(12) UK Patent Application (19) GB (11) 2551126 (13) A

(43) Date of A Publication 13.12.2017

(21) Application No: 1609765.1

(22) Date of Filing: 03.06.2016

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(51) INT CL:
A47J 43/08 (2006.01) ***A47J 43/04*** (2006.01)
B01F 7/30 (2006.01)

(56) Documents Cited:
GB 2515552 A **CZ 000003813 U1**
FR 002405685 A1 **SU 001836134 A3**
US 20040145965 A1

(58) Field of Search:
INT CL **A47J, B01F**
Other: **WPI, EPODOC, TXTA**

(54) Title of the Invention: **Food processor**
Abstract Title: **Food Processor**

(57) A food processor 100 comprises a receptacle 02, a rotary tool 05 for processing food in the receptacle 02, which is driven in a planetary-like motion about a first axis 06 and a central or main axis 12, wherein a radial distance between an inner sidewall of the receptacle 02 and the central axis 12 varies depending on angular position relative to the central axis, and the rotary tool 05 comprises a first tool element that extends radially away from the main axis 12 by a distance greater than a minimum radial distance between the sidewall and the main axis 12 during part of the movement of the rotary tool 05 about the second axis 12. The tool is preferably driven by a planetary drive assembly allowing dynamic changing of the gearing ratio, and the receptacle 02 is preferably a non-circular bowl, e.g. square, triangular, oval, hexagonal, pentagonal etc. The bowl may include an RFID tag to ensure that the optimum parameters for the bowl type are set. The food processor may comprise a safety sensor that detects the position of the sun and/or planetary gears to detect an unsafe condition, e.g. broken or damaged teeth.

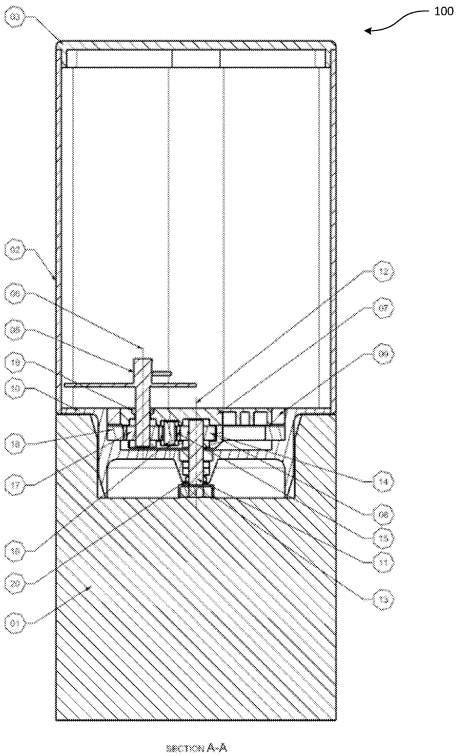

Figure 4

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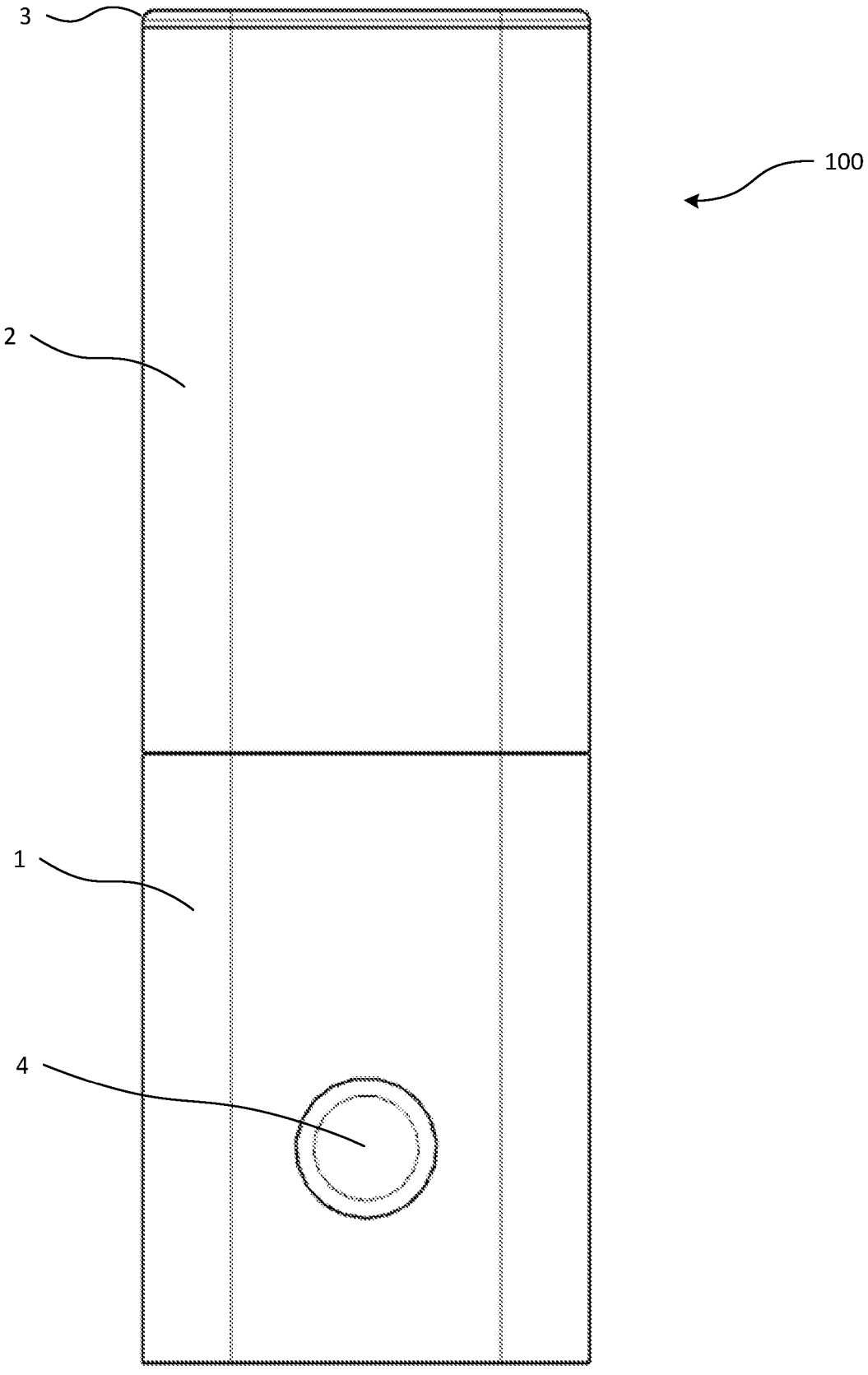


Figure 1

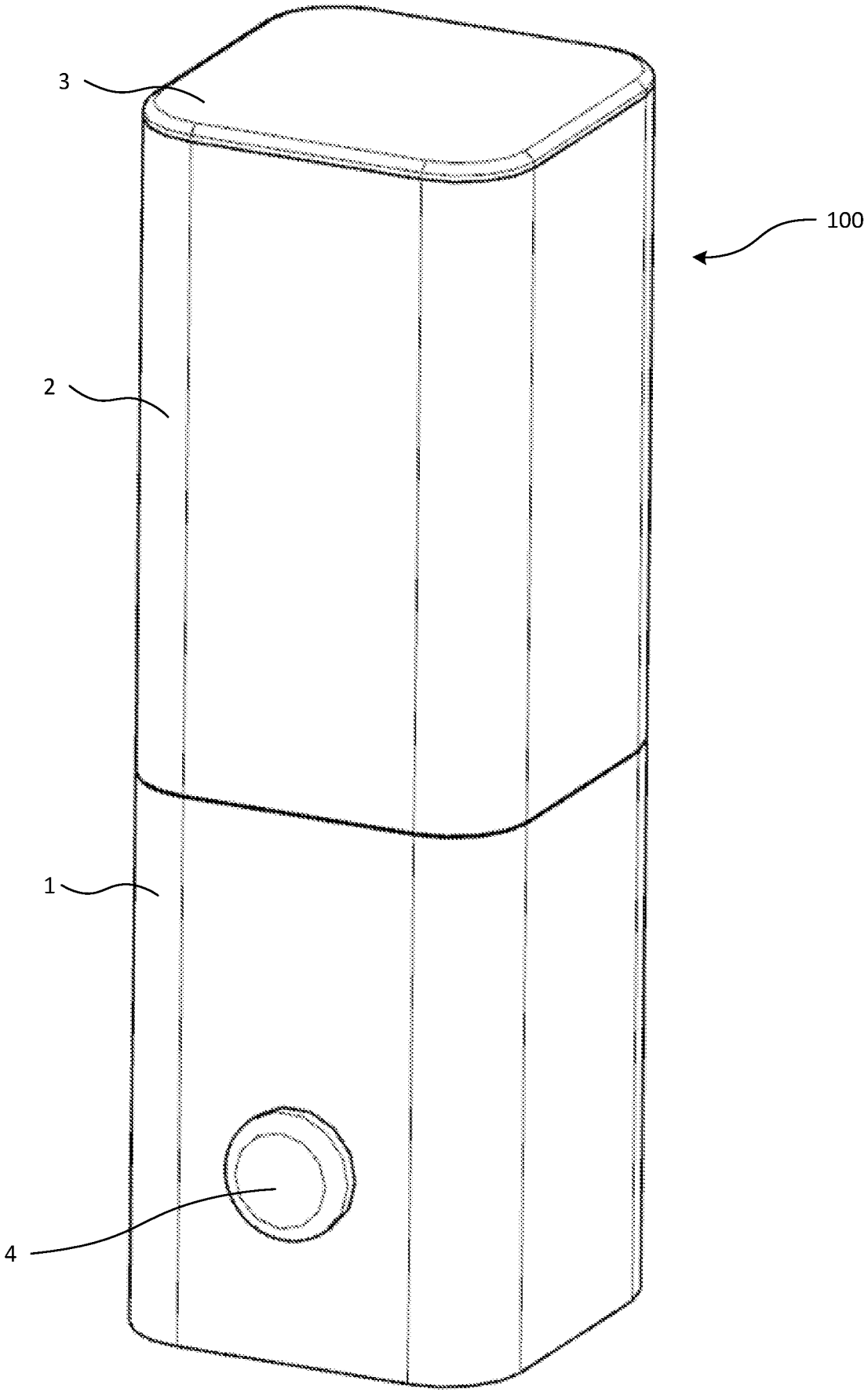
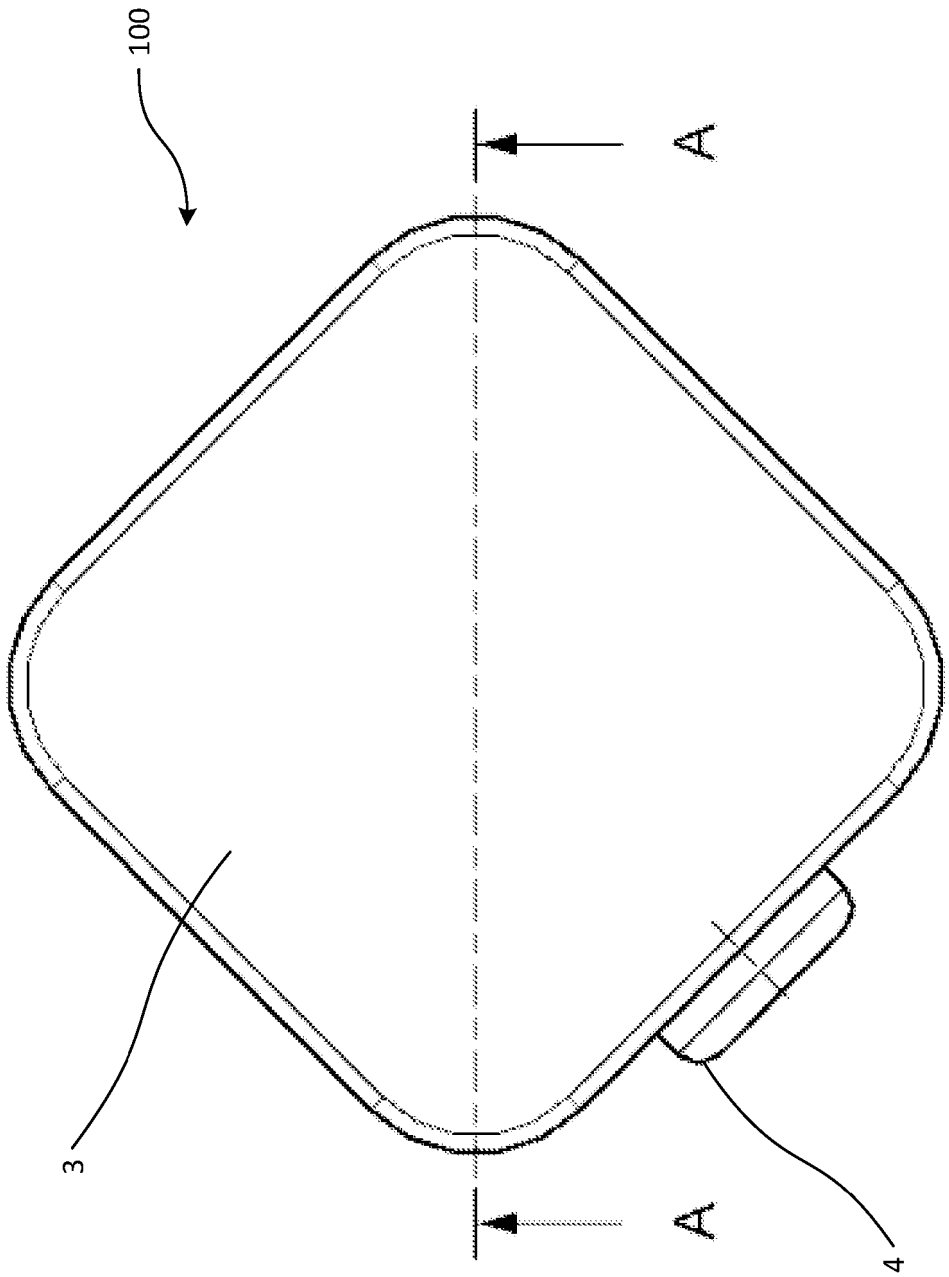


