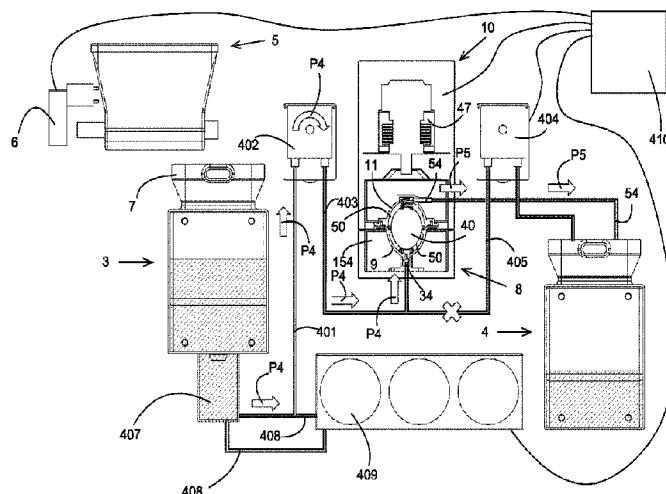




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(54) Title: AN APPARATUS FOR COOKING AT LEAST ONE EGG WITH AN EGGSHELL AS WELL AS SUCH A
METHOD



(57) **Abrégé/Abstract:**

An apparatus and method for cooking at least one egg with an eggshell The apparatus comprises a housing provided with a device for providing microwave radiation in a confined space in the housing and a holder located in the confined space. The holder is provided with at least one cavity adapted to the shape of the egg with the eggshell. The apparatus further comprises means to insert a liquid into the holder for filling the cavity with the liquid to at least partly surround the eggshell of the egg located in the cavity. The apparatus comprises also means to control the amount of liquid in the holder during a cooking process of the at least one egg, wherein: - a first amount of liquid is inserted into the cavity before providing microwave radiation in the cavity, which first amount of liquid surrounds the eggshell of the egg located in the cavity; - a second amount of liquid is gradually inserted into the cavity.

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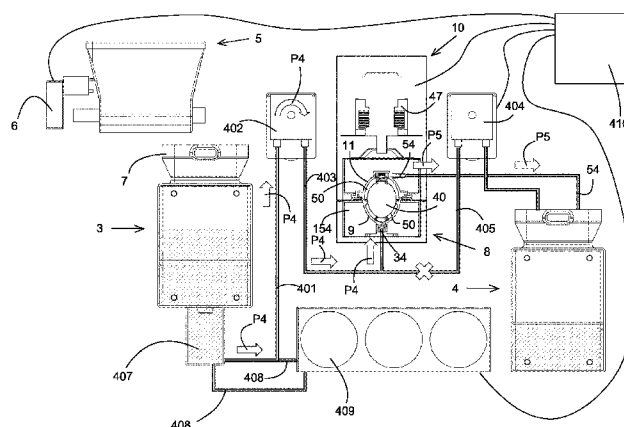


Fig. 14

(57) **Abstract:** An apparatus and method for cooking at least one egg with an eggshell. The apparatus comprises a housing provided with a device for providing microwave radiation in a confined space in the housing and a holder located in the confined space. The holder is provided with at least one cavity adapted to the shape of the egg with the eggshell. The apparatus further comprises means to insert a liquid into the holder for filling the cavity with the liquid to at least partly surround the eggshell of the egg located in the cavity. The apparatus comprises also means to control the amount of liquid in the holder during a cooking process of the at least one egg, wherein: - a first amount of liquid is inserted into the cavity before providing microwave radiation in the cavity, which first amount of liquid surrounds the eggshell of the egg located in the cavity; - a second amount of liquid is gradually inserted into the cavity.

WO 2015/162032 A1

An apparatus for cooking at least one egg with an eggshell as well as such a method

FIELD OF THE INVENTION

5

The invention relates to apparatus for cooking at least one egg with an eggshell, which apparatus comprises a housing provided with a device for providing microwave radiation in a confined space in the housing and a holder located in the confined space, which holder being provided with at least one cavity adapted to the shape of the egg with the eggshell, which
10 apparatus further comprises means to insert a liquid into the holder for filling the cavity with the liquid to at least partly surround the eggshell of the egg located in the cavity.

The invention also relates to a method for cooking at least one egg
15 with an eggshell in such an apparatus.

BACKGROUND OF THE INVENTION

By such an apparatus, which is known from WO2012002814A1, liquid
20 is inserted in the cavity to surround the eggshell of the egg, after which the device for providing microwave radiation is turned on, whereby the liquid as well as the egg is being heated. The liquid is in heat exchanging contact with the eggshell, whereby due to the layer of liquid around the eggshell a good cooking process of the egg by means of the microwave radiation is obtained.

25 The egg can be cooked in less than two minutes. The apparatus of WO2012002814A1 is provided with an outlet being coupled to a drain for removal of the liquid from the holder after use.

During the cooking process all liquid is maintained inside the cavity to maintain a desired layer of liquid around the egg. A disadvantage of the
30 known apparatus is that a build up of the pressure inside the cavity will

occur. Due to said pressure build up the holder needs to be relative strong to be able to withstand the relatively high pressure. Furthermore, at such a system with pressure build up, for example components such as seals and hoses are relatively heavy loaded, are relatively critical, and are relatively demanding and thus relatively expensive. The holder will need to be kept closed with a relatively large force. This limits the feasibility of manual or motorized actuated open-close mechanisms for the holder.

SUMMARY OF THE INVENTION

It is an object of the apparatus according to the invention to maintain a desired layer of liquid around the egg, whilst reducing the pressure build up in the cavity.

This object is achieved by the apparatus according to the invention in that the apparatus comprises means to control the amount of liquid in the holder during a cooking process of the at least one egg, wherein:

- a first amount of liquid is inserted into the cavity before providing microwave radiation in the cavity, which first amount of liquid at least partly surrounds the eggshell of the egg located in the cavity;

- a second amount of liquid is gradually inserted into the cavity during providing microwave radiation to replenish the amount of liquid that has been evaporated and has left the cavity during providing microwave radiation in the cavity and to maintain a desired layer of liquid around the egg located in the cavity.

By the apparatus according to the invention liquid is allowed to escape from the cavity when the pressure in the cavity rises, for example through a relief valve to limit the pressure build up or by having the cavity in open communication with the environment so that no pressure build up will occur. To maintain the desired layer of liquid around the egg, the second amount of liquid is gradually added, to replenish the amount of

liquid that has been evaporated and has left the cavity during providing microwave radiation in the cavity.

It has to be noted that US20080145491A1 discloses an apparatus for cooking at least one egg with an eggshell. However, this apparatus
5 comprises a carrier plate with square openings with rounded corners that constitute holders for the vertical positioning of eggs. The carrier plate can be made from a wired structure in order to ensure adequate circulation of steam around the eggs. The square openings with rounded corners in the carrier plate do not form cavities which can be filled with a liquid to at least
10 partly surround the eggshell of the egg located in the cavity so that a desired layer of liquid around the egg located in the cavity can be maintained.

An embodiment of the apparatus according to the invention is characterized in that the second amount of liquid is gradually inserted into the cavity after a first predetermined period of time of providing microwave
15 radiation and during a second predetermined period of time of providing microwave radiation.

The first and second predetermined periods of time can be based on experiments or can theoretically be determined. Furthermore, adding liquid based on predetermined time periods can easily be controlled.

20 Another embodiment of the apparatus according to the invention is characterized in that first predetermined period of time of providing microwave radiation is shorter for the cooking process of a soft-boiled egg than for a hard-boiled egg.

By adding an additional amount of liquid relatively early in the
25 process of cooking the egg, a soft-boiled egg will be obtained, whilst by adding the additional amount of liquid later in the process of cooking the egg, a hard-boiled egg will be obtained. In this manner a user can simply obtained the desired boiled egg by amending the first predetermined period of time.

Another embodiment of the apparatus according to the invention is characterized in that the second amount of liquid is larger for the cooking process of a soft-boiled egg than for a hard-boiled egg.

By adding a relatively large second amount of liquid, preferably
5 during a longer second predetermined period of time of providing microwave radiation, a soft-boiled egg will be obtained, whilst by adding a smaller second amount of liquid, preferably during a smaller second predetermined period of time of providing microwave radiation, a hard-boiled egg will be obtained. In this manner a user can simply obtained the
10 desired boiled egg by amending the second amount of liquid.

Another embodiment of the apparatus according to the invention is characterized in that the second amount of liquid is added in pulses during the second predetermined period of time of providing microwave radiation.

In this manner the amount and timing of the second amount of
15 liquid into the cavity can easily be controlled.

Another embodiment of the apparatus according to the invention is characterized in that a constant power of the microwave radiation is used during the cooking process of the at least one egg.

By operating the device for proving microwave radiation at a
20 constant power no irregular change in the microwave radiation will occur. Furthermore, such a device is relatively cheap and is readily available on the market, especially when a device operating at 2.45 GHz will be used. Relatively simple devices for proving microwave radiation have the disadvantage that amending the power of the microwave radiation in the
25 cavity during operation means that the device will be switched on and off during several seconds. Furthermore, the on/off cycle is not very accurate and each time the device needs to start up again whereby an irregular change in the microwave radiation in the cavity will occur. Due to the irregular change in the microwave radiation the egg will not be cooked well
30 and uniformly.

Another embodiment of the apparatus according to the invention is characterized in that the sum of the first predetermined period of time of providing microwave radiation and the second predetermined period of time of providing microwave radiation is about the same for the cooking
5 process of a soft-boiled egg and a hard-boiled egg.

In this manner it is predictable and known in advance how long the cooking process of the egg will take. By simply shifting to a shorter first predetermined period of time and a longer second predetermined period of time a soft-boiled egg will be obtained, whilst by shifting to a longer first
10 predetermined period of time and a shorter second predetermined period of time a hard-boiled egg will be obtained.

Another embodiment of the apparatus according to the invention is characterized in that the first amount of liquid is between 30 and 60 millilitre, whilst the second amount of liquid is between 60 and 120
15 millilitre.

In this manner the amount of liquid inside the cavity is relatively small, which relatively small amount of liquid can easily be heated up by the microwave radiation, whilst the amount can also easily be replenished.

Another embodiment of the apparatus according to the invention is characterized in that at a power of 1000 Watt and 2.45 GHz of the device
20 for providing microwave radiation, the first predetermined period of time is between 15 and 40 seconds, with a total period of time of providing microwave radiation between 90 and 120 seconds.

With such power and frequency an egg can be well boiled in less than
25 2 minutes.

Another embodiment of the apparatus according to the invention is characterized in that the liquid is an aqueous liquid with a dielectric constant with an imaginary part, ϵ'' , between 20-500 at a temperature between 0°C - 100°C at a microwave frequency of 2.45 GHz, preferably
30 water with NaCl, more preferably 0,2M NaCl.

With such an aqueous liquid it is found out that a good cooking process of an egg is obtained whereby both the egg yolk as well as the egg white get the desired properties. The advantages of the aqueous liquid with the described dielectric constant are described in WO2012002814A1.

5 For example salt preferably NaCl can be added to the liquid, for example water, to obtain the desired aqueous liquid. The apparatus can use tap water to which salt preferably NaCl can be added to obtain the desired aqueous liquid. Water is easily available in every household or restaurant and also salt like NaCl can easily be obtained. Furthermore, a combination of water with such an amount of NaCl is not toxic for humans.

10 Other kinds of liquid and components are also possible.

Another embodiment of the apparatus according to the invention is characterized in that the apparatus comprises a conduit guiding liquid into the cavity, which conduit is at least partly located in the confined space, wherein the second amount of liquid is preheated in the conduit by the microwave radiation before the liquid is inserted into the holder.

15 By preheating the second amount of liquid it can be realised that the temperature of the liquid in the cavity will not or nearly not drop during the insertion of the second amount of liquid in the cavity. By preheating the second amount of liquid by the microwave radiation no additional means for preheating the second amount of liquid to the desired temperature for entering the cavity is needed.

20 Another embodiment of the apparatus according to the invention is characterized in that the part of the conduit located in the confined space is between 40 and 80 centimetres long.

Such a length is long enough to heat up the liquid in the conduit from for example 20 °C when entering said part to about the same temperature as the liquid already present in
25 the cavity, when leaving said part.

Another embodiment of the apparatus according to the invention is characterized in that the liquid has an average layer thickness between the holder and the eggshell of the egg between 2 and 8 millimetres.

With such an average layer thickness the amount of liquid needed for cooking the egg is limited while the layer is thick enough to provide a good cooking process of the egg. As the egg is preferably supported in the cavity by spacers inside the holder and is preferably being pressed against said spacers by a spring, there will be some direct contact between the egg and the holder. However, such contact is limited and nearly the whole eggshell is surrounded by the liquid at the beginning of the cooking process.

Another embodiment of the apparatus according to the invention is characterized in that the means to insert a liquid into the holder comprises at least two pumps, wherein a first pump is connected by a first conduit to the liquid inlet, whilst a second pump is connected by a second conduit to the liquid outlet.

By having two pumps, one for pumping liquid into the cavity through the liquid inlet and one for pumping the liquid out of the cavity through the liquid outlet, no valves are needed between the pumps and the cavity since by switching the pumps on or off, transport of liquid through each pump is being controlled.

Another embodiment of the apparatus according to the invention is characterized in that the second holder part comprises an open outlet for at least a gaseous phase of the liquid formed in the cavity during the cooking process.

When heating the egg and the liquid surrounding the eggshell of the egg, the liquid will be turned into a gaseous phase which gas or steam can escape through the open outlet to prevent a pressure build up in the cavity. Since no large pressure build up occurs in the cavity, the forces on the first and second holder part are relatively low so that a relatively light apparatus can be built.

The invention also relates to a method for cooking at least one egg with an eggshell by means of an apparatus as described above.

5 A BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1a and 1b show a perspective front view and rear view of a first embodiment of an apparatus according to the invention in an open position of the housing parts.

10 Figure 1c shows a cross section of a part of the apparatus as shown in figures 1a-1b.

Figures 2-4 show perspective views of parts of the apparatus as shown in figures 1a-1c.

Figure 5 shows a top view of the part as shown in figure 4.

15 Figures 6a and 6b show a perspective front view and rear view of the apparatus as shown in figure 1a-1b in a closed position of the housing parts.

Figure 6c shows a cross section of the apparatus as shown in figures 6a-6b.

20 Figure 7 shows a perspective view of a part of the apparatus as shown in figures 6a-6c.

Figure 8a and 8b show a front and rear perspective view of a second embodiment of the apparatus according to the invention in an open position of the housing parts.

25 Figure 9 shows a perspective front view and rear view of the apparatus as shown in figure 8a-8b in a closed position of the housing parts.

Figure 10a and 10b show a front and rear perspective view of a third embodiment of the apparatus according to the invention in an open position of the housing parts.

Figure 11 shows a perspective front view and rear view of the apparatus as shown in figure 10a and 10b in a closed position of the housing parts.

Figure 12a and 12b show a front and rear perspective view of a fourth
5 embodiment of the apparatus according to the invention in an open position of the housing part.

Figure 13 shows a perspective front view and rear view of the apparatus as shown in figure 12a and 12b in a closed position of the housing parts.

10 Figure 14 shows a working scheme of the apparatus as shown in the figures 6a-6b, 9, 11, 13 during the filling of the cavity and the cooking of the egg.

Figure 15 shows a diagram disclosing the microwave radiation time versus the amount of liquid added to the cavity.

