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(54) **Title**: MILLING DEVICE

(57) **Abstract**: A milling device (1) comprising: one milling space (2) through which items pass and are milled, the milling space(1) having a uniform height; a first milling head (3) having a first milling surface (4);a second milling head (5) having a second milling surface (6);and a biasing means (7) biasing the milling surfaces together such that in use the milling surfaces are parallel to define the milling space(2).In a second aspect, a milling system comprising: a milling device (1) for milling items; a base (34) on which the milling device is located; a container (31) for receiving the milled items; and a heating means(33) to heat the container (31).

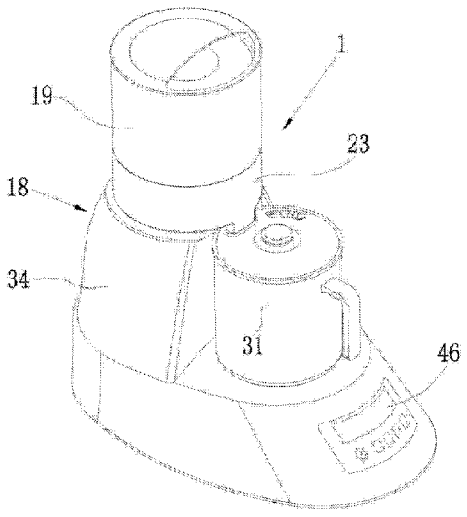

Fig. 1

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MILLING DEVICE

Technical Field

[1] The present invention relates to milling devices and systems, and in particular, milling devices and systems for milling food. The present invention is described herein primarily in relation to milling devices and systems used in domestic kitchens, but is not limited to this particular application.

Background Art

[2] Milling devices break down or grind items such as food into smaller particles. Milling is utilized in cooking or food preparation processes where smaller particles of food or milled food is required. This includes using milling in beverage preparation processes. For example, soy bean is milled in order to make a soy bean beverage.

[3] Prior milling devices include blade grinders, blenders, and burr grinders. Blade grinders and blenders typically employ a plurality of blades on the end of a rotating shaft that is immersed in the food item being milled. The blades break the food items down in a chopping action. However, it has been found that the resulting food particles tend to have sharp edges. If such particles are used in preparing beverages, the beverage exhibits a rough texture when consumed.

[4] Also, since a spinning shaft is used, blade grinders, blenders, and other similar types of milling devices require a seal around the shaft where it enters the body of the milling device. The seal represents a point where oils, grease, lubricants, or other contaminating substances used in the body of the milling device can escape and contaminate the food items being prepared. Conversely, food items can also infiltrate the body of the milling device through the seal potentially damaging the milling device.

[5] Burr grinders are typically used to grind hard food items such as peppercorns, salt, and coffee. Burr grinders, however, are not suited to producing fine grounds such as those required to make beverages. Burr grinders are also not suited to milling softer food items such as soy bean, green beans, red beans, and cooked rice.

Disclosure of Invention

Technical Problem

[6] It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

Solution to Problem

Technical Solution

[7] The present invention provides, in a first aspect, a milling device comprising:

[8] one milling space through which items pass and are milled, the milling space having

a uniform height;

[9] a first milling head having a first milling surface;

[10] a second milling head having a second milling surface; and

[11] a biasing means biasing the milling surfaces together such that in use the milling surfaces are parallel to define the milling space.

[12] In one embodiment, the biasing means is adjustable to adjust the force biasing the milling surfaces together, thereby adjusting the uniform height of the milling space depending on the hardness of the items.

[13] In one embodiment, at least one milling surface has one or more grooves extending from a centre portion of said milling surface towards a perimeter portion of said milling surface. In one embodiment, at least one groove has a depth below said milling surface, and the depth decreases from the centre portion towards the perimeter portion of said milling surface. In one embodiment, at least one groove has a width, and the width decreases from the centre portion towards the perimeter portion of said milling surface. In one embodiment, at least one groove is curved. In one embodiment, said milling surface has a plurality of said grooves and at least one of said grooves intersects at least another of said grooves. In one embodiment, said milling surface has a plurality of said grooves arranged in a plurality of groups, the grooves in each group converging together, and at least one group intersecting another group. In one embodiment, the perimeter portion is smooth.

[14] In one embodiment, the first milling head has a boss protruding from the first milling surface. In one embodiment, the second milling head has a boss aperture into which the boss protrudes to allow rotational motion between the first and second milling heads whilst preventing transverse movement between the first and second milling heads.

[15] In one embodiment, the second milling head has a milling inlet in the form of a through hole to allow items to pass through the second milling head into the milling space. In one embodiment, the second milling head has a milling inlet in the form of a through hole to allow items to pass through the second milling head into the milling space, the milling inlet overlapping or meeting with the boss aperture such that when the boss protrudes into the boss aperture, the boss can push the items passing through the milling inlet into the milling space when the boss rotates relative to the second milling head. In one embodiment, the boss has a plurality of guiding grooves extending vertically from the first milling surface to facilitate the pushing of items passing through the milling inlet into the milling space when the boss rotates relative to the second milling head. In one embodiment, the milling inlet has a ramp extending from the second milling surface through the second milling head to facilitate the entry of items through the milling inlet.

[16] In one embodiment, the first milling head is driven to rotate relative to the second

milling head.

[17] In one embodiment, the milling device has a motor with a drive shaft, and wherein the first milling head has a blind hole passing into the inside of the boss, the drive shaft located inside the blind hole to rotate the first milling head relative to the second milling head.

[18] In one embodiment, the second milling head is fixed in position. In one embodiment, the milling device has a housing and a hopper for containing items to be milled, the hopper lockingly engaged with the second milling head and lockingly engaged with the housing such that the second milling head is fixed in position. In one embodiment, the hopper is lockingly engaged with the second milling head and lockingly engaged with the housing against the biasing means.

[19] In one embodiment, the hopper is heated. In one embodiment, the hopper is heated by electric heating elements adjacent a wall of the hopper. In another embodiment, the hopper is heated by an infrared heating tube inside the hopper.

[20] In another embodiment, the hopper is heated by steam entering the hopper. In one embodiment, the milling device comprises a steam generator to provide steam to the hopper.

[21] In one embodiment, the milling device comprises a water tank and a pump to supply water from the water tank to the hopper.

[22] In one embodiment, the milling device comprises a collection space for receiving items after being milled through and passing through the milling space. In one embodiment, the collection space is an annular channel surrounding the first milling head to collect the milled items exiting the milling space. In one embodiment, the milling device comprises an outlet spout in fluid communication with the collection space, the outlet spout directing the milled items to a container.

[23] In one embodiment, the milling device comprises a water tank and a pump to supply water from the water tank to the collection space.

[24] In one embodiment, the milling device comprises a container for receiving items after being milled through and passing through the milling space. In one embodiment, the container is heated. In one embodiment, the milling device comprises a heating plate for heating a container for receiving items after being milled through and passing through the milling space. In another embodiment, the milling device comprises a steam generator to provide steam to a container for receiving items after being milled through and passing through the milling space, thereby heating the container. In one embodiment, the milling device comprises a steam outlet through which the steam generator supplies steam, and the container comprises a complementary steam inlet connectable with the steam outlet to receive steam into the container. In one embodiment, the milling device comprises a water tank and a pump to supply water from

the water tank to the steam generator.

[25] In one embodiment, the milling device comprises a stirring apparatus for stirring items received in a container after being milled through and passing through the milling space. In one embodiment, the stirring apparatus comprises a contactless stirrer placed inside the container. In one embodiment, the stirring apparatus comprises a magnetic drive to drive the contactless stirrer.

[26] In one embodiment, the milling device comprises a control apparatus to control one or more components of the milling device. In one embodiment, the milling device comprises one or more temperature sensors. In one embodiment, the milling device comprises one or more water level sensors. In one embodiment, the control apparatus receives temperature signals provided by the temperature sensors. In one embodiment, the control apparatus receives water level signals provided by the water level sensors. In one embodiment, the control apparatus receives wireless temperature signals and/or water level signals. In one embodiment, the wireless signals are in accordance with the Bluetooth protocol. In one embodiment, the control apparatus controls one or more components of the milling device wirelessly. In one embodiment, the wireless control uses the Bluetooth protocol. In one embodiment, the control apparatus has a control panel for use by a user.

