



(51) International Patent Classification:

A47J 43/25 (2006.01) A47J 43/08 (2006.01)
A47J 43/07 (2006.01)

(21) International Application Number:

PCT/GB2017/052010

(22) International Filing Date:

07 July 2017 (07.07.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1611961.2 08 July 2016 (08.07.2016) GB

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(81) Designated States (unless otherwise indicated, for every kind of national protection available):

AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available):

ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, 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))

(54) Title: FOOD PROCESSOR

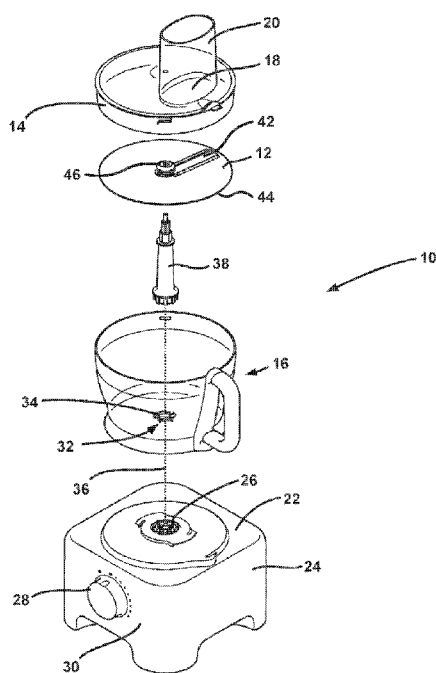


Figure 1

(57) Abstract: Apparatus for processing food (10) comprising a processing tool (12); a mechanism arranged to drive the tool (54); and a data processor (52); in which the data processor is arranged: to receive an input corresponding to a required number of operations of the tool, to receive an input corresponding to the number of operations which the tool has performed, and to determine when the required number of operations has been performed.



Food Processor

The present invention relates to a food processor, and, more particularly, to a food processor having means for performing a specified number of operations.

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It has long been known to provide food processors with cutter discs, which typically consist of a cutter disc having a blade and an aperture through which cut food items can pass into a bowl below. Cutter discs are most often used to grate, shred, or cut slices of food that are introduced to the cutter disc from above. Such cutter discs are typically
10 supported on a bottom-driven shaft above a bowl of the food processor and adjacent a feed-tube entry.

A food processor can rotate the disc at very high speeds, so large volumes of processed food items such as slices can be produced very quickly. The high speed of rotation is
15 also desirable because it improves cutting performance and results in a superior slice of food. Slicing food at low rotation speeds can often result in incomplete or torn slices. The high speeds used make it difficult for users to control how much of any food item introduced to the cutter disc is processed; typically, the entire food item introduced to the cutter disc is processed. This may require that the user perform pre-processing on a food
20 item in order to ensure that the appropriate amount of a food item is processed, or otherwise that they attempt to introduce the food item to the cutter disc for only a short period of time.

This problem is particularly acute where a user wishes to produce a specified number of
25 slices of a food item for a particular purpose, due to the high level of accuracy that is required. In practice, it is very difficult for a user to obtain a specified number of slices, because all of the food stuff is sliced so quickly that even stopping the machine at an approximate number of slices is impractical. In order to produce a specific number of slices on a conventional food processor, the user would have to pre-cut the food to a
30 required height (i.e. equal to the slice thickness multiplied by the desired number of slices). Alternatively, if they knew the rotation speed of the disk they could introduce the food stuff for only a set amount of time, but they would need to have extremely fast reflexes. Both of these methods are impractical.

Therefore often too many slices are cut, with the excess either going to waste or being put back into storage, where the increased exposed surface area causes accelerated decomposition. As a result of these issues, the user may instead resort to cutting the required number of slices of the food item by hand, which is likely to cause a delay in
5 food preparation.

Furthermore, rotary tools (such as cutter discs and mixing tools) for use with food processors may be driven according to a program, which may specify how long certain food items are to be processed for and the force with which the tool is to be driven in
10 such processing in order to achieve a required processing result. In such cases however, the operating speed of the tool will depend on the resistance that the tool encounters (which may depend on the density of the food item, for example) as well as the force with which the tool is driven. If the resistance encountered by the tool differs from what is expected in the program, food items may be processed to a greater or
15 lesser extent than desired.

The present invention is directed to at least partially ameliorating the above-described problems.

20 The present invention provides a food processor which counts the number of slices or other processing operations performed.

In an aspect of the invention, there is provided apparatus for processing food comprising a processing tool; a mechanism arranged to drive the tool (preferably, so as to rotate);
25 and a data processor; in which the data processor is arranged: to receive an input corresponding (preferably directly) to a required number of operations of the tool, to receive an input corresponding (preferably directly) to the number of operations which the tool has performed (preferably, performed since receiving the input corresponding to a required number of operations of the tool), and to determine when the required number
30 of operations has been performed. The processor may be arranged to control the mechanism, for example to stop operation of the tool after performing the said number of operations.

Thus the processing apparatus such as a food processor is able to perform a required number of processing operations, such as slicing of food, and then may stop or otherwise indicate that the required number has been performed, so that excess processed food need not be produced. For example, the tool is of the type which
5 performs repeated operations (equating to repeated drive operations) in a continuous process or motion, such as a rotating tool or an oscillating tool, for example a cutting tool such as a rotating cutter disc. An operation of the tool may be defined as an oscillation or rotation of the tool, or as a motion which produces a unit of processed food, such as a slice or other predetermined quantity or measure.

10

Furthermore, the processing apparatus may perform only a specified amount of processing based on the input corresponding to the number of operations, to avoid under-processing and over-processing. For example, one operation may be one complete revolution of a rotary tool, which may be a continuously rotating tool, or other
15 predetermined amount of travel or processing action of a tool.

The processor may be arranged to stop the operation of the tool within one complete operation of the tool, so that for example in the case of a cutter disc the required number of slices is not exceeded. Additionally, the mechanism may be arranged to drive the tool
20 to an operating speed within one complete operation of the tool after the mechanism is started. Furthermore, the data processor may stop the operation of the tool by deactivating the mechanism before the required number of operations has been performed, such that the tool comes to rest after the required number of operations have been performed. This may prevent more than the required number of operations from
25 being performed. The operation of the tool may be conveniently stopped using magnetic and/or physical brakes.

The apparatus may be arranged to provide to detect a parameter relating to the presence of food at the processing tool, and to provide to the data processor a
30 corresponding input. The data processor may be arranged to determine the number of operations which the tool has performed after receiving an input corresponding to the presence of food at the tool. Thus the processing apparatus may be switched on to operate to drive the tool, but only start to 'count' the number of operations when food is

introduced, increasing convenience for the user. Also, the processor may be arranged to determine the number of operations which the tool has performed only whilst receiving an input corresponding to the presence of food at the tool, so that in the case where food is removed or exhausted, and then reintroduced, the 'count' may be paused and then continued.

For example, the apparatus may comprise a sensor to detect when food is present at the processing tool, or to detect a change in the presence of food at the tool (such as the insertion or removal and/or exhaustion of food in a feed tube) The parameter relating to the presence of food at the tool may thus comprise an indication of food being in contact with the tool, such as an output of a capacitance system, or may comprise an output of a sensor arranged to sense a parameter of the drive mechanism, such as a parameter corresponding to a braking torque level for the tool. One simply way of sensing a braking torque of a tool such as a cutter disc can be to measure the motor current of a motor forming part of the drive mechanism. The sensor may be arranged to provide the indication when the torque level increases, or when there is a step change in the torque level. For example, a step change in torque level can be interpreted as the exhaustion of a food stuff being introduced. Step changes in torque level can be detected by comparing the torque level against a predetermined torque level limit relative to the average torque level over a predetermined time period. This may assist in differentiating increases in torque due to food being present from increases in torque due to noise, for example. Detected step changes may only be recognised as such when the predetermined torque level limit is exceeded for a further predetermined time period. In this case, the operations performed within the further predetermined time period may be included in the determined number of operations, to prevent any genuine operations not being counted. Preferably, the sensor is arranged to disregard step changes in torque level relating to the start up or shut down of the mechanism in providing the indication.

