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(54) Washing machine pump

Waschmaschinenpumpe

Pompe de machine à laver

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(56) References cited:
EP-A1- 0 597 508
WO-A1-03/005875
GB-A- 858 694
US-A- 2 864 312
US-A1- 2003 051 514

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Description

[0001] The present invention generally relates to the field of household appliances. More specifically, the present invention relates to laundry washing machines and laundry washing/drying machines, both for domestic and professional use.

[0002] Laundry washing and washing/drying machines (hereinafter simply referred to as "washing machines") are household appliances designed to wash laundry and typically comprise a washing tub housing a rotatable drum in which the laundry to be washed can be loaded/unloaded.

[0003] In order to carry out washing operations on laundry loaded into the drum, washing liquid (e.g., water, water mixed with washing products and/or water mixed with rinsing products) is introduced - through an inlet line - in the washing tub of the washing machine during a washing liquid loading phase. Being the drum perforated, the washing liquid penetrates thereinto, soaking the laundry.

[0004] Then, a washing phase is started in which the drum is rotated, so that the laundry loaded into the drum is washed thanks to the chemical reactions exerted by the washing liquid, and to the mechanical action exerted by the tumbling action caused by the rotation of the drum.

[0005] At the end of the washing phase, the washing liquid (which is at this point mixed with dirt particles removed from the laundry) is drained from the washing tub for allowing the carrying out of rinsing and/or spin-drying operations on the laundry.

[0006] For this purpose, the washing machine is provided with a discharge system adapted to selectively drain the washing liquid from the washing tub. In some kind of known washing machines, the discharge system comprises a discharge duct for receiving washing liquid from the washing tub. For this purpose, the discharge duct is fluidly coupled with the washing tub through a discharge hole provided at the bottom of the washing tub. A drain pump, usually positioned downstream the discharge duct, is operable to cause the washing liquid located into the discharge duct to be discharged through a drain duct adapted to be connected to the water drain network system.

[0007] In some different kinds of washing machines, the discharge pump is directly connected to the washing tub (e.g. the pump chamber, or a part thereof, can be obtained in a single piece construction with the washing tub), in which case the discharge duct is not provided and the water goes directly from the washing tub to the discharge pump.

[0008] Some known washing machines are also provided with a recirculation system which, during the washing liquid loading phase and/or washing phase and/or rinsing phase, takes some liquid from the bottom of the tub, and reintroduces this liquid into a different region of the washing tub, or directly into the drum, so as to deliver the liquid to the laundry from more than one directions, and not only from the bottom of the tub; this allows a better wetting of the laundry, and therefore using a smaller amount of liquid during the above mentioned phase(s).

[0009] According to a solution known in the art, the recirculation system comprises a recirculation conduit fluidly coupled with a bottom region of the washing tub, and a recirculation pump, usually positioned downstream the discharge duct in parallel with the drain pump, which is operable to cause the washing liquid located into the discharge duct to be reintroduced into the washing tub through the recirculation conduit. The recirculation conduit feeds one or more nozzles arranged to spray the recirculated washing liquid into the washing tub, for example directly inside the drum.

[0010] According to this solution, when the recirculation pump is active and the drain pump is off, washing liquid is taken from the discharge duct and sprayed back into the drum; when the recirculation pump is off and the drain pump is active, washing liquid located in the discharge duct is instead discharged through the drain duct. This solution is quite expensive, since it provides for two dedicated pumps, *i.e.*, the drain pump and the recirculation pump. Moreover, since such two pumps have to be installed in parallel with each other downstream the discharge duct, the installation thereof is quite time consuming and it also disadvantageously reduces the space available in the washing machine for housing other hydraulic, mechanic and/or electric apparatuses of the washing machine.

[0011] GB 858694 discloses a washing having an electric motor-driven pump for circulating washing- liquid from and to a tub. An impedance is inserted into the motor circuit to reduce the motor speed when the pump is used for draining the tub. The impedance is preferably a resistor but could be an inductor or capacitor. A valve for changing from circulation to draining is operated by a control-shaft which also operates a switch controlling the impedance. The switch has four positions: A-circuit open; B-a water heater with safety switch energized ; C-pump motor energized under control of a timer; D-impedance in circuit with pump motor. In positions A and B valve is closed, in position C valve directs water to a nozzle, and in position D water is discharged through a hose. The heater is mounted in a cylindrical well separated from a generally square tub by a strainer having a perforated annular section.

[0012] WO 03/005875 relates to a dishwasher comprising spraying arms and a circulating pump, which has an impeller, an intake fitting and at least one pressure joint on the pump casing. The dishwasher also comprises a water branching, which is provided on the pump pressure side and serves to produce a flow-through from an inlet to an outlet that can be selected from a number of outlets assigned to the spraying arms. The water branching comprises a blocking element having at least one aperture, which can be positioned by a drive device into at least one discharge position. The aim of the invention is to obtain a high hydraulic efficiency of the flow system circulating pump / water branching in a dishwasher of the

aforementioned type. To this end, the water branching is integrated in the circulating pump in such a manner that the inlet of the water branching is formed by the intake fitting of the circulating pump, and the outlet of the water branching is formed by a number of pressure joints of the circulating pump. In addition, the dimensions and arrangement of the blocking element inside the circulating pump are provided in such a manner that the desired discharge position is achieved by rotating the blocking element in its peripheral direction. These measures permit the hydraulic efficiency of the waterways, particularly that of the circulating pump, to be held constant and to obtain a nearly equal structural volume and dead volume like those of a circulating pump that does not have a water branching. No additional structural volume is to be provided inside the appliance since the same piping as provided in a conventional pump can be used.

[0013] EP 597508 discloses a filter and flow-diverter unit for a washing machine with recirculation. The filter and flow-diverter unit comprise a cylindrical body which has at least three fluid inlet/outlet connectors and which is open at the front in order to house a removable filter element forming a flow path between a first connector of the body and an internal connector of the removable element, the body also housing a diaphragm controlled by an actuator which closes and opens a second connector of the body and the connector of the removable element in a mutually exclusive manner.

[0014] US 2864312 discloses a centrifugal pump comprising a casing defining a cylindrical pump chamber, a laterally disposed housing having a space therein, a pair of substantially diametrically spaced outlet passages joining said chamber and said space and arranged tangentially with respect to said chamber, a valve seat at the entrance of each of said passages into said space, a conduit extending from said space adjacent each of said valve seats, an impeller for rotation within said chamber, one of said passages confronting flow within said chamber for one direction of rotation of said impeller, the other of said passages confronting flow within said chamber for the other direction of rotation of said impeller so that the fluid pressure is higher in said one passage for said one direction of rotation and in said other passage for said other direction of rotation, an axial inlet through which fluid enters said chamber, a pair of valves mounted within said space for movement to and from said valve seats respectively, said valves being operable by the pressure developed by said pump in said passages so that one valve is unseated during rotation of said impeller in one direction and the other valve is unseated during rotation of said impeller in the other direction, and force transmitting means arranged between said valves in said space for producing mutual movement thereof, said force transmitting means comprising a body of flowable material confined in said space between said valves in contact with each valve whereby the unseating of either valve causes the seating of the other valve.

[0015] US 2003/051514 relates to a washing machine, which is capable of forcibly circulating water from the lower portion of a washing tub to the upper portion of the washing tub, thereby enabling circulation washing of the laundry. The washing machine includes a casing, a washing tub, an arrangement for holding the washing tub in the casing and an arrangement for forcibly circulating washing water. The washing tub is mounted in the casing. The holding arrangement serves to allow the washing tub to be positioned to be inclined at a predetermined angle with regard to a vertical axis. The water circulating arrangement forcibly circulates washing water from a bottom of the washing tub to a top of the washing tub and is extended from the bottom of the washing tub to the top of the washing tub.

[0016] The aim of the present invention is therefore reducing the production/assembly costs of laundry washing machines provided with a recirculation system.

[0017] Within this aim, a further object of the invention is reducing the overall dimensions of the recirculation system of a laundry washing machine, so as to increase the space available for housing other hydraulic, mechanic and/or electric apparatuses of the washing machine.

[0018] Applicant has found that by using a pump operable to selectively cause washing/rinsing liquid located into the washing tub of the machine to be discharged outside the machine or to be conveyed back into the washing tub, the pump comprising a pump chamber for receiving washing/rinsing liquid from the washing tub and a diverter element movably arranged in the pump chamber and movable between a first position, in which it causes washing liquid in the pump chamber to be recirculated, and a second position, in which the diverter element causes washing liquid in the pump chamber to be drained outside the machine, it is possible using a single pump both for recirculating and for draining the washing/rinsing liquid, which allows reducing the production/assembly costs of the machine. In addition, since the diverter element is arranged in the pump chamber, the pump keeps a very compact structure, which allows reducing the overall dimensions of the recirculation system.

[0019] The present invention proposes a laundry washing machine as defined by the features of the independent claim.

[0020] In the proposed washing machine, the diverter element is moved from the outside of the pump body by means of an actuator system that does not directly contact the diverter element itself. Indeed, with the proposed solution the actuator system has not to reach the inside of the pump chamber for contacting the diverter element, the magnetic coupling therebetween being contactless. Therefore, the proposed solution allows to avoid liquid from leaking from the actuator system/diverter element coupling, since the magnetic coupling allows to transmit the motion between two elements that are already hydraulically insulated without the need of any additional gasket elements, such as O-rings or other watertight elements.

[0021] According to an advantageous embodiment of

the present invention, one between the actuator system and the diverter element comprises at least one magnetic member, and the other one between the actuator system and the diverter element comprises at least one magneto-responsive member.