[27] In one embodiment, one or both of the milling surfaces are made of zirconia-based ceramics.

[28] The present invention also provides, in a second aspect, a milling system comprising:

[29] a milling device for milling items;

[30] a base on which the milling device is located;

[31] a container for receiving the milled items; and

[32] a heating means to heat the container.

[33] In one embodiment, the heating means comprises a heating plate in the base on which the container sits and is heated. In another embodiment, the heating means comprises a steam generator in the base, the steam generator supplying steam to the container. In one embodiment, the base comprises a steam outlet through which the steam generator supplies steam, and the container comprises a complementary steam inlet connectable with the steam outlet to receive steam into the container.

[34] In one embodiment, the milling system comprises a stirring apparatus for stirring milled items in the container. In one embodiment, the stirring apparatus comprises a contactless stirrer placed inside the container. In one embodiment, the stirring apparatus comprises a magnetic drive located in the base to drive the contactless stirrer when the container is located on the base over the magnetic drive.

[35] In one embodiment, the milling device is in accordance with the milling device described above in the first aspect of the invention.

[36] It will be appreciated that the features above may be combined in various combinations in various embodiments of the present invention.

[37] Throughout this specification, including the claims, the words "comprise", "comprising", and other like terms are to be construed in an inclusive sense, that is, in the sense of "including, but not limited to", and not in an exclusive or exhaustive sense, unless explicitly stated otherwise or the context clearly requires otherwise.

Brief Description of Drawings

Description of Drawings

[38] Preferred embodiments in accordance with the best mode of the present invention will now be described, by way of example only, with reference to the accompanying figures, in which:

[39] Fig. 1 is a perspective view of a milling device in accordance with an embodiment of the present invention;

[40] Fig. 2 is an exploded perspective view of a milling device in accordance with an embodiment of the present invention;

[41] Fig. 3 is a cutaway side view of a milling device in accordance with an embodiment of the present invention;

[42] Fig. 4 is an enlarged view of the parts of the milling device shown in Fig. 3 in the area indicated as "A" in Fig. 3;

[43] Fig. 5 is a cutaway side view of a milling device in accordance with another embodiment of the present invention;

[44] Fig. 6 is a cutaway side view of a milling device in accordance with a further embodiment of the present invention;

[45] Fig. 7 is an exploded perspective view of milling heads in accordance with an embodiment of the present invention;

[46] Fig. 8 is a cutaway side view of a milling device in accordance with another embodiment of the present invention; and

[47] Fig. 9 is an enlarged view of the parts of the milling device shown in Fig. 8 in the area indicated as "B" in Fig. 8.

Best Mode for Carrying out the Invention

Best Mode

[48] Referring to the figures, there is provided a milling device 1 comprising one milling space 2 through which items pass and are milled. The milling space 2 has a uniform height. The milling device 2 has a first milling head 3 having a first milling surface 4, and a second milling head 5 having a second milling surface 6. The milling device 2 also has a biasing means 7 biasing the milling surfaces 4 and 6 together such that in use the milling surfaces are parallel to define the milling space 2.

[49] The biasing means 7 is adjustable to adjust the force biasing the milling surfaces 4 and 6 together, thereby adjusting the uniform height of the milling space 2 depending on the hardness of the items.

[50] In the embodiment shown in the figures, the biasing means 7 is a helical spring. However, in other embodiments, other biasing means can be used, including leaf springs, and even resilient materials such as rubber.

[51] At least one milling surface 4 or 6 has one or more grooves 8 extending from a centre portion 9 of the milling surface 4 or 6 towards a perimeter portion 10 of the milling surface. In the embodiments shown in the figures, both the first and second milling surfaces 4 and 6 have a plurality of grooves 8 extending from the centre portion 9 to the perimeter portion 10.

[52] The grooves each have a depth below the milling surface. It should be noted that "milling surface" in the present context refers to the smooth surface that coincides with the outermost surface portions of the milling surface. That is, if the milling surface is horizontal and facing upwards, the smooth surface passes over the surfaces of the grooves that are below the topmost horizontal surface surrounding the grooves. Put another way, the "milling surface" is the smooth surface that existed before the grooves were cut into the surface. Thus, when the milling surfaces 4 and 6 are parallel to each other, the milling space 2 defined in between the milling surfaces 4 and 6 has a uniform height.

[53] A "uniform height" in the present context means that the distance between the milling surfaces 4 and 6 is the same over the whole area over which the milling surfaces overlap to form the milling space 2. Further, the "uniform height" is uniform at a given time or under given conditions. In particular, the actual height depends on the force produced by the biasing means 7 (e.g. if the biasing means is a spring, then the force produced depends on the tension in the spring), and the hardness of the items being milled in between the milling surfaces 4 and 6. However, whatever the actual height is, it is the same height over the whole area over which the milling surfaces overlap. Thus, this "uniform height" may change over the same milling operation since the hardness of the batch of items being milled in that milling operation may vary.

[54] In some embodiments, such as those as best shown in Figs. 3 to 7, the milling surfaces are planar. In other embodiments, such as that best shown in Figs. 8 and 9, the milling surfaces 48 are conical or form part of a cone. In particular, the first milling surface 4, which is the lower milling surface, forms part of the outer surface of a cone having a point oriented upwards and a circular base oriented downwards. The second milling surface 6, which is the upper milling surface, has a complementary shape to the first milling surface 4 and fits over the first milling surface to define the milling space 2 between the milling surfaces. However, in all of these embodiments, there is a

uniform height, as described above, between the milling surfaces, that is, the milling space 2 between the milling surfaces has a uniform height.

[55] Returning to the description of the embodiments shown in the figures, each groove 8 has a depth below the respective milling surface 4 or 6, and the depth decreases from the centre portion 9 towards the perimeter portion 10 of the milling surface 4 or 6. Each groove 8 has a width, and the width decreases from the centre portion 9 towards the perimeter portion 10 of the milling surface 4 or 6. Also, each groove is curved. In other embodiments, one or more of the grooves can have one or more of these depth, width, and curve characteristics.

[56] In the present embodiments, the plurality of grooves 8 are arranged in a plurality of groups, the grooves in each group converging together, and each group intersecting another group. In other embodiments, one or more groups intersect another group. In yet other embodiments, one or more grooves intersect at least another groove. Fig. 7 shows an embodiment of the milling heads 3 and 5 where the pattern of grooves 8 on the first milling surface 4 can be seen. The milling heads are circular in cross-section. Moving circumferentially around the first milling surface 4, there are alternating groups of curved grooves 8. The groups alternate between groups of curved grooves that converge as the curved grooves extend towards the perimeter, and diverge as the curved grooves extend towards the perimeter. Each group of grooves intersects with the adjacent groove. The effect is to form ridges and teeth at the milling surface 4, or channels that extend below the milling surface 4. The ridges and teeth help break down the items being milled and the channels help move the milled items to the perimeter of the milling surfaces where the milled items exit the milling space 2.

[57] The perimeter portion 10, however, is smooth. That is, the grooves 8 do not extend into the perimeter portion 10. In one embodiment, the perimeter portion 10 is from 1 mm to 1.5 mm wide. In another embodiment, the perimeter portion 10 is from 1 mm to 5 mm wide. However, the perimeter portion can have a variety of widths depending on the requirements of different designs. The perimeter portion is the narrowest area between the milling surfaces since there are no grooves that extend below the milling surfaces 4 and 6. This allows very fine milled items to be produced before exiting the milled space 2.

[58] The first milling head has a boss 11 protruding from the first milling surface 4. The second milling head 5 has a boss aperture 12 into which the boss 11 protrudes to allow rotational motion between the first and second milling heads 3 and 5 whilst preventing transverse movement between the first and second milling heads.

[59] The second milling head 5 also has a milling inlet 13 in the form of a through hole to allow items to pass through the second milling head 5 into the milling space 2. The milling inlet 13 overlaps or meets with the boss aperture 12 such that when the boss

protrudes into the boss aperture, the boss 11 can push the items passing through the milling inlet 13 into the milling space 2 when the boss rotates relative to the second milling head 5. The boss 11 has a plurality of guiding grooves 14 extending vertically from the first milling surface 4 to facilitate the pushing of items passing through the milling inlet 13 into the milling space 2 when the boss rotates relative to the second milling head 5. The milling inlet is ramped, having a ramp 15 extending from the second milling surface 6 through the second milling head 5 to facilitate the entry of items through the milling inlet 13.