Figure 2



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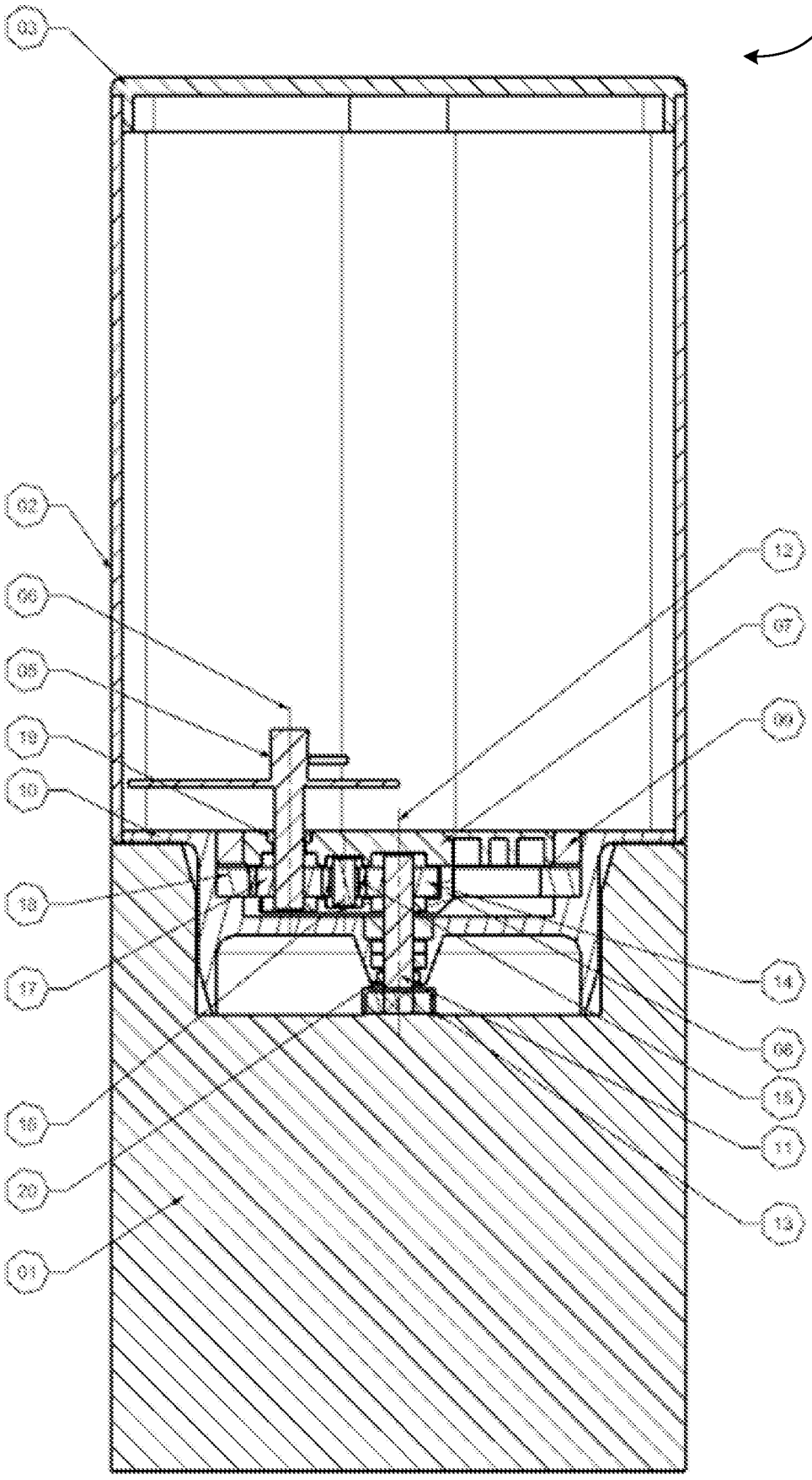


Figure 4

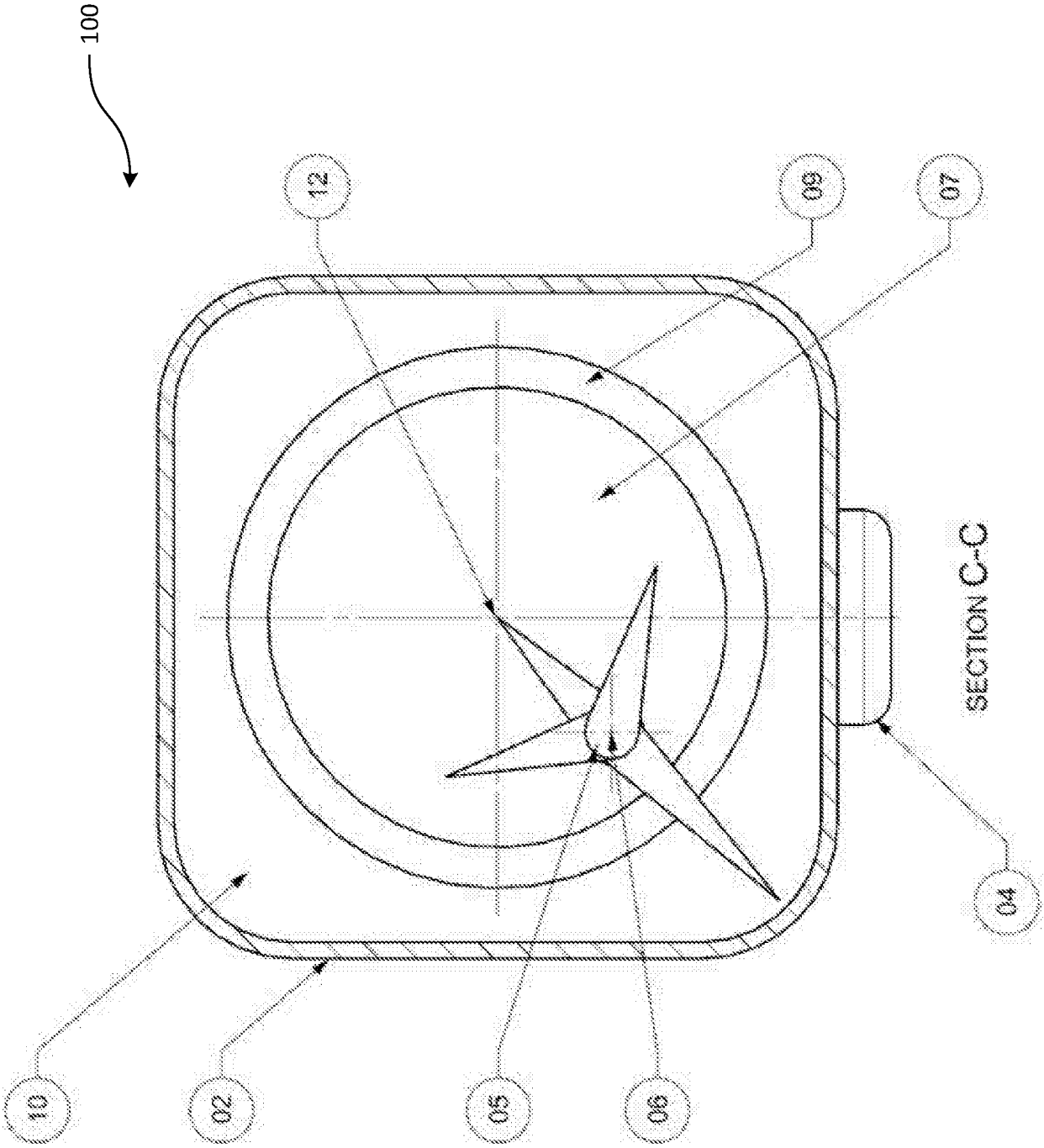
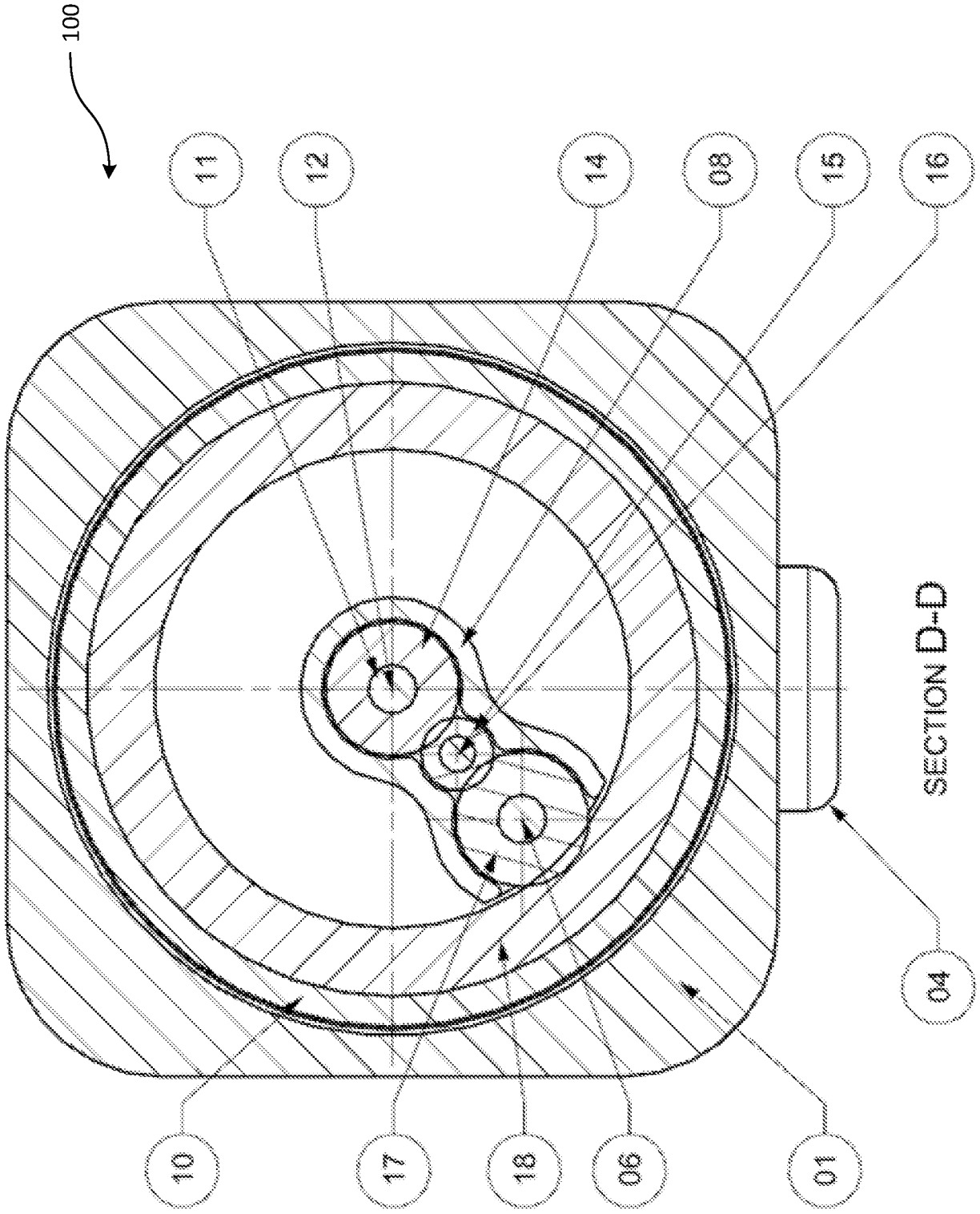


Figure 5



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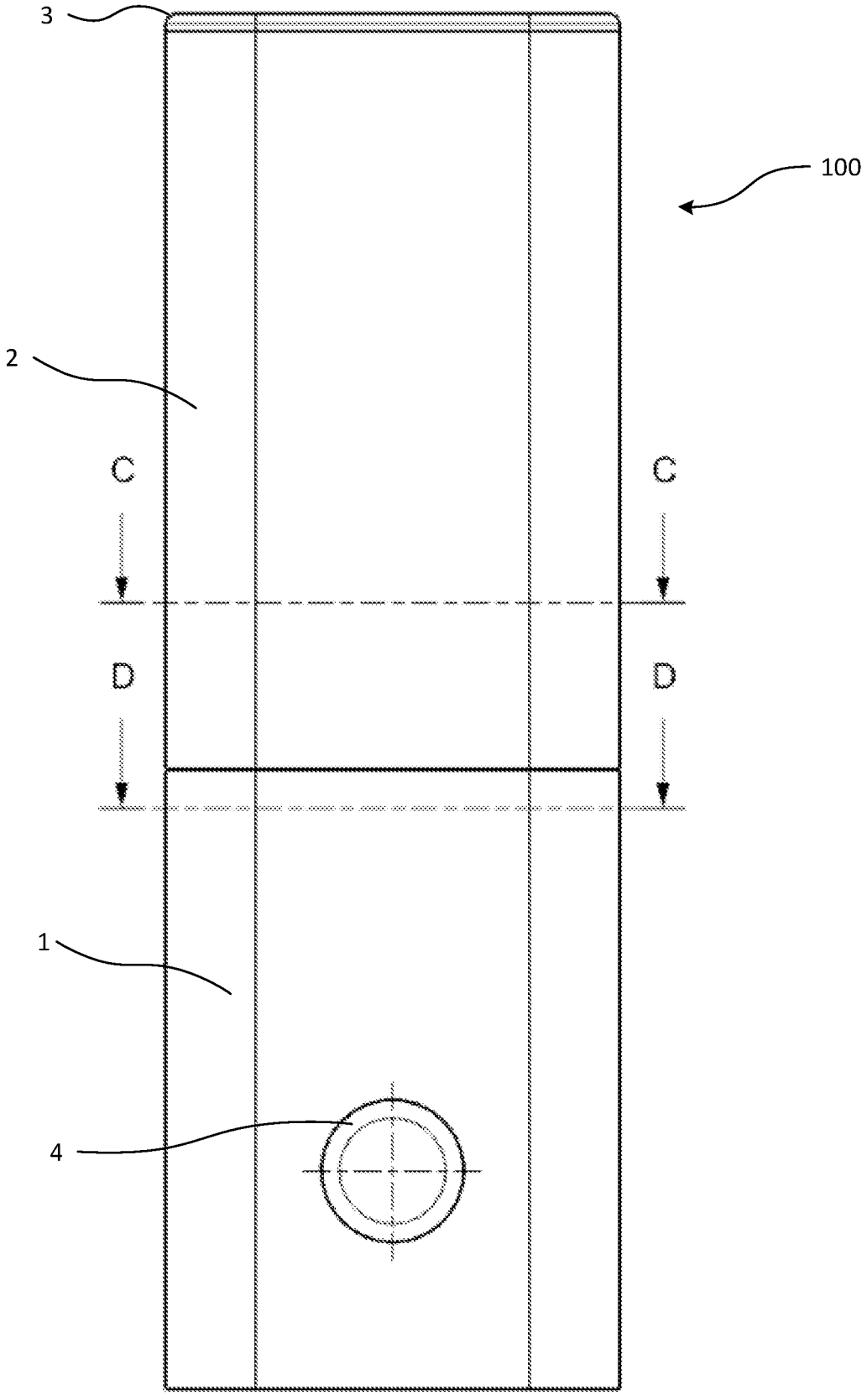