[0022] For the purposes of the present description, with "magnetic member" it is meant any element able to generate a magnetic field - such as a permanent magnet -, and with "magnetic-responsive member" it is meant any element capable of magnetically interacting with the magnetic filed generated by a magnetic member - such as a ferromagnetic material element, a ferrite element or a permanent magnet - in such a way to be attracted/repulsed toward/by said magnetic member.

[0023] According to the present invention, the actuator system is operable to move, from the outside of the pump body, said diverter element between said first and second position through a contactless magnetic coupling between said at least one magnetic member and said at least one magneto-responsive member.

[0024] Preferably, said pump comprises an input port connected to said washing tub, a drain output port connected to said drain duct, and a recirculation output port connected to said recirculation conduit. Said washing tub, said drain duct and said recirculation conduit are adapted to be brought in fluid communication with said pump chamber through said input port, said drain output port and said recirculation output port, respectively. Said diverter element is arranged in such a way to block said recirculation output port and to keep opened said drain output port when in said first position, and to block said drain output port and to keep opened said recirculation output port when in said second position.

[0025] According to a preferred embodiment of the present invention, said diverter element comprises a hollow member provided with an input opening facing said input port, and a further opening arranged in such a way to face said drain output port when said diverter element is in the first position, and to face the recirculation output port when said diverter element is in said second position.

[0026] According to the present invention, said diverter element is rotatably arranged in said pump chamber and it is movable in said first and second positions by rotation. Said actuator system comprises a rotatable transmission element rotatably fitted around an external surface of the pump body, the at least one between said at least one magnetic member and said at least one magneto-responsive member comprised in said actuator system being located on said rotatable transmission element.

[0027] Said actuator system is operable to rotate the rotatable transmission element so as to cause a corresponding rotation of the diverter element between said first and second position by contactless magnetic coupling between said at least one magnetic member comprised in one between said rotatable transmission element and said diverter element, and said at least one magneto-responsive member comprised in the other between said rotatable transmission element and said diverter element.

[0028] According to a preferred embodiment of the invention, said rotatable transmission element comprises one or more first seats, each one adapted to house a respective magnetic member or a respective magneto-responsive member, and said diverter element comprises one or more second seats each one adapted to house a respective magnetic member or a respective magneto-responsive member.

[0029] According to another embodiment of the present invention, said actuator system comprises an electric motor coupled to the rotatable transmission element and operable to rotate the rotatable transmission element when activated.

[0030] According to an advantageous embodiment of the present invention, the actuator system comprises a linearly movable element operable to be moved along a linear direction between a retracted position and an extended position, and having teeth that mesh with corresponding teeth provided on said rotatable transmission element for converting the linear movement of said linearly movable element into a corresponding rotational movement of said rotatable transmission element.

[0031] According to an advantageous embodiment of the present invention the washing machine comprises an electronic control system configured to control said actuator system in such a way to selectively position said diverter element in said first or in said second position, according to the phase of the specific washing program selected by the user which is being performed.

[0032] These, and others, features and advantages of the solution according to the present invention will be better understood by reading the following detailed description of some embodiments thereof, provided merely by way of exemplary and non-limitative examples, to be read in conjunction with the attached drawings, wherein:

Figure 1 is a schematic front view of a washing machine in which embodiments of the present invention may be implemented;

Figure 2A is a perspective view of a pump of the washing machine of Figure 1 according to an embodiment of the present invention;

Figure 2B is a partially exploded view of the pump of Figure 2A;

Figures 2C-2E are cross-sectional views of the pump of Figures 2A and 2B; and

Figure 3 is a perspective view of the pump of Figures 2A-2E when installed in a basement element of the washing machine of Figure 1

[0033] With reference to the drawings, Figure 1 is a front view of a washing machine 100 in which embodiments of the present invention may be implemented.

[0034] The washing machine 100 is a machine for treating (washing, or washing/drying) laundry of the front-loading type. Anyway, it should be apparent from the following description that the inventions can be applied,

without any substantial modification, to a washing machine of the top-loading type.

[0035] In the example at issue, the washing machine 100 advantageously comprises a casing 105, preferably substantially parallelepiped-shaped, that encloses a washing tub 107 wherein laundry is treated, along with any other components of the washing machine 100 necessary for the operation (e.g., hydraulic, electronic and electromechanical apparatuses known in the art and, therefore, not herein described for sake of conciseness). The washing tub 107 has preferably a substantially cylindrical shape and it is made of waterproof material which is also able to withstand operating temperatures and chemicals reactions promoted by washing liquids during the washing machine operation, such as a plastic polymer.

[0036] The washing tub 107 houses a rotatable drum 110, preferably perforated, preferably substantially cylindrical-shaped, in which laundry 112 to be washed can be loaded.

[0037] In order to allow a user to access the washing tub and the inside of the drum 110 (for loading/unloading the laundry), a loading/unloading opening, closable by a door, not illustrated, is advantageously provided, preferably on a front side of the washing machine 100.

[0038] A water supply system 120 and a detergent supply system 122 are arranged preferably in the upper part of the washing machine 100 for supplying washing liquid into the washing tub 107. The detergent supply system 122 advantageously comprises a removable drawer 123 provided with compartments suited to be filled with washing and/or rinsing products.

[0039] Water flowing through the water supply system 120 is advantageously supplied into the washing tub 107 by making it flow through the drawer 123 and through an inlet line 125 in fluid communication with the washing tub 107. Advantageously, the water supply system 120 further comprises a main pipe 130 fluidly connecting the drawer 123 to an external water supply line 135, preferably by means of a controlled input supply valve 140.

[0040] Washing liquid which reaches the washing tub 107 may selectively contain one of the products (e.g. detergent, softener, bleach) contained in the compartments of the drawer 123, or may be clean water (*i.e.*, which does not contain any product), depending on the washing program which is actually performed. Alternative arrangements may be provided, for example with a separate water inlet line adapted to supply exclusively clean water into the washing tub 107.

[0041] The washing machine 100 is provided with a discharge system 145 adapted to selectively remove (or drain) washing/rinsing liquid from the washing tub 107.

[0042] The discharge system 145 comprises a discharge duct 150 fluidly connected to the washing tub 107 for receiving the washing/rinsing liquid to be discharged. The discharge duct 150 may be made of a rigid material, such as plastic. Anyway, in a further advantageous embodiment, the discharge duct 150 may be a flexible hose, for example made of a flexible material, such as rubber. The discharge duct 150 is arranged to be, preferably selectively, in fluid communication with the washing tub 107 through a discharge hole 155 provided at the bottom of the washing tub 107. Preferably, a valve 160 is provided for selectively opening/closing the discharge hole 155, in order to selectively allow/block liquid to flow between the washing tub and 107 the discharge duct 150. Downstream the valve 160, an anti-fluff / anti-clog filter 165 is preferably provided.

[0043] Downstream the anti-fluff / anti-clog filter 165, a pump 170 is provided, which is operable to selectively cause liquid located into the discharge duct 150 to be discharged through a drain duct 175 adapted to be connected to a water drain network system (not illustrated), or to be conveyed back into the washing tub 107 through a recirculation conduit 180, preferably for being sprayed inside the drum 110, *e.g.*, by means of nozzle(s) 185 located on the drum 110 in proximity of the rotation axis thereof.

[0044] Figure 2A is a perspective view of the pump 170 according to an advantageous embodiment of the present invention. Figure 2B is a partially exploded view of the pump of Figure 2A.

[0045] The pump 170 comprises a hollow pump body 200, for example made of plastic material, having an input portion 202 and an output portion 204. In the advantageous example at issue, both the input portion 202 and the output portion 204 of the pump body 200 have substantially the shape of hollow cylinders; preferably the input portion 202 has a diameter lower than the one of the output portion 204. Similar considerations apply if the input portion 202 and the output portion 204 have different shapes and/or sizes. The input portion 202 and the output portion 204 are connected to each other, with an end of the input portion 202 that is linked to an end of the output portion 204. The pump 170 has an input port 205 located preferably at a free end of the input portion 202, and connected to the discharge duct 150 (see Figure 1). The pump 170 comprises some output ports, preferably two, located preferably on a lateral surface of the output portion 204: a drain output port 210 connected to the drain duct 175, and a recirculation output port 215 connected to the recirculation conduit 180 (which recirculation conduit 180 is not illustrated in Figure 2A).

[0046] A pump driving motor 220 (not illustrated in Figure 2A), preferably an electric motor, is operable to rotate an impeller 225. The pump driving motor 220 is advantageously connected to a free end of the output portion 204, so as to define, together with the output portion, a pump chamber 230 (which is therefore delimited by the pump body 200 and by the housing of the pump driving motor 220 itself), in which the impeller 225 is housed. The discharge duct 105, the drain duct 175 and the recirculation conduit 180 are adapted to be brought in fluid communication with the pump chamber 230 through the input port 205, the drain output port 210 and the recirculation output port 215, respectively.

[0047] When the pump driving motor 220 is active, and the impeller 225 is in rotation, washing liquid coming from the discharge duct 150 is sucked into the pump chamber 230 through the input port 205.

[0048] As will be described in detail in the following, pump 170 is operable to selectively cause the washing liquid entering into the pump chamber 230 to be recirculated into the drum 110 through the recirculation output port 215, the recirculation conduit 180 and the nozzles 185 (see Figure 1), or discharged toward the water drain network system through the drain output port 210 and the drain duct 175 (see Figure 1).

[0049] For this purpose, according to an advantageous embodiment of the present invention, a diverter element 240 is provided, adapted to selectively close at least one between the recirculation output port 215 and the drain output port 210 while keeping the other one opened. The diverter element 240 is preferably in the form of a hollow member rotatably arranged in the pump chamber 230, upstream the recirculation output port 215 and the drain output port 210. In the embodiment illustrated in the figures, the diverter element 240 has advantageously substantially the shape of a cylinder adapted to be rotatably fitted into the output portion 204 of the pump body 202. Preferably, the diverter element 240 is made of a plastic rigid material. The diverter element 240 is preferably designed with an opening 255 located on the lateral surface thereof.

[0050] The diverter element 240 is operable to be movable (advantageously, in the embodiment illustrated in enclosed Figures, it is rotatable) into the pump chamber 230 from a first position, in which the opening 255 faces the drain output port 210, to a second position, in which the opening 255 faces the recirculation port 215, and *vice versa*.

[0051] Figure 2C is a cross-sectional view of the pump 170 taken along a plane perpendicular to the symmetry axis of the pump body 200 and crossing the recirculation output port 215 and the drain output port 210, in which the diverter element 240 is in the first position, *i.e.*, with the opening 255 that faces the drain output port 210.

[0052] When the pump 170 is in operation, with the impeller 225 that rotates, washing liquid sucked through the input port 205 reaches the diverter element 240 through an input opening 265 located on a frontal surface 268 of the diverter element 240 facing the input port 205 (see Figure 2B).

[0053] If the diverter element 240 is in the above mentioned first position, the recirculation output port 215 is blocked by a portion of the lateral surface of the diverter element 240, while the drain output port 210 is open, since the opening 255 faces the drain output port 210. In this situation, the washing liquid is diverted to the drain duct 175.

[0054] If instead the diverter element 240 is in the above mentioned second position, the drain output port 210 is blocked by a portion of the lateral surface of the diverter element 240, while the recirculation output port 215 is open, since the opening 255 faces the recirculation output port 215. In this situation, the washing liquid is diverted to the recirculation conduit 180.

[0055] The movement (advantageously, in the embodiment illustrated in enclosed Figures, this movement is a rotation) of the diverter element 240 that allows to switch between the first and the second positions is carried out by means of an actuator system 270. According to an advantageous embodiment of the present invention, the actuator system 270 comprises a linearly movable element 272, a linear actuator 274 and a transmission element 276. The linear actuator 274 is operable to move the linearly movable element 272 by linear motion. The linear motion of the linearly movable element 272 is converted into a rotational motion of the rotatable transmission element 276. For this purpose, according to an embodiment of the present invention, the linearly movable element 272 is a linear gear bar provided with teeth 278 that mesh with corresponding teeth 279 provided on the rotatable transmission element 276.

[0056] Preferably the actuator system 270 is controlled by the electronic control system 400 (*e.g.*, a programmable electronic board) of the washing machine 100, only schematically illustrated in Figure 1, in such a way to take the diverter element 240 selectively in the first and second position, according to the phase of the specific washing program selected by the user (for example by a suitable user interface, not illustrated, provided in the washing machine) which is being performed.

[0057] According to an advantageous embodiment of the present invention, the linear actuator 274 is located outside the pump chamber 230, for example housed in a proper support 280 fixed to the pump body 200.

[0058] According to an advantageous embodiment of the present invention, the rotatable transmission element 276 is rotatably fitted around the external surface of the input portion 202 of the pump body 200, in such a way to allow the rotatable transmission element 276 to rotate - around the symmetry axis of the pump body 202- with respect to the input portion 202 of the pump body 200.

[0059] In the embodiment of the invention illustrated in the figures, the rotatable transmission element 276 has advantageously substantially the shape of a "C", with the teeth 279 located on a shelf element 282 which protrudes from a surface of the rotatable transmission element 276 facing the input port 205 and which is adapted to slide substantially in contact with the external surface of the input portion 202 of the pump body 200 when the rotatable transmission element 276 is in rotation.

[0060] Similar considerations apply in case the rotatable transmission element 276 has a different shape, such as for example the one of a ring adapted to be fitted around the external surface of the input portion 202 of the pump body 200, and/or if the teeth 279 are located on different portions of the rotatable transmission element 276, such as for example protruding from an external border thereof.

[0061] According to an advantageous embodiment of

the present invention, the rotatable transmission element 276 is magnetically coupled with the diverter element 240 so that the rotation of the rotatable transmission element 276 with respect to the input portion 202 of the pump body 202 causes a corresponding rotation of the diverter element 240 inside the pump chamber 230, without requiring any physical contact therebetween.

[0062] For this purpose, according to an advantageous embodiment of the present invention, one between the diverter element 240 and the rotatable transmission element 276 comprises at least one magnetic member (*i.e.*, able to generate a magnetic field, such as a permanent magnet), whereas the other one between the diverter element 240 and the rotatable transmission element 276 comprises at least one corresponding magneto-responsive member (*i.e.*, able to be attracted or repulsed by the magnetic field generated by the magnetic member, such as a ferromagnetic material element, a ferrite element or a permanent magnet).

[0063] For example, according to an advantageous embodiment of the present invention, the rotatable transmission element 276 is provided with a one or more (three, in the example illustrated in the figures) seats 283, for example arranged on the surface of the rotatable transmission element 276 from which the shelf element 282 protrudes, each one adapted to house a respective magnetic member 284, and the diverter element 240 is provided with one or more (three, in the example illustrated in the figures) seats 286, for example arranged on the free end of the diverter element in such a way to surround the input opening 265, each one adapted to house a respective magneto-responsive member 288. Similar considerations apply if the number of magnetic members 284 and magneto-responsive members 288 is different, if the seats 283, 286 are arranged in different positions, and/or if the magnetic members 284 are housed in the one or more seats 286 of the diverter element 240 and the magneto-responsive members 288 are housed in the one or more seats 283 of the rotatable transmission member 276.

[0064] Figure 2D is a cross sectional view of a portion of the pump taken along a plane passing through the symmetry axis of the pump body 202, in which a magnetic member 284 and a magneto-responsive member 288 are visible. In operation, each magnetic member 284 is adapted to magnetically couple with a corresponding magneto-responsive member 288, so that any rotational movement of the rotatable transmission element 276 causes a corresponding rotational movement of the diverter element 240.

[0065] Figure 2E s a cross-sectional view of the pump 170 taken along a plane perpendicular to the symmetry axis of the pump body 202 and crossing the linearly movable element 272, the rotatable transmission element 276 and the input portion 202 of the pump body 200.

[0066] The linearly movable element 272 is advantageously operable to move along a linear direction from a first, retracted, position to a second, extended, position, and *vice versa*.

[0067] According to the embodiment of the present invention illustrated in the figures, in which the linearly movable element 272 is provided with teeth 278, the linear movement of the linearly movable element 272 is advantageously converted into a corresponding rotational movement of the rotatable transmission element 276 thanks to the mechanical interaction between the teeth 278 and the teeth 279 of the rotatable transmission element 276. Moreover, the rotational movement of the rotatable transmission element 276 is converted into a corresponding further rotational movement of the diverter element 240 thanks to the magnetic coupling between the magnetic members 284 on the rotatable transmission element 276 and the magneto-responsive member 288 on the diverter element 240.

[0068] Making reference to the example illustrated in the figures, when the linearly movable element 272 is in the retracted position, the diverter element 240 is in the first position, with the opening 255 thereof that faces the drain output port 210. If the linearly movable element 272 is moved toward its extended position, the rotatable transmission element 276 rotates with respect to the input portion 202 of the pump body 202, so that the diverter element 240 correspondingly rotates within the pump chamber 230.

[0069] The actuator system 270 is advantageously designed so that when the linearly movable element 272 reaches its extended position, the diverter element 240 is in the second position, with the opening 255 thereof that faces the recirculation output port 215. The diverter element 240 is brought from the second position to the first position by moving the linearly movable element 272 in the opposite direction, *i.e.*, toward its retracted position. Naturally, similar considerations apply if the actuator system 270 is designed so that when the linearly movable element 272 reaches the retracted position, the diverter element 240 is in the second position, with the opening 255 thereof that faces the recirculation output port 215, and when reaches the extended position, the diverter element 240 is in the first position, with the opening 255 thereof that faces the drain output port 210.

[0070] The pump according to the present invention is very efficient and cost effective. Indeed, a single pump is used to fed two different hose/conduits.

[0071] Moreover, in the pump according to the present invention, since the actuator system is coupled to the diverter element by a magnetic coupling, the diverter element placed within the pump chamber can be moved from the outside of the pump body without directly contacting the diverter element, which allows obtaining a watertight coupling of the diverter element with the actuator system without requiring any additional gasket element, such as O-rings and the like, greatly simplifying the structure (and reducing the manufacturing costs) of the pump.

[0072] According to an advantageous embodiment of the present invention, the linear actuator 274 is a wax actuator, comprising a block of wax 297 enclosed in a

box 298. The box 298 is provided with an opening exposing a portion of the block of wax 297. An end of the linearly movable element 272 is fixed to the exposed portion of the block of wax 297. Heating device, preferably an electric heater, is provided for selectively heating the block of wax 297. When the heating device is activated, the block of wax 297 is heated and it expands, driving the linearly movable element 272 outwards toward the extended position. When the heating deice is deactivated, the block of wax 297 cools down and contracts, withdrawing the linearly movable element 272 toward the retracted position.

[0073] Instead of using a wax actuator as the linear actuator 274, the concepts of the present invention may be also applied to other linear actuators particularly suited to move a linearly movable element between two positions, such as, for example:

- an hydraulic or a pneumatic actuator, comprising a hollow cylinder having a piston, connected to the linearly movable element 272, inserted in it;
- a piezoelectric actuator, with the linearly movable element 272 connected to a block of a piezoelectric material, and
- an electromagnetic linear actuator, with the linearly movable element 272 connected to a moving coil.