15 Figure 16 shows a working scheme of the apparatuses as shown in the figures 6a-6b, 9, 11, 13 during emptying of the cavity after cooking of the egg.

In the drawings like reference numerals refer to like elements.

DESCRIPTION OF PREFERRED EMBODIMENTS

20

Figure 1a-7 show different views of a first embodiment of an apparatus 1 according to the invention and specific parts thereof. From the apparatus 1 only relevant components are shown and other components like covers and mounting constructions for mounting elements in the apparatus
25 are left out for reason of clarity.

The apparatus 1 comprises a base 2 on which two containers 3 and 4 are located. Above the containers 3 and 4 a container 5 is located which container is provided with a dosing unit 6. The dosing unit 6 is located above an opening 7 of the container 3. The apparatus 1 further comprises a
30 first housing part 8 with a first holder part 9 as well as a second housing

part 10 with a second holder part 11. The second housing part 10 is connected in the apparatus 1 to the base 2 and has a fixed relation thereto. The first housing part 8 is movable with respect to the second housing part 10 between a first open position as shown in figures 1a-1c and a second closed position as shown in figures 6a-6c. The first housing part 8 is movable with respect to the second housing part 10 by means of manually operated gearing mechanisms 12 located on each side of the first and second housing part 8, 10. Each gearing mechanism 12 comprises a curved rod 13 which is provided with teeth 14 on a side directed to the base 2 and the containers 3, 4. The curved rods 13 are connected on two opposite sides of the first housing part 8. Each gearing mechanism 12 further comprises a first gear wheel 16 being pivotable about a pivot axis 17 and a second gear wheel 18 having a smaller diameter than the gear wheel 16, which second gear wheel 18 being connected to the gear wheel 16 and being rotatable simultaneously therewith about the pivot axis 17. The pivot axis 17 has a fixed position in the apparatus 1. The first gear wheel 16 cooperates with the teeth 14 of the rod 13. The second gear wheel 18 cooperates with teeth 19 on a disc 20, which disc 20 is pivotable about a pivot axis 21. The pivot axis 21 has a fixed position in the apparatus 1. The disc 20 is connected on a side remote of the teeth 19 to a U-shaped handle 22. The handle 22 comprises two legs 23 located on both sides of the second housing part 10 and connected to the discs 20, which legs 23 are interconnected on sides remote of the discs 20 by means of a bridge shaped part 24. By pivoting the handle 22 about the pivot axis 21 in a direction as indicated by arrow P1 the teeth 19 on the disc 20 will cooperate with the second gear 18 and will rotate the gear 18 in a clockwise direction as indicated by arrow P2. Since the second gear 18 is connected to the first gear 16, the first gear 16 will also be rotated in clockwise direction. As the teeth of the gear 16 cooperate with the teeth 14 on the rod 13, the rotation of the gear 16 will cause the rod 13 to move along the gear 16, whereby due to the curved shape of the rods 13 the first

housing part 8 will firstly be moved in a mainly horizontal direction towards the containers 3, 4, after which the first housing part 8 will be moved simultaneously towards the containers 3, 4 as well as to the second housing part 10, whereby in the final stage of movement of the first housing part 8, the first housing part 8 will be moved vertically towards the second housing part 10 to the second closed position as shown in figures 6a-6c. During the whole movement both housing parts 8, 10 remain horizontal. Especially the horizontal open position of the first housing part 8 being moved forwardly away from the containers 3, 4, facilitates the placement and removal of the eggs and easily prevents the egg from falling out of the first housing part.

As can be seen in figures 1c, 3-5, 6c and 7 the first housing part 8 comprises a square bottom wall 30 and four side walls 31 extending perpendicularly to the bottom wall 30. On the bottom wall 30 a spirally conduit 32 is located which opens near the middle of the bottom wall 30 in a vertically extending tube 33. The end 34 of the conduit 32 is in connection with the container 3, 4 as will be explained with reference to the figures 14 and 16. The first housing part 8 is further provided with the first holder part 9, which holder part 9 has a shape of half an egg and is provided with spacers 35 extending from the wall 36 of the first holder part 9. The first holder part 9 is provided at its lowest part with a tube 37, which fits into the tube 33 in the first housing part 8. The tube 37 is provided with a sealing ring 38 on the outside thereof to provide a watertight sealing between the tubes 33 and 37. The tube 37 is provided on a side near the wall 36 with a grid comprising a number of openings 39. In case that an egg 40 located in the first holder part 9 will break, the grid will prevent parts of the egg shell and the egg to enter the tubes 37, 33 and the conduit 32. As can be seen in figure 1c the spacers 35 keep the eggshell of the egg 40 at a predetermined distance from the wall 36 of the first holder part 9. The wall 36 of the first holder part 9 is provided with a conical part 41 at a side directed towards the second housing part 10.

The second housing part 10 is provided with a square top wall 45 and four side walls 46 extending downwardly therefrom. Inside the walls 45, 46 a device 47 for providing microwave radiation is located. Such an device is well known in the art and will not further be explained.

5 Below the device 47 a square chamber 48 is located in which the second holder part 11 is mounted. The second holder part 11 is provided with an inner wall 49 having a shape of half an egg. The wall 49 of the second holder part 11 together with the wall 36 of the first holder part 9 define a cavity 50 having an egg shaped form wherein a first longitudinal end being relatively narrow is located near the bottom of the first holder
10 part 9 whilst a second longitudinal end being relatively wide is located near a top of the wall 49. Near the top of the wall 49 a spring 51 is provided, which spring 51 rests against the second end of the egg 40 when the housing parts 8, 10 are in their first closed position (see figures 6, 7), thereby pressing
15 the egg 40 on the spacers 35 to maintain a fixed position of the egg 40 in the cavity 50.

The second holder part 11 is provided with a conical part 52, which cooperates with the conical part 41 of the first holder part 9 to facilitate the correct positioning of the first housing part 8 with respect to
20 the second housing part 10. The second holder part 11 is further provided with a ring shaped seal 53 which rests against the first holder part 9 in the closed position, as shown in figure 6c and provides a water tight seal between the first holder part 9 and the second holder part 11. The second holder part 11 is connected near the top thereof to a conduit 54, which
25 conduit 54 is in fluid communication with the container 4, as will be further explained with reference to the figures 14 and 16. In the closed position as show in the figures 6a-6c, microwave radiation can be generated by the device 47 in the confined space 154, which space 154 is bounded by the chamber 48 of the second housing part 10 and the walls 30, 31 of the first
30 housing part 8. The first holder part 9 and the second holder part 11 are

made from materials being transparent to microwave radiation so that microwave radiation will also reach the cavity 50 in which an egg 40 is being positioned. Such materials are well known in the art, for example as described in the above mentioned initial patent application
5 WO2012002814A1. Before explaining the operation of the apparatus 1, other embodiments of apparatuses according to the invention will be described since the working principles of these apparatuses are mainly the same.

Figure 8a-9 disclose a second embodiment of an apparatus 101 according to the invention which apparatus 101 differs from the apparatus 1
10 in that the gear 18 is driven by an electric motor 102 instead of by pivoting the handle 24 manually.

The figures 10a-11 disclose a third embodiment of an apparatus 201 according to the invention which differs from the apparatus 1, 101 in that the first housing part 8 is only pivotable with respect to the second
15 housing part 10. The first housing part 8 is provided at a side near the containers 3, 4 with two L-shaped brackets 202, which L-shaped brackets 202 are pivotable with respect to the base 2 about pivot axis 203. The pivot axis 203 has a fixed position in the apparatus 201. At a side remote of the containers 3, 4 the first housing part 8 is provided with a handle 204. By
20 means by the handle 204 a user can manually move the first housing part 8 from the open position as shown in figures 10a-10b to the closed position as shown in figure 11 and vice versa. In the handle 204 a locking mechanism is provided to lock the handle 204 to the second housing part 10 in the closed position of the housing parts 8, 10. Well known locking mechanisms can be
25 used for such a lock. The base 2 of the apparatus 201 is provided with a slanted surface 205 on which the first housing part 8 rests in the open position thereof.

To provide a smooth movement of the first housing part 8 from the closed position to the open position and to prevent that the first housing

part 8 simply drops on the slanted surface 205, the apparatus 201 is provided with a damping mechanism 206.

The damping mechanism 206 comprises on each L-shaped bracket 202 a disc 207 being provided with teeth 208. The teeth 208 cooperate with
5 a gear wheel 209, which is rotatable about an axis which has an fixed position in the apparatus 201. The gearwheel 209 is prevented against relatively fast rotation so that only by moving the teeth 208 relatively slowly in or opposite a direction as indicated by arrow P₃ the first housing part 8 can be moved with respect to the second housing part 10.

10 Figures 12a-13 disclose a fourth embodiment of an apparatus 301 according to the invention which differs from the apparatus 201 in that the gear wheel 209 is now electrically driven by a motor 302 which motor has a fixed position in the apparatus 301. By operating the electric motor 302, the gear wheel 209 is being driven. Since the gearwheel 209 cooperates with the
15 teeth 208 on the disc 207, the disc 207 as well as the L-shaped bracket 202 and the first housing part 8 will be moved in a direction as indicated by arrow P₃ to move the first housing part 8 from the open position as shown in figure 12a-12b to the closed position as shown in figure 13. By rotating the gearwheel 209 in the opposite direction the first housing part 8 will be
20 moved in a direction opposite to arrow P₃ from the closed position to the open position.

Figures 14 and 16 show a more schematic view of the apparatus 1, 101, 201, 301.

As can be seen the first container 3 is connected via a conduit 401 to a
25 first peristaltic pump 402. An outlet of the peristaltic pump 402 is connected via a conduit 403 to the end 34 of the spirally conduit 32 in the first housing part 8. The apparatus 1, 101, 201, 301 is further provided with a second peristaltic pump 404, which is connected by means of a conduit 405 to the end 34 of the spirally conduit 32 and is connected on another side of the
30 pump 404 by means of a conduit 406 to the container 4. The conduit 54,

which is connected to the cavity 50 in the second holder part 11 opens at an end remote of the cavity 50 into the container 4. Both the containers 3, 4 are open at the top so that in the containers 3, 4 the atmospheric pressure exists.

5 The first container 3 is provided at its lower part with a buffer unit 407. The buffer unit 407 is connected by means of a conduit 408 to a heat exchanger, for example a Peltier heat exchanger 409 to preheat the liquid before it enters first housing part 8. In the buffer 407 a temperature sensor may be present to check whether the liquid has the desired temperature.

10 The peristaltic pumps 402, 404, the device 47 for providing microwave radiation in the space 154, the Peltier heat exchanger, the dose unit 6 as well as sensors to check for example the liquid level in the containers 3, 4 are all controlled by means of a computer 410.

 Figure 14 discloses a scheme of the filling of the cavity 50 as well as
15 the process during the cooking process of the egg 40.

 The operations of the apparatus 1, 101, 201, 301 are as follows.

 After placing an egg 40 in the cavity 50 and closing the first housing part 8 and the second housing part 10 the liquid in the buffer unit 407 will be heated to a predetermined temperature of for example 20 degrees
20 Celsius.

 After the liquid has reached the desired temperature the liquid will be pumped by means of the first pump 402 through the conduit 401 and the conduit 403 in the direction as shown by the arrow P4 into the spirally conduit 32 and into the cavity 50. The egg 40 will be nearly completely
25 surrounded by the liquid except for the locations where the egg is in contact with the spacers 35 and the spring 51. It is also possible that a small part of the egg 40 near the spring 51 is not completely covered with the liquid. The liquid can be water with an addition of NaCl, for example preferably 0,2M NaCl (about 12 gram/litre water), to obtain a liquid with a dielectric

constant with an imaginary part, ϵ'' , between 20-500 at a temperature between 0°C -100°C and at a microwave frequency of 2.45 GHz.

With an egg of about 60-65 grams and a length of about 56-60 millimetres an amount of about 45 millilitre of liquid will be sufficient to fill
 5 the space between the eggshell of the egg 40 and the walls 36, 49 of the first holder part 9 and the second holder part 11, whereby a layer of liquid around the eggshell is obtained having an average thickness of 2-8 millimetres.

After the cavity 50 is initially filled with the desired amount the
 10 device 47 operating at a common 2.45GHz is switched on at a constant power of for example 1000 Watt, whereby microwave radiation is generated in the space 154 to heat the liquid as well as the egg 40 in the cavity 50. As soon the liquid starts to boil, the generated steam can escape through the conduit 54 and will flow in the direction indicated by arrow P5 into the
 15 container 4. To prevent that due to the evaporation of the liquid the egg 40 will no longer be surrounded with liquid, additional liquid is added to the cavity 50. This liquid enters the first housing part 8 at a temperature of about 20 degrees in small pulses by activating the first pump 402 during a predetermined time. Since the conduit 32 is located inside the cavity 54, also
 20 the liquid present in the conduit 32 will be heated by the microwave radiation. The conduit 32 might have a length of for example 40-80 centimetres being long enough to heat up the liquid in the conduit 32 at the end 34 from 20 °C so that the liquid when entering the cavity 50 will have about the same temperature as the liquid already present in the cavity 50.
 25 Other lengths are also possible.

As can be seen in figure 15 a first amount V1 of liquid is added before the microwave radiation starts. After a period of time T11 of for example 25 seconds a small amount V2 of for example 5 millilitres is added to the cavity 50 which amount V2 is then added every 3,5 seconds. In the diagram, the
 30 pulses are shown by a line 501. In the diagram also the average amount of

liquid added to the cavity 50 is indicated by means of a line 502. During the cooking process by means of the microwave radiation, the power of the device 47 is kept constant at 1000 Watt. By operating the device at a constant power no irregular change in the microwave radiation will occur.

5 After 95 seconds the microwave radiation will be stopped as can be seen in the diagram. As shown in figure 15 almost 100 millilitres have been added to the cavity 50 after the initial first amount of 45 millilitres. By adding such a relatively large second amount of liquid starting after such a relatively short time T_{11} , a soft-boiled egg will be obtained.

10 By starting the insertion of additional liquid in the cavity 50 after a longer period of time T_{12} , for example after 32 seconds of the start of the microwave radiation and by adding the same amount V_2 in the same intervals of 3,5 seconds a middle-boiled egg will be obtained. The lines 503, 504 show respectively the pulses and the average amount of added liquid.

15 The total second amount of liquid added to the cavity 50 for a middle-boiled egg is less than for a soft-boiled egg.

If the insertion of additional liquid starts even later, for example after a longer period of time T_{13} , for example after 39 seconds with the same amount V_2 and the same interval, a hard-boiled egg will be obtained. The

20 lines 505, 506 show respectively the pulses and the average amount of added liquid. The total second amount of liquid added to the cavity 50 for a hard-boiled egg is less than for a soft-boiled egg and a middle-boiled egg.

After the microwave radiation has been switched off, the second pump 404 is switched on to pump 405 the liquid in the cavity 50 in a

25 direction as indicated by arrow P6 through the conduit 32 into the conduit 404, through the pump 405 into the conduit 406 into the container 4 for waste liquid. The conduit 32 as well as the tubes 33, 37 are used both as inlet for the liquid into the cavity 50 as well as an outlet of the liquid from the cavity 50.

It is also possible to use microwave radiation whereby the power thereof is changed, for example lowered during the cooking process. In such a case the amount of liquid added during the microwave radiation will be different from the amount as shown in figure 15. It is also possible that
5 instead of adding the liquid in pulses with an amount of V2 to add the liquid in smaller or larger amounts with a interval being larger or smaller than described above.