[60] In the embodiments shown, the first milling head 3 is driven to rotate relative to the second milling head 5. The milling device 1 has a motor 16 with a drive shaft 17. The first milling head 3 has a blind hole passing into the inside of the boss 11, and the drive shaft 17 is located inside the blind hole to rotate the first milling head 3 relative to the second milling head 5. The second milling head 5 is fixed in position. In other embodiments, the first milling head 3 can be fixed and the second milling head 5 rotates, or both milling heads can rotate at different speeds or in different directions, as long as there is relative rotation between the milling heads 3 and 5. However, it has been found that it is advantageous to fix the second milling head 5, which is in the upper position, and to rotate the first milling head 3, which is in the lower position below the second milling head. In particular, this allows the motor and drive mechanism to be located in the base of the milling device 1. Furthermore, the one or both milling heads 3 and 5 can be rotated at varying speeds. This results in a variety of milling or grinding speeds. Different milling or grinding speeds can be selected depending on the type of item being milled or ground in order to optimize the milling or grinding of the item.

[61] The milling device 1 has a housing 18 and a hopper 19 for containing items to be milled. The hopper 19 lockingly engages with the second milling head 5 and lockingly engages with the housing 18 such that the second milling head 5 is fixed in position. In particular, the hopper 19 is lockingly engaged with the second milling head 5 and lockingly engaged with the housing 18 against the biasing means 7.

[62] The hopper 19 includes a plurality of locking lugs 20 that fit through complementary slots 21 in a flange 22 in an upper section 23 of the housing 18. The hopper 19 is locked to the upper section 23 by passing the locking lugs 20 through the slots 21. In order to pass the locking lugs 20 through the slots 21 the hopper 19 is pushed down onto the second milling head 5, which in turn pushes down onto the first milling head 3 against the biasing means 7, which in this case is a helical spring bearing on the underside of the first milling head. The hopper 19 is then rotated which rotates the locking lugs 20 under the flange 22 adjacent the slots 21, thereby locking the hopper 19 to the upper section 23. Since the spring 7 was compressed to pass the locking lugs 20 through the slots 21, the hopper 19 is locked against the biasing force provided by

the biasing means 7.

[63] The hopper 19 also has a plurality of locking tabs (not shown) that fit into complementary locking channels 24 on the second milling head 5, thereby locking the second milling head 5 in a fixed position relative to the hopper 19. Since the hopper 19 is locked in a fixed position relative to the upper section 23 of the housing 18, as described above, and the second milling head 5 is locked in a fixed position relative to the hopper 19, the second milling head is also locked in a fixed position relative to the upper section 23.

[64] In one embodiment, as best shown in Figs. 4 and 9, the drive shaft 17 has two pieces, a main drive shaft 171 and a slave drive shaft 172. The main drive shaft 171 is connected to the motor 16 and has a spindle. The slave drive shaft 172 fits inside the blind hole passing through the inside of the boss 11 of the first milling head 3, whereby the slave drive shaft 172 is connected to the first milling head 3 so that rotation of the slave drive shaft 172 rotates the first milling head 3. The slave drive shaft also has an aperture for receiving the spindle of the main drive shaft 171, whereby the spindle is connected to the aperture so that rotation of the main drive shaft 171 rotates the slave drive shaft 172. Thus, rotation of the main drive shaft 171 by the motor 16 rotates the slave drive shaft 172 which in turn rotates the first milling head 3. This arrangement facilitates the disassembly of the milling device 1. In particular, having the two-piece drive shaft 17, with a main drive shaft 171 and a slave drive shaft 172, allows the easy disassembly of the upper section 23 of the housing 18 from the remainder of the housing.

[65] The hopper 19 can be heated. In one embodiment, the hopper 19 is heated by electric heating elements 25 adjacent a wall of the hopper. In another embodiment, the hopper is heated by an infrared heating tube 26 inside the hopper.

[66] The hopper 19 can also be heated by steam entering the hopper. For example, a steam generator can provide steam to the hopper.

[67] In the embodiments shown, the milling device 1 comprises a water tank 27 and a pump 28 to supply water from the water tank to the hopper 19. This is useful for items that break down more easily when wet or once they have been soaked, such as soy beans. Heating the hopper 19 as described above also assists the breaking down of some items. Supplying water to the hopper is also useful in making beverages since water is a required ingredient.

[68] The milling device 1 comprises a collection space 29 for receiving items after being milled through and passing through the milling space 2. The collection space 29 is an annular channel surrounding the first milling head 3 to collect the milled items exiting the milling space 2. The milling device preferably includes an outlet spout 30 in fluid communication with the collection space 29. The outlet spout 20 directs the milled

items to a container 31.

[69] The milling device 1 comprises a water tank and a pump to supply water from the water tank to the collection space 29. In the embodiments shown, the water tank is the same water tank 27 and the pump is the same pump 28 described above supplying water to the hopper 19. Solenoid valves 32 control the water supply from the pump 28 to the hopper 19 and the collection space 29. Water is supplied to the collection space 29 primarily to clean the collection space between milling operations. In other embodiments, there can be separate water tanks and/or pumps supplying the hopper 19 and the collection space 29.

[70] In the embodiments shown, the milling device 1 comprises the container 31 for receiving items after being milled through and passing through the milling space 2. The combination can also be referred to as a "milling system". In other embodiments, the container 31 is not supplied with the milling device 1 as a system. In these other embodiments, other containers can be used to collect the milled items.

[71] The container 31 can be heated. In some embodiments, as best shown in Figs. 2 and 3, the milling device 1 comprises a heating plate 33 for heating the container 31. In the embodiments shown, the milling device 1 (or milling system) includes a base 34, and the heating plate 33 is part of the base. The container 31 is placed on top of the heating plate 33 for heating. The heating plate 33 can include electric heating elements to produce the required heat for heating.

[72] In other embodiments, as best shown in Fig. 8, the milling device 1 comprises an inductive heating component 47 for heating the container 31. In the embodiment shown, the inductive heating component 47 is part of the base 34. The container 31 is placed on top of the inductive heating component 47 for heating.

[73] In further embodiments, as best shown in Fig. 6, the milling device 1 comprises a steam generator to provide steam to the container 31, thereby heating the container. The steam generator can be the same steam generator 35 that supplies steam to heat the hopper 19 as described above. The milling device 1 comprises a steam outlet 41 through which the steam generator 35 supplies steam, and the container 31 comprises a complementary steam inlet 42 connectable with the steam outlet 41 to receive steam into the container 31. In the embodiment shown, the milling device 1 (or milling system) includes a base 34. The steam outlet 41 is in the base 34 and the container 31 sits on the base when the steam outlet 41 is connected with the steam inlet 42.

[74] The milling device 1 comprises a water tank and a pump 36 to supply water from the water tank to the steam generator. In the embodiment shown in Fig. 6, the water tank is the same water tank 27 described above supplying water to the hopper 19 and the collection space 29. A multi-point connector 37 can be used to supply water to both pumps 28 and 36. In other embodiments, there can be separate water tanks and/or

pumps supplying the hopper 19, the collection space 29, and the steam generator 35, or there can be other arrangements where one or more water tanks or one or more pumps are shared. Also, one, some, or all of the water tanks and/or pumps can be supplied separate to the milling device and connected to milling device when needed. However, it is advantageous to include the water tanks and pumps with the milling device to form an integrated milling system. It is particularly advantageous to have one common water tank 27, one pump 28 to supply water to the hopper 19 and the collection space 29, and one pump to supply the steam generator 29, as shown in the embodiments depicted in the appended figures. All of these components are preferably housed in the housing 18, and more preferably, in the base 34.

[75] The milling device 1 comprises a stirring apparatus 38 for stirring items received in the container 31. The stirring apparatus 38 comprises a contactless stirrer 39 placed inside the container 31. The stirring apparatus 38 comprises a magnetic drive 40 to drive the contactless stirrer 39. The electromagnetic flux generated by the magnetic drive rotates the contactless stirrer 39 inside the container 31. Again, the stirring apparatus 38 can be supplied with the milling device 1 as a "milling system", or the stirring apparatus can be separate to the milling device and added when needed.

