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(54) **Washing machine pump**

(57) A laundry washing machine (100) is provided. The laundry washing machine (100) comprises 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), and 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). The pump (170) comprises a pump body (200) comprising a pump chamber (230) for receiving washing/rinsing liquid drawn from said washing tub (107), and a

diverter element (240) movably arranged in said pump chamber (230) and movable 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 liquid in the pump chamber (230) to be diverted to said recirculation conduit (180). The laundry washing machine (100) further comprises an actuator system (270) operable to move said diverter element (240) between said first and second position, wherein said actuator system (270) is coupled to said diverter element (240) by a magnetic coupling.

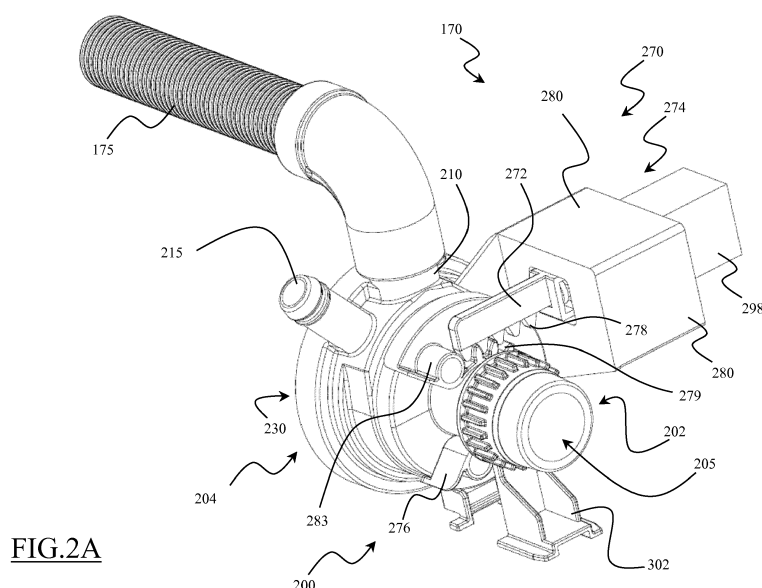


FIG. 2A

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

[0012] 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.

[0013] 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.

[0014] One aspect of the present invention proposes a laundry washing machine comprising a washing tub in which washing/rinsing liquid may be loaded, a drain duct for discharging outside the machine washing/rinsing liq-

uid drawn from the washing tub, a recirculation conduit for circulating washing/rinsing liquid drawn from the washing tub back into the washing tub, and a pump operable to selectively cause washing/rinsing liquid drawn from the washing tub to be discharged via said drain duct or to be circulated via said recirculation conduit. The pump comprises a pump body comprising a pump chamber for receiving washing/rinsing liquid drawn from said washing tub, and a diverter element movably arranged in said pump chamber and movable between a first position in which said diverter element causes washing/rinsing liquid in the pump chamber to be diverted to said drain duct, and a second position, in which said diverter element causes washing/rinsing liquid in the pump chamber to be diverted to said recirculation conduit. The laundry washing machine further comprises an actuator system operable to move said diverter element between said first and second position. Said actuator system is coupled to said diverter element by a magnetic coupling.

[0015] 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.

[0016] 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.

[0017] 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 field 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/re-pulsed toward/by said magnetic member.

[0018] According to an advantageous embodiment of 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.

[0019] 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.

[0020] 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.

[0021] According to an advantageous embodiment of 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.

[0022] Preferably, 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] According to an advantageous embodiment of 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. The actuator system comprises a linearly movable element, said at least one magnetic member or said at least one magneto-responsive member comprised in the actuator system being located on said linearly movable element, said linearly movable element being further operable to be moved along a linear direction between a retracted position and an extended position 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 linearly movable element and said diverter element, and said at least one magneto-responsive member comprised in the other between said linearly movable element and said diverter element.

[0027] According to an advantageous embodiment of the present invention:

- when said linearly movable element is in said retracted position, said diverter element is in said first position, and when said linearly movable element is in said extended position, said diverter element is in said second position,
- or
- when said linearly movable element is in said retracted position, said diverter element is in said second position, and when said linearly movable element is in said extended position, said diverter element is in said first position.