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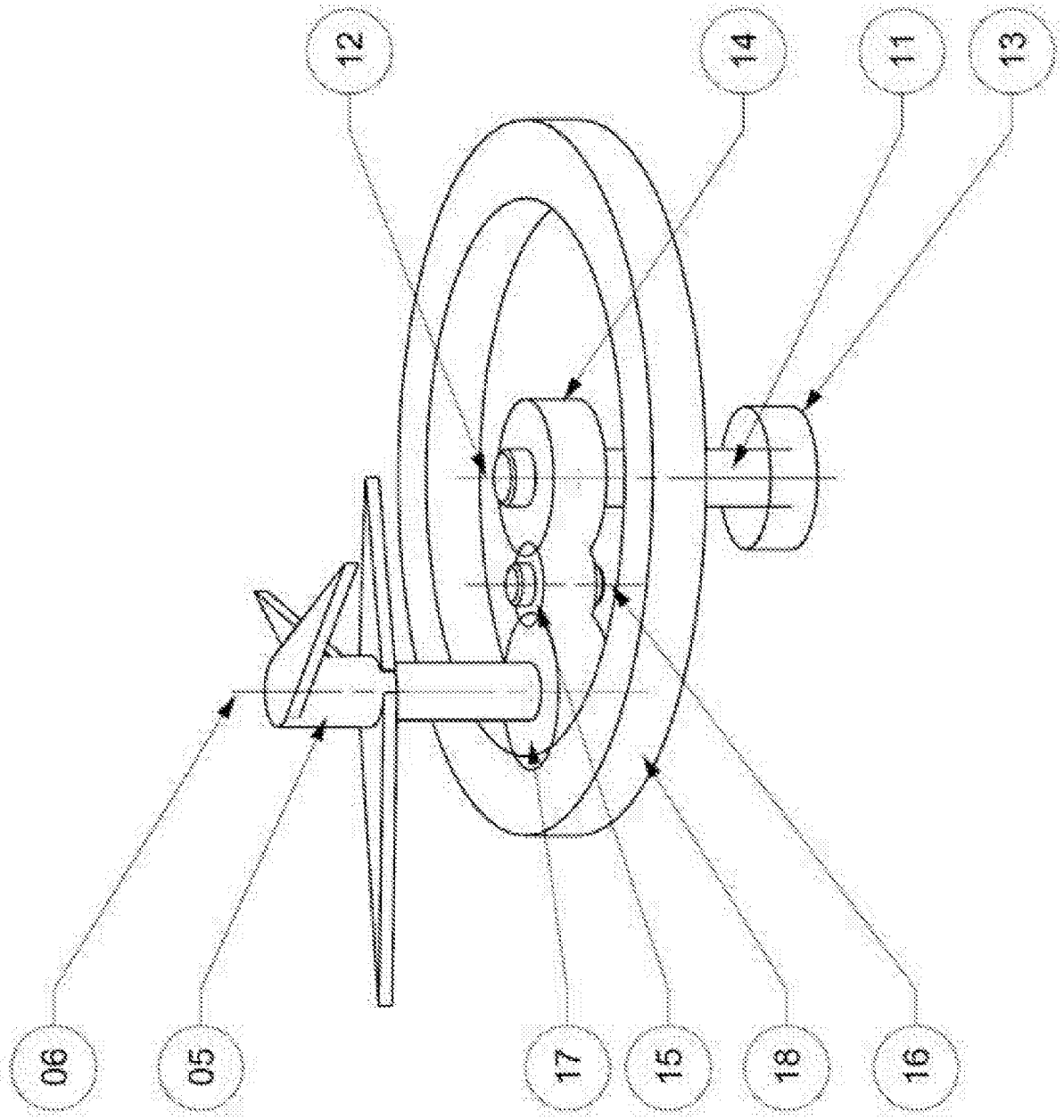