It is also possible to add the liquid at a constant rate or to vary the amount of added liquid in time. Also, smaller step sizes can be chosen, such
10 that the flow is accurately controlled by means of pulse width modulation, resulting in the same egg preparation program with the same amounts of pumped liquids.

It is also possible to have different holders for different sizes of eggs.

It is also possible to have other amounts of NaCl in the water, for
15 example between 10 and 14 gram/litre water.

It is also possible to preheat the liquid to another temperature, for example about 30-35 degrees Celsius before entering the housing.

It is also possible to start the addition of the second amount of liquid based on for example the temperature in the cavity or the amount of liquid
20 that has been evaporated and has left the cavity.

The person skilled in the art will realize that the present invention is by no means limited to the preferred embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings,
25 the disclosure, and the appended claims.

In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures

cannot be used to advantage. Any reference signs in the scope should not be construed as limiting the scope of the claims.

LIST OF REFERENCE SIGNS

5		
	1	apparatus
	2	base
	3	container
	4	container
10	5	container
	6	dosing unit
	7	opening
	8	first housing part
	9	first holder part
15	10	second housing part
	11	second holder part
	12	gearing mechanism
	13	rod
	14	teeth
20	16	gear wheel
	17	pivot axis
	18	gear wheel
	19	teeth
	20	disc
25	21	pivot axis
	22	handle
	23	leg
	24	bridge shaped part
	30	bottom wall
30	31	side wall

	32	conduit
	33	tube
	34	end
	35	spacer
5	36	wall
	37	tube
	38	sealing ring
	39	opening
	40	egg
10	41	conical part
	45	top wall
	46	side wall
	47	device
	48	chamber
15	49	wall
	50	cavity
	51	spring
	52	conical part
	53	seal
20	54	conduit
	101	apparatus
	154	space
	201	apparatus
	202	bracket
25	203	pivot axis
	204	handle
	205	surface
	206	damping mechanism
	207	disc
30	208	teeth

	209	gear wheel
	301	apparatus
	302	motor
	401	conduit
5	402	peristaltic pump
	403	conduit
	404	peristaltic pump
	405	conduit
	406	conduit
10	407	buffer
	409	heat exchanger
	410	computer
	501	line
	502	line
15	503	line
	504	line
	505	line
	506	line
	P ₃	arrow
20	P ₄	arrow
	P ₆	arrow
	V ₁	amount of liquid
	V ₂	amount of liquid
	T ₁₁	period of time
25	T ₁₂	period of time
	T ₁₃	period of time

CLAIMS

1. An apparatus (1, 101, 201, 301) for cooking at least one egg (40) with an eggshell, which apparatus (1, 101, 201, 301) comprises a housing (8, 10) provided with a device (47) for providing microwave radiation in a confined space in the housing (8, 10) and a holder (9, 11) located in the confined space, which holder (9, 11) being provided with at least one cavity (50) adapted to the shape of the egg (40) with the eggshell, which apparatus (1, 101, 201, 301) further comprises a pump system that includes means to insert a liquid into the holder (9, 11) for filling the cavity (50) with the liquid to at least partly surround the eggshell of the egg (40) located in the cavity (50), characterized in that the apparatus (1, 101, 201, 301) comprises means (410) to control the amount of liquid in the holder (9, 11) during a cooking process of the at least one egg (40), wherein:

- a first amount of liquid is inserted into the cavity (50) before providing microwave radiation in the cavity (50), which first amount of liquid at least partly surrounds the eggshell of the egg (40) located in the cavity (50);
- a second amount of liquid is inserted into the cavity (50) during providing microwave radiation to replenish the amount of liquid that has been evaporated and has left the cavity (50) during providing microwave radiation in the cavity (50) and to maintain a desired layer of liquid around the egg (4) located in the cavity (50).

2. The apparatus (1, 101, 201, 301) according to claim 1, characterized in that the apparatus comprises means to insert the second amount of liquid into the cavity (50) after a first predetermined period of time of providing microwave radiation and during a second predetermined period of time of providing microwave radiation.

3. The apparatus (1, 101, 201, 301) according to claim 1 or 2, characterized in that the first predetermined period of time of providing microwave radiation is shorter for the cooking process of a soft-boiled egg (40) than for a hard-boiled egg (40).

4. The apparatus (1, 101, 201, 301) according to claim 1, 2 or 3, characterized in that the second amount of liquid is larger for the cooking process of a soft-boiled egg (40) than for a hard-boiled egg (40).
- 5 5. The apparatus (1, 101, 201, 301) according to claim 2, characterized in that the second amount of liquid is added in pulses during the second predetermined period of time of providing microwave radiation.
6. The apparatus (1, 101, 201, 301) according to any one of claims 1-5, characterized in
10 that a constant power of the microwave radiation is used during the cooking process of the at least one egg (40).
7. The apparatus (1, 101, 201, 301) according to claim 2, characterized in that the sum
15 of the first predetermined period of time of providing microwave radiation and the second predetermined period of time of providing microwave radiation is about the same for the cooking process of a soft-boiled egg (40) and a hard-boiled egg (40).
8. The apparatus (1, 101, 201, 301) according to any one of claims 1-7, characterized in
20 that the first amount of liquid (V1) is between 30 and 60 millilitre, whilst the second amount of liquid is between 60 and 120 millilitre.
9. The apparatus (1, 101, 201, 301) according to any one of claims 1-8, characterized in
that at a power of 1000 Watt and 2.45 GHz of the device for providing microwave radiation,
the first predetermined period of time (T11, T12, T13) is between 15 and 40 seconds, with
25 a total period of time of providing microwave radiation between 90 and 120 seconds.
10. The apparatus (1, 101, 201, 301) according to any one of claims 1-9, characterized in
that the liquid is an aqueous liquid with a dielectric constant with an imaginary part, ϵ'' ,

between 20-500 at a temperature between 0 ° C - 100 ° C at a microwave frequency of 2.45 GHz.

11. The apparatus (1, 101, 201, 301) according to any one of claims 1-10, characterized in that the apparatus comprises a conduit (32) guiding liquid into the cavity, which conduit (32) is at least partly located in the confined space, wherein the second amount of liquid is preheated in the conduit (32) by the microwave radiation before the liquid is inserted into the holder (9, 11).

12. The apparatus (1, 101, 201, 301) according to claim 11, characterized in that the part of the conduit (32) located in the confined space is between 40 and 80 centimetres long.

13. The apparatus (1, 101, 201, 301) according to any one of claims 1-12, characterized in that the liquid has an average layer thickness between the holder (9, 11) and the eggshell of the egg (40) between 2 and 8 millimetres.

14. The apparatus (1, 101, 201, 301) according to any one of claims 1-13, characterized in that the pump system comprises at least two pumps (402, 404), wherein a first pump (402) is connected by a first conduit (403) to a liquid inlet, whilst a second pump (404) is connected by a second conduit (405) to a liquid outlet.

15. The apparatus (1, 101, 201, 301) according to any one of claims 1-14, characterized in that a second holder (11) comprises an open outlet for at least a gaseous phase of the liquid formed in the cavity (50) during the cooking process.

16. A method for cooking at least one egg (40) with an eggshell in an apparatus (1, 101, 201, 301) comprising a housing (8, 10) provided with a device (47) for providing microwave radiation in a confined space in the housing (8, 10) and a holder (9, 11) located in the confined space, which holder (9, 11) being provided with at least one cavity adapted to the

shape of the egg (40) with the eggshell, which apparatus (1, 101, 201, 301) further comprises a pump system that includes means to insert a liquid into the holder (9, 11) for filling the cavity (50) with the liquid to at least partly surround the eggshell of the egg (40) located in the cavity (50), characterized in that the apparatus (1, 101, 201, 301) comprises means to
 5 control the amount of liquid in the holder (9, 11) during a cooking process of the at least one egg (40), wherein:

- a first amount of liquid (V1) is inserted into the cavity (50) before providing microwave radiation into the cavity (50), which first amount of liquid (V1) at least partly surrounds the eggshell of the egg (40) located in the cavity (50);

- 10 - a second amount of liquid is inserted into the cavity (50) during providing microwave radiation.

17. The method according to claim 16, characterized in that the second amount of liquid is inserted into the cavity after a first predetermined period of time of providing microwave
 15 radiation and during a second predetermined period of time of providing microwave radiation.

18. The method according to claim 17, characterized in that the first predetermined period of time (T11, T12, T13) of providing microwave radiation is shorter for the cooking
 20 process of a soft-boiled egg (40) than for a hard-boiled egg (40).

19. The method according to claim 16, 17 or 18, characterized in that the second amount of liquid is larger for the cooking process of a soft-boiled egg (40) than for a hard-boiled egg
 (40).

25

20. The method according to claim 17, characterized in that the second amount of liquid is added in pulses during the second predetermined period of time of providing microwave radiation.

21. The method according to any one of claims 16-20, characterized in that a constant power of the microwave radiation is used during the cooking process of the at least one egg (40).
- 5 22. The method according to claim 17, characterized in that the sum of the first predetermined period of time (T11, T12, T13)) of providing microwave radiation and the second predetermined period of time of providing microwave radiation is about the same for the cooking process of a soft-boiled egg (40) and a hard-boiled egg (40).
- 10 23. The method according to any one of claims 16-22, characterized in that the first amount of liquid (V1) is between 30 and 60 millilitres, whilst the second amount of liquid is between 70 and 110 millilitres.
24. The method according to claim 17, characterized in that at a power of 1000 Watt and
15 2.45 Ghz of the device (47) for providing microwave radiation, the first predetermined period of time (T11, T12, T13) is between 15 and 40 seconds, with a total period of time of providing microwave radiation between 90 and 120 seconds.
25. The method according to any one of claims 16-24, characterized in that the liquid is
20 an aqueous liquid with a dielectric constant with an imaginary part, ϵ'' , between 20-500 at a temperature between 0°C - 100°C at a microwave frequency of 2.45 GHz.
26. The method according to any one of claims 16-25, characterized in that the apparatus
25 comprises a conduit (32) guiding liquid into the cavity (50), which conduit (32) is at least partly located in the confined space, wherein the second amount of liquid is preheated in the conduit (32) by the microwave radiation before the liquid is inserted into the holder (9, 11).
27. The method according to claim 26, characterized in that the part of the conduit (32) located in the confined space is between 40 and 80 centimetres long.

28. The method according to any one of claims 16-27, characterized in that the liquid has an average layer thickness between the holder (9, 11) and the eggshell of the egg (40) between 2 and 8 millimetres.

5

29. The method according to any one of claims 16-28, characterized in that the pump system comprises at least two pumps (402, 404), wherein a first pump (402) is connected by a first conduit (403) to the liquid inlet, whilst a second pump (404) is connected by a second conduit (405) to the liquid outlet.

10

30. The method according to any one of claims 16-29, characterized in that a second holder (11) comprises an open outlet for at least a gaseous phase of the liquid formed in the cavity (50) during the cooking process.

