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(54) **WASHING MACHINE**

(57) A washing machine (1) comprising a fall duct (16) which connects a detergent container (14) to an intake passage (17) extending through an annular seal (8) into a laundry drum (11) so as to convey a mixture of mains water and detergent from the detergent container

(13), through the intake passage (17), directly into the laundry drum (11), wherein the fall duct (16) forms an auxiliary opening (46) forming an overflow wall (47) for an overflow of liquid by bypassing the intake passage (17) in the event of a blockage in the fall duct (16).

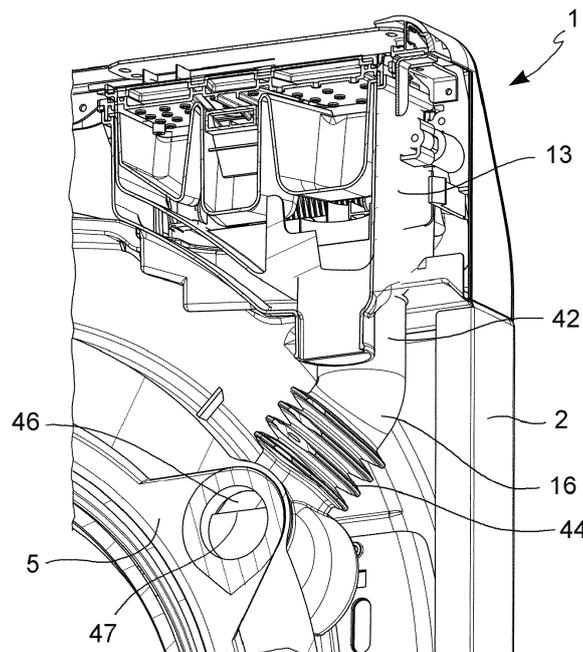


FIG. 12

Description

[0001] The present invention relates to a device and a method for washing laundry, in particular a domestic washing machine.

[0002] The washing machines and combo washer dryers of the background art and the washing and drying methods implemented thereby, although satisfactory in many respects, involve a high consumption of water, electricity and detergent and do not always achieve the desired washing results, in particular, in the presence of stains which would require a treatment with a more concentrated detergent solution with respect to that usually present in domestic washing machines.

[0003] In order to reduce the consumption of water and detergent, it is known to equip washing machines with recirculation systems which remove the washing liquid from the bottom of the tub (where it accumulates even before wetting the laundry inside the drum) and reintroduce it into the laundry drum so that a reduced volume of liquid is repeatedly poured onto the laundry to be washed.

[0004] Such recirculation systems usually use an electric recirculation pump which, however, consumes electricity and does not recirculate a concentrated washing solution, but instead a washing solution diluted into a considerable amount of water.

[0005] The mains water and the detergent, introduced into the washing tub, instead of acting immediately and intensely with the laundry, are introduced into the tub by gravity, allowing them to initially accumulate on the bottom of the washing tub, and require energy to be pumped (in the case of a washing system with recirculation) or dragged/lifted upwards again (by rotating the laundry drum) and dropped on the bottom of the laundry drum or thereinside, where they finally come into contact with the laundry.

[0006] Furthermore, during the early washing steps, the detergent is not yet completely transferred from the detergent drawer into the washing tub and the detergent portion brought into the tub is not uniformly mixed with the water but tends to deposit on the bottom of the tub. Consequently, during the early washing steps the concentration of detergent in the laundry is undesirably low.

[0007] Known automatic washing systems and methods are also generally lacking an initial step of direct "soaping" of the laundry, possibly accompanied by rubbing, which is usual in hand washing and of great help for a targeted and economical use of detergent.

[0008] Washing machines are also known in which a solution of water and detergent is introduced directly into the front opening of the drum, by means of a duct which extends from the outside of the washing tub to an opening formed in an annular seal arranged between the front opening of the washing tub and the front opening of the housing of the washing machine. These known solutions obviate an excessive dilution of the detergent but, according to the inventors, have further room for improve-

ment.