[0028] Preferably, the actuator system further comprises a linear actuator operable to move the linearly movable element. The linear actuator comprises a block of wax, an end of said linearly movable element being connected to a portion of said block of wax, and a heating device operable to selectively heat said block of wax.

[0029] Preferably, when said heating device is activated, said block of wax is heated and expands, driving said linearly movable element toward said extended position, and when said heating device is deactivated, said block of wax cools down and contracts, driving said linearly movable element toward said retracted position.

[0030] 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.

[0031] 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

[0032] 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.

[0033] 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.

[0034] 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.

[0035] 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.

[0036] In order to allow a user to access the washing tub and the inside of the drum 110

[0037] (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 is 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 feed 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 device 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 ele-

ment 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) for receiving washing/rinsing liquid drawn from said washing tub (107), and

b) a diverter element (240) movably arranged in said pump chamber (230) and movable 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 liquid in the pump chamber (230) to be diverted to said recirculation conduit (180);

- an actuator system (270) operable to move said diverter element (240) between said first and second position, wherein said actuator system (270) is coupled to said diverter element (240) by a magnetic coupling.

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

- one between the actuator system (270) and the diverter element (240) comprises at least one magnetic member (284), and the other one between the actuator system (270) and the diverter element (240) comprises at least one magneto-responsive member (288), the actuator system (270) 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 of the preceding claims 2 to 4, wherein:

- said diverter element (240) is rotatably arranged in said pump chamber (230) and it is movable in said first and second positions by rotation;
- said actuator system (270) comprises a rotatable transmission element (276) rotatably fitted around an external surface of the pump body (200), the at least one between said at least one magnetic member (284) and said at least one magneto-responsive member (288) comprised in said actuator system (270) being located on said rotatable transmission element (276).

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

7. The washing machine (100) of claim 5 or 6, 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).

8. The washing machine (100) of any one among claims 5 to 7, 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.

9. The washing machine (100) of any one among claims 5 to 7, 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).

10. The washing machine (100) of any one among claims 2 to 4, wherein:

- said diverter element (240) is rotatably arranged in said pump chamber (230) and it is movable in said first and second positions by rotation;
- said actuator system (270) comprises a linearly movable element (272), said at least one magnetic member (284) or said at least one magneto-responsive member (288) comprised in the actuator system (270) being located on said linearly movable element (272), said linearly movable element (272) being further operable to be moved along a linear direction between a retracted position and an extended position 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 linearly movable element (272) and said diverter el-

ement (240), and said at least one magneto-responsive member (288) comprised in the other between said linearly movable element (272) and said diverter element (240).

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11. The washing machine (100) of claim 9 or 10, wherein:

- when said linearly movable element (272) is in said retracted position, said diverter element (240) is in said first position, and when said linearly movable element (272) is in said extended position, said diverter element (240) is in said second position, 10
- or
- when said linearly movable element (272) is in said retracted position, said diverter element (240) is in said second position, and when said linearly movable element (272) is in said extended position, said diverter element (240) is in said first position. 15 20

12. The washing machine (100) of any one among claims 9 to 11, wherein said actuator system (270) further comprises a linear actuator (274) operable to move linearly the movable element (272), said linear actuator (274) comprising: 25

- a block of wax (297), an end of said linearly movable element (272) being connected to a portion of said block of wax (297), and 30
- a heating device operable to selectively heat said block of wax (297).