1/23

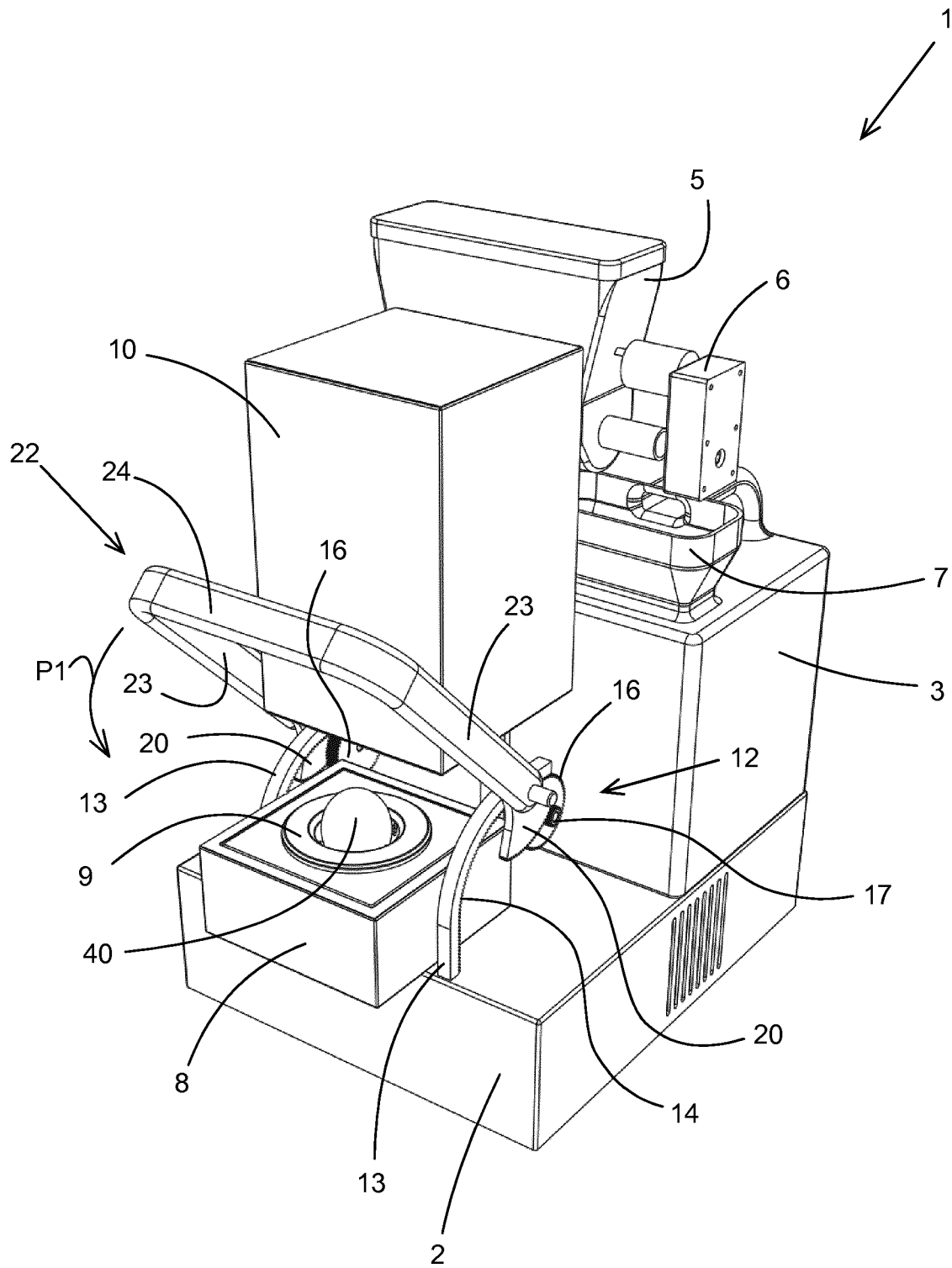


Fig. 1A

2/23

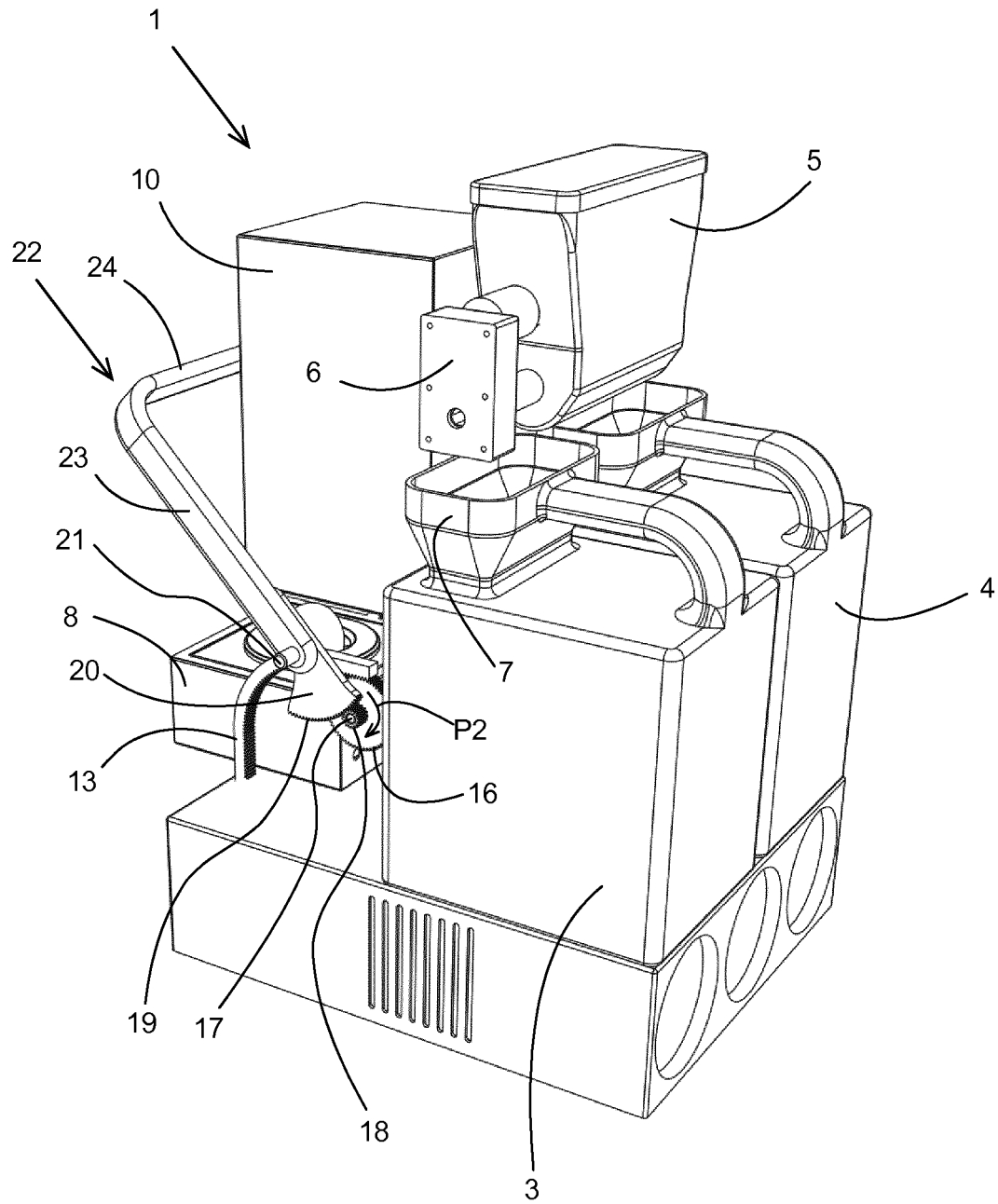


Fig. 1B

3/23

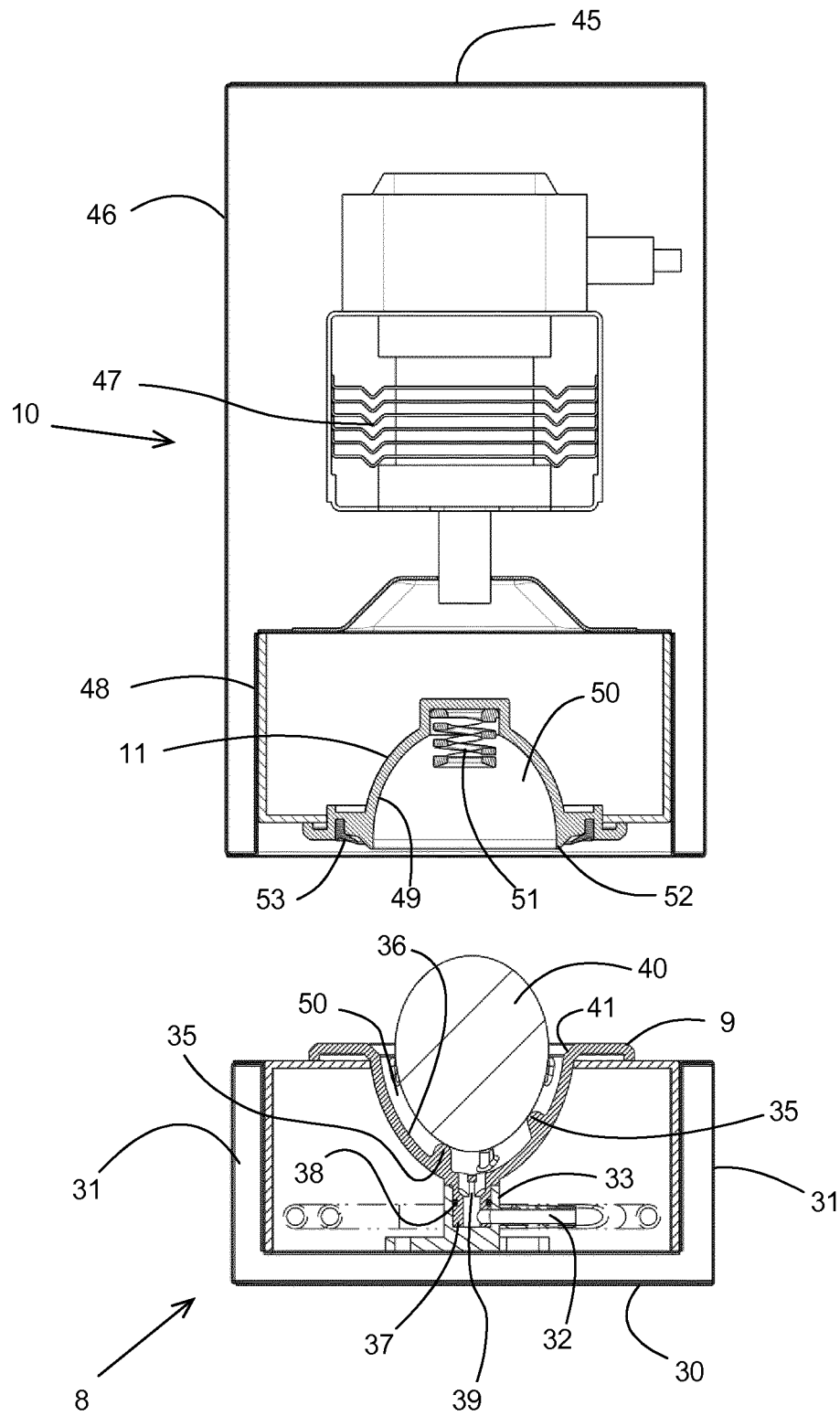


Fig. 1C

4/23

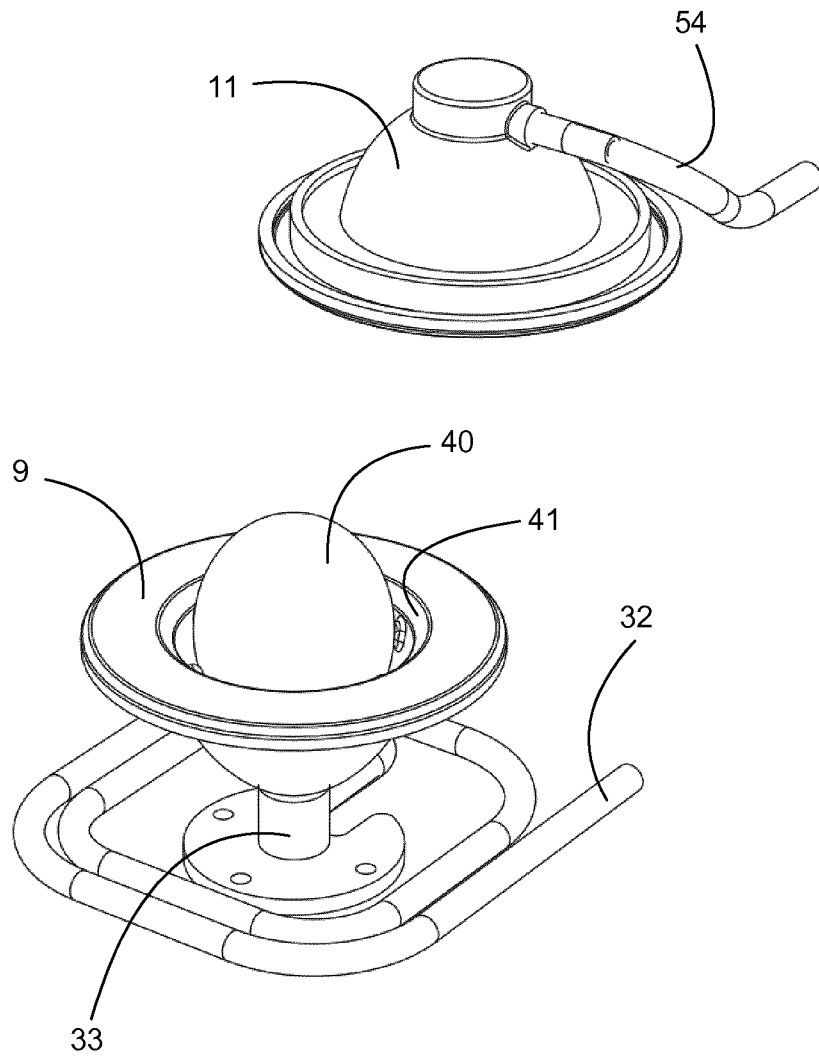


Fig. 2

5/23

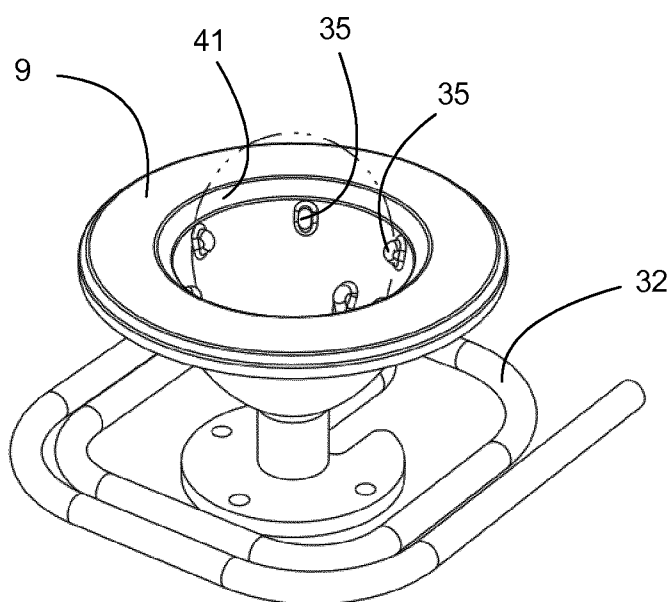
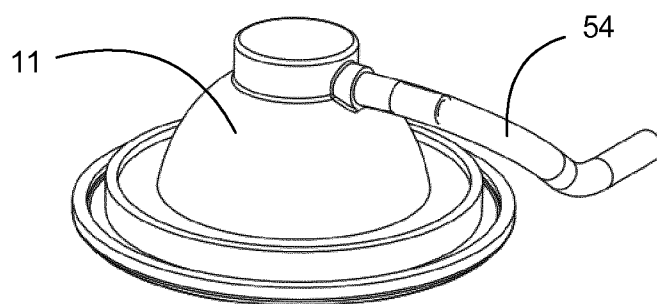


Fig. 3

6/23

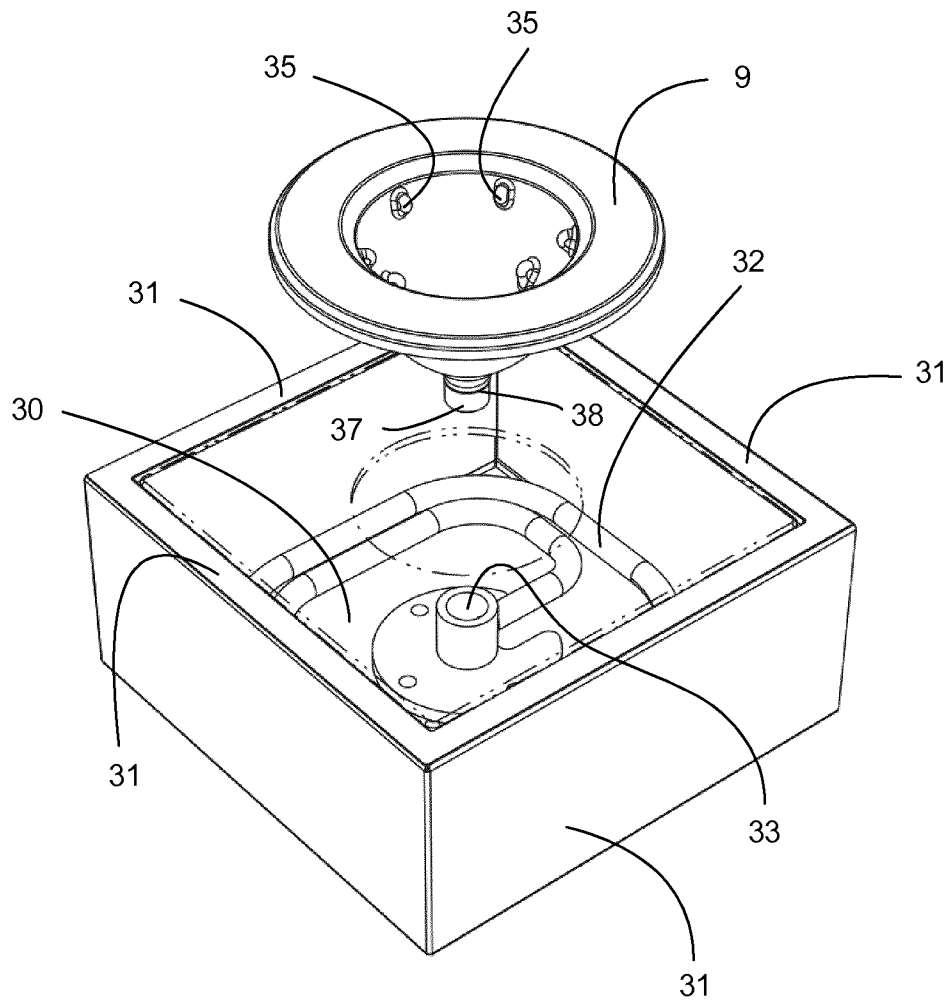


Fig. 4

7/23

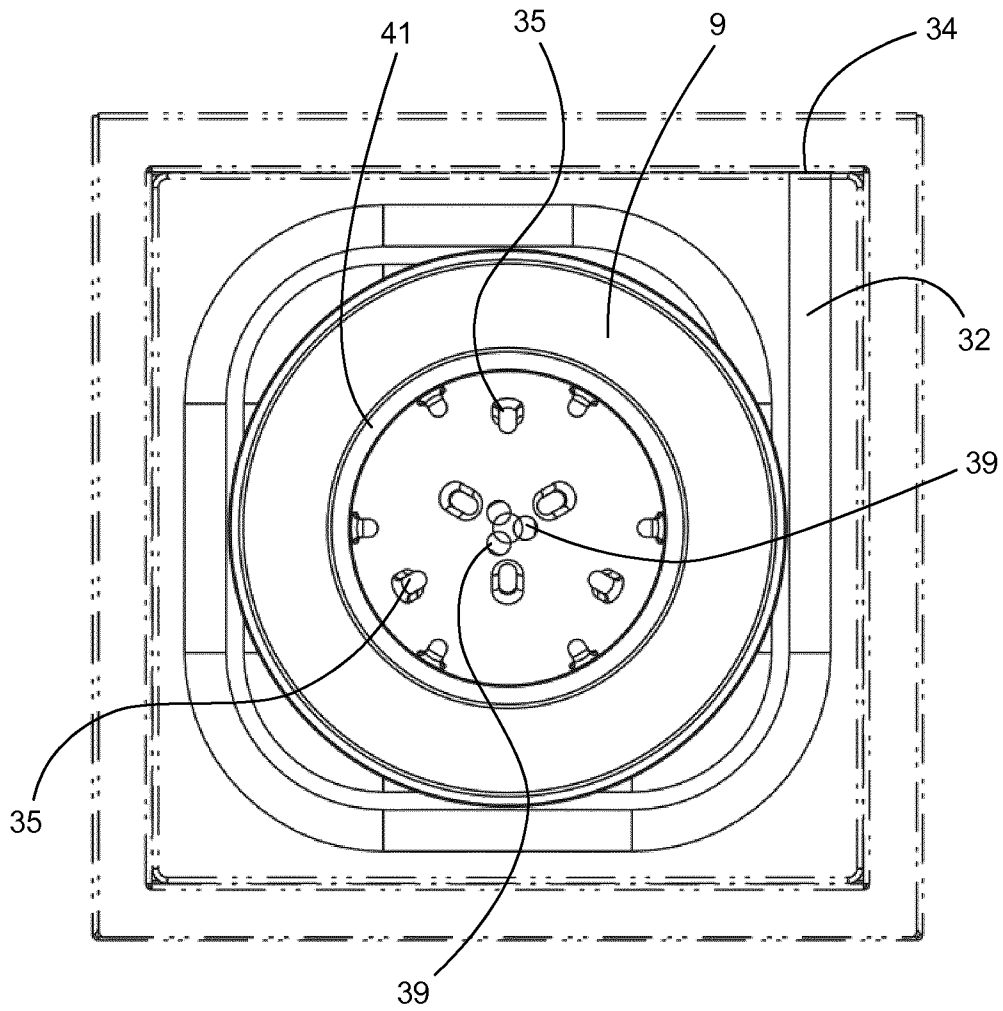


Fig. 5

8/23

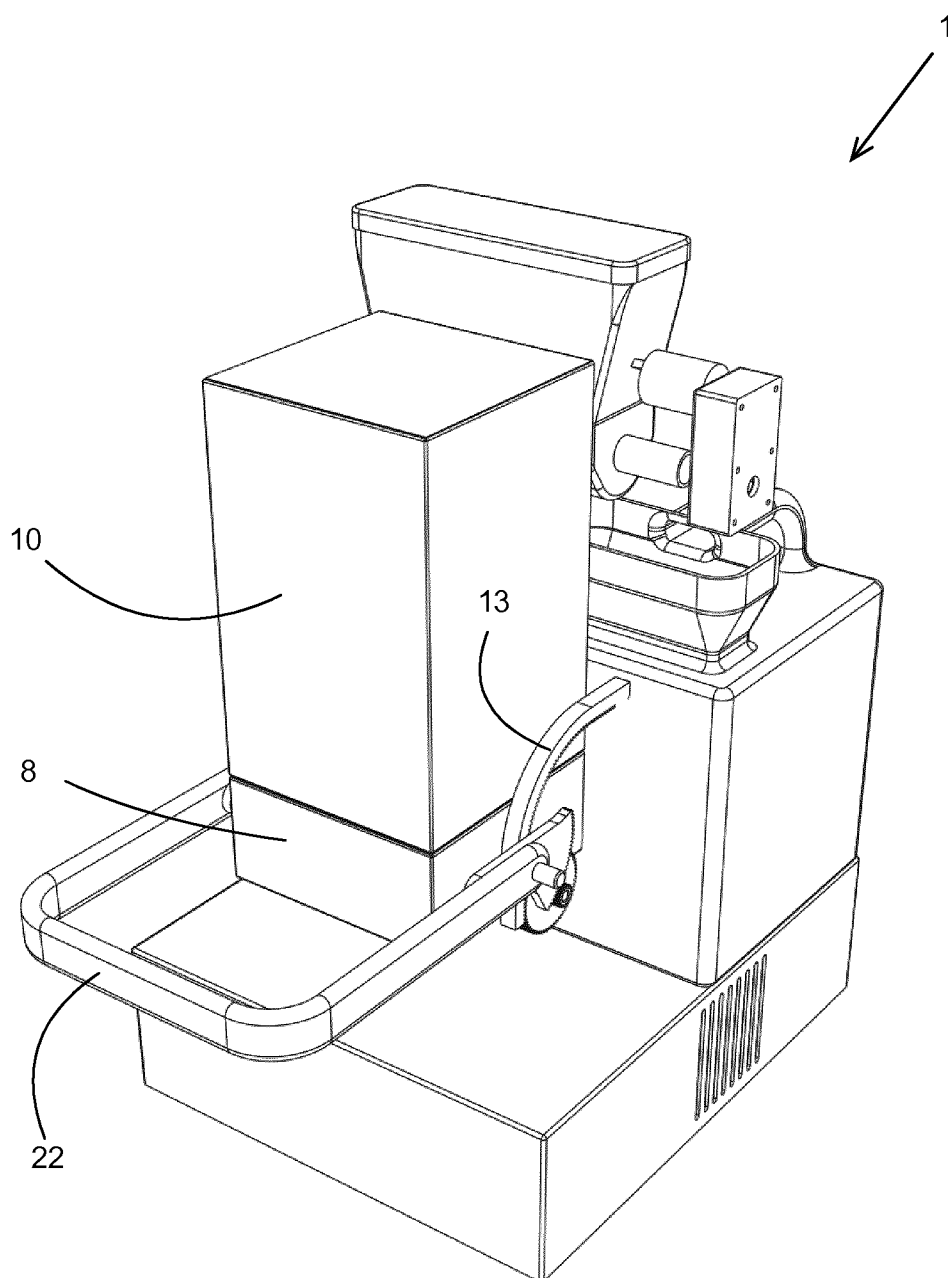


Fig. 6A

9/23

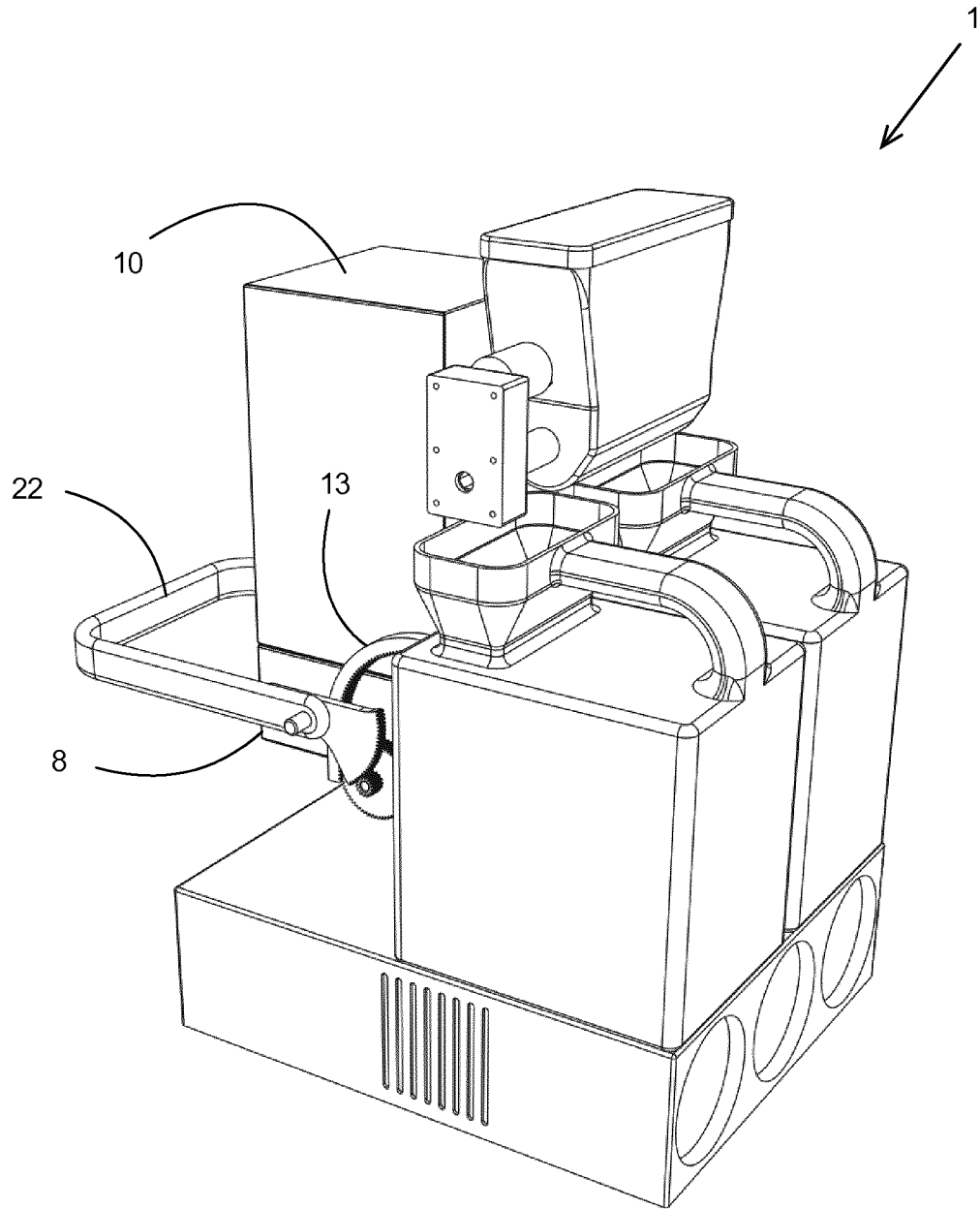


Fig. 6B

10/23