Figure 8

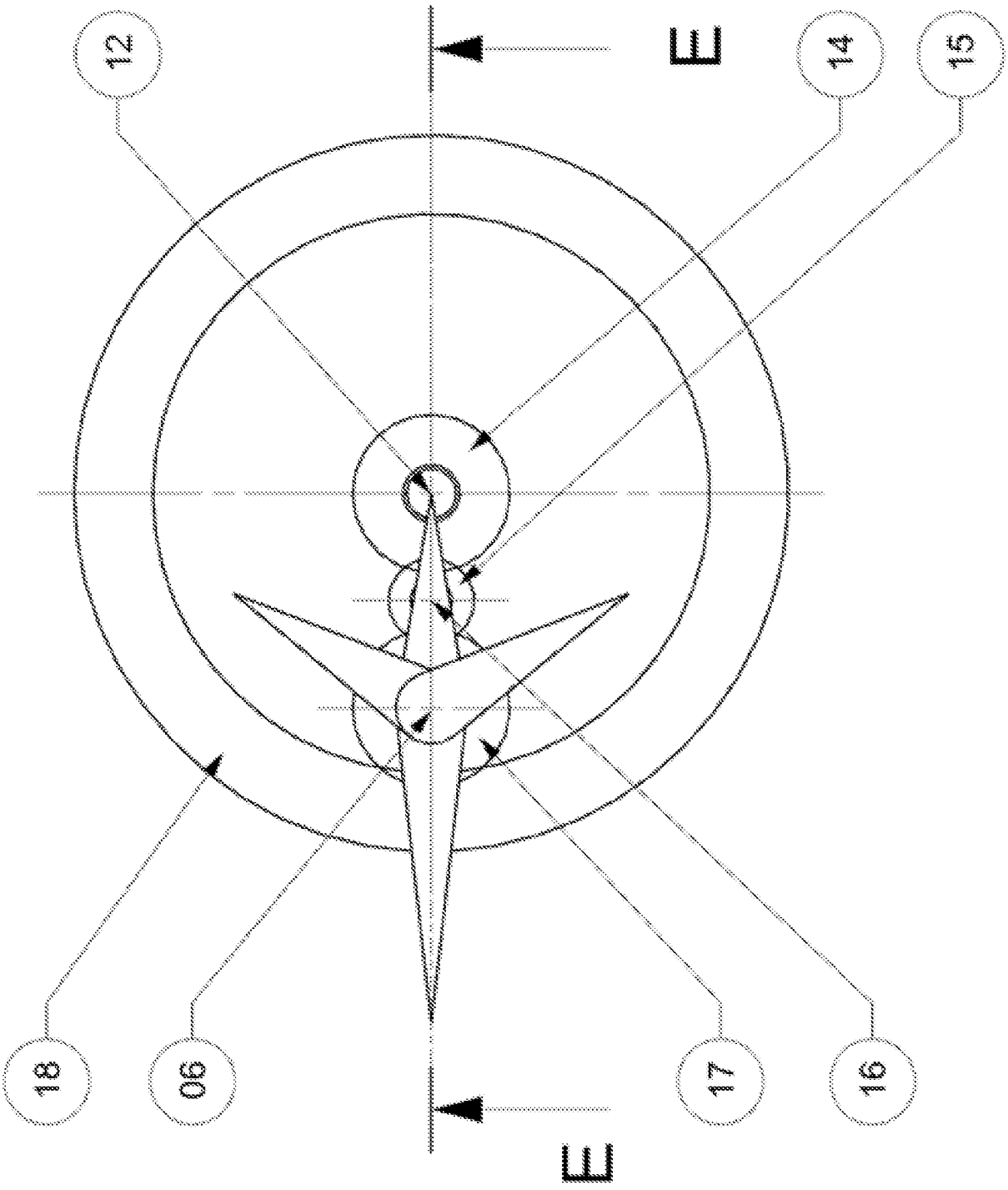


Figure 9

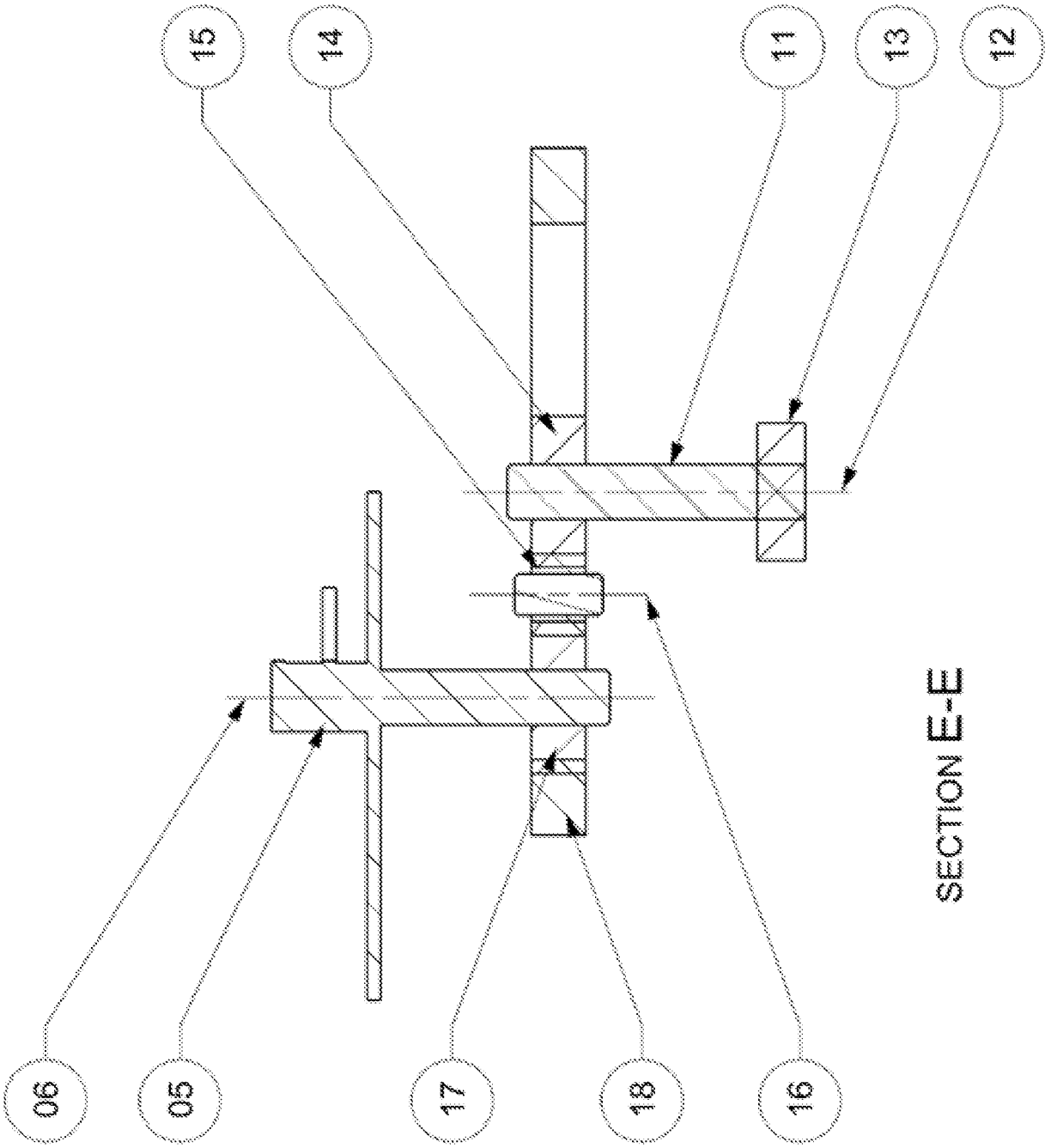


Figure 10

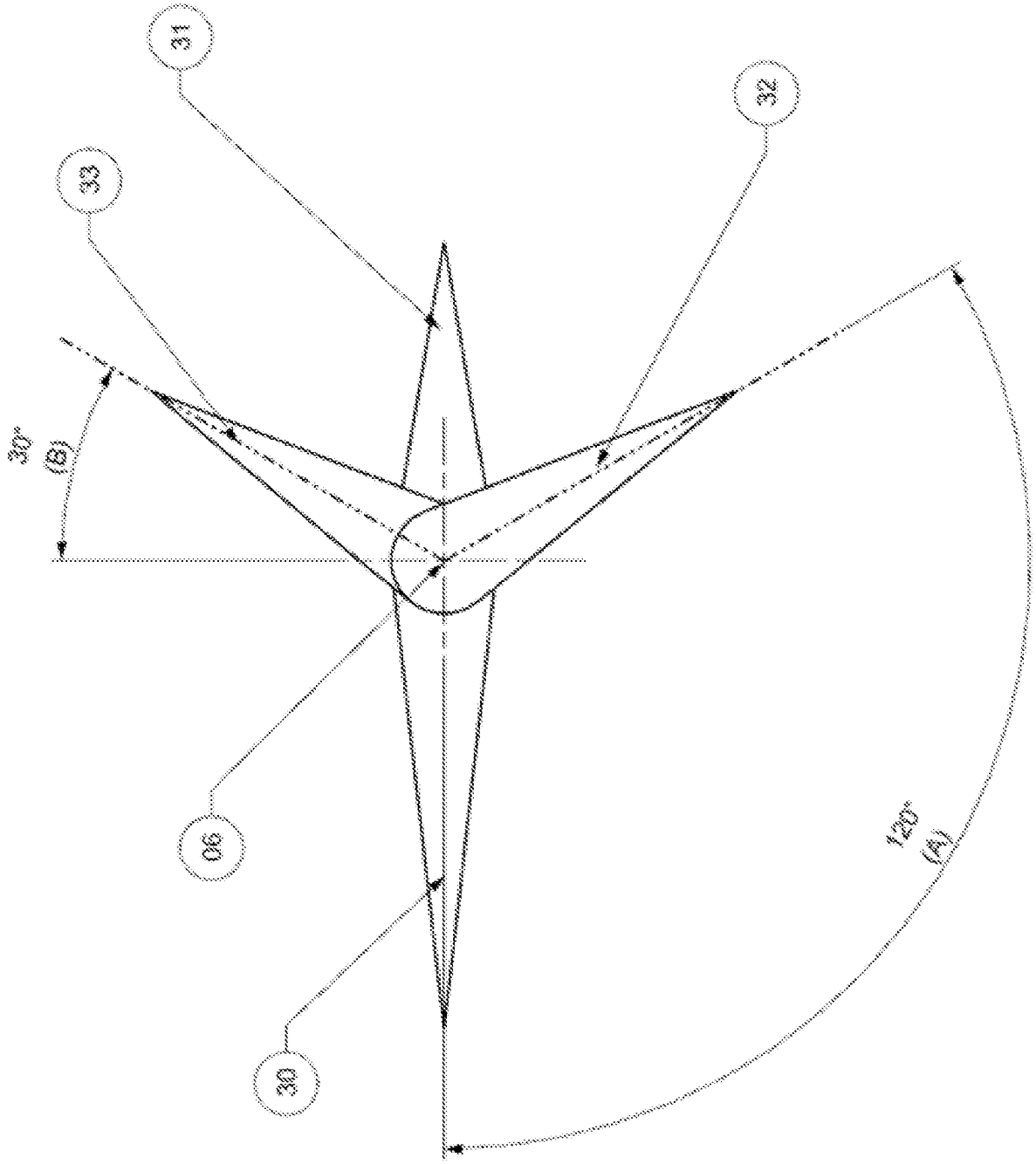


Figure 11

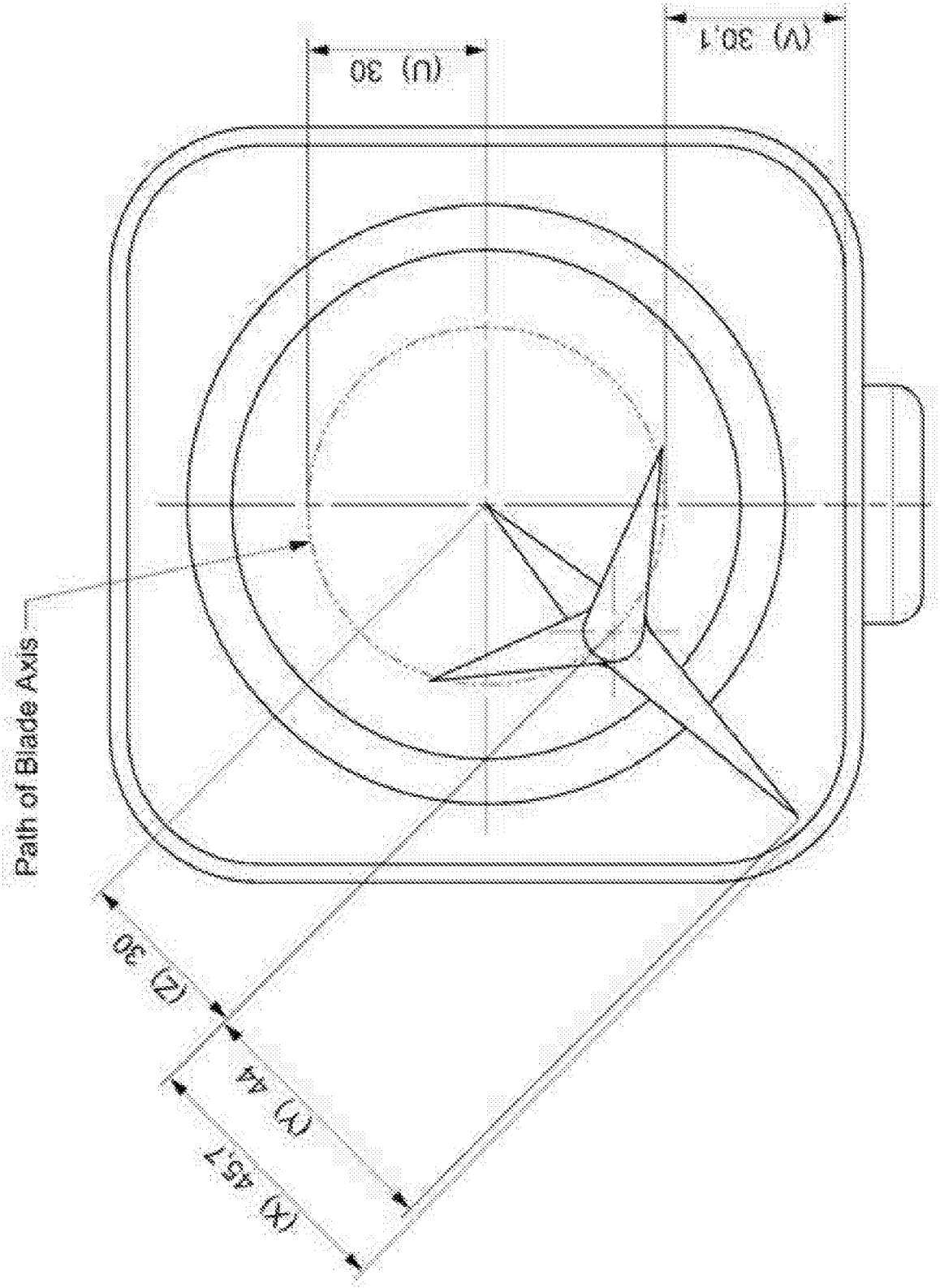
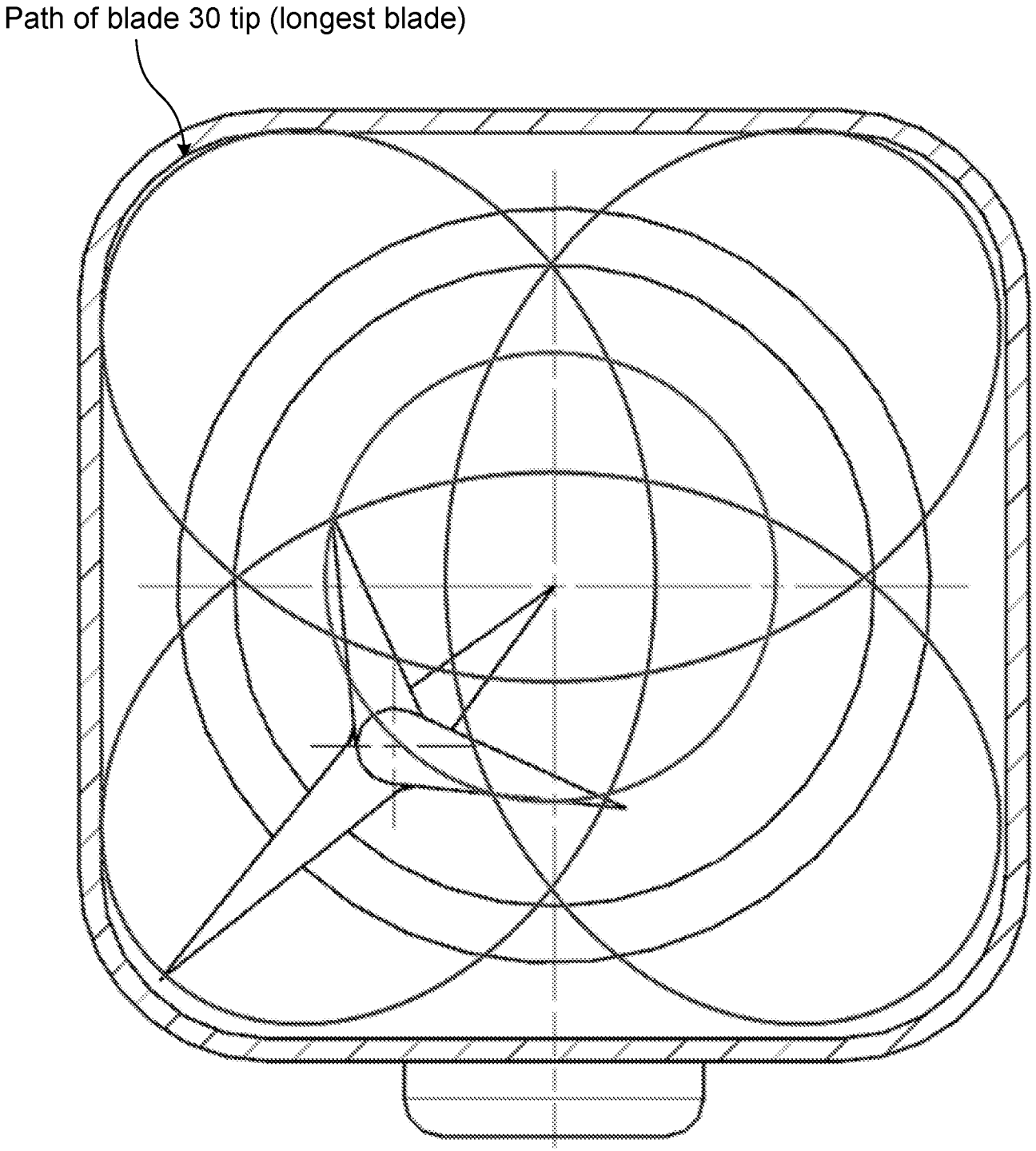
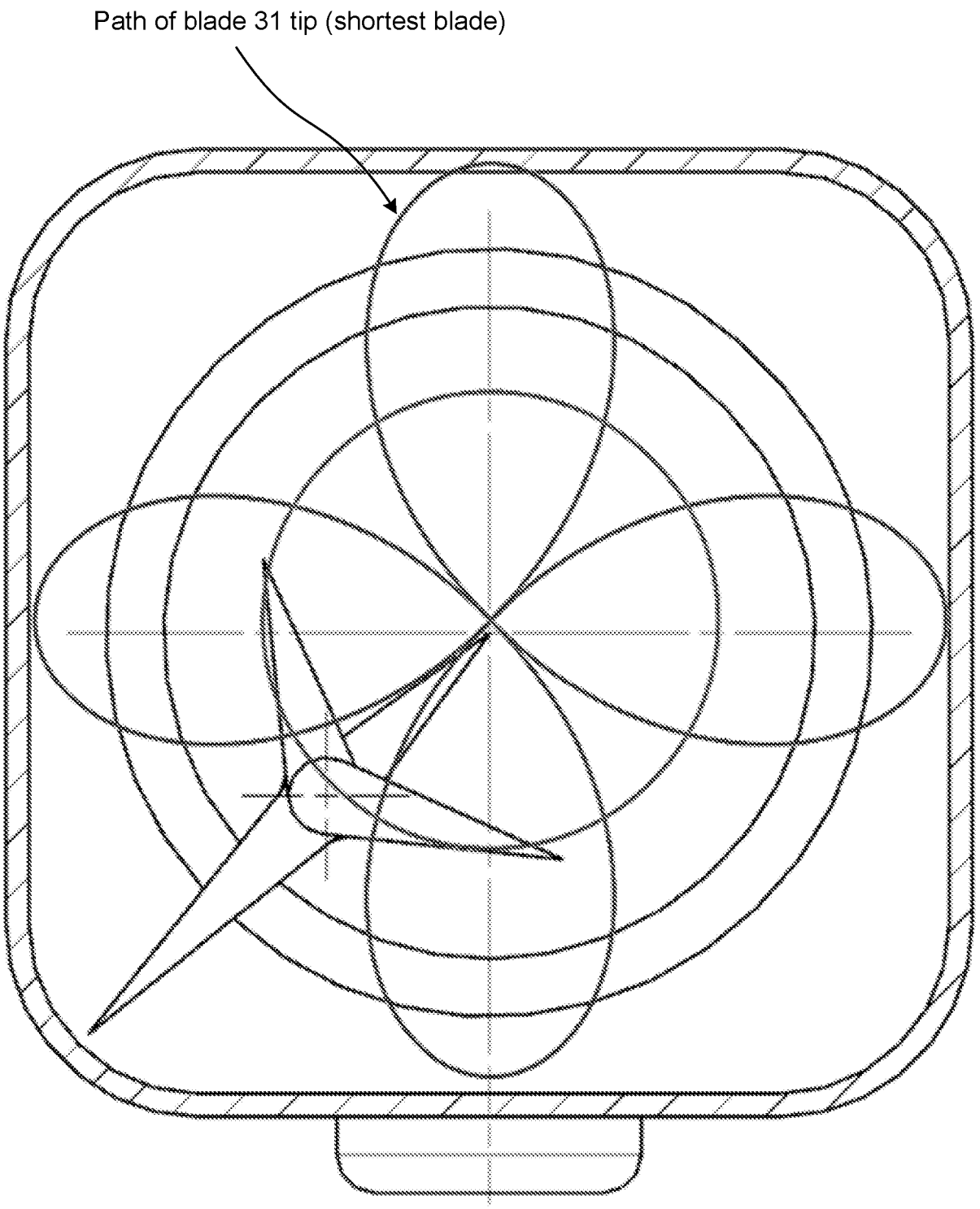