[76] One or both of the milling surfaces 4 and 6 are made of zirconia-based ceramics. The milling surfaces 4 and 6 can also be made of metal, or a combination of metal and ceramic. For example, one or both milling heads including the milling surfaces can be make entirely of metal, or entirely of ceramic, or they can be made as a metal body and faced with a ceramic layer to form the milling surfaces.

[77] The milling device 1 can also include one or more temperature sensors 43 and one or more water level sensors 44. For example, one temperature sensor 43 measures the temperature of the contents of the container 31 and provides a temperature signal. One water level sensor measures the level of water in the water tank 27 and provides a water level signal. The milling device 1 can also include a control apparatus 45 for controlling the operation and functions of the milling device. For example, the control apparatus 45 controls the operation of one or more of the components of the milling device 1 such as the motor 16, the electric heating elements 25, the infrared heating tube 26, the pumps 28 and 36, the solenoid valves 32, the heating plate 33, the steam generator 35, and the magnetic drive 40. In doing so, the control apparatus 45 can receive the temperature and water level signals from the temperature sensors 43 and water level sensors 44 in order to generate suitable control signals to control the milling device 1 and the various components of the milling device. For example, the control apparatus 45 can switch off the heating plate 33 or the steam generator 35 if the temperature measured by the temperature sensor 43 for the container 31 reaches a pre-determined maximum. The control apparatus 45 can also switch off the pumps 28 and

36 if the water level measured by the water level sensor 44 for the water tank 27 reaches a predetermined minimum or indicates the tank is empty.

[78] The control apparatus 45 can control the various components of the milling device 1 using wireless signals such as those in accordance with the Bluetooth protocol. For example, the control apparatus 45 has a Bluetooth transceiver that communicates wirelessly with respective Bluetooth transceivers included with the components. This provides the important advantage that the milling device 1 does not require wires and wired connections or a uses a minimum of wires and wired connections enhancing the safety and the ease of manufacture of the milling device 1. The milling device 1 or one or more components of the milling device, such as the control apparatus 45 and the Bluetooth transceivers can be battery powered. This further enhances the safety of the milling device 1 and improves the portability of the milling device.

[79] The control apparatus 45 can include a control panel 46 to allow a user to control the operation and functions of the milling device 1. The control panel 46 can also display operational data of the milling device 1 such as temperature and water level. The control apparatus 45 can also include a timer to automatically switch off the milling device 1 or one or more components of the milling device, and the control panel 46 can display the elapsed time or time remaining before the milling device 1 or one or more components of the milling device is switched off.

[80] It can be appreciated that the milling device 1 can be used in a variety of different modes. These include modes in which items are simply milled or ground using the first and second milling heads 3 and 5, modes in which items are pre-heated in the hopper 19 and milled or ground, and modes in which the items are milled or ground in the presence of water pumped from the water tank 27 with or without pre-heating. There are also modes in which the items are pre-heated and pre-soaked in water whilst in the hopper 19 for a predetermined amount of time before being milled or ground. These modes can be entered into manually by a user by operating the control panel 46. These modes can also be pre-programmed into the control apparatus 45 and selected by a user by operating the control panel 46. The pre-programmed modes can correspond to specific items, such as specific food items, and the modes are selected by the user by selecting the specific item via the control panel 46.

[81] The present invention also provides a milling system as described at various points above. In particular, the present invention provides a milling system comprising: a milling device for milling items; a base on which the milling device is located; a container for receiving the milled items; and a heating means to heat the container.

[82] In one embodiment, the milling device is the milling device 1 described above, the base is the base 34 described above, the container is the container 31 described above, and the heating means is the heating means described above. However, the milling

device can be other prior milling devices. In another embodiment, the milling system also comprises the stirring apparatus 38 described above for stirring milled items in the container.

[83] It has been found that the milling devices and systems provided by the present invention produce higher quality milled items. The milled items are finer and more consistent. In particular, it has been found that the milling devices and systems of the present invention are well suited to milling food items such as rice, soy bean, green beans, red beans, and coffee beans. For example, beverages such as soy bean beverages, rice milk, and soy milk have a much smoother texture, which enhances the drinking experience. In particular, the features of the present invention described above such as different milling or grinding speeds, preheating of the hopper, providing water to the hopper for pre-soaking, and the different modes described above, can be selected to optimize the milling or grinding of different items, such as the variety of food items described above. Also, since the milling heads 3 and 5 are separate components that can be easily disassembled from the milling device 1 (as further described below), different types of milling heads can be used. In particular, different sizes of milling heads, and milling heads with different patterns of grooves on milling surfaces 4 and 6 can be used. This is advantageous since specific types of milling heads 3 and 5 that are especially suited to particular types of items being milled or ground can be used in the milling device 1 to optimize the milling or grinding of the items.

[84] The milling devices and systems provided by the present invention can also be disassembled and assembled conveniently for ease of cleaning and storage. In particular, the structures described above, such as the hopper 19, the locking lugs 20, the complementary slots 21 in the flange 22, and the biasing means 7 allows the milling heads 3 and 5, which are separate components, to be disassembled from the milling device 1 for ease of cleaning, repair, replacement, and storage. Furthermore, the two-piece drive shaft 17, which comprises the main drive shaft 171 and the slave drive shaft 172, allows the disassembly of the upper section 23, which contains the milling heads 3 and 5 from the remainder of the housing 18, which in some embodiments comprises the base 34, the motor 16, the control apparatus 45, and other electrical components. This allows the milling heads 3 and 5, and the upper section 23 to be easily separated for cleaning away from the electrical components. It also allows the easy replacement of milling heads with other types of milling heads.

[85] It can be appreciated that the aforesaid embodiments are only exemplary embodiments adopted to describe the principles of the present invention, and the present invention is not merely limited thereto. Various variants and modifications may be made by those of ordinary skill in the art without departing from the spirit and essence of the present invention, and these variants and modifications are also covered within

the scope of the present invention. Accordingly, although the invention has been described with reference to specific examples, it can be appreciated by those skilled in the art that the invention can be embodied in many other forms. It can also be appreciated by those skilled in the art that the features of the various examples described can be combined in other combinations.

Claims

[Claim 1] A milling device comprising:
one milling space through which items pass and are milled, the milling space having a uniform height;
a first milling head having a first milling surface;
a second milling head having a second milling surface; and
a biasing means biasing the milling surfaces together such that in use the milling surfaces are parallel to define the milling space.

[Claim 2] A milling device according to claim 1 wherein the biasing means is adjustable to adjust the force biasing the milling surfaces together, thereby adjusting the uniform height of the milling space depending on the hardness of the items.

[Claim 3] A milling device according to any one of claims 1 to 2 wherein at least one milling surface has one or more grooves extending from a centre portion of said milling surface towards a perimeter portion of said milling surface.

[Claim 4] A milling device according to claim 3 wherein at least one groove has a depth below said milling surface, and the depth decreases from the centre portion towards the perimeter portion of said milling surface.

[Claim 5] A milling device according to any one of claims 3 to 4 wherein at least one groove has a width, and the width decreases from the centre portion towards the perimeter portion of said milling surface.

[Claim 6] A milling device according to any one of claims 1 to 5 wherein the first milling head has a boss protruding from the first milling surface.

[Claim 7] A milling device according to claim 6 wherein the second milling head has a boss aperture into which the boss protrudes to allow rotational motion between the first and second milling heads whilst preventing transverse movement between the first and second milling heads.

[Claim 8] A milling device according to any one of claims 1 to 7 wherein the second milling head has a milling inlet in the form of a through hole to allow items to pass through the second milling head into the milling space.

[Claim 9] A milling device according to any one of claims 1 to 8 wherein the first milling head is driven to rotate relative to the second milling head.

[Claim 10] A milling device according to any one of claims 6 to 8 having a motor with a drive shaft, and wherein the first milling head has a blind hole passing into the inside of the boss, the drive shaft located inside the

blind hole to rotate the first milling head relative to the second milling head.

[Claim 11] A milling device according to any one of claims 9 to 10 wherein the second milling head is fixed in position.

[Claim 12] A milling device according to claim 11 having a housing and a hopper for containing items to be milled, the hopper lockingly engaged with the second milling head and lockingly engaged with the housing such that the second milling head is fixed in position.

