

(51) International Patent Classification:
D06F 49/00 (2006.01)

(21) International Application Number:

PCT/US2015/062789

(22) International Filing Date:

25 November 2015 (25.11.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

14/555,081 26 November 2014 (26.11.2014) US

(71) Applicant: **EXTRACTOR CORPORATION** [US/US];
685 Martin Drive, South Elgin, IL 60177 (US).(72) Inventors: **HOFFMAN, Lindsay, A.**; 624 Buckboard Lane, Sycamore, IL 60178 (US). **HOFFMAN, Hugh, J.**; 12 N 005 Hidden Hill Trail, South Elgin, IL 60124 (US). **NOWAK, Amber, D.**; 1019 Valley Stream Drive, Pingree Grove, IL 60140 (US). **SLOWIK, Steven, C.**; 332 Thelma Court, Wheeling, IL 60090 (US). **SCOLA, Michael, J.**; 760 Red Maple Lane, Roselie, IL 60172 (US). **MILLER, Benjamin, D.**; 1131 Laurel Ave., Deerfield, IL 60015 (US).(74) Agent: **ERICKSON, Randall, T.**; Erickson Law Group, PC, 1749 S. Naperville Rd., Suite 202, Wheaton, IL 60189 (US).

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

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

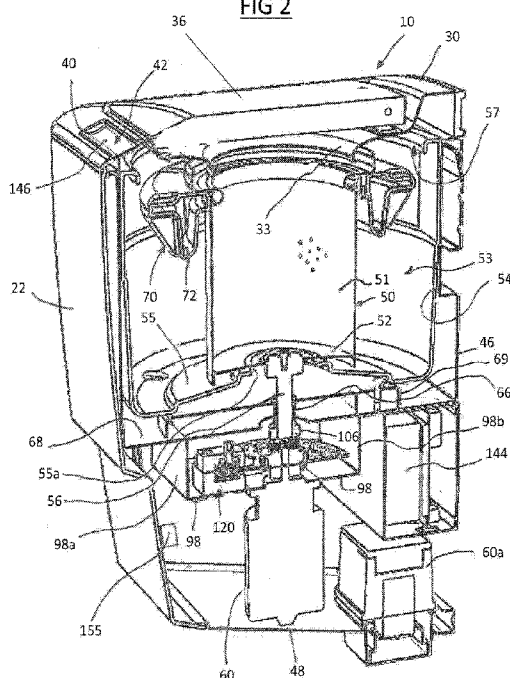
Published:

— with international search report (Art. 21(3))

[Continued on next page]

(54) Title: CENTRIFUGAL SEPARATOR

FIG 2



(57) Abstract: A centrifugal separator, such as a spin dryer that separates water from wet clothing includes a stationary chamber. A perforated basket is arranged to spin within the stationary chamber. A DC or AC motor is arranged below the bottom floor fastened to a mechanical floor. A driveshaft can be connected to the motor output shaft via a flexible coupling and passes through the bottom floor and is connected to the basket. A brake disc is operatively fixed to the output shaft, and a brake caliper is fixed to the mechanical floor to stop the brake disc. A balance ring, having an annular chamber holding a balance fluid, is mounted to an outside of the basket. The centrifugal separator can include a cycle controller that can ramp up or down the basket speed and reverse spinning direction of the basket.



-
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

CENTRIFUGAL SEPARATOR

BACKGROUND

This invention relates to a centrifugal separator which uses centrifugal force to
5 separate liquid from solids. In one embodiment the centrifugal separator is in the form
of a spin dryer for separating water from clothing.

This application is an improvement of previous spin dryers disclosed in U.S. Pat.
Nos. 4,412,390 and 4,742,624, the disclosures of which are incorporated herein by
reference.

10 Although the spin dryers disclosed in these two patents are well suited for their
intended application, the present inventors have recognized that further improvements
can be made.

The present inventors have recognized that the design can be improved to
further decrease vibration and noise during operation. The present inventors have
15 recognized that the design can provide for even smoother operation by further
decreasing the potential for uneven wear on interconnected parts. The present
inventors have recognized that an even safer operating system can be provided with an
improved power shut-off mechanism and an improved braking system.

20 SUMMARY

The embodiments of the invention disclose a centrifugal separator, such as a
spin dryer for separating water from objects or wet clothing, such as bathing suits.
Although a spin dryer is described herein, other uses for the centrifugal separator are

encompassed by the invention including liquid separators in a laboratory setting or a manufacturing setting.

Embodiments of the invention provide a centrifugal separator that includes a stationary chamber. The stationary chamber has a surrounding side wall or walls and a bottom floor. The housing can also include a mechanical floor below the bottom floor.
5 A basket is arranged to spin within the stationary chamber. The basket has a perforated surrounding sidewall. A motor is arranged below the bottom floor. The motor has a motor housing and an output shaft.

The motor housing can be fastened to the mechanical floor. A driveshaft can be connected to the output shaft via a flexible coupling and the driveshaft passes through
10 the bottom floor and is connected to the basket.

The motor can comprise a DC or AC motor.

A brake disc is operatively fixed to the output shaft, such as being fixed to the coupler, to rotate therewith, and a brake caliper is fixed to the mechanical floor. The
15 caliper has brake shoes that are engagable to opposite faces of the brake disc.

A balance ring having an annular chamber holding a balance fluid, can be mounted to an outside of the basket to rotate therewith.

A control panel has a display that includes an indicator that circulates illuminated signals around a path to indicate the spinning of the basket.

20 A fluid dispenser can be controlled by the controller to dispense a fluid, such as a liquid or gas, for example a fragrance, liquid solution or disinfectant, intermittently into the stationary chamber.

An ultraviolet light inside the stationary chamber can be controlled by the controller to intermittently illuminate to sterilize an inside of the chamber.

Fins or blades can be arranged on the bottom of the basket to circulate air inside the basket.

5 A moisture sensor can be provided in the stationary chamber, in signal-communication with a machine controller to control operation of the spin dryer. The sensor can sense water droplets received from the spinning basket. For example, the spin dryer can be operated for different durations depending on the wetness of the garment.

10 The centrifugal separator can include a cycle controller and an indicator. The controller can start the cycle by locking the lid closed, and the indicator can use an image to indicate the basket is spinning. The image can move around a continuous path while the basket is spinning.

15 The controller can ramp up the speed of the basket during starting and ramp down the speed during stopping. The controller can spin the basket according to a pre-selected variation in basket speed and direction. For example, the controller can reverse or oscillate the spinning direction, i.e., spinning the basket back and forth in reverse rotational directions, to dislodge a jam or to pre-arrange and pre-balance the load before a spin cycle is started.

20 The pre-selected variation in basket speed and direction can comprise a user selected routine.

The controller can spin the basket according to a controlled variation in basket speed and direction depending on a sensed condition, such as vibration or moisture.

The controller can spin the basket according to a controlled variation in basket speed and direction, comprising a routine wherein the basket is brought up to operating speed through a region of increased basket vibration, and wherein the controller can vary the spinning speed of the basket through the region at one rate and once past the
5 region, speed is changed to operating speed at a different rate. The region of increased vibration can be sensed using a vibration sensor or estimated by experimental data.

For example, the controller can increase the spinning speed of the basket through the region of increased vibration slowly, and once past the region, increase the speed to operating speed at a greater rate.

10 The improved spin dryer utilizes an innovative design which enhances a spin dryer's operation, low cost and low maintenance.

The spin dryer includes an automatic operation cycle which obviates the need to hold the lid down during the cycle. The spin dryer includes an automatic safety lock out which prevents the opening of the lid until the cycle is complete and the basket is
15 stationary. The spin dryer includes a pre-selected cycle profile and includes visual feedback of cycle operation. The spin dryer provides dynamic balancing via a balancing ring. This reduces vibration and sound during the cycle operation. The spin dryer provides an electronically operated caliper brake. The brake mode is on by default until the controller releases the brake for operating the cycle. Advantageously, a
20 smaller, lighter marine grade DC motor can be used.

The spin dryer cabinet can provide for a larger capacity basket, possibly 30% larger. The cabinet is arranged for access to internal mechanical components from the

front of the cabinet. The cabinet can have a stainless steel top and lid for durability and cleanliness. The cabinet can have a high impact thermoplastic front.

Numerous other advantages and features of the present invention will become readily apparent from the following detailed description of the invention and the
5 embodiments thereof, from the claims and from the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

The invention is illustrated more or less diagrammatically in the accompanying drawings wherein:

10 Figure 1 is a perspective view of the centrifugal separator of the present invention;

Figure 2 is a perspective sectional view of the centrifugal separator of Figure 1, taken generally along line 2-2 in Figure 1;

15 Figure 3 is an enlarged fragmentary sectional view taken generally along line 2-2 of Figure 1;

Figure 4 is a fragmentary enlarged view taken from Figure 3;

Figure 5 is a fragmentary enlarged view taken from Figure 3;

Figure 6 is a sectional view taken generally along line 2-2 of Figure 1;

Figure 7 is a sectional view taken generally along line 2-2 of Figure 1;

20 Figure 8 is a perspective view of a balance ring taken from Figure 2;

Figure 9 is a sectional view taken generally along line 9-9 of Figure 8;

Figure 10 is a sectional view taken generally along line 10-10 of Figure 8;

Figure 11 is an enlarged perspective view of a coupling taken from Figure 2;

Figure 12 is a schematic diagram of the control system of one embodiment of the present invention;

Figure 13 is a perspective view of an alternate brake assembly to be used in the apparatus of Figures 1-7;

5 Figure 14 is an exploded perspective view of the brake assembly of Figure 13;

Figure 15 is a fragmentary perspective view of a portion of the brake assembly of Figure 13;

Figure 16 is an enlarged, fragmentary perspective view of a portion of centrifugal separator of Figure 1; and

10 Figure 17 is a fragmentary sectional view of the portion of Figure 16.

DETAILED DESCRIPTION

While this invention is susceptible of embodiment in many different forms, there are shown in the drawings, and will be described herein in detail, specific embodiments
15 thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the specific embodiments illustrated.

Like reference numbers will be used to refer to like parts from figure to figure in the following description of the embodiments of the invention.

20 In Figure 1, a centrifugal separator, such as a spin dryer, is illustrated generally at 10. The dryer 10 includes side panels 16, 18, an upper front panel 22 and a recessed lower front panel 24. The upper and lower front panels 22, 24 can be one unitary panel. A top panel 30 includes a recessed area 32 having an opening 33. The recessed area

32 and opening 33 are covered by a hinged lid 36. The top panel 30 also has an opening or recess 40 for a control panel 42. A rear panel 46 closes a back side of the dryer 10 and can be used to support the dryer 10 on a wall. A floor 48 substantially closes the bottom of the dryer.

5 The panels 16, 18, 22, 24, 30 can be connected together by fasteners and/or by interlocking lips and/or clips or other means. Once the front panel 22 is removed, the top panel 30 can be removed. Also, once the front panels 22, 24 are removed access can be had to the electrical and mechanical components of the dryer 10.

 Figures 2-5 illustrate internal components of the dryer 10. A cylindrical basket 50
10 has a perforated, cylindrical sidewall 51 and a floor 52 and is supported on a driveshaft 56. The driveshaft 56 is coupled to a motor 60. A stationary chamber 53 includes a cylindrical sidewall 54 and a floor 55 substantially closing an open bottom end of the sidewall 54. The sidewall forms an open top end 57. The chamber 53 surrounds the basket 50. The floor 55 includes a central hole 55a to allow passage of the driveshaft
15 56.

 Operation of the motor 60 spins the driveshaft 56 and the basket 50. The motor is controlled by a motor control 60a. The driveshaft 56 passes through a guide or sleeve bearing 66 which is fastened to, or pressed into a plate 67. The plate 67 is mounted to an intermediate floor 68 via three circumferentially spaced-apart isolation
20 mounts 69. The mounts can be elastomeric bushings, or the like.