[0074] Moreover, according to another advantageous embodiment of the present invention not illustrated in the figures, instead of including a linearly movable element 272 moved by a linear actuator 274, the actuator system 270 may include an electric motor, for example fitted around the external surface of the input portion 202, and mechanically coupled to the rotatable transmission element 276 for rotating the latter when activated.

[0075] According to a further embodiment of the present invention not illustrated in the figures, the actuator system 270 does not include the rotatable transmission element 276, and the rotation of the diverter element 240 is directly caused by the contactless magnetic coupling between magnetic members 284 or magneto-responsive members 288 fitted in the diverter element 274 and corresponding at least one magneto-responsive member 288 or magnetic member 284 operable to be moved along a linear direction, for example intersecting the projection of the frontal surface 268 of the diverter element 240 along the symmetry axis of the pump body 200. For example, according to an embodiment of the present invention, the actuator system 270 has the linearly movable element 272 that is directly provided with at least one magneto-responsive member 288 or magnetic member 284, or which includes at least a portion made of a magneto-responsive or magnetic material. In this way, thanks to the magnetic coupling, the linear movement of the linearly movable element 272 caused by the linear actuator 274 is directly transformed in a rotational movement of the diverter element 240 without the need of any rotatable transmission element such as the rotatable transmission element 276.

[0076] As illustrated in Figure 3, the pump 170 according to the embodiments of the present invention may be installed in a basement element 300 which closes the casing 105 of the washing machine 100 at its bottom portion for housing and supporting at least some of the components of the washing machine 100 necessary for its operation. For this purpose, the pump 170 is advantageously provided with a support element 302 protruding from the body pump 200 (see Figures 2A-2C) and adapted to be fixed to a corresponding portion of the basement element 300, for example by means of snap-fit engagements, pins, screws, glue or soldering.

[0077] According to another embodiment of the present invention not illustrated in the figures, instead of installing the pump 170 in the basement element 300, no discharge duct 150 is provided, and the pump 170 is directly installed on a bottom portion of the washing tub 107, for example inserted in a support element which protrudes downward from the washing tub 107 near the discharge hole 155.

[0078] Naturally, in order to satisfy local and specific requirements, a person skilled in the art may apply to the solution described above many logical and/or physical modifications and alterations.

Claims

1. A laundry washing machine (100) comprising:

- a washing tub (107) in which washing/rinsing liquid may be loaded;
- a drain duct (175) for discharging outside the machine (100) washing/rinsing liquid drawn from the washing tub (107);
- a recirculation conduit (180) for circulating washing/rinsing liquid drawn from the washing tub (170) back into the washing tub (170);
- a pump (170) operable to selectively cause washing/rinsing liquid drawn from the washing tub (107) to be discharged via said drain duct (175) or to be circulated via said recirculation conduit (180), said pump (170) comprising:

a) a pump body (200) comprising a pump chamber (230) housing an impeller (225), the pump chamber being adapted to receive washing/rinsing liquid drawn from said washing tub (107), and

b) a diverter element (240) rotatably arranged in said pump chamber (230) and movable by rotation between a first position in which said diverter element (240) causes washing/rinsing liquid in the pump chamber (230) to be diverted to said drain duct (175), and a second position, in which said diverter element (240) causes washing/rinsing liq-

uid in the pump chamber (230) to be diverted to said recirculation conduit (180);

- the laundry washing machine (100) further comprises an actuator system (270) including a rotatable transmission element (276) rotatably fitted around an external surface of the pump body (200), said rotatable transmission element (276) being magnetically coupled to said diverter element (240) so that the rotation of the rotatable transmission element (276) with respect to the pump body (200) causes a corresponding rotation of the diverter element (240) inside the pump chamber (230).

2. The washing machine (100) of claim 1, wherein:

- one between the rotatable transmission element (276) and the diverter element (240) comprises at least one magnetic member (284), and the other one between the rotatable transmission element (276) and the diverter element (240) comprises at least one magneto-responsive member (288), the rotatable transmission element (276) being operable to move, from the outside of the pump body (200), said diverter element (240) between said first and second position through a contactless magnetic coupling between said at least one magnetic member (284) and said at least one magneto-responsive member (288).

3. The washing machine (100) of claim 1 or 2, wherein:

a) said pump (170) comprises:

- an input port (205) connected to said washing tub (107);
- a drain output port (210) connected to said drain duct (175), and
- a recirculation output port (215) connected to said recirculation conduit (180),
wherein said washing tub (107), said drain duct (175) and said recirculation conduit (180) are adapted to be brought in fluid communication with said pump chamber (230) through said input port (205), said drain output port (210) and said recirculation output port (215), respectively,
and wherein

b) said diverter element (240) is arranged in such a way to block said recirculation output port (215) and to keep opened said drain output port (210) when in said first position, and to block said drain output port (210) and to keep opened said recirculation output port (215) when in said second position.

4. The washing machine (100) of claim 3, wherein said diverter element (240) comprises a hollow member provided with:

- an input opening (265) facing said input port (205), and
- a further opening (255) arranged in such a way to face said drain output port (210) when said diverter element is in the first position, and to face the recirculation output port (215) when said diverter element (240) is in said second position.

5. The washing machine (100) of any one among claims 2 to 4, wherein said actuator system (270) is operable to rotate the rotatable transmission element (276) so as to cause a corresponding rotation of the diverter element (240) between said first and second position, by contactless magnetic coupling between said at least one magnetic member (284) comprised in one between said rotatable transmission element (276) and said diverter element (240), and said at least one magneto-responsive member (288) comprised in the other between said rotatable transmission element (276) and said diverter element (240).

6. The washing machine (100) of claim 5, wherein:

- said rotatable transmission element (276) comprises one or more first seats (283) each one adapted to house a respective magnetic member (284) or a respective magneto-responsive member (288), and
- said diverter element (240) comprises one or more second seats (286) each one adapted to house a respective magnetic member (284) or a respective magneto-responsive member (288).

7. The washing machine (100) of any one among the preceding claims, wherein said actuator system (270) further comprises an electric motor coupled to the rotatable transmission element (276) and operable to rotate the rotatable transmission element (276) when activated.

8. The washing machine (100) of any one among the preceding claims, wherein said actuator system (270) further comprises a linearly movable element (272) operable to be moved along a linear direction between a retracted position and an extended position, and having teeth (278) that mesh with corresponding teeth (279) provided on said rotatable transmission element (276) for converting the linear movement of said linearly movable element (272) into a corresponding rotational movement of said rotatable transmission element (276).

9. The washing machine (100) of any one of the previous claims, comprising an electronic control system (400) configured to control said actuator system (270), in such a way to selectively position said diverter element (240) in said first or in said second position, according to the phase of the specific washing program selected by the user which is being performed.

Patentansprüche

1. Eine Wäschewaschmaschine (100), die aufweist:

- eine Waschwanne (107), in die eine Wasch/Spül-Flüssigkeit geladen werden kann;
- ein Ablassrohr (175) zum Auslassen der aus der Waschwanne (107) gesaugten Wasch/Spül-Flüssigkeit aus der Maschine (100) heraus;
- eine Rückführungsleitung (180) zum Zirkulieren der aus der Waschwanne (170) gesaugten Wasch/Spül-Flüssigkeit zurück in die Waschwanne (170);
- eine Pumpe (170), die betriebsfähig ist, um selektiv zu bewirken, dass die aus der Waschwanne (107) gesaugte Wasch/Spül-Flüssigkeit über das Ablassrohr (175) ausgelassen oder über die Rückführungsleitung (180) zirkuliert wird, wobei die Pumpe (170) aufweist:

a) einen Pumpenkörper (200) mit einer Pumpenkammer (230), die ein Flügelrad (225) aufnimmt, wobei die Pumpenkammer dazu ausgelegt ist, die aus der Waschwanne (107) gesaugte Wasch/Spül-Flüssigkeit aufzunehmen, und
b) ein Leitelement (240), das drehbar in der Pumpenkammer (230) angeordnet ist und durch eine Drehung zwischen einer ersten Position, in der das Leitelement (240) bewirkt, dass die Wasch/Spül-Flüssigkeit in der Pumpenkammer (230) zum Ablassrohr (175) geleitet wird, und einer zweiten Position, in der das Leitelement (240) bewirkt, dass die Wasch/Spül-Flüssigkeit in der Pumpenkammer (230) zur Rückführungsleitung (180) geleitet wird, beweglich ist;
wobei:

die Wäschewaschmaschine (100) ferner ein Aktuatorsystem (270) mit einem drehbaren Übertragungselement (276) aufweist, das um eine äußere Fläche des Pumpenkörpers (200) drehbar angebaut ist, wobei das drehbare Übertragungselement (276) magnetisch mit dem Leitelement (240) gekoppelt ist, so dass die Drehung des drehbaren Übertragungselements (276) in Bezug auf den Pumpenkörper (200) eine entsprechende Drehung des Leitelements (240) innerhalb der Pumpenkammer (230) bewirkt.

2. Die Waschmaschine (100) nach Anspruch 1, wobei:

- entweder das drehbare Übertragungselement (276) oder das Leitelement (240) mindestens ein magnetisches Teil (284) aufweist und das andere zu dem drehbaren Übertragungselement (276) oder dem Leitelement (240) mindestens ein Magnetreaktionsteil (288) aufweist, wobei das drehbare Übertragungselement (276) betriebsfähig ist, um das Leitelement (240) von außerhalb des Pumpenkörpers (200) zwischen der ersten und der zweiten Position durch eine kontaktlose magnetische Kopplung zwischen dem mindestens einen magnetischen Teil (284) und dem mindestens einen Magnetreaktionsteil (288) zu bewegen.