13. The washing machine (100) of claim 12, wherein: 35

- when said heating device is activated, said block of wax (297) is heated and expands, driving said linearly movable element (272) toward said extended position, and
- when said heating device is deactivated, said block of wax (297) cools down and contracts, driving said linearly movable element (272) toward said retracted position. 40

14. 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. 45 50

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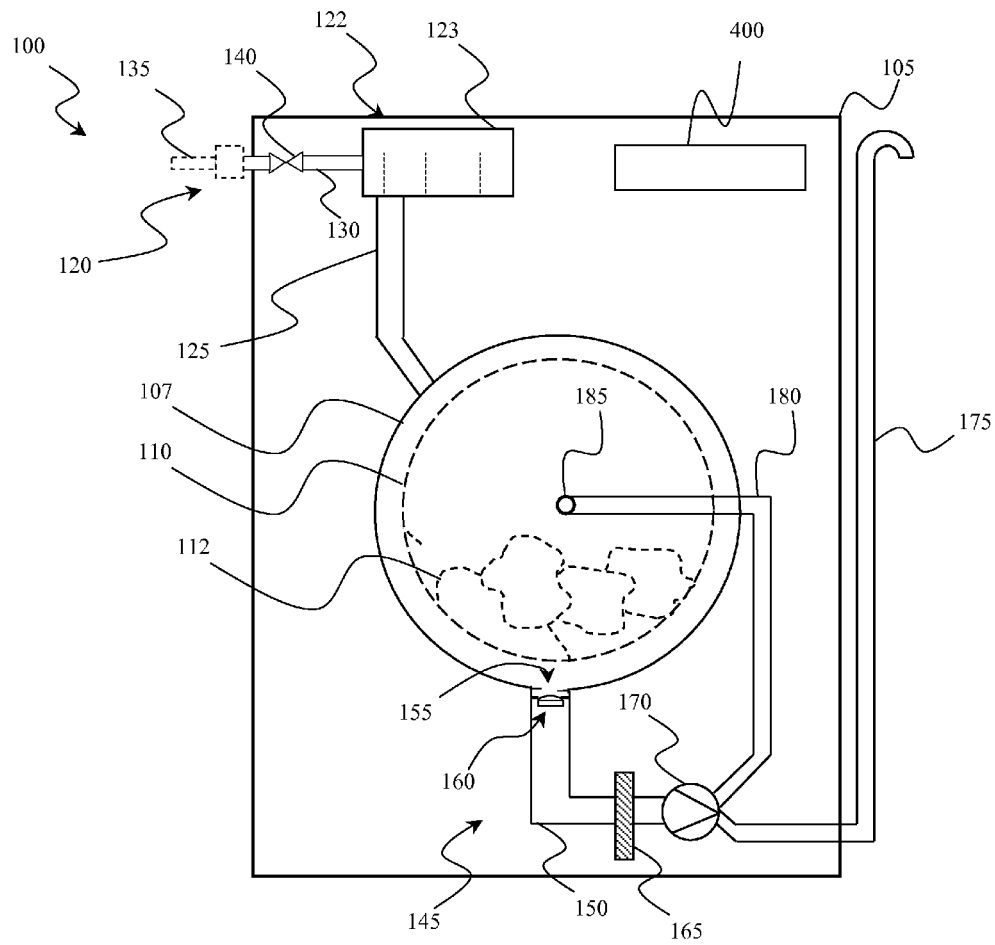