 A balance ring 70 is fastened around an upper portion of the basket 50 within the stationary chamber 53. The balance ring 70 has a sealed annular chamber 72 that contains a balance fluid, such as a saturated saline solution. The balance ring can be

attached with fasteners or can have interacting formations to be snap fit over the basket.

As shown in Figures 8-10, the balance ring 70 has an annular chamber 72 with a substantially triangular cross section defined by an upwardly and outwardly inclined outer wall 70b and a substantially vertical inner wall 70c. The annular chamber 72 is closed by a top wall 70d. Triangular ribs 70e are arranged spaced apart around the circumference of the ring 70. The ribs 70e extend radially inward from the outer wall 70b and terminate about halfway between the outer wall 70b and the inner wall 70c. The annular chamber 72 around the inner wall 70c, adjacent to the inner wall 70c, is continuously open, i.e., unbroken by the ribs 70e. The annular chamber 72 holds the fluid when stationary and as the ring spins, the fluid moves outward and upward along the outer wall 70b to increase inertia of the ring 70. The ribs 70e act as paddles to reduce the tendency of the fluid to remain stationary and slip with respect to the ring, i.e., the ribs 70e ensure the fluid moves rotationally with the ring 70 as it rotates.

Figures 2-5 illustrate the driveshaft 56 includes an enlarged or shaped head portion 80 that fits into a recessed portion 82 of the floor 52 of the basket 50, and is fastened thereto by a fastener 84. The driveshaft 56 is guided in the guide or sleeve bearing 66. The plate 67 compresses vibration isolators 69 to the floor 68 via fasteners 71 extending between the plate 67 and the floor 68.

The basket is easily removed for cleaning or maintenance by removal of the front panel 22 and the top panel 30 with the hinged lid 36, removal of the fastener 84 and withdrawing the basket 50 and balance ring 70 together vertically out through the open

top end 57 of the stationary chamber 53, that is otherwise closed by the top cover 30 and lid 36.

A mechanical floor 98 is hung from the intermediate floor 68 via sidewalls 98a, 98b. The motor 60 is fastened to the mechanical floor 98.

5 At a lower end, the driveshaft 56 is connected to a flexible coupling 106 that is connected to an output shaft 108 of the motor 60. The coupling is shown in Figure 11. The coupling 106 includes an upper clamp 106a that clamps the driveshaft 56 into an opening 106b via two fasteners fit through holes 106c, 106d. The coupling 106 includes a lower clamp 106e that clamps the motor output shaft 108 into an opening 106f via one
10 or two fasteners fit through one or two holes 106g, 106h. A helical slot 106i between the two clamps 106a, 106e provides the flexible connection between the driveshaft 56 and the motor output shaft 108. A flange 112 is fixed between the helical slot 106i and the bottom clamp 106e.

 The output flange 112 is part of, or fastened to, coupling 106 to rotate therewith.
15 A brake disc 118 is fastened to the output flange 112 to rotate therewith. A brake caliper 120 is fastened to the mechanical floor 98. The caliper 120 includes an upper housing 122a and a lower housing 122b, and upper and lower brake shoes 126, 128 arranged on opposite sides of the disc 118. A spring 130 acts to separate the brake shoes, by urging them away from the disc 118.

20 An additional spring 131 acts to exert a downward force on the upper shoe 126 to compress the disc 118 between the two shoes 126, 128. A solenoid acts to release the brake. A solenoid cylinder 132, when energized, exerts force to pivot a lever 133 about a fulcrum 133a to lift a piston 133b to overcome spring force from the spring 131

to relieve compression of the disc 118 from between his shoes 126, 128 to allow the disc 118 to rotate freely. When the solenoid is not energized or powered, the brake shoes 126, 128 clamp the disc 118 under power of the spring 131 to stop the basket 50. The spring 131, the cylinder 132, the lever 133, and the fulcrum 133a are shown
5 schematically. An alternate brake arrangement is shown and described below with respect to Figures 13-15.

In operation, when the basket receives a wet article and the motor is activated to run a spin cycle, the centrifugal force on the spinning article separates water out of the article, through the perforations in the basket wall 51 and into the stationary chamber
10 53. A drain pipe 53a (shown dashed in Figure 6) allows water collected in the stationary chamber 53 to drain out of the dryer 10.

A controller 144 (Figure 12) is responsive to input instruction (e.g., start, stop, etc.) from a user through the control panel 42, such as through a touch screen keypad 145. Alternately, starting may be automatic upon closing the lid. An indicator 146
15 shows the status of the dryer, e.g., on, off, spinning, locked, maintenance needed, unbalanced load, etc. Particularly, a circular array of illuminators 148 cycle (on then off) sequentially around the circle to indicate that the dryer is spinning.

As shown in detail in Figures 16 and 17, one or more spring locks 147 hold the lid locked closed during operation. The spring lock 147 automatically locks the lid when
20 it is closed. A "U" shaped strike 148 having a horizontal bottom portion 148a is attached to the lid 36. A latch 149 fabricated of spring steel or other material is attached to the top cover 30 at the location 149a by welding, fasteners or other means.

The latch 149 may flex downward but not upward with respect to its rest position relative to the top cover 30.

When the lid is closed, as the lid 36 pivots downward the bottom portion 148a of the strike 148 engages the top of a tab 150 on the latch 149 which causes the latch 149
5 to flex downward and around the circular cross section of the horizontal bottom portion 148a of the U shaped strike 148.

The horizontal bottom portion 148a passes below the tab 150, and the latch 149 springs back, engaging the bottom of the tab 150 with the top portion of the horizontal bottom portion 148a. Since the latch 149 is limited in upward movement by its proximity
10 at point 151 to the top cover 30, any attempt to pry the lid open increases engagement of the latch and strike to prevent forced opening.

In order to release the latch 149, according to one embodiment, the user pushes a control selection on the control panel 42, and a cable 152, within a stationary sheath 153 that is fixed to a back of the lock 147 at 153a, is pulled in the tension direction P
15 along the cable 152 to bend the latch 149 clockwise (Figure 17) about the attachment location 149a. The cable 152 is pulled with respect to the sheath 153 by a solenoid 155, fixed with the sheath to stationary structure of the dryer (Figures 2 and 16), or other means to flex the latch 149 downward around the circular cross section of the horizontal bottom portion 148a. The lid moves downward slightly to accomplish this
20 action, and the latch 149 is disengaged from the strike.

The lid 36 is biased slightly open via a spring hinge 36a (Figure 3) or other similar device which allows it to pop open when the latch is disengaged. The controller 144 operates the solenoid 155 to release the spring lock 147 to unlock the lid for

opening the lid when operation has ceased. The controller 144 can be programmed to run the dryer through one cycle and then release the latch for the lid to pop open. A manual override by (maintenance personnel only) can be incorporated into the latch beneath the front cover.

5 A lid closed or open sensor 154 (Figure 3) is provided between the lid 36 and the cover 30 to communicate with the controller whether the lid is open or closed. The controller will prevent the dryer from starting if the lid is not closed and locked, and will prevent the lid from being opened during operation.

 The controller 144 can run the spin cycle according to a pre-selected routine or
10 can change the pre-selected routine according to sensed conditions by controlling the motor control 60a. For example, if the load is unstable or unbalanced, sensed by a vibration sensor 156 (shown schematically in Figure 3) that signals the controller 144, the controller can cause the basket to be rotated in forward then reverse directions to attempt to re-arrange and balance the load. A similar cycle can be run to fix a jammed
15 condition. A moisture sensor 158 (shown schematically in Figure 3) can be provided to sense the degree of moisture passing through the basket and communicate to the controller 144 which adjusts the cycle speed or duration accordingly.

 The controller can ramp up the speed of the basket during starting and ramp down the speed during stopping. The controller can spin the basket according to a pre-
20 selected variation in basket speed and direction. For example, the controller can reverse or oscillate the spinning direction, i.e., spinning the basket back and forth in reverse rotational directions, to dislodge a jam or to pre-arrange and pre-balance the load before a spin cycle is started.

The pre-selected variation in basket speed and direction can comprise a user selected routine.

The controller can spin the basket according to a controlled variation in basket speed and direction depending on a sensed condition, such as vibration or moisture.

5 The controller 144 can spin the basket 50 according to a controlled variation in basket speed and direction, comprising a routine wherein the basket 50 is brought up to operating speed through a region of increased basket vibration, and wherein the controller increases in spinning speed through the region slowly and once past the region, speed is increased to operating speed at a greater rate. The region of increased
10 vibration can be sensed using a vibration sensor.

Figure 6 illustrates another aspect or enhancement of embodiments of the invention. An ultraviolet light 150 is mounted to an underside of the lid 36 and the ultraviolet light is energized between cycles. The ultraviolet light sterilizes surfaces within the basket. A similar arrangement can be used to intermittently spray a
15 fragrance, liquid solution or disinfectant into the basket and/or the stationary chamber via a nozzle 152 controlled by the controller, fed from a fluid reservoir 153.

Figure 7 illustrates another aspect or enhancement of embodiments of the invention. In this embodiment the floor 52 of the basket 50 includes fan blades or fins 160 that circulate air in the basket 50 and the stationary chamber 53.

20 Figure 12 illustrates the control system of the dryer 10. The controller 144 can receive signals from the moisture sensor 158, the vibration sensor 156, the lid lock 147 and operator input from the keypad 145. The controller 144 can send signals to the

motor control 60a to adjust the speed, duration and direction of the motor 60. The controller 144 can send a signal to the brake solenoid 132 to release the brake upon starting of the spin dryer for an operating cycle. The controller 144 can signal the brake solenoid 132 to de-energize to stop the basket at the end of the operating cycle. When
5 the motor stops the lid lock 147 is released by the controller so the lid can be opened. The controller 144 can send signals to the display to indicate operation or status of the dryer or indicate trouble or faults in the dryer. The controller can send a signal to the UV light 150 and fluid dispenser 152 to intermittently treat the inside of the dryer.

Figures 13 through 15 illustrated an alternate brake assembly 200. The assembly
10 200 includes the caliper 120 having upper and lower housings 122a, 122b which house upper brake shoe or pad 126 and lower brake shoe or pad 128, respectively. The housings 122a, 122b are fastened together and to the mechanical floor 98. The brake disc 118 is located partly between the upper and lower pads 126, 128. A lever 220 is fixed to a plunger 226 and rotationally connected to an L-shaped pin 228 at the distal
15 end. The connection also allows vertical movement between the L-shaped pin 228 and the lever 220. The L-shaped pin is moved horizontally by a linear actuator, such as a solenoid actuator 230 when the L-shaped pin is extended out of, or retracted into, the solenoid actuator. The lever 220 rotates and causes rotation of a plunger 236.

The plunger 236 includes a cam disc 240 at a bottom end thereof. The cam disc
20 240 includes two cam tracks 244, 246 formed in rotational symmetry on opposite sides of the cam disc 240. Two roller bearings 254, 256 are held within the upper housing 122a, fixed in position but allowed to rotate about their axes and effectively ride on the respective cam tracks 244, 246 when the plunger 236 is rotated. The cam tracks each

have an inclined surface 260 which causes the plunger 236 to be lowered when the plunger rotated about $\frac{1}{4}$ turn or less, caused by the roller bearings 245, 256 in effect riding up the inclined surfaces 260. The cam disc 240 presses down on a pad plunger 266 which presses on the upper brake pad 126 to cause the upper and lower brake pads 126, 128 to pinch the brake disc therebetween, actuating the brake.

Figure 15 illustrates the plunger 236 lowered for purpose of showing the cam disc 240 more clearly. After assembly, the plunger 236 would be raised as shown in Figure 13 to be attached to the lever 220, and the roller bearings 245, 256 would be in contact with the cam track 244, 246 on each side of the cam disc 240.