3. Die Waschmaschine (100) nach Anspruch 1 oder 2, wobei:

a) die Pumpe (170) aufweist:

- einen Eingangsanschluss (205), der mit der Waschwanne (107) verbunden ist;
- einen Ablassausgangsanschluss (210), der mit dem Ablassrohr (175) verbunden ist, und
- einen Rückführungsausgangsanschluss (215), der mit der Rückführungsleitung (180) verbunden ist,
wobei die Waschwanne (107), das Ablassrohr (175) bzw. die Rückführungsleitung (180) so ausgelegt sind, dass sie mit der Pumpenkammer (230) durch den Eingangsanschluss (205), den Ablassausgangsanschluss (210) bzw. den Rückführungsausgangsanschluss (215) in Fluidverbindung gebracht werden,
und wobei

b) das Leitelement (240) in einer solchen Weise angeordnet ist, um den Rückführungsausgangsanschluss (215) zu blockieren und den Ablassausgangsanschluss (210) geöffnet zu halten, wenn es in der ersten Position ist, und den Ablassausgangsanschluss (210) zu blockieren und den Rückführungsausgangsanschluss (215) geöffnet zu halten, wenn es in der zweiten Position ist.

4. Die Waschmaschine (100) nach Anspruch 3, wobei

das Leitelement (240) ein hohles Teil aufweist, das versehen ist mit:

- einer Eingangsöffnung (265), die dem Eingangsanschluss (205) zugewandt ist, und
- einer weiteren Öffnung (255), die in einer solchen Weise angeordnet ist, dass sie dem Ablassausgangsanschluss (210) zugewandt ist, wenn das Leitelement in der ersten Position ist, und dem Rückführungsausgangsanschluss (215) zugewandt ist, wenn das Leitelement (240) in der zweiten Position ist.

5. Die Waschmaschine (100) nach einem der Ansprüche 2 bis 4, wobei das Aktuatorsystem (270) betriebsfähig ist, um das drehbare Übertragungselement (276) zu drehen, um eine entsprechende Drehung des Leitelements (240) zwischen der ersten und der zweiten Position zu bewirken, durch kontaktlose magnetische Kopplung zwischen dem mindestens einen magnetischen Teil (284), das in dem drehbaren Übertragungselement (276) oder dem Leitelement (240) enthalten ist, und dem mindestens einen Magnetreaktionsteil (288), das im anderen zu dem drehbaren Übertragungselement (276) oder dem Leitelement (240) enthalten ist.

6. Die Waschmaschine (100) nach Anspruch 5, wobei:

- das drehbare Übertragungselement (276) einen oder mehrere erste Sitze (283) aufweist, die jeweils dazu ausgelegt sind, ein jeweiliges magnetisches Teil (284) oder ein jeweiliges Magnetreaktionsteil (288) aufzunehmen, und
- das Leitelement (240) einen oder mehrere zweite Sitze (286) aufweist, die jeweils dazu ausgelegt sind, ein jeweiliges magnetisches Teil (284) oder ein jeweiliges Magnetreaktionsteil (288) aufzunehmen.

7. Die Waschmaschine (100) nach einem der vorangehenden Ansprüche, wobei das Aktuatorsystem (270) ferner einen Elektromotor aufweist, der mit dem drehbaren Übertragungselement (276) gekoppelt ist und betriebsfähig ist, um das drehbare Übertragungselement (276) zu drehen, wenn er aktiviert wird.

8. Die Waschmaschine (100) nach einem der vorangehenden Ansprüche, wobei das Aktuatorsystem (270) ferner ein linear bewegliches Element (272) aufweist, das betriebsfähig ist, um entlang einer linearen Richtung zwischen einer zurückgezogenen Position und einer ausgefahrenen Position bewegt zu werden, und Zähne (278) hat, die mit entsprechenden Zähnen (279) verzahnen, die am drehbaren Übertragungselement (276) vorgesehen sind, zum Umwandeln der linearen Bewegung des linear beweglichen Elements (272) in eine entsprechende Drehbewegung des drehbaren Übertragungselements (276).

9. Die Waschmaschine (100) nach einem der vorangehenden Ansprüche, die ein elektronischen Steuersystem (400) aufweist, das dazu ausgelegt ist, das Aktuatorsystem (270) in einer solchen Weise zu steuern, um selektiv das Leitelement (240) in der ersten oder in der zweiten Position zu positionieren gemäß der Phase des durch den Benutzer ausgewählten spezifischen Waschprogramms, das durchgeführt wird.

Revendications

1. Machine à laver le linge (100) comprenant :

- une cuve de lavage (107) dans laquelle du liquide de lavage/rinçage peut être chargé ;
- une conduite d'évacuation (175) pour évacuer hors de la machine (100) du liquide de lavage/rinçage tiré de la cuve de lavage (107) ;
- une conduite de recyclage (180) pour faire circuler du liquide de lavage/rinçage tiré de la cuve de lavage (170) pour le ramener dans la cuve de lavage (170) ;
- une pompe (170) actionnable pour amener sélectivement le liquide de lavage/rinçage tiré de la cuve de lavage (107) à être évacué par l'intermédiaire de la conduite d'évacuation (175) ou à être recyclé par l'intermédiaire de la conduite de recyclage (180), la pompe (170) comprenant :

a) un corps de pompe (200) comprenant une chambre de pompe (230) abritant une roue à aubes (225), la chambre de pompe étant adaptée à recevoir du liquide de lavage/rinçage tiré de la cuve de lavage (107), et b) un élément de déviation (240) agencé de façon rotative dans la chambre de pompe (230) et mobile par rotation entre une première position dans laquelle l'élément de déviation (240) amène le liquide de lavage/rinçage se trouvant dans la chambre de pompe (230) à être dévié vers la conduite d'évacuation (175), et une deuxième position dans laquelle l'élément de déviation (240) amène le liquide de lavage/rinçage se trouvant dans la chambre de pompe (230) à être dévié vers la conduite de recyclage (180) ;
dans laquelle :

- la machine à laver le linge (100) com-

prend en outre un système d'actionneur (270) comprenant un élément de transmission rotatif (276) monté de façon rotative autour d'une surface externe du corps de pompe (200), l'élément de transmission rotatif (276) étant couplé magnétiquement à l'élément de déviation (240) de sorte que la rotation de l'élément de transmission rotatif (276) par rapport au corps de pompe (200) provoque une rotation correspondante de l'élément de déviation (240) à l'intérieur de la chambre de pompe (230).

2. Machine à laver (100) selon la revendication 1, dans laquelle :

- l'un de l'élément de transmission rotatif (276) et de l'élément de déviation (240) comprend au moins un élément magnétique (284), et l'autre de l'élément de transmission rotatif (276) et de l'élément de déviation (240) comprend au moins un élément à sensibilité magnétique (288), l'élément de transmission rotatif (276) étant actionnable pour déplacer, à partir de l'extérieur du corps de pompe (200), l'élément de déviation (240) entre la première et la deuxième position par l'intermédiaire d'un couplage magnétique sans contact entre ledit au moins un élément magnétique (284) et ledit au moins un élément à sensibilité magnétique (288).

3. Machine à laver (100) selon la revendication 1 ou 2, dans laquelle :

a) la pompe (170) comprend :

- un port d'entrée (205) connecté à la cuve de lavage (107) ;
- un port de sortie d'évacuation (210) connecté à la conduite d'évacuation (175), et
- un port de sortie de recyclage (215) connecté à la conduite de recyclage (180),

dans laquelle la cuve de lavage (107), la conduite d'évacuation (175) et la conduite de recyclage (180) sont adaptées à être mises en communication de fluide avec la chambre de pompe (230) par l'intermédiaire du port d'entrée (205), du port de sortie d'évacuation (210) et du port de sortie de recyclage (215), respectivement,
et dans laquelle

b) l'élément de déviation (240) est agencé de façon à bloquer le port de sortie de recyclage (215) et à maintenir ouvert le port de sortie d'évacuation (210) lorsqu'il est dans la première position, et à bloquer le port de sortie d'évacuation (210) et à maintenir ouvert le port de sortie de recyclage (215) lorsqu'il est dans la deuxième position.

4. Machine à laver (100) selon la revendication 3, dans laquelle l'élément de déviation (240) comprend un élément creux muni de :

- une ouverture d'entrée (265) en face du port d'entrée (205), et
- une autre ouverture (255) agencée de façon à être en face du port de sortie d'évacuation (210) lorsque l'élément de déviation est dans la première position, et à être en face du port de sortie de recyclage (215) lorsque l'élément de déviation (240) est dans la deuxième position.

5. Machine à laver (100) selon l'une quelconque des revendications 2 à 4, dans laquelle le système d'actionneur (270) est actionnable pour faire tourner l'élément de transmission rotatif (276) de façon à provoquer une rotation correspondante de l'élément de déviation (240) entre les première et deuxième positions, par un couplage magnétique sans contact entre ledit au moins un élément magnétique (284) inclus dans l'un de l'élément de transmission rotatif (276) et de l'élément de déviation (240), et ledit au moins un élément à sensibilité magnétique (288) inclus dans l'autre de l'élément de transmission rotatif (276) et de l'élément de déviation (240).

6. Machine à laver (100) selon la revendication 5, dans laquelle :

- l'élément de transmission rotatif (276) comprend un ou plusieurs premiers sièges (283), chacun étant adapté à abriter un élément magnétique (284) respectif ou un élément à sensibilité magnétique (288) respectif, et
- l'élément de déviation (240) comprend un ou plusieurs deuxièmes sièges (286), chacun étant adapté à abriter un élément magnétique respectif (284) ou un élément à sensibilité magnétique (288) respectif.