The processor may be arranged to start the mechanism when the presence of food at the tool is indicated. This may improve efficiency. The processor may also stop the mechanism when the presence of food is not indicated, which may improve safety and/or power usage efficiency. The mechanism may only be stopped after a predetermined time period in which the presence of food is not indicated, to avoid the mechanism having to

restart after only short delays or due to a momentary failure to detect food.

Conveniently, the apparatus comprises a user interface such as a touch screen or user actuable buttons arranged to provide the required number of operations of the tool from a 5 user input.

Typically, food processing appliances carry out processing according to a program, wherein the program specifies that the rotary tool be driven by the motor with a specific force so as to achieve a desired speed. The processor may be arranged to operate the 10 tool in accordance with a predetermined program, and the required number of operations of the tool may be determined in accordance with the program. For example, the program may be a program of mixing operations.

Where the speed of operation of the tool is known, the input corresponding to a number 15 of operations performed by the tool may be an amount of time for which the tool has been operating. The input corresponding to a number of operations performed by the tool may also be a total thickness of food to be processed.

The tool may be a rotatable tool, in which case an operation of the tool may comprise a 20 rotation of the tool. The operations may be cutting operations. The tool may comprise a cutter disc (or slicing disc) having at least one blade. The cutter disc may be arranged to cut a predetermined number of slices of food upon rotation of the disc when food is in contact therewith. For example, where the disc has a single blade, with each rotation, the blade passes through the food once, so the number of rotations where the foodstuff is in 25 contact with the disk is equal to the number of slices produced.

Optionally, the input corresponding to the number of operations which the tool has performed may be a measurement of the number of slices produced by the apparatus. For example, slices can be counted as they fall. Alternatively, a dimension of a food 30 processed by the apparatus may be used as the input corresponding to the number of operations performed by the tool. For example, the mechanism could be stopped when the food items in a feed tube have reduced in height by a distance that corresponds to the desired number of slices. The input corresponding to a required number of

operations of the tool may be user-set.

The mechanism may comprise a reluctance motor, in which case the input corresponding to the number of operations which the tool has performed may comprise a
5 cyclical variation in an electrical parameter of the reluctance motor. The mechanism may comprise a motor having an encoder to measure the number of operations performed by the tool. A computer controlled motor (e.g. a digital motor such as a synchronous reluctance motor) having such functionality may be used. Alternatively a closed loop control system incorporating a motor and an encoder may be used to perform a set
10 number of rotations.

Preferably, the number of operations of the tool is the number of repeated movements or oscillations or rotations of the tool. Preferably, the apparatus further comprises means for determining (and/or counting) the number of operations performed by the tool, more
15 preferably wherein the means is a sensor, for example a Hall Effect sensor.

In a further aspect of the invention, there is provided a method of operating a food processor having a processing tool, comprising receiving an input at a data processor corresponding to a required number of operations of the tool; causing the tool to perform
20 processing operations; receiving an input at the data processor corresponding to the number of operations which the tool has performed; determining when the required number of operations has been performed; and stopping operation of the tool after performing the said number of operations.

25 An indication of the presence of food at the processing tool may be received at the data processor, and the determination of when the required number of operations has been performed may take place only whilst food is present at the processing tool.

A braking torque level of the tool may be detected, and the indication of the presence of
30 food may be provided in response to the torque level detected at a sensor. The indication may be provided when the torque level increases, or when there is a step change in the torque level. Such step changes in torque level relating to the start up or shut down of the mechanism are preferably disregarded in providing the indication.

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Conveniently, the required number of operations of the tool may be provided at a user input. The operation of the tool may be stopped within one complete rotation of the tool, so that the required number of slices is not exceeded.

- 5 The mechanism may be started when the presence of food at the tool is indicated; and the mechanism may be stopped when the presence of food is not indicated. Additionally, the mechanism may only be stopped after a predetermined time period in which the presence of food is not indicated.
- 10 Conveniently, the tool may be operated in accordance with a predetermined program, and the required number of operations of the tool may be determined in accordance with the program.

Alternatively, the processor may simply provide information to a user by outputting the
15 count of processing operations, such as a number of slices cut, for example to an interface such as a screen, by detecting when food is present at the tool, and performing a count only when food is detected.

Thus in another aspect, the invention provides an apparatus for processing food
20 comprising a processing tool; a mechanism arranged to drive the tool; and a data processor arranged to control the mechanism; in which the data processor is arranged: to receive an input indicating whether food is present at the processing tool, to receive an input corresponding to the number of operations which the tool has performed, and to provide an output corresponding to the number of operations which the tool has
25 performed during the presence of food at the tool.

The invention extends to apparatus and/or a method substantially as described herein and shown in the accompanying figures.

- 30 The invention also provides a computer program and a computer program product for carrying out any of the methods described herein and/or for embodying any of the apparatus features described herein, and a computer readable medium having stored thereon a program for carrying out any of the methods described herein and/or for

embodying any of the apparatus features described herein. The invention also provides a signal embodying a computer program for carrying out any of the methods described herein and/or for embodying any of the apparatus features described herein, a method of transmitting such a signal, and a computer product having an operating system which
5 supports a computer program for carrying out any of the methods described herein and/or for embodying any of the apparatus features described herein.

Any apparatus feature as described herein may also be provided as a method feature, and vice versa. As used herein, means plus function features may be expressed
10 alternatively in terms of their corresponding structure, such as a suitably programmed processor and associated memory.

Any feature in one aspect of the invention may be applied to other aspects of the invention, in any appropriate combination. In particular, method aspects may be applied
15 to apparatus aspects, and vice versa. Furthermore, any, some and/or all features in one aspect can be applied to any, some and/or all features in any other aspect, in any appropriate combination.

It should also be appreciated that particular combinations of the various features
20 described and defined in any aspects of the invention can be implemented and/or supplied and/or used independently.

In this specification the word 'or' can be interpreted in the exclusive or inclusive sense unless stated otherwise.

25

Furthermore, features implemented in hardware may generally be implemented in software, and vice versa. Any reference to software and hardware features herein should be construed accordingly.

30 Whilst the invention has been described in the field of domestic food processing and preparation machines, it can also be implemented in any field of use where efficient, effective and convenient preparation and/or processing of material is desired, either on an industrial scale and/or in small amounts. The field of use includes the preparation

and/or processing of: chemicals; pharmaceuticals; paints; building materials; clothing materials; agricultural and/or veterinary feeds and/or treatments, including fertilisers, grain and other agricultural and/or veterinary products; oils; fuels; dyes; cosmetics; plastics; tars; finishes; waxes; varnishes; beverages; medical and/or biological research materials; solders; alloys; effluent; and/or other substances.

The invention described here may be used in any kitchen appliance and/or as a stand-alone device. This includes any domestic food-processing and/or preparation machine, including both top-driven machines (e.g., stand-mixers) and bottom-driven machines (e.g., food processors). It may be implemented in heated and/or cooled machines. The invention may also be implemented in both hand-held (e.g., hand blenders) and table-top (e.g., blenders) machines. It may be used in a machine that is built-in to a work-top or work surface, or in a stand-alone device. The invention can also be provided as a stand-alone device, whether motor-driven or manually powered.