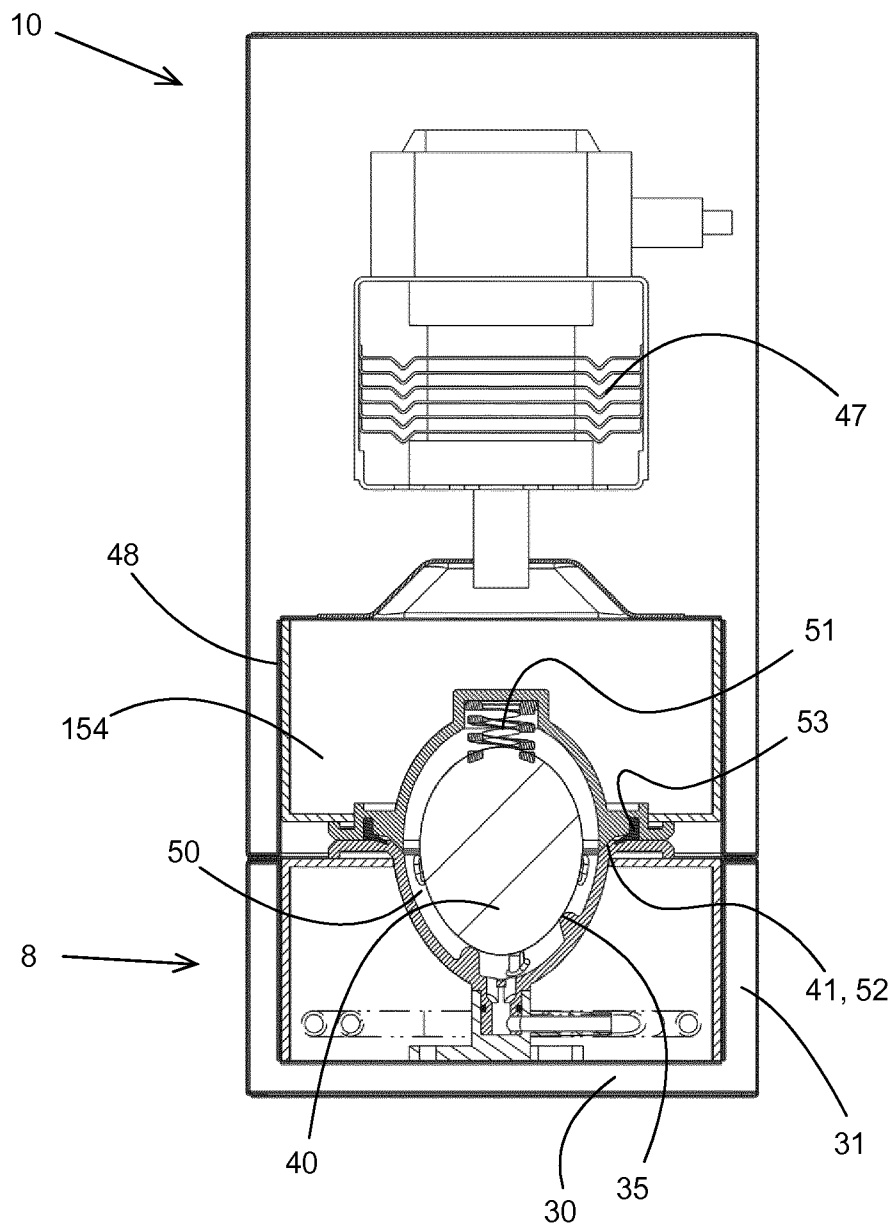


Fig. 6C

11/23

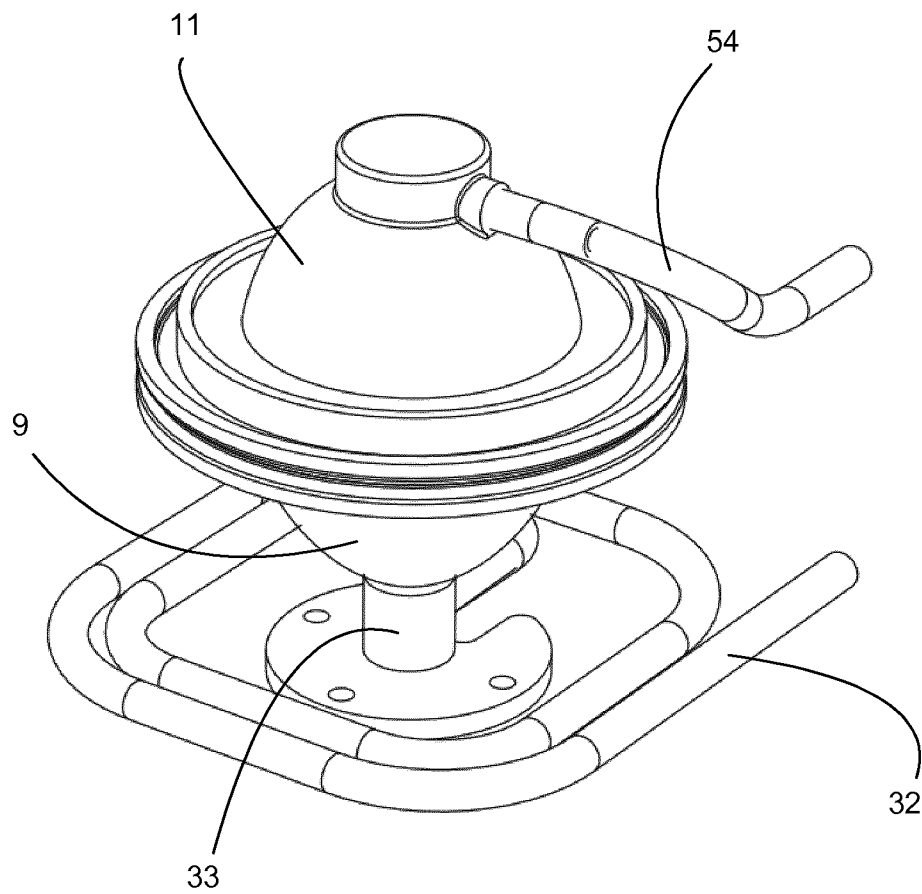


Fig. 7

12/23

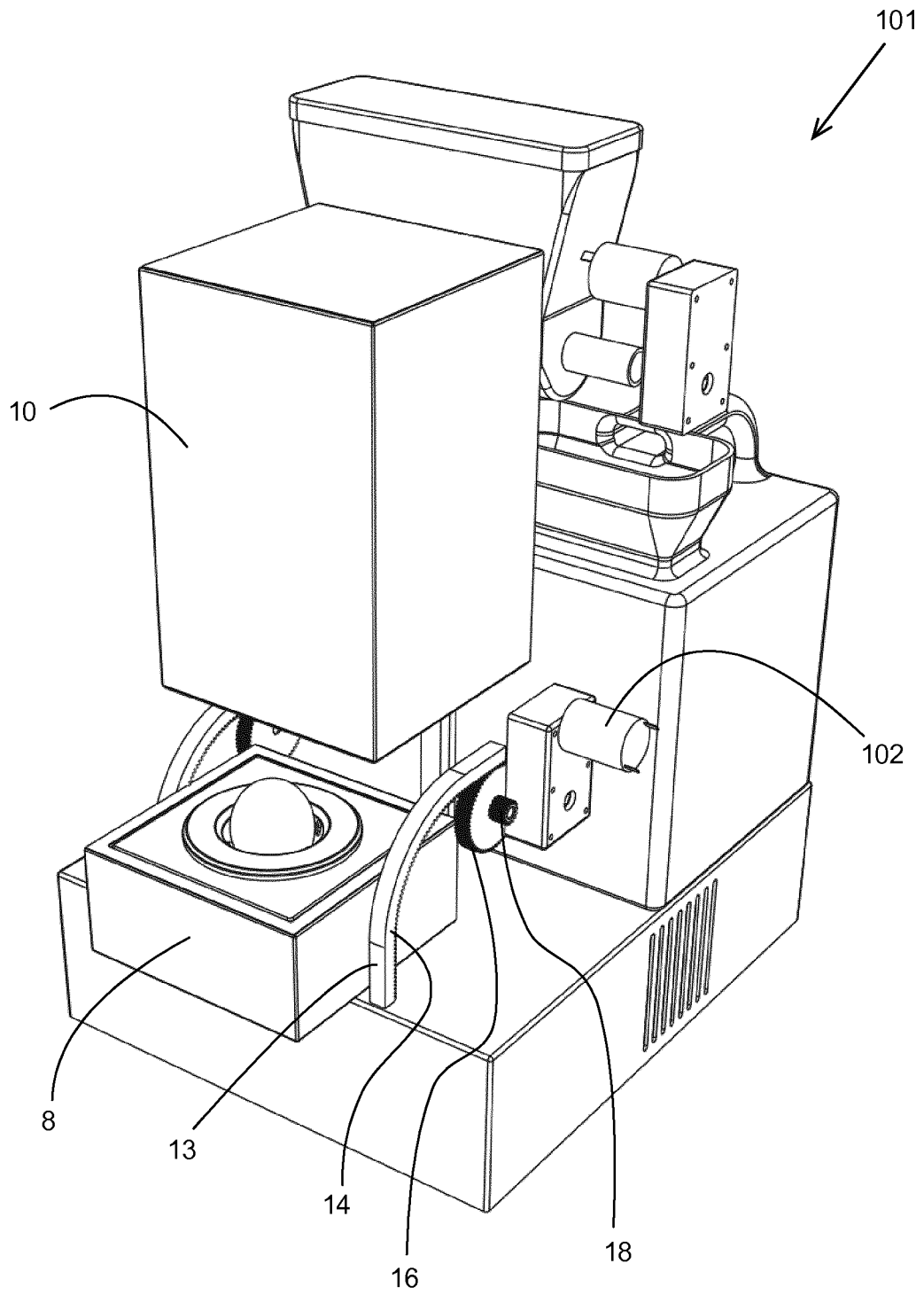


Fig. 8A

13/23

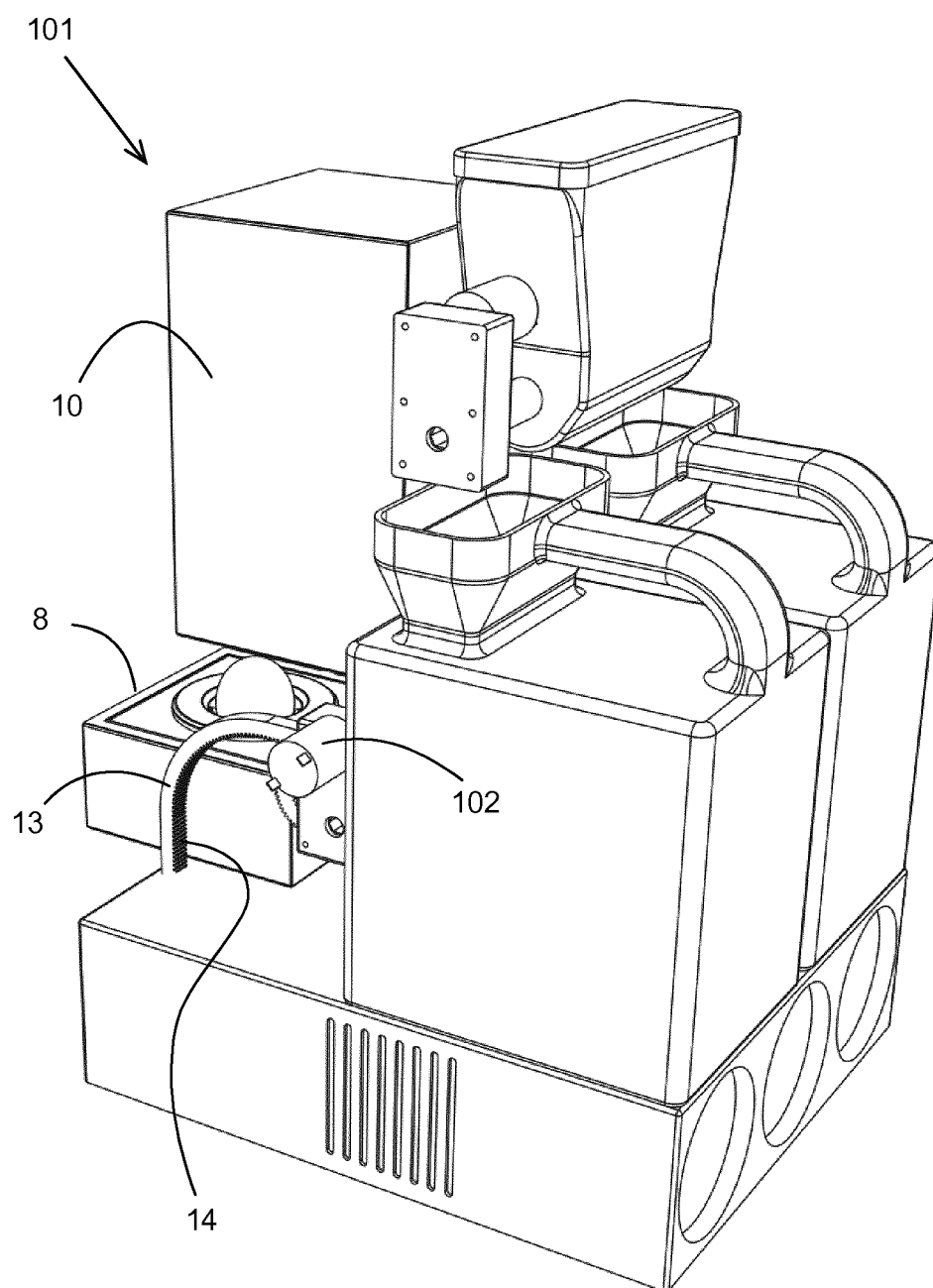


Fig. 8B

14/23

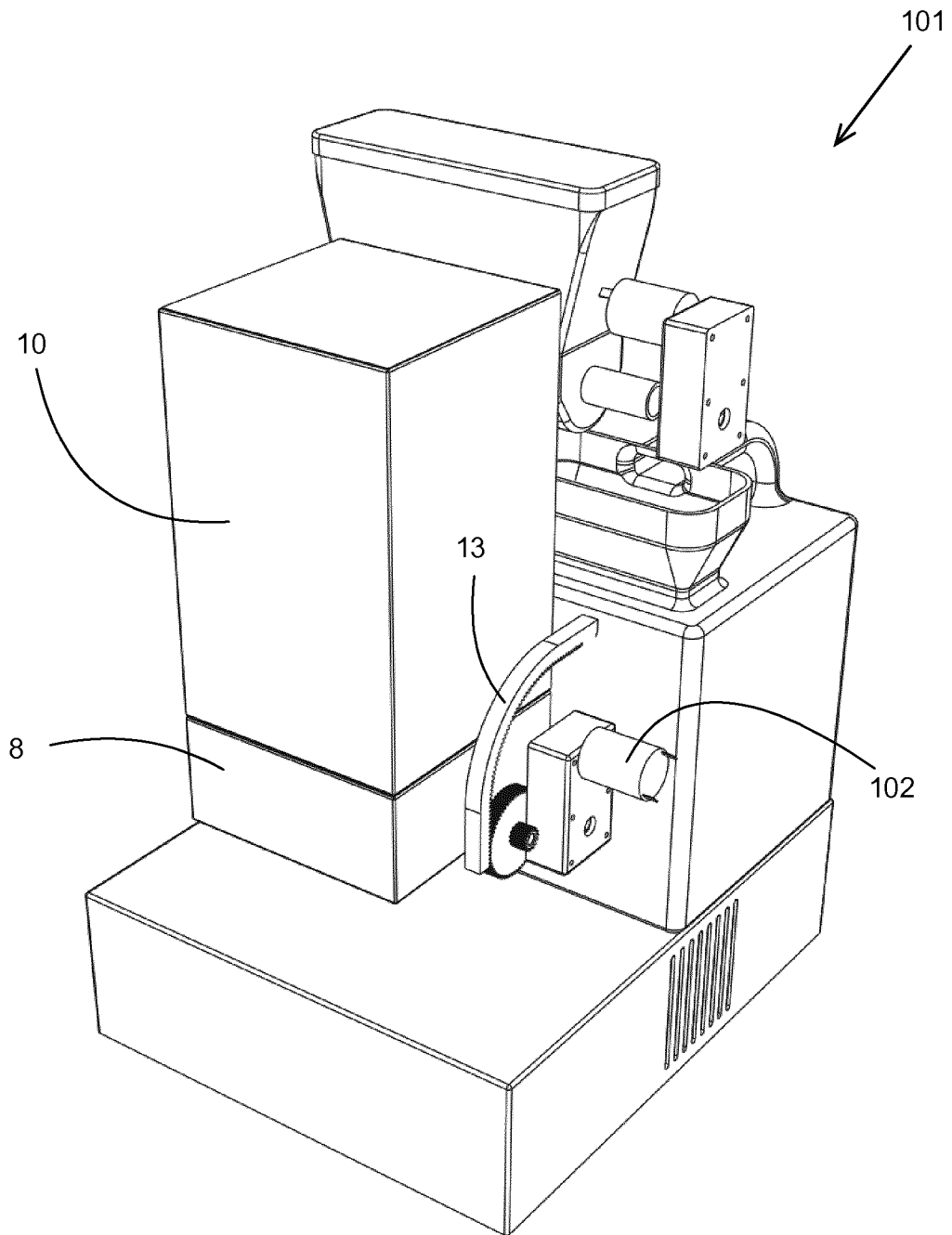


Fig. 9

15/23

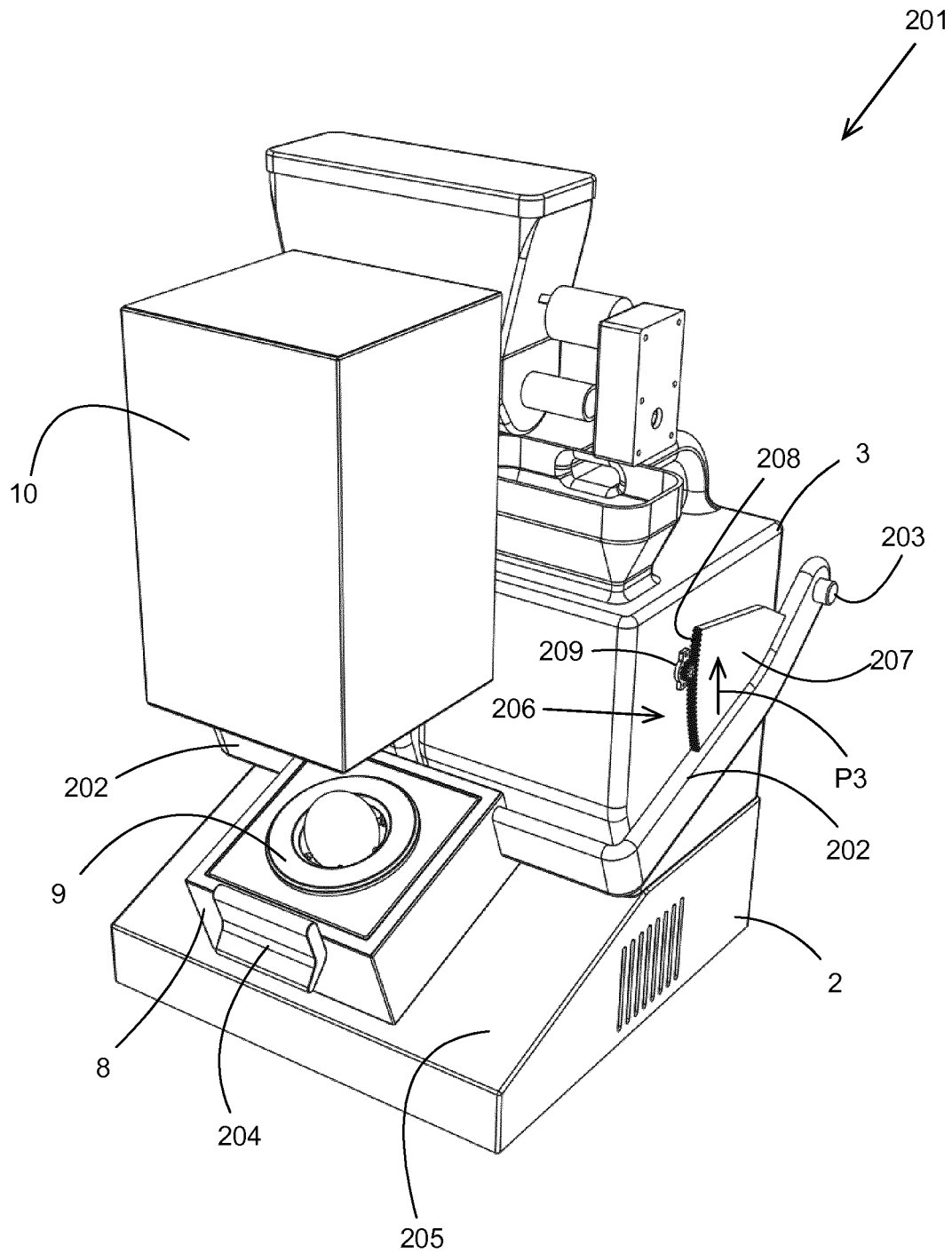


Fig. 10A

16/23

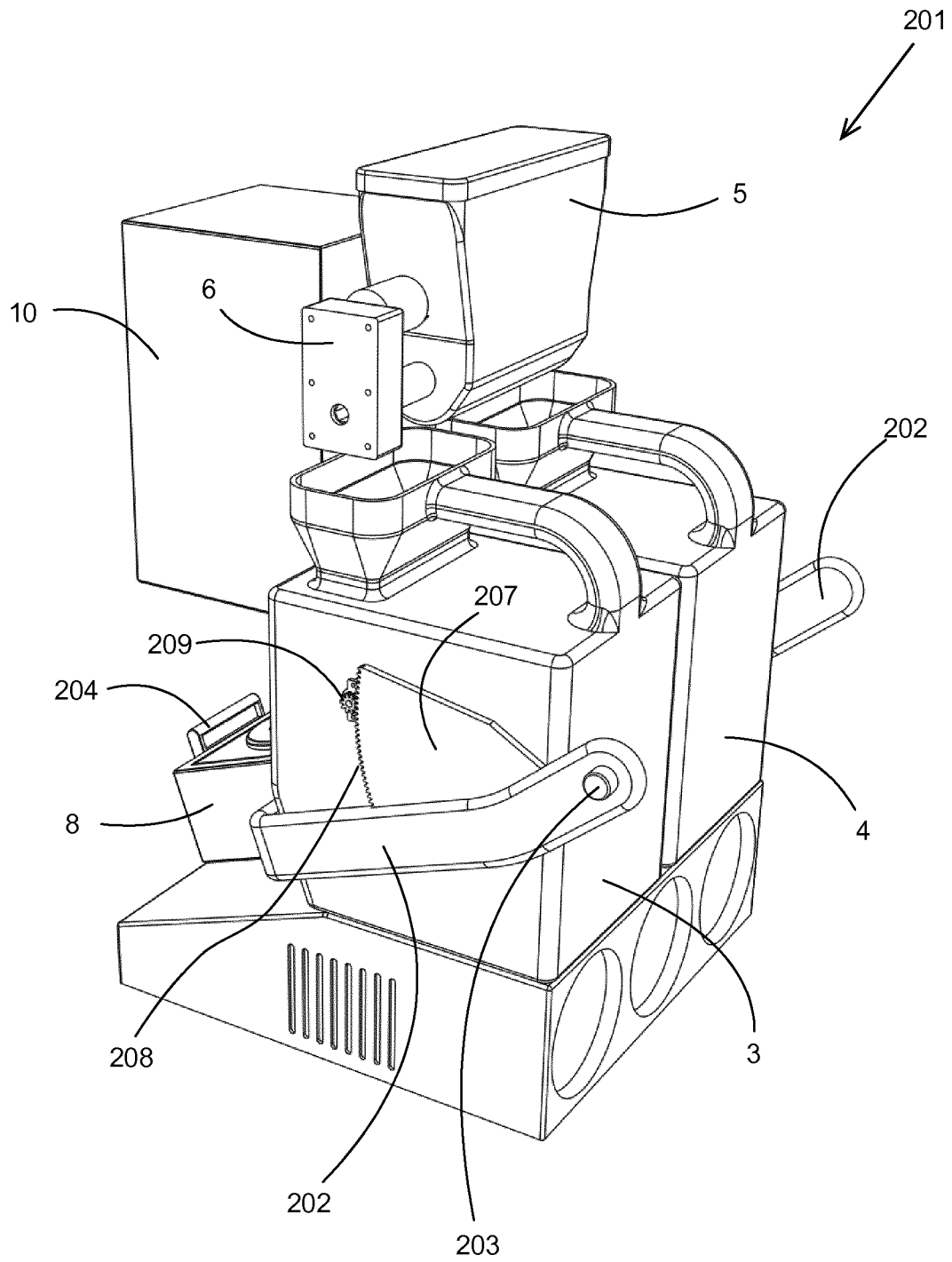


Fig. 10B

17/23

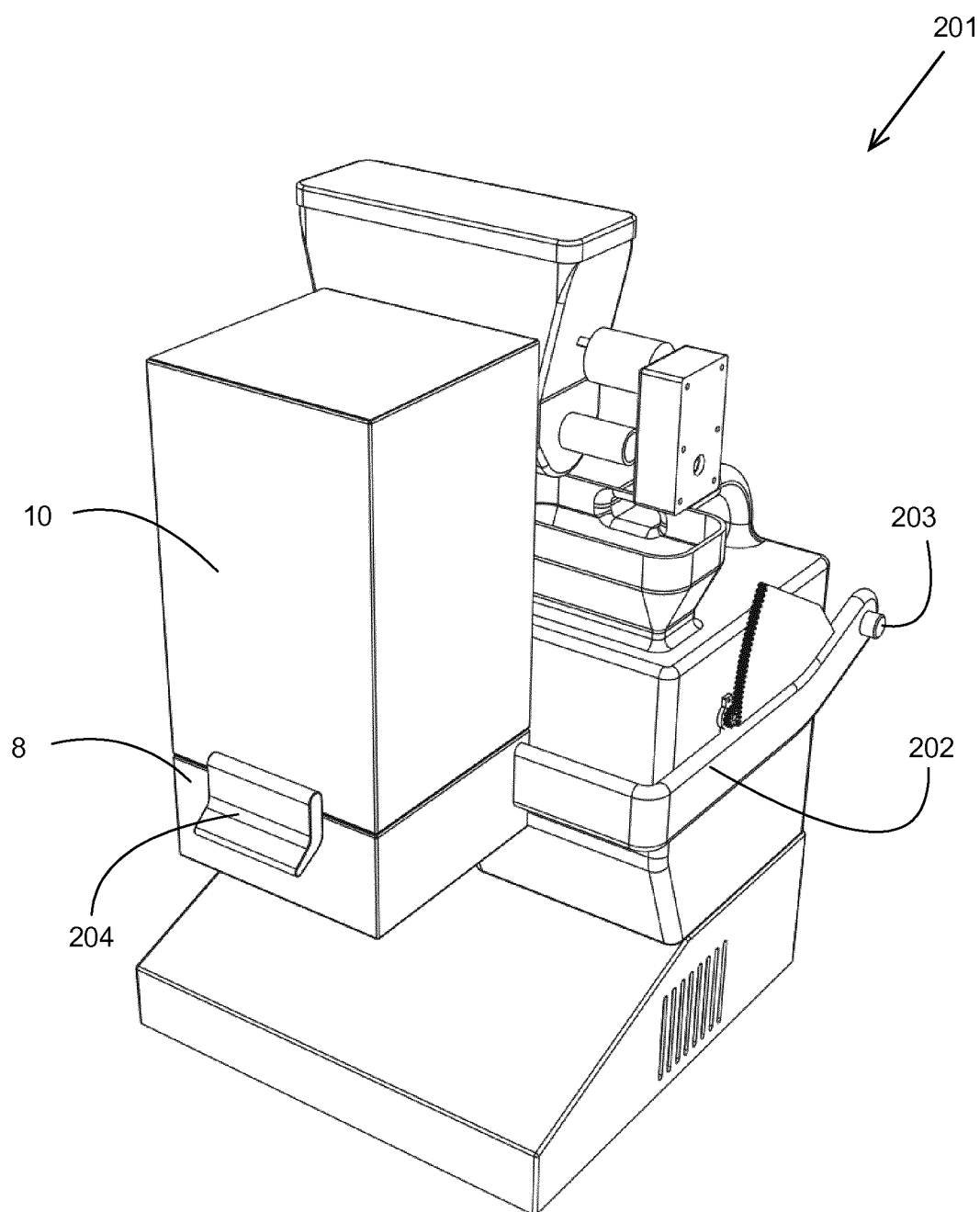


Fig. 11

18/23

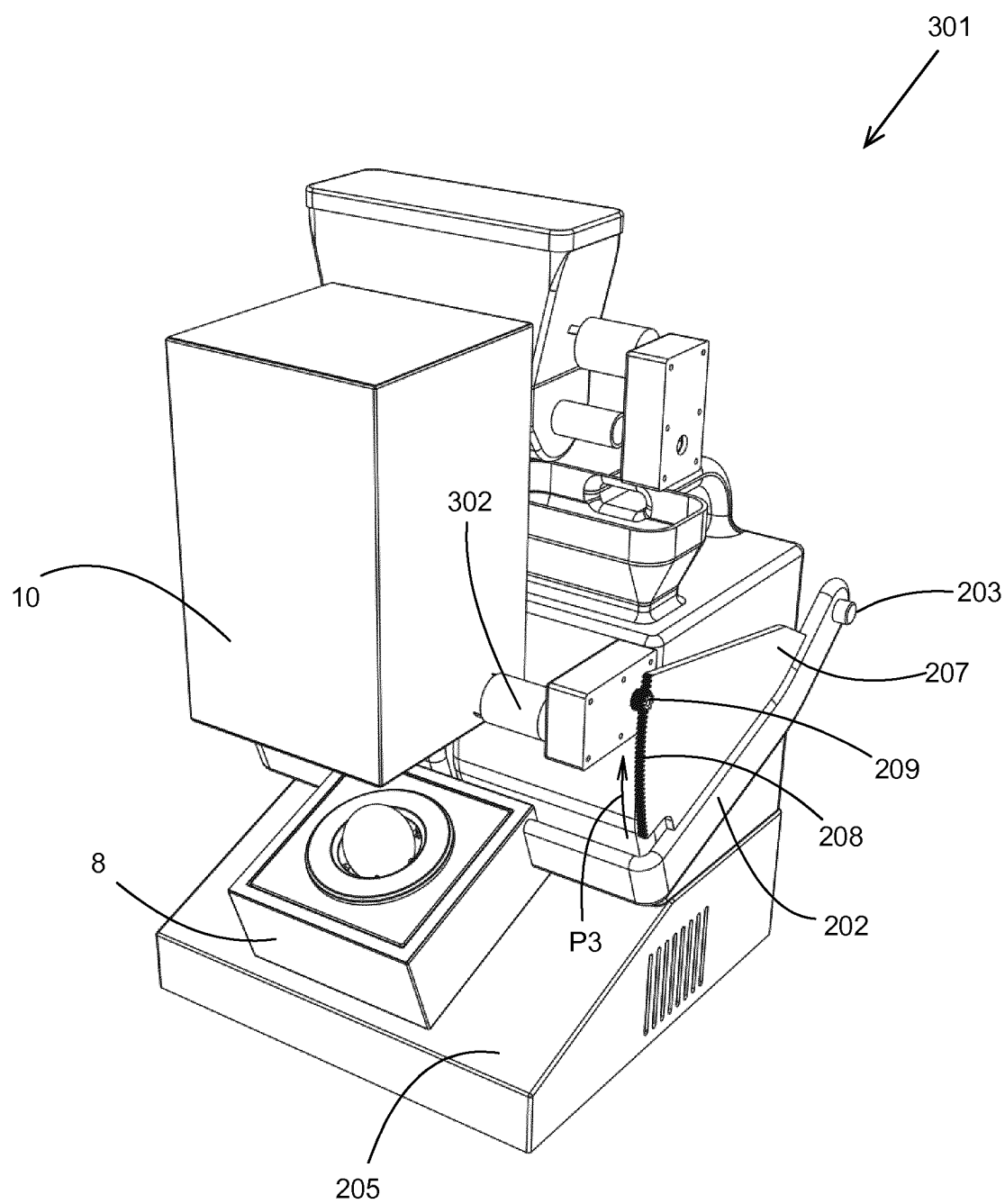


Fig. 12A

19/23

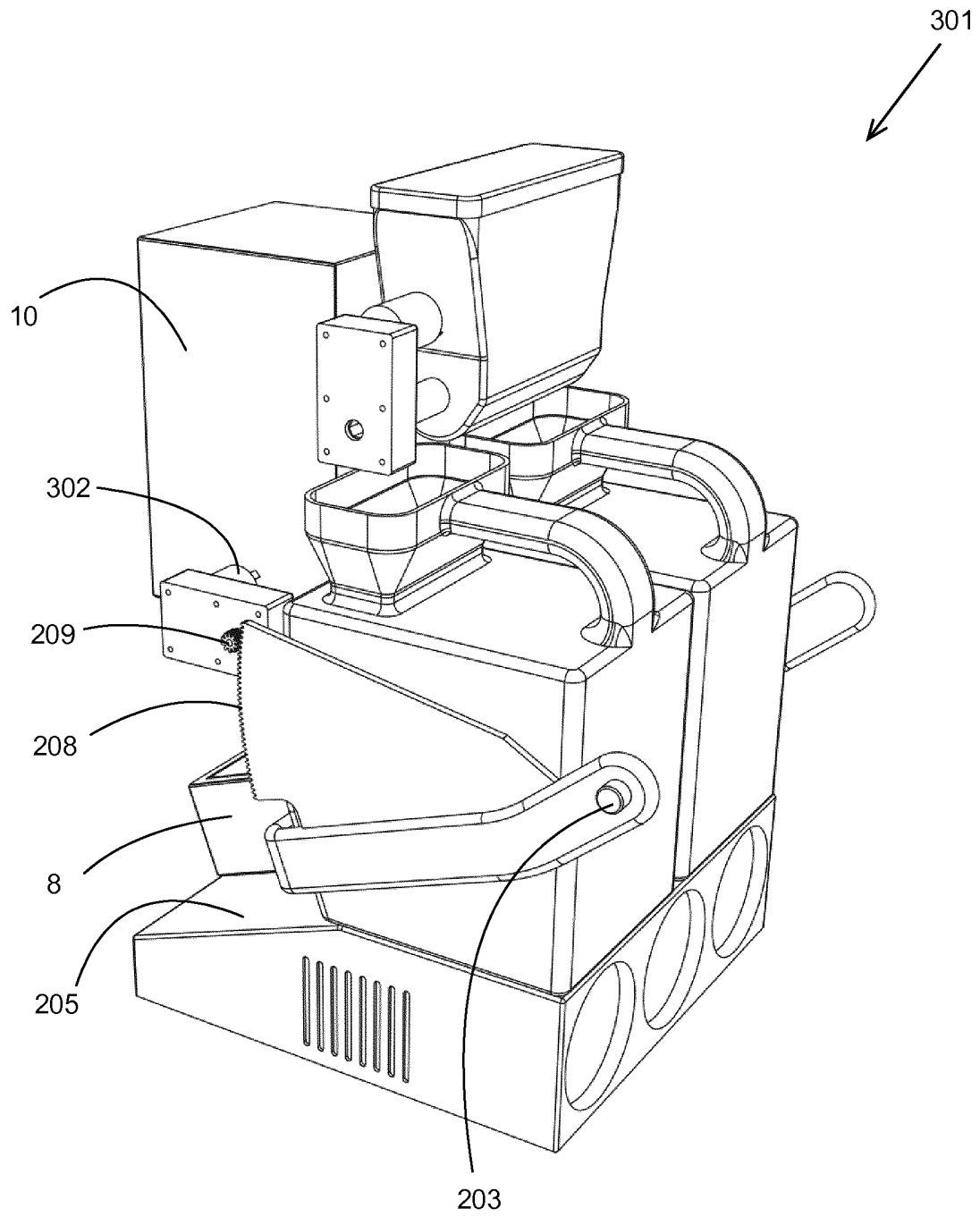


Fig. 12B

20/23

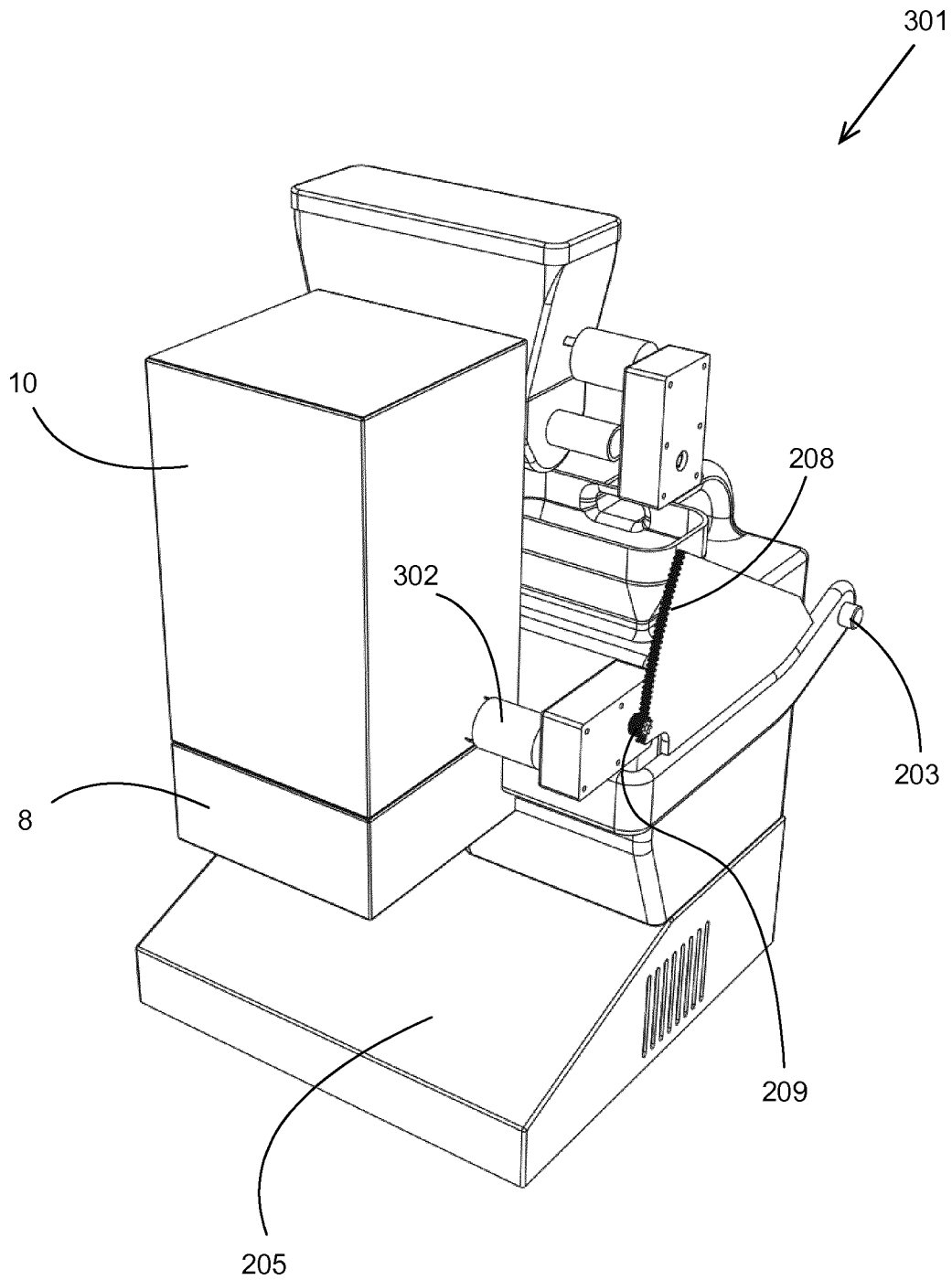


Fig. 13

21/23

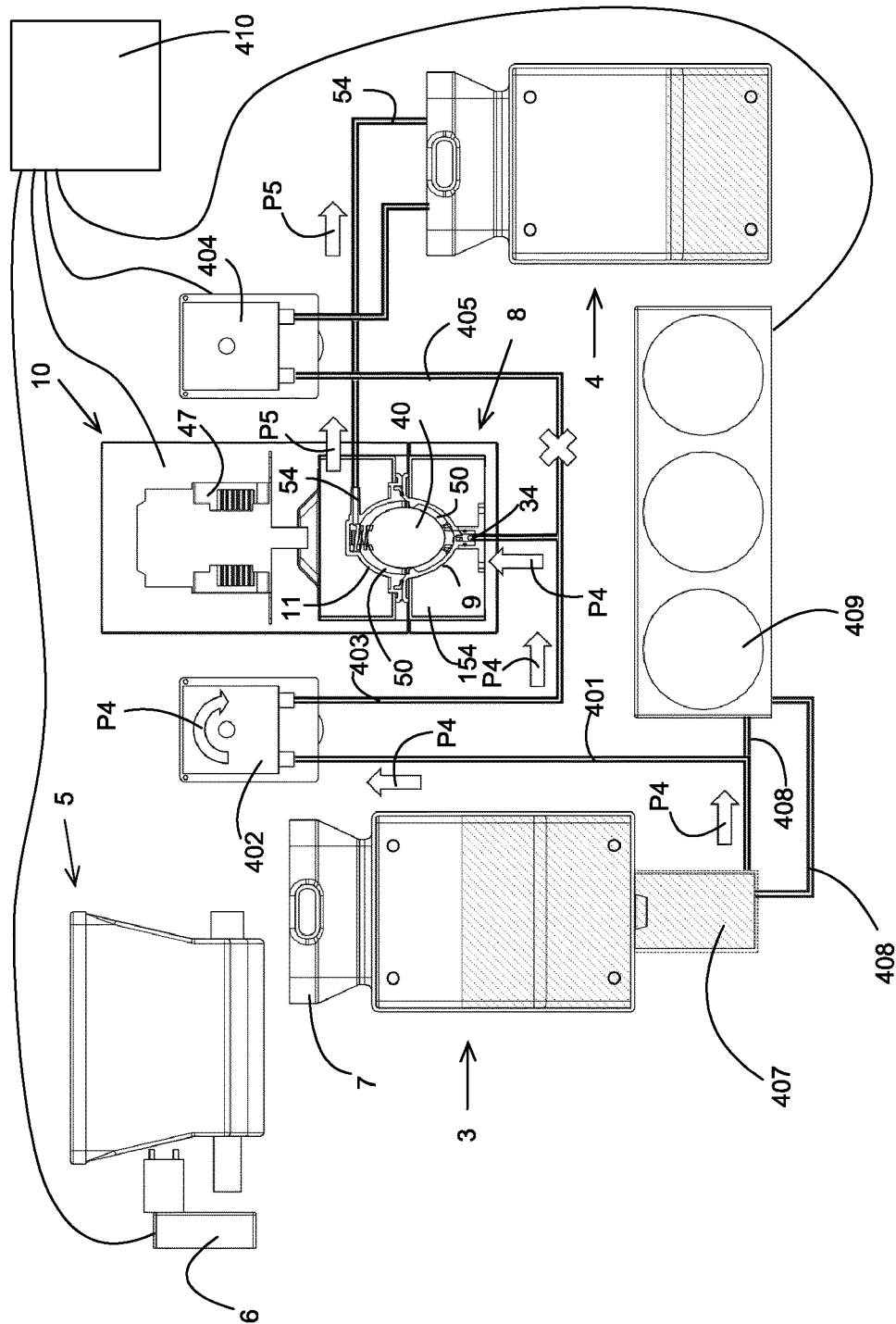


Fig. 14

22/23

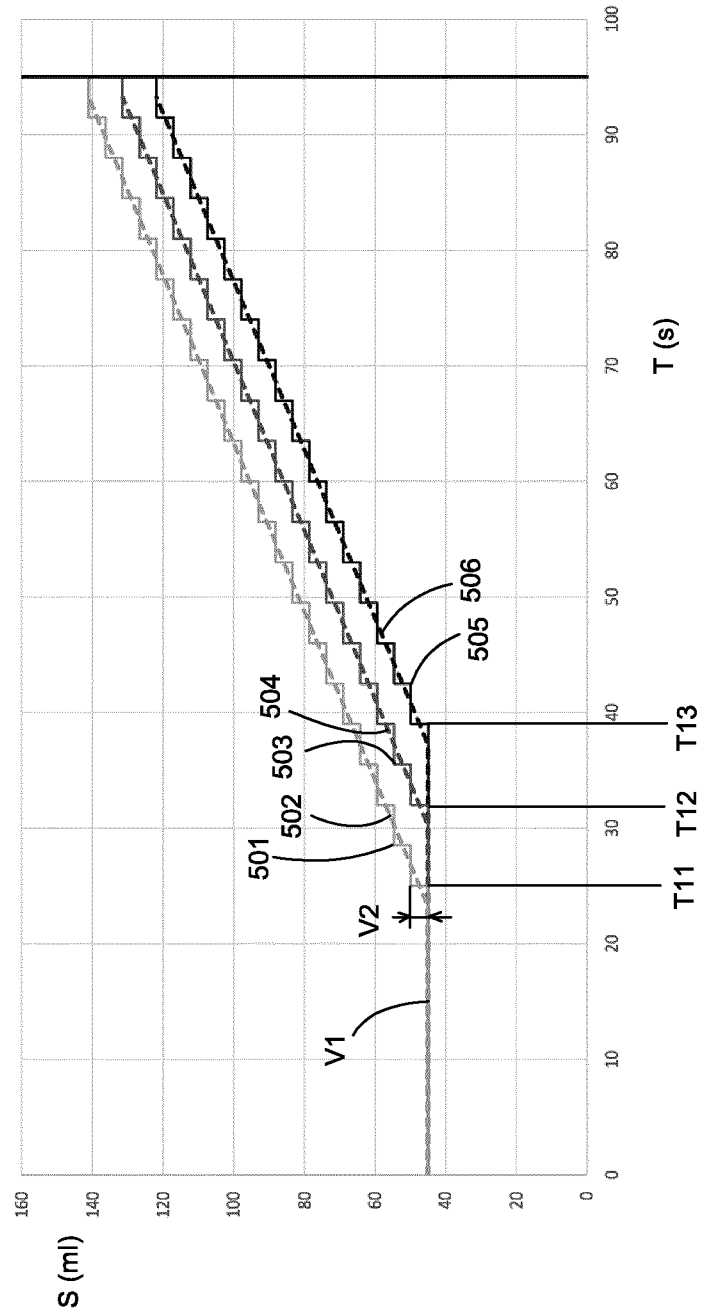


Fig. 15

23/23

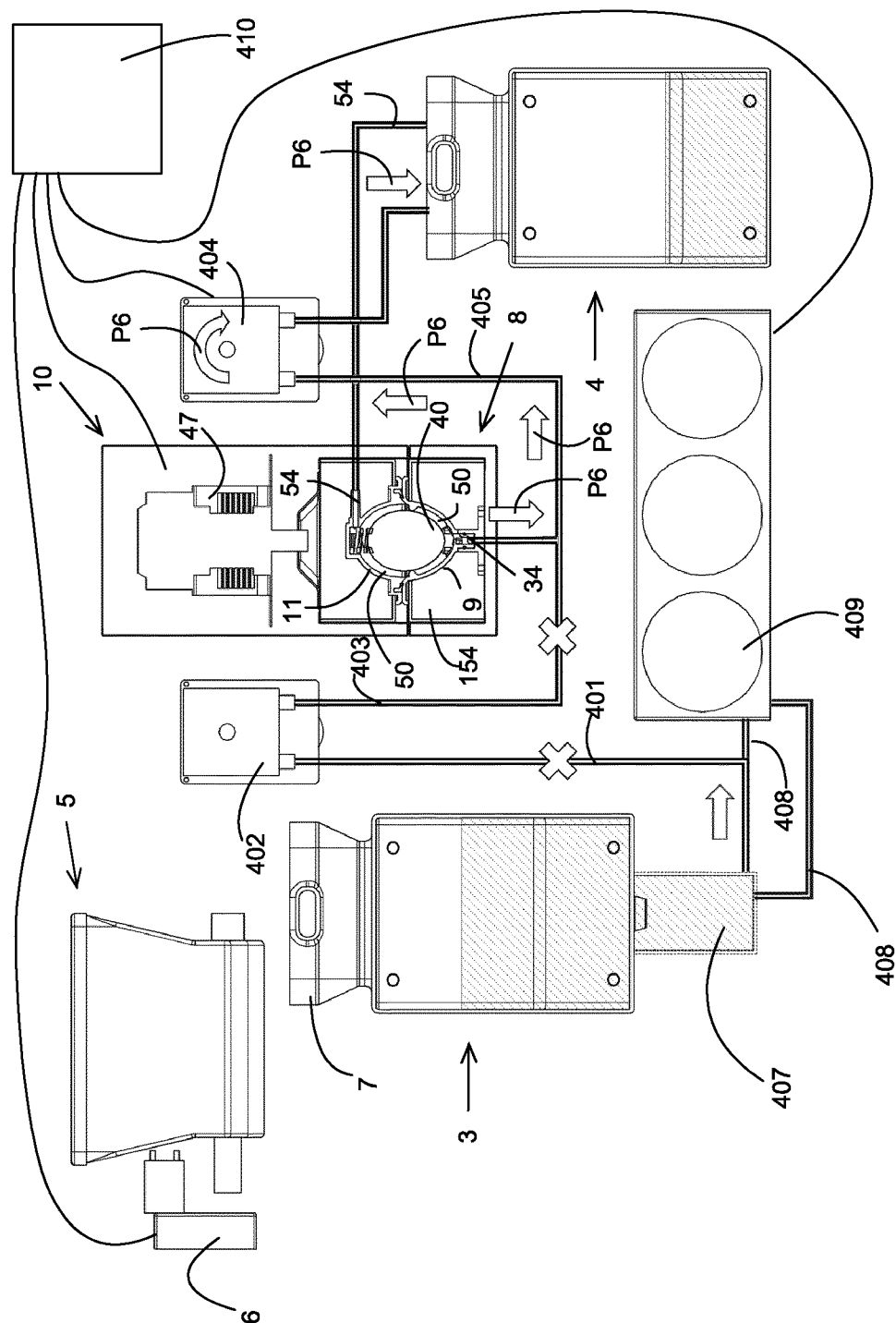


Fig. 16