FIG.1

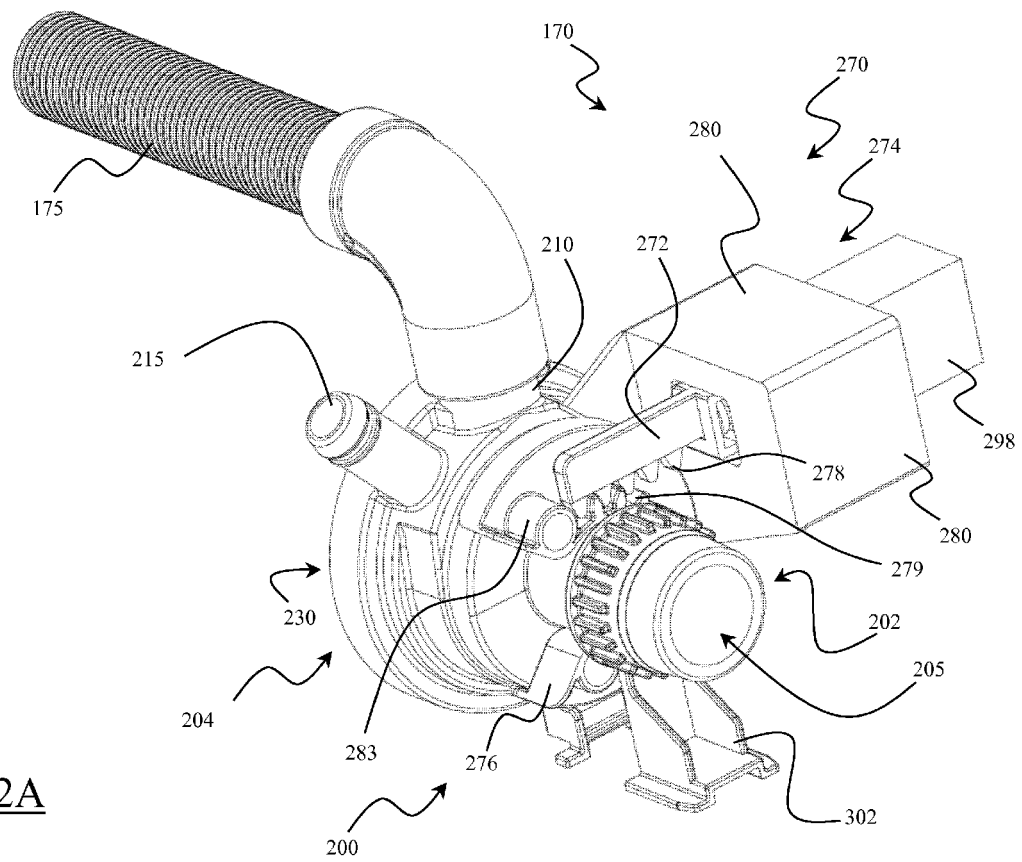


FIG. 2A

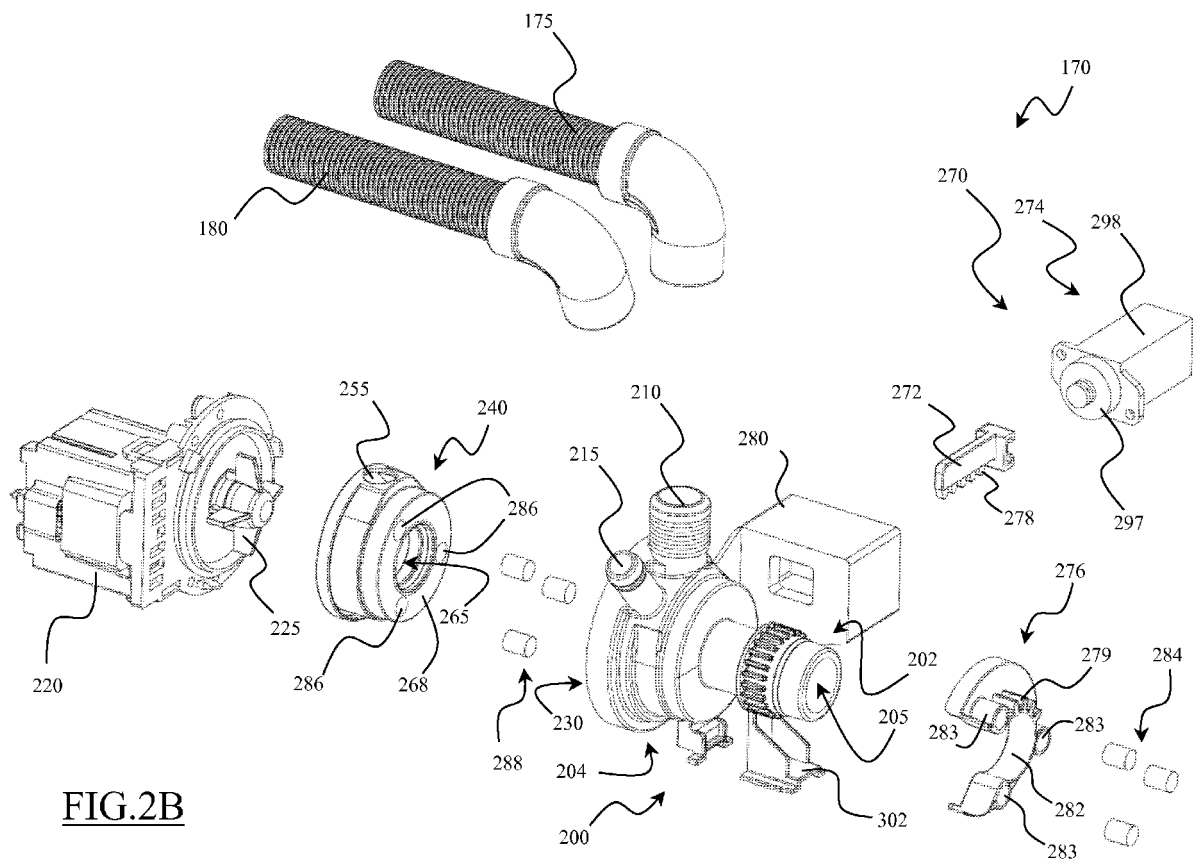
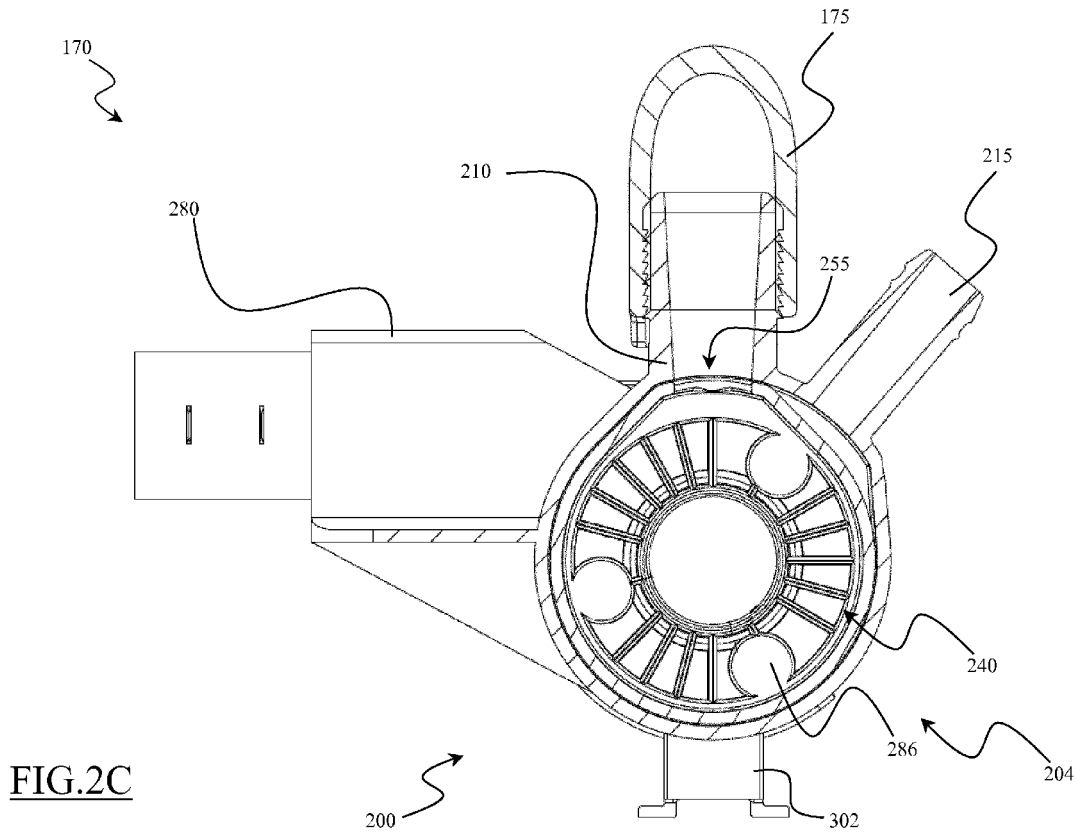