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One or more aspects will now be described, by way of example only and with reference to the accompanying drawings having like-reference numerals, in which:

Figure 1 shows an exploded view of a food processor according to an aspect of the invention;

Figure 2 shows a system diagram demonstrating how user inputs are processed by the food processor;

Figure 3 shows an exemplary process of cutting a specified number of slices of a food item using the food processor;

25 Figure 4 shows a further exemplary process of cutting a specified number of slices of a food item using the food processor; and

Figure 5 shows a graph of motor current and the number of rotations of a cutter disc of a food processor in an example scenario.

30 Referring now to Figure 1, a food processor 10 comprises a tool such as a cutter disc 12, which is made up of a generally circular plate 44 and one or more blades 42 supported on a centrally located annulus 46. The one or more blades 42 are located at a predetermined distance above the plate 44, such that the predetermined distance

corresponds to the width of any slices of food that are produced by the action of the rotating one or more blades 42 on food items urged onto the cutter disc 12 from above the blade. The predetermined distance may be adjustable, such that different widths of slices may be produced by the same cutter disc 12. The plate 44 comprises an aperture 5 (not shown) which is arranged to allow sliced food items to pass through it, such that sliced food items move away from the cutter disc 12.

When used in the food processor 10, the cutter disc 12 is supported on and driven by a shaft 38 which may be located in or may protrude through a processing bowl 16. The shaft 38 (and thereby the cutter disc 12) are preferably located along a central axis 36 of the bowl 16. The cutter disc 12 may be located at or near an end of the shaft 38 such that the cutter disc 12 is located near or within a lid 14 for the bowl 16 when in use. The lid comprises an aperture 18 having a feed tube 20 protruding away from the bowl 16 having an upward facing opening. One or more food items may be introduced into the food processor 10 via the feed tube 20 and the aperture 18, whereupon they come into contact with the cutter disc 12 under the action of gravity or, optionally, by being urged by a pusher device. The food items may then be cut into slices by the cutter disc 12, and the slices may then fall into the bowl 16.

The bowl 16 is supported on a base unit 24, which comprises a mechanism such as a motor for driving the rotation of the shaft 38 and a system for controlling the motor. The base unit 24 may further comprise a drive outlet 26 located on an upper surface 22 of the base unit 24 and a user interface 28 on an upright surface of the base unit 24. The user interface 28 may take the form of a rotatable knob which allows the user to select between a plurality of settings and/or modes, but it will be appreciated that a variety of other user interfaces may be used as an alternative or in addition to the rotatable knob. For example, a graphical user interface may be provided and/or the food processor 10 may be controlled remotely using a computing device. The shaft 38 may be arranged to interface with a drive socket 34 located around an aperture 32 in the base of the bowl 16, where the drive socket 34 is arranged to transmit drive from the drive outlet 26 to the shaft 38 via a sealed drive coupling.

Figure 2 shows a system diagram demonstrating how user inputs are processed by the

food processor 10. A mechanism comprising a motor 54 is provided in the base unit 24 to drive the cutter disc 12 via the shaft 38. The motor 54 is controlled by a data processor 52, which, as shown in the Figure, may receive inputs from a user via the user input 28 and control the motor 54 accordingly. The processor 52 may then change the rotation speed of the motor 54 (and thereby the operating speed of the tool) according to the input from a user. The data processor 52 may also receive inputs from one or more sensors 56 operable to detect a property relating to an output of a tool, for providing an indication of the number of operations performed by the tool, and may control the motor 54 accordingly. These sensors 56 may either be discreet components in electronic communication with the data processor 52, or integral to the data processor 52. For example the data processor 52 may be configured or arranged to act as a sensor by a program running on it.

When the food processor 10 is in operation, the data processor 52 is operable to control the motor 54 based on an input from a user and a detected property relating to a number of processing operations of the tool of the food processor 10. For example, the input may be a desired number of slices to be cut, where the desired number is input by the user via the user interface 28 and the actual number of slices cut is detected by the sensor 56. The desired number of slices corresponds to a certain number of rotations of the tool while a food item is in a position to be processed by the tool. Where the tool is a cutter disc 12, the number of slices produced by the cutter disc 12 in a single operation (i.e. a complete rotation) of the cutter disc 12 will depend on the number of blades 42 used with the cutter disc 12.

Where a desired number of slices are being produced, the motor 54 may be stopped when the data processor 52 detects that the desired number of slices has been produced such that no more than the desired number of slices are cut. Alternatively the processor may provide an indication to the user, such as an alert, when the desired number of slices are cut. Preferably, the cutter disc 12 is arranged so as to come to a complete stop before another operation is performed. For example, where the cutter disc 12 is provided with one blade 42, the cutter disc 12 is arranged to come to a complete stop within one full rotation of the cutter disc 12. The food processor 10 may optionally further comprise means for slowing the rotation of the cutter disc 12, such as a brake (or damper)

arranged to operate on the shaft 38, to assist in stopping the cutter disc 12 where backlash from the motor 54 is insufficient to stop the rotation of the cutter disc 12 before a food item is contacted by a blade 42. Alternatively or additionally, where a reversible, brushless motor such as a switched or synchronous reluctance motor is used, the motor 5 may be decelerated by magnetic braking using the stator poles. The motor may also be deactivated prior to the desired number of slices being achieved such that the desired number of slices will have been achieved by the time the cutter disc 12 comes to rest through the momentum of the cutter disc 12.

10 The motor 54 is preferably of a type which can be directly controlled to perform a selected number of rotations. Examples of suitable motors include synchronous reluctance motors, switched reluctance motors, other stepper motors, servo motors, or brushless DC motors.

15 In an example, the data processor 52 and/or the motor 54 are operable to detect the number of complete rotations of the shaft 38. For example, the motor 54 may comprise a rotary encoder operable to transmit information relating to the rotational position of the shaft 28. Alternatively or additionally the motor 54 may have windings which have electrical parameters which vary cyclically depending on the position of the rotor of motor
20 54. For example, these may be the windings of the stator poles of a switched or synchronous reluctance motor. This cyclical variation can be detected directly by data processor 52 to determine how many rotations have taken place and the position of the shaft 28 through feedback from the motor 54. Information on the rotary position of the shaft 28 detected via the preceding method or by other means may be used by the data
25 processor 52 to determine when the slice has occurred and so when to increment the number of operations carried out.

Alternatively, the actual number of slices produced may be detected using the sensor 56. For example, a reduction in height of food in the feed tube or an increase in the height of
30 a stack of processed food may be measured.

Figure 3 shows an exemplary process of cutting a specified number of slices of a food item using the food processor 10. In an initial step 301, the user enters the desired

number of slices of a food item via the user interface 28. In a following step 302, the user introduces the food item to the cutter disc 12 via the aperture 18. In a following step 303, the motor 54 may be started. At the same time, the data processor 52 may begin to monitor and count the number of rotations of the shaft 28. In a following step 304, the data processor 52 determines whether the number of rotations corresponds to the desired number of slices of the food item. If the cutter disc 12 has one blade 42, the number of rotations of the shaft 28 will be equal to the desired number of slices when the desired number have been produced, however, this will vary if more than one blade 42 is provided. In a final step 305, the motor 54 is stopped when the required number of rotations of the shaft 28 have been completed.