7. Machine à laver (100) selon l'une quelconque des revendications précédentes, dans laquelle le système d'actionneur (270) comprend en outre un moteur électrique couplé à l'élément de transmission rotatif (276) et actionnable pour faire tourner l'élément de transmission rotatif (276) lorsqu'il est activé.

8. Machine à laver (100) selon l'une quelconque des revendications précédentes, dans laquelle le système d'actionneur (270) comprend en outre un élément mobile linéairement (272) actionnable pour être déplacé suivant une direction linéaire entre une position rétractée et une position déployée, et com-

portant des dents (278) qui s'engrènent avec des dents correspondantes (279) prévues sur l'élément de transmission rotatif (276) pour convertir le mouvement linéaire de l'élément mobile linéairement (272) en un mouvement rotatif correspondant de l'élément de transmission rotatif (276).

9. Machine à laver (100) selon l'une quelconque des revendications précédentes, comprenant un système de commande électronique (400) agencé pour contrôler le système d'actionneur (270), de manière à positionner sélectivement l'élément de déviation (240) dans la première ou dans la deuxième position, en fonction de la phase en cours d'exécution du programme de lavage spécifique sélectionné par l'utilisateur.

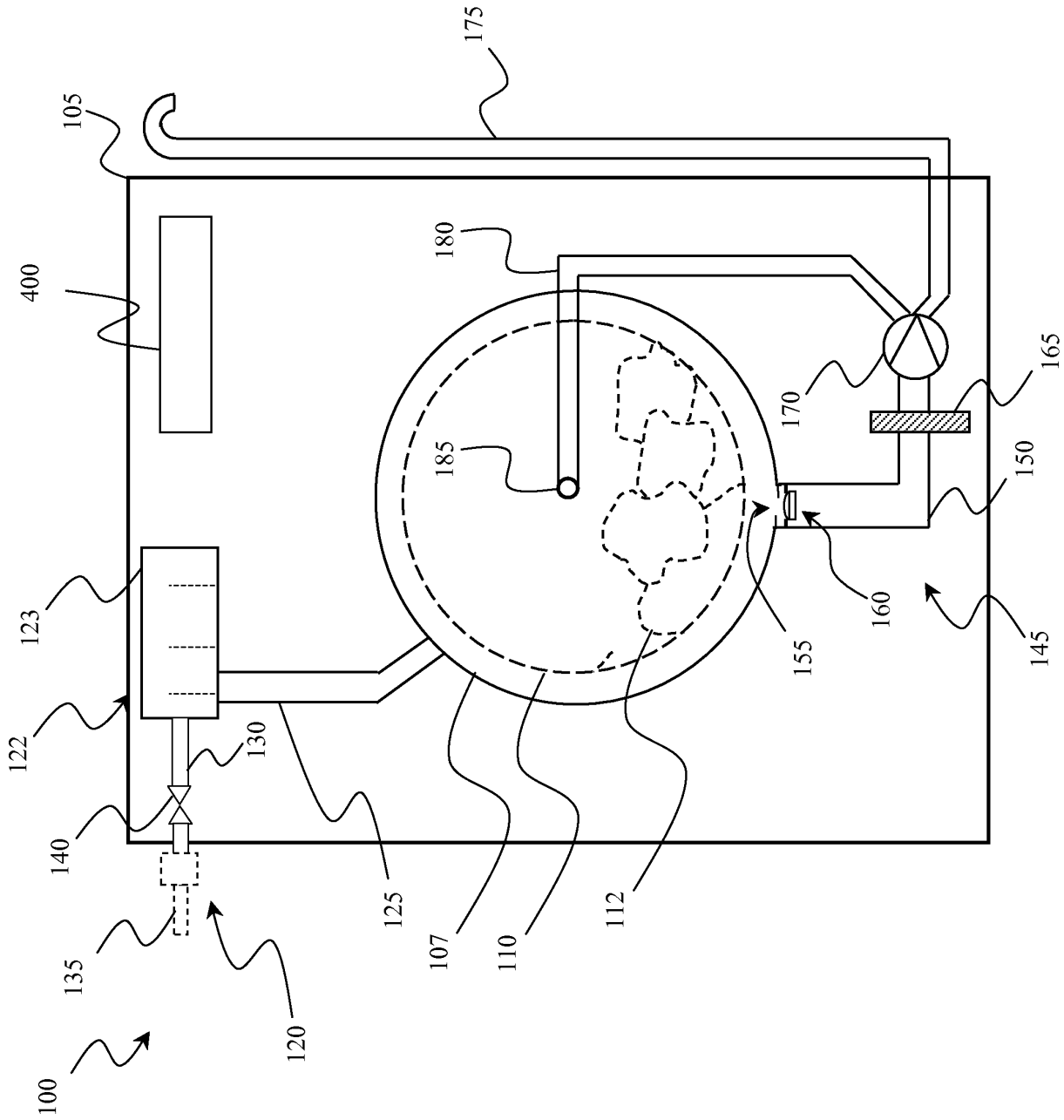

175
105
400
180
165
170
185
150
123
160
155
145
122
130
140
125
107
110
112
135
120
100

FIG.1

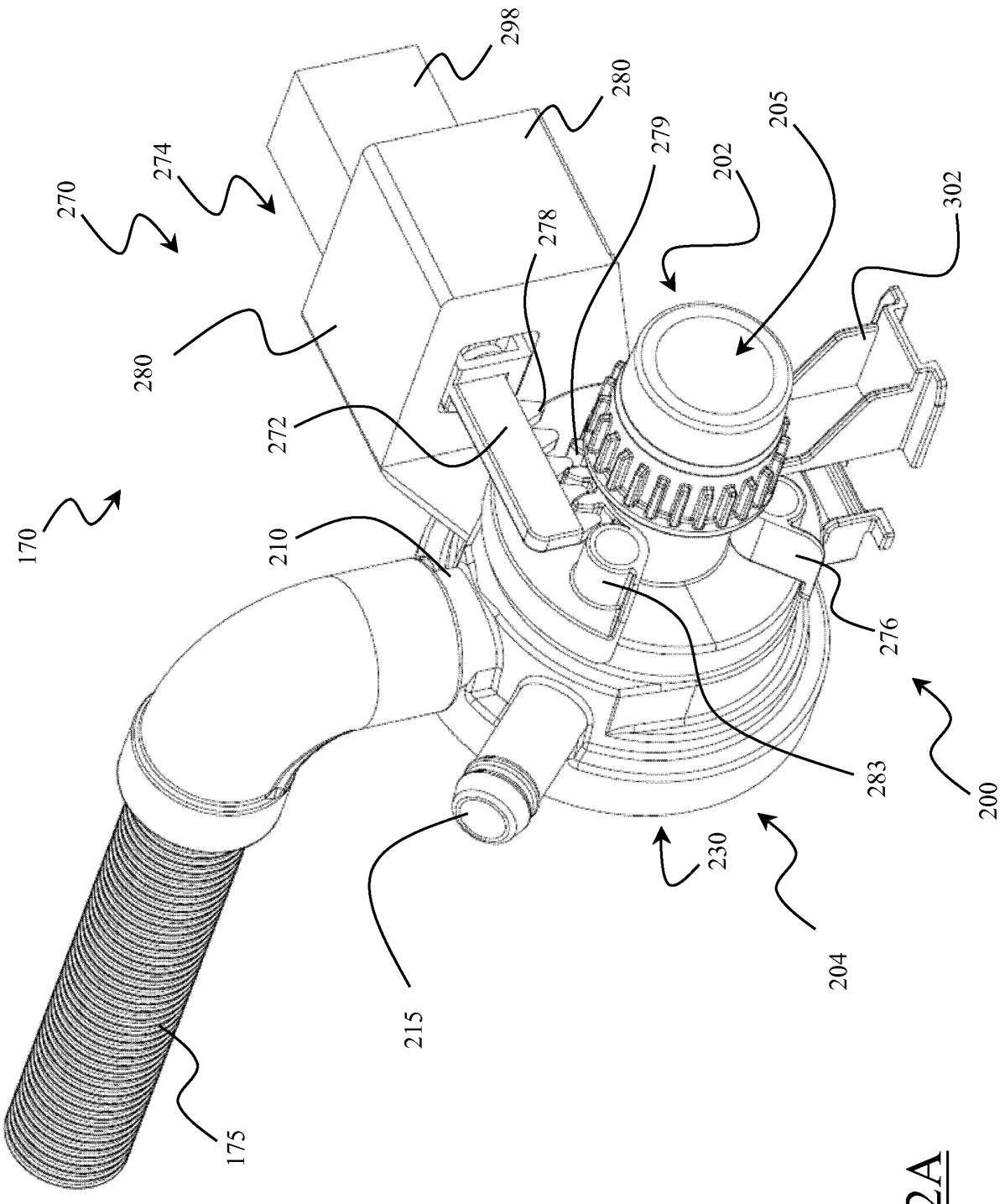
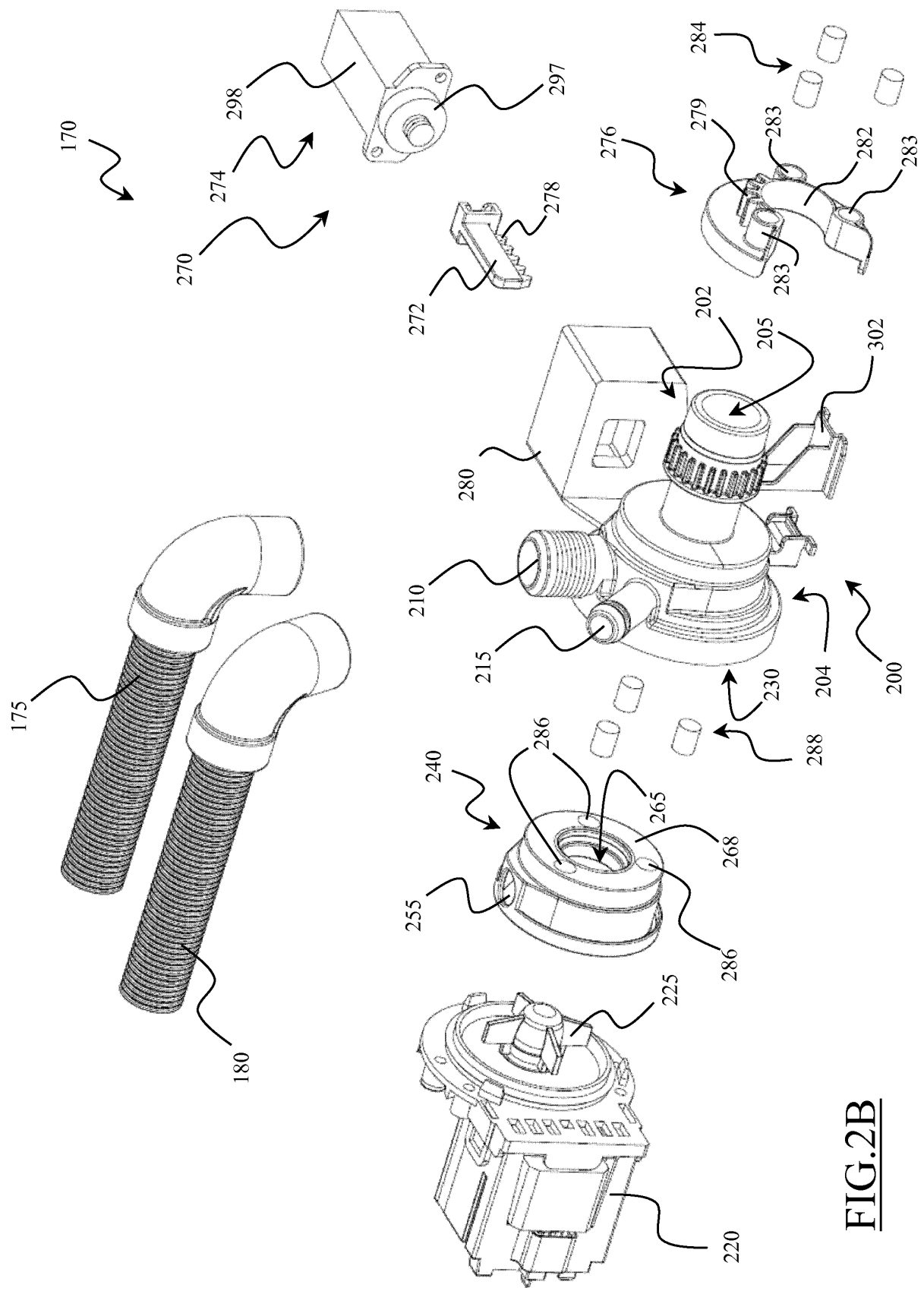