Figure 12



SECTION C-C

Figure 13



SECTION C-C

Figure 14

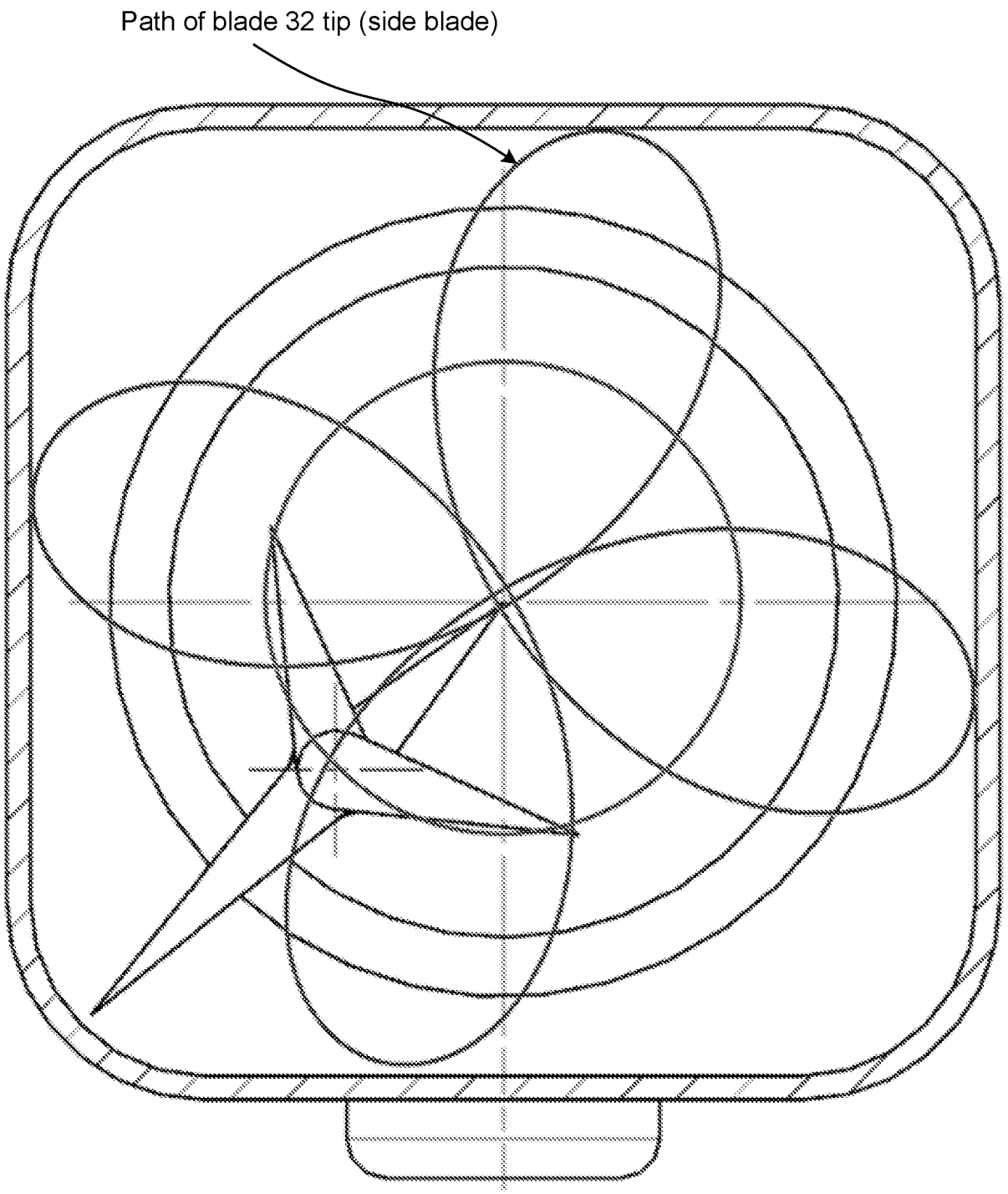
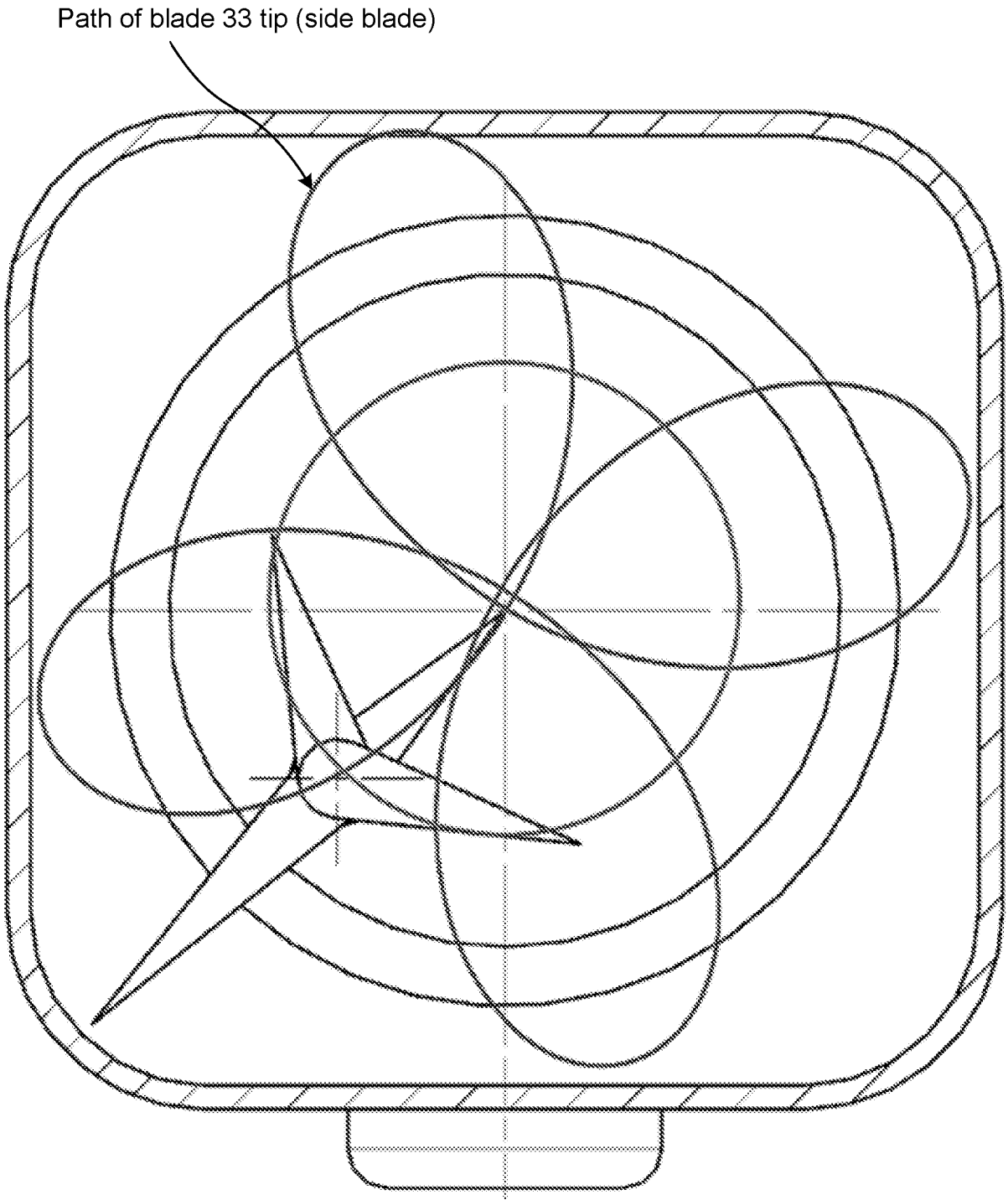
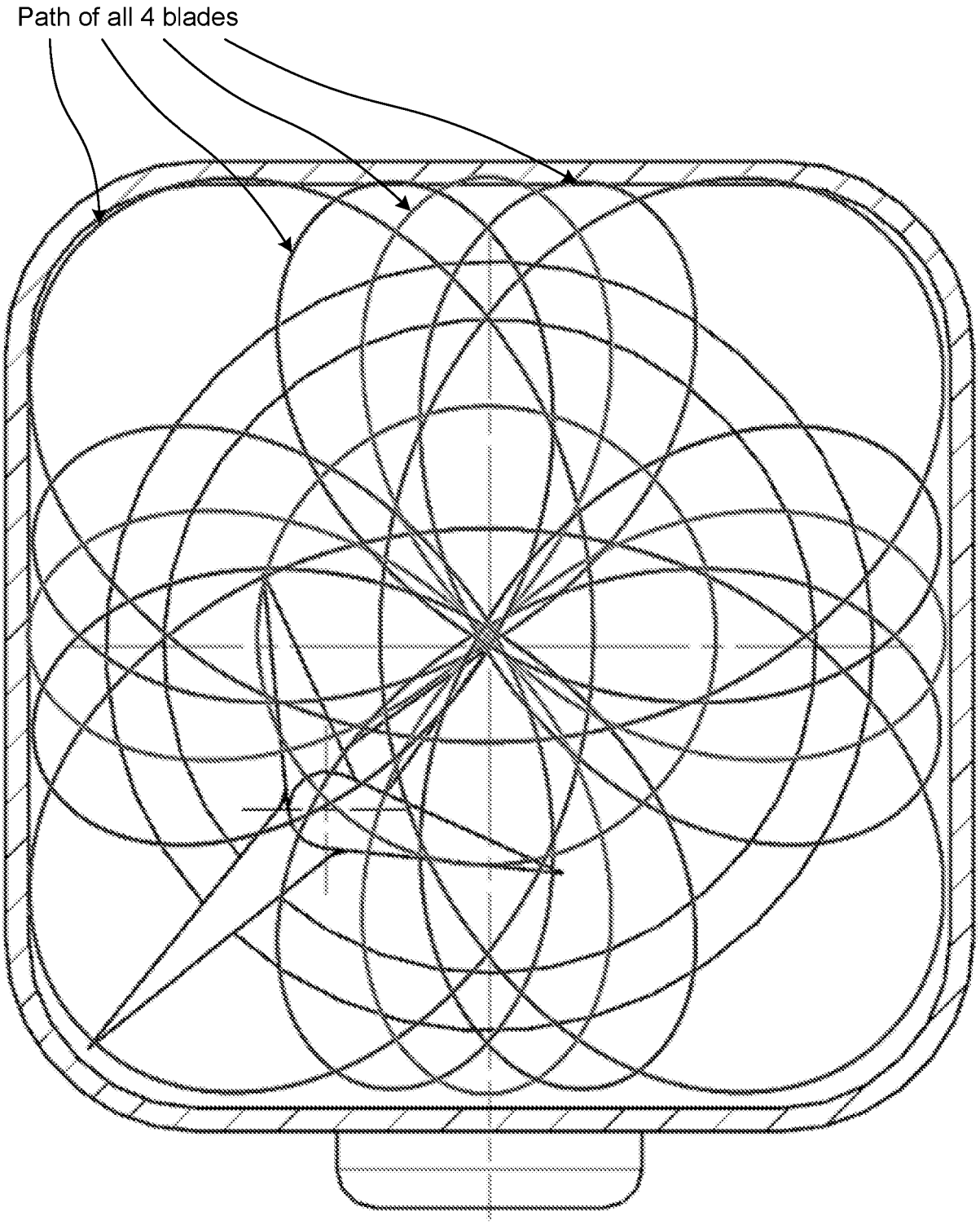