Since the number of rotations of the shaft 38 will correspond to the number of slices being produced only when food items are in a position to be processed (i.e. when the food items are present at the cutter disc 12), the process described with reference to Figure 3 allows for a desired number of slices of a food item to be cut only if the user has already introduced the food when switching on the food processor. However it may be desirable for the user to be able to switch on the food processor before introducing the food. Therefore it is preferable to include an arrangement to detect the presence of a food item at the cutter disc 12.

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Figure 4 shows a further exemplary process of cutting a specified number of slices of a food item using the food processor 10. In an initial step 401, the user switches on the processor and enters the desired number of slices of a food item via the user interface 28. In a following step 402, with the motor 54 operating, the data processor 52 detects whether food items are located at the cutter disc 12 ready to be processed. Various ways in which the food items may be detected will be described later on. Only after receiving an indication that a food item is detected will the data processor 52 begin to monitor and count the number of rotations of the motor 54 or shaft 28 (in a following step 403). In following optional steps 404 and 405, if it is detected that a food item is no longer present at the cutter disc 12 (due to the food item being removed or being entirely processed by the cutter disc 12), the data processor 52 may stop or pause counting the number of rotations of the shaft. The count of the number of rotations may resume when it is detected that the user has introduced further food items (in the previous step 402).

Optionally, the food processor may prompt the user to introduce more food items in such a case, such as by emitting an audio signal or displaying a message on a graphical user interface (if provided). In final steps 406 and 407, the motor 54 is stopped when the counted number of rotations corresponds to the desired number of slices, as previously 5 described. Optionally, the motor may only be activated when food is detected in the proximity of the cutter disc 12.

Providing a mechanism to detect the presence of food items at the cutter disc 12 may serve to avoid breaks in food processing by allowing a desired number of slices to be cut 10 while the food processor 10 is operating, and/or may be easier or more convenient for a user not having to start the food processor whilst holding food in position. Additionally, it allows for the count of the detected number of rotations to be paused when it is detected that the food item has been exhausted or removed. This may allow the user to cut a 15 desired number of slices that is larger than the maximum number of slices that can be produced from a single food item or the capacity of the feed tube 20. Optionally, the motor 54 may also be stopped when a food item is exhausted or removed for safety reasons or to save power. Optionally, the motor 54 may be stopped following the expiry of a predetermined time period in which no food items are detected at the cutter disc 12.

20 A variety of means may be used to detect the presence of food items at the cutter disc 12. In an example, the braking torque of the cutter disc 12 is measured. This may be done by monitoring the motor current, which is simple and convenient, requiring no further sensors, and may accurately show when food items are being processed by the blade 42.

25

Figure 5 shows a graph of motor current and the number of rotations of a cutter disc 12 of the food processor 10 in an example scenario, demonstrating how monitoring motor current and the number of rotations of the shaft 28 may be used to monitor the number of slices produced by the food processor 10. In an example scenario, a user may wish to 30 make 15 cucumber sandwiches, each requiring 8 slices, so that exactly 120 slices of cucumber are required. The user may enter this desired number via the user interface 28, either before or after starting the motor 54. In this scenario, no food items are initially present at the cutter disc 12. When the motor 54 is started, a high start-up current may

occur (shown at A on the graph). The data processor 52 may be configured to ignore the initial high current for the purpose of monitoring braking torque by, for example, not counting operations during an initial period of acceleration required to reach a stable speed, or may ignore operations that occur during a fixed amount of time starting with
5 the activation of the motor 54. Alternatively or additionally the known wave-form of motor current for the start-up period (e.g., the first 1 to 5 seconds) when not under load may be compared by the data processor 52 to the detected motor current during the start-up period to determine whether the motor current is in excess of the known unloaded motor current and that the motor is under load, and if so to count the operations during the
10 start-up period.

After the motor 54 is started, the current will fall to a low value (shown at B on the graph), indicating that the braking torque on the cutter disc 12 is low. When the user introduces a cucumber into the feed tube 20 such that an end comes into contact with the cutter disc
15 12, the cucumber will apply a braking torque to the cutter disc 12, causing the motor current to increase (shown at C on the graph). The data processor 52 is arranged to recognize this increase in motor current as an indication to begin counting the number of rotations of the shaft 28 and comparing the same against the desired number of slices. The motor current (and thereby the torque) will tend to rise sharply to a peak and then
20 decrease as the food item is exhausted. The data processor 52 may wait until the motor current has risen above a certain level relative to the motor current when not under load before counting to avoid spurious counting caused by noise in the motor current. For example, the motor current may need to rise above twice the motor current when not under load before the data processor 52 begins counting operations. Alternatively, the
25 data processor 52 may require the average motor torque over a given time period (e.g., 0.5-3 seconds) to exceed a certain amount (e.g., twice the average unloaded motor torque) before counting slices, and include the slices that took place during the preceding sampling period (i.e., the period during which the average torque first indicated slicing was taking place) within that count.

30

When the food item is exhausted, the motor current will drop back to the low value indicative that no food item is present (shown at D in the graph). The data processor 52 recognizes this as an indication to pause counting the number of rotations of the cutter

disc 12. In the scenario described, the cucumber is exhausted after 80 slices, leaving 40 slices still to be cut. The cutter disc 12 continues to rotate, but the rotations are not counted by the data processor 52 until the user introduces a second cucumber to the cutter disc 12 (shown at E on the graph), causing the motor current to rise. When the total number of 'counted' rotations equals the desired number of slices, the motor 54 is switched off, causing the motor current to drop to zero (shown at F in the diagram). Since only 40 slices of the second cucumber have been cut, the remainder of the cucumber can be returned to storage.

10 The shaft torque may be measured using alternative means to measuring the motor current. In an example, a torque transducer may be provided to detect changes in torque. Preferably, any such torque transducer is chosen to have an accuracy and sampling rate high enough to differentiate between slicing blade strikes of the food and the food simply resting or being pressed on the rotating disk.

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It will be appreciated that a wide variety of other methods may be provided to detect the presence of a food item at the cutter disc 12. For example, a sensor arranged to detect contact between a food item and the cutter disc 12 may be used, such as a force sensor, pressure sensor, or a capacitive sensor (e.g., one similar to that used in a touch screen).

20 Alternatively, a sensor arranged to detect an object extending above the blade may be used, such as a photoelectric sensor or a proximity sensor.

It will also be appreciated that the time during which the cutter disc 12 is rotating in contact with a food item may be measured to determine the number of slices produced, if the rotation speed is known and/or measured using an encoder. The measured time may be used as an alternative to counting the number of rotations of the cutter disc 12.

It will also be appreciated that the number of slices produced may be determined in a number of other ways using the one or more alternative sensors 56. For example, a torque transducer (as described above) may be provided, where the torque transducer has a sampling rate that is higher than the maximum rotation speed of the cutter disc 12 such that the changes in torque over the course of a single rotation may be measured. Such a torque transducer may be used to detect and count the number of individual

blade strikes on a food item to determine the number of slices produced. In this example, the torque transducer should be selected to be sufficiently accurate to differentiate between blade strikes and the food item resting on the cutter disc 12 and/or blade 42. Ways in which blade strikes on food may be detected includes detecting increases in 5 motor torque (using a torque transducer or by another method such as by sampling the motor current) that occur over only part of the rotation and/or which occur where the blade position is determined by the data processor 52 to be beneath a feed tube 20, so as to avoid spurious counting.

10 In a further example, the number of slices produced may be determined directly by counting the slices as they fall, for example by using a photoelectric sensor or a proximity sensor. Alternatively, a sensor such as a force-sensitive resistor sensor may be used to detect the impact of a slice on the bottom of the bowl 16. The impacts may then be counted to determine the number of slices produced.

