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(71) Applicant *(for all designated States except US)*: **SUNBEAM CORPORATION LIMITED** [AU/AU]; Units 5 & 6, 13 Lord Street, Botany, New South Wales 2019 (AU).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **O'LOUGHLIN, Nick** [AU/AU]; Unit 8/5 Elanora Street, Rose Bay, New South Wales 2029 (AU). **CORKIN, Daniel** [AU/AU]; 18 Winston Place, Narellan Vale, New South Wales 2567 (AU).

(74) Agent: **FREEHILLS PATENT & TRADE MARK ATTORNEYS**; Level 38, MLC Centre, 19-29 Martin Place, Sydney, New South Wales 2000 (AU).

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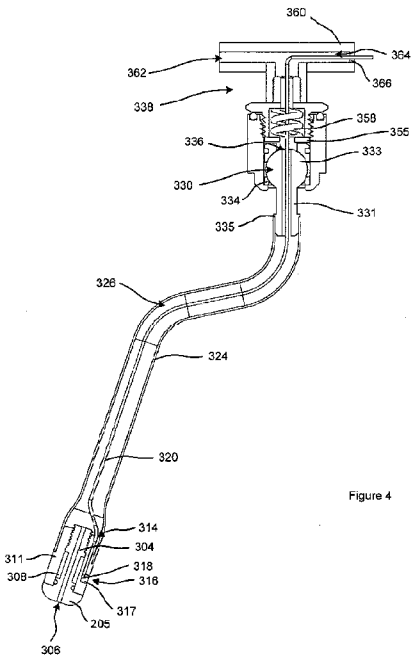

Figure 4

(57) Abstract: A beverage maker including a steam generation means, a steam wand, and a control valve for controlling the passage of steam from the steam generation means to the steam wand is described. The steam wand includes an arm, a nozzle located at a distal end of the arm, a steam duct defined within the steam wand through which, in use, steam from the steam generation means is vented, via the nozzle, into a liquid. The steam wand also includes a temperature sensor for sensing the temperature of the liquid, the temperature sensor being transversely spaced from a central axis of the steam wand and an insulating member for insulating the temperature sensor from heat generated by steam travelling through the steam duct.

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Steam wand

Field of the invention

The present invention relates to a steam wand for heating and/or frothing milk. The steam wand is suitable for use with an espresso coffee machine or similar, and will be described in relation to that embodiment.

Background of the invention

Many beverage makers such as espresso machines include a steam wand for preparing milk for mixing in the beverage.

When making a beverage (e.g. a cappuccino, café latte, hot chocolate) the steam wand is inserted into a jug of milk, and a valve is operated to produce steam and emit it from the end of the wand in order to heat and froth the milk. The heated milk is then mixed in the beverage.

When making beverages such as coffees or hot chocolate, the temperature of the milk is of critical importance. If the milk is under heated the resulting beverage will be cold. On the other hand, if the milk is overheated it may be scalded or burnt and impart an unpleasant flavour to the beverage, not froth properly, and/or be of a temperature dangerous to the end consumer.

During operation, the steam flowing through the steam wand can heat the wand to high temperatures. This can, in turn, cause injury or discomfort if the steam wand is inadvertently or deliberately touched during or after operation. It would be desirable to provide an beverage maker which reduces this risk of injury.

Traditionally, the correct temperature of the milk has been gauged by the operator of the machine estimating the temperature of the milk by feeling the outside of the stainless steel jug in which the milk is heated with their hand. Once the operator decides the milk is at the correct temperature operation of the steam wand is terminated and the steam wand removed from the milk. This means for determining the correct temperature

requires both a significant amount of skill and experience to determine the correct temperature for the milk, and constant attention to the milk whilst the steam wand is in operation.

An alternative method of measuring milk temperature is to place a thermometer in the milk. The thermometer may be held in place during use by a clip or similar, however does not alleviate the requirement for constant attention and, additionally, can get in the way.

It would also, or alternatively, be desirable to provide an alternative and more reliable means for providing heated and/or frothed milk for beverages.

In addition, or by way of a further alternative, it would be desirable to provide consumers with a useful choice.

Reference to any prior art in the specification is not, and should not be taken as, an acknowledgment or any form of suggestion that this prior art forms part of the common general knowledge in Australia or any other jurisdiction or that this prior art could reasonably be expected to be ascertained, understood and regarded as relevant by a person skilled in the art.

Summary of the invention

In one aspect the present invention provides a beverage maker including a steam generation means, a steam wand, and a control valve for controlling the passage of steam from the steam generation means to the steam wand, the steam wand including: an arm; a nozzle located at a distal end of the arm; a steam duct defined within the steam wand and through which, in use, steam from the steam generation means is vented, via the nozzle, into a liquid; a temperature sensor for sensing the temperature of the liquid, the temperature sensor being transversely spaced from a central axis of the steam wand; and an insulating member for insulating the temperature sensor from heat generated by steam travelling through the steam duct.

The steam wand may include an insulating air gap through which steam cannot flow, the air gap located between the temperature sensor and the steam duct.

The air gap may be provided by at least one of a recess in the nozzle and a recess in the insulating member.

The temperature sensor may be mounted in the insulating member and, in use, in thermal communication with the liquid.

The insulating member may be an insulating sleeve surrounding and coaxial with the steam path.

The insulating member may be mounted to the arm and define a bore into which a stem of the nozzle is received, thereby mounting the nozzle to the insulating member, the bore defined by the insulating member being coaxial with the steam path.

The bore defined by the insulating member and the stem of the nozzle may be complementarily threaded to allow the nozzle to be removably screwed into the insulating member.

The beverage maker may further include a threaded nozzle mount located at a distal end of the arm, the nozzle mount and nozzle being complementarily threaded to allow the nozzle to be removably screwed into the nozzle mount.

The insulating member may define a bore which receives the nozzle mount.

An outer peripheral surface of the insulating member may be flush with a peripheral surface of a head of the nozzle.

An outer peripheral surface of the arm may be flush with the outer peripheral surface of the insulating member to provide a steam wand with a smooth and unbroken profile.

The insulating member may be is provided with an opening in which a thermally conductive plug is received, and the temperature sensor may be mounted in the thermally conductive plug.

The temperature sensor may be connected to a beverage maker controller by a sensor cable, the sensor cable passing through the insulating member and the arm.

The sensor cable may pass through a sensor cable conduit, at least part of the sensor cable conduit being located within the arm.

A proximate end of the arm may be connected to a joint mounted in the beverage maker, the joint allowing for angular and/or rotational movement of the arm, and wherein the sensor cable passes through the ball joint.

The beverage maker may further include a temperature display for displaying the temperature sensed by the temperature sensor. The temperature display may be a dial display.

The beverage maker may further include a parameter display for displaying desirable beverage making parameters. The parameter display may be a dial display.

The beverage maker may include a flow sensor and/or a pressure sensor, and the beverage making parameters may include parameters relating to the flow-rate of liquid in the beverage maker and/or the pressure of liquid in the beverage maker. The beverage maker may further include a user interface operable by a user to vent steam from the steam wand, and the beverage maker controller may be adapted to terminate generation of steam through the steam wand if the temperature sensor senses that the liquid has exceeded a predetermined temperature.

A user may input the type of liquid via a user interface, and the type of liquid input may determine the predetermined temperature at which the controller will terminate generation of steam through the steam wand.

The steam duct may be defined by an external wall of the arm.

Alternatively, the steam duct may not be defined by an external wall of the arm.

The beverage maker may further include a steam insulation means for insulating the external wall of the arm and/or the sensor cable from steam travelling through the steam duct.

The steam insulation means may include an air gap.

The steam duct may be formed of an insulating material and form part of the steam insulation means. The steam duct may be manufactured from PTFE.

In a second aspect the present invention provides a beverage maker including a steam generation means, a steam wand, and a control valve for controlling the passage of steam from the steam generation means to the steam wand, the steam wand including: an arm having an external wall; a nozzle located at a distal end of the arm; an internal steam duct defined within the steam wand through which, in use, steam from the steam generation means is vented, via the nozzle, into a liquid; a temperature sensor for sensing the temperature of the liquid, the temperature sensor being transversely spaced from a central axis of the steam wand; a steam insulation means for insulating the external wall from steam travelling through the steam duct.

The steam insulation means may include an air gap.

The internal steam duct may be formed of an insulating material and form part of the steam insulation means.

The internal steam duct may be manufactured from PTFE.

Also described herein is a beverage maker including a steam generation means, a steam wand, and a control valve for controlling the passage of steam from the steam generation means to the steam wand, the steam wand including: an arm having an external wall; a nozzle located at a distal end of the arm; a internal steam conduit running inside the arm; and an insulating means interposed between the external wall of the arm and the internal steam conduit.

As used herein, except where the context requires otherwise, the term "comprise" and variations of the term, such as "comprising", "comprises" and "comprised", are not intended to exclude further additives, components, integers or steps.

Brief description of the drawings

An embodiment of the invention will now be described in relation to the following figures in which:

Figure 1 provides a perspective view of a beverage maker in accordance with an embodiment of the invention;

Figure 2A provides a functional block diagram of beverage maker components suitable for use with the beverage maker of figure 1;

Figure 2B provides a functional block diagram of an alternative set of beverage maker components suitable for use with the beverage maker of figure 1;

Figure 2C provides a functional block diagram of a further alternative set of beverage maker components suitable for use with the beverage maker of figure 1;

Figure 3 provides an exploded perspective view of a steam wand for use with the beverage maker of figure 1 in accordance with a first embodiment of the invention;

Figure 4 provides a sectional perspective view of the steam wand of figure 3;

Figure 5A provides a sectional perspective view of the distal end of the steam wand of figure 3;

Figure 5B provides a sectional perspective view of the proximate end of the steam wand of figure 3;

Figure 6 provides a depiction of the steam wand of figure 3 being used in a receptacle of liquid;

Figure 7A provides a sectional view of the proximate end of a steam wand in accordance with an alternative embodiment of the invention;

Figure 7B provides a sectional perspective view of the distal end of a steam wand in accordance with a further alternative embodiment of the invention;

Figure 7C provides a sectional view of the distal end of a steam wand in accordance with yet a further embodiment of the invention;

Figure 7D provides a perspective view of the distal end of the steam wand of figure 7C;

Figures 8A to 8D depict the steps involved in producing an insulating sleeve with a temperature sensor for use with the steam wand of figure 3;

Figure 9 provides a plan view a steam wand in accordance with an alternative embodiment of the invention;

Figure 10 provides a partial perspective view of the distal end of the steam wand of figure 9;

Figure 11 provides a partial sectional view of the distal end of the steam wand of figure 9 without the nozzle in place; and

Figure 12 provides a partial sectional view of the distal end of the steam wand of figure 9 with the nozzle in place.

Detailed description of the embodiments

Figure 1 provides a perspective view of a beverage maker 100 in accordance with an embodiment of the invention.

In this instance the beverage maker 100 is an espresso machine and includes a steam wand 102, a user interface 104 in the form of press buttons, and a filter holder head 106 removably mountable to the beverage maker 100. The beverage maker also includes

display area 110 for displaying information such as (e.g.) the mode of operation of the beverage maker 100 and, if the steam wand 102 is being used, the temperature of the liquid in which the steam wand 102 is placed.

The display area 110 may include a variety of displays, such as one or more digital, LCD, and/or LED displays, one or more touch screen displays, analogue dials, digital screens representing analogue dials, and/or or other displays. In the present embodiment, and as shown in figure 1, display area 110 includes a pair of analogue dial type displays 111 and 113. Dial displays 111 and 113 each include a needle 115 and 117 which rotates to indicate a particular point on a scale 119 and 121. As can be seen on scale 121, the dial may also display range information to indicate to the user acceptable or optimal operational ranges.

As is known in the art, in order to make an espresso coffee grounds are placed in the filter holder 106 and the beverage maker operated (via the user interface 104) to force heated water through the grounds held in the filter holder 106 at pressure. The water forced through the grounds drips into a cup or similar placed on tray 108, thereby providing a shot of espresso coffee.

The beverage maker is also usable to deliver steam via the steam wand 102. The free (or distal) end of the steam wand is inserted into a jug of liquid such as milk and operated (again via the user interface) to vent steam into the liquid thereby heating and frothing the liquid which can then be added to the espresso coffee (or used for any other purpose).

Turning to figures 2A to 2C, functional block diagrams 200 showing beverage maker components suitable for use in beverage maker 100 are provided.

The components depicted in functional block diagram 200 of figure 2A include a water reservoir 202, a pump 204 and a water heater 206, together providing a steam generation means. In the illustrated beverage maker a valve 208 is operable to open/close a fluid path from the water reservoir 202 to the filter holder 106 (in order to make the shot of espresso) or to open/close a path from the water reservoir 202 to the

steam wand 102. Depending on the type of beverage maker the user may also be able to operate the beverage maker 100 to vent either steam or hot water out of the steam wand 102.