The solenoid 230 would have a spring return which would bias the pin 228 to an extended position to rotate the lever 220 clockwise (looking down on the lever in Figure 13) which would depress the plunger 236 to actuate the brake. An electrical signal to the solenoid would retract the pin 228 and rotate the lever 220 counter clockwise (looking down on the lever in Figure 13) to raise the plunger 236 and disengage the brake.

From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the spirit and scope of the invention. It is to be understood that no limitation with respect to the specific apparatus illustrated herein is intended or should be inferred.

The invention claimed is:

1. A centrifugal separator, comprising:

5 a housing that includes a stationary chamber having a side wall and a bottom floor, and the housing also including a mechanical floor below the bottom floor;

 a basket arranged to spin within the stationary chamber, the basket having a perforated surrounding sidewall;

 a motor arranged below the bottom floor, the motor having a motor housing and
10 an output shaft;

 a driveshaft connected to the output shaft via a flexible coupling, the driveshaft passing through the bottom floor and connected to the basket, the motor housing fastened to the mechanical floor.

15 2. The centrifugal separator according to claim 1, wherein the motor comprises a DC motor.

 3. The centrifugal separator according to claim 1, comprising a brake disc operatively fixed to the output shaft to rotate therewith, and a brake caliper fixed to the
20 mechanical floor and having brake shoes that are engagable to opposite faces of the brake disc.

4. The centrifugal separator according to claim 1, comprising a balance ring having an annular chamber holding a balance fluid, the balance ring mounted to an outside of the basket to rotate therewith.

5. The centrifugal separator according to claim 1, comprising a control panel having an indicator that circulates illuminated signals around a path to indicate the spinning of the basket.

6. The centrifugal separator according to claim 1, comprising a fluid dispenser controlled by the controller to dispense fluid intermittently into the separator.

7. The centrifugal separator according to claim 1, comprising an ultraviolet light inside the separator that is controlled by the controller to intermittently illuminate.

8. The centrifugal separator according to claim 1, comprising blades arranged to rotate within the separator to circulate air inside the separator.

9. A centrifugal separator, comprising:
a housing that includes a stationary chamber having a side wall and a bottom floor;
a basket arranged to spin within the stationary chamber, the basket having a perforated surrounding sidewall;

a balance ring having an annular chamber holding a balance fluid, the balance ring mounted to an outside of the basket to rotate therewith;

a motor arranged below the bottom floor, the motor having a motor housing and an output shaft; and

a driveshaft connected to the output shaft and passing through the bottom floor and connected to the basket.

10. The centrifugal separator according to claim 9, wherein the housing also includes a mechanical floor below the bottom floor, and comprising a brake disc operatively fixed to the output shaft to rotate therewith, and a brake caliper fixed to the mechanical floor and having brake shoes that are engagable to opposite faces of the brake disc.

11. The centrifugal separator according to claim 9, wherein the housing also includes a mechanical floor below the bottom floor, and wherein the driveshaft is connected to the output shaft via a flexible coupling, and the motor housing is fastened to the mechanical floor.

12. The centrifugal separator according to claim 9, comprising a dispenser controlled by the controller to dispense a liquid or gas intermittently into the separator.

13. The centrifugal separator according to claim 9, comprising an ultraviolet light inside the stationary chamber that is controlled by the controller to intermittently illuminate.

14. The centrifugal separator according to claim 9, comprising blades arranged on the bottom of the basket to circulate air inside the basket.

15. A centrifugal separator, comprising:
a housing that includes a stationary chamber having a side wall and a bottom floor;
a basket arranged to spin within the stationary chamber, the basket having a perforated surrounding sidewall;
a controller and an indicator, the controller starting the cycle by locking the lid closed, the indicator using a image to indicate the basket is spinning;
a motor arranged below the bottom floor, the motor having a motor housing and an output shaft; and
a driveshaft connected to the output shaft and passing through the bottom floor and connected to the basket.

16. The centrifugal separator according to claim 15, wherein the image is moving around a continuous path when the basket is spinning.

17. The centrifugal separator according to claim 15, wherein the controller is configured to ramp up the speed of the basket during starting and to ramp down the speed during stopping.

18. The centrifugal separator according to claim 15, wherein the controller spins the basket according to a pre-selected variation in basket speed and direction.

19. The centrifugal separator according to claim 15, wherein the controller spins the basket, oscillating back and forth in reverse rotational directions.

20. The centrifugal separator according to claim 15, wherein the controller spins the basket according to a pre-selected variation in basket speed and direction, wherein the pre-selected variation in basket speed and direction comprises a user selected routine.

21. The centrifugal separator according to claim 15, wherein the controller spins the basket according to a controlled variation in basket speed and direction depending on a sensed condition, including one condition selected from vibration and moisture.

22. The centrifugal separator according to claim 15, wherein the controller spins the basket according to a controlled variation in basket speed and direction, comprising a routine wherein the basket is brought up to operating speed through a region of increased basket vibration, and wherein the basket is increased in spinning speed through the region slowly and once past the region, basket spinning speed is increased to operating speed at a greater rate.

23. A centrifugal separator, comprising:

a housing that includes a stationary chamber having a side wall and a bottom floor, and the housing also including a mechanical floor below the bottom floor;

a basket arranged to spin within the stationary chamber, the basket having a perforated surrounding sidewall;

a motor arranged below the bottom floor, the motor having a motor housing and an output shaft;

a driveshaft connected to the output shaft and passing through the bottom floor and connected to the basket; and

a brake disc fixed to rotate with the driveshaft, and a brake caliper fixed with respect to the stationary chamber and operable on the brake disc to stop the basket from spinning.

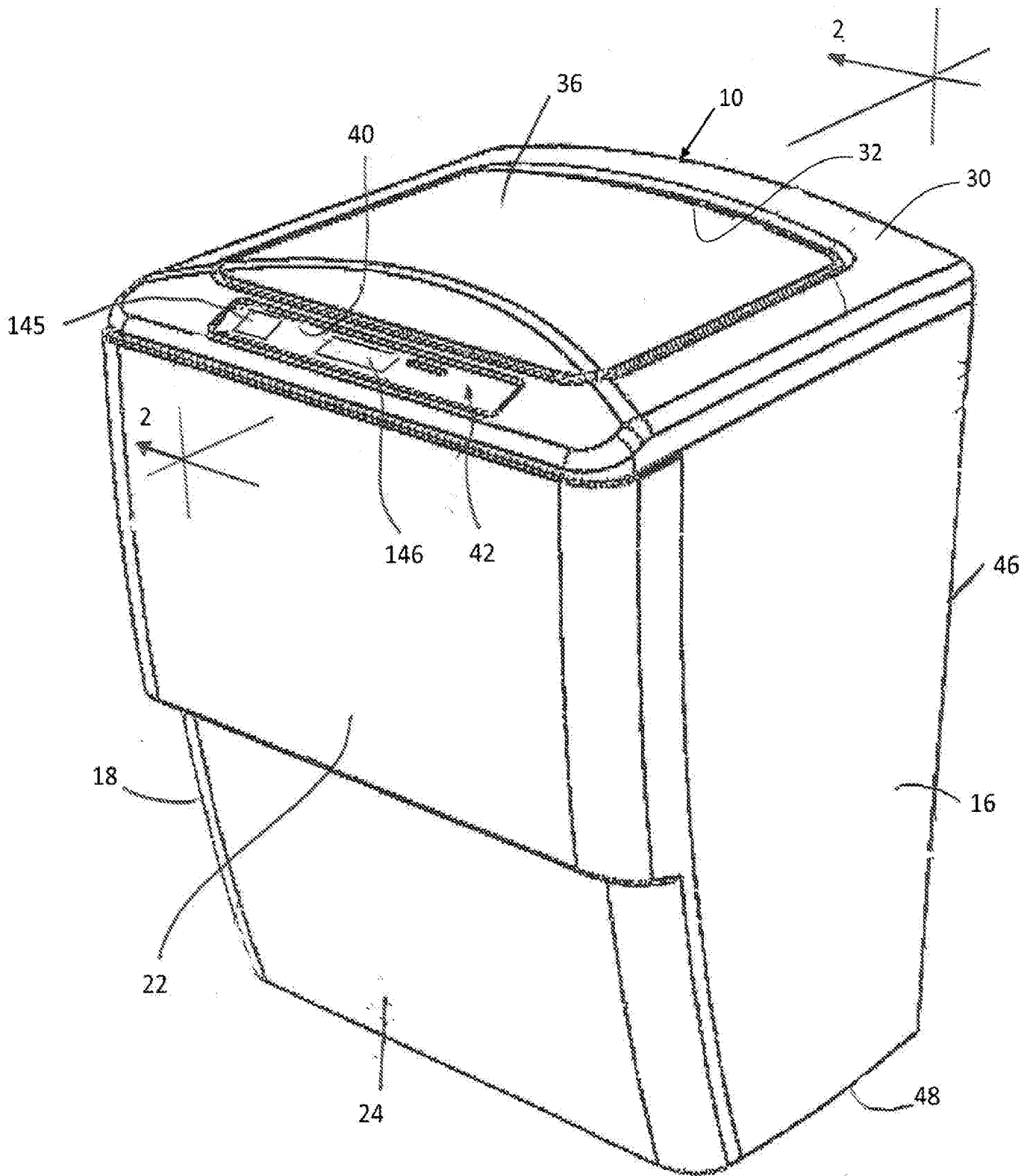
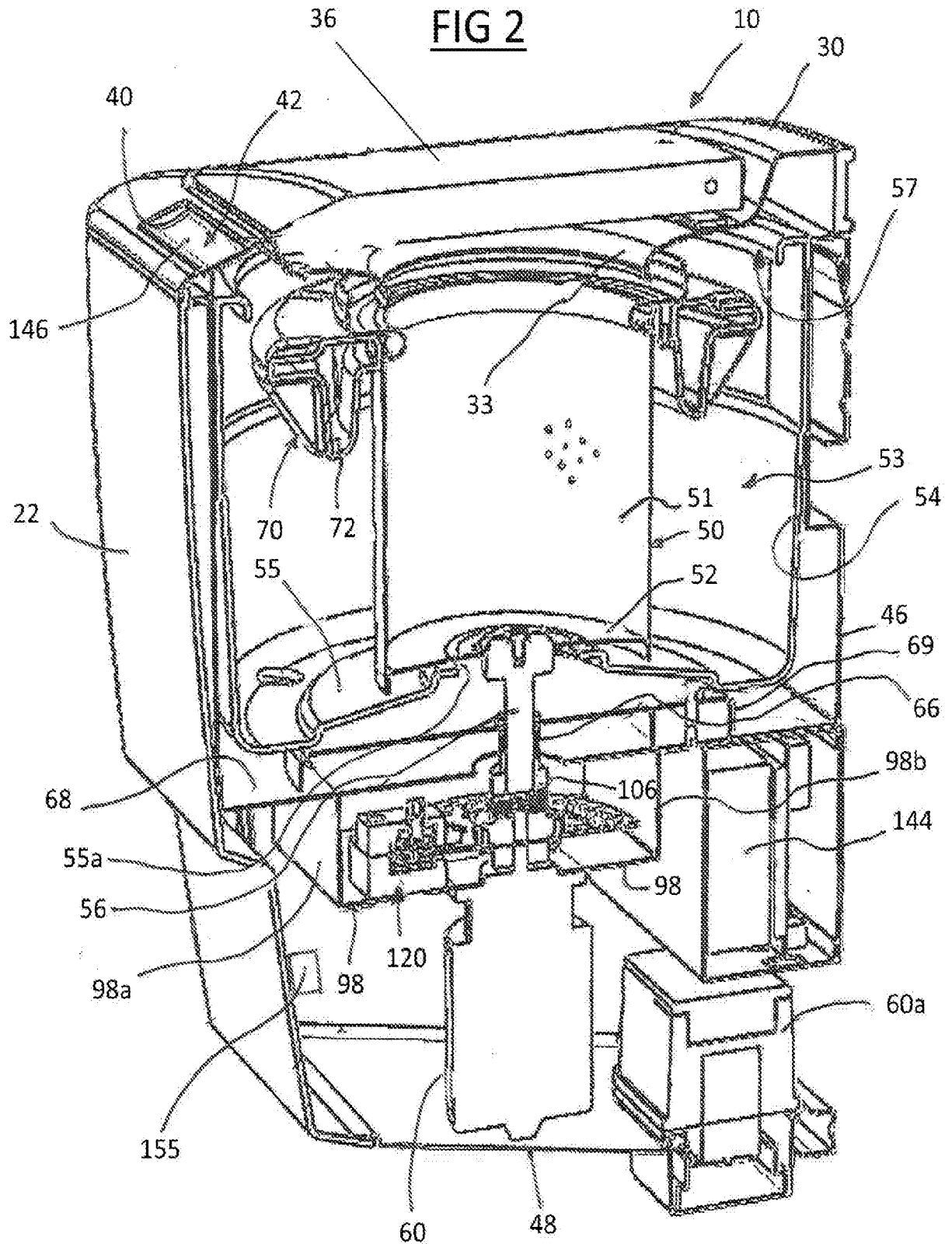


FIG 1



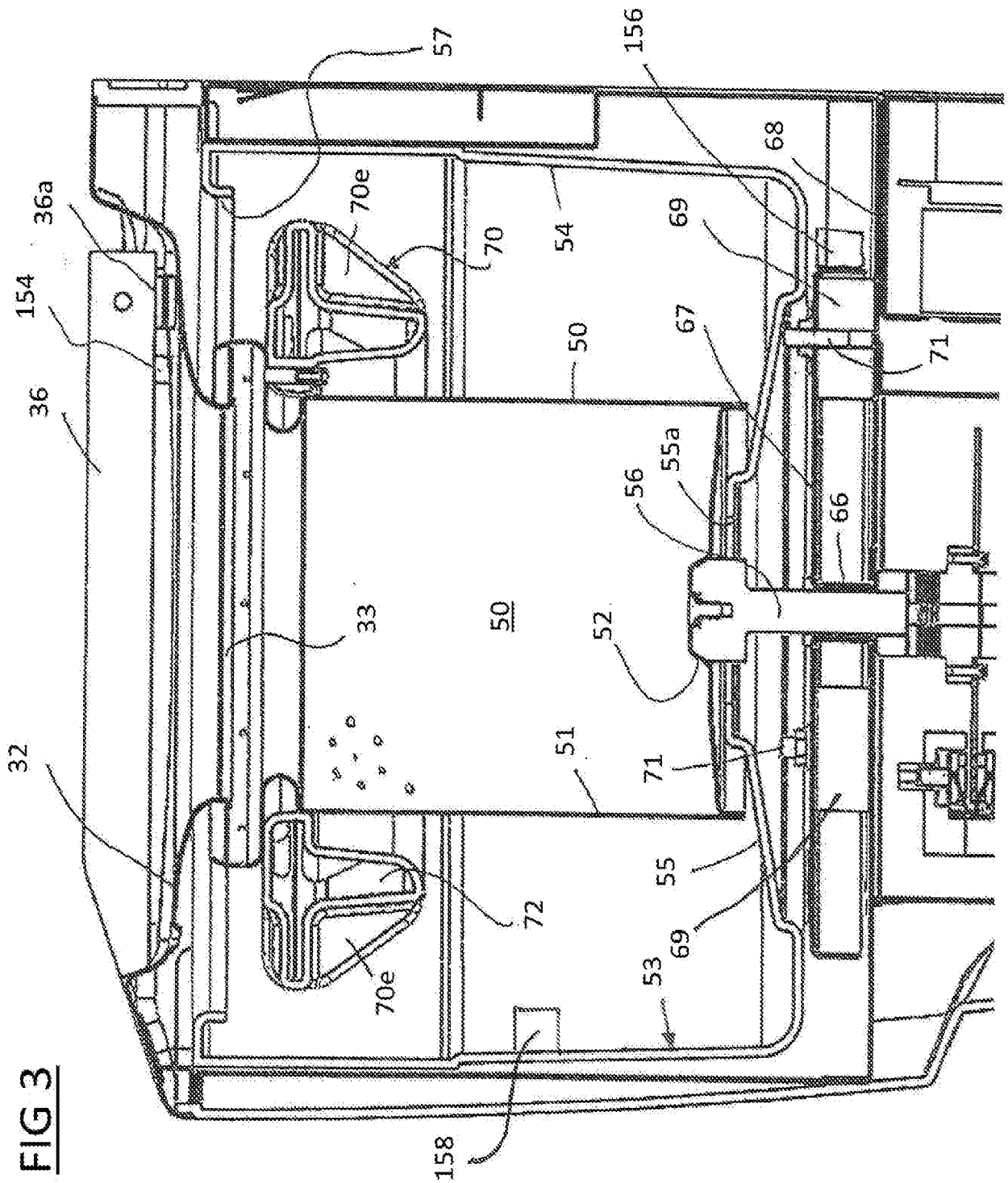
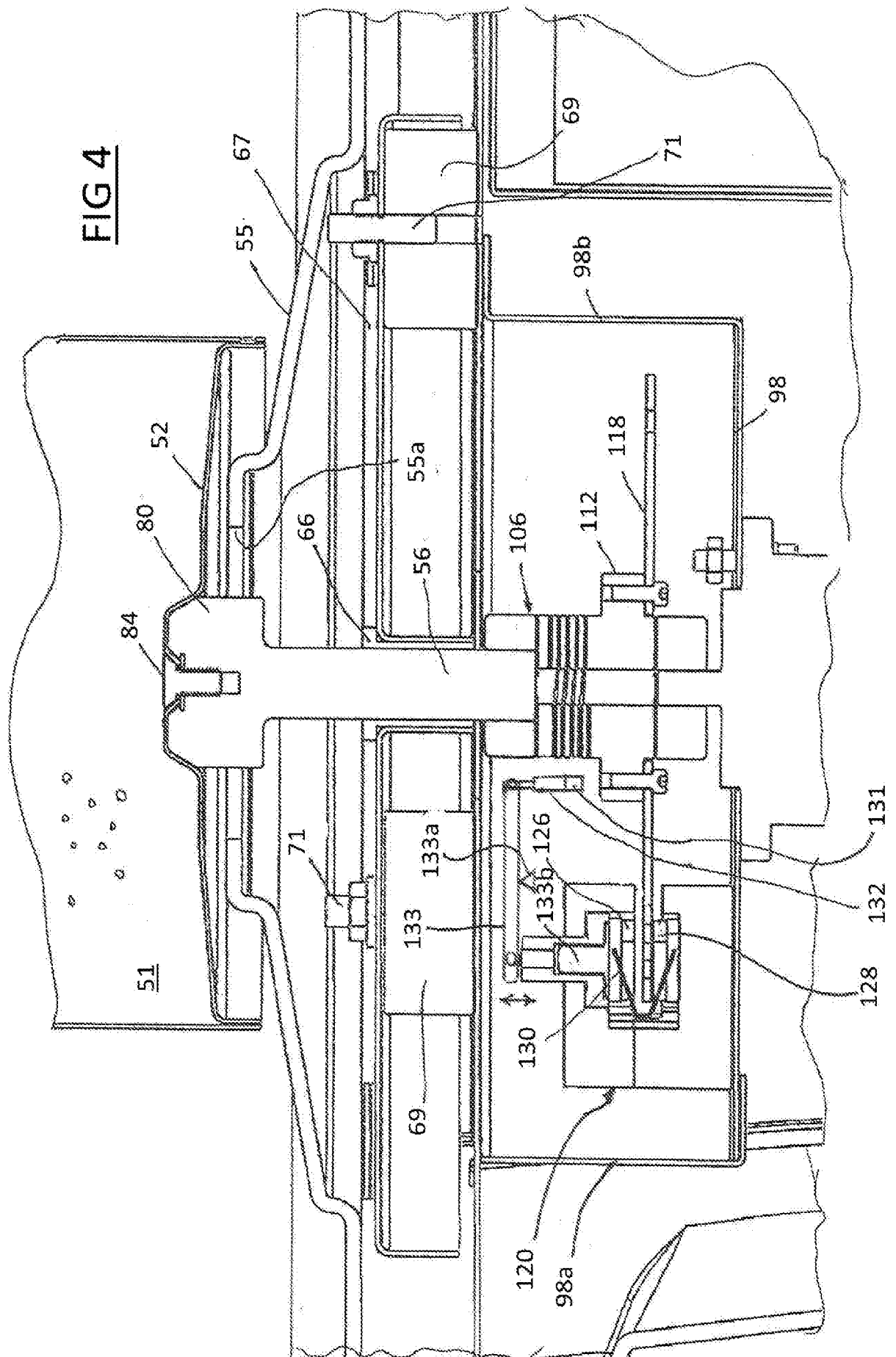


FIG 4



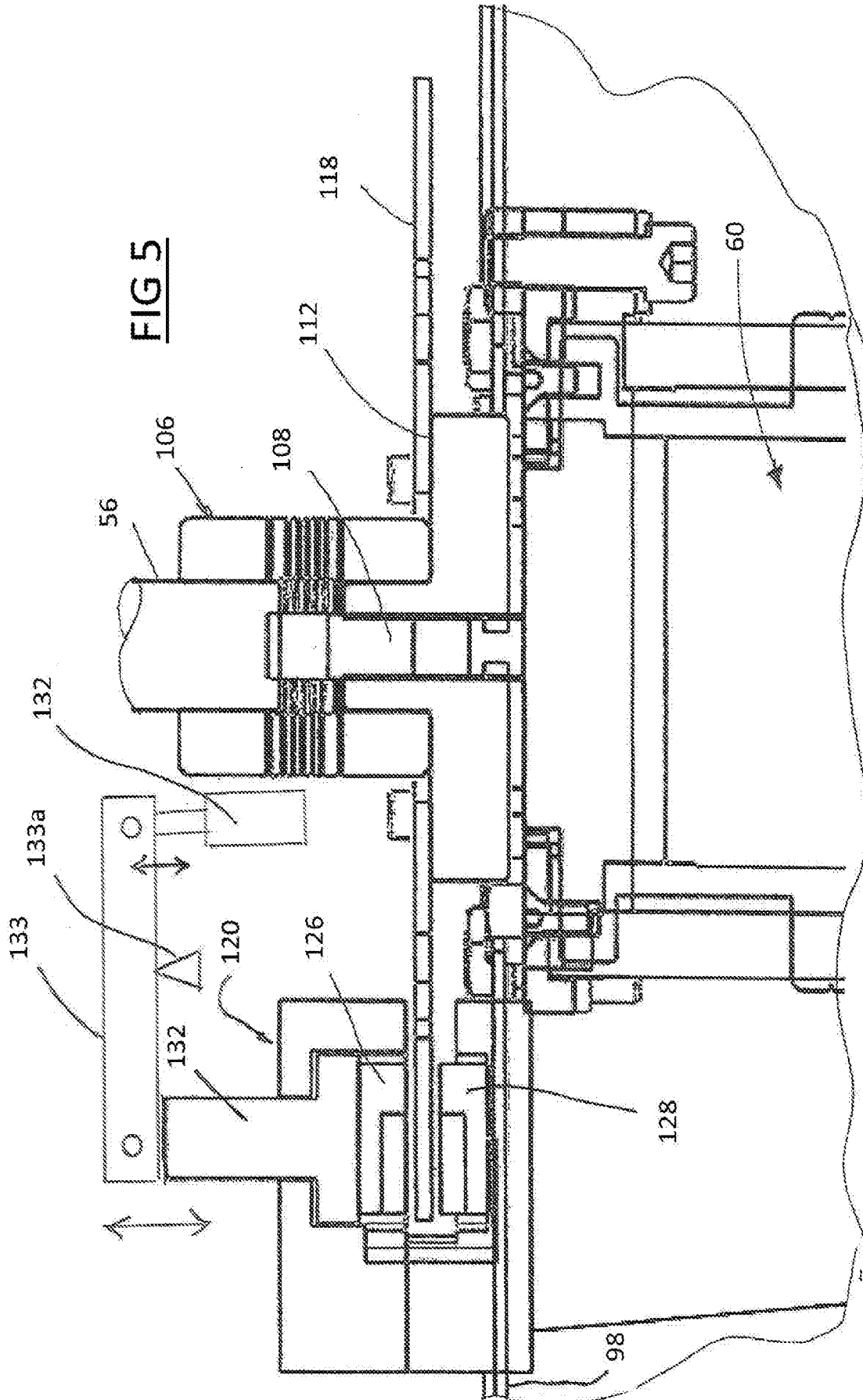


FIG 6

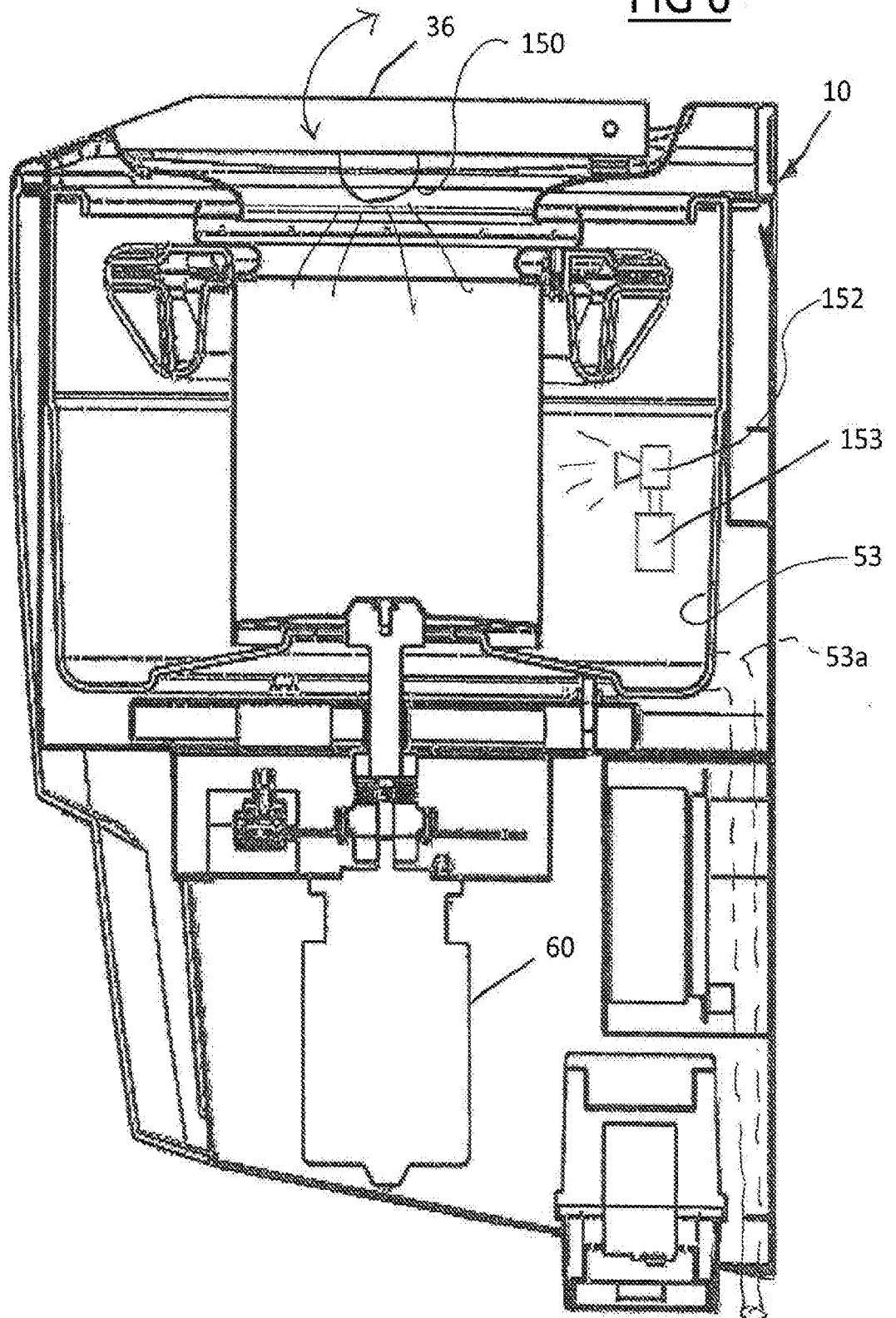
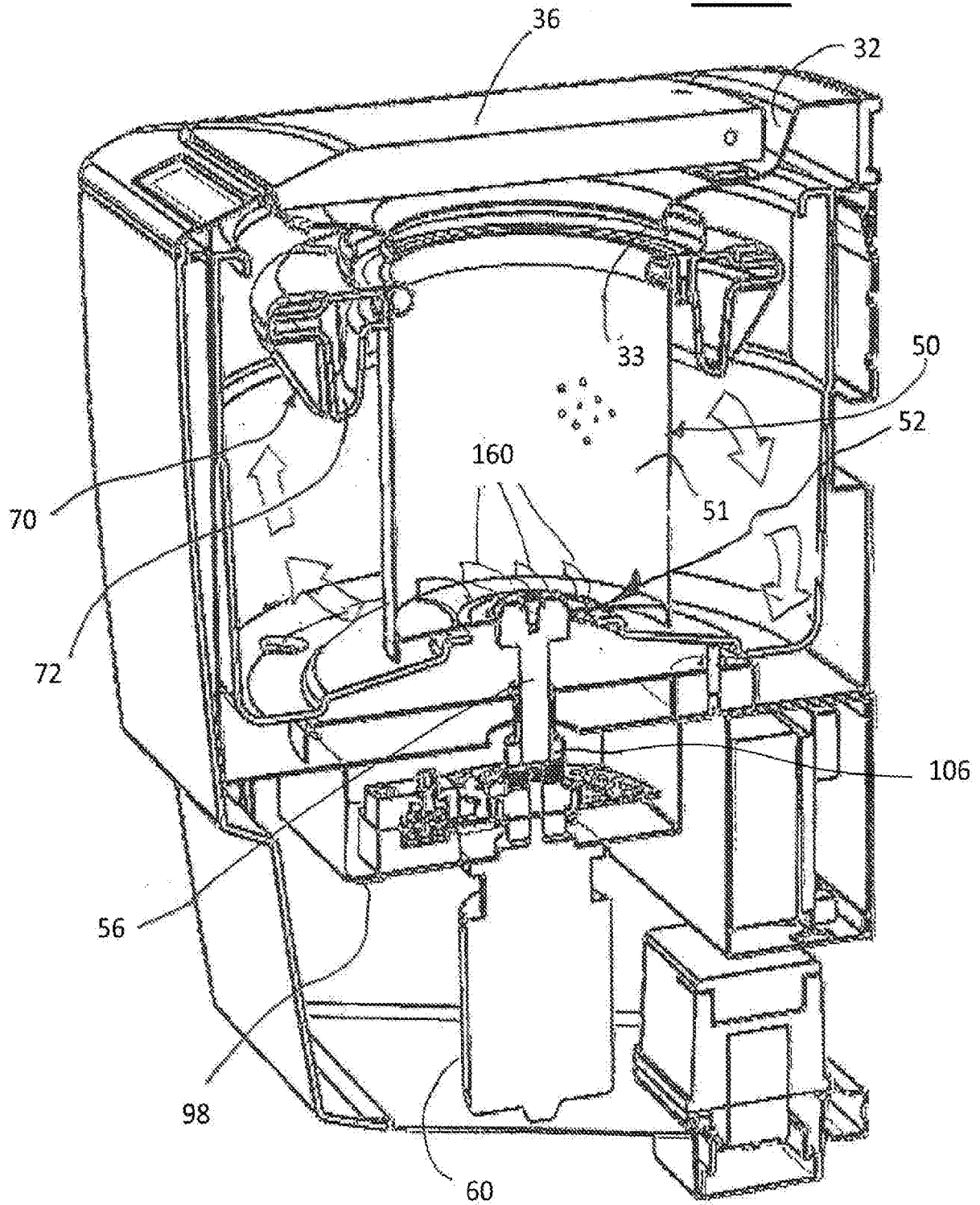


FIG 7



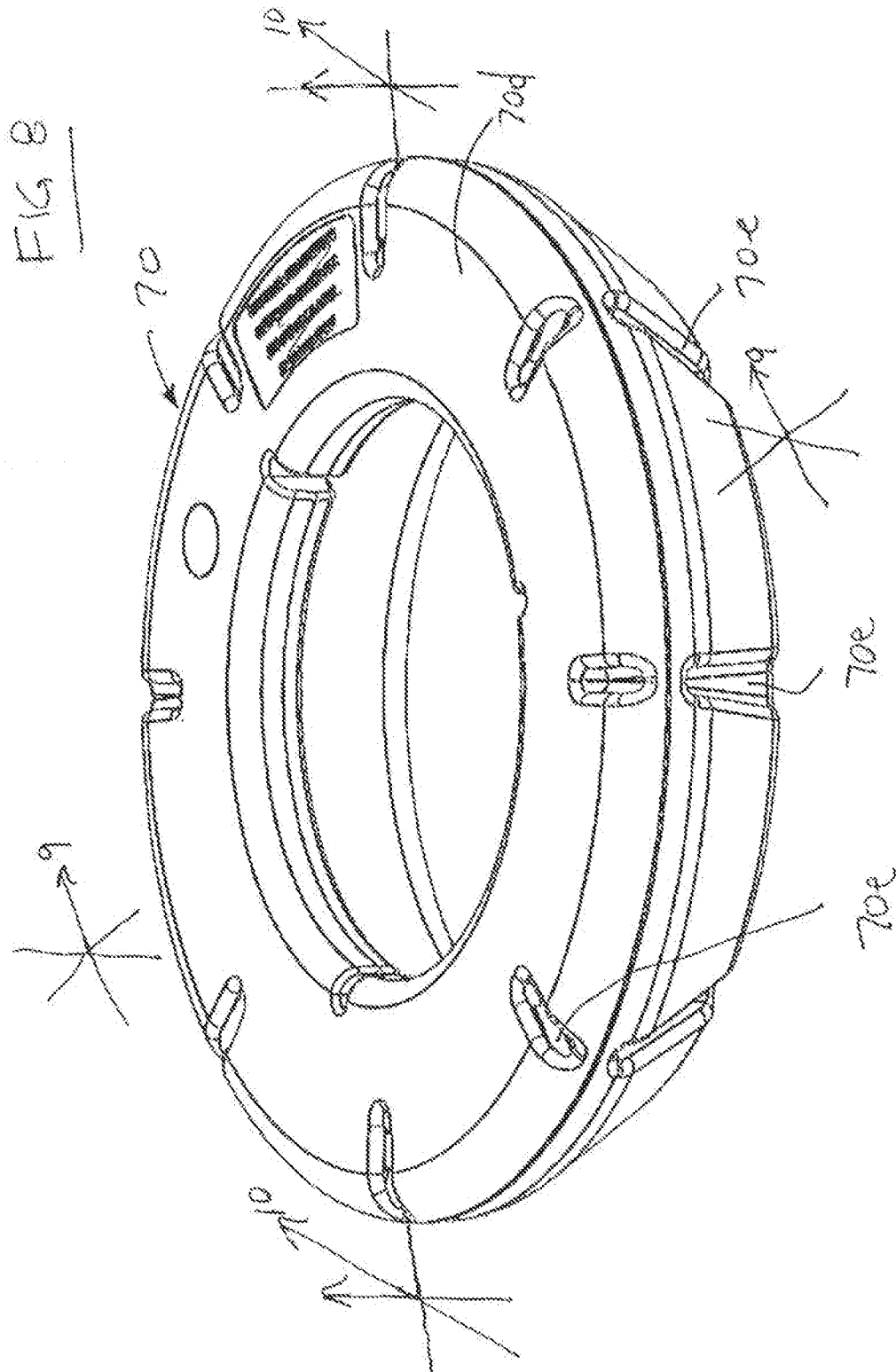


FIG 9

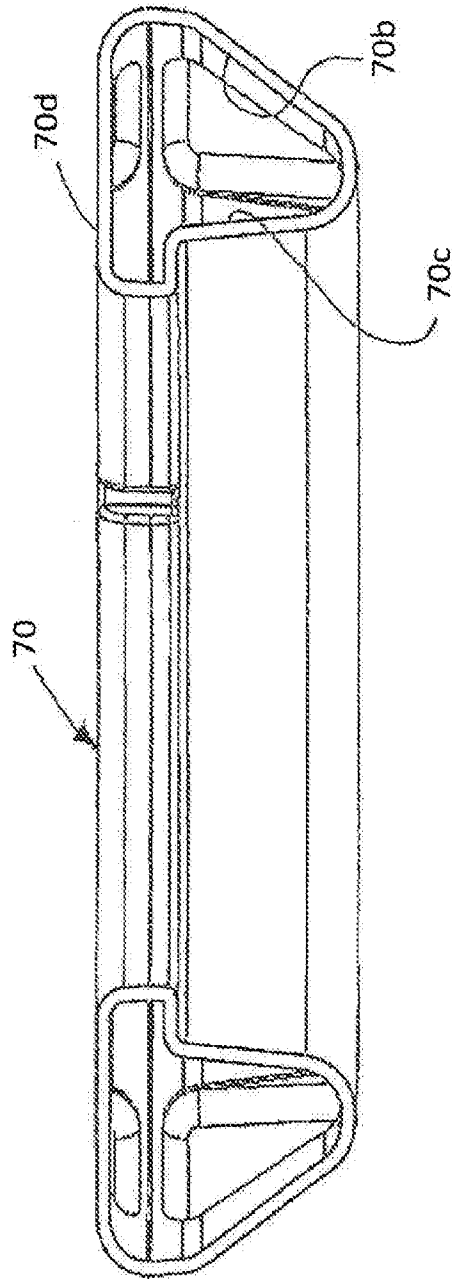
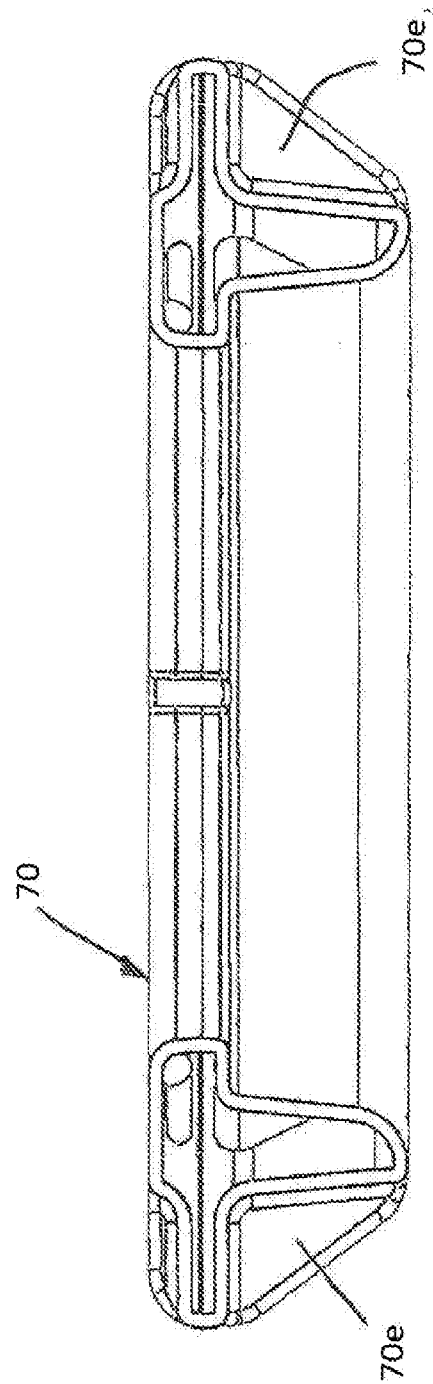
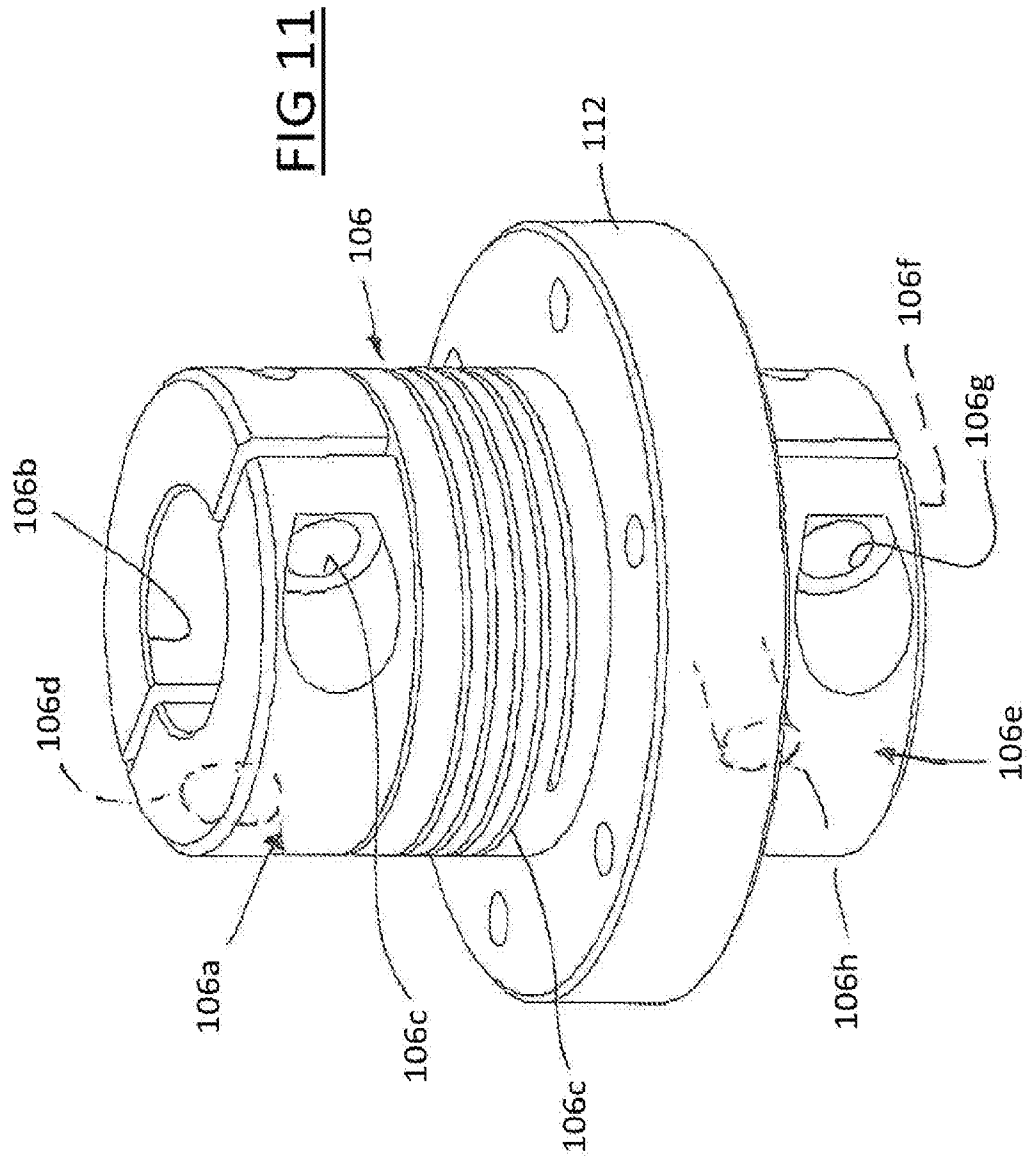