15

In a further example, the height of a stack of produced slices may be measured using a sensor such as a laser, LED, or ultrasonic sensor. The number of slices may then be determined based on a known width of a slice, which depends on the height of the blade 42 above the plate 44. Alternatively, the height of a food item in the feed tube 20 may be 20 measured, and the motor 54 may be stopped when the height of the food item has decreased by a height corresponding to the desired number of slices multiplied by the thickness of a slice. The thickness of a slice may for example be of either a fixed thickness stored by the data processor 2 on an associated memory, or the thickness may be detected from an RFID tag associated with the cutting disc by a suitable RFID reader 25 associated with the food processor. The height of items in the feed tube may be determined directly using a sensor (as described with reference to measuring the height of a stack). Alternatively, a pusher device for use with the feed tube 20 may be used, where the pusher device comprises a detectable tag. The position of the tag (and thereby the height of the food items in the feed tube) may be determined by use of a 30 sensor. For example, RFID or Hall effect sensors may be used. Instead of a number of slices to be cut, the user may enter a total thickness to be cut, and the food processor will operate until the number of slices cut multiplied by their thickness adds up to the total thickness to be cut.

In another example, instead of the user inputting a required number of slices, the processor may provide to the user a count of the number of slices which have been cut, or other processing operations which have been performed, during food processing.

5

The described apparatus and method for performing a specified number of operations may be used as one or more steps in a broader food processing program. For example, a desired number of slices of a food item may be produced, then the next step in a food processing operation (which may use different tools or capabilities of the food processor) may be started.

It will be appreciated that the described apparatus and method may be used with tools other than cutter discs. Other disc tools may be used, such as grating, shredding or chipping tools. For example, other bladed tools used to slice foods may be used, such as guillotine-like blades. Furthermore, non-bladed tools may be used, such as whisks, beaters, and mixing or kneading tools, where the apparatus and method may be used to allow a specified number of operations of said tools to be performed to obtain a required processing result.

20 It will be understood that the present invention has been described above purely by way of example, and modifications of detail can be made within the scope of the invention.

Each feature disclosed in the description, and (where appropriate) the claims and drawings may be provided independently or in any appropriate combination.

25

Reference numerals appearing in the claims are by way of illustration only and shall have no limiting effect on the scope of the claims.

CLAIMS:

1. Apparatus for processing food comprising:
a processing tool;
5 a mechanism arranged to drive the tool; and
a data processor;
in which the data processor is arranged:
to receive an input corresponding to a required number of operations of the tool,
to receive an input corresponding to the number of operations which the tool has
10 performed, and
to determine when the required number of operations has been performed.
2. Apparatus as claimed in claim 1, in which the data processor is arranged to
control the mechanism to stop operation of the tool after performing the said
15 number of operations.
3. Apparatus as claimed in claim 2, in which the data processor is arranged to stop
the operation of the tool within one complete operation of the tool.
- 20 4. Apparatus as claimed in claim 2 or claim 3, in which the data processor is
arranged to stop operation of the tool by deactivating the mechanism before the
required number of operations has been performed, such that the tool comes to
rest after the required number of operations have been performed.
- 25 5. Apparatus as claimed in any of claims 2 to 4, in which the operation of the tool is
stopped using magnetic and/or physical brakes.
6. Apparatus as claimed in any preceding claim, the apparatus being arranged to
provide to the data processor an input indicating whether food is present at the
30 processing tool, in which the data processor is arranged to determine the number
of operations which the tool has performed after receiving an input indicating the
presence of food at the tool.

- 20 -

7. Apparatus as claimed in claim 6, in which the data processor is arranged to determine the number of operations which the tool has performed only whilst receiving an input indicating the presence of food at the tool.
- 5 8. Apparatus as claimed in claim 6 or 7, in which the input indicating the presence of food at the tool comprises an indication of food being in contact with the tool.
9. Apparatus as claimed in any of claims 6 to 8, comprising a sensor arranged to sense a parameter corresponding to a braking torque level of the tool, and to
10 providing an indication whether food is present at the tool in response to the torque level detected.
10. Apparatus as claimed in claim 9, in which the sensor is arranged to provide the
15 indication when the torque level increases, or when there is a step change in the torque level.
11. Apparatus as claimed in claim 10, in which the data processor is arranged to detect step changes in torque level by comparing the torque level against a
20 predetermined torque level limit relative to the average torque level over a predetermined time period.
12. Apparatus as claimed in claim 11, in which the data processor is arranged to detect step changes in torque level when the predetermined torque level limit is
25 exceeded for a further predetermined time period, and in which the operations performed within the further predetermined time period are included in the determined number of operations.
13. Apparatus as claimed in any of claims 10 to 12, in which the sensor is arranged to disregard step changes in torque level relating to the start up or shut down of the
30 mechanism in providing the indication.
14. Apparatus as claimed in any one of claims 3 to 13, in which the data processor is arranged to start the mechanism when the presence of food at the tool is

indicated and to stop the mechanism when the presence of food is not indicated, optionally in which the mechanism is stopped after a predetermined time period in which the presence of food is not indicated.

- 5 15. Apparatus as claimed in any preceding claim, comprising a user interface arranged to provide the required number of operations of the tool from a user input, and preferably to alert the user when the required number of operations has been performed.
- 10 16. Apparatus as claimed in any preceding claim, in which the mechanism is arranged to drive the tool to an operating speed within one complete operation of the tool after the mechanism is started.
- 15 17. Apparatus as claimed in any preceding claim, in which the data processor is arranged to operate the tool in accordance with a predetermined program, and in which the required number of operations of the tool is determined in accordance with the program.
- 20 18. Apparatus as claimed in any of the preceding claims, in which the input corresponding to a number of operations performed by the tool is an amount of time.
- 25 19. Apparatus as claimed in any one of the preceding claims, in which the input corresponding to a number of operations performed by the tool is a total thickness of food to be processed.
20. Apparatus as claimed in any preceding claim, in which the tool is a rotatable tool, and an operation of the tool comprises a rotation of the tool.
- 30 21. Apparatus as claimed in any preceding claim, in which the number of operations which the tool has performed is a number of cutting operations.

22. Apparatus as claimed in claim 21, in which the tool comprises a cutter disc having at least one blade and being arranged to cut a predetermined number of slices of food upon rotation of the disc when food is in contact therewith.
- 5 23. Apparatus as claimed in claim 21 or 22, which the input corresponding to the number of operations which the tool has performed is a measurement of the number of slices produced by the apparatus, or a dimension of a food processed by the apparatus.
- 10 24. Apparatus as claimed in any preceding claim, in which the input corresponding to a required number of operations of the tool is user-set.
25. Apparatus as claimed in any preceding claim, in which the mechanism comprises a reluctance motor, and the input corresponding to the number of operations
15 which the tool has performed comprises a cyclical variation in an electrical parameter of the reluctance motor.
26. Apparatus as claimed in any preceding claim, in which the mechanism comprises a motor having an encoder to measure the number of operations performed by
20 the tool.
27. Apparatus as claimed in any preceding claim, in which the apparatus comprises a food processor.
- 25 28. Apparatus as claimed in any preceding claim, in which the tool is an oscillating tool, and the number of required operations of the tool is the number of required oscillations of the tool, and/or the number of operations which the tool has performed is the number of oscillations which the tool has performed.
- 30 29. Apparatus as claimed in any preceding claim, further comprising means for determining the number of operations performed by the tool, preferably wherein the means is a sensor, for example a Hall Effect sensor.

30. A method of operating a food processor having a processing tool, comprising receiving an input at a data processor corresponding to a required number of operations of the tool;
causing the tool to perform processing operations;
- 5 receiving an input at the data processor corresponding to the number of operations which the tool has performed; and
determining when the required number of operations has been performed;
31. A method as claimed in claim 30, comprising stopping operation of the tool after
10 performing the said number of operations.
32. A method as claimed in claim 31, comprising stopping the operation of the tool within one complete rotation of the tool.
- 15 33. A method as claimed in claim 31 or claim 32, comprising deactivating the mechanism before the required number of operations has been performed, such that the tool comes to rest after the required number of operations have been performed
- 20 34. A method as claimed in any of claims 30 to 33, comprising receiving an indication at the data processor of the presence of food at the processing tool; and
determining when the required number of operations has been performed only whilst food is present at the processing tool:
- 25 35. A method as claimed in claim 34, further comprising detecting a braking torque level of the tool, and providing the indication of the presence of food in response to the torque level detected at a sensor.
- 30 36. A method as claimed in claim 35, wherein the indication is provided when the torque level increases, or when there is a step change in the torque level.

37. A method as claimed in claim 36, comprising detecting step changes in torque level by comparing the torque level against a predetermined torque level limit relative to the average torque level over a predetermined time period
- 5 38. A method as claimed in claim 37, comprising step changes in torque level when a predetermined torque level limit is exceeded for a further predetermined time period, and in which the operations performed within the further predetermined time period are included in the determined number of operations.
- 10 39. A method as claimed in any of claims 36 to 38, comprising disregarding step changes in torque level relating to the start up or shut down of the mechanism in providing the indication.
- 15 40. A method as claimed in any of claims 34 to 39, comprising starting the mechanism when the presence of food at the tool is indicated; and stopping the mechanism when the presence of food is not indicated, optionally comprising stopping the mechanism after a predetermined time period in which the presence of food is not indicated.
- 20 41. A method as claimed in any of claims 30 to 40, comprising providing the required number of operations of the tool at a user input.
- 25 42. A method as claimed in any of claims 30 to 41, further comprising operating the tool in accordance with a predetermined program, and determining the required number of operations of the tool in accordance with the program.
43. Apparatus substantially as herein described and/or illustrated with reference to the accompanying drawings.
- 30 44. A method substantially as herein described and/or illustrated with reference to the accompanying drawings.

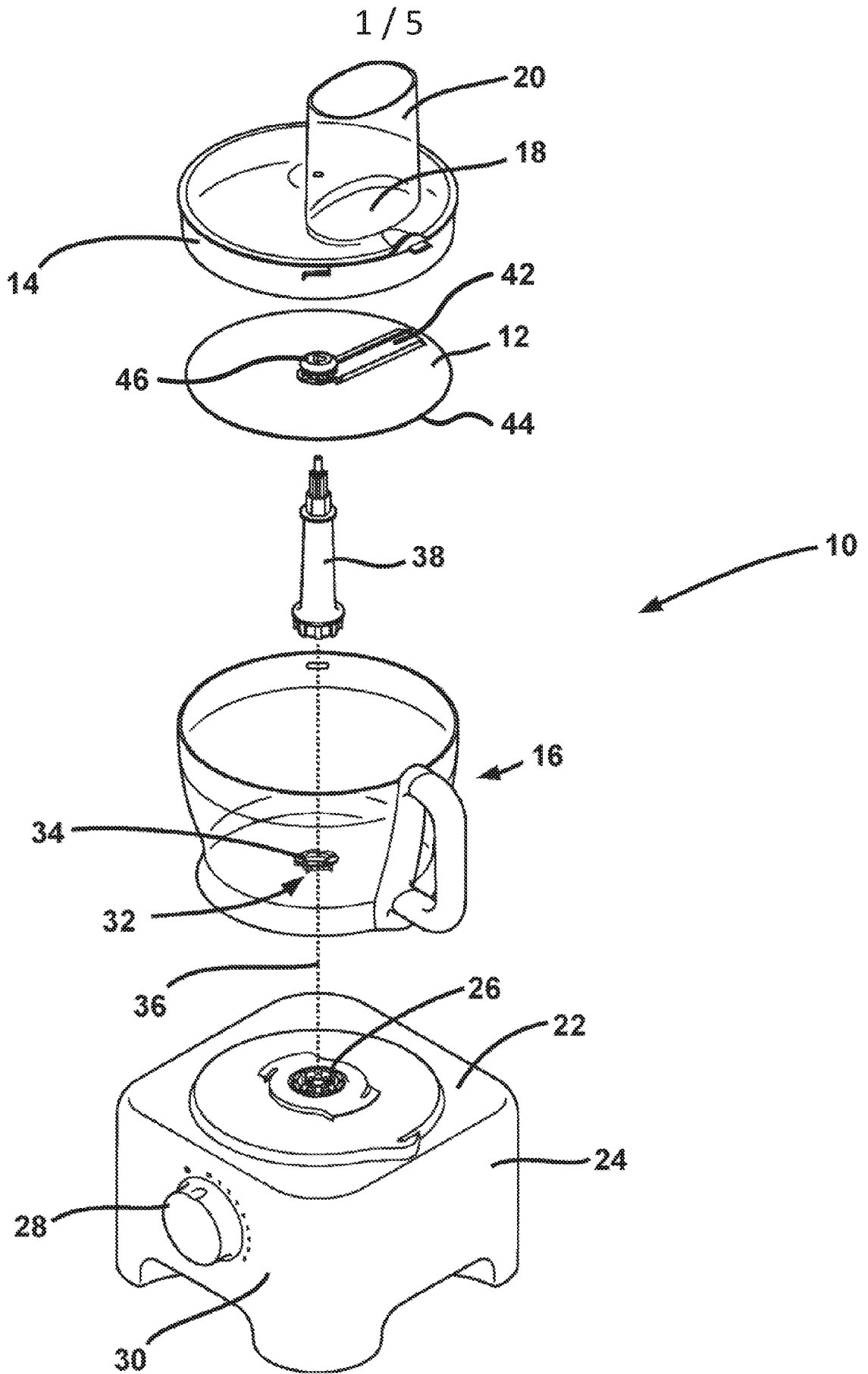


Figure 1

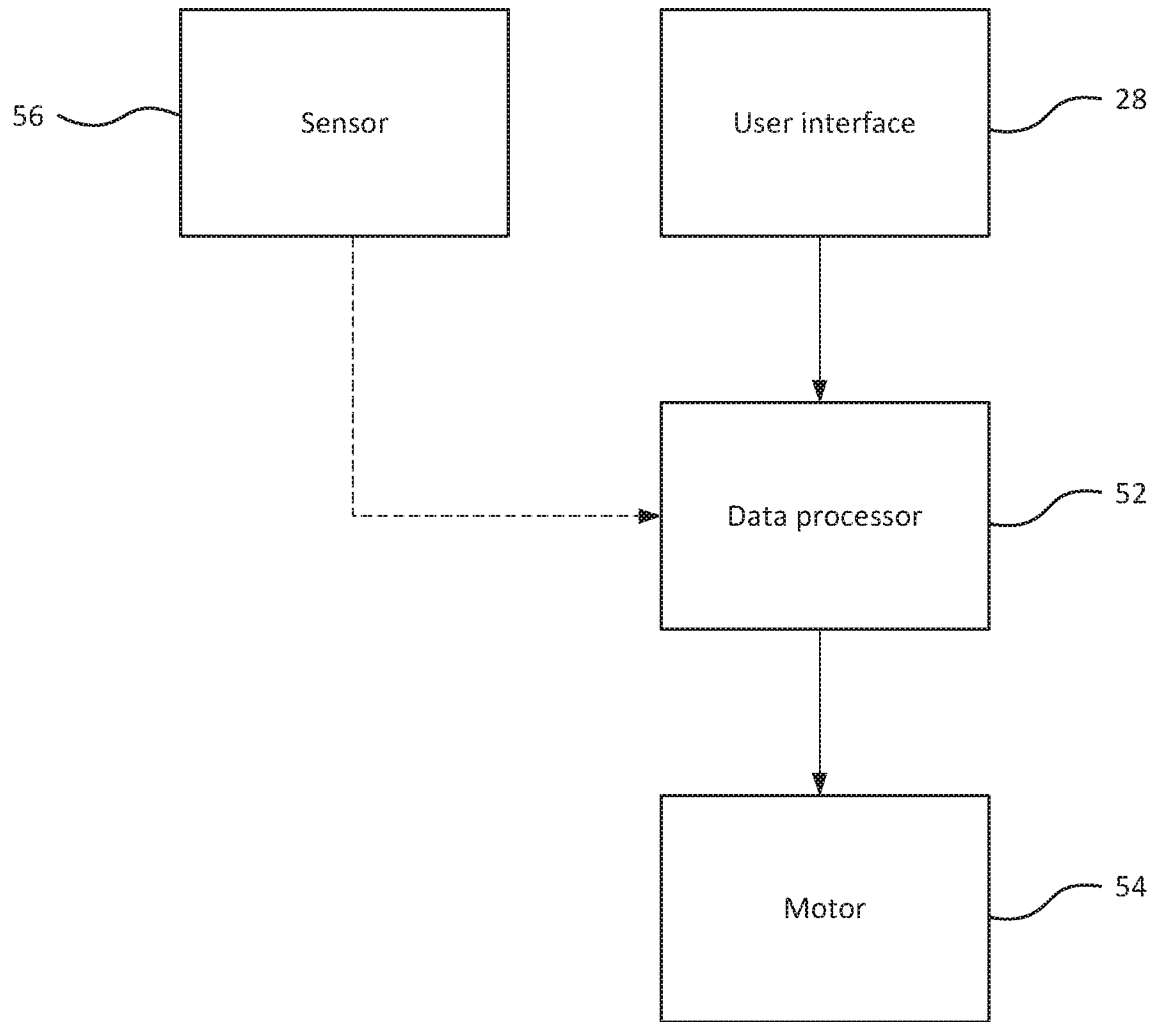


Figure 2

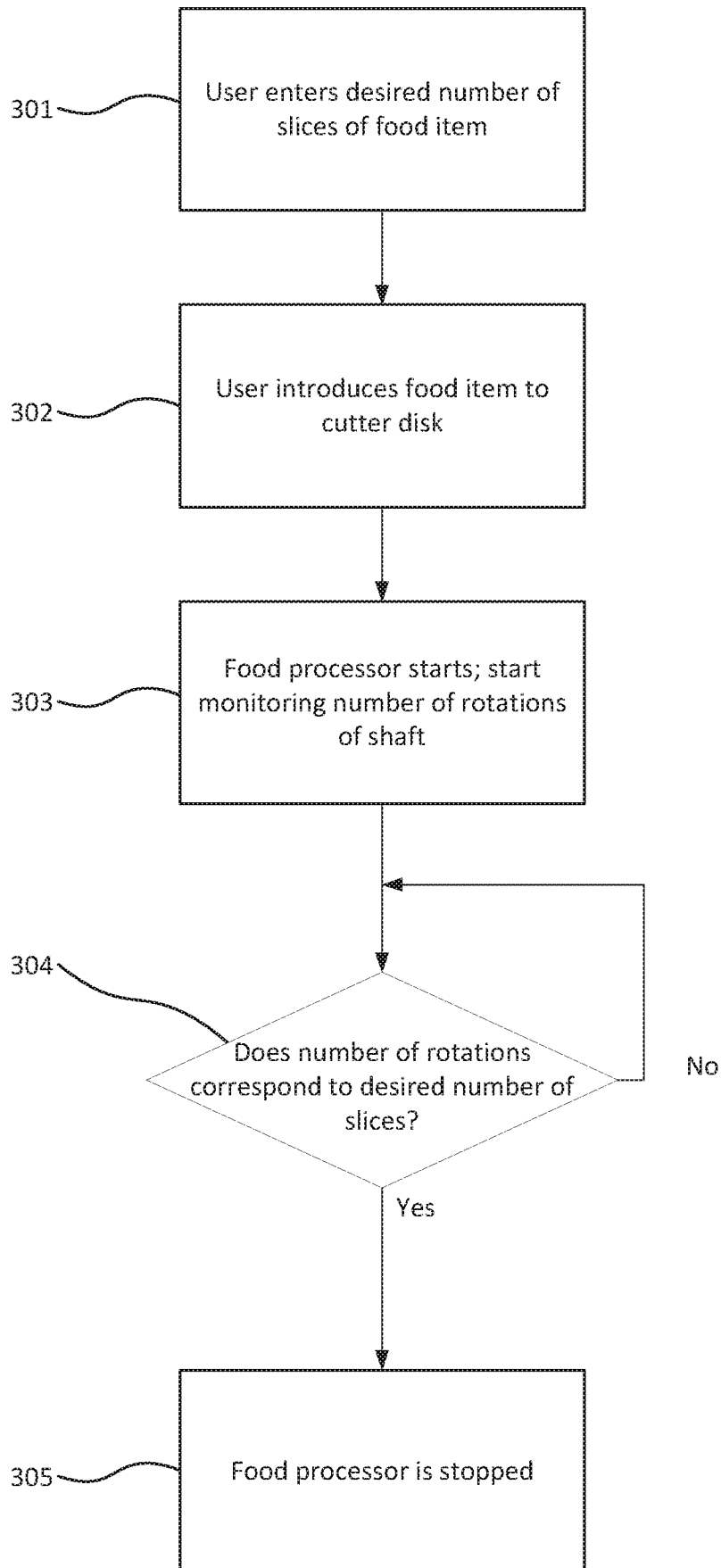


Figure 3

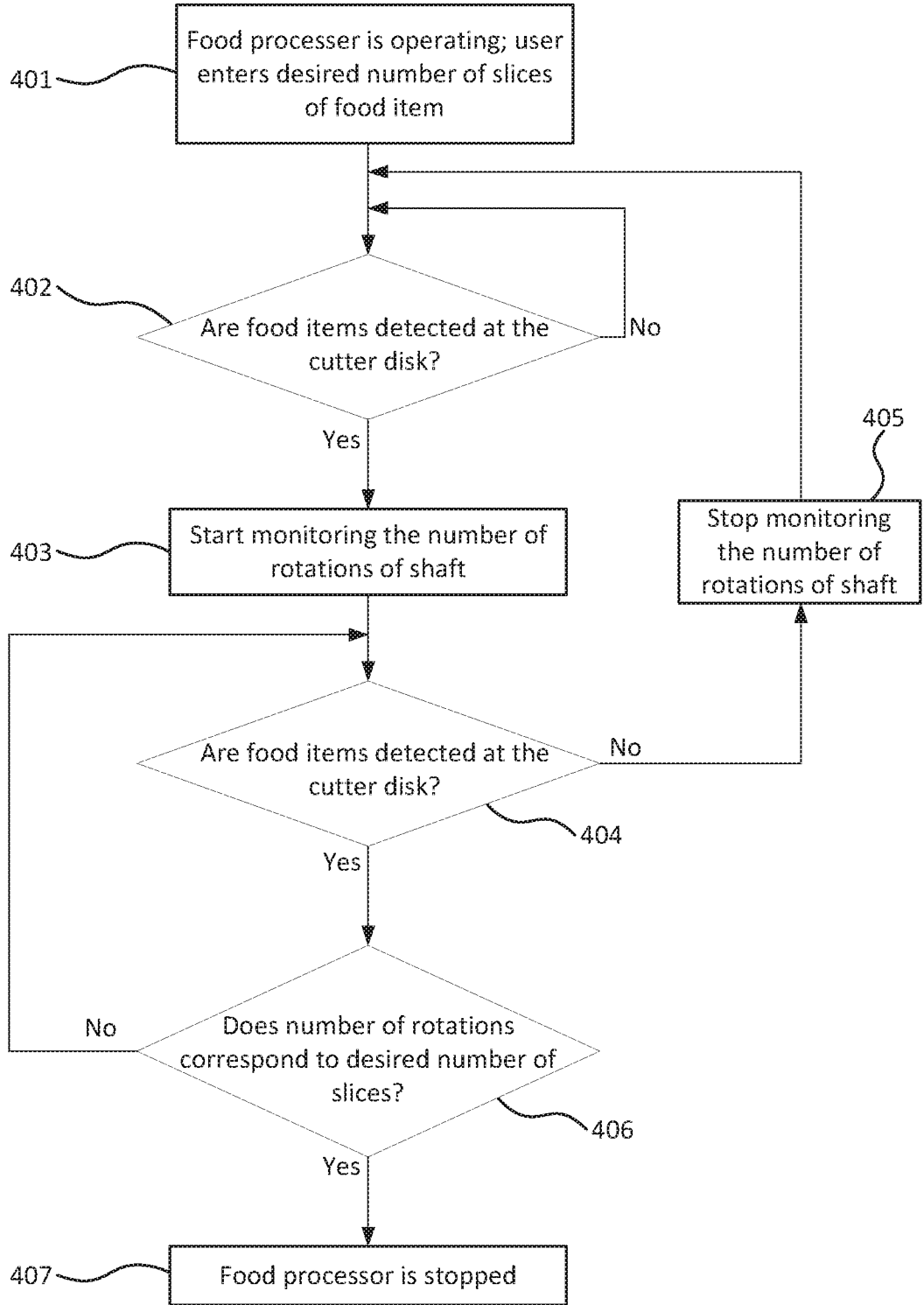


Figure 4

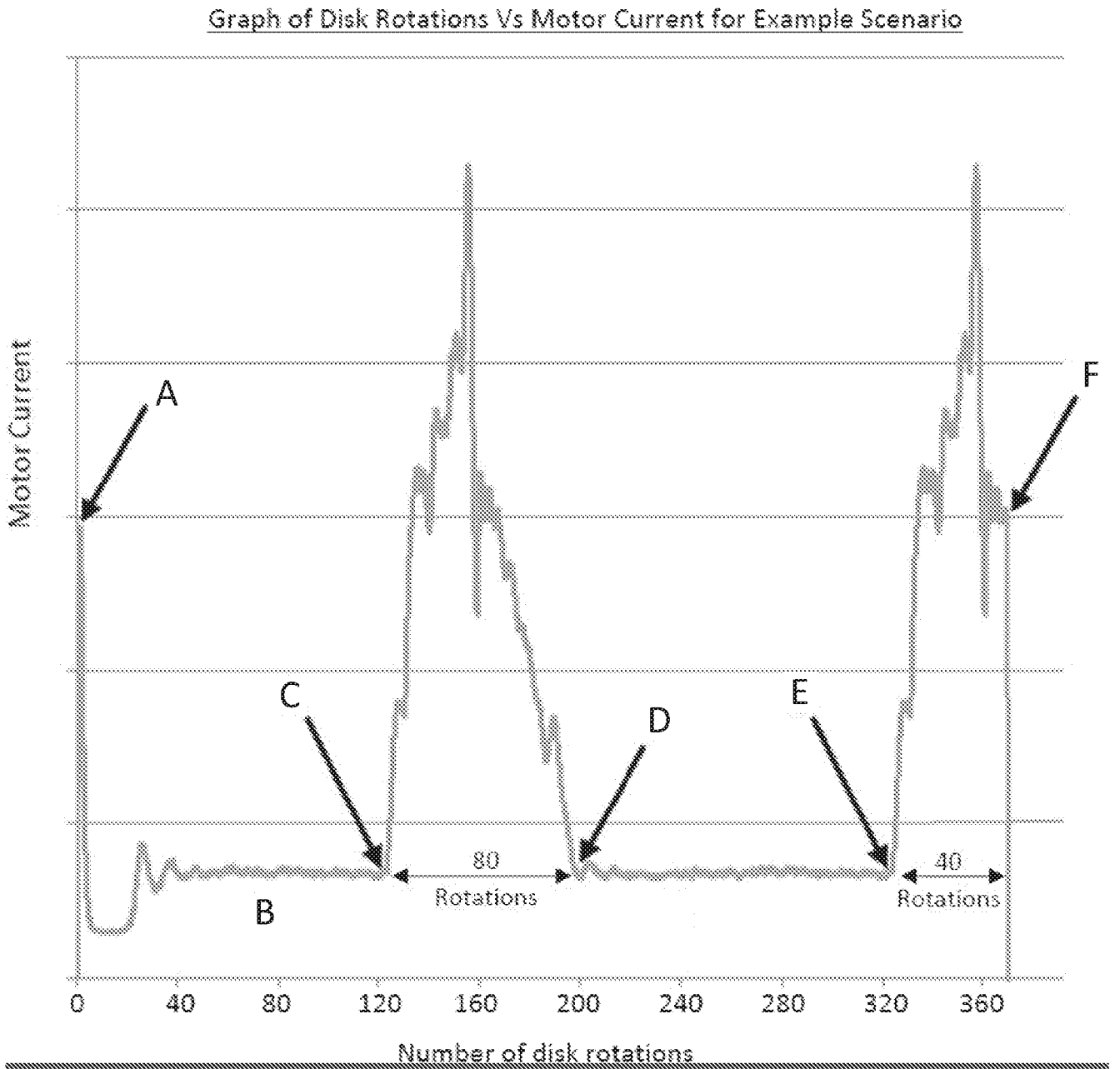


Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2017/052010

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47J43/25 A47J43/07 A47J43/08
ADD.
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)
A47J B26D G07F
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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 774 275 A1 (DITO SAMA [FR]) 6 August 1999 (1999-08-06)	1-8, 15-22, 24,27, 29-34, 41-44
Y A	page 1, line 1 - page 4, line 28 figures	25,26 9-14, 35-40
X	----- US 3 823 821 A (WALLACE G) 16 July 1974 (1974-07-16) column 6, line 6 - column 27, line 9 figures	1,15-17, 20-24, 27-30,41
Y	----- US 2009/080285 A1 (BROTZ JOHN C [US] ET AL) 26 March 2009 (2009-03-26) paragraph [0034] - paragraph [0039] ----- -/--	25

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents :

"A" 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 31 August 2017	Date of mailing of the international search report 07/09/2017
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer López-García, G
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INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2017/052010

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005/096786 A1 (KIM JUN-HO [KR]) 5 May 2005 (2005-05-05) paragraph [0031] -----	26

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2017/052010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2774275	A1	06-08-1999	NONE
US 3823821	A	16-07-1974	NONE
US 2009080285	A1	26-03-2009	NONE
US 2005096786	A1	05-05-2005	KR 20050028540 A 23-03-2005
			US 2005096786 A1 05-05-2005
			US 2007151204 A1 05-07-2007