[Claim 13] A milling device according to claim 12 wherein the hopper is lockingly engaged with the second milling head and lockingly engaged with the housing against the biasing means.

[Claim 14] A milling device according to any one of claims 1 to 13 wherein one or both of the milling surfaces are made of zirconia-based ceramics.

[Claim 15] A milling system comprising:
a milling device for milling items;
a base on which the milling device is located;
a container for receiving the milled items; and
a heating means to heat the container.

[Claim 16] A milling system according to claim 15 wherein the heating means comprises a heating plate in the base on which the container sits and is heated.

[Claim 17] A milling system according to any one of claims 15 to 16 wherein the heating means comprises a steam generator in the base, the steam generator supplying steam to the container.

[Claim 18] A milling system according to any one of claims 15 to 17 comprising a stirring apparatus for stirring milled items in the container, the stirring apparatus comprising a contactless stirrer placed inside the container.

[Claim 19] A milling system according to claim 18 wherein the stirring apparatus comprises a magnetic drive located in the base to drive the contactless stirrer when the container is located on the base over the magnetic drive.

[Claim 20] A milling system according to any one of claims 15 to 19 wherein the milling device is in accordance with any one of claims 1 to 14.

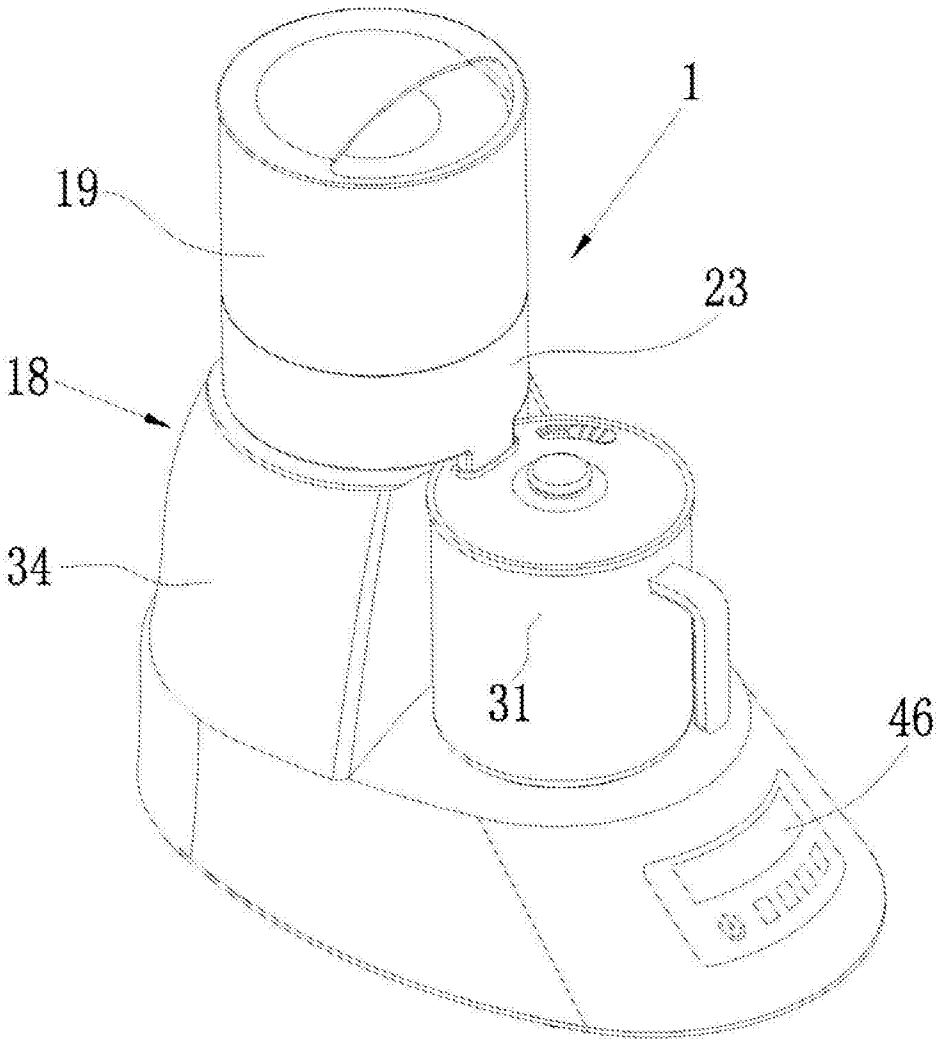

Fig. 1

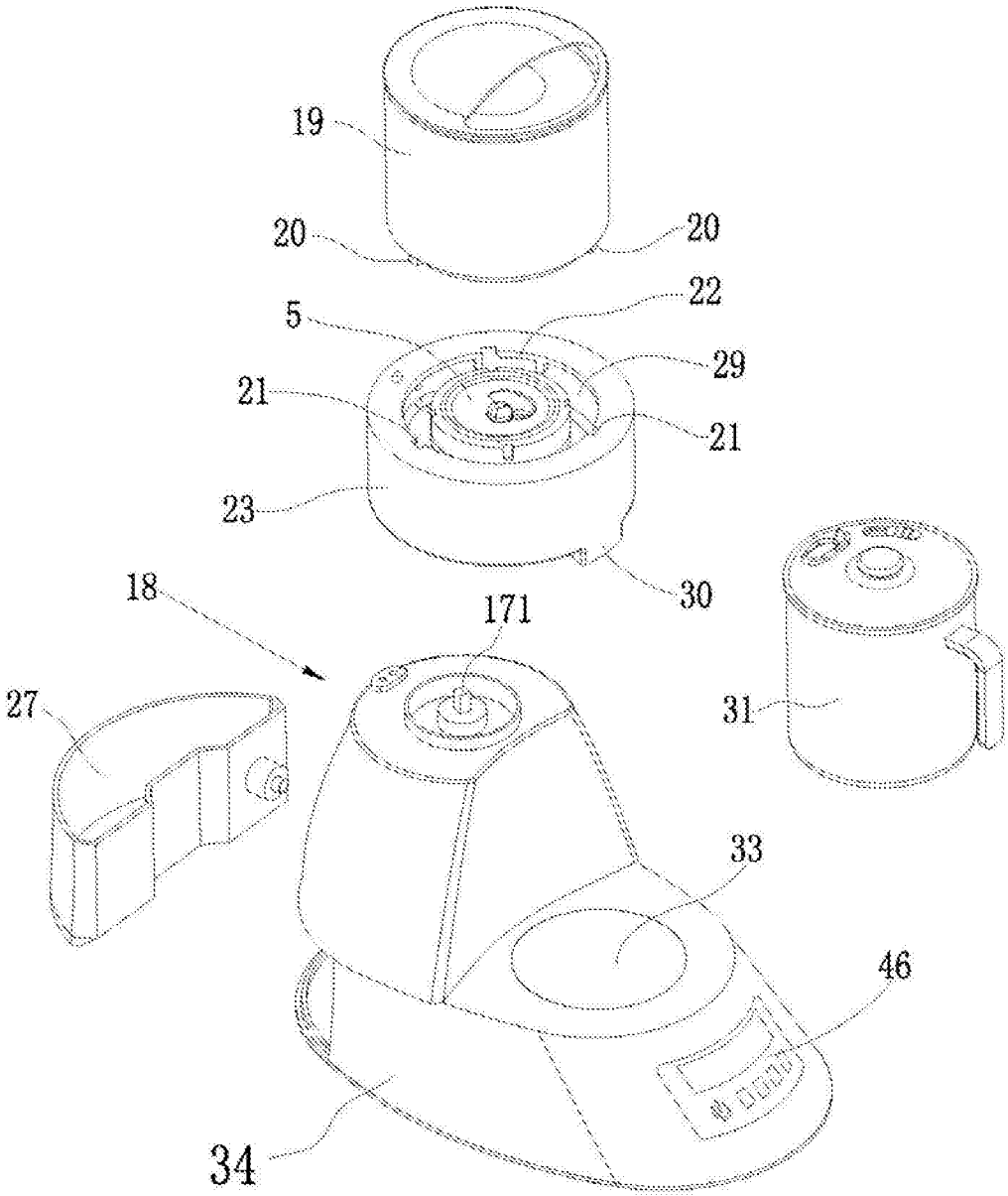

Fig. 2

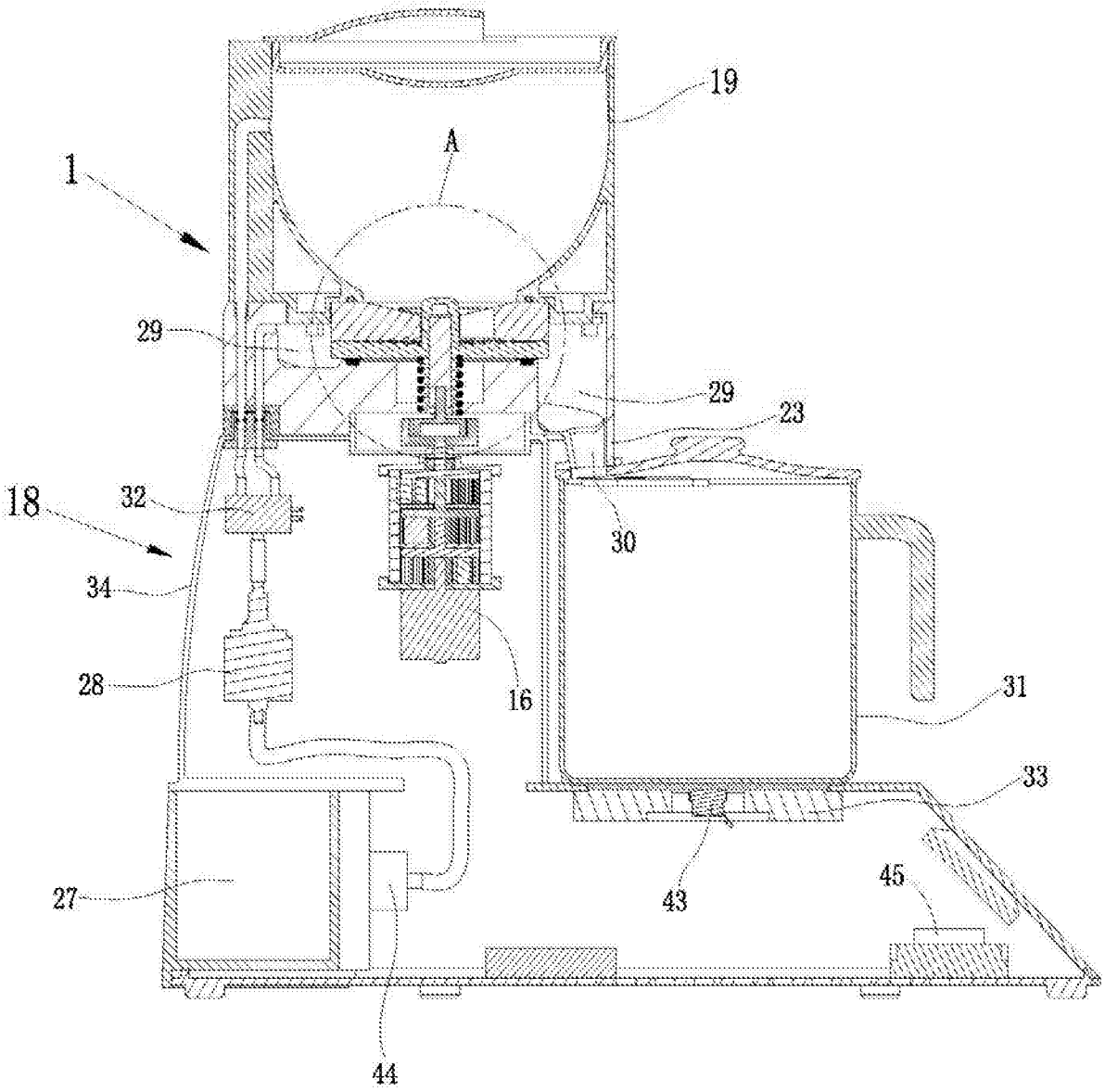

Fig. 3

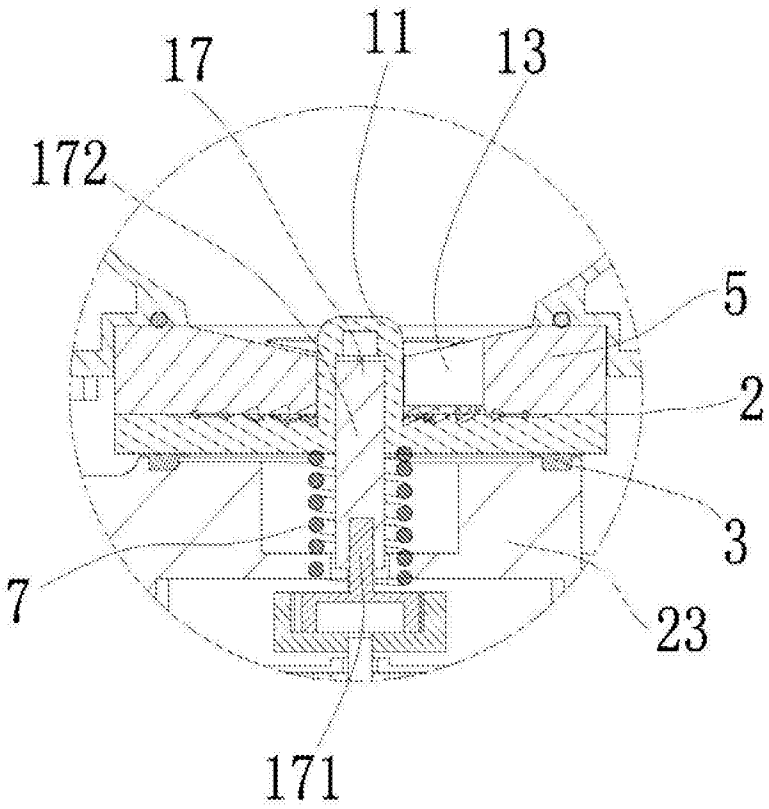

Fig. 4

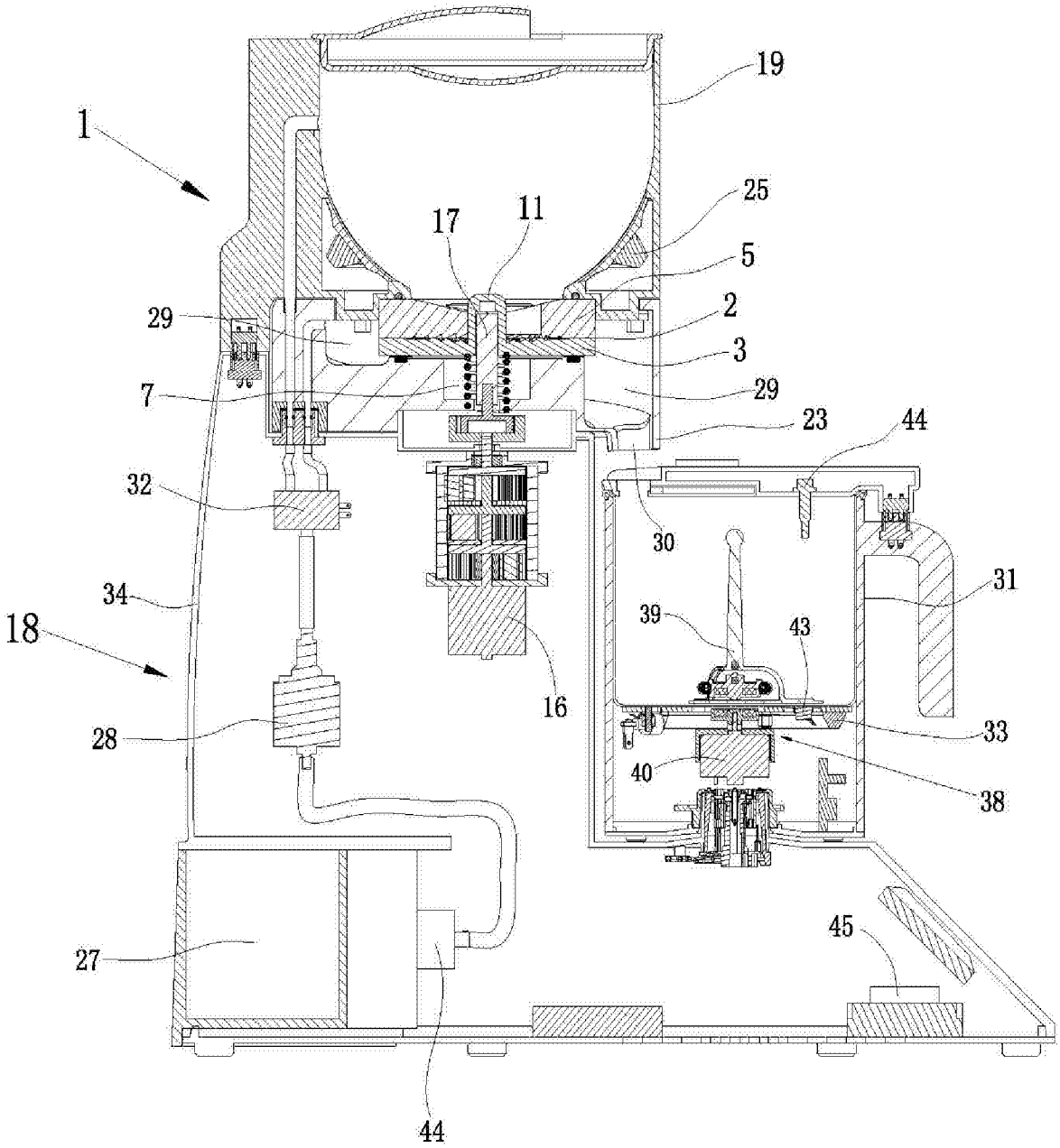
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Fig. 5

