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(54) **Laundry washing machine**

(57) A laundry washing machine (1) comprising: a laundry drum (5) supported within a washing tub (3) suitable to hold a washing liquid, a detergent basin (8) suitable to hold a detergent, a first supply valve (6) connectable to the water supply system, a first supply conduit (17) connecting the first supply valve (6) in flow communication with the detergent basin (8) so as to supply mains water in the detergent basin (8), a second conduit (18)

connecting the detergent basin (8) in flow communication with the interior of the laundry drum (5), and pumping means (19) connected to the second supply conduit (18) and actuable for suctioning mains water along with the detergent from the detergent basin (8) by means of an accelerated jet or Venturi jet and for spraying the suctioned mixture of water and detergent directly into the laundry drum (5).

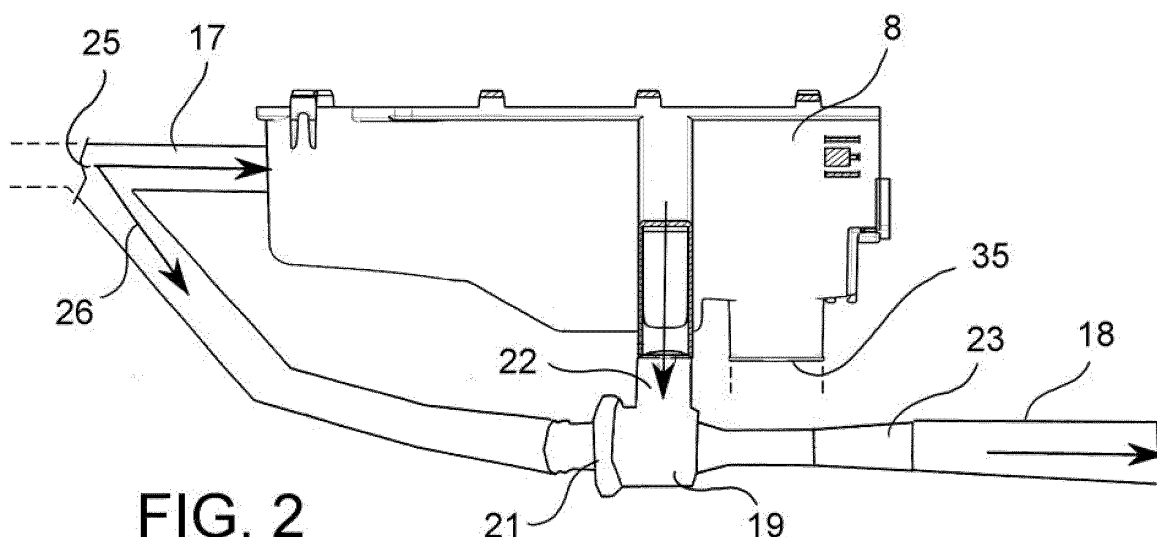


FIG. 2

Description

[0001] The present invention relates to a device and method for washing laundry, particularly a household laundry washing machine.

[0002] The household laundry washing machines comprise a support and housing structure, inside which a washing tub is housed, which is provided with a front opening that can be closed by a porthole door frontally hinged to the housing. A drum to receive the laundry to be subjected to the washing operation is housed inside the washing tub, in a rotatable manner about a horizontal or inclined axis. The drum also defines a front opening arranged at the washing tub opening, in order to be able to carry out the laundry loading and unloading.

[0003] The washing tub is suitable to hold the washing liquid during the laundry washing steps.

[0004] In order to allow the loading of the tub with mains water and detergent substances and additives, a system for loading the washing water is provided for, which is connectable to the water supply system. A drain conduit is provided for on the washing tub bottom, with an associated drain pump that provides for the removal of the washing liquid from the tub and that controls, together with the loading system, the liquid level inside the tub. In order to heat the washing liquid contained in the tub, an electric resistor is provided for, which is arranged inside the tub in the interspace between the tub wall and the laundry drum.

[0005] The washing and washer-dryer machines of the prior art, and the washing and drying methods implemented thereby, while being satisfactory from several aspects, are bulky and have a high consumption of water, electric power, and detergent.

[0006] In order to decrease the consumption of water and detergent, it is known to provide the laundry washing machines with recirculation systems that remove the washing liquid from the tub bottom (where it builds up still before wetting the laundry inside the drum) and put it back into the laundry drum, so that a reduced liquid volume is repeatedly poured onto the laundry to be washed. Such recirculation systems typically use an electric recirculation pump that, however, consumes electric power, in addition to increase the manufacturing cost and the overall dimensions of the laundry washing machine.

[0007] Furthermore, pumps are known, which are referred to as jet pumps or ejectors, which use the Venturi effect of a converging-diverging nozzle to convert the pressure energy of a motor fluid into velocity energy, which, in turn, creates a low pressure that draws and drags a driven fluid. The motor fluid and the dragged driven fluid may be liquids or gases.

[0008] During the testing of washing systems and methods, a number of configurations of electric pumps and ejectors for recirculating the washing liquid from the tub bottom into the laundry drum of the laundry washing machine have been tested. Some washing systems and

methods that have been tested and are the object of a not yet published patent applications, provide for the use of an ejector as a recirculation pump in order to save electric power and reduce the overall dimensions of the laundry washing machine.

[0009] However, the washing methods and systems with or without recirculation of the washing liquid known to date have some drawbacks, which have not solved to date.

[0010] The mains water and the detergent inserted in the washing tub, instead of acting immediately and in an intense manner with the laundry, are inserted into the tub by gravity, thus initially building up on the washing tub bottom, and require energy to be pumped again (in the case of a washing system with recirculation) or dragged/lifted upwardly (by the rotation of the laundry drum) and let fall on the laundry drum bottom or inside it, where they finally contact the laundry.

[0011] Furthermore, in the first washing steps, the detergent is not yet completely transferred from the detergent basin into the washing tub, and the portion of detergent brought into the tub is not evenly mixed with water, but tends to deposit on the tub bottom. Consequently, in the first washing steps the concentration of detergent in the laundry is undesirably low.

[0012] Finally, the repetitive recirculation, necessary to bring the detergent deposited on the tub bottom in contact with the laundry inside the laundry drum, although it could be done with electric pumps with high efficiency or by an ejector, involves operating costs and consumption of electric power and water.

[0013] The known automatic washing systems and methods are further generally lacking an initial step of direct "soaping" of the laundry, possibly associated to a rubbing operation, which is usual in the manual washing and of great help for a targeted and saving use of cleaning.

[0014] Therefore, the main object of the present invention is to provide a washing machine and a washing method, which have such characteristics as to obviate at least some of the drawbacks mentioned with reference to the prior art.

[0015] Specific objects of embodiments of the invention are the increase of the washing efficiency, the reduction of the consumptions of detergent and water, the reduction of the overall energy usage for an automatic washing of the laundry, and the simplification of the washing system itself.

[0016] A further object of the invention is to provide a laundry washing machine with an improved water and detergent supply system and, consequently, with improved washing performance.

[0017] These and other objects are achieved by a laundry washing machine comprising:

- a laundry drum supported within a washing tub suitable to hold a washing liquid,
- a detergent basin suitable to hold a detergent,

- a first supply valve connectable to the water supply system and a first supply conduit connecting the first supply valve in flow communication with the detergent basin so as to supply mains water in the detergent basin,
- a second supply conduit connecting the detergent basin in flow communication with the interior of the laundry drum,
- pumping means connected to the second supply conduit and actuatable for suctioning mains water along with the detergent from the detergent basin and spraying the suctioned mixture of water and detergent directly onto the laundry within the laundry drum.

[0018] By virtue of the forced suctioning of the detergent basin, the detergent initially contained in the basin is rinsed away in a quicker and more complete manner, and it mixes in a more intense manner with the water. This mixture with a high detergent concentration, instead of falling onto the washing tub bottom, is sprayed directly and with an accelerated jet (compared to the effect only of the gravity) onto the laundry within the laundry drum. Due to the drum rotation, the laundry is located from the start along a "satellized" ring along the drum circumferential wall, exposing a high amount of surface to the jet of the detergent mixture.

[0019] A direct soaping of the laundry in the initial washing step is thus obtained, along with a mechanical action given by the hydrodynamic pressure of the spray. Furthermore, a deposition of unused detergent onto the tub bottom is obviated, since the mixture of water and detergent sprayed in the laundry within the drum, before being able to reach the outside of the rotating drum, has to pass through, hence to interact with the entire thickness of the laundry ring arranged along the cylindrical wall of the drum.

[0020] By spraying the water-detergent mixture from the detergent basin directly into the laundry drum, the need to (and the energy consumption necessary to) lift the detergent from the tub bottom and recirculate it in the laundry drum is further obviated.

[0021] Further advantageous aspects of the invention will be apparent from the following description of some embodiments thereof by way of non-limiting example, with reference to the appended Figures, in which

- Fig. 1 is a schematic view of a laundry washing machine according to an embodiment of the invention;
- Fig. 2 shows an enlarged detail of a laundry washing machine according to a further embodiment of the invention;
- Fig. 3 is a perspective view of a detergent basin (with lid removed) of a laundry washing machine according to an embodiment of the invention;
- Fig. 4 is a sectional view of the detergent basin in Fig. 3;
- Fig. 5 is a top view of the detergent basin in Fig. 3;

- Fig. 6 shows the conduction system of the washing liquid into a laundry washing machine according to an embodiment, in which the outer housing and some other components of the laundry washing machine are omitted;
- Fig. 7 is a side view of the system in Fig. 6;
- Fig. 8 shows a front view of the system in Fig. 6, as well as an embodiment variation indicated by hatched lines;

[0022] With reference to the figures, a laundry washing machine 1 or washer-dryer machine, intended as a particular embodiment of the laundry washing machine, comprises a support and housing structure 2, inside which a washing tub 3 is housed, which is provided with a front opening that is closable by a porthole door 4 frontally hinged to the housing 5. A drum 5 to receive the laundry to be subjected to the washing operation is housed inside the washing tub 3, in a rotatable manner about a horizontal or inclined axis. The drum 5 also defines a front opening arranged at the washing tub 3 opening, in order to be able to carry out the laundry loading and unloading.

[0023] The washing tub 3 is suitable to hold the washing liquid during the laundry washing steps.

[0024] In order to allow the loading of the tub 3 with mains water and detergent substances and additives, a system for loading the washing water is provided for, which is connectable to the water supply system. Such washing water loading system may comprise a plurality of washing flow paths, extending, for example, from two supply electrovalves 6, 7, through respective detergent compartments 11 of a detergent basin 12, up into the washing tub 3.

[0025] A drain conduit 9 connects to the bottom 12 of the washing tub 3, with associated drain pump 10 which provides for the removal of the washing liquid from the tub 3 and which controls, together with the supply electrovalves 6, 7 the liquid level within the tub 3.

[0026] In order to heat the washing liquid contained in the tub 3, an electric coil resistor 11 may be provided for, which is arranged inside the tub 3, particularly on the tub bottom 12, in the interspace between the wall of the tub 3 and the laundry 5.

[0027] For the stirring and mixing of the laundry with the washing liquid, the laundry drum 5 may be actuated in rotation by an electric motor 13 and a transmission 14, for example a belt.

[0028] The operation of the laundry washing machine 1 is controlled by an electronic, electric, or electromechanical control unit 15, operatively connected to a user control interface 16 which is located at an outer wall of the support structure 2 and which allows selecting the washing cycles and the characteristics thereof. In response to the selections carried out by the user by the user interface 16, the control unit 15 controls the various components of the laundry washing machine 1 to automatically carry out the washing of the laundry.

[0029] According to an embodiment, the laundry washing machine 1 comprises:

- a first conduit 17 connecting a first supply valve 6 in flow communication with the detergent basin 8 so as to supply mains water in the detergent basin 8,
- a second conduit 18 connecting the detergent basin 8 in flow communication with the interior of the laundry drum 5, and
- pumping means connected to the second supply conduit 18 and actuatable for suctioning mains water along with the detergent from the detergent basin 8 and for spraying the suctioned mixture of water and detergent directly onto the laundry within the laundry drum 5.

[0030] By virtue of the forced suctioning of the detergent basin 8, the detergent initially contained in the basin is rinsed away in a quicker and more complete manner, and it mixes in a more intense manner with the water. This mixture with a high detergent concentration, instead of falling onto the washing tub 3 bottom, is sprayed directly (onto the laundry) in the laundry drum 5.

[0031] A direct soaping of the laundry in the initial washing step is thus obtained, along with a mechanical action given by the hydrodynamic pressure of the spray. Furthermore, a deposition of unused detergent onto the tub bottom 3 is obviated, since the mixture of water and detergent sprayed in the drum 5, before being able to reach the outside of the rotating drum, has to pass through, hence to interact with the entire thickness of the laundry ring arranged along the cylindrical wall 20 of the drum 5.

[0032] By spraying the water-detergent mixture from the detergent basin 8 directly into the laundry drum 5, the need to (and the energy consumption necessary to) lift the detergent and the water from the tub bottom and recirculate it in the laundry drum 5 is further obviated.

[0033] In accordance with an embodiment, the pumping means comprise an ejector 19 with a motor fluid inlet opening 21 connectable to the water supply system by one of the electrovalves 6, 7, a suction opening 22, and an outlet opening 23 that are connected in the second conduit 18, as illustrated e.g., in Fig. 2.

[0034] By virtue of the use of the ejector 19 to pump the liquid from the detergent basin 8 into the laundry drum 5, a further electric power saving is obtained, as well as a reduction of the overall dimensions and the manufacturing cost compared to the use of an electric pump.

[0035] However, the invention also contemplates the use of alternative pumping means, e.g., an electric pump.

[0036] According to an embodiment, the motor fluid inlet opening 21 of the ejector 19 is connected to a third conduit 24 branching directly from the first conduit 17 in a branch point 25 upstream of the detergent basin 8.

[0037] In this manner, during the supply of mains water into the detergent basin 8, a partial flow 26 (Fig. 2) of mains water is directed into the ejector 19, where it per-

forms the function of motor fluid for the pumping operation.

[0038] In addition to the suction effect, also the geometry of the Venturi with narrowing and the abrupt speed and flow direction changes within the ejector 19 concur to an intense mixing between the detergent and the mains water before the application thereof onto the laundry.

[0039] Branching the flow of the ejector motor fluid directly from the first conduit 17, a functional and control simplification is further obtained. In fact, by actuating the first supply valve 6, a concomitant filling with liquid of the detergent basin 8 and the conduits connected to the ejector 19 is obtained, without any needs for a further synchronization of the introduction of water in the detergent basin 8 and the pumping means.

[0040] In an embodiment, the control unit 15 of the laundry washing machine 1 is configured so as to rotate the laundry drum 5 and simultaneously spraying the mixture of water and detergent suctioned from the detergent basin 8 into the laundry drum 5.

[0041] In this manner, the rotational motion and the centrifugal force arrange and distribute the laundry in an annular zone along the (cylindrical or conical) side wall 20 of the drum 5 and make it pass continuously under the jet or spray of the water-detergent mixture, which thus reaches directly a large laundry surface.

[0042] In a further embodiment, the second supply conduit has a plurality of outlet openings or nozzles 27 so as to produce a plurality of individual jets directed onto different areas within the laundry drum 5, preferably on areas of the inner surface of the side wall 20 along which the laundry subjected to the washing is arranged.

[0043] The nozzle(s) 27 preferably face the front opening of the laundry drum 5 so as to directly spray through that opening to the inside thereof. Advantageously, the nozzle(s) 27 are located at an elastic gasket 28 formed between the front opening of the tub 3 and the housing 2, as shown, for example, in the Figs. 6 and 8.

[0044] In an embodiment, the second conduit 18 branches downstream of the pumping means, forming two conduit lengths 29, 30 connected to nozzles 27 that are mutually spaced apart and arranged, for example, on two opposite sides of the front opening of the tub 3 (Figs. 1 and 8).

[0045] The ejector 19 can be arranged in an otherwise unused space between the detergent basin 8 and the washing tub 3, preferably in the upper third of the height of the tub 3 (Fig. 6). In order to obviate the risk of damages due to the vibrations of the tub 3, the ejector 19 is advantageously located in the proximity of an outer side of the detergent basin 8 facing away from the tub 3.

[0046] In an embodiment, the detergent basin 8 forms a first tank cavity 31 with a first discharge opening 32 formed in a bottom wall of the first tank cavity 31 and connected to the second conduit 18. Adjacent to the first tank cavity 31 a second tank cavity 33 is formed, with a second discharge opening 34 formed in a bottom wall of the second tank cavity 33 and connected by a descending

conduit 35 directly to the washing tank 3. Between the first 31 and the second tank cavity 33, a partition wall 36 is formed, with a predetermined height defining an isolated maximum filling level only of the first tank cavity 31. The mains water coming from the first conduit 17 is directed, for example, guided by the shape of the detergent compartments above, in the first tank cavity 31 and, only when the maximum filling level is exceeded, it overflows an upper edge 37 of the partition wall 36 from the first tank cavity 31 into the second tank cavity 33.

[0047] In this manner, it is possible to produce in the second conduit 18 a liquid column that increase the hydrostatic pressure and provide a liquid build-up that ensures the continuity of the flow in the pumping means. In the case of an excessive build-up, the excess liquid may freely overflow in the second tank cavity 33 and fall by gravity through the descending conduit 35 into the washing tub 3.

[0048] In addition to the first conduit 17, a further supply conduit (fifth conduit 38) can be provided for, which connects a second supply valve 7 in flow communication with the detergent basin 8 so as to be able to direct a further flow of mains water in the detergent basin 8 and, by the selection and combination of the two independent flows (e.g., single flow from the first conduit, single flow from the fifth conduit or crossed flow from the first and fifth conduit) rinsing detergents and additives from different detergent compartments of the detergent basin 8.

[0049] The description hereto provided relates to a front loading laundry washing machine. However, the concepts of the invention can be similarly applied also to top loading laundry washing machines. In such machines, the laundry drum 5 has a loading opening, for example, a casement loading opening, formed in a side wall of the drum 5 and that can be overlapped by an upper opening of the washing tub and the support structure, which may be closed and opened by a hinged lid. In the top loading laundry washing machines, the detergent basin can be preferably formed or connected directly to the hinged lid, and it is arranged in flow connection with the several conduits at least when the lid is closed (operative state of the machine).

[0050] The laundry washing machine 1 may further comprise a system for the recirculation of the washing liquid from the tub bottom to the laundry drum, similarly to the recirculation systems described with reference to the prior art.

[0051] Finally, the present invention also relates to the washing method described with exemplary reference to the washing machine 1, and the characteristic thereof are not repeated herein for the sake of brevity.

[0052] It shall be apparent that, to the laundry washing machine and the washing method according to the present invention, those skilled in the art, in order to meet contingent, specific needs, will be able to make further modifications and variations, all of which anyhow fall within the protection scope of the invention, as defined by the following claims.

Claims

1. A laundry washing machine (1) comprising:

- a laundry drum (5) supported within a washing tub (3) suitable to hold a washing liquid,
- a detergent basin (8) suitable to hold a detergent,
- a first supply valve (6) connectable to the water supply system, and a first supply conduit (17) connecting the first supply valve (6) in flow communication with the detergent basin (8) so as to supply mains water in the detergent basin (8),
- a second conduit (18) connecting the detergent basin (8) in flow communication with the interior of the laundry drum (5), and
- pumping means (19) connected to the second supply conduit (18) and actuatable for suctioning mains water along with the detergent from the detergent basin (8) and for spraying the suctioned mixture of water and detergent directly into the laundry drum (5).

2. The laundry washing machine (1) according to claim 1, wherein the pumping means comprise an ejector (19) with a motor fluid inlet opening (21) connectable to the water supply, a suction opening (22) and an outlet opening (23) that are connected in the second conduit (18).

3. The laundry washing machine (1) according to claim 2, wherein the motor fluid inlet opening (21) of the ejector (19) is connected to a third conduit (24) branching directly from the first conduit (17) in a branch point (25) upstream of the detergent basin (8).

4. The laundry washing machine (1) according to one of the preceding claims, wherein the laundry washing machine (1) is configured so as to rotate the laundry drum (5) and to concomitantly actuate the pumping means (19) so as to spray a mixture of water and detergent suctioned from the detergent basin (8) in the inside of the rotating laundry drum (5).

5. The laundry washing machine (1) according to one of the preceding claims, wherein the second supply conduit has a plurality of nozzles (27) directing a plurality of individual jets onto different areas within the laundry drum (5).

6. The laundry washing machine (1) according to one of the preceding claims, wherein the second supply conduit has one or more nozzles (27) facing a front opening of the laundry drum (5) and spray directly through said front opening into the laundry drum (5).

7. The laundry washing machine (1) according to claim

6, wherein said one or more nozzles (27) are located at a gasket (28) that is formed between a front opening of the tub (3) and a housing (2) of the laundry washing machine (1).

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8. The laundry washing machine (1) according to claim 7, wherein the second conduit (18) branches downstream of the pumping means (19), forming two conduit lengths (29, 30) connected to nozzles (27) that are mutually spaced apart and arranged on two opposite sides of the front opening of the tub (3).

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9. Washing machine (1) according to one of the claims 2 to 8, wherein the ejector (19) is arranged on a side of the detergent basin (8) facing away from the tub (3) in the upper third of the tub (3) height.

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10. The laundry washing machine (1) according to one of the preceding claims, wherein the detergent basin (8) forms:

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- a first tank cavity (31) with a first discharge opening (32) formed in a bottom wall of the first tank cavity (31) and connected to the second conduit (18),
- a second tank cavity (33) with a second discharge opening (34) formed in a bottom wall of the second tank cavity (33) and connected by a descending conduit (35) to the washing tank (3),
- a partition wall (36) between the first tank cavity (31) and the second tank cavity (33), said wall having a predetermined height defining a maximum filling level of the first tank cavity (31),

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wherein the detergent basin (8) has such an internal shape as to guide the liquid in the first tank cavity (31) from which it overflows, only when the maximum filling level is exceeded, passing over an upper free edge (37) of the partition wall (36) in the second tank cavity (33).

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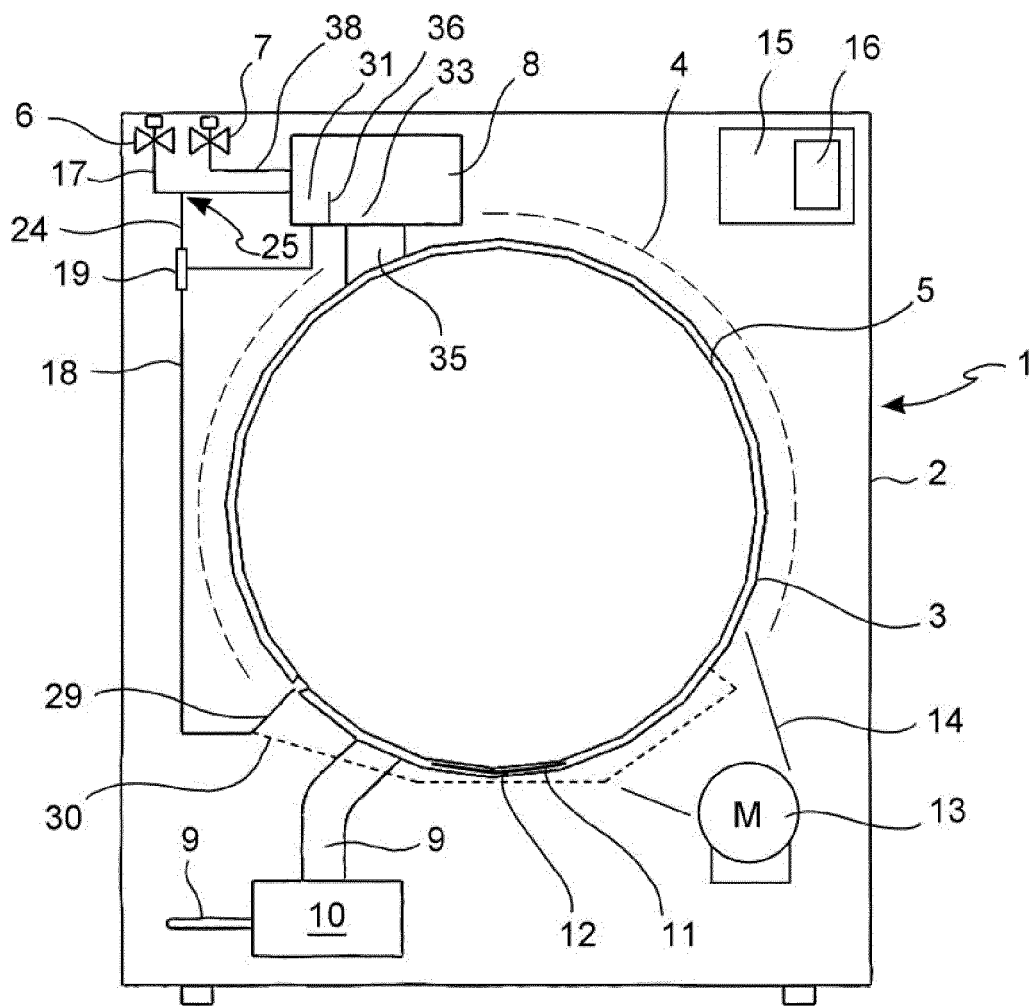


FIG. 1

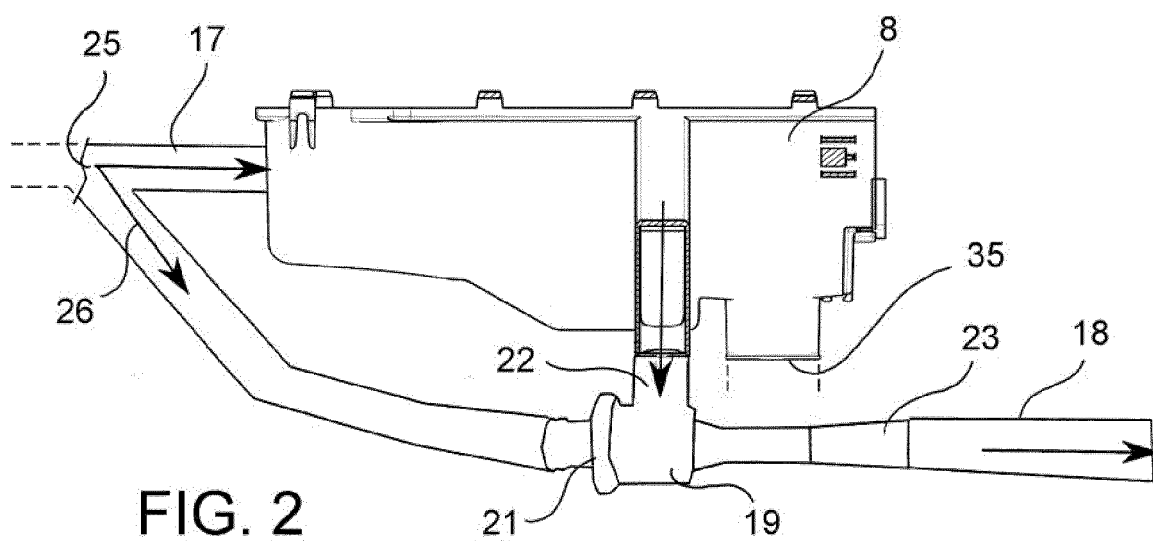
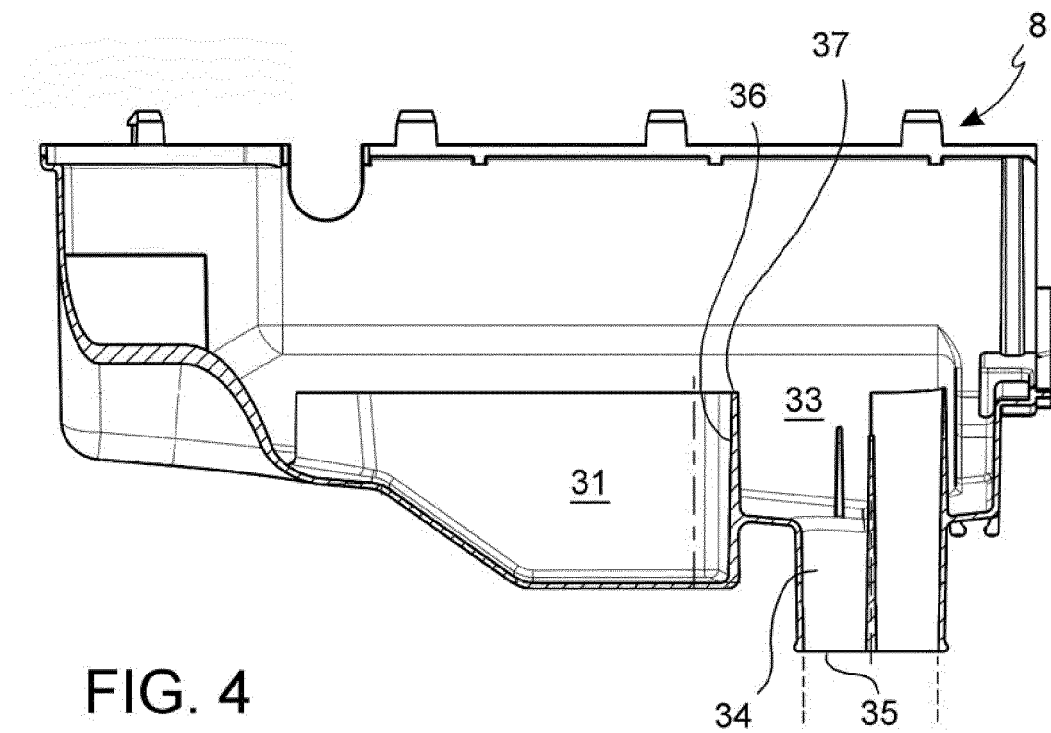
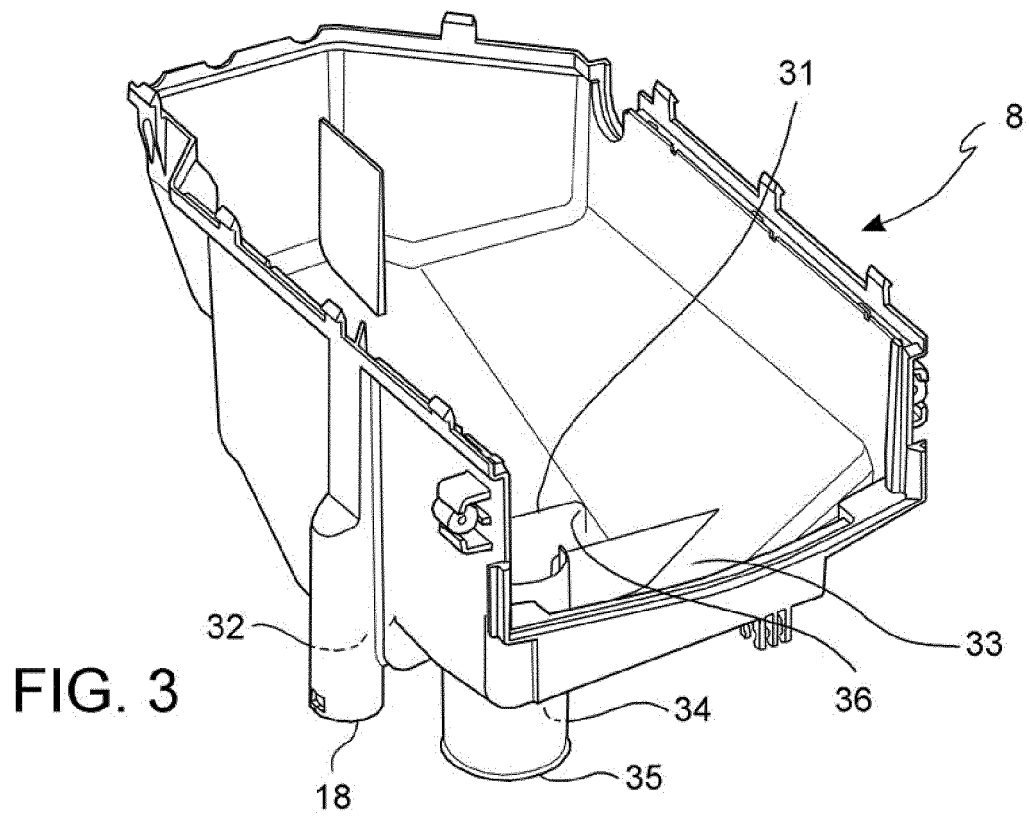


FIG. 2



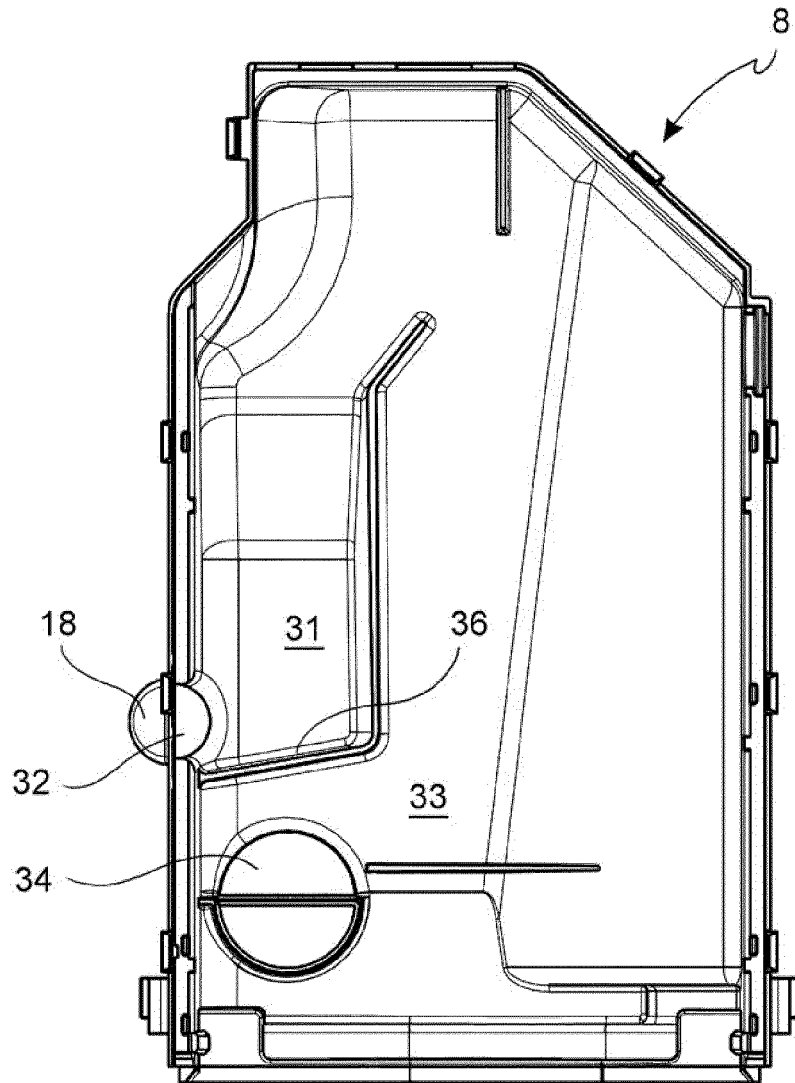


FIG. 5

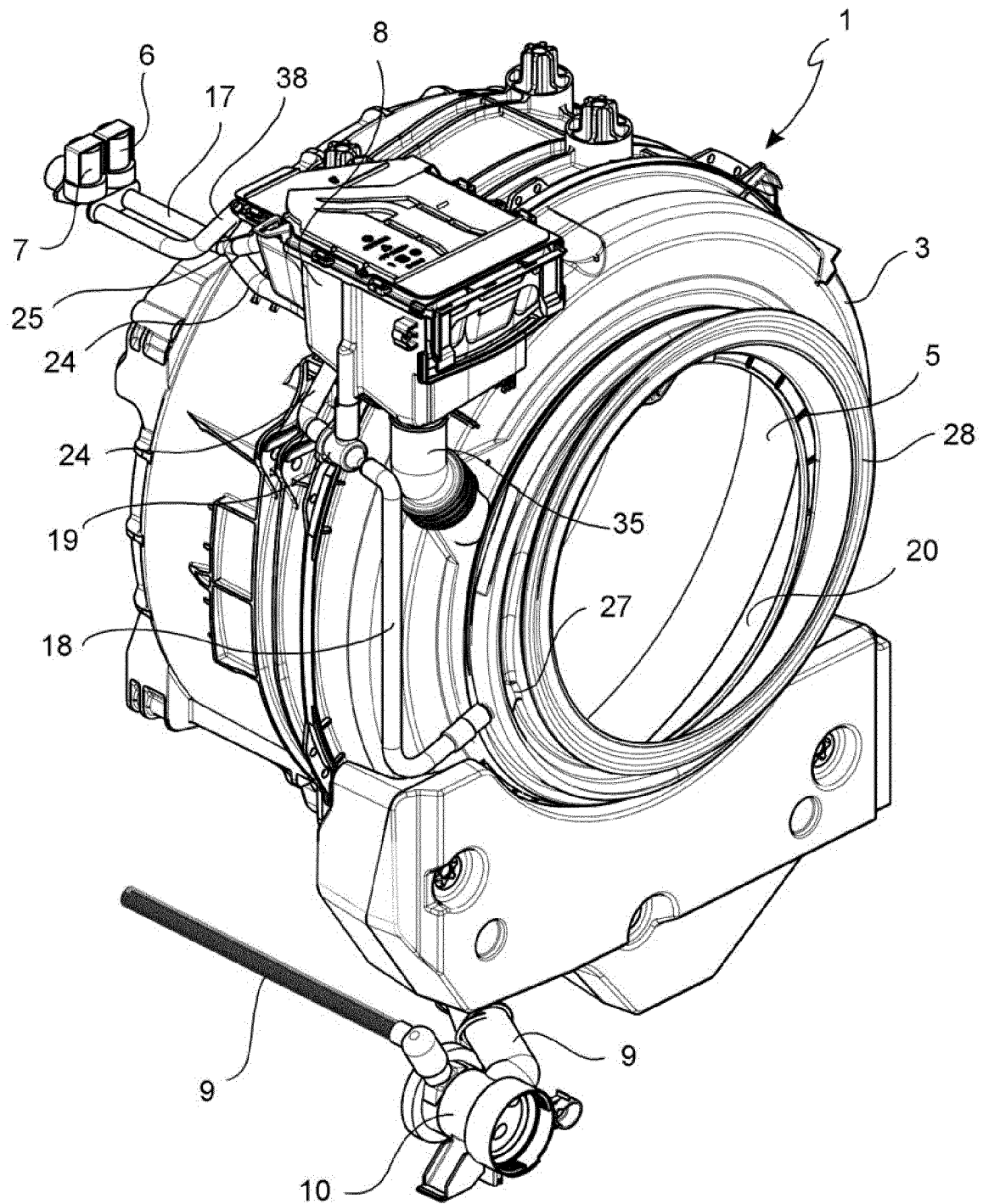


FIG. 6

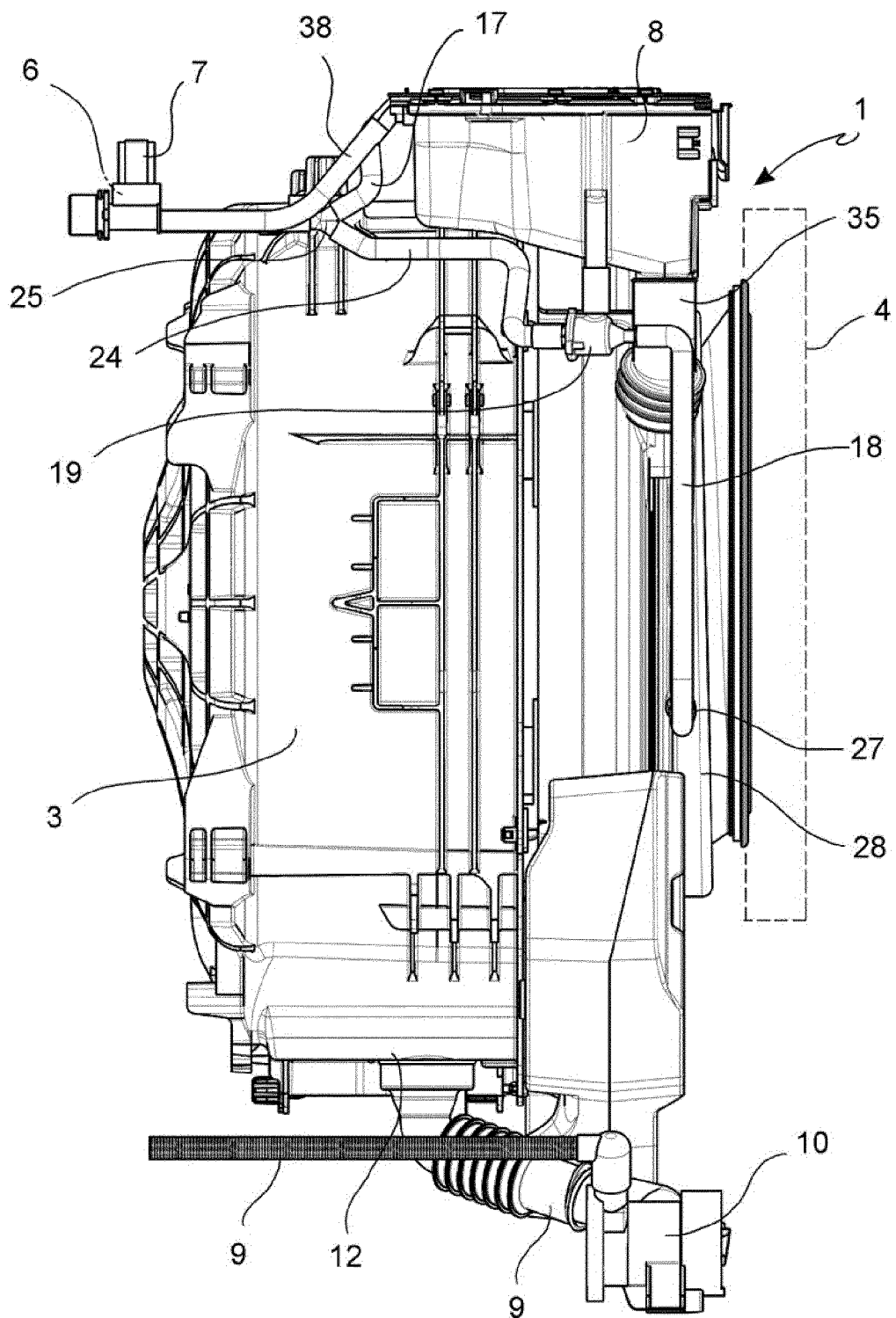


FIG. 7

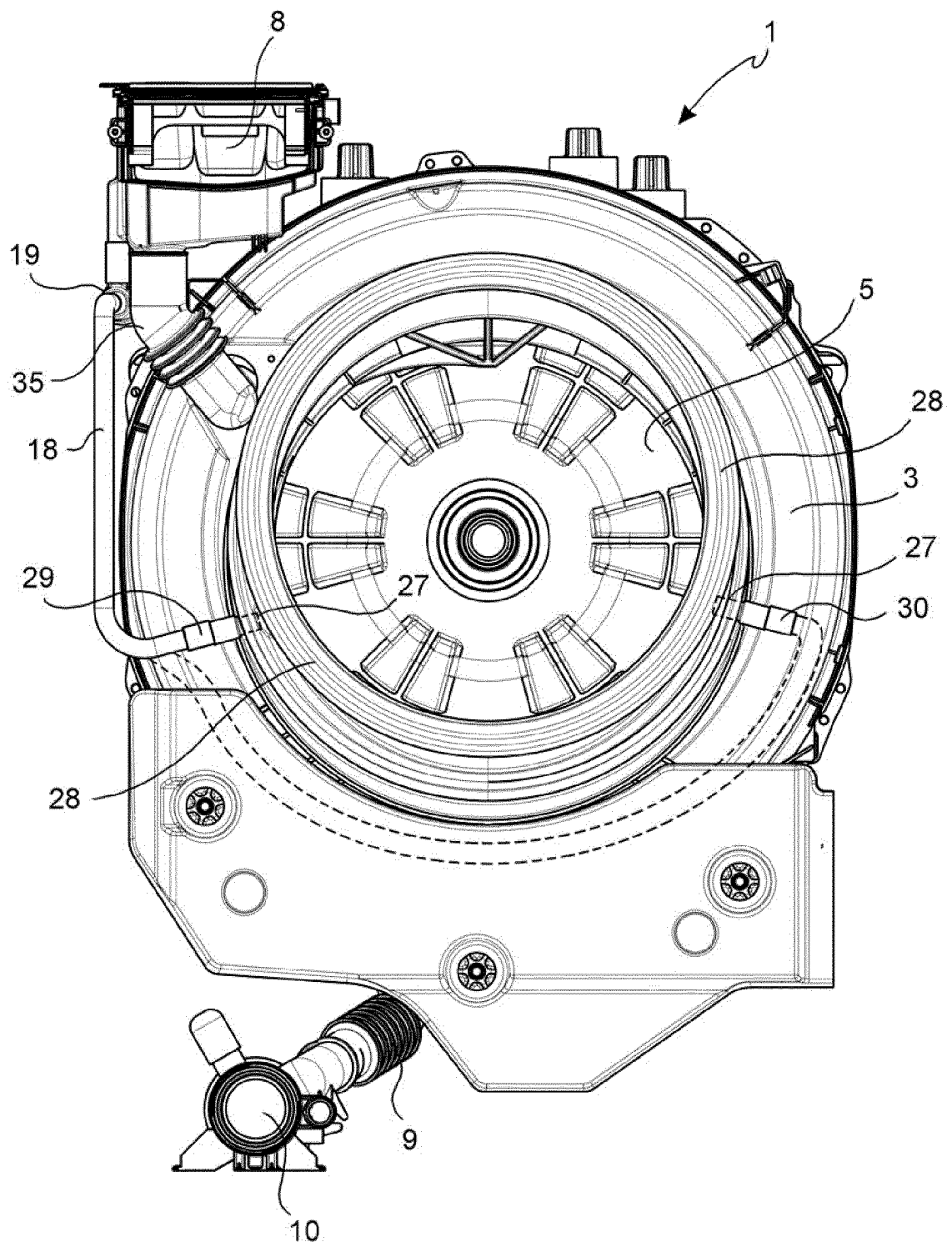


FIG. 8



EUROPEAN SEARCH REPORT

 Application Number
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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