The beverage maker 100 includes a controller 210 which is connected to the water reservoir 202, pump 204, water heater 206, valve 208, steam wand 102, user interface 104, and display area 110.

It will of course be appreciated that the present invention may be embodied in a variety of different beverage makers and/or with beverage makers having additional or alternative components. For example, the plumbing of the beverage maker may split flows for beverage making (i.e. delivery to the filter holder 106) and steam venting (via steam wand 102) earlier and provide separate pumps and/or heaters for each path. By way of further example, pressure relief valves may be provided as appropriate in the plumbing to prevent dangerous or undesirable pressure build-up.

In this embodiment the controller 210 is a programmable logic controller. Other controllers are, of course, possible, such as (by way of non-limiting example) a microprocessor-based controller and/or a printed circuit board controller. Controller 210 is programmed to receive a user input from the user interface 104 and operate the pump 204, water heater 206 and valve 208 accordingly. The controller 210 may also receive input from the various components of the beverage maker 100 and display these on the display area 110. For example, the controller 210 may receive water level signals from a water level sensor (not shown) in the water reservoir 202, operational information from the pump 204, heater 206 and/or valve 208, and, as discussed in more detail below, temperature sensor signals from the steam wand 102. In the present embodiment the controller 210 is configured to display the temperature sensed by the temperature sensor 318 on dial display 111.

Turning to figure 2B, a functional block diagram 212 depicting a slightly alternative set of beverage maker components suitable for use with the beverage maker of figure 1 is provided. As can be see, the components shown in figure 2B are largely the same as those shown in figure 2A (with the same reference numerals being used for simplicity),

however further include a flow sensor 214. Flow sensor 214 may be of any suitable type, for example a turbine type flow meter, and is located between the water reservoir 202 and the pump 204 and is adapted to send information regarding the flow of water to the controller 210. Flow sensor 214 could, alternatively, be located downstream of the pump 204, however in this case the flow sensor 214 would need to be capable of dealing with the high pressure flow generated by the pump 214.

Flow sensor 214 may also be used to measure the correct amount of liquid for a operation selected by the user. For example, if the user selects to make a single beverage the controller 210 may use the flow sensor 214 to measure out 30mm (or the desired amount per beverage) of water. Alternatively, if a user selects to make two beverages the controller 210 may use the flow sensor 214 to measure out 60mm (or twice the volume required for a single beverage).

In addition to displaying the temperature sensed by sensor 318 on dial display 111 (as described above), the controller 210 can use dial display 113 (or, in alternative embodiments, any other suitable type of display) to display beverage making parameters. For example, the controller 210 may use information from the flow sensor 214 to display the flow rate of liquid through the beverage maker 100. This parameter (the flow rate of liquid) can be used to indicate whether the beverage maker is operating within acceptable/optimal beverage making parameters. When the beverage maker 100 is used to make coffee, the coffee grounds packed into the filter holder 106 create back-pressure in the plumbing of the beverage maker 100 which in turn influences the flow rate sensed by the flow sensor 214. By providing an acceptable/optimal range on the range indicator 121 of dial display 113, the controller 210 can display whether optimal beverage making parameters have been reached. The range 121 may be presented to indicate upper and lower flow rate bounds for desirable/optimal flow rates. The actual optimal flow may vary according to the particular beverage maker, however for a relatively standard beverage maker, a flow rate of approximately 30ml/30seconds is acceptable and may be represented by the controller 210 on dial 113 as being within the optimal range.

Figure 2C provides a further alternative to the components indicated in figures 2A and 2B. Once again, the components indicated in functional block diagram 216 of figure 2C are largely the same as in figures 2A and 2B, however the additional component of a pressure sensor 218 located between the pump and the 204 and the water heater 206 is provided. Pressure sensor 218 measures the pressure in the beverage maker 100 between the pump 204 and the compressed coffee grounds in the filter holder 106.

Dial display 113 may be a mechanical pressure display linked directly to the pressure sensor 218 in order to display the pressure sensed. Alternatively, the pressure sensor 218 may transmit signals to the controller 210 for display on an alternative display means (such as a digital display). The range 121 of dial display 113 is, in this instance, set to highlight approximately 9 Bar as the optimal pressure for making espresso coffee (the typically accepted pressure for brewing espresso is 8.8 atmospheres of pressure).

While figure 2C also includes the flow sensor 214, it will be appreciated that if the pressure sensor 218 is used to indicate acceptable/optimal beverage making conditions, the flow sensor 214 is not required for this purpose. Flow sensor 214 may, however, have alternative uses such as measuring the correct volume of liquid as described above.

As will be appreciated, the embodiment described in figure 2B allows a single sensor (flow sensor 214) to provide information on both the optimal beverage making conditions (based on flow rate) and the measurement of the volume of liquid delivered. This is in contrast with the embodiment of figure 2C which relies on the pressure sensor 218 to determine/display the optimal beverage making conditions (based on pressure).

Turning to figures 3 to 5, the steam wand 102 according to a first embodiment of the invention will now be described in detail.

Steam wand 102 includes a nozzle 302 having a threaded stem 304 and defining an axially extending nozzle conduit 306 through which, in use, steam/water is vented. The nozzle 302 is provided with an intermediate elongate annular recess 308 formed in the shaft below the thread and is provided with a lower O-ring recess 309. The nozzle 302

is manufactured from stainless steel which is inert to most liquids (e.g. milk or water) in which the nozzle 302 may be placed and is easily cleaned. The nozzle 302 may, of course, be manufactured from alternative suitable materials such as chromed brass or even an insulating material such as nylon.

The stem 304 of the nozzle 302 is received in an insulating sleeve 311 moulded, in this instance, from nylon (though alternative insulating materials are of course possible such as silicone, glass, polytetrafluoroethylene (PTFE, e.g. Teflon), or ceramic materials. The insulating sleeve is provided with a threaded axial bore 213 for receiving the threaded stem 304 of the nozzle 302, and an O-ring placed in the O-ring recess 309 serves to seal the connection. As can be seen, the outer peripheral surface of the insulating sleeve 311 is flush with the head 305 of the nozzle 302 providing both an aesthetically streamlined steam wand and allowing the steam wand 102 to be easily cleaned after use. In particular, the smooth and continuous finish facilitates the wiping off of dried milk residue.

The insulating sleeve includes a cable conduit 314 and an opening 316. When assembled, the cable conduit 314 of the insulating sleeve 311 accommodates a temperature sensor 318 which is connected to the controller 210 via a sensor cable 320. The temperature sensor 318 is located in the opening 316 and connected to a stainless steel plug 317 which occupies the opening 316 (to prevent liquid entering) and transfers heat from the liquid to the sensor 318. Manufacture of the plug 317 and connection to the temperature sensor 318 and insulating sleeve 311 is described in more detail below and with reference to figure 8. The temperature sensor cable 320 is accommodated in the cable conduit 314. The temperature sensor 318 is, in this instance, an electronic temperature sensor such as a thermistor, however an alternative sensor (e.g. a thermocouple) could of course be used.

The insulating sleeve 311 is secured in a distal end 322 of an arm 324 by an adhesive (or, if desired, mechanical means) such that the outer surface of the arm 324 is relatively flush with the outer peripheral surface of the insulating sleeve 311. The arm 324 may be made of chrome plated brass, stainless steel, or any other suitable material. A suitable adhesive for securing the insulating sleeve 311 in the arm 324 is

RTV (a silicone based glue) which serves to both fix the insulating sleeve 311 in place and seal the interface between the insulating sleeve 311 and arm 324. Alternative means of securing the insulating sleeve 311 are possible, for example a mechanical interlock or combination of mechanical lock and adhesive. The arm 324 is hollow and defines an arm conduit 326 through which sensor cable 320 passes and (in use) steam/water flows. In the present embodiment the arm conduit 326 itself acts as a steam duct.

As shown in detail in figure 5B, and in accordance with the present embodiment, a proximate end 328 of the steam arm 324 is connected to a ball joint 330. The ball joint 330 includes a stem 331 (to which the proximate end 328 of the steam arm 324 is welded) and ball 333 (which allows for angular and rotational movement of the steam arm 324). The connection of the steam arm 324 with the ball joint 330 facilitated by a shoulder 335, a nylon ball joint cover 332 and lower nylon bush 334. The ball joint 330 is also hollow, defining a joint conduit 336 through which the sensor cable 320 and (in use) steam/water pass.

To secure the ball joint 330 in the beverage maker 100 and allow the ball joint 330 (and attached steam arm 324) to swivel freely a brass compression connector 338 is used. The compression connector includes a lower housing 340 defining a cavity 342 for receiving the ball joint 330. The lower housing 340 has an opening 344 through which the stem 331 of the ball joint 330 passes. The compression connector also includes an upper housing 346 which is screwed into the lower housing 340 (with a compression O-ring 348 interposed between). The upper housing 346 also includes a hollow threaded shaft 350 defining an upper housing conduit 352 through which sensor cable 320 and steam/water pass.

When assembled the ball joint 330 is located in the cavity 342 with the stem 331 of the ball joint 330 extending through opening 344. A hollow nylon bush 354 with O-ring 356 and a stainless steel spring 358 are positioned above the ball joint 330 and the upper housing 346 screwed into the lower housing 340. Once assembled the spring 358 bears on a washer 355 which urges the bush 354 onto the ball joint 330 and the ball joint 330 into the lower nylon bush 334 in the bottom of the cavity 342.

By connecting the steam wand 102 to the beverage maker 100 in this manner the steam wand 102 can be swivelled and rotated as desired. As will be appreciated, unrestricted rotation of the steam wand 102 (for example continual rotation in the same direction) could result in undesirable twisting or other stresses to the sensor cable 320. If desired a stop (not shown) may be fitted to the ball joint 330, the compression connector 338, or the beverage maker 100 itself to limit the available movement of the steam wand 102.

It will also be appreciated, however, that the steam wand 102 could be connected to the beverage maker 100 in alternative ways for allowing rotational and/or angular movement of the steam wand 102 or, if desired, for securing the steam wand 102 immovably in place. For example, in the alternative embodiment described below with reference to figure 9 a cylindrical joint is provided to attach the steam wand 102 to the beverage maker 100.

The threaded shaft 350 of the compression connector 338 is received in a complementarily threaded T-connector 360 (as shown in figure 5B). A fluid arm 362 of the T-connector 360 is (via additional plumbing) adapted to receive steam/water from the water reservoir 202 (heated by heater 206). A cable arm 364 of the T-connector 360 is adapted to accommodate the sensor cable 320 (which continues from the cable arm 364 to the controller 210) and is provided with a fluid-tight seal 366 to prevent steam/water flowing through the fluid arm 362 from escaping through the cable arm 364. Seal 366 may, for example, be manufactured from a silicone compound such as RTV silicone.

The various components of the steam wand 102 define a fluid path/duct through which steam/water from the water reservoir 202 can pass. The fluid path is defined by the fluid arm 362 of the T-connector 360, the hollow threaded shaft 350 of the compression connector 338, the ball joint conduit 336, the arm conduit 326, and the nozzle conduit 306.

The various components also provide a cable path though which the cable 320 connecting the temperature sensor 318 to the controller 210 passes. The cable path is,

in this instance, defined by the cable arm 364 of the T-connector 258, the hollow threaded shaft 350 of the compression connector 338, the ball joint conduit 336, the arm conduit 326, and the cable conduit 314 in the insulating sleeve 311. As the steam/water and sensor cable 320 occupy (in part) the same path, the sensor cable 320 is sheathed in Teflon (or any other suitable thermally and/or electrically insulating material) to prevent any adverse effects to the cable from the steam/water.

By housing the sensor cable 320 in the conduit of the steam arm 102 the danger of the cable being caught or damaged during use is minimised, and the sensor cable 320 is prevented from accumulating dried milk/liquid (which could be the case, for example, if the cable were carried on the outside of the steam arm 102). Also, the external appearance of the beverage maker 100 is not compromised by the addition of an extra external cable.

Referring to figure 6, when the steam wand 102 is to be used the distal end 322 (including the nozzle 302 and temperature sensor 318) it is placed in a jug 602 or similar of liquid (e.g. milk). In order for the temperature sensor 318 to effectively sense the temperature of the liquid the plug 317 must be in contact with the liquid, defining a minimum level of immersion of the steam wand 102 (or, alternatively, a minimum liquid level 604).A user then operates the beverage maker 100 (via the user interface 104) to vent steam from the steam wand 102, causing the controller 210 to pump water from the reservoir 202 through the water heater 206 (where it is heated to steam) and open valve 208 to allow the steam to flow to the steam wand 102 and though the fluid path in the steam wand. As the liquid is heated heat is transferred to the temperature sensor 318 via the plug 317 allowing the temperature sensor 318 to monitor the temperature of the fluid.

As will be appreciated, the arrangement of the steam wand 102 is such that the temperature sensor 318 is insulated from steam flowing through the steam path in the steam wand 102 (and, in particular, through the nozzle conduit 306).