[0009] For example, the convex surface of the glass of the porthole door conventionally extends in the trajectory of the flow of water and detergent so that, undesirably, the flow of water and detergent is withheld and guided along the inner surface of the glass of the porthole door downwards and, through the gap between the annular seal and the drum, at least part of the flow flows into the washing tub, instead of directly impacting the laundry inside the drum.

[0010] A further issue of the known solutions for introducing water and detergent through the annular seal between the washing tub and the housing of the washing machine is due to the very narrow space in the seal area. In the event of partial or total obstruction of this very narrow space, for example, due to a garment or due to a lump of detergent not completely dissolved, the flow of water and detergent may not flow inside the drum, and the consequent blockage causes a rise in the level of the liquid in the duct with a consequent overflow of the liquid at the detergent drawer towards the outside of the washing machine.

[0011] A further disadvantage of known solutions for introducing water and detergent through the annular seal between the washing tub and the housing of the washing machine is the risk of the impermeability in the hydraulic connections between the duct and the elastomeric seal and the structure (of the seal and of the duct/nozzle) undesirably complex and difficult to achieve by injection molding.

[0012] It is therefore the main object of the present invention to provide a washing machine and a washing method having improved features and such to obviate at least some of the drawbacks mentioned with respect to the background art.

[0013] Specific objects of the embodiments of the invention are the increase of the washing efficiency, a better control of the direction of the flow of water and detergent directly towards the laundry inside the drum, a reduction of the risk of unwanted leaks in case of obstruction of the passage of the flow to the seal, a structure which is simple and easy to construct by injection molding and to mount, as well as a reliable and resistant hydraulic connection.

[0014] These and other objects are achieved by means of a washing machine comprising:

- a housing forming a front opening for loading the laundry delimited by a front annular edge,
- a washing tub adapted to contain a washing liquid, arranged in the housing and forming a fore opening for loading the laundry delimited by a fore annular edge,
- an annular elastomeric seal, extending about the front opening and about the fore opening and fixed to the fore edge and front edge,
- a porthole door which is constrained to the housing and movable from an open position to a closed po-

sition, in which an inner surface of the door engages the annular seal, so as to close the front opening and the fore opening,

- a laundry drum supported inside the washing tub and forming a drum opening at the fore opening of the washing tub,
- a detergent container adapted to contain a detergent,
- a first supply valve which is connectable to the water supply system and a first supply duct which connects the first supply valve in flow communication to the detergent container, so as to supply mains water to the detergent container,
- a fall duct which connects the detergent container in flow communication to an intake passage formed in the annular seal, between the front edge and the fore edge, so as to convey a mixture of said mains water and said detergent from the detergent container, through the intake passage, directly into the laundry drum.

[0015] In accordance with a first independent aspect, the washing machine comprises an intake nozzle inserted into the intake passage and forming:

- a tubular portion having an inlet end, and
- a flattened portion connected to the tubular portion in a transition region, opposite to the inlet end, and having a free outlet end facing the interior of the drum,

[0016] in which the flattened portion is folded, or inclined with respect to the tubular portion, away from the inner surface of the door in the closed position,

[0017] in which the intake passage of the annular seal forms:

- a tubular seat extending in the longitudinal direction and protruding towards a radially outer side of the annular seal and having an inlet opening on said radially outer side,
- a flattened seat bordered with the tubular seat in a transition area, opposite to the inlet opening, and having an outlet opening on a radially inner side of the seal,

in which said tubular seat accommodates said tubular portion and said flattened seat accommodates said flattened portion, and

in which a lower end portion of the fall duct, the tubular seat of the intake passage and the tubular portion of the intake nozzle are inserted into each other and tightened together.

[0018] By virtue of the inclination or folding of the flattened portion of the intake nozzle, the flow of water and detergent coming out from the outlet end enters deeper into the drum and does not meet the inner surface of the porthole door.

[0019] Furthermore, by virtue of the particular shape of the intake nozzle and of the intake passage, as well as by virtue of the insertion and tightening of the lower end portion of the fall duct with the tubular seat of the intake passage and with the tubular portion of the intake nozzle, a sure and repeatable positioning of the intake nozzle, a waterproof and resistant hydraulic connection, as well as an overall simple, robust and easily assembled structure are obtained.