FIG.2B



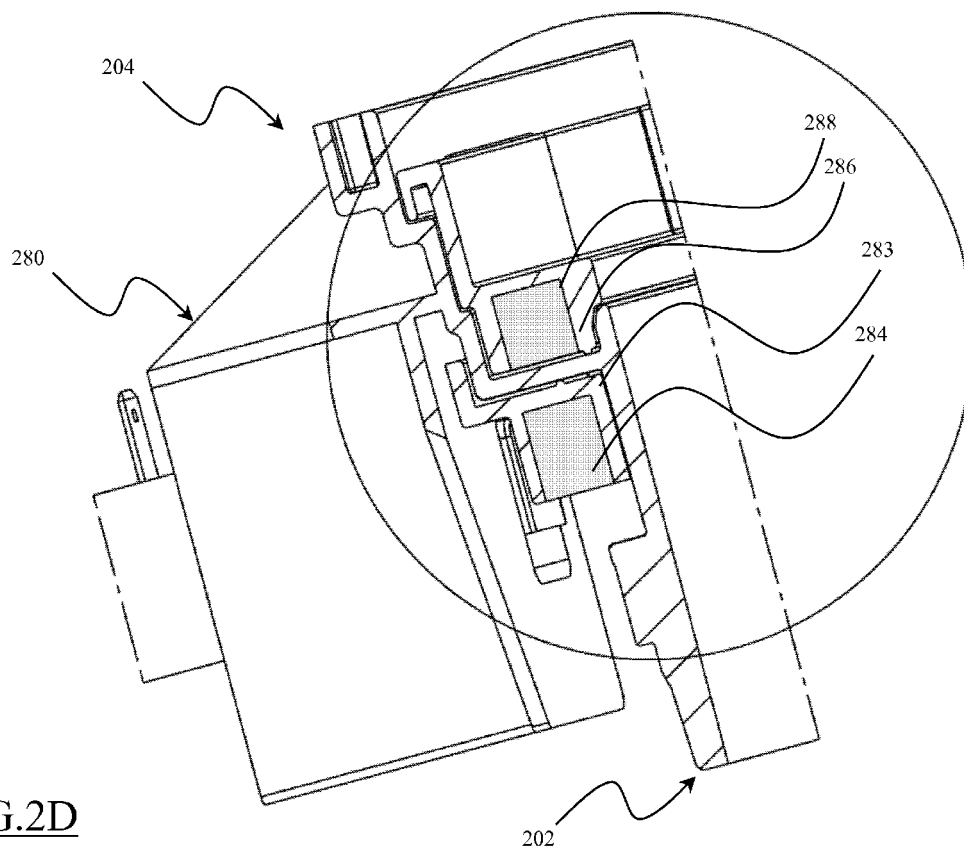


FIG. 2D

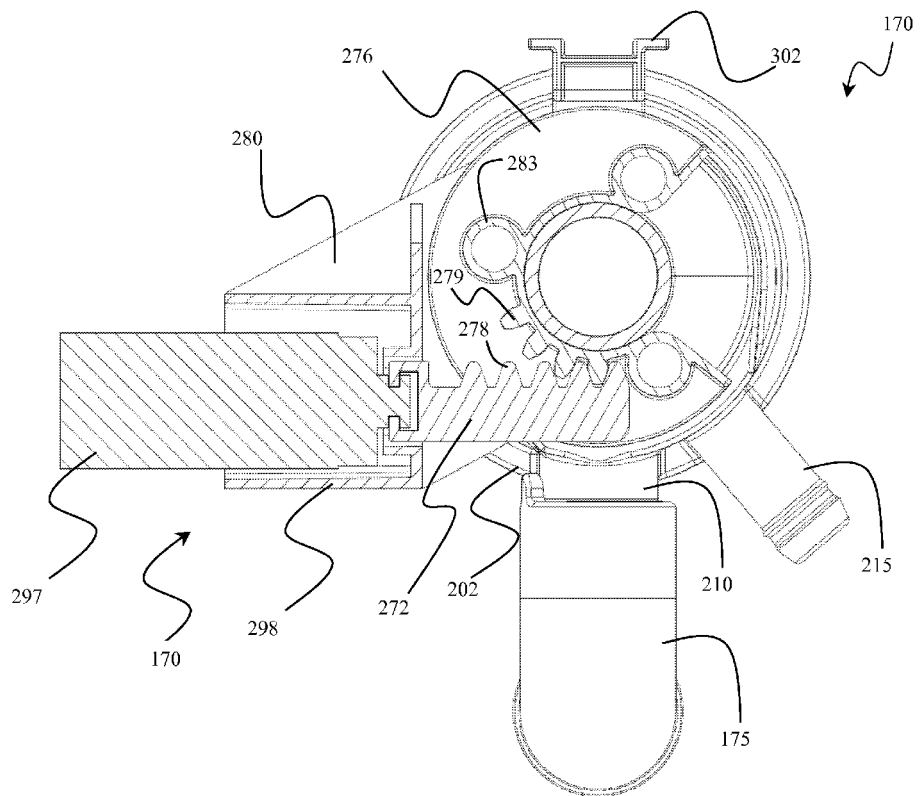


FIG. 2E

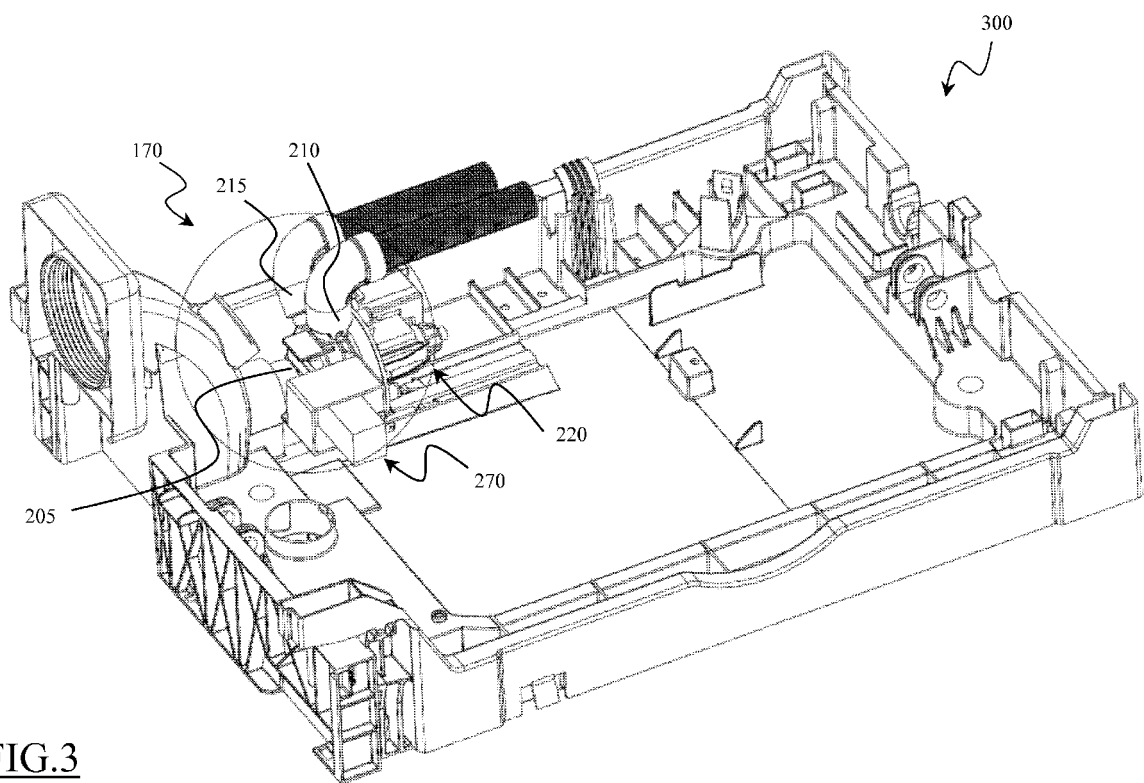


FIG.3



EUROPEAN SEARCH REPORT

Application Number
EP 13 17 3048

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Place of search Munich		Date of completion of the search 6 November 2013	Examiner Weidner, Maximilian
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