In this embodiment the insulation of the temperature sensor 318 is achieved by the combination of the air gap between the nozzle 302 and the insulating sleeve 311

(provided by the annular recess 308 in the nozzle 302) and the insulating material of the insulating sleeve 311 itself. While the air gap in this embodiment is provided by the recess 308 in the nozzle, the recess could alternatively be provided in the insulating sleeve 311 itself. The opening 316 in the insulating sleeve 311 allows fluid to come into contact with the temperature sensor 318 and provide accurate readings.

Figures 7A to 7D depict alternative embodiments of a steam wand according to the present invention.

In the embodiment depicted in 7A, the sensor cable 320 does not travel through the entire ball joint 330 but exits from an opening 702 in the stem 331 of the ball joint 330 (the opening sealed by a sealant such as RTV or a moulded silicone). As can be seen, the opening 702 is positioned inside the beverage maker 100 so, once again, the cable is internal to the beverage maker 100.

In the embodiment illustrated in figure 7B the insulating sleeve 311 is further provided with a thermally conductive sleeve 710. Thermally conductive sleeve 710 is made of chrome plated brass though may be made of an alternative conductor. As can be seen, the thermally conductive sleeve 702 is countersunk so as to remain flush with the remainder of the insulating sleeve 311 and the head of the nozzle 302. As with the temperature sensor 318 the thermally conductive sleeve 702 is insulated from steam passing through the nozzle 302 by the air gap and the insulating sleeve 311. The thermally conductive sleeve 702 covers opening 316 and plug 317, transmitting heat to the temperature sensor 318 via plug 317.

In the embodiment of figures 7C and 7D, the insulating sleeve is replaced with a localised sensor insulator 720 which houses plug 317 and temperature sensor 318. The localised sensor insulator seats in a stainless steel sensor holder 722 which includes a conduit 724 for housing the sensor cable 320 and into which nozzle 302 screws .

The controller 210 is configured to receive signals from the temperature sensor 318 indicative of the sensed temperature. Where the beverage maker 100 includes a display (as per the current embodiment) the controller 210 can be configured to display the

temperature of the fluid to the user on display area 110. In the illustrated embodiment the temperature is displayed on the dial display 111, although alternative means for displaying the temperature (such as a digital display) may, of course, be provided. Additionally (or alternatively), the controller may generate an audible alarm when a pre-determined temperature is reached to alert a user to this. When the user sees/hears that a certain temperature has been reached (and, for example, that the milk will burn) they can manually terminate operation of the steam wand 102 by closing the valve 208. In some embodiments the controller 210 may be configured to automatically terminate operation of the steam wand 102 (e.g. by closing valve 208 and/or ceasing operation of pump 204) when the predetermined temperature is sensed by the temperature sensor 318.

Noting that in an espresso machine milk will most often be the fluid being heated/frothed, an appropriate pre-determined temperature to prevent boiling and/or burning of the milk is in the range of 55° to 65°.

If desired, instead of being programmed/configured to terminate operation of the steam wand 102 at a single temperature, the controller 210 may allow a user to specify (via the user interface 104) the type of fluid being heated/frothed by the steam arm 102 and terminate operation of the steam wand at a pre-determined temperature appropriate for that fluid. For example, if full cream milk is specified the pre-determined temperature may be 60°, while if skim milk is specified the pre-determined temperature may be 50°. Temperatures may also be set for other fluids such as soy milk and rice milk.

Turning to figures 8A to 8D, one method for manufacturing an insulating sleeve 311 with a temperature sensor 318 and thermally conductive plug 317 for the steam arm of the above described embodiment is depicted.

Initially (and as shown in figure 8A) the thermally conductive plug 317 is machined, for example from stainless steel. The plug 317 is provided with a cavity 802 which, as shown in figure 8B, receives the temperature sensor 318. The temperature sensor 318 (in this case a thermistor) is glued into the cavity 802 by using a strong thermally conductive resin.

As shown in figure 8C the plug 317 with temperature sensor 318 received therein is then moulded into an insert 804. Moulding the plug 317 and temperature sensor 318 (and part of the temperature sensor cable 320) into the insert 804 holds these components in place for the final moulding step described below. The insert 804 is moulded from an insulating material (in this instance nylon) and includes a pair of apertures 806 which allow the manufacturing tool (when closed) to hold the sensor cable 220 in place during moulding. When closed the tool also holds the plug 317 in place. Insert 804 also includes recesses 808 which interlock with the insulating sleeve body 810.

In figure 8D the moulded insert 804 (carrying the plug 317, temperature sensor 318 and part of the sensor cable 320) is moulded into the body 810 of the insulating sleeve 311. Body 810 is also moulded from an insulating material such as nylon. As the portion of the insulating sleeve 311 above shoulder 812 is hidden within arm 324, making the insulating sleeve 311 appear as a single moulding to the end user. Shoulder 812 is the same width as the wall of the arm 324 providing (as described above) a continuous and flush surface formed by the arm 324 and insulating sleeve 311.

A steam wand 900 in accordance with alternative embodiment of the invention will now be described with reference to figures 9 to 12.

Broadly speaking, and referring to figures 9 and 10, steam wand 900 includes a steam arm 902 terminating in a nozzle 904 at its distal end 905 and passing through a cylindrical joint 906 at its proximate end 907. As with the previous embodiments, the distal end 905 of the steam arm 902 is provided with a temperature sensor 908. The arm 902 is hollow and defines an insulating void 910 through which a sensor cable conduit 912 and an internal steam duct 914 pass.

Turning to figures 11 and 12, the distal end 905 of the steam wand 900 will now be described. Figure 11 provides a cross-sectional view of the distal end 905 of the steam arm 900 without the nozzle 904, and figure 12 provides the same view with the nozzle 904 in place.

As can be seen, at the distal end 905 the steam arm 902 is provided with a cut-away portion 916 through which the temperature of the milk (or other liquid) can be sensed by the temperature sensor 908 when in use.

The distal end 905 of the steam arm 902 is also fitted with an annular bracket 918. Bracket 918 is, in this instance, is fixed to the inside of the distal end 905 of the steam arm 902 by welding with a silver solder, and is provided with a thread by which a nozzle mount 920 (discussed below) can be secured in the steam arm 902. If desired the bracket 918 could be fixed to the steam arm 918 and/or the nozzle mount 920 by alternative means.

The distal end 905 of the steam arm 902 is provided with a moulded insulating sleeve 919. As described in the above embodiment, insulating sleeve 919 may be manufactured from nylon. Insulating sleeve 919 is secured in the end of the steam arm 902 (via a friction fit between the external wall of the arm 902, and the nozzle mount 920). If required the insulating sleeve 919 may be additionally or alternatively secured by an adhesive or other bond. The insulating sleeve 919 serves to both mount the temperature sensor 908 (discussed below) in place and insulate the temperature sensor 908 from steam flowing through the steam arm 902.

Insulating sleeve 919 is provided with a channel 921 which receives a stainless steel sensor sheath 922. The stainless steel sensor sheath 922 also passes through an aperture 917 in bracket 918, and carries the temperature sensor cable 923 with the temperature sensor 908 mounted at its end. As with the previous embodiment, the temperature sensor 908 is connected to a stainless steel plug 909 and is spaced transversely from the central axis of the steam wand. The stainless steel plug 909 transfers heat from the liquid to the sensor 908.

At the point where the sensor sheath 922 exits the aperture 917 in bracket 918, the sheath 922 is further covered by the sensor cable conduit 912. As can be seen, the sensor cable conduit 912 extends beyond the end of the sensor sheath 922, providing a cover for the temperature sensor cable 923 along the length of the steam arm 902. In this instance the sensor cable conduit 912 is a PTFE (Teflon™) tube which serves to

insulate the sensor cable 923, however alternative insulating/protective materials could be used.

The nozzle mount 920 is provided with an outer thread by which the mount 920 is secured to the bracket 918, and an inner thread for receiving the nozzle 904. In this instance the nozzle mount 920 is manufactured from brass, though alternative materials could be used (e.g. stainless steel, nylon, etc). The nozzle mount 920 defines a passage with a narrow duct receiving bore 924 (through which the steam duct 914 passes) and a threaded nozzle receiving bore 925 (for receiving the nozzle 904). In this particular embodiment steam duct 914 is a PTFE (Teflon™) tube fitted with a brass tube end 927.

The end of the steam duct 914 downstream of the duct receiving bore 924 passes through a silicone O-ring 928. Downstream of the O-ring 928 the steam duct 914 is further fitted with a brass annulus 932 that prevents the O-ring 928 from sliding off the steam duct 914, as well as preventing the steam duct 914 from passing back through the duct receiving bore 924. When the nozzle 904 is screwed into place, the end of the nozzle 904 bears against the brass annulus 932 which, in turn, deforms the O-ring 928 to seal the duct receiving bore 924.

As shown in figure 12, the nozzle receiving bore 925 of the nozzle mount 920 receives the nozzle 904, which is complementarily threaded. Nozzle 904 defines a stepped nozzle conduit 929. When the nozzle 904 is screwed into the nozzle mount 920 the larger diameter region of the stepped conduit accommodates the steam duct 914, with the end 927 of the steam duct 914 abutting the shoulder 930 of the step. The narrower diameter region of the step aligns with the end 927 of the steam duct 914, allowing steam flowing through the steam duct 914 to exit the nozzle 904.

The nozzle mount 920 and nozzle 904 are shaped such that when the nozzle 904 is screwed into the nozzle mount 920 an air gap 931 exists between the nozzle conduit 929 and the nozzle mount 920. This air gap 931 serves to further insulate the temperature sensor 908 from the flow of steam through the steam arm 902.

In use, steam to be vented through the steam wand 900 travels through the steam duct 914. By providing a separate steam duct 914 within the hollow steam arm 902 the both the external wall of the steam arm 902 and the sensor cable 923 (and cable conduit 912) is insulated from steam travelling through the steam wand 900. In the embodiment illustrated the steam insulation is achieved by the air-gap 911 between the steam duct 914 and the external wall/sensor cable 923 as well as by the material of the steam duct 914 itself. If desired, the air gap 911 may be partially or wholly filled with a further insulating material. This serves to insulate the temperature sensor cable 923 from noise that may otherwise be introduced by the passage of steam through the arm 902.

Additionally, by insulating the external wall of the steam arm 902 the arm 902 remains cooler during use and as such if touched during or after use, is less likely to injure/burn a user.

At the proximate end 907 the steam wand 900 of the present embodiment is connected to the beverage maker via cylindrical joint 906. Joints such as the cylindrical joint 906 are known in the art, and provide a connection that allows a limited range of angular movement of the steam wand 900 about a single axis only. The proximate end 907 of the steam wand 900 extends through the cylindrical joint 906, carrying both the steam duct 914 and the sensor cable conduit 912 (housing the temperature sensor cable 923) pass. This arrangement prevents either the steam duct 914 or the sensor cable conduit 912 from twisting, kinking, or being otherwise stressed during movement of the steam arm 900.

Upstream of the joint 906 the steam duct 914 is connected to the plumbing of the beverage maker such that steam is supplied directly into the steam duct 914, and the sensor cable 923 is connected, either directly or indirectly, to the controller 210.

If desired, an alternative joint (for example the ball joint 330 described in relation to the above embodiment) could be used to connect the steam arm 900 to the beverage maker. As a further alternative, the steam arm 900 could be fixedly connected to the beverage maker (i.e. in a static and unmovable position), rendering the requirement for a movable joint unnecessary.

It will be understood that the steam wand of the present invention may be used with alternative beverage makers than that described and depicted. The steam wand may, further alternatively, be provided as a stand-alone unit.

As a further alternative the temperature sensor 318 may be provided with a transmitter for wirelessly communicating with a receiver. In one embodiment the receiver may be adapted to communicate with a receiver controlled by controller 210, thereby avoiding the need for a sensor cable 320. In an alternative embodiment the transmitter may wirelessly communicate with a stand-alone receiver/display device which receives signals from the temperature sensor transmitter and provides a temperature read-out visible to a user. As will be appreciated this embodiment would allow a temperature sensing nozzle and receiver/display device to produced and sold, the nozzle capable of being retrofitted to existing steam wands/espresso makers.

It will be understood that the invention disclosed and defined in this specification extends to all alternative combinations of two or more of the individual features mentioned or evident from the text or drawings. All of these different combinations constitute various alternative aspects of the invention.

CLAIMS

1. A beverage maker including a steam generation means, a steam wand, and a control valve for controlling the passage of steam from the steam generation means to the steam wand, the steam wand including:

an arm;

a nozzle located at a distal end of the arm;

a steam duct defined within the steam wand through which, in use, steam from the steam generation means is vented, via the nozzle, into a liquid;

a temperature sensor for sensing the temperature of the liquid, the temperature sensor being transversely spaced from a central axis of the steam wand; and

an insulating member for insulating the temperature sensor from heat generated by steam travelling through the steam duct.