[0020] The highly concentrated detergent mixture, instead of ending up on the bottom of the washing tub, is dispensed or sprayed directly on the laundry inside the laundry drum. Due to the rotation of the drum, the laundry is arranged from the beginning along a "satellite" ring along the circumferential wall of the drum, exposing a large surface to the jet of the detergent mixture.

[0021] According to a further independent aspect, the fall duct forms an auxiliary opening, in a higher position with respect to the position of a lower end portion, said auxiliary opening forming an overflow wall for a safety overflow which allows a safe and controlled emptying of the fall duct 16 in the event of obstruction of the intake passage or of the intake nozzle.

[0022] The auxiliary opening may be connectable or connected to a corresponding receiving opening formed in a wall of the washing tub. Thereby, the overflowed liquid is unloaded in a controlled manner directly into the washing tub.

[0023] Further advantageous aspects of the invention will become apparent from the following description of some embodiments thereof, given by way of non-limiting example, with reference to the accompanying Figures, in which:

- Figure 1 shows a diagrammatic view of a washing machine according to an embodiment of the invention;
- Figure 2 shows a detergent container, a fall duct and an annular seal, mutually assembled, of the washing machine according to an embodiment;
- Figure 3 shows a disassembled view of the detergent container, the fall duct, the annular seal, as well as an intake nozzle, of the washing machine according to an embodiment;
- Figures 4 and 5 show, from different points of view, the fall duct, a detail of the annular seal forming an intake passage, as well as the intake nozzle, of a washing machine according to an embodiment,
- Figure 6 shows a perspective view of the fall duct according to an embodiment;
- Figures 7, 8 and 9 show views of the intake nozzle according to an embodiment,
- Figure 10 shows a detail of the washing machine according to an embodiment, in which the detergent container, the fall duct, the washing tub, the annular seal with the intake passage and a tightening clip, as well as the laundry drum, are visible
- Figure 11 shows a sectional view according to a sec-

tional plane which crosses the fall duct, the washing tub, the annular seal with the intake passage and the tightening clip, as well as the laundry drum,

- Figure 12 shows a sectional view according to a sectional plane which crosses the detergent container, an overflow opening of the fall duct and the washing tub, and in which an upper end of the fall duct is detached from the detergent container,
- Figure 13 shows a side view of a detail of the washing tub, of the annular seal and of the fall duct.

[0024] With reference to the Figures, a washing machine 1 comprises:

- a housing 2 forming a front opening 3 delimited by a front annular edge 4 for loading and extracting the laundry,
- a washing tub 5 adapted to contain a washing liquid, arranged in the housing 2 and forming a fore opening 6 delimited by a fore annular edge 7,
- an annular elastomeric seal 8, extending about the front opening 3 and about the fore opening 6 and fixed to the fore 7 and front 4 edges,
- a porthole door 9 which is constrained to the housing 2 and movable, for example rotatable, from an open position (in which the openings 3, 6 are free) to a closed position, in which an inner surface 10 of the door engages the annular seal 8, so as to close the front opening 3 and the fore opening 6,
- a laundry drum 11 supported inside the washing tub 5 and forming a drum opening 12 at the fore opening 6 of the washing tub 5,
- a detergent container 13 adapted to contain a detergent,
- a first supply valve 14 which is connectable to the water supply system and a first supply duct 15 which connects the first supply valve 14 in flow communication to the detergent container 13, so as to supply mains water to the detergent container 14,
- a fall duct 16 which connects the detergent container 14 in flow communication to an intake passage 17 extending through the annular seal 8, between the front edge 4 and the fore edge 7, so as to convey, in particular by virtue of a gravitational effect, a mixture of said mains water and said detergent from the detergent container 13, through the intake passage 17, directly into the laundry drum 11.

[0025] According to an embodiment, the washing machine 1 comprises an intake nozzle 18 inserted into the intake passage 17 and forming:

- a tubular portion 19 having an inlet end 20,
- a flattened portion 21 connected to the tubular portion 19 in a transition region 22, opposite to the inlet end 20, and having a free outlet end 23 facing the interior of the drum 11.