FIG 10





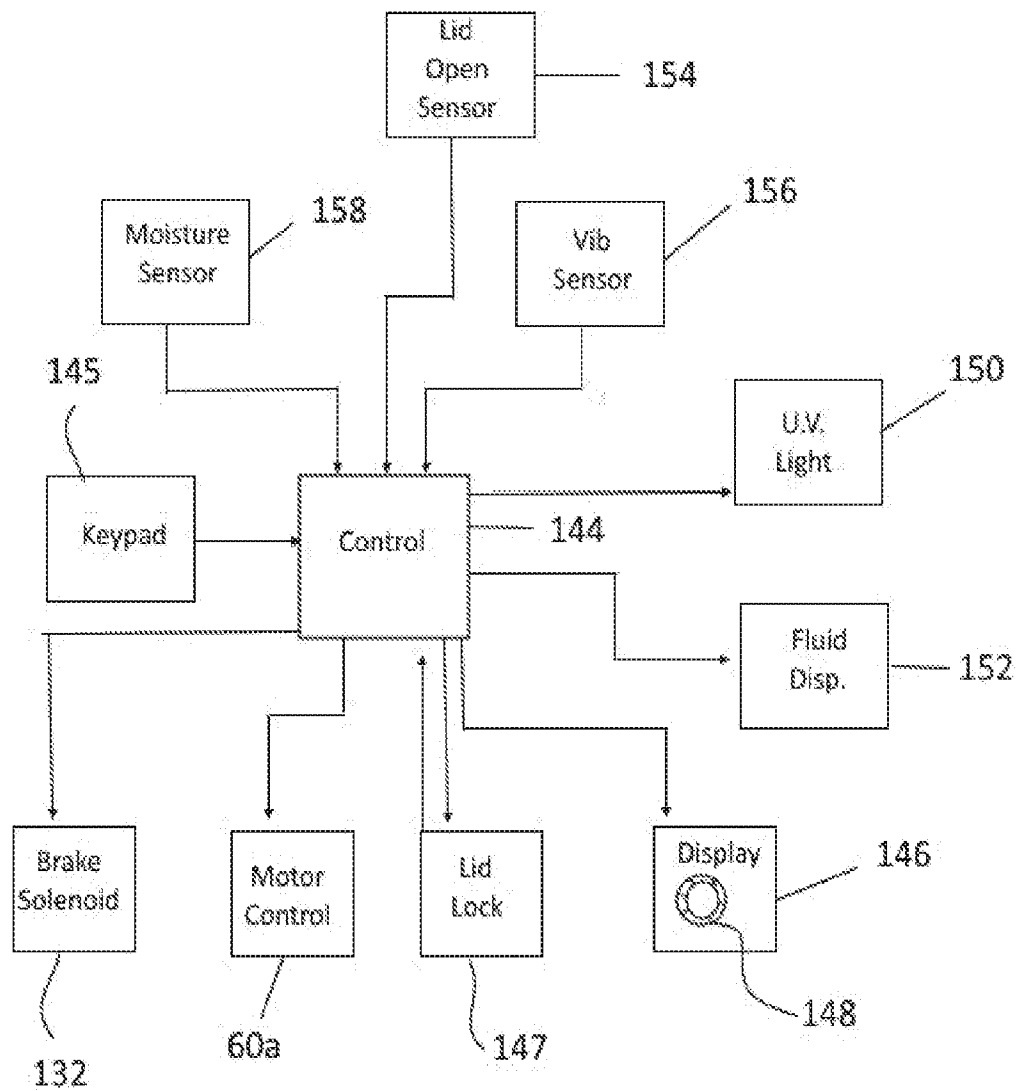
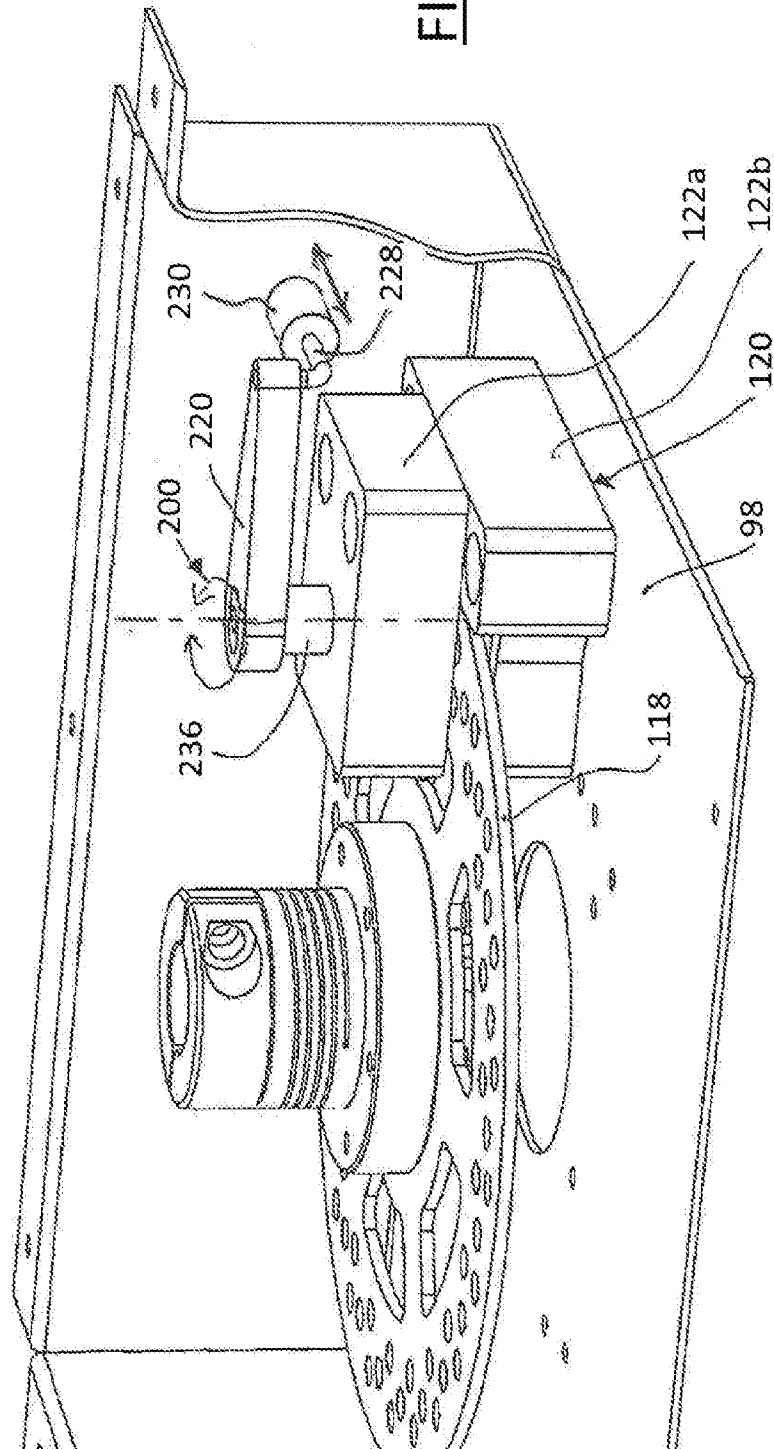
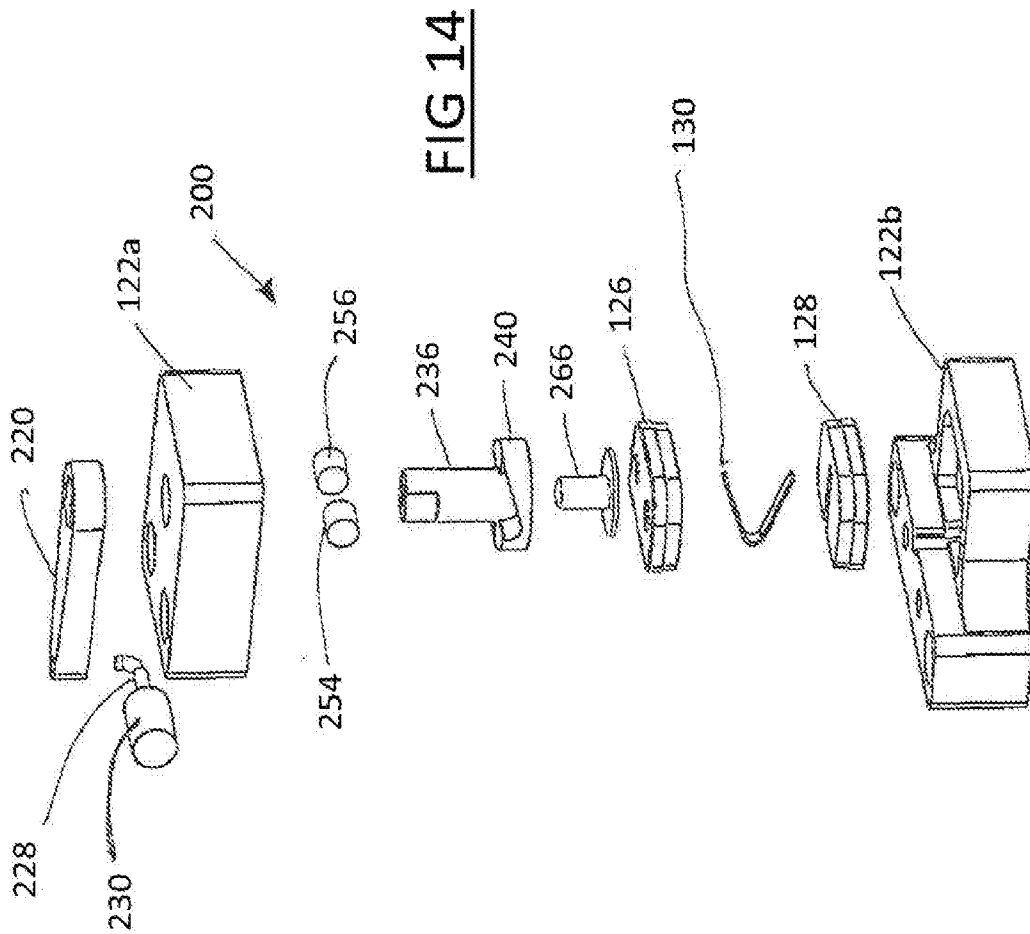
Fig 12

FIG 13





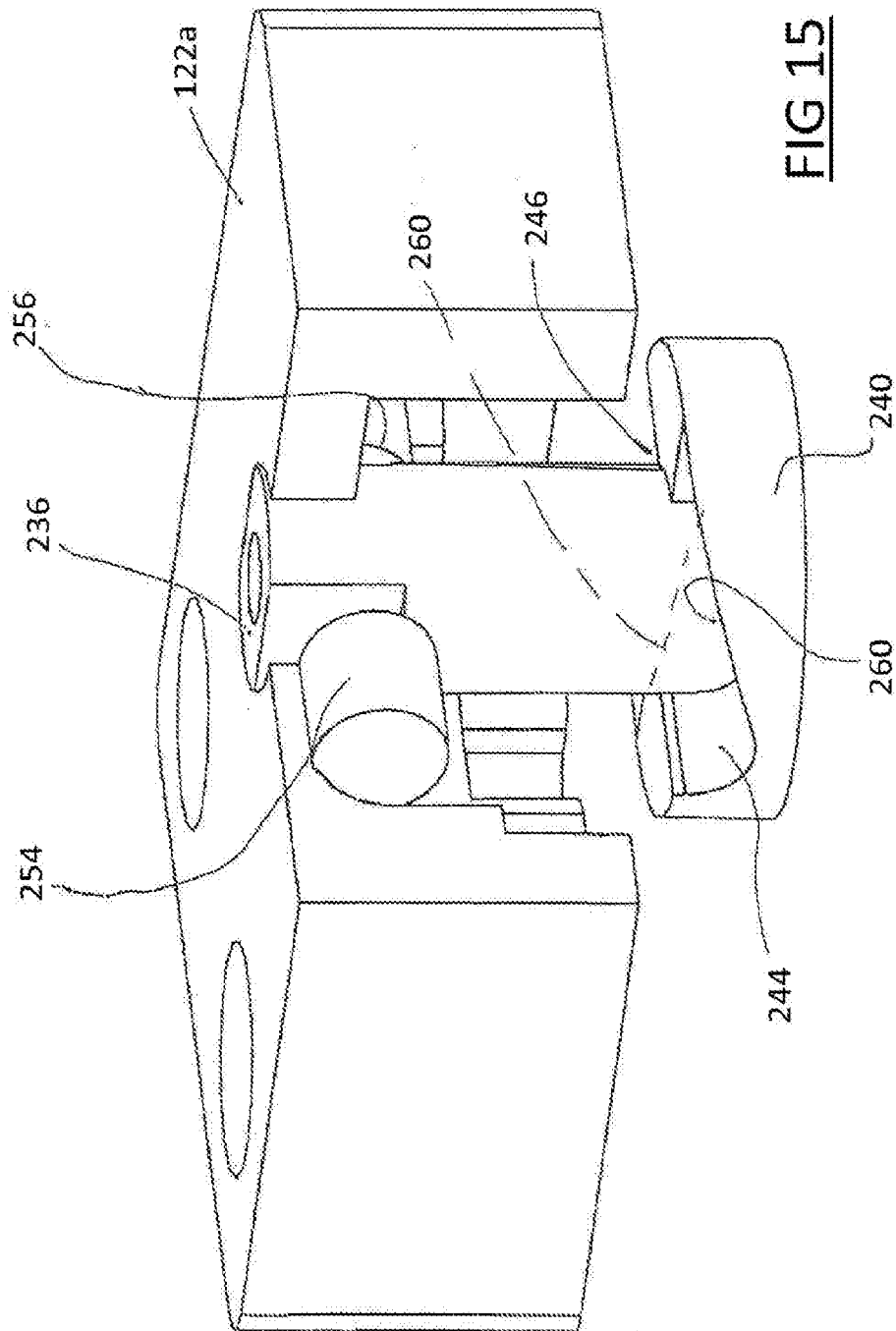


FIG 16

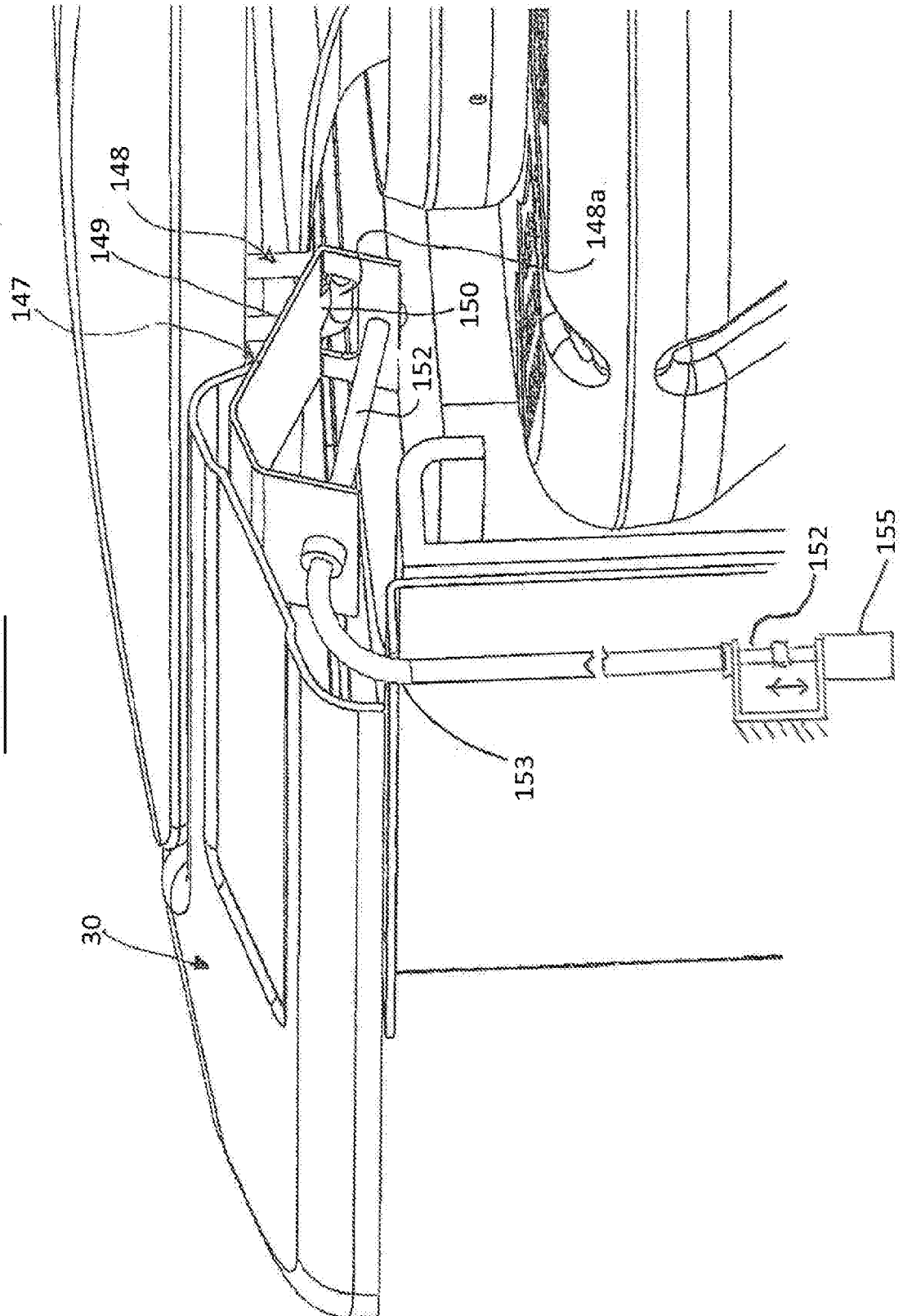
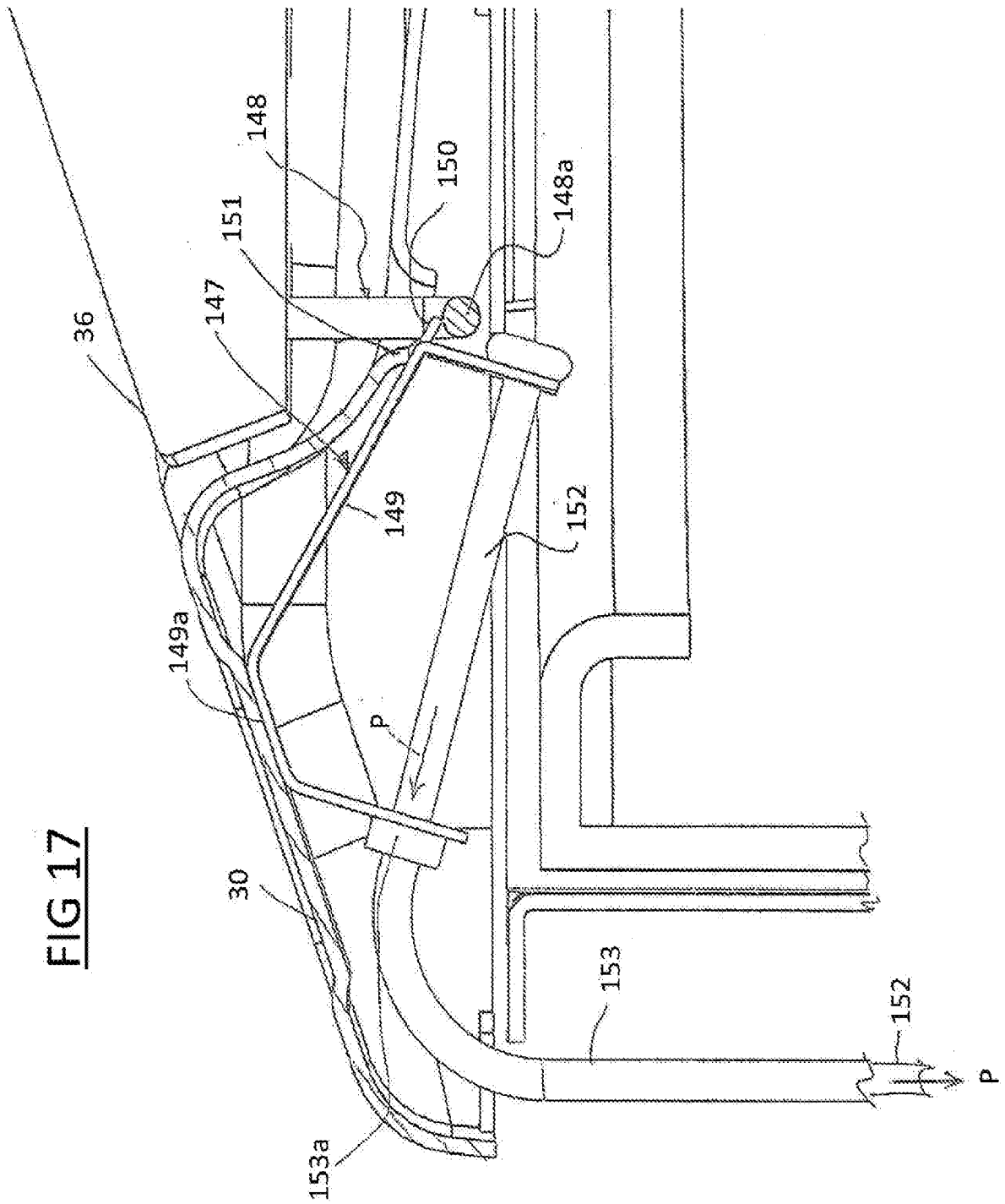


FIG 17



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/62789

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - D06F 49/00 (2016.01) CPC - D06F 49/00 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) IPC(8): D06F 49/00, D06F 49*, D06F 37/* (2016.01) CPC: D06F 49/00, D06F 49*, D06F 37/*		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched search terms listed below		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatBase; Google (Patent, Web, Scholar) Search terms used: Spin dryer drive shaft motor basket centrifugal separator control panel circulates illuminated lights spinning indicator circulates signals brak* disc disk caliper* shoe drier separat* washer basket drum		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,391,469 A (Reeder) 09 July 1968 (09.07.1968), entire document, especially Fig. 3, col. 3-4	1-2
Y		3-4, 7-8
A		5-6
Y	US 4,412,390 A (Grant) 01 November 1983 (01.11.1983), entire document, especially Fig. 1, col. 4	3
Y	US 4,044,626 A (Hayashi et al.) 30 August 1977 (30.08.1977), entire document, especially Figs. 3-5, col. 2	4
Y	US 6,877,248 B1 (Cross et al.) 12 April 2005 (12.04.2005), entire document, especially Figs. 2-5, col. 2, 4	7
Y	US 2,533,722 A (De Remer) 12 December 1950 (12.12.1950), entire document, especially Figs. 1-2, col. 3-7	8
A	US 5,293,760 A (Tani et al.) 15 March 1994 (15.03.1994), entire document	1-8
A	US 6,202,452 B1 (Ura et al.) 20 March 2001 (20.03.2001), entire document	1-8
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
* Special categories of cited documents:	"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 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "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		
Date of the actual completion of the international search 20 April 2016 (20.04.2016)	Date of mailing of the international search report <div style="font-size: 1.5em; font-weight: bold;">28 APR 2016</div>	
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer: <div style="text-align: right;">Lee W. Young</div> <div style="font-size: 0.8em;"> PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774 </div>	

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/62789

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
-See Supplemental Box-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
Claims 1-8

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Box III - Observations where unity of invention is lacking-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-8, directed to a centrifugal separator with a flexible coupling and motor housing fastened to a mechanical floor.

Group II: Claims 9-14, directed to a centrifugal separator with a balance ring.

Group III: Claims 15-22, directed to a centrifugal separator with a controller.

Group IV: Claim 23, directed to a centrifugal separator with a brake disc.

The inventions listed as Groups I-IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

SPECIAL TECHNICAL FEATURES

The invention of Group I includes the special technical feature of a driveshaft connected to an output shaft via a flexible coupling and a motor housing fastened to a mechanical floor, not required by the claims of Groups II-IV.

The invention of Group II includes the special technical feature of a balance ring having an annular chamber holding a balance fluid, the balance ring mounted to an outside of a basket to rotate therewith, not required by the claims of Groups I, III-IV.

The invention of Group III includes the special technical feature of a controller and an indicator, the controller starting a cycle by locking a lid closed, the indicator using an image to indicate the basket is spinning, not required by the claims of Groups I-II, IV.

The invention of Group IV includes the special technical feature of a brake disc fixed to rotate with a driveshaft, and a brake caliper fixed with respect to a stationary chamber and operable on the brake disc to stop a basket from spinning, not required by the claims of Groups I-III.

COMMON TECHNICAL FEATURES

Groups I-IV share the common technical features of a centrifugal separator (Title: Balancing centrifugal drying and washing machine), comprising:

a housing (casing 10; Fig. 1, col. 3 ln. 45) that includes a stationary chamber (unlabeled interior void containing basket 27; Fig. 1) having a side wall (outer wall 15; Fig. 1; col. 3 ln. 45) and a bottom floor (tapered bottom 16; Fig. 1; col. 3 ln. 46); a basket arranged to spin within the stationary chamber, the basket having a perforated surrounding sidewall;

a motor arranged below the bottom floor, the motor having a motor housing and an output shaft;

a driveshaft connected to the output shaft, the driveshaft passing through the bottom floor and connected to the basket. However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 2,533,722 A to De Remer, which discloses a centrifugal separator, comprising:

a basket (basket or receptacle 27; Fig. 1; col. 3 ln. 59) arranged to spin within the stationary chamber (col. 3 ln. 22-25 "the laundry machine according to the invention comprises, in general, a tank 10 containing a clothes basket 27. The basket is centrifugally driven by a spin shaft"), the basket having a perforated surrounding sidewall (col. 3 ln. 67-69 "at the widest part of the receptacle 27 a plurality of bleeder holes 36 are provided in the side wall 28");

a motor (electric motor 98; Fig. 1; col. 3 ln. 29) arranged below the bottom floor (see Fig. 1 showing electric motor 98 disposed beneath bottom floor 16), the motor having a motor housing (unlabeled housing surrounding internal motor components; Fig. 1) and an output shaft (inner shaft 104; Fig. 2; col. 5 ln. 61);

a driveshaft (rotor shaft 40; Fig. 2, col. 4 ln. 19) connected to the output shaft (rotor shaft 40 is connected to drive shaft 48 via universal joint 52, which is connected to gear 55, which is connected to gear 106, which is connected to inner shaft 104), the driveshaft passing through the bottom floor (see Fig. 2 showing rotor shaft 40 passing through bottom 16) and connected to the basket (col. 4 ln. 15-16 "The receptacle 27 is supported by a rotor shaft 40 secured to the hub 41 of the receptacle at 42").

Groups I and IV share the common technical features of the housing also including a mechanical floor below the bottom floor. However, this shared technical feature does not represent a contribution over prior art as being anticipated De Remer which teaches the housing also including a mechanical floor (base 22; Fig. 1; col. 3 ln. 51) below the bottom floor (col. 3 ln. 51 "The casing is supported by a base 22").

As the common technical features were known in the art at the time of the invention, these cannot be considered special technical feature that would otherwise unify the groups.

Therefore, Groups I-IV lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.