2. A beverage maker according to claim 1, wherein the steam wand includes an insulating air gap through which steam cannot flow, the air gap located between the temperature sensor and the steam duct.

3. A beverage maker according to claim 2, wherein the air gap is provided by at least one of a recess in the nozzle and a recess in the insulating member.

4. A beverage maker according to any one of claims 1 to 3, wherein the temperature sensor is mounted in the insulating member and, in use, in thermal communication with the liquid.

5. A beverage maker according to any one of claims 1 to 4, wherein the insulating member is an insulating sleeve surrounding and coaxial with the steam duct.

6. A beverage maker according to any one of claims 1 to 5, wherein the insulating member is mounted to the arm and defines a bore into which a stem of the nozzle is received, thereby mounting the nozzle to the insulating member, the bore defined by the insulating member being coaxial with the steam duct.

7. A beverage maker according to claim 6, wherein the bore defined by the insulating member and the stem of the nozzle are complementarily threaded to allow the nozzle to be removably screwed into the insulating member.

8. A beverage maker according to any one of claims 1 to 5, further including a threaded nozzle mount located at a distal end of the arm, the nozzle mount and nozzle being complementarily threaded to allow the nozzle to be removably screwed into the nozzle mount.

9. A beverage maker according to claim 8, wherein the insulating member defines a bore which receives the nozzle mount.

10. A beverage maker according to any one of claims 1 to 9, wherein an outer peripheral surface of the insulating member is flush with a peripheral surface of a head of the nozzle.

11. A beverage maker according to claim 10, wherein an outer peripheral surface of the arm is flush with the outer peripheral surface of the insulating member to provide a steam wand with a smooth and unbroken profile.

12. A beverage maker according to any one of claims 1 to 7, 10, or 11, wherein the insulating member is provided with an opening in which a thermally conductive plug is received, and wherein the temperature sensor is mounted in the thermally conductive plug.

13. A beverage maker according to any one of claims 1 to 12, wherein the temperature sensor is connected to a beverage maker controller by a sensor cable, the sensor cable passing through the insulating member and the arm.

14. A beverage maker according to claim 13, wherein the sensor cable passes through a sensor cable conduit, at least part of the sensor cable conduit being located within the arm.

15. A beverage maker according to claim 13 or claim 14, wherein a proximate end of the arm is connected to a joint mounted in the beverage maker, the joint allowing for movement of the arm, and wherein the sensor cable passes through the joint.

16. A beverage maker according to claim 15 when dependent on claim 14, wherein the sensor cable conduit passes through the joint.

17. A beverage maker according to claim 15 or claim 16, wherein the joint is a ball joint allowing for angular and rotational movement of the arm.

18. A beverage maker according to claim 15 or claim 16, wherein the joint is a cylindrical joint allowing for angular movement of the arm.

19. A beverage maker according to any one of claims 1 to 18 further including a temperature display for displaying the temperature sensed by the temperature sensor.

20. A beverage maker according to claim 19, wherein the temperature display is a dial display.

21. A beverage maker according to any one of claims 1 to 20 further including a parameter display for displaying one or more desirable beverage making parameters.

22. A beverage maker according to claim 21, wherein the parameter display is a dial display.

23. A beverage maker according to claim 21 or claim 22, wherein the beverage maker includes a flow sensor and the one or more beverage making parameters include a parameter relating to the flow-rate of liquid in the beverage maker.

24. A beverage maker according to any one of claims 21 to 23, wherein the beverage maker includes a pressure sensor, and the one or more beverage making parameters include a parameter relating to the pressure of liquid in the beverage maker.

25. A beverage maker according to any one of claims 1 to 24 further including a user interface operable by a user to vent steam from the steam wand, and wherein the beverage maker controller is adapted to terminate generation of steam through the steam wand if the temperature sensor senses that the liquid has exceeded a predetermined temperature.

26. A beverage maker according to claim 25, wherein a user may input a type of liquid via a user interface, the type of liquid input determining the predetermined temperature at which the controller will terminate generation of steam through the steam wand.

27. A beverage maker according to any one of claims 1 to 26, wherein the steam duct is defined by an external wall of the arm.

28. A beverage maker according to any one of claims 1 to 26, wherein the steam duct is not defined by an external wall of the arm.

29. A beverage maker according to claim 28, wherein the beverage maker further includes a steam insulation means for insulating the external wall of the arm from steam travelling through the steam duct.

30. A beverage maker according to claim 29 when dependent on claim 13 or claim 14, wherein the steam insulation means insulates the sensor cable from steam travelling through the steam duct.

31. A beverage maker according to claim 29 or claim 30, wherein the steam insulation means includes an air gap.

32. A beverage maker according to claim 29, 30, or 31, wherein the steam duct is formed of an insulating material and forms part of the steam insulation means.

33. A beverage maker according to claim 32, wherein the steam duct is manufactured from PTFE.

34. A beverage maker including a steam generation means, a steam wand, and a control valve for controlling the passage of steam from the steam generation means to the steam wand, the steam wand including:

an arm having an external wall;

a nozzle located at a distal end of the arm;

an internal steam duct defined within the steam wand through which, in use, steam from the steam generation means is vented, via the nozzle, into a liquid;

a temperature sensor for sensing the temperature of the liquid, the temperature sensor being transversely spaced from a central axis of the steam wand;

a steam insulation means for insulating the external wall from steam travelling through the steam duct.

35. A beverage maker according to claim 34, wherein the steam insulation means includes an air gap.

36. A beverage maker according to claim 34 or claim 35, wherein the internal steam duct is formed of an insulating material and forms part of the steam insulation means.

37. A beverage maker according to claim 36, wherein the internal steam duct is manufactured from PTFE.

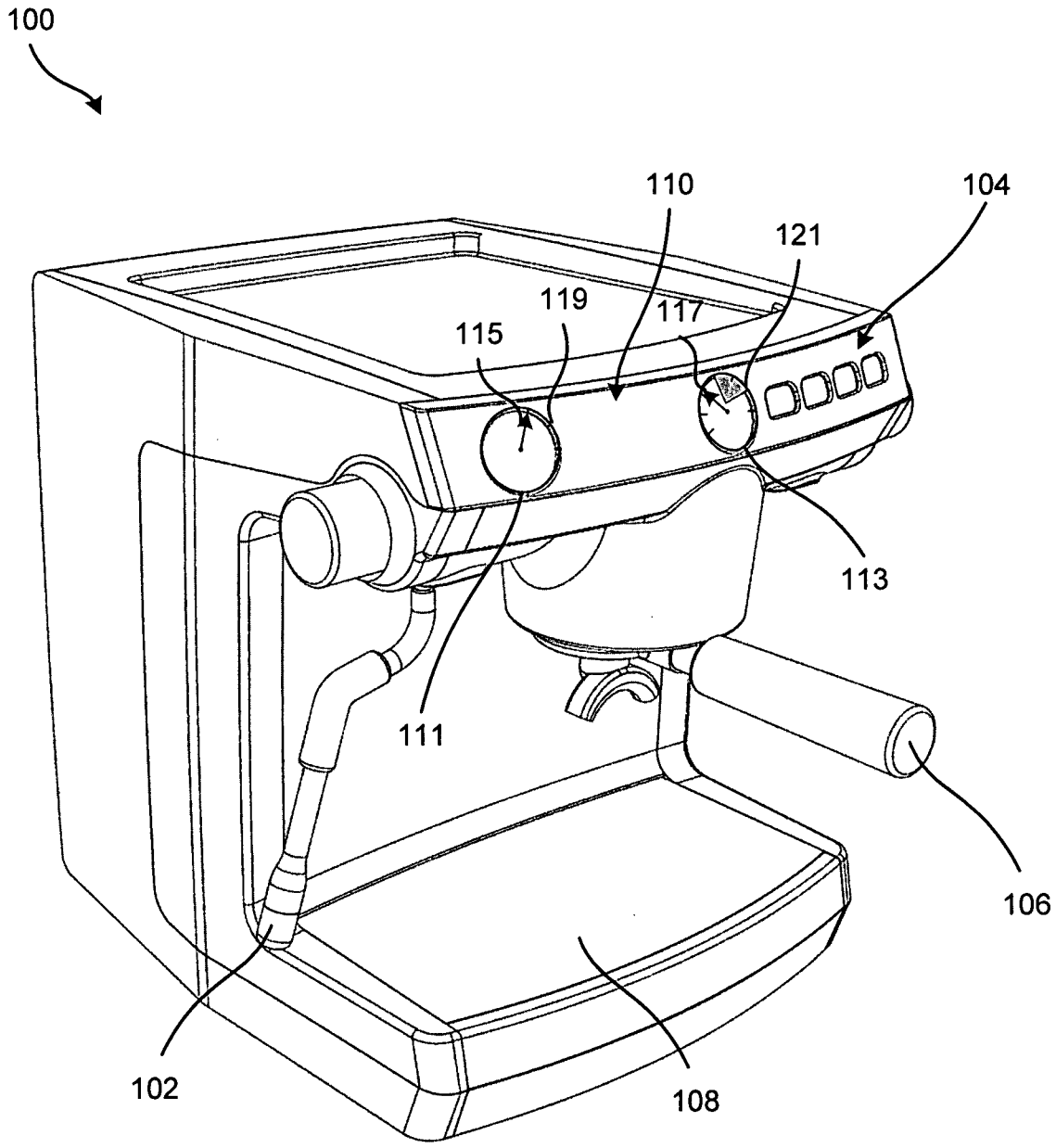

Figure 1

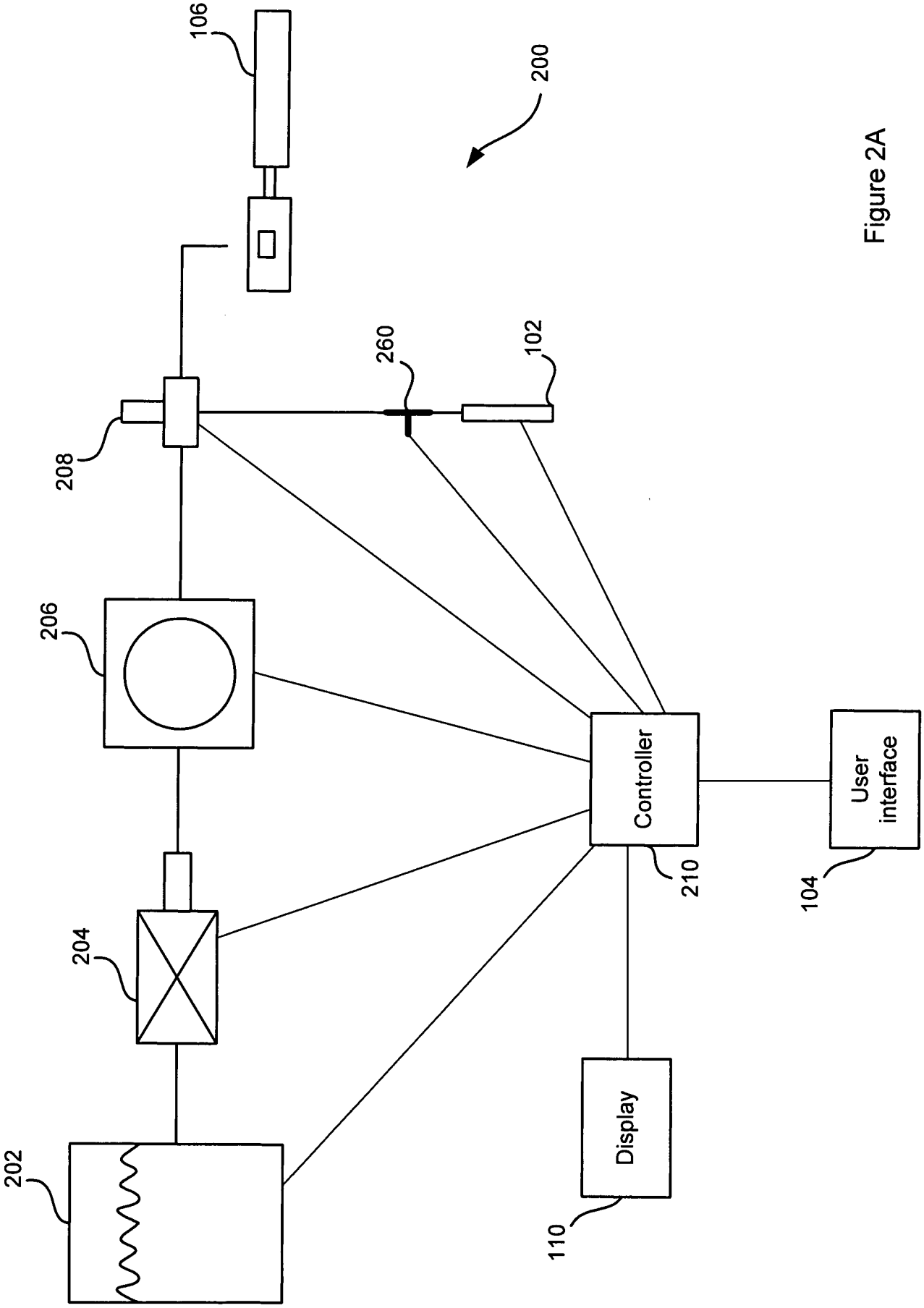
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Figure 2A