[0026] The flattened portion 21 is folded, or inclined with respect to the tubular portion 19, away from the inner surface 10 of the door 9 in the closed position.

[0027] The intake passage 17 is formed by the annular seal 8 and forms:

- a tubular seat 24 protruding towards a radially outer side of the annular seal 8 and having an inlet opening 25 on said radially outer side,
- a flattened seat 26 bordering with the tubular seat 24 in a transition area 27, opposite to the inlet opening 25, and having an outlet opening 60 on a radially inner side of the seal 8.

[0028] The tubular seat 24 accommodates the tubular portion 19 and the flattened seat 26 accommodates the flattened portion 21.

[0029] A lower end portion 28 of the fall duct 16, the tubular seat 24 of the intake passage 17 and the tubular portion 19 of the intake nozzle 18 are inserted into each other and tightened together.

[0030] By virtue of the inclination or folding of the flattened portion 21 of the intake nozzle 18, the flow of water and detergent coming out from the outlet end 23 enters deeper into the laundry drum 11 and is not attracted and diverted by the inner surface 10 of the porthole door 9.

[0031] Furthermore, by virtue of the particular shape of the intake nozzle 18 and of the intake passage 17, as well as by virtue of the insertion and tightening of the lower end portion 23 of the fall duct 16 with the tubular seat 24 of the intake passage 17 and with the tubular portion 19 of the intake nozzle 18, a sure and repeatable positioning of the intake nozzle 18, a waterproof and resistant hydraulic connection, as well as an overall simple, robust and easily assembled structure are obtained.

Detailed description of the intake nozzle 18

[0032] According to an embodiment, the tubular portion 19 is substantially cylindrical, for example, with a circular or oval section, and extending along a longitudinal direction 29. The flattened portion 21 has a length 30 in said longitudinal direction 29, a width 31 in a first transverse direction 32 perpendicular to the longitudinal direction 29, and a height 33 in a second transverse direction 34 perpendicular to the longitudinal direction 29 and to the first transverse direction 32.

[0033] In a view in the first transverse direction 32, the height 33 of the flattened portion is tapered from the transition region 22 to the free outlet end 23 and the flattened portion 21 is folded or inclined in a divergent manner from the longitudinal direction 29.

[0034] According to an embodiment, the flattened portion 21 forms an outer wall/surface 35 facing the front opening 3 and an opposite inner wall/surface 36 facing the interior of the laundry drum 11, in which the outer wall/surface 35 has an externally convex shape, for example, curved in a continuous or uniform manner, while

the opposite inner wall/surface 36 has an externally concave shape, for example, consisting of two substantially planar portions 36', 36" mutually oriented at an obtuse angle (Figures 7, 8, 9).

[0035] This geometric configuration reconciles the need for a reduced resistance to the flow inside the intake nozzle 18, in particular on the outer side of the curve where the speed of the flow is greater, with the need for a positioning of the intake nozzle 18 by means of a shape coupling, facilitated by a geometry with non-gradual edges and corners.

[0036] With a further advantage, on the side of the outer wall/surface 35, the tubular portion 19 terminates at the start of the flattened portion 21, while, on the opposite side of the inner wall/surface 36, the tubular portion 19 extends beyond the start of the flattened portion 21, overlapping the latter by more than 30%, preferably more than 50%, of the length 30 thereof (Figure 7).

[0037] This ensures a better flow continuity inside the intake nozzle 18 and a better geometric coupling of the intake nozzle 18 with the intake passage 17.

[0038] According to an embodiment, in the transition region 22, the intake nozzle 18 forms an outer widening step 37 from the tubular portion 19 to the flattened portion 21. Similarly, in the transition area 27, the intake passage 17 forms an inner step 38 having a substantially complementary shape to the shape of the outer step 37.

[0039] This allows an insertion of the inlet nozzle 18 from the inside of the seal 8 to a certain positioning abutment, formed by the support between the inner 38 and outer 37 steps.

[0040] Advantageously, the outer step 37 is larger in the first transverse direction 32 and smaller or absent in the second transverse direction 34.

[0041] In a view in the second transverse direction 34, the flattened portion 21 widens starting from the transition region 22 to the free outