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(54) **Integrated washing machine pump**

(57) A drain pump (and/or recirculating pump) for a clothes washing machine which has no dynamic leak paths exterior to the washing machine outer bowl (1, 20). The pump (19) is contained within a housing (3/9, 25) which is either formed integrally with the outer bowl or connects directly within an aperture provided in the bottom of the bowl using a single static seal. The pump inlet is directly exposed to the interior of the outer bowl. The pump motor (5, 64) has a rotor (4, 29) mounted within the pump housing with the interconnected pump impeller (8, 27) to obviate the need for a dynamic water seal for the rotor drive shaft (7,31). The rotor can run wet. The stator (6, 35) is mounted outside of the housing such that the housing wall (14, 28) lies in the motor air gap. The motor is preferably a brushless dc motor.

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Description

FIELD OF THE INVENTION

[0001] This invention relates to clothes washing machines and in particular drain or recirculating pumps for such machines.

BACKGROUND TO THE INVENTION

[0002] Clothes washing machines require a pump to drain the machine bowl of both wash and rinse water. In machines where wash water is recirculated a pump is required for this purpose also. Hitherto such pumps have taken the form of discrete components mounted outside the washing machine bowl and connected thereto by means of ducts and hoses.

[0003] The use of discrete component pumps in washing machines gives rise to the risk of water leakage because of the number of joints required between ducts, hoses and pumps and hose deterioration.

SUMMARY OF THE INVENTION

[0004] It is an object of the present invention to provide an integrated washing machine and pump structure which will at least reduce the abovementioned disadvantage.

[0005] Accordingly in one aspect the invention consists in a clothes washing machine having an outer bowl which in use selectively contains wash and rinse liquid and a rotary pump driven by an electric motor which drains or recirculates liquid in said bowl, *characterized* in that:

a housing for the pump is formed in the base or bottom of said outer bowl and integral therewith;
said motor has a rotor which is rotatably mounted in said housing,
said pump has an impeller connected to said rotor to rotate within said housing,
said housing is open to the interior of said outer bowl to allow liquid in said bowl to enter said pump; and
said motor has a stator which co-acts with said rotor and which is mounted about the exterior of said housing such that the wall of said housing lies between said stator and said rotor.

[0006] In a second aspect the invention consists in a clothes washing machine having an outer bowl which in use selectively contains wash and rinse liquid and a rotary pump driven by an electric motor which drains and/or recirculates liquid in said bowl, *characterised* in that:

said outer bowl has an aperture in the bottom,
a housing for the pump is sealably mounted within said aperture to be integral with said outer bowl,
said motor has a rotor which is rotatably mounted in said housing,
said pump has an impeller connected to said rotor to rotate within said housing,
said housing is open to the interior of said outer bowl to allow liquid in said bowl to enter said pump, and
said motor has a stator which co-acts with said rotor and which is mounted about the exterior of said housing such that the wall of said housing lies between said stator and said rotor.

[0007] In a third aspect the invention consists in a pump for a clothes washing machine having a water containing outer bowl which drains and/or recirculates liquid in said bowl, said bowl having an aperture in the bottom and said pump having a housing which includes an electric motor, *characterised* in that:

said housing is adapted to be sealably mounted within said aperture so as to be integral with said outer bowl,
said motor has a rotor which is rotatably mounted in said housing,
said pump has an impeller connected to said rotor to rotate within said housing,
said housing in use is open to the interior of said outer bowl to allow liquid in said bowl to enter said pump, and
said motor has a stator which co-acts with said rotor and which is mounted about the exterior of said housing such that the wall of said housing lies between said stator and said rotor.

[0008] Preferably said rotor includes a drive shaft and said impeller is mounted on said drive shaft.

[0009] Preferably a transverse partition is mounted in said housing which separates said rotor and said impeller into separate compartments and which supports a waterproof bearing in a central aperture through which said drive shaft passes and is journalled.

[0010] Preferably said impeller is mounted within said housing proximate to said outer bowl and said rotor is mounted in said housing distal to said outer bowl.

[0011] Preferably said partition has a small aperture therein to allow wash liquid to enter said rotor compartment and to vent pneumatic pressure in said compartment when hot.

[0012] Preferably a filter is mounted in said aperture to prevent foreign objects from entering said rotor compartment.

[0013] Preferably said distal portion of said housing has a cylindrical wall and said cylindrical wall lies between said stator and said rotor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Preferred embodiments of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 diagrammatically shows a first embodiment of a drain/recirculating pump integrated with a washing machine bowl,

Figure 2 shows a second embodiment of a drain/recirculating pump integrated with a washing machine bowl,

Figure 3 shows an enlarged view of detail A in Figure 2,

Figure 4 shows an exploded pictorial view of a drain/recirculating pump to be integrated with a washing machine bowl,

Figure 5 shows a cross-section through the pump of Figure 4.

DETAILED DESCRIPTION

[0015] The essence of the present invention is the integration of a drain/recirculation pump (preferably a centrifugal pump) with a washing machine bowl, thereby reducing the number of water connections outside the watertight bowl. One embodiment of the invention is illustrated diagrammatically in Figure 1.

[0016] A washing machine outer bowl 1 has a floor 2 into which is moulded a cylindrical recess 3 which forms part of the drain/recirculation pump housing. In particular a cylindrical recess 3 forms the lower portion of the pump housing and houses a rotor 4 of an electric motor (generally indicated as 5). The motor stator 6 is mounted exteriorally of the washing machine bowl 2 about the cylindrical wall 14 of recess 3 so as to be co-axial and coplanar with rotor 4. The wall of the pump housing, which forms part of the outer bowl lies in the motor air gap. Motor 5 is preferably a brushless dc motor with the windings of stator 6 commutated electronically.

[0017] Rotor 4 carries a drive shaft 7 which is connected to a pump impeller 8 which in turn is contained within the upper portion 9 of the pump housing. The pump housing 9 has an inlet 10 in the form of an opening to the interior of outer bowl 1 through which wash and rinse water may flow to be pressurised by impeller 8.

[0018] The pump outlet duct 11 extends from pump housing 9 within the outer bowl and terminates at a connector 12 to which a flexible hose 13 may be connected to convey drain water external to the bowl. A recirculating outlet (not shown) feeds a pipe contained within the bowl, configured so as to discharge onto the clothes load.

[0019] Exemplifying an advantage of the invention, in this embodiment it can be seen that there is only one potential leak path and that is at connection 12. Since that is located inside the bowl then if the joint leaks the leakage remains within the watertight bowl 1. Some advantage could be achieved by putting the pump inside the outer bowl and the entire drive motor outside it. However, by also putting the rotor of the pump motor within the outer bowl the need for an aperture in the outer bowl and a dynamic shaft seal, with associated potential for leakage, is avoided.

[0020] A more easily fabricated embodiment will now be described with reference to Figures 2 to 5. Here the pump 19 is a separate part which is integrated with base 21 of a washing machine outer bowl 20 (see Figures 2 and 3). The bowl is plastics moulded and is of the type disclosed in US Patent 4,813,248. Within base 21 at a suitable drain point near a side wall of the bowl there is moulded a drain sump and in the floor of the sump a flanged aperture 22 is provided. In the preferred form this is elliptical. Pump 19 is mounted in this aperture 22 and when mounted completely closes it off.

[0021] Referring in particular to Figures 4 and 5, the pump housing comprises a proximate portion 26 which houses a pump impeller 27 and a distal portion 28 which houses a rotor 29 of an electric motor 64 powering the pump. In the particular arrangement shown the housing connects to the bowl base with its axis substantially vertical. With this orientation the distal portion 28 of the housing is lower than the proximate portion which contains the impeller. The lower portion 28 of the pump housing is cylindrical and closed off at the bottom with an integrally moulded floor section 30. The flange 48 of the pump housing 25 fits about the flange of the bowl aperture 22. A static sealing ring 50 which fits around the periphery of housing cap 42 seals the pump housing within the bowl aperture. The housing is fastened to the outer bowl by screws passing through lugs 47 provided about flange 48 of the upper portion 26 of the housing.

[0022] The pump is of the centrifugal type with impeller 27 configured so as to be capable of pumping when driven in either a clockwise or an anti-clockwise direction. The electric drive motor 64 is of the brushless permanent magnet DC type. The permanent magnet rotor 29 is rotatably mounted within the lower portion 28 of the pump housing. Rotor 29, which in the preferred embodiment may run wet (see below), rotates on a drive shaft 31 which connects to impeller 27. A partition member 33 (see in particular Figure 5) separates the upper and lower portions of the pump housing into an upper compartment 65 and a lower compartment 66 and provides a support for an upper bearing 34 within which drive shaft 31 is journalled. Partition 33 together with dynamic shaft seal prevents materials entrained in the machine wash or rinse water from entering the lower compartment 66 of the pump housing to thereby cause wear or jamming of the rotor. However a small aperture 60 is provided in partition member 33 to allow controlled water flow into the lower compartment of the pump housing. The presence of water assists in cooling and lubricating the rotor and bearings 61 and 34. Aperture 60 is preferably provided with a filter (not shown) to exclude particulate matter or other foreign bodies from entering the motor rotor compartment 66. Aperture 60 also vents pneumatic pressure in the rotor compartment when hot.

[0023] Rotor drive shaft 31 is also journalled in a lower bearing 61 which is supported in a cavity 62 in the floor 30 of the pump housing. The motor stator 35 is mounted on the exterior of the pump housing co-axially with the rotor and in the same principal plane as the rotor about

the lower portion 28 of the pump housing. The cylindrical walls of the lower portion of the pump housing reside within the "air gap" between the rotor and stator. The stator may typically be of the salient pole type preferably having six poles 36. The stator, being external to the pump housing, is in a dry environment notwithstanding the rotor part of the motor is contained within the pump housing and therefore in essence within the washing machine bowl. The stator is protected by a plastics cover 37 which has a removable base 38 held in place by screws 63.

[0024] The stator 35 comprises substantially annular laminations of magnetic steel which are over moulded with a plastics case which also covers the integrally formed poles to provide plastic bobbins around which the windings 36 are wound. The pole tips are arcuate and lie on a circle of a diameter equal to the outer diameter of the cylindrical wall of the lower portion of the pump housing. The stator is clamped in place by base 38.

[0025] The brushless DC motor preferably has a controller which uses the back EMF induced in an unused stator winding to provide the necessary rotor position sensing. Controllers of the type suitable for the present motor are disclosed in US 6,034,493 and WO 2005/062460.

[0026] Instead of back EMF sensing of the rotor position other known techniques can be used such as Hall effect sensing.

[0027] In operation water pressurised by the centrifugal forces induced by rotation of impeller 27 leaves the upper portion of the pump housing through either outlet 40 to which is connected a drain hose or through outlet 39 into a recirculation duct (not shown) which guides the water back onto the top of the clothes load. Whether the water is drained or recirculated is determined by the direction in which impeller 27 is rotated. Mounted in association with impeller 27 is a bi-state flapper valve 41 which depending on the direction in which water leaves impeller 27 revolves between one of two states. In one state valve 41 seals off outlet 39 and water is directed to drain outlet 40 and in the other state water is directed to the recirculation outlet 39.

[0028] It is necessary to direct water from drain sump 23 in an efficient manner into the pump housing while at the same time ensuring that foreign objects are prevented from entering the pump, and also minimising the potential for blockage by clothes lint. These objectives are met by the use of a top cap 42 in association with a complementary pump hood 43 which define the water inlet path to the pump. Water from the drain sump enters under the hood and over the top of the scalloped peripheral wall 44 of top cap 42 (which forms a first weir) and into the cap inlet aperture 45 defined by cylindrical wall 46 which forms a second weir.

[0029] A drain/recirculating pump integrated with a washing machine outer bowl in the manner disclosed ensures a water handling system with reduced leak paths external to the bowl.

Claims

1. A clothes washing machine having an outer bowl (1) which in use selectively contains wash and rinse liquid and a rotary pump driven by an electric motor (5) which drains or recirculates liquid in said bowl, ***characterized* in that**:

a housing (3, 9) for the pump is formed in the base or bottom of said outer bowl (1) and integral therewith;
said motor has a rotor (4) which is rotatably mounted in said housing,
said pump has an impeller (8) connected to said rotor to rotate within said housing,
said housing (3, 9) is open to the interior of said outer bowl to allow liquid in said bowl to enter said pump; and
said motor (5) has a stator (6) which co-acts with said rotor and which is mounted about the exterior of said housing such that the wall (14) of said housing lies between said stator and said rotor.

2. A clothes washing machine having an outer bowl (20) which in use selectively contains wash and rinse liquid and a rotary pump (19) driven by an electric motor (64) which drains and/or recirculates liquid in said bowl, ***characterised* in that**:

said outer bowl (20) has an aperture (22) in the bottom,
a housing for the pump is sealably mounted within said aperture (22) to be integral with said outer bowl,
said motor has a rotor (29) which is rotatably mounted in said housing (25),
said pump has an impeller (27) connected to said rotor (29) to rotate within said housing,
said housing is open to the interior of said outer bowl to allow liquid in said bowl to enter said pump, and
said motor has a stator (35) which co-acts with said rotor and which is mounted about the exterior of said housing such that the wall (28) of said housing lies between said stator and said rotor.

3. A pump for a clothes washing machine having a water containing outer bowl which drains and/or recirculates liquid in said bowl, said bowl having an aperture in the bottom and said pump having a housing (3/9, 25) which includes an electric motor, ***characterised* in that**:

said housing is adapted to be sealably mounted within said aperture so as to be integral with said outer bowl,

said motor has a rotor (4, 29) which is rotatably mounted in said housing,
said pump has an impeller (8, 27) connected to said rotor to rotate within said housing,
said housing in use is open to the interior of said outer bowl to allow liquid in said bowl to enter said pump, and
said motor has a stator (35) which co-acts with said rotor and which is mounted about the exterior of said housing such that the wall of said housing lies between said stator and said rotor.

4. A clothes washing machine according to any one of claims 1 to 3 wherein said rotor (4, 29) includes a drive shaft (7, 31) and said impeller (8, 27) is mounted on said drive shaft.

5. A clothes washing machine according to claim 4 wherein a transverse partition (33) is mounted in said housing (25) which separates said rotor and said impeller into two compartments (26, 28) and which contains a waterproof bearing (34) in a central aperture through which said drive shaft passes and is journalled.

6. A clothes washing appliance according to claim 5 wherein said impeller (27) is mounted within said housing (25) proximate to said outer bowl (20) and said rotor (29) is mounted in said housing distal to said outer bowl.

7. A clothes washing appliance according to claim 6 wherein said partition (33) has a small aperture (60) therein which allows wash liquid to enter the rotor compartment and to vent pneumatic pressure in said rotor compartment (28).

8. A clothes washing appliance according to claim 7 wherein a filter is located in said aperture (60) to prevent foreign bodies entrained in said wash liquid from entering said rotor compartment (28).

9. A clothes washing appliance according to any one of the preceding claims wherein said distal portion of said housing has a cylindrical wall and said cylindrical wall lies between said stator and said rotor.

10. A clothes washing machine as claimed in any one of the preceding claims wherein said pump motor is a brushless dc motor.

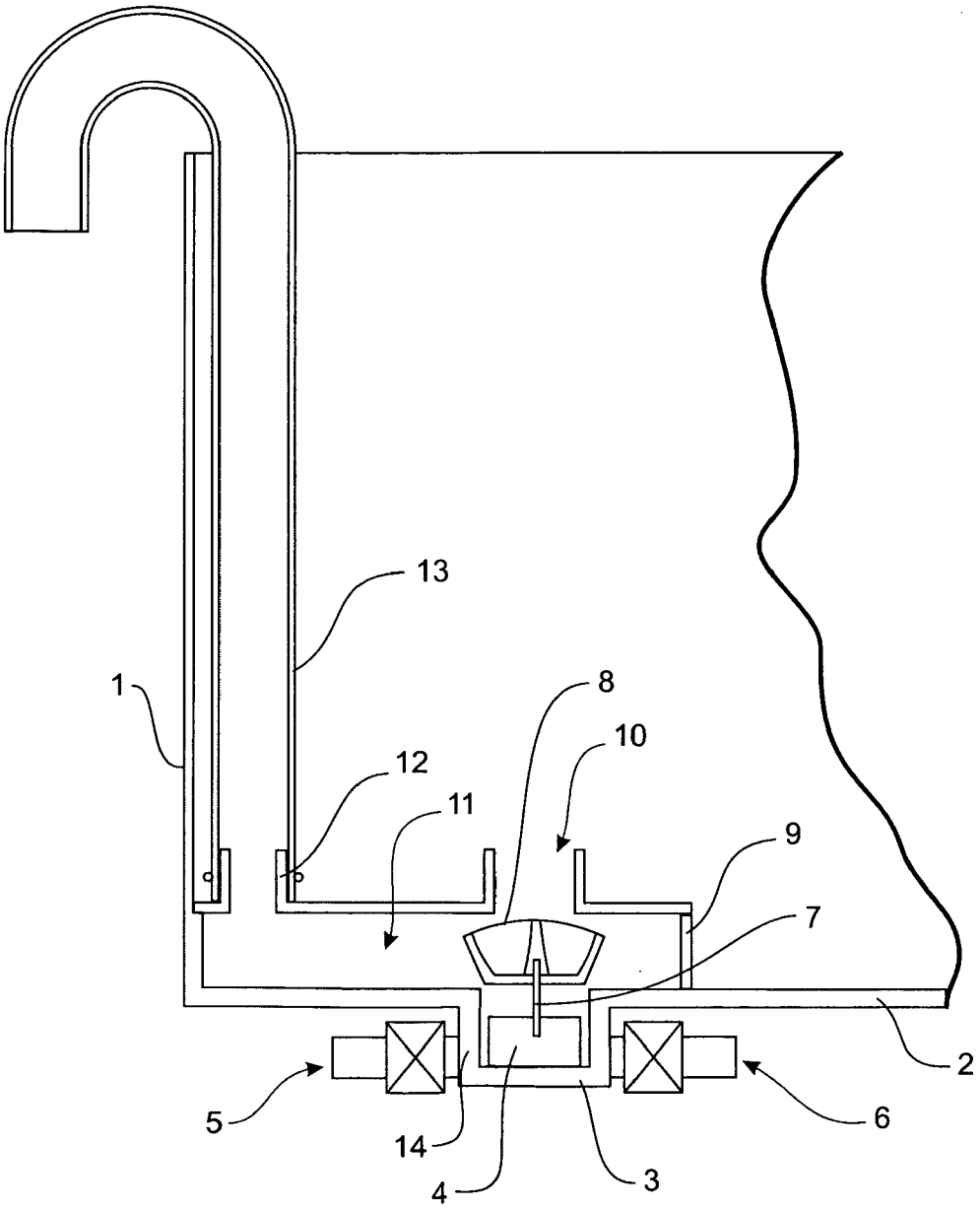

FIGURE 1

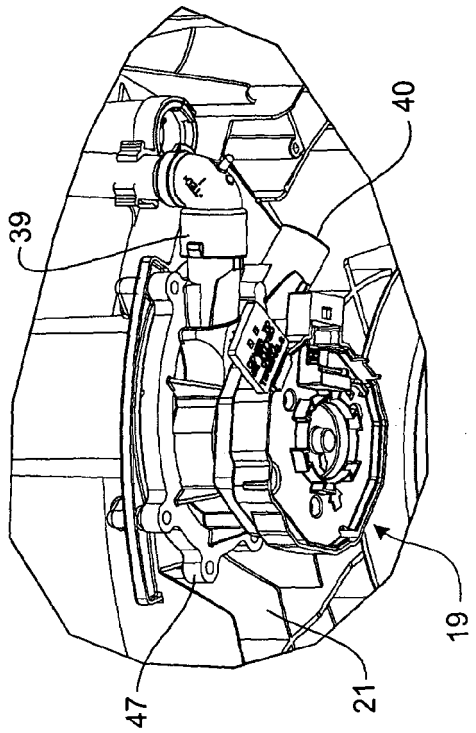

FIGURE 3

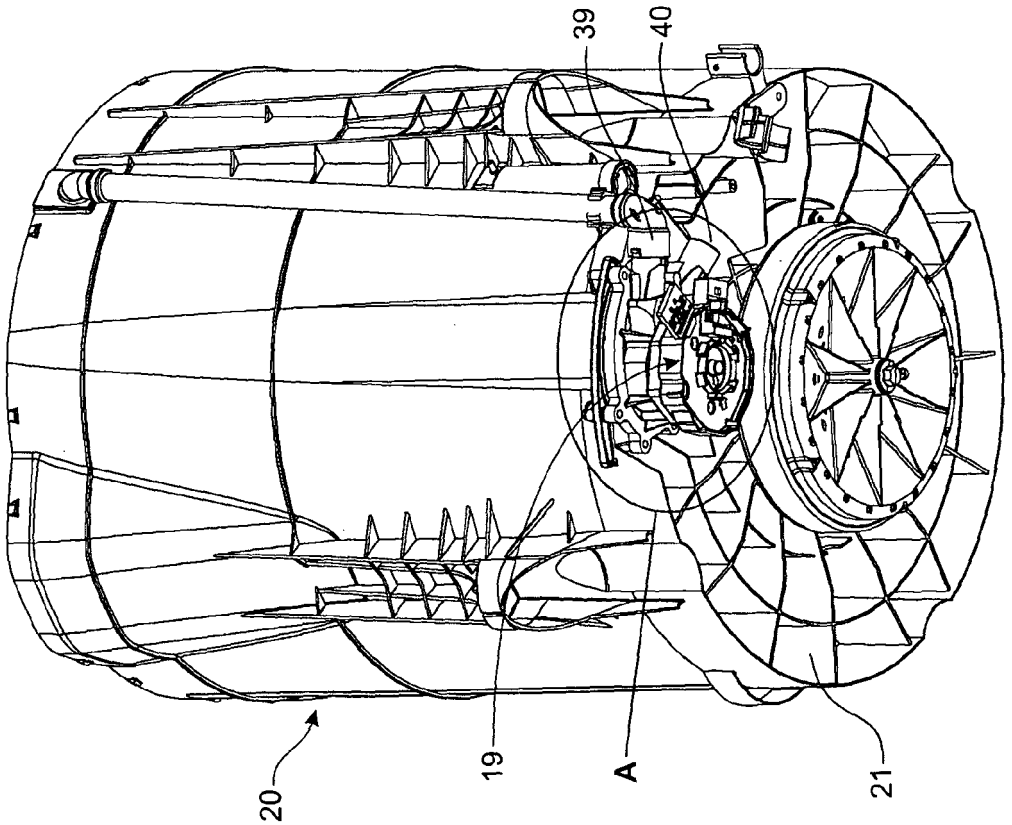

FIGURE 2

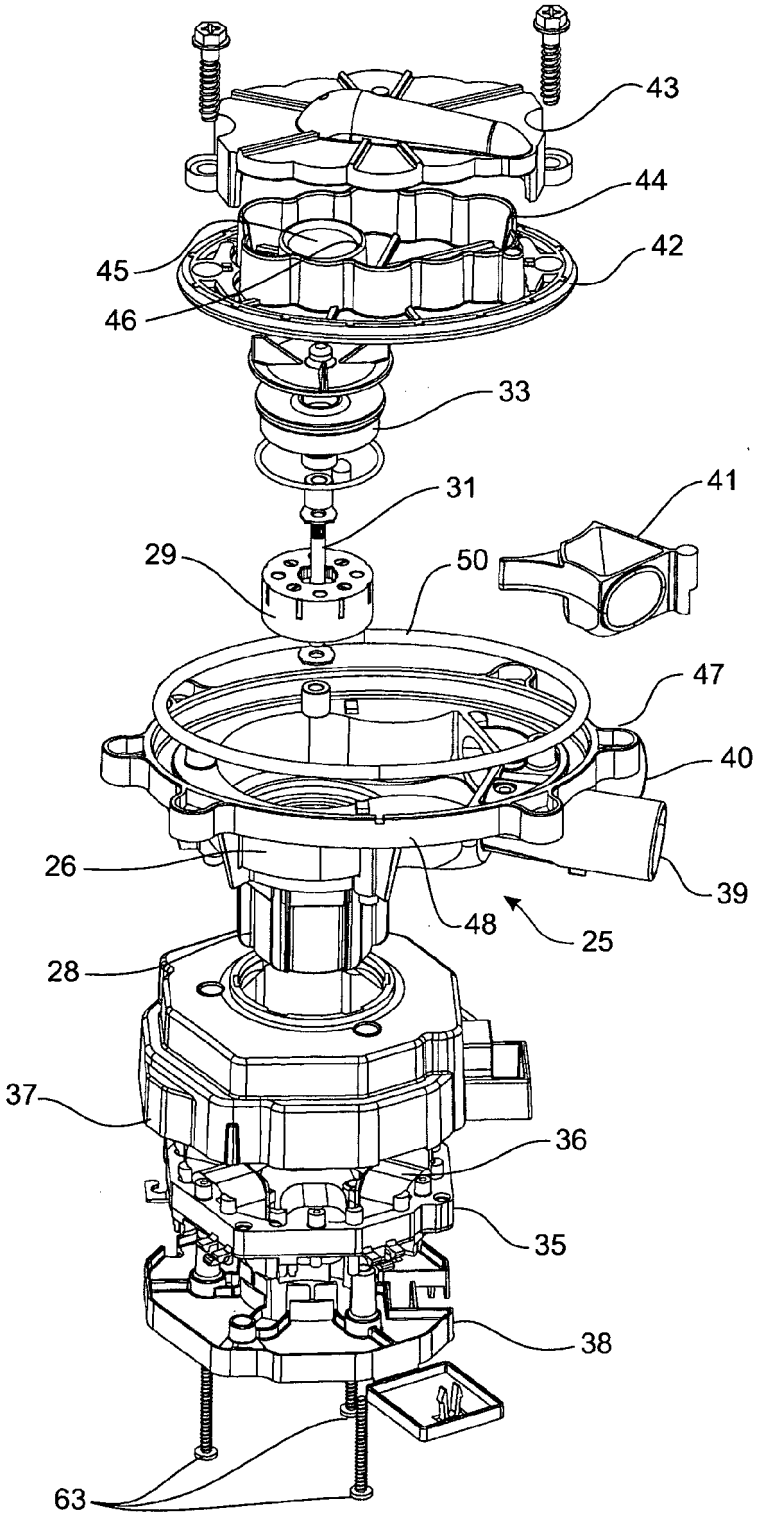

FIGURE 4

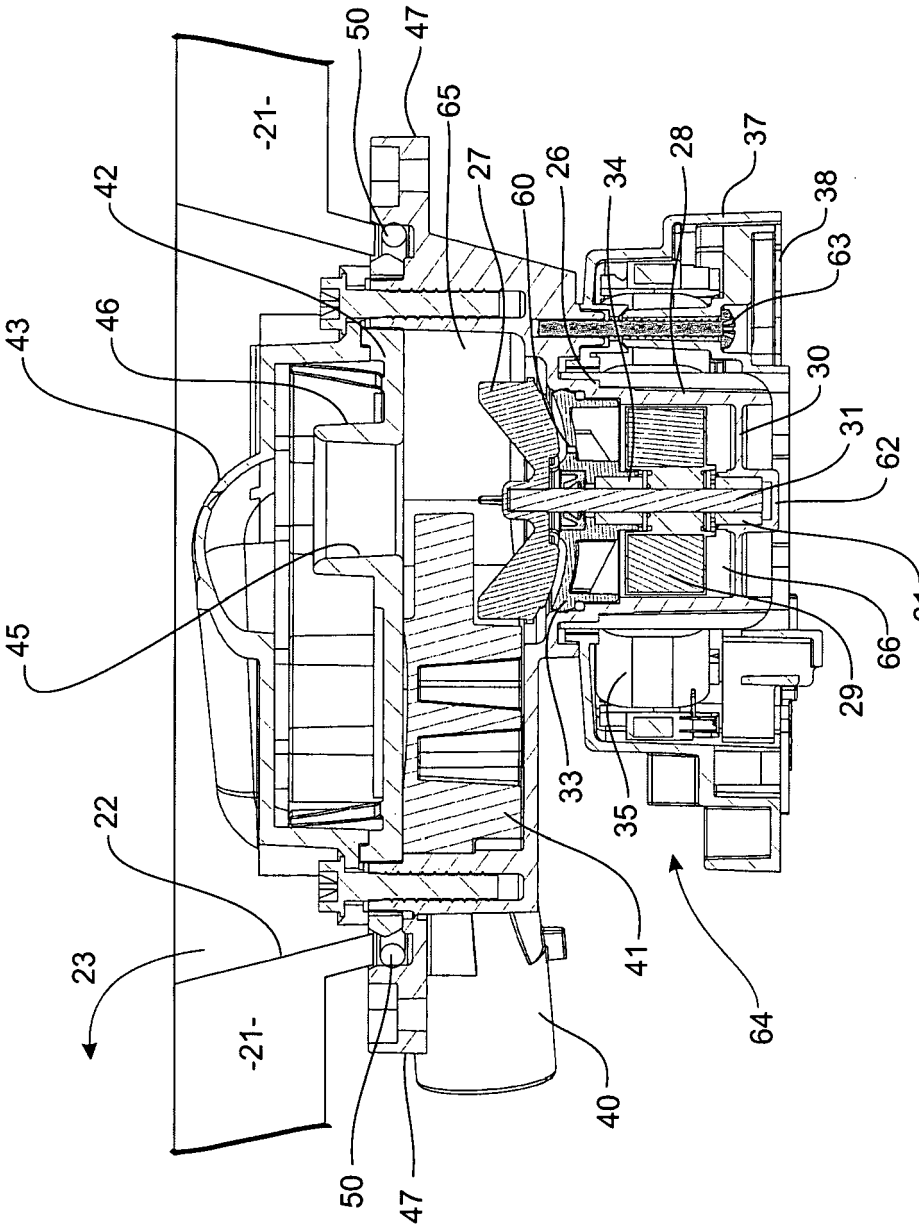
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FIGURE 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4813248 A **[0020]**
- US 6034493 A **[0025]**
- WO 2005062460 A **[0025]**