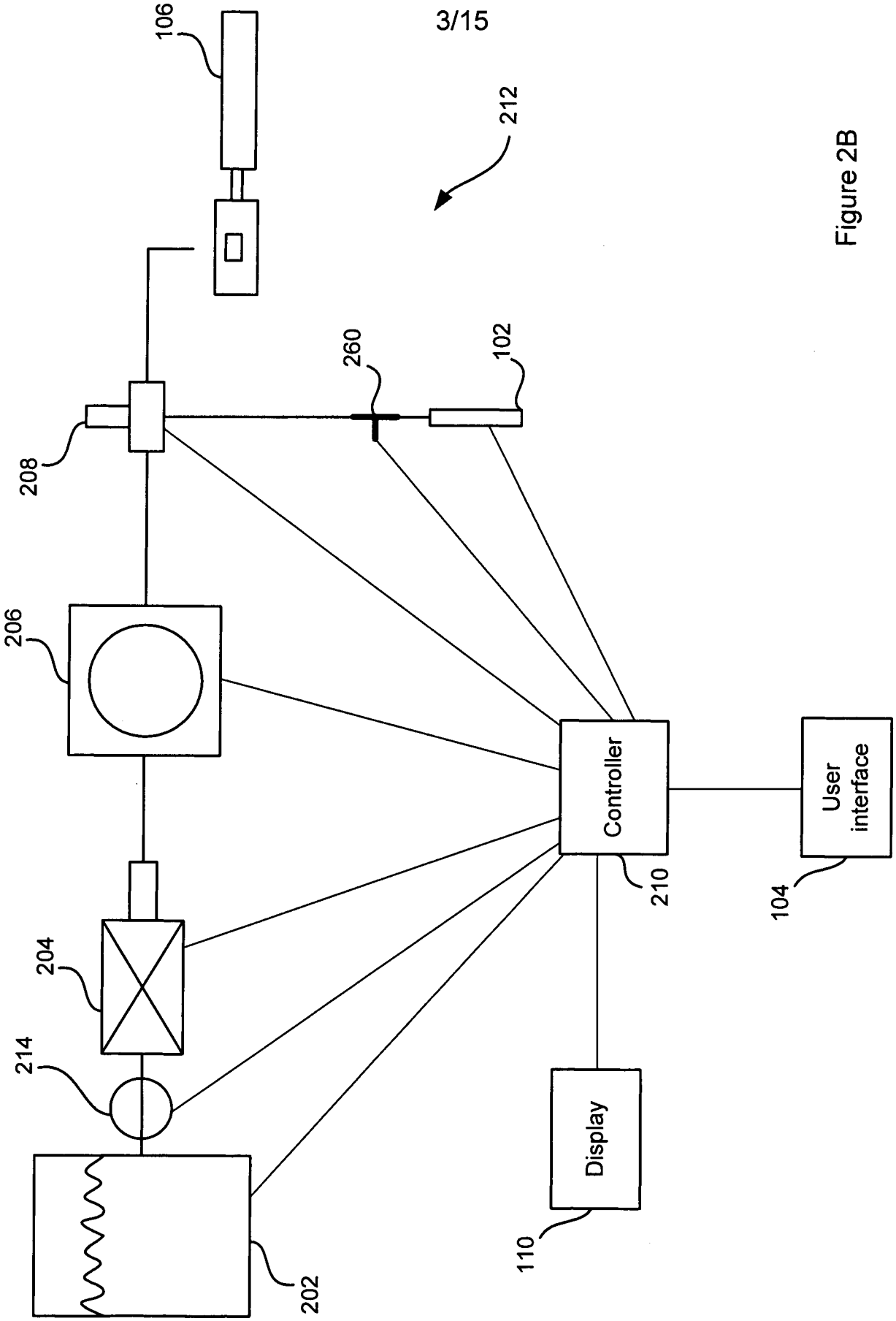
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Figure 2B

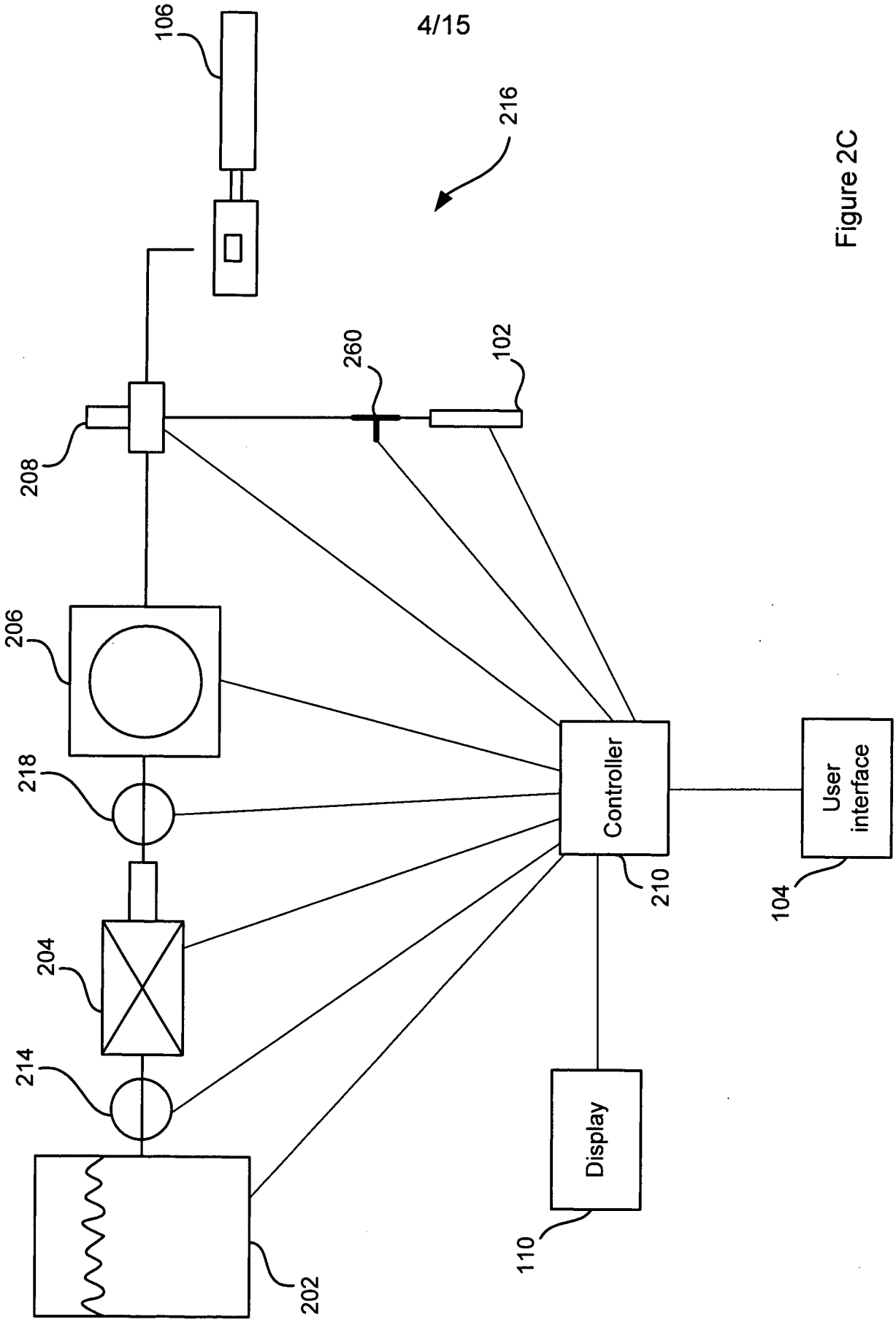
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Figure 2C

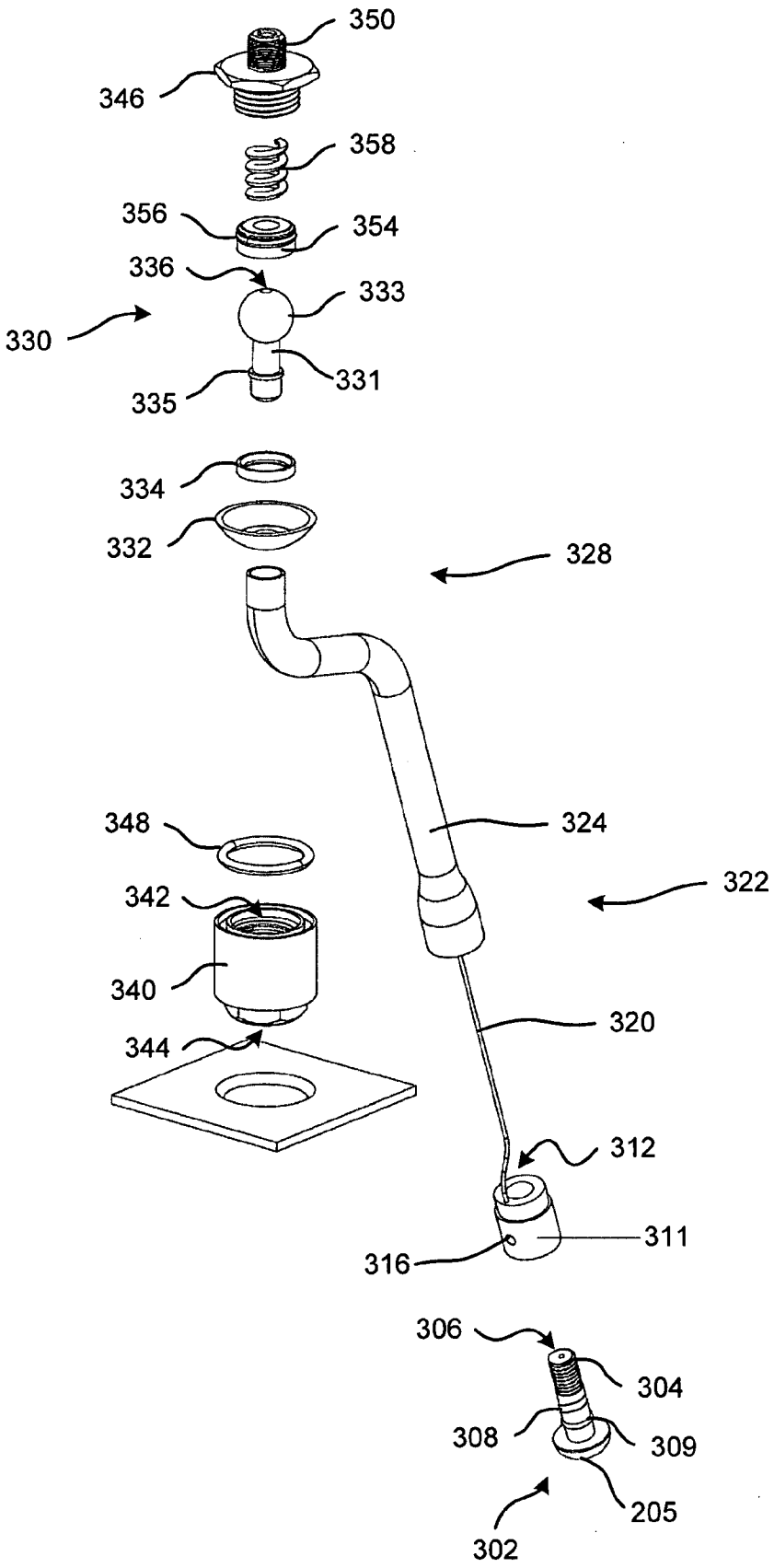
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Figure 3

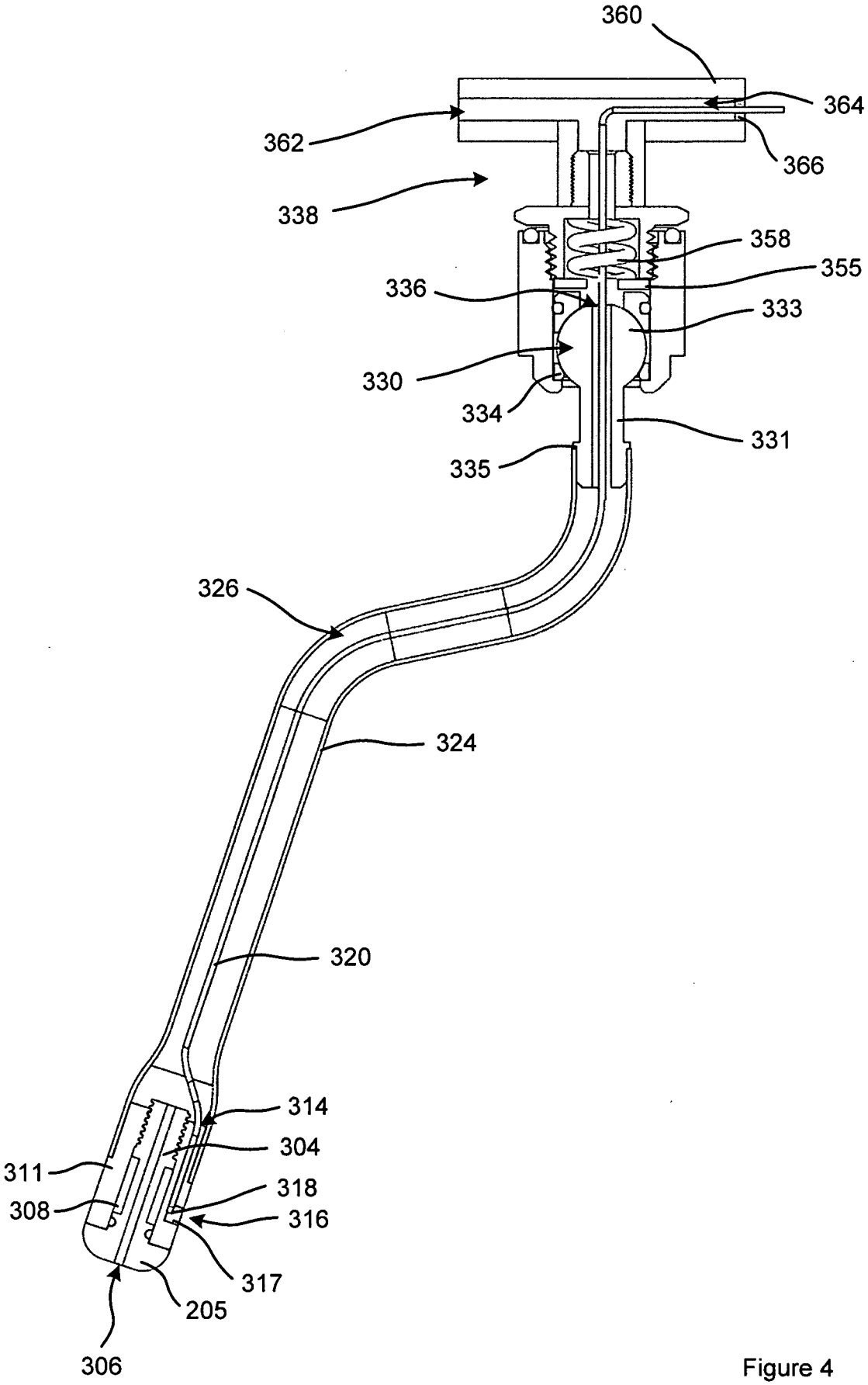
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Figure 4

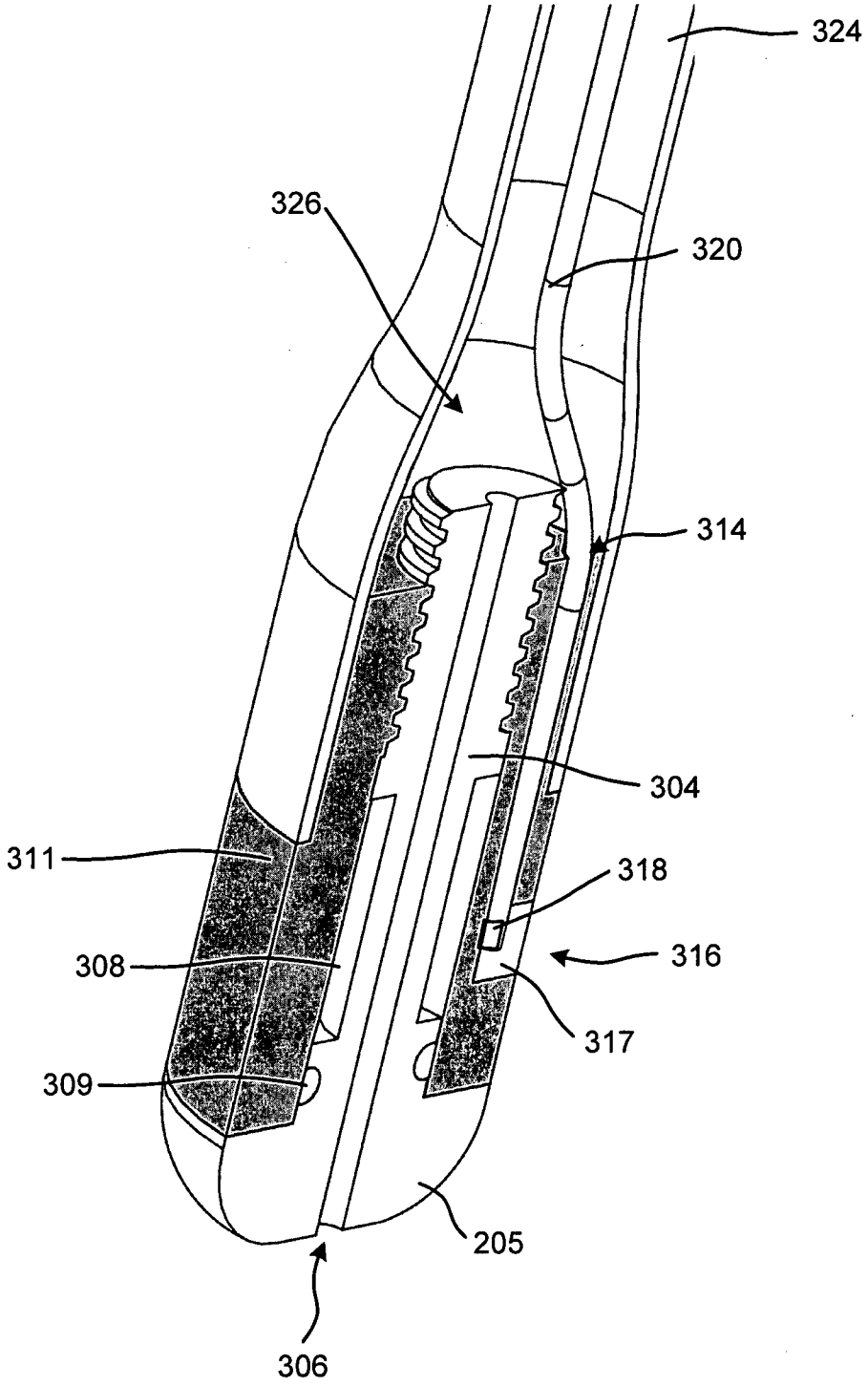

Figure 5A

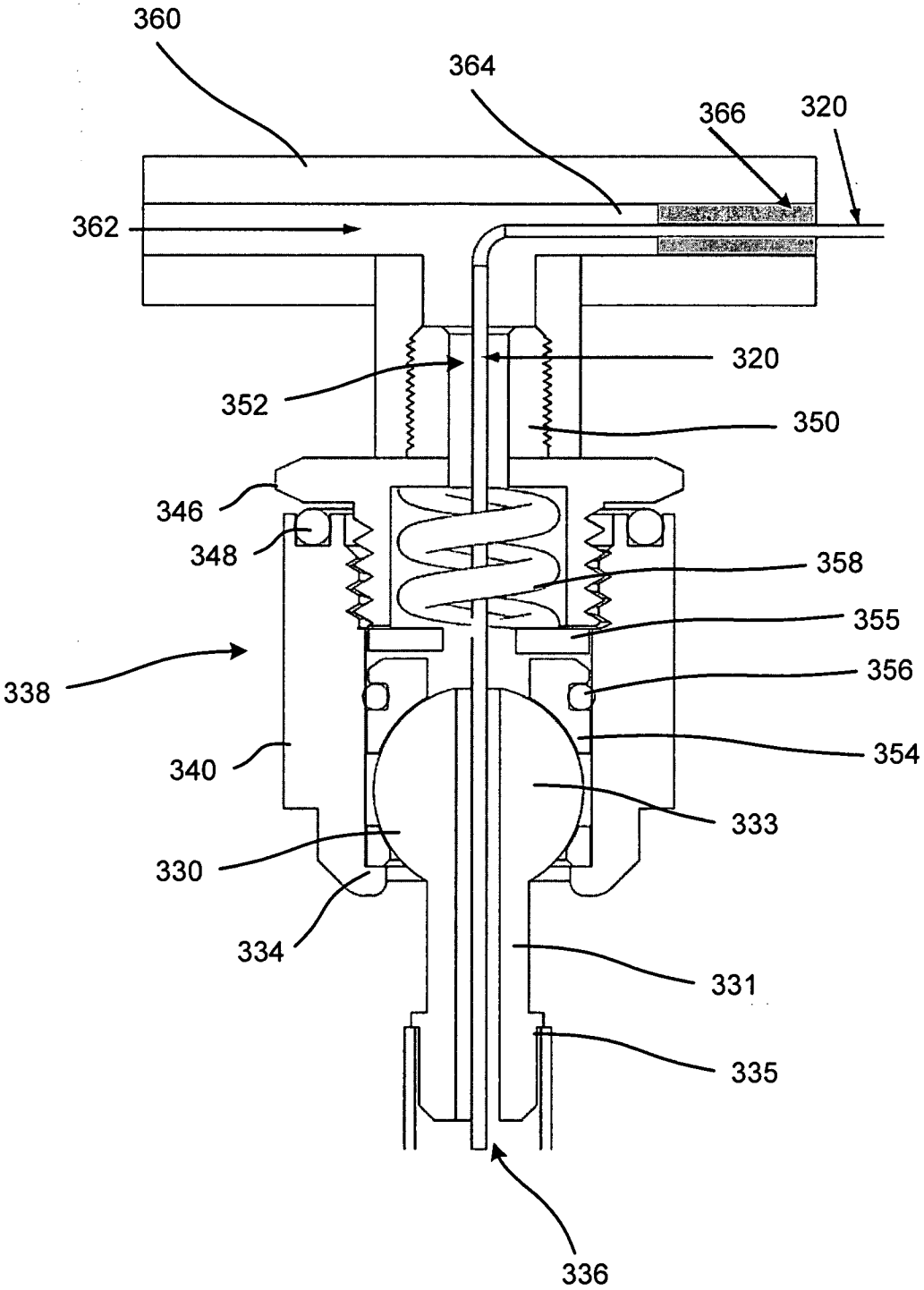
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Figure 5B