Figure 15



SECTION C-C

Figure 16



SECTION C-C

Figure 17

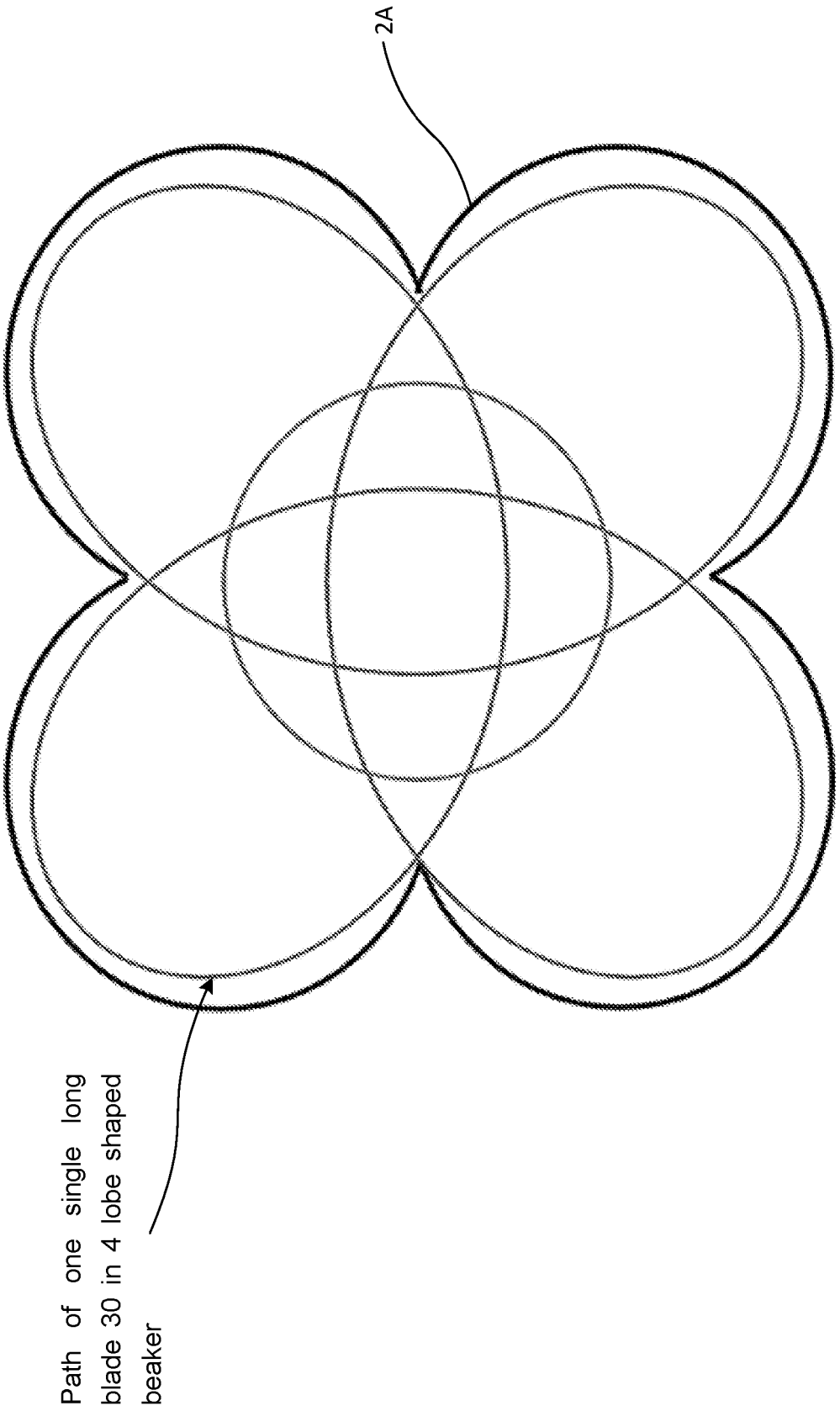


Figure 18

Path of one single long blade 30 and one short blade in 3 lobes (triangle) shaped beaker

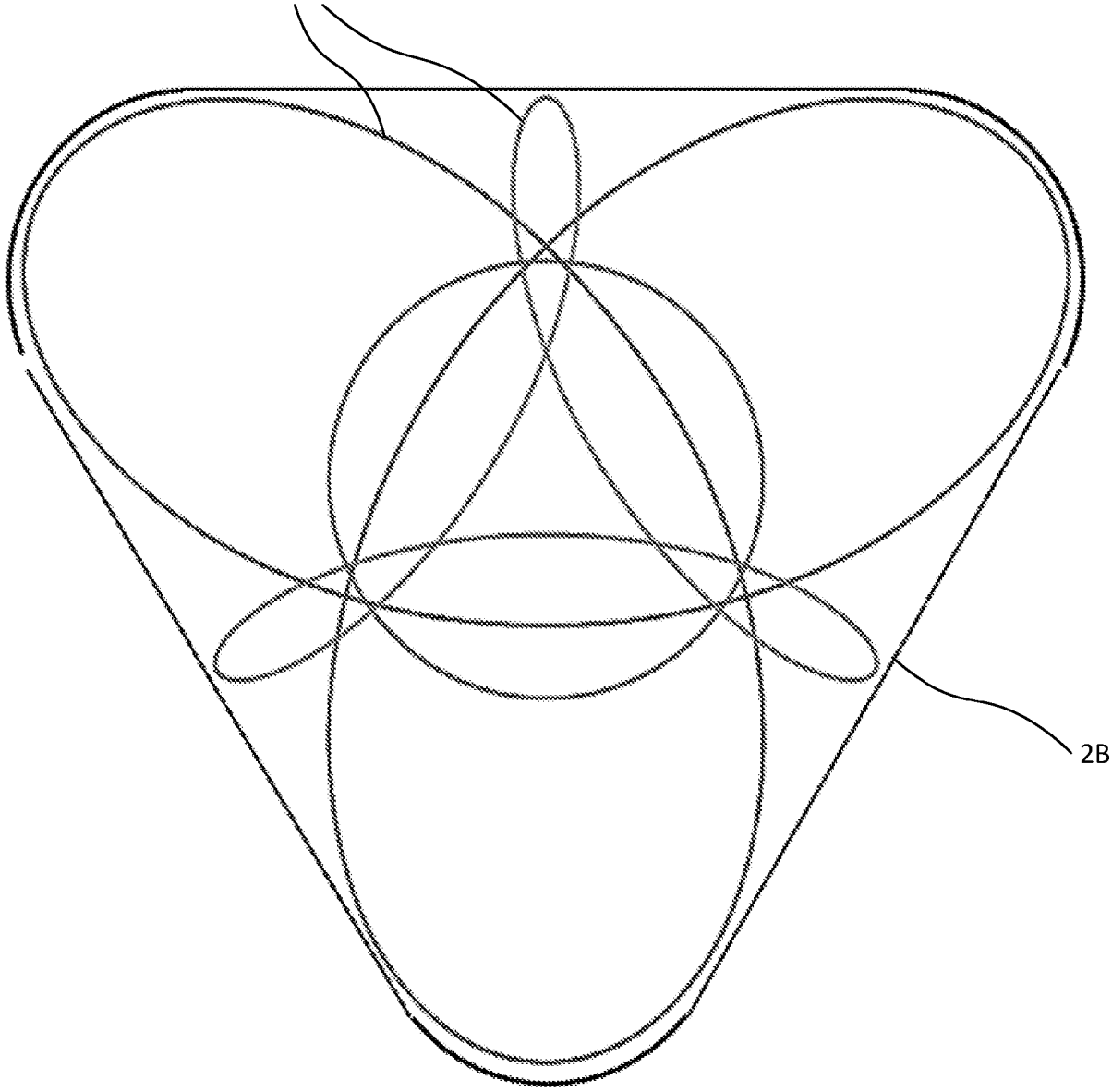


Figure 19

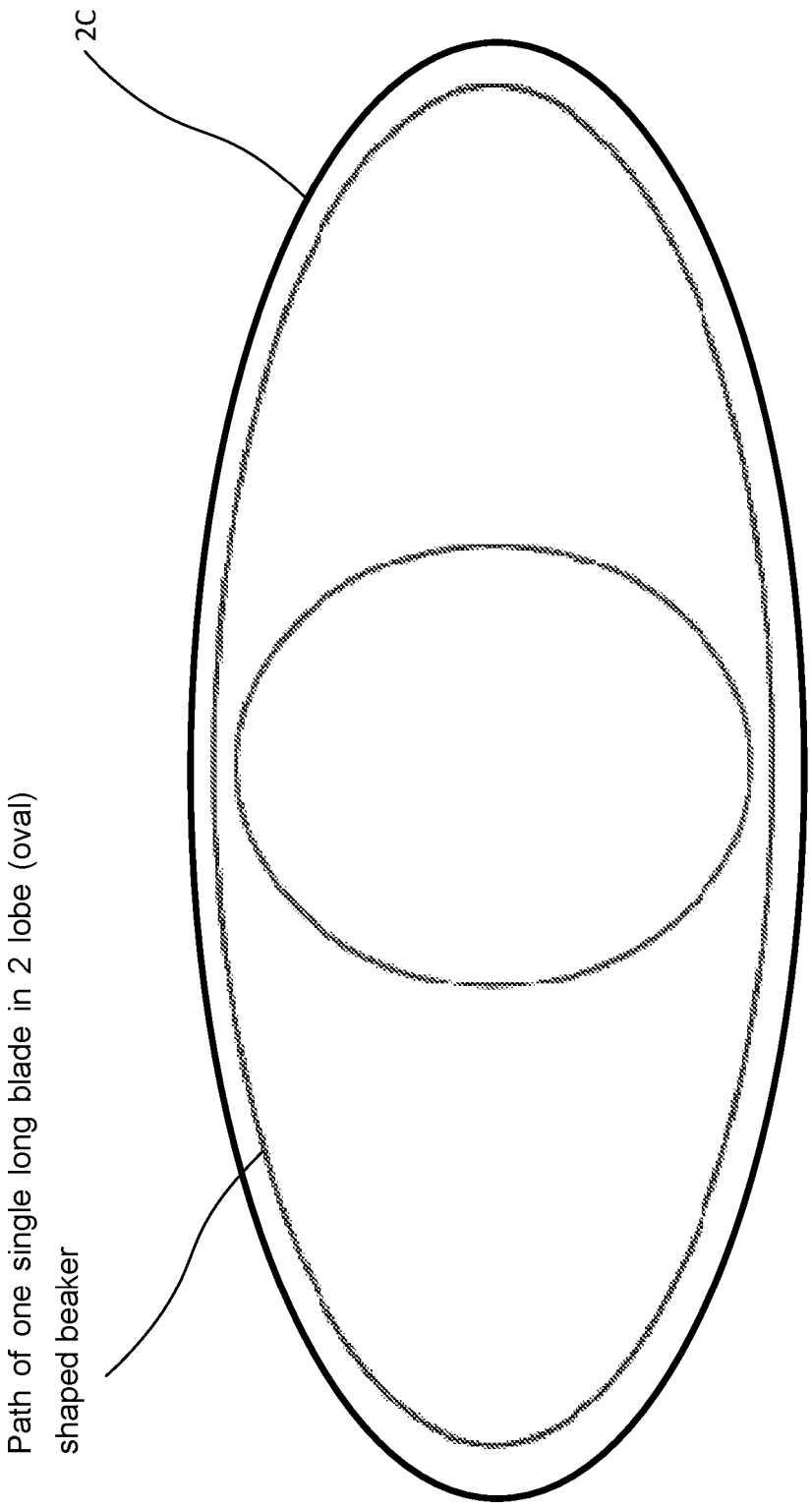


Figure 20

FOOD PROCESSOR

Field

The present invention relates to a food processor device and, more particularly, to a tool arrangement for a food processor device.

Background

Typically a food processing appliance, such as a blender or a stand-mixer, is a multipurpose kitchen appliance which helps and reduces physical work required while food preparation and cooking. A food processing appliance is a motor-driven kitchen machine in which a rotary tool (e.g., rotary blades) is typically mounted in the base of a food receptacle (e.g., bowl) and driven from beneath the receptacle by means of a suitable drive coupling from an electric motor. Alternatively the tool may be mounted above the receptacle, and depend into it, receiving drive from the motor via an arm unit, as in the case of a typical stand-mixer.

Food processing appliance food receptacles have traditionally been cylindrical in shape, with the major axis of the receptacle aligned with the fixed rotational axis of the tool and motor assembly. In such an arrangement, centrally-rotating tools can easily reach close (e.g., 5mm or less) to the inner side-wall of the receptacle through their entire rotation.

However, in recent years there has been a fashion for non-cylindrical receptacles, including receptacles that have a square-sided, hexagonal, rectangular, ovular/ovoid, triangular, or any other non-circular foot-print. These non-cylindrical receptacles are advantageous in that they are easier to grip and deter the formation of standing vortices. However, by contrast with the cylindrical containers, traditionally centrally-rotating tools rotating about fixed axes of rotation cannot reach proximate to the side-wall of the receptacle throughout their entire rotation as they can only be as long as the minimum distance between the side-wall of the receptacle and the fixed axis of rotation and thus cannot reach into the corners of the receptacle. This creates dead-zones and food-traps where food can collect without being processed, leading to inefficient processing and potential health-hazards.

Whilst these dead-zones can be reduced in size by increasing the speed of rotation of the rotary tool, this also increases the noise generated by the machine, and the faster the blade spins, the faster the food in the container also spins, so the relative speed between the blade and the food is not increased proportionately. This is inefficient.

The applicant's patent application doc. no. GB2508236A disclosed a way for achieving a food processing blade with improved performance. Whilst this does not have a tool rotating about a fixed axis of rotation, but instead discloses a tool rotating about an axis that in turn moves in a planetary motion about the centre of the receptacle, this arrangement does not entirely overcome the above-described problem of processing in non-cylindrical receptacles.

This invention therefore seeks to address the draw-backs of the prior art.

Summary of Invention

In one aspect of the invention, a food processing appliance comprises a receptacle for receiving food to be processed, a rotary tool having a first tool element for processing food in the receptacle; wherein the rotary tool is arranged to be driven to rotate about a first axis and simultaneously driven to move bodily about a second axis different to the first axis; and wherein the receptacle is shaped such that a radial distance between an inner sidewall of the receptacle and the second axis is not constant; and wherein during part of the rotary movement of the rotary tool about the second axis, the at least one tool element extends radially away from the second axis by a distance greater than a minimum radial distance between the sidewall of the receptacle and the second axis, so as to extend closer to the sidewall of the receptacle. This is advantageous as it means that the first tool element can reach beyond the minimum radial distance between the second axis and the inner sidewall of the receptacle.

The rotary tool may comprise a second tool element that extends radially from the first axis by a smaller distance and at a different angular position to the at least one first tool element. These second tool elements may sweep areas left unswept by the first

tool elements. The at least one second tool element may extend from the first axis at a different axial locations from the at least one first tool elements. This means that axial locations differing to those at which the one or more first tool elements may be swept.

At least two first tool elements may be included in the rotary tool, which can be configured to balance the rotary tool about a centre of gravity concentric with the first axis. This can result in a balanced tool. Alternatively or in addition, the at least one second tool element can be configured to balance the weight of the first tool element(s) about a centre of gravity concentric with the first axis.

Optionally, the rotary tool is configured to be driven about the first axis and move bodily about the second axis by the planet gear of a planetary drive assembly. This can have the advantage of being relatively easy and cheap to construct. The planetary drive assembly can comprise a sun gear receiving rotary power from a motor of the food processor to rotate about the second axis, the sun gear being arranged to drive the planet gear to rotate about the first axis in interference with a ring gear, such that the planet gear simultaneously moves bodily about the second axis. The planetary drive assembly may further comprise an idler gear communicating rotary drive between the sun gear and the planet gear. This can allow the communication of driving force between the sun gear and the planet gear without loss of torque.

The planetary drive assembly can further comprise a gearbox permitting dynamic changing of the gearing ratio between the planet gear and the sun gear. This permits flexible operation of the planetary drive assembly. A data processor may also be included in the planetary drive assembly, in electronic communication with an actuator for selecting a gearing ratio of the gearbox, and a sensor for detecting an RFID tag of the receptacle, wherein the processor is arranged to select a gearing ratio based on feedback from the sensor. This allows the food processing appliance to adapt to different receptacles.

The data processor can be in electronic communication with a safety sensor and a motor of the food processing appliance, wherein the processor is operable to automatically reduce power to the motor, or power down the motor, on receiving feedback from the safety sensor indicating an unsafe condition. In this way unsafe operation can be avoided. The safety sensor may comprise one or more rotary-position

sensors arranged to detect a rotary position of at least one of the sun gear and the planet gear to detect an unsafe and/or broken gear-tooth condition.

The rotary tool may extend into the receptacle at an angle of less than 90 degrees relative to a base of the receptacle. This can have the advantage of deterring the formation of vortexes.

Optionally, the radial distance between the inner sidewall of the receptacle and the second axis have one or more minima and one or more maxima corresponding to different angular locations relative to the second axis, and the tool is driven to rotate about the first axis and to move bodily about the second axis such that the at least one first tool element reaches maximum extension away from the second axis at the angular location(s) relative to the second axis corresponding to the maxima, and optionally also to reach minimum extension away from the second axis at the angular location(s) corresponding to each minima. This ensures thorough processing of material within the receptacle by the first tool-elements. The number of maxima may be two or more, and the maxima may be substantially equally spaced around the second axis. This simplifies construction. Such maxima may comprise arcuate lobe-shaped sections defined by the inner wall of the receptacle. These arcuate lobe-shaped sections are more easily swept by the blade as it extends outwardly and retracts inwardly.

The one or more first elements may comprise only one first element, and the number of rotations the tool makes about the first axis for each time it moves bodily about the second axis is equal to the number of maxima minus one. This can allows efficient coverage of the interior of the receptacle. For example, the rotary tool can be arranged to rotate about the first axis at a speed relative to the rotation about the second axis such that the first tool element describes a consistent path relative to the receptacle.

The rotary tool can extend upwardly into the receptacle through the base thereof for use with a bottom-driven appliance. Alternatively or additionally, the rotary tool can depend downwardly into the receptacle through an upper opening thereof, such as for use with a mixer.

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

alternatively in terms of their corresponding structure, such as a suitably programmed processor and associated memory.

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 (e.g., as a file for use with a 3D printer to construct the apparatus and apparatus elements herein described), a method of transmitting such a signal, and a computer product having an operating system which supports a computer program for carrying out any of the methods described herein and/or for embodying any of the apparatus features described herein.

The invention also encompasses a kit of parts for constructing any of the apparatuses or apparatus elements herein described.

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 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 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.

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.

Brief Description of Drawings

One or more embodiments 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 a side-on view of a food processor according to the present invention;

Figure 2 shows a perspective view of food processor of Figure 1;

Figure 3 shows a top-down view of a food processor of Figure 1;

Figure 4 shows a section through the food processor along the line A-A of Figure 3;

Figure 5 shows a section through the line C-C of Figure 7;

Figure 6 shows a section through the line D-D of Figure 7;

Figure 7 shows a side-on view of the food processor of Figure 1;

Figure 8 shows a perspective view of a gearing arrangement according to the present invention;

Figure 9 shows a top-down view of the gearing arrangement of Figure 8;

Figure 10 shows a section through the line E-E of Figure 9;

Figure 11 shows a top-down view of a tool according to the present invention;

Figure 12 shows a top-down view of a tool, receptacle, and tool axis path according to the present invention;

Figure 13 shows a top-down view of a path of a tip of a tool blade according to the present invention;

Figure 14 shows another top-down view of a path of a tip of a tool blade according to the present invention;

Figure 15 shows a different top-down view of a path of a tip of a tool blade according to the present invention;

Figure 16 shows yet another top-down view of a path of a tip of a tool blade according to the present invention;

Figure 17 shows a top-down view of the path of four tool-blade tips according to the present invention;

Figure 18 shows a top-down view of a path of a tip of a tool blade in a four-lobed receptacle according to the present invention;

Figure 19 shows a top-down view of the paths of two tips of tool blades in a three-lobed receptacle according to the present invention; and

Figure 20 shows a top-down view of the paths of a tip of a tool blade in a two-lobed receptacle according to the present invention.

Specific Description

Figs. 1, 2, and 3 show a working-medium processing machine (in this example, a food processor) 100. In this example the food processor 100 is divided into a base 01 and a removable receptacle 02 into which working medium can be placed for processing. The base contains a motor (not shown) and a control knob 04 for controlling the food processor 100 (though other control means could be used including a touch-screen, microphone with a voice-recognition module, wireless control by a mobile device or external server etc.). The receptacle 02 includes a removably attachable lid 03. Whilst receptacle 02 is removably attachable to base 01, it could instead be integrally formed with it.

Both the base 01 (which forms the main body of the food processor 100) and the receptacle 02 (in this case, a beaker) have a roughly square foot-print (i.e., are square when viewed from above) and are roughly rectangular parallelepiped-shaped (or cuboid) as a whole. However, either or both of the base 01 and the receptacle 02 may be of another shape, including triangular, ovular (or oval-shaped), flower-petal (i.e., a central circle from which one or more arcuate 'lobes' extend), hexagonal, pentagonal, or another non-circular shape (or, indeed, a circular shape that is not centred on the central axis 12) in foot-print, or may be circular at the base but vary in shape above the base.

As shown in Fig. 4, which is a cut-away through the food-processor 100 along the line A-A in Fig. 3, the receptacle 02 is removably attachable to a base 01 by locking elements or a screw-thread (not shown) that screw into or lock with matching locking elements/screw threads in the base 01 (also not shown). The Receptacle 02 includes a receptacle base 10 in which a cavity is formed that that contains a planetary gear assembly 14, 15, 17, 18.

As can be seen also in Figs. 8 and 10, the planetary gear assembly 14, 15, 17, 18 comprises a sun gear 14 receiving drive from the main shaft 11 which is in urn

connected to the motor in base 01 by drive coupling 13. Sun gear 14 rotates about central (or main) axis 12, and an idler gear 15 which receives drive from sun gear 14 rotates about about idler axis 16. Planet gear 17 in turn receives drive from idler gear 15 and rotates about a tool (in this case, blade) axis 06 that drives the tool (in this case, a blade-assembly with an upright axle driving one or more blades to rotate) 05 to rotate around blade axis 06. As the planet gear 17 is inter-meshed about its circumference with a ring gear 18 that is mounted concentrically with the main axis 12, when planet gear 17 rotates this also results in it being driven about the main axis 12, causing the tool 05 and the carrier 07 through which the tool 05 extends to also rotate about main axis 12. Whilst tool 05 is shown as extending at a right-angle to the carrier 07, it could extend by another angle less than 90 degrees, such as 45 degrees, thus helping to deter vortex-formation.

The intermeshings of the gears of the planetary assembly 14, 15, 17, 18 are shown by the over-lapping circles of gears 14, 15, 17, and 18 in Figs. 6 and 8. These inter-meshings can be square-edged or saw-shaped teeth, or another form known in the art. Alternatively these gears may have rounded circumferences made of a resilient material (e.g., rubber) and drive each other frictionally. In an additional alternative, the gears 14, 15, 17, 18 could be partially or wholly replaced by belt-drive mechanisms, pulleys, bevel-gears or other similar mechanisms for transmission of rotational drive.

As can be seen in Figs. 4, 5 and 9, the bottom-surface of the interior of receptacle 02 is co-operatively formed by the carrier 07 that supports the tool 05 as it rotates, and the base 10 that surrounds the carrier 07. A seal 09 is formed between the carrier 07 and the base 10 to ensure that material cannot escape from the receptacle as the carrier 07 rotates within the base 10. Additionally, a tool seal 19 is formed between the tool 05 and the carrier that serves the same purpose. These seals 09, 19 are preferably formed of a flexible, dish-washer and food-safe material such as rubber or artificial rubber to form a tight, food-safe seal. Where the food processor 100 includes a heating element in either the receptacle 02 or the base 01, or the food-processor is otherwise intended for use with hot material, these seals should also be heat-resistant (e.g., of temperatures in the range 90-200 degrees centigrade). Alternatively the carrier 07 may be stationary, with the tool 05 moving along a ring-shaped (or other suitable shape for a non-circular ring gear 18) hole seallingly defined through it.

In an alternative to the above, the planetary gear assembly 14, 15, 17, 18, carrier 07, and tool 05 may be integral to base 01, in which case receptacle 02 will be a "bottomless" receptacle that mates to base 01 about its circumference. In an additional alternative, the planetary gear mechanism 14, 15, 17, 18 is located in the base 01 but the tool 05 and carrier 07 are located in the receptacle 02 and the tool 05 is removable attachable to planet gear 17.

An example tool 05 is shown in Fig. 11. In this example the tool 05 is made up of tool-elements that in this case are four double-edged cutting blades 30, 31, 32, 33 extending at different angles from the central axle of the tool 05. One of these cutting blades 30 is significantly longer than the others 31, 32, 33 and separated from the shorter blades by a larger angle (e.g., 120 degrees) than they are from each other (e.g., 60 degrees). One of the short blades 31 extends in the opposite direction to the longer blade 30, whilst the other two (32, 33) extend from the axle of the tool 05 on either side of the short blade 31.

Whilst a separation angle of 120 degrees is shown between the long blade 30 and the short blades 31, 32, 33 in Fig. 11, this can be anywhere between 90 and 180 degrees. More preferably the angle should be between 100 and 130 degrees. Alternatively the shorter blades 31, 32, 33 may be omitted, or differ in number from one to any suitable number.

The short blades 31, 32, 33 may extend from the central axle of the tool 05 at the same height as the long blade 30 above the bottom-surface of receptacle 02 or at a different height, or indeed at different heights from each other, so as to maximise the processing volume of the tool 05. Being double-edged in this case is useful as the planetary-motion of the tool 05 means that it is possible that the blades 30, 31, 32, 33 will strike the working-medium being processed in either direction.

The short blades 31, 32, 33 are preferably of such a weight that they balance out the weight of the longer blade 30 about a centre of gravity concentric with the tool axis 06. This avoids uneven forces acting on the drive shaft of the tool 05. The gearing assembly 14, 15, 17, 18 can include a second planet-gear 17 on the opposite side of the sun gear 14 to the first planet gear 17, this may also have a rotary tool attached (thus increasing processing) and/or may be weighted so as to act as a counterbalance to the

first planet gear 17 thus reducing vibration of the machine during operation. Indeed, more than one additional planet gear may be included.

An example of the relative dimensions of the blades 30, 31, 32, and 33 and the receptacle 02 are shown in Fig. 12. Where a distance between the main axis 12 and the tool axis 06 (U) is 30 units, the length of the longest blade 30 (Y) is 44 units, and the length of the shorter blade 31 (Z) is 30 units, whilst the minimum distance between the path of the tool axis 06 and the inner sidewall of the receptacle 02 (V) is 30.1 units to ensure that the shorter blades 31, 32, 32 clear the inner side-wall of receptacle 02 by at least 0.1 units, resulting in a maximum distance (X) of 45.7 units between the path of the tool axis 06 and the inner sidewall of the receptacle 02.

In the roughly square footprint receptacle 02 shown in Fig. 12, the gearing of the planetary assembly 14, 15, 17, 18 may be ratioed such that during a single rotation of the tool axis 06 about the main axis 12 results in three rotations of the tip of the longest blade 30 about tool axis 06 (or 3/4ths of a turn per corner). The ring gear 18 causes the tool 05 to rotate about the tool axis 06 in a retrograde fashion – that is, in the opposite direction of rotation to that of the tool axis 06 about the main axis 12. An example of such ratioing would be for the sun gear 14 to have 20 teeth, the planet gear 17 to have 20 teeth, and the ring gear 18 to have 80 teeth. The purpose of the idler gear 15 in this arrangement is to communicate motive force between the sun gear 14 and the planet gear 17 whilst avoiding reduction in torque, however the idler gear 15 may instead be omitted and sun gear 14 be increased in size so as to contact planet gear 17 directly.

As is shown in Fig. 13, the combination of the blade-angles and blade-lengths of blades 30, 31, 32, 33, and the planetary gearing assembly 14, 15, 17, 18 with the above-described gear-ratios, allows the tip of the long blade 30 to enter into each of the corners of the receptacle 02, extending beyond the minimum distance between the path of the tool axis 06 and the inner wall of the receptacle 02. Meanwhile, as is shown in Figs. 14, 15, 16, and 17, the tips of the shorter blades 31, 32, 33 sweep the majority of the area missed by the long blade 30. This results in thorough processing of working medium within the receptacle 02 even where it is non-cylindrical, and has a square-footprint, thus eliminating dead-zones.

Figs. 18, 19, and 20 show similar arrangements of a blade that is longer than the minimum distance between the inner sidewall of the receptacle 02 and the path of the tool axis 06 operating without colliding with the inner sidewall of the receptacle 02 by extending outwardly proximate to the maxima and extending inwardly proximate to the minima.

Fig. 18 shows a receptacle 02A with a flower-petal-shaped footprint, which is to say an inner circle from which arcuate-lobe-shaped-spaces extend (in this case, four). In this case, where the gears are suitably ratioed, only the longest blade is needed to sweep the entirety of the interior, excepting the clearance-space between the blade and the inner wall of the receptacle 02. In this case the ratioing of the planetary gearing assembly can be the same as in the example of Fig. 13. Alternatively, a balanced blade of two long blades of equal length extending in opposite directions may be used, in which case the gearing ratio should be such that the tool 05 only rotates once for every single rotation of the tool axis 06 about the main axis 12 (or 1/4th of a turn per corner).

Fig. 19 shows a receptacle 02B with a roughly triangular-shaped footprint, albeit with rounded corners. In this case, where the gears are suitably ratioed, the longest blade 30 may sweep the majority of the footprint of the receptacle 02 with a single shorter blade 31 extending in the opposite direction to the long blade 30 sweeping a significant part of the remaining space unswept by the long blade 30. In this case the ratio of the gears should be such that during a single rotation of the tool axis 06 about the main axis 12 results in two rotations of the tip of the longest blade 30 about tool axis 06 (or 2/3rds of a turn per corner).

Fig. 20 show a receptacle 02C with an oval-shaped footprint - that is, a central circular part from which two arcuate lobes extend in opposite directions. A single long blade 30 may sweep the majority of the footprint of the receptacle 02 where the gearing is of a ratio such that the tool 05 rotates about the tool axis 06 once for every rotation of the tool axis about the main axis 12 (or a half-turn per corner). For a balanced tool 05 with two long blades 30 extending in opposite directions, the tool should also rotate about tool axis 06 once for each rotation of tool axis 06 about main axis 12.

In each of the above cases, where a single long blade 30 is used, the gearing is ratioed to produce rotation of the tool according to the following formula:

$$\frac{number\ of\ tool\ rotations\ about\ tool\ axis}{number\ of\ tool\ rotations\ about\ main\ axis} = number\ of\ corners - 1$$

Corners as described herein are the points located about the main axis 12 at which the inner sidewall of the receptacle 02 reaches a maximum distance from the main axis 12.

To ensure that the long blade 30 is positioned appropriately (i.e., extending outwardly proximate to the points at which the inner sidewall of the receptacle 02 reaches a maximum distance from the main axis 12, and inwardly at the minimum distances) during manufacture and assembly the position of the long blade needs to be set correctly in relation to the corners/"lobes" in the receptacle 02. This can be achieved by use of timed gears, marks on gears indicating where they should be turned to during assembly, tooth missing gears, assembly jigs and many other common methods. Similar methods can be used by the user during disassembly for cleaning.

Whilst the tool-elements of the above example are blades, other tool-elements may be used in any appropriate combination, including whisks, dough-hooks, stirring elements, scraping elements, flexible wipers, or other known rotary tools for processing working medium that may in turn include driven elements – for example a tool element may simply be an arm carrying a driven rotary tool on its extremity. Where the tool elements are intended to contact or come close to the inner walls of the receptacle 02 (e.g., to scrape or wipe them) the clearances can be reduced or eliminated.

Whilst the corners of the above example receptacles 02, 02A, 02B, and 02C are angularly separated by the same angle (e.g., the corners of the square-footprint receptacle 02 are provided 90 degrees apart relative to the centre of the receptacle) corners which are separated by differing angular separations may be catered for by altering the spacing of the teeth of the ring gear 18 so as to drive the tool 05 to rotate about its axis 06 more slowly over some parts of the rotation of the tool axis 06 about the main axis 12 than others. Additionally, the ring-gear 18 may be non-circular (e.g., oval-shaped), with rotational drive communicated between the sun gear 1 and the planet gear 17 by an extendable transmission means such as a stretchable drive-belt or telescoping-shaft bevel-gear arrangement, and planet gear 17 may be connected to a central hub by

a telescoping arm which is outwardly biased by e.g., a helical spring, to receive rotational drive to rotate about main axis 12.

The receptacle 02 and lid 03 are preferably made of a light, non-toxic, food-safe, dishwasher-friendly material such as glass, Tritan™ or another copolyester, or a different transparent plastic such as polycarbonate. The tool 05, carrier 07, and base 10 are preferably made of a durable but equally non-toxic and food/dishwasher-safe substance such a stainless steel. The gears 14, 15, 17, and 18 can be made of a durable, cheap to manufacture metal such as die-cast aluminium or steel.

To adapt the above-described invention for use in a stand-mixer (a food processing device that is C-shaped in profile where tools depend from a head into a mixing bowl), the gearing mechanism 14, 15, 17, and 18 need only be located in the head of the stand-mixer so as to receive drive from the stand-mixer motor with the shaft of the tool 05 attaching to the planet gear 17 so as to depend downwardly into a food receptacle 02 through the upper opening of the receptacle 02, preferably depending proximate to the an inner bottom surface of the receptacle 02, which may be a mixing bowl removably attachable to the stand mixer. A bottom-driven tool 05 may be provided in the same machine.

To prevent damage to the receptacle 02 being cause by broken gear-teeth causing the tool 05 to rotate improperly or inappropriate positioning of the gears during assembly, the food processor 100 may include a processor connected to (i.e., in electronic communication with) a rotary position sensor detecting the rotational position of the tool 05 relative to the tool axis 06 and/or the main axis 12. The processor may electronically power-down the motor of the base 01 if it detects that the tool 05 is rotating improperly (e.g., not according to the ratios and positions described above). The processor may also act on feedback from other sensors indicating mal-function of the gearing mechanism, including vibration sensors and temperature sensors. The processor may cause information of the malfunction to be communicated to the user via a user interface or a suitable alarm.

Whilst various arrangements have been discussed above for rotating a long blade 30 of fixed length such that it moves into and away from corners of the receptacle 02 as it rotates in a way that is relatively simple and cheap to manufacture, the long

blade 30 may also (or alternatively) extend and retract dynamically as it rotates to reach into corners. An example of such a mechanism would be a rotary tool with a telescoping blade driven by linear actuator controlled according to a program running on a processor in electronic communication with the linear actuator.

The gearing ratio of the gearing mechanism 14, 15, 17, and 18 need not be fixed and may be changed dynamically through the use of, for example, a changeable gearbox. Indeed, where a configuration where the gearing is retained in the base 01 is used, the food processor 100 may automatically change the gearing ratio depending on the shape of the container attached 02 to the base 01 based on feedback from a sensor detecting an RFID tag attached to the receptacle 02 identifying its shape or the appropriate ratio to be used. This dynamic changing may be carried out using a processor in electronic communication with an actuator for changing the gearing in the gearbox, and an RFID sensor for detecting an RFID tag of the receptacle.

Terms like “electronic communication”, “data transmission” as used herein can include all forms of electronic communication including data-transmission and powering-on/off, digital or analogue, wireless or wired, or any suitable combination of these. This includes WiFi Zigbee, Bluetooth, RFID, NFC, other radio-frequency transmission means, parallel or serial bus communication, and other communication means. Furthermore it includes datatransmission even where mediated partly or wholly through non-electronic forms including fibre-optic, laser, sonic, infra-red, mechanical etc.

Where one element of the invention disclosed herein is shown or described (either implicitly or explicitly) as being electronically inter-networked with others (i.e., connected to another element that is connected to one or more further elements), this should be read as including the possibility of communication of data and instructions between any one of the elements and any other of the elements with which it is inter-networked unless otherwise stated. Clouds, servers, processors, user interfaces, sensors, memories, routers, adapters, and other electronic elements should all be considered as including processors, and/or data-transmission/storage suitable for their described tasks.

The invention may take a form different to that specifically described above.

Where blending is used as an example of a food processing activity above, other food processing activities can be carried out including beating, whisking, mixing, folding, stirring etc. with suitable tools.

Where a bottom-driven food processing machine (e.g., a blender) is used as an example , it may instead be implemented in a top-driven food processing machine (e.g., a stand-mixer or kitchen machine), or indeed in a machine where the rotary tool is initially oriented horizontally or at another angle. Whilst table-top domestic food processing machines have been used as an example implementation, the invention may also be implemented in a hand-held tool such as a hand-blender or hand-blender attachment. The term “kitchen appliance” encompasses all such devices.

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. Mechanical and other improvements disclosed herein may find application in automotive and industrial fields, the field of tools including hand-tools, the plumbing field, the field of hydraulics, and are not limited in application to kitchen appliances.

The invention described here may be used in any kitchen appliance and/or as a standalone 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 implemented as a stand-alone device, whether motor-driven or manually powered.

Further modifications will be apparent to those skilled in the art without departing from the scope of the present invention.

It will be understood that the 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.

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

CLAIMS:

1. A food processing appliance comprising:

a receptacle for receiving food to be processed;

a rotary tool having a first tool element for processing food in the receptacle; wherein

the rotary tool is arranged to be driven to rotate about a first axis and simultaneously driven to move bodily about a second axis different to the first axis; and wherein

the receptacle is shaped such that a radial distance between an inner sidewall of the receptacle and the second axis is not constant; and wherein

during part of the rotary movement of the rotary tool about the second axis, the at least one tool element extends radially away from the second axis by a distance greater than a minimum radial distance between the sidewall of the receptacle and the second axis, so as to extend closer to the sidewall of the receptacle.

2. The food processing appliance of claim 1, wherein the rotary tool comprises a second tool element that extends radially from the first axis by a smaller distance and at a different angular position to the at least one first tool element.

3. The food processing appliance of claim 2, wherein the at least one second tool element extends from the first axis at a different axial locations from the at least one first tool element.

4. The food processing appliance of any preceding claim, wherein the rotary tool comprises at least two first tool elements which are configured to balance the rotary tool about a centre of gravity concentric with the first axis.

5. The food processing appliance of any of claims 2 to 4, wherein the at least one second tool element is configured to balance the weight of the first tool element(s) about a centre of gravity concentric with the first axis.

6. The food processing appliance of any preceding claim comprising a planetary drive assembly having a planet gear configured to drive the rotary tool to rotate

about the first axis and move bodily about the second axis.

7. The food processing appliance of claim 6, comprising a motor arranged to drive a sun gear of the planetary drive assembly to rotate about the second axis, the sun gear being arranged to drive the planet gear to rotate about the first axis in interference with a ring gear, such that the planet gear simultaneously moves bodily about the second axis.

8. The food processing appliance of claim 7, wherein the planetary drive assembly further comprises an idler gear arranged to communicate rotary drive between the sun gear and the planet gear.

9. The food processing appliance of any one of claims 7 to 8, wherein the planetary drive assembly further comprises a gearbox arranged to permit dynamic changing of the gearing ratio between the planet gear and the sun gear.

10. The food processing appliance of claim 9, further comprising a data processor in electronic communication with an actuator for selecting a gearing ratio of the gearbox, and a sensor for detecting an RFID tag of the receptacle, wherein the processor is arranged to select a gearing ratio based on feedback from the sensor.

11. The food processing appliance of any preceding claim, further comprising a data processor in electronic communication with a safety sensor and a motor of the food processing appliance, wherein the processor is operable to automatically reduce power to the motor on receiving feedback from the safety sensor indicating an unsafe condition.

12. The food processing appliance of claim 11 as depending from claims 7-10, wherein the safety sensor comprises one or more rotary-position sensors arranged to detect a rotary position of at least one of the sun gear and the planet gear to detect an unsafe condition.

13. The food processing appliance of any preceding claim, wherein the rotary tool extends into the receptacle at an angle of less than 90 degrees relative to a base

of the receptacle.

14. The food processing appliance of any preceding claim, wherein the radial distance between the inner sidewall of the receptacle and the second axis have one or more minima and one or more maxima corresponding to different angular locations relative to the second axis, and wherein the tool is driven to rotate about the first axis and to move bodily about the second axis such that the at least one first tool element reaches maximum extension away from the second axis at the angular location(s) relative to the second axis corresponding to the maxima.

15. The food processing appliance of claim 14, wherein the at least one first tool element reaches minimum extension away from the second axis at the angular location(s) corresponding to each minima.

16. The food processing appliance of claim 14 or 15, wherein the number of maxima is two or more and the maxima are substantially equally spaced around the second axis.

17. The food processing appliance of claims 14 to 16, wherein the maxima comprise arcuate lobe-shaped sections defined by the inner wall of the receptacle.

18. The food processing appliance of any one of claims 14 to 17, comprising one first tool element, and where the number of rotations the tool makes about the first axis for each time it moves bodily about the second axis is equal to the number of maxima minus one.

19. The food processing appliance of any preceding claim, wherein the rotary tool is arranged to rotate about the first axis at a speed relative to the rotation about the second axis such that the first tool element describes a consistent path relative to the receptacle.

20. The food processing appliance of any preceding claim, wherein the rotary tool extends upwardly into the receptacle through a base thereof.

21. The food processing appliance of any preceding claim, wherein the rotary tool

depends downwardly into the receptacle through an upper opening thereof.

22. A food processing appliance substantially as herein described with reference to the accompanying drawings.

Intellectual Property Office

Application No:	GB1609765.1	**Examiner:**	Dr Katy Nelson
Claims searched:	1-22	**Date of search:**	26 October 2016

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1, 6-12, 14-19 & 21	FR2405685 A1 (SEB) See figures 1 & 10-15, the EPODOC abstract and WPI abstract accession number 1979-53058B.
X	1-5, 13-14, 16 & 19-20	SU1836134 A3 See figures 1-2
X	1-5, 13-14, 16 & 19-20	CZ3813 U1 (Bubenicek) See the title and figures 1-3.
X	1, 11-12, 14, 16 & 21	GB2515552 A (Kenwood) See figures 4-5 & 9-11 and page 9 line 25 to page 10 line 5.
X	1, 11-12, 14, 16 & 21	US2004/145965 A1 (Chiaphua) See figure 1 and paragraphs [0021] & [0064].

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

A47J; B01F

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, TXTA

Intellectual Property Office

International Classification:

Subclass	Subgroup	Valid From
A47J	0043/08	01/01/2006
A47J	0043/04	01/01/2006
B01F	0007/30	01/01/2006