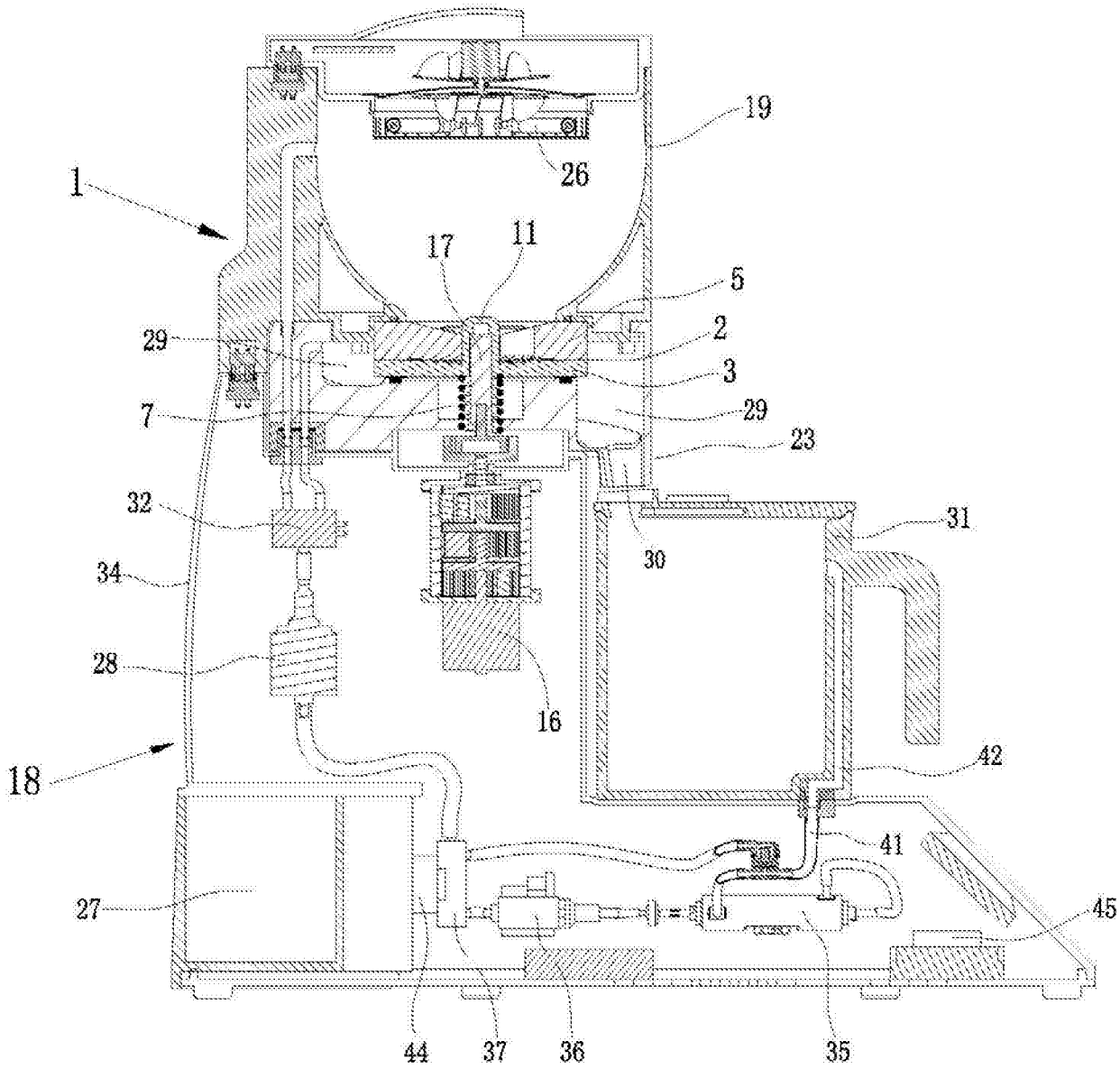

Fig. 6

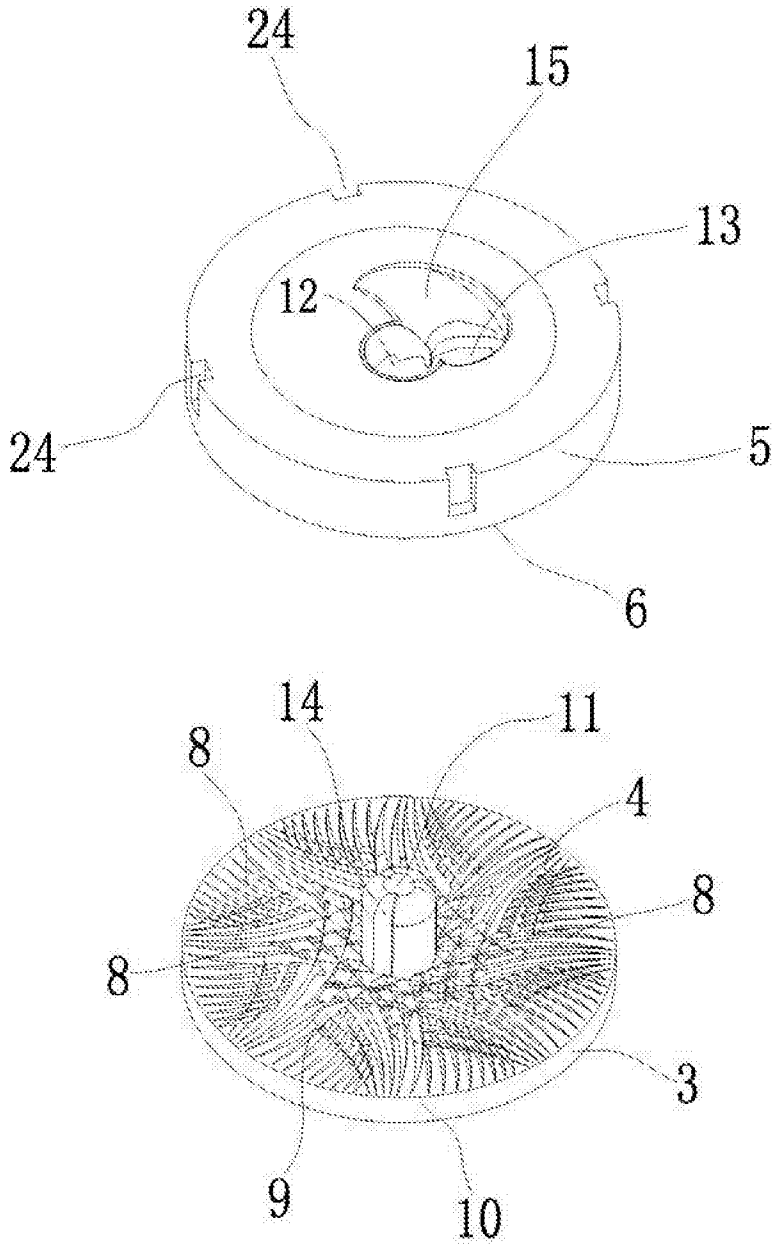

Fig. 7

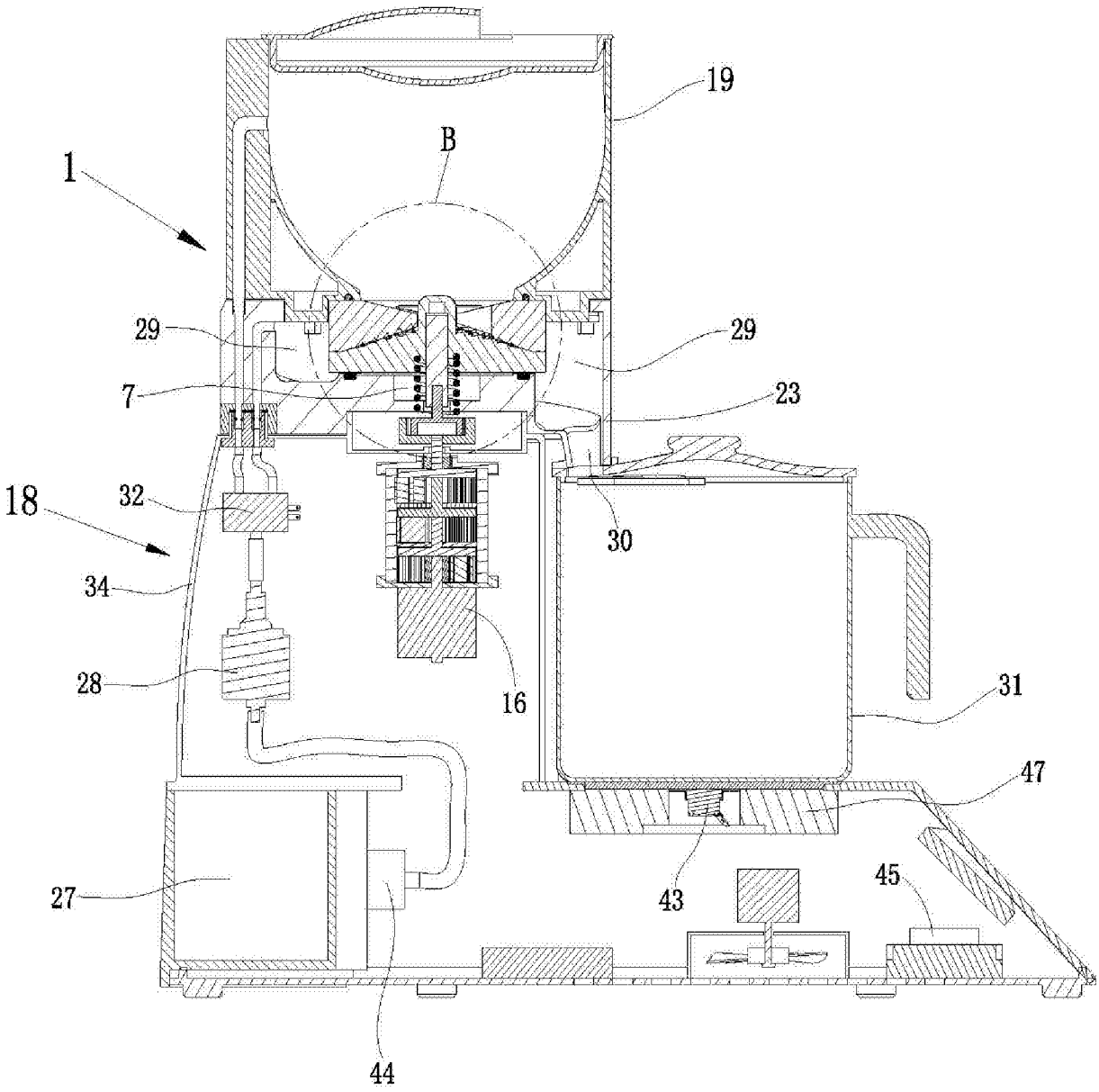

Fig. 8

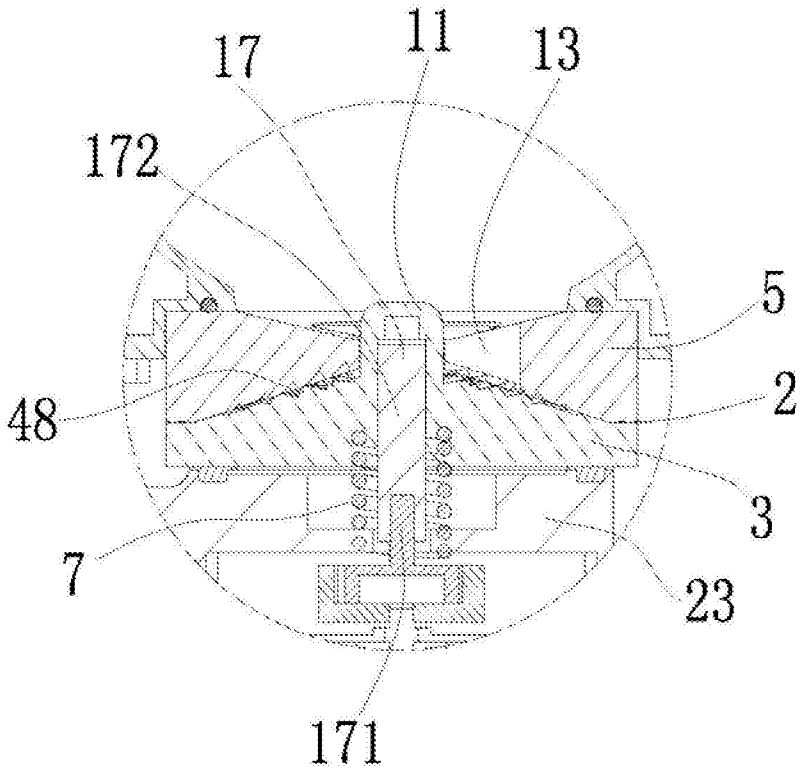

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2014/074224

A. CLASSIFICATION OF SUBJECT MATTER

A47J 31/00(2006.01)i

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; A23C; B01F; A23L

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)

EPODOC, WPI, CNPAT, CNKI: grind+, mill+, beverage, coffee, uniform, height, head, plate, surface, biasing, spring, space, base, parallel, heat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 201591106 U (ELEC-TECH INT CO LTD) 29 September 2010 (2010-09-29) see description, page 2 to page 4 and figures 1-3	1-20
A	CN 201044718 Y (YANG Z) 09 April 2008 (2008-04-09) see the whole document	1-20
A	JP 2001258766 A (SANYO ELECTRIC CO) 25 September 2001 (2001-09-25) see the whole document	1-20
A	CN 201831677 U (CHEN J ET AL.) 18 May 2011 (2011-05-18) see the whole document	1-20
A	WO 2012120363 A3 (CERRETI GIANFRANCO) 08 November 2012 (2012-11-08) see the whole document	1-20
A	JP 2007260104 A (FUJI ELECTRIC RETAIL SYSTEMS) 11 October 2007 (2007-10-11) see the whole document	1-20

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

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 December 2014	**19 December 2014**

Name and mailing address of the ISA/CN	Authorized officer
STATE INTELLECTUAL PROPERTY OFFICE OF THE P.R.CHINA(ISA/CN) **6,Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088 China**	**LI,Chunliang**
Facsimile No. **(86-10)62019451**	Telephone No. **(86-10)62089982**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2014/074224

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	201591106	U	29 September 2010		Non	e	
CN	201044718	Y	09 April 2008		Non	e	
JP	2001258766	A	25 September 2001	JP	3945957	B2	18 July 2007
CN	201831677	U	18 May 2011		Non	e	
WO	2012120363	A3	08 November 2012	WO	2012120363	A2	13 September 2012
				IT	VR20110047	A1	08 September 2012
JP	2007260104	A	11 October 2007		Non	e	