298
280
279
205
274
270
202
278
302
280
272
170
210
276
283
200
230
204
215
175

FIG.2A


170
298
297
274
270
278
272
276
279
283
284
282
283
283
202
205
302
280
210
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240
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265
268
255
286
225
220
175
180

FIG.2B

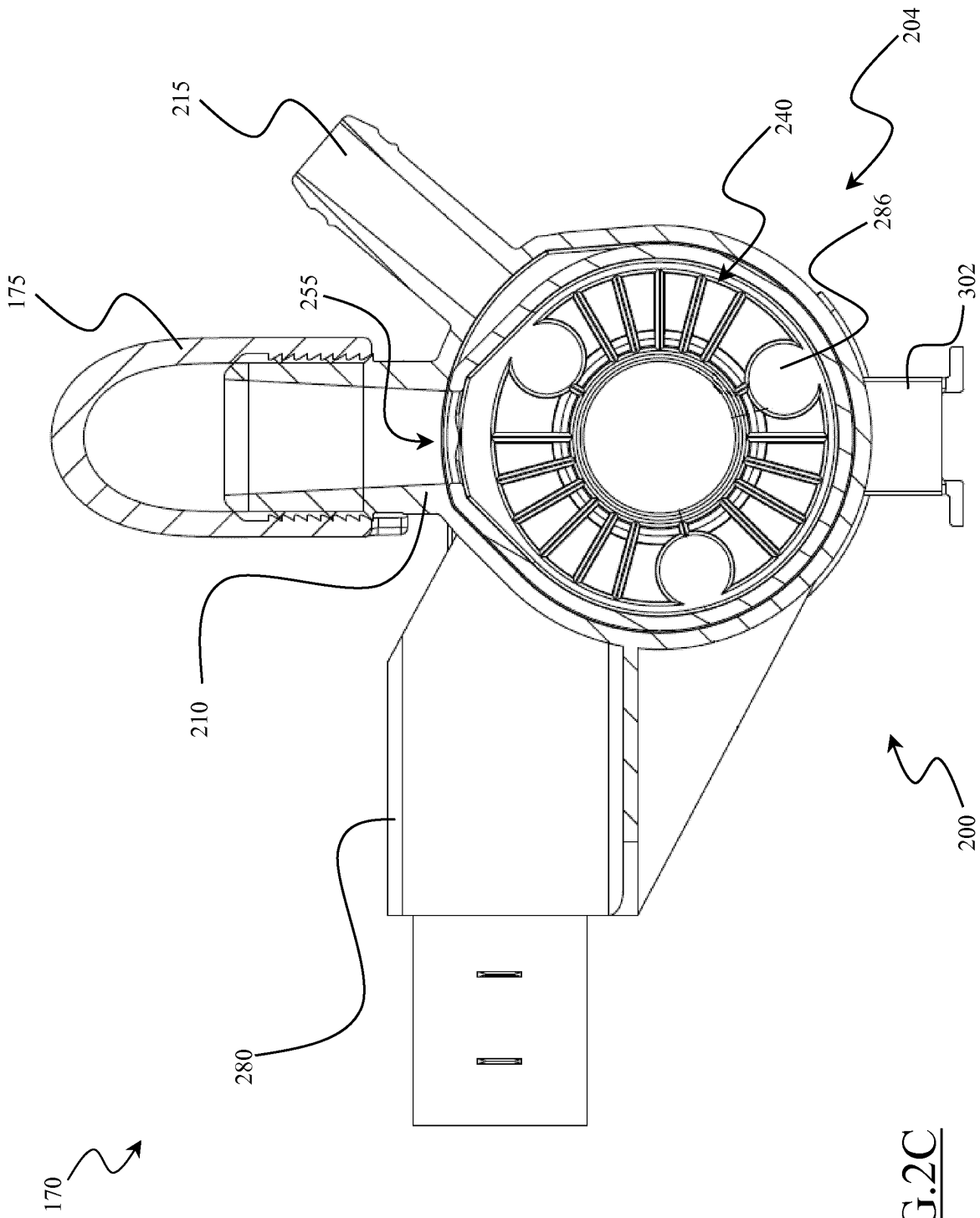

FIG.2C

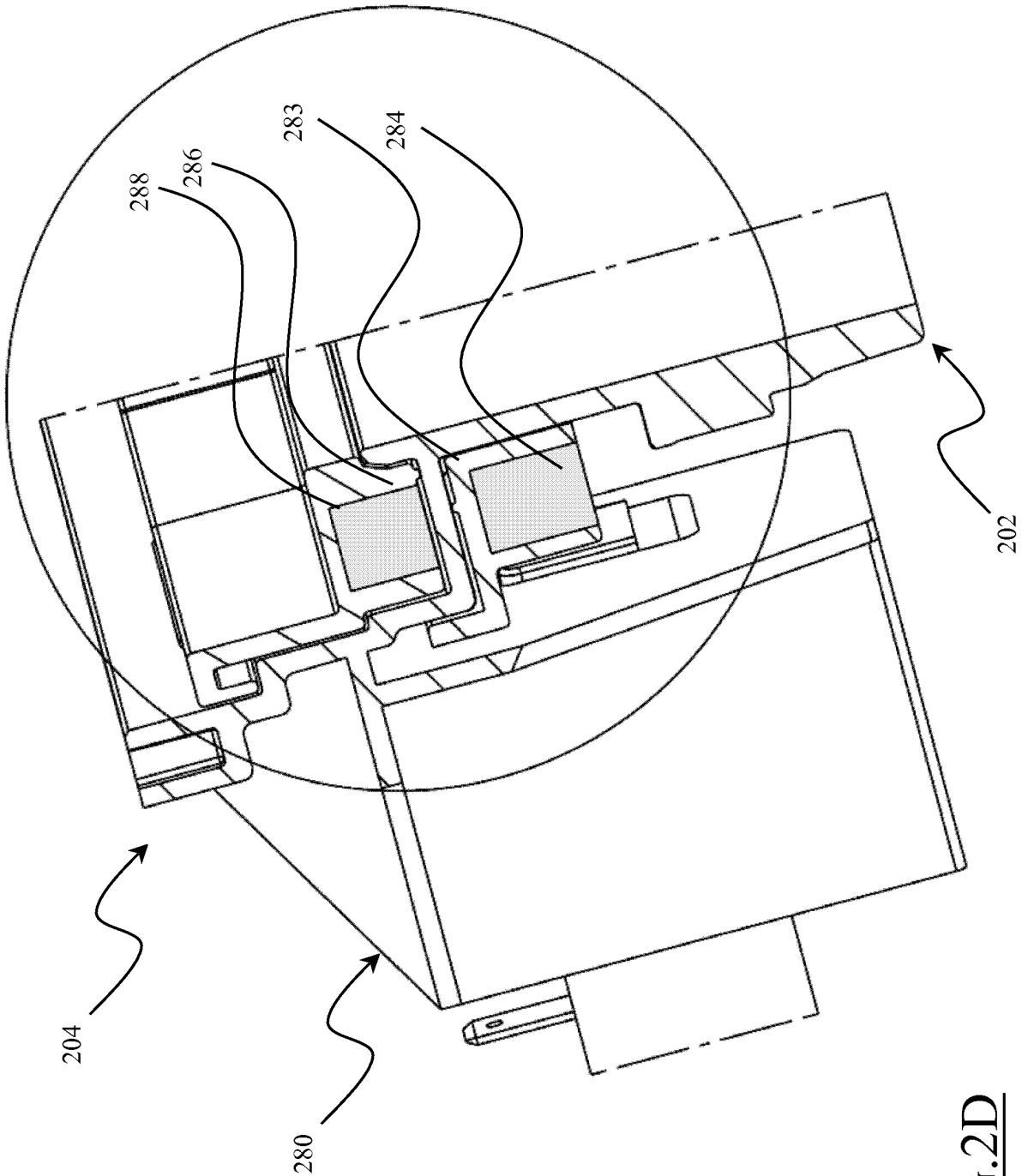

FIG.2D

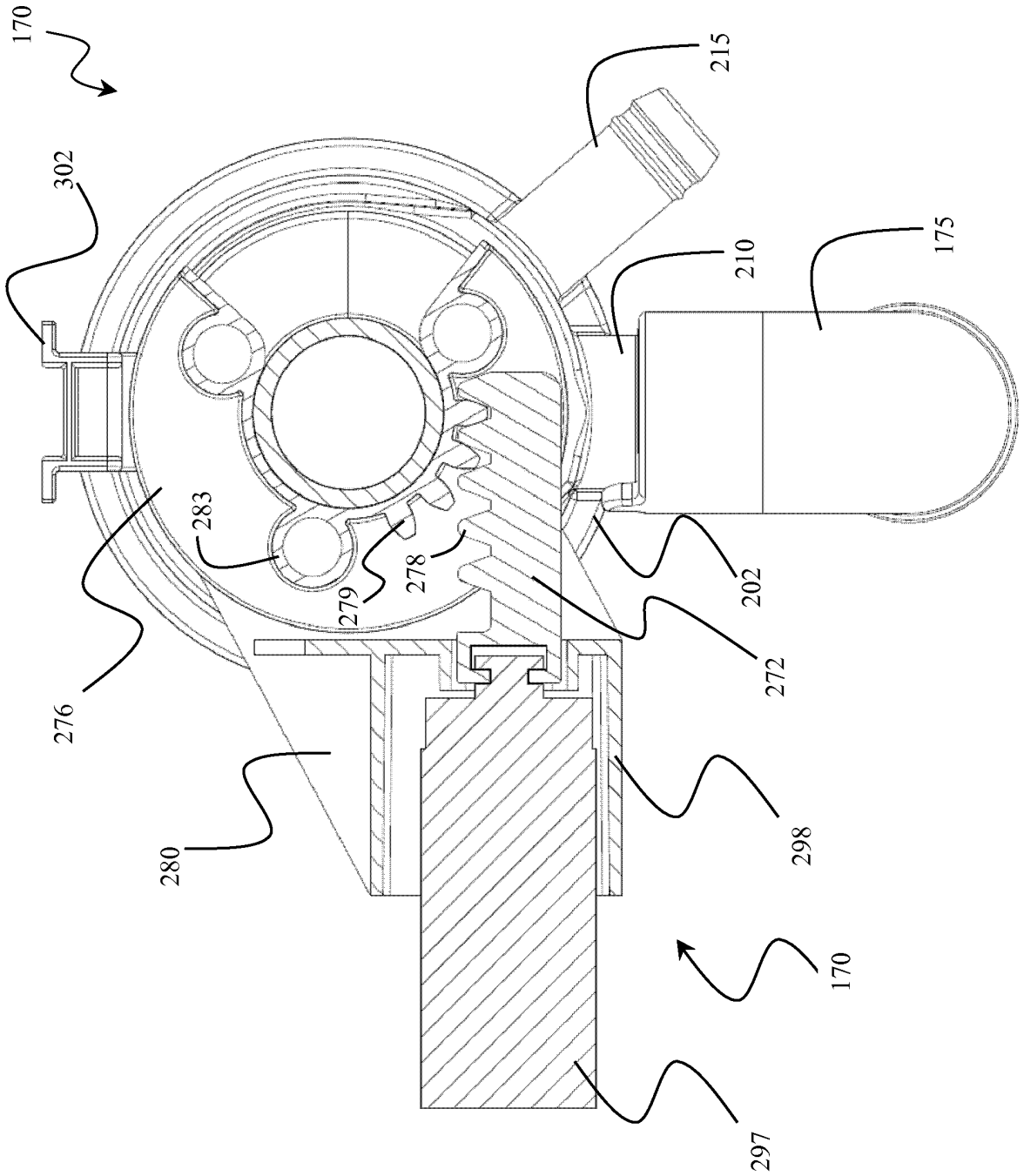

FIG.2E

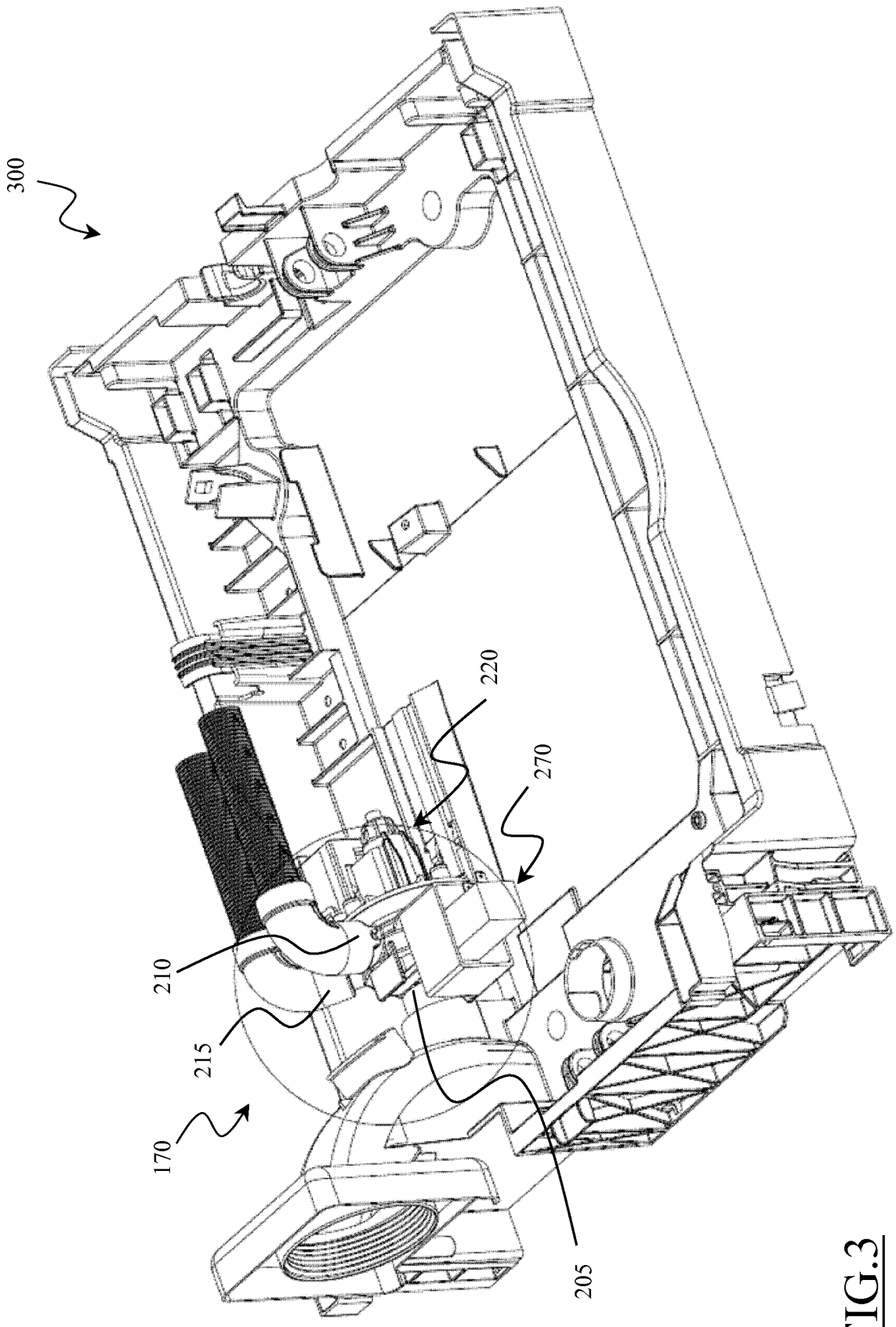

FIG.3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB 858694 A **[0011]**
- WO 03005875 A **[0012]**
- EP 597508 A **[0013]**
- US 2864312 A **[0014]**
- US 2003051514 A **[0015]**