substance will tend to remain near the inlet end below the funnel 22 because of the slight inclination upwards from inlet end to outlet end of the body 14, 15. Excess fluid can also be drained off at the outlet end by adjusting the inclination of the axis of the helical body such that it is inclined slightly downwards as discussed above.

The scraping/stirring elements 27 are pressed against the interior surface of the cylindrical portion 14 by the effect of the weight of the helical body 4, 5 as the entire weight of same is supported by the cylindrical portion 14 because of the pivotal suspension of the assemblies 8.

35 Thereby, removal by scraping of any layer of foodstuff adhering to the interior surface of the cylindrical portion 14 will be assured so that any such layer will not carbonize and degrade the
taste and odour of the stir-fried product.

So as to ensure that the entire area of the interior surface of the cylindrical portion 14 contacted by the discrete pieces 28 during the stir-frying is scraped clean by the scraping elements 27, the helical body 4, 5 is moved in a direction transverse to the axis thereof by means of the cylinder piston assembly 8, the piston rod 7 being reciprocated so that the helical body 4, 5 is forced to move transversely such that region of maximum pressure between the elements 27 and the interior surface of the cylindrical portion 14 moves to and fro along the circumference thereof such that maximum scraping pressure is intermittently applied to substantially the entire inner surface of the heated cylindrical portion 14.

This transverse movement of the helical body is allowed relative to the drive unit 12, 13 by the double universal joint 13a. This effect may also be obtained by mounting the drive unit for transverse movement together with the helical body or by arranging the motor 12 laterally relative to the helical body and replacing the gear box 13 by a chain and sprocket wheel interconnection to the shaft 6.

Although the prior art scrapers described above function reasonably well, it has turned out that when the cylindrical portion or casing 14 when heated deforms and bends downwards in the middle to form a "banana" like shape. Hereby, the middle portion of the heated interior surface of the casing 14 will not be scraped very well and even not at all.

It has been disclosed in US 6,331,132 that the scraping elements may be resiliently urged towards the heated surface by means of a plate spring, however, this solution cannot in practical terms compensate for large deformations of the heated surface and furthermore has the serious disadvantages that there is a risk that the plate springs are dislodged and end in the product and that particles of the material to be stir-fried will build up in the recess containing the plate spring which inter alia will give rise to problems of hygiene.

Therefore a new improved arrangement according to the invention has been provided, and two embodiments thereof are illustrated in Figs. 4-16.

Referring now to Figs.3-5 and 7-8, one embodiment of a resiliently deformable element 6a according to the invention for allowing the helical edge or rim 5a of the screw 4 to move at right angles to the axis 34 so as to allow the scrapers to scrape the bent down portion of the heated surface, is illustrated.
The resiliently deformable element 6a is a reduced cross section area region of the shaft 4 which is made as shown in Fig. 7 where a tube 6b has been welded to two tubes 6c having a larger diameter than tube 6b by means of discs 6d and 6e.

Because of the reduced cross section area, the elements 6a will function as resilient hinges allowing the shaft 4 to bend such that the rim 5a of the screw 4 can follow the deformation of the casing 14 such that the scraping elements 27 can also scrape the middle portion of the heated surface even when the casing 14 has a "banana"-like shape when heated.

The number of elements 6a and the locations thereof along the length of the shaft 6 may be varied, but is currently preferred that three elements are arranged as shown in Fig. 8.

Referring now to Figs.4-6 and 9-14, a system of scraper elements designed to enhance the scraping effect when the heated surface deviates from a perfect circular cylinder are shown.

A row of scrapers 32 that will be described more in detail below are shown mounted in slots 33 on the rim 5a of the turns of the screw. The scrapers are placed at an angle v (see Fig. 5) relative to the axis 34 of the screw for ensuring a smooth contact between the scrapers and the frying surface of the casing during rotation of the helix. The number of rows of scrapers can be from two to six depending on the specific use of the apparatus. In Fig. 6, the possibility of mounting three rows of scrapers is exemplified.

Referring now to Figs.9-14, a scraper 32 according to the invention comprises a first elongate body or scraping beam 35 having a substantially planar and rectilinear scraping surface 36 for engaging and scraping the frying surface. The beam 35 has a first end portion 36 and a second end portion 37.

The scraper 32 also comprises a second elongate body or biasing beam 38 having a third end portion 39 and a fourth end portion 40 and a central first screw attachment portion 41 provided with a concave circular cylindrical surface portion. The scraping beam 35 is interconnected with the biasing beam 38 by means of two rigid rods or beams 43.

Three consecutive turns 44-46 of the screw 4 are provided with slots 47-49, respectively, extending from the rim of the turns towards the axis of the screw. The bottom of the slot 48 of the intermediate turn 45 is provided with a second screw attachment portion 50 having a
convex circular cylindrical surface portion 5 in pivotable contact with surface portion 4 of the beam 38.

The depth or extent of the slots 47-49 is such relative to the total height or dimension of the scraper 32 at right angles to the scraping surface that the beam 35 projects a certain distance outside the slots as shown in exaggeration in Fig. 12. The beam 35 project between 3 and 10 mm outside the slots such that when the beam is pressed against the frying surface, the spring or biasing function of beam 38 is activated as shown in Figs. 10 and 11.

When, during rotation of the screw, the beam 35 encounters the edge of the casing 14 (see Fig. 14) then because of the angle \( v \) between the scraper and the axis 34, the scraper is compressed as the beam 35 is urged inwards by the casing. This causes that end portions 39 and 40 and the attachment portion 41 to press against the bottom of the slots 39, 40 and 41, respectively. Hereby the situation shown in Fig. 10 arises where the beam 38 flexes and transmits a scraping counter-pressure against the frying surface to the scraping surface 36 of the beam 35 through the interconnections 43.

The frying surface is not perfectly rectilinear for a number of reasons, primarily because of the effect of heating the casing from the bottom which gives rise to a slight "banana" shape, i.e. an upwards concave arcuate shape. To ensure that the angle of the scraping surface 36 can vary to accommodate this arcuate shape and maintain an effective scraping contact with the frying surface it is important that the scraper can pivot around the screw attachment portions 41 and 50 as shown in Fig. 11. The screw attachment means can be constructed in other manners than shown, for instance the concave cylindrical surface 42 may be arranged on the portion attached to the screw or the cylindrical surfaces may be substituted by co-operating concave and convex spherical surfaces.

The beams 35 and 38 do not necessarily have to be rectangular in cross section as long as the scraping surface 36 is substantially rectilinear.

The material of the scraper is preferably PEEK, but other resilient materials such as Nylon and Teflon or any other resilient food-approved materials may be employed. The material used should of course be stable at the frying temperatures employed.
Although it is preferred that the scraper spans over three turns of the screw, it is envisioned that longer scrapers spanning 4 or more turns may be useful and perhaps have the advantage of ease of replacement.

Referring now to Figs. 15 to 16, the currently preferred embodiment of the apparatus according to the invention is illustrated.

A circular cylindrical heated casing 60 having an axis 61 partly surrounds an axle or shaft 62 having the same axis 61. The shaft 62 carries three rows of plane plates 63, 64 and 65, respectively. The plates 63-65 are shaped like triangular pie sections having a circular side or edge 66 and two straight edges or sides 67 and 68 intersecting one another at the apex 69 of the triangular plate.

The plates 63-65 are mounted on pivots 70 attached to the shaft 62 in such a manner that the plates can rotate around the pivot, the plates are inclined such that the plane of a plate forms an acute angle with the axis 61, and the neighbouring plates of the rows 63-65 are mutually offset as indicated in Fig. 17 such that a helical surface or virtual screw is formed where the sides 66 correspond to the rim 5a of the screw 4 of the previously described embodiment.

The side 67 is shorter than the side 68, and one end of a tension spring 71 constituting a resiliently deformable element according to the invention is attached to the short side 67 and the other end is attached to a pivot 72 attached to the shaft 62.

A scraping element 73 having a circular outer surface 74 and wherein beam-like or rod-like elements 75 arranged at either end and spaced therefrom are attached to the scraper beam 73 by means of transverse connection rods 76 and 77. An attachment portion 78 similar to the attachment portion 41 in Figs. 9 and 13 is adapted for receiving an attachment pin 79 on the plate 63 for pivotal attachment of the scraper 73 to the plate 63. Support pins 80 and 81 on the plate 63 are adapted to support the rod elements 75 when the scraper 73 is attached to the plate 73 by attachment portion 79.

The material of the scraper is preferably PEEK, but other resilient materials such as Nylon and Teflon or any other resilient food-approved materials may be employed. The material used should of course be stable at the frying temperatures employed.
Not shown lateral support elements attached to the rim area of the plate support the scrapers 73 against movement in a direction transverse to the plane of the plates 63-65 so that the scrapers are supported against the friction forces exerted transversely on the scrapers 73 by the heated surface during scraping thereof when the screw constituted by the axle 62 and plates 63-65 turns in the clock-wise direction indicated by the arrow R1.

In use, when the screw 62-65 rotates clock-wise to transport the material to be stir-fried in the longitudinal direction of the apparatus and scrape the heated frying surface, the plates outside the casing 60, in Fig. 16 the plate 63, will be in a position with the circular side 66 farthest away from the axis 61 because the tension spring 71 has pivoted it clock-wise as far as it can because of the difference in lengths between the sides 67 and 68.

When the plate 63 reaches the slightly flared right hand edge of the casing 60, the plate will be forced to pivot counter clock-wise against the bias of the spring 71 and will thereby be forced closer to the axis 61.

However, if the casing 60, because of the "banana" shape is displaced away from the axis 61 because of heating, then the tension spring 71 will pivot the plate clock-wise so that the rim 66 is displaced away from the axis 61 and the scraper surface 74 is maintained in scraping contact with the radially displaced portion of the heated frying surface, thereby ensuring continued effective scraping of the entire frying surface.

The pins 80 and 81 will resiliently deform the rods 75 in the manner shown in Fig. 16 so that an effective scraping pressure is exerted by the scraper surface on the frying surface at all times.

It should be noted that the various elements such as the scraper elements, the resilient elements for accommodating the "banana" shape of the frying surface and, the configuration of the helical rim disclosed in relation to the various can, according to the invention, be combined in all possible permutations.
CLAIMS

1. An apparatus for stir-frying discrete pieces or particles of one or more foodstuffs, the apparatus comprising
- a heated surface in the form of the interior surface of a substantially circular cylindrical body having a first axis,
- stirring means comprising an axle having a second axis extending generally parallel to said first axis and one or more screw elements arranged on said axle for providing a generally helical surface with a generally helical edge, thereby forming a screw arranged for rotation at least partly within and in close proximity to said heated surface such that rotation of said screw transfers said discrete pieces along said cylindrical body substantially parallel to said first axis such that said screw and said heated surface form a screw conveyor, and
- scraping elements arranged on said helical edge for scraping said heated surface when said screw rotates so as to remove any layer of material originating from the foodstuffs and adhering to said heated surface,
characterized in that said screw comprises one or more resiliently deformable elements adapted and arranged for allowing said helical edge with said scraping elements to move in a direction at right angles to said first axis such that if said cylindrical body because of thermal deformation deviates from extending parallel to said first axis, said scraping elements will continue to scrape substantially the entire heated surface when said screw rotates.

2. An apparatus according to claim 1, wherein said axle along the length thereof is provided with one or more regions having a smaller cross sectional area than the rest of the axle such that said region or regions serve as said resiliently deformable element or elements allowing said axle to deflect from a rectilinear shape.

3. An apparatus according to claim 1 or 2, wherein said screw element is constituted by a continuous helical plate fixedly attached to said axle.

4. An apparatus according to claim 1 or 2, wherein said screw elements comprise one or more, preferably three rows of discrete plates each shaped as a generally triangular pie section with one triangle side thereof forming a section of a circle and the other two triangle sides extending from each end of said circular side and intersecting one another at the apex of said triangular pie section, one of said intersecting sides being shorter than the other, said pie section being pivotably attached to said axle at said apex, and wherein said resiliently deformable elements
comprise tension springs each having one end attached to the shortest of the said sides of a plate and the other end attached to said axle.

5. An apparatus according the any of the preceding claims, wherein said scraping elements comprise:
   - a first elongate body made of a resilient material, preferably PEEK, polyetheretherketone, and having a scraping surface for engaging and scraping said interior surface and a first and a second end portion, and
   - a second elongate body made of a resilient material, preferably PEEK, polyetheretherketone, and having a third and a fourth end portion and having a first screw attachment portion for attachment to said screw and located between said third and fourth end portions, preferably equidistantly from said third and fourth end portions,
   wherein said first and second elongate bodies are interconnected at points located between said third end portion and said first screw attachment portion and between said fourth end portion and said first screw attachment portion in such a manner that said second body is spaced from said first body.

6. An apparatus according to claim 5 as dependent on claim 3, wherein said scraping surface is rectilinear.

7. An apparatus according to claim 5 as dependent on claim 4, wherein said scraping surface is circular with the same radius as said interior heated surface.

8. An apparatus according the any of the claims 1 - 4, wherein said scraping elements comprise:
   - a first elongate body made of a resilient material, preferably PEEK, polyetheretherketone, and having a scraping surface for engaging and scraping said interior surface and a first and a second end portion, and
   - two second elongate bodies made of a resilient material, preferably PEEK, polyetheretherketone, and each having a third and a fourth end connected to said first body by interconnection means in such a manner that said second bodies are substantially parallel with and spaced from said first body and are mutually spaced,
   - said first elongate body having a screw attachment portion for attachment to said screw and located between said first and second end portions, preferably equidistantly from said first and second end portions, and
- one of said second bodies is arranged near, preferably adjacent said first end portion, and the
other of said second bodies is arranged near, preferably adjacent said second end portion.

9. An apparatus according to claim 8 as dependent on claim 3, wherein said scraping surface is
rectilinear.

10. An apparatus according to claim 8 as dependent on claim 4, wherein said scraping surface
is circular with the same radius as said interior heated surface.

11. An apparatus according to any of the claims 5-10, wherein said first and second elongate
bodies each have a substantially rectangular cross section.

12. An apparatus according to any of the claims 5-11, wherein said interconnection means
comprise rods or beams.

13. An apparatus according to any of the claims 5-12, wherein said first and second bodies and
said interconnection means are mutually integral.

14. An apparatus according to any of the claims 4-13, wherein said screw attachment portion
comprises a circular cylindrical surface.

15. An apparatus according to any of the claims 4-13, wherein said screw attachment portion
comprises a spherical surface.

16. A scraper element comprising the features of the scraper element in any of the preceding
claims.
Fig. 4

--- Position of a row of scrapers

Outlet Port

Heat Source (Natural Gas)

Inlet Funnel
MOUNTED AND COMPRESSED AGAINST THE FRYING SURFACE

Fig. 10
MOUNTED, COMPRESSED AND TILTED FITTING THE FRYING SURFACE

Fig. 11
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

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

INV. A47J37/12

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A47J

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

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

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 6 331 323 B1 (ADLER-NISSEN JENS [DK] ET AL) 18 December 2001 (2001-12-18) cited in the application column 13, line 30 - column 14, line 6; figures 10-12 column 10, line 32 - column 26, line 17; figures ---</td>
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<td>1-3,5-6, 8-9, 11-16</td>
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Further documents are listed in the continuation of Box C

See patent family annex

Date of the actual completion of the international search

1 March 2010

Date of mailing of the international search report

09/03/2010

Name and mailing address of the ISA/

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Authorized officer

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<td>A</td>
<td>GB 596 128 A (DENNIS KILBUERN) 29 December 1947 (1947-12-29) page 2, line 46 - page 3, line 51; figures</td>
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## INTERNATIONAL SEARCH REPORT

Information on patent family members

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