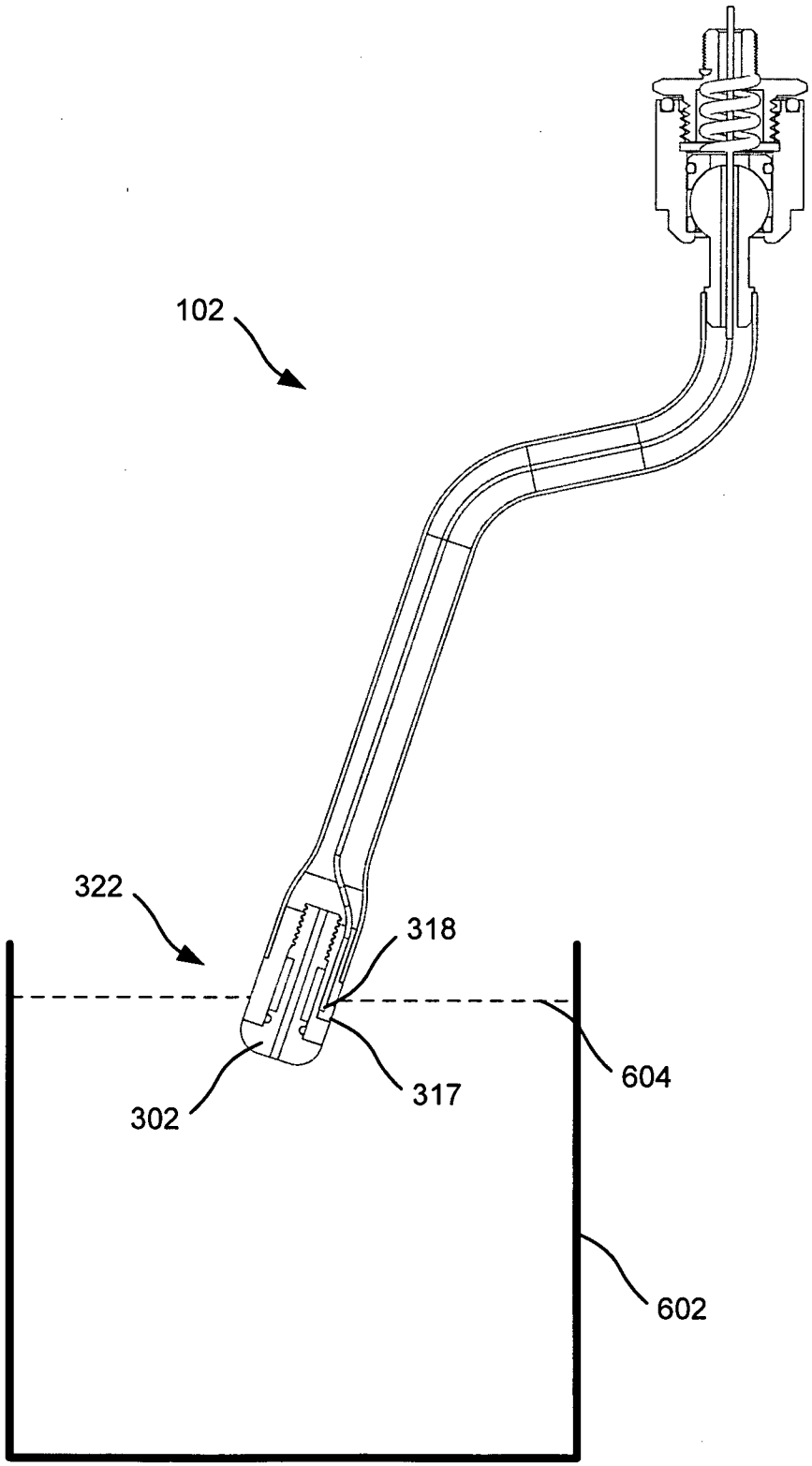

Figure 6

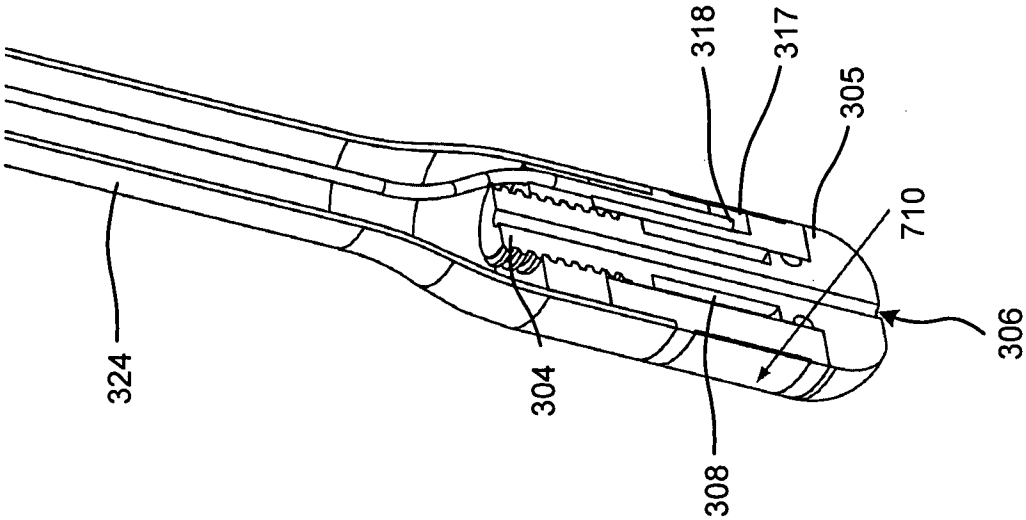

Figure 7B

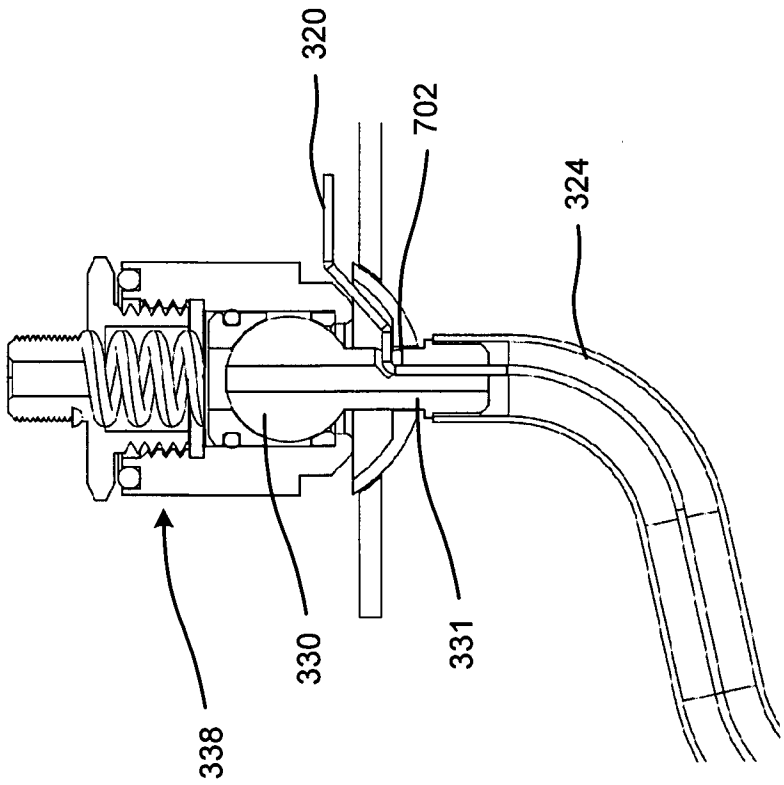

Figure 7A

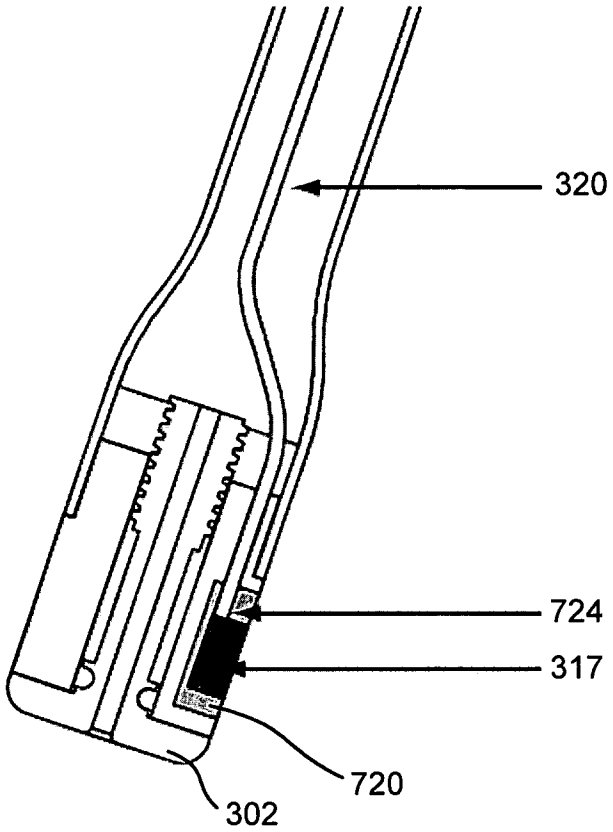

Figure 7C

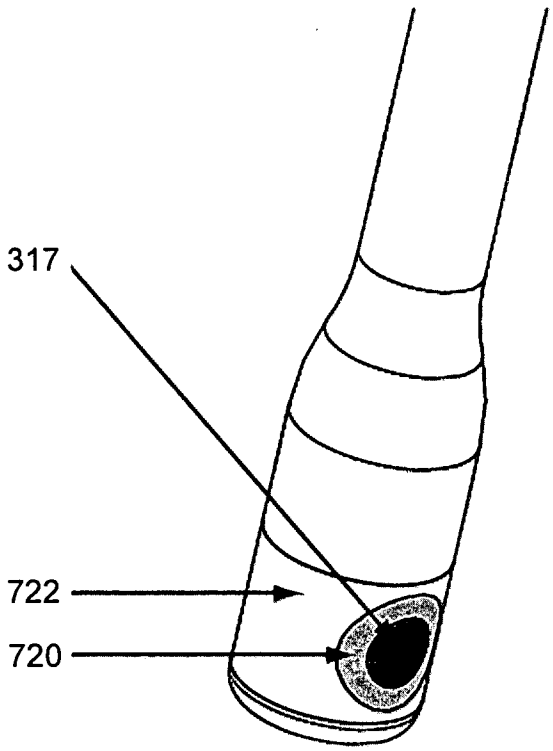

Figure 7D

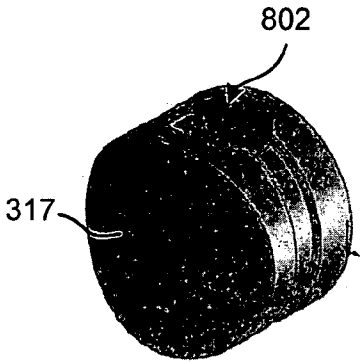

Figure 8A

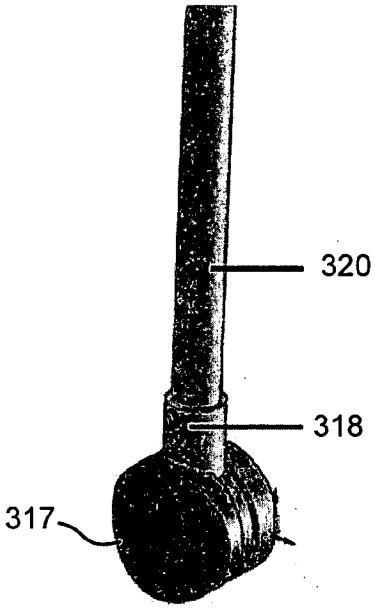

Figure 8B

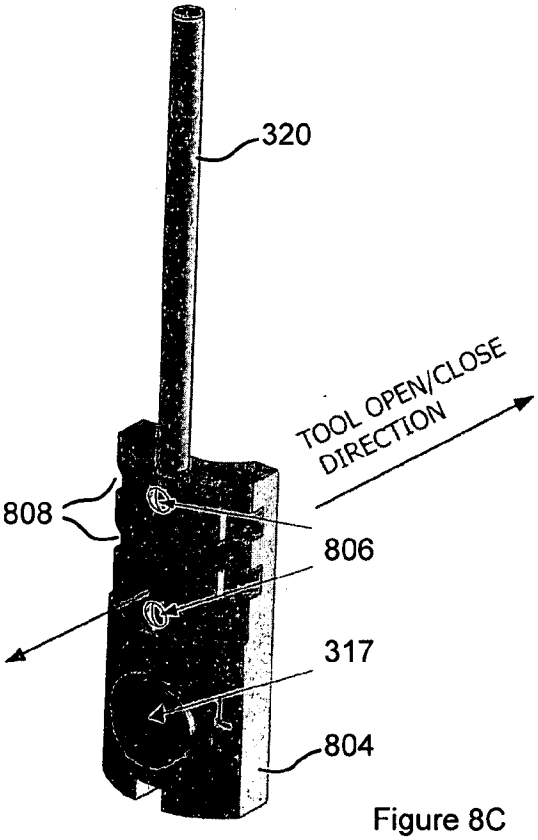

Figure 8C

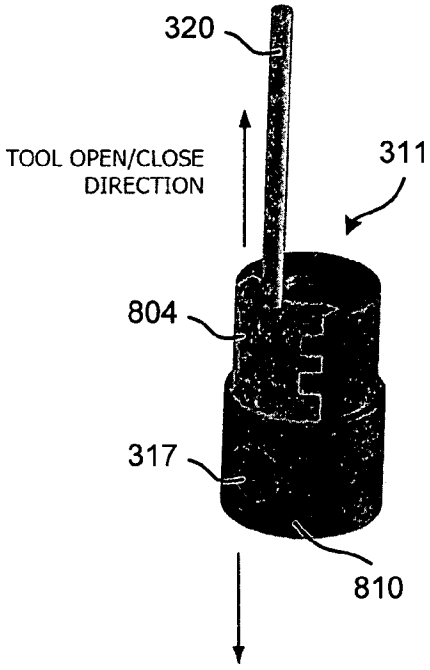

Figure 8D

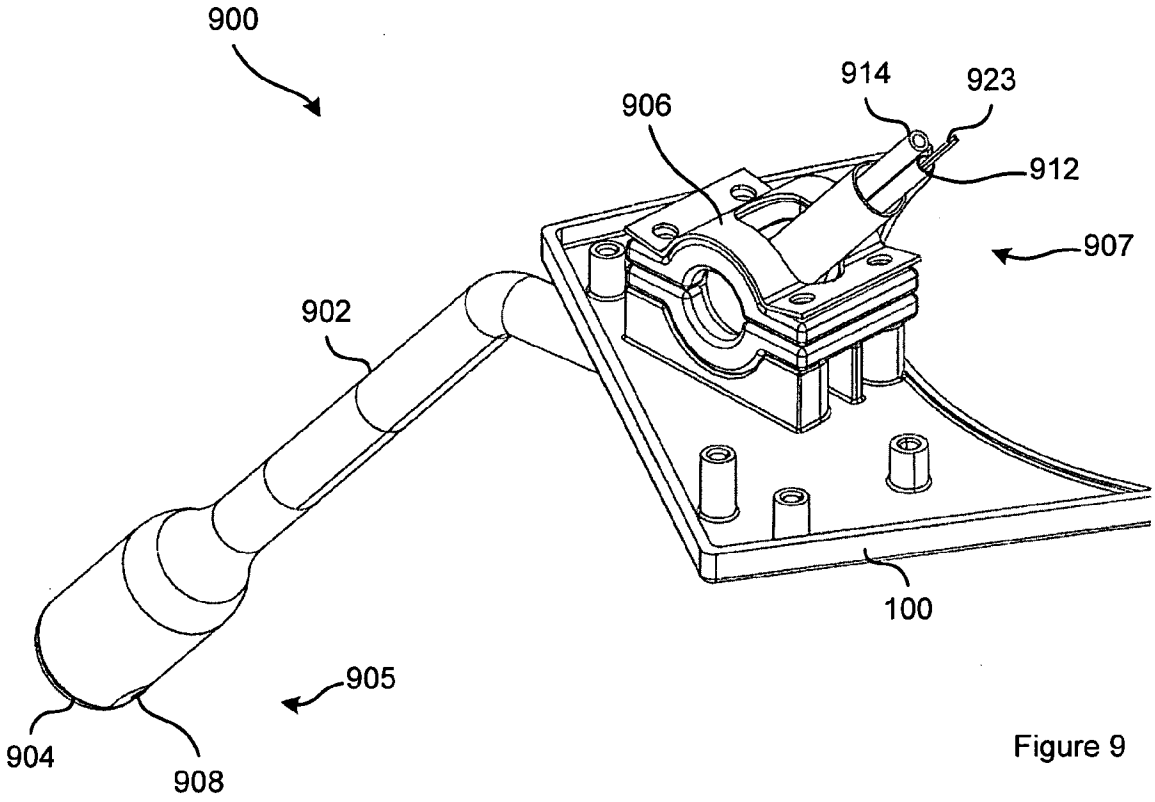

Figure 9

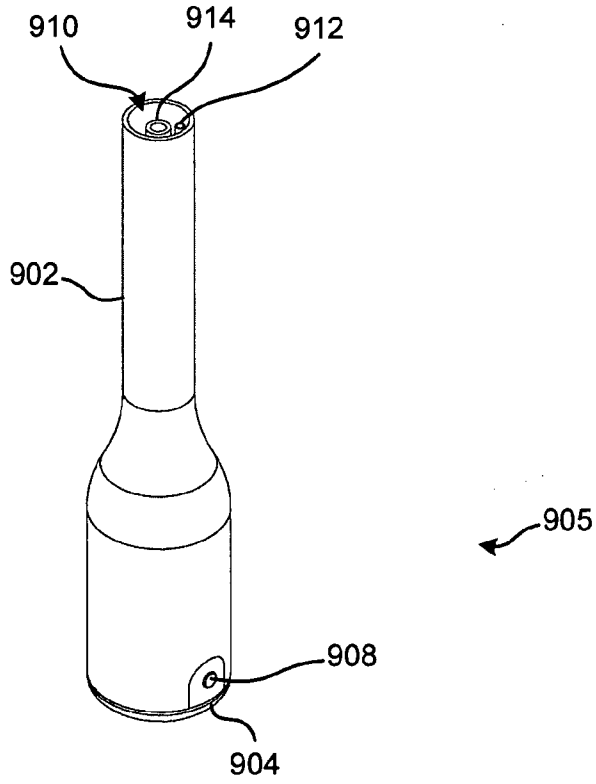

Figure 10

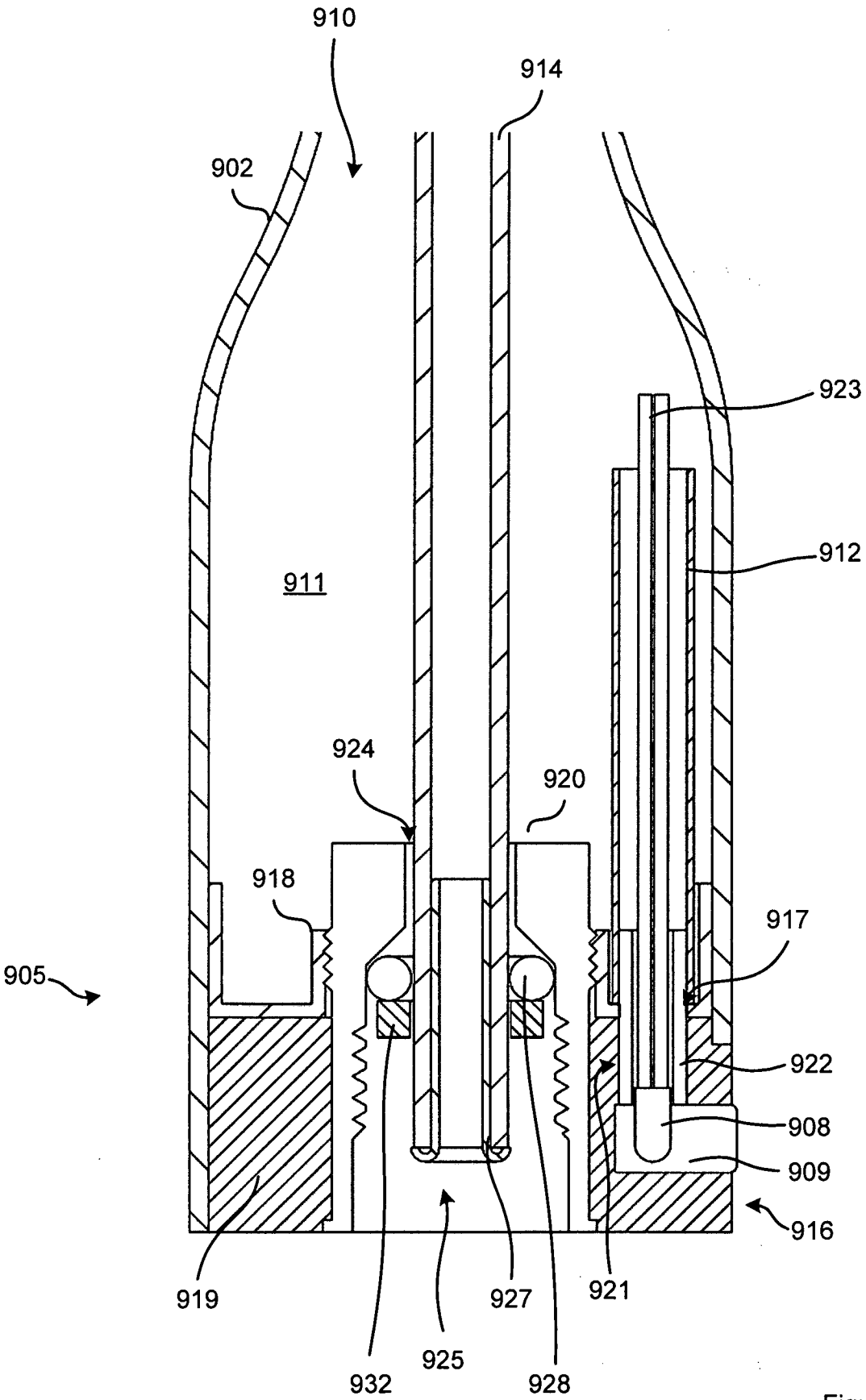
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Figure 11

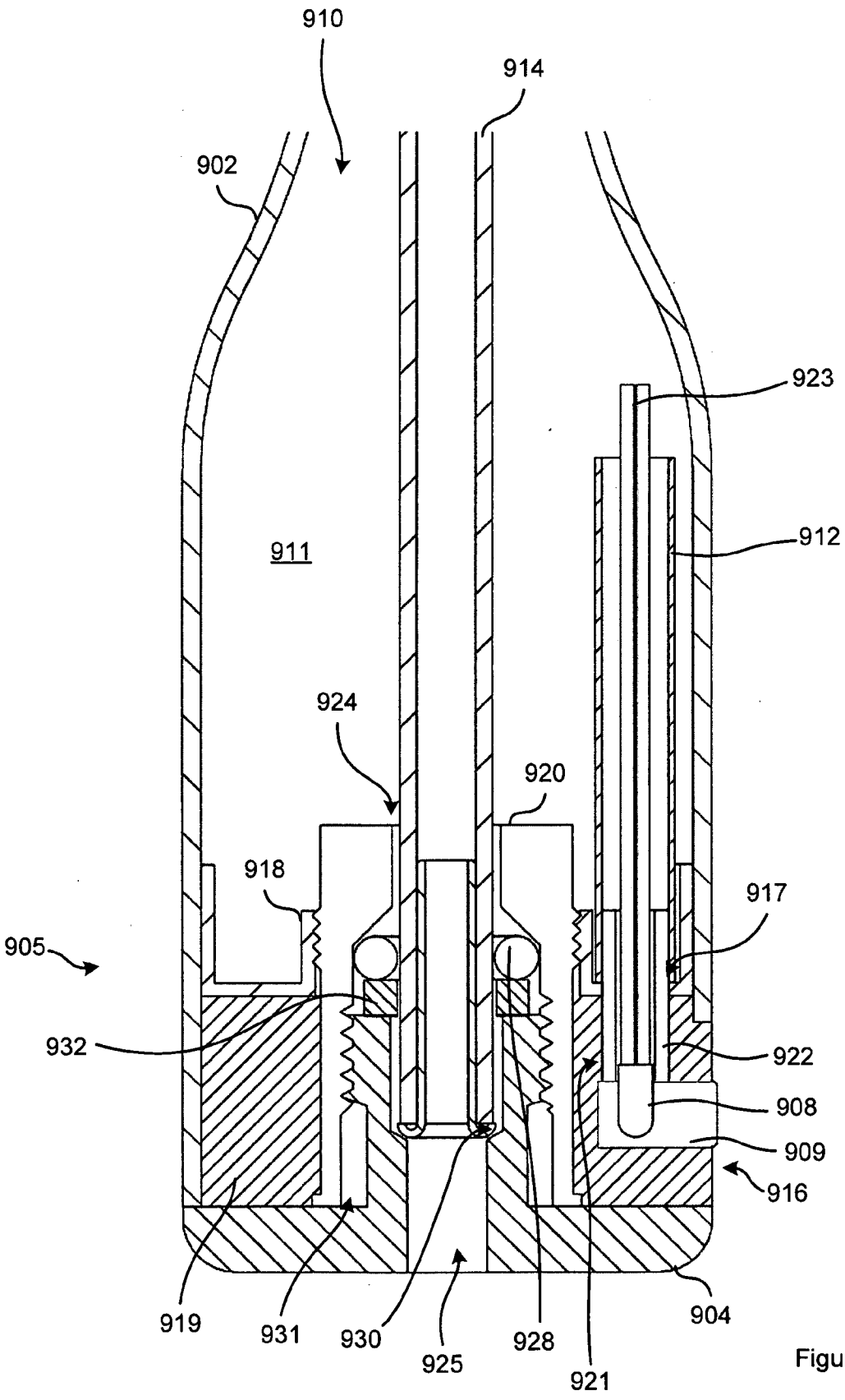
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Figure 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2010/000443

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

A47J 31/44 (2006.01)

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)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI/EPODOC - IPC/ECLA: A47J31 & Keywords (Temperature, thermal, heat, detect, sensor, measure, gauge, determine, thermometer, thermocouple, thermistor, thermostat, steam, wand, lance) & like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,Y X Y	WO 2004/089173 A2 (RANCILIO MACCHINE PER CAFFE SPA) 21 October 2004 abstract, figs 1-3, pg 3 last paragraph, pg 5 line 4-20, pg 8 line 22 to pg 9 line 17	1, 8, 19-27 4 5-6
X	WO 1991/003951 A1 (SELSYS CORPORATION) 4 April 1991 abstract, figure 1, pages 3-4	1-9, 12-26, 28-37
Y	WO 1990/014774 A1 (SELSYS CORPORATION) 13 December 1990 figure 1, abstract, page 1, 2nd last paragraph to page 2, 3rd paragraph	1, 5-6, 8, 19-27

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"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

"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

Date of the actual completion of the international search
16 June 2010

Date of mailing of the international search report
18 JUN 2010

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
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Facsimile No. +61 2 6283 7999

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2010/000443

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1949829 A1 (RANCILIO MACCHINE PER CAFFE SPA) 30 July 2008 abstract, figure 1, paragraphs 25-40	1-37
A	WO 1994/023623 A2 (SEATTLE ESPRESSO MACHINE COMPANY) 27 October 1994 abstract, figures 1, 4-5, page 10, line 8 to page 11, line 33	1-37

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2010/000443

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	2004089173	AU	2004228777	CN	1771001	EP	1610658
		US	2006272516	US	7487711		
WO	9103951	AU	59417/90				
WO	9014774	AU	58225/90				
EP	1949829	AU	2008208629	CN	101588741	US	2010047407
		WO	2008090482				
WO	9423623	AU	66348/94	US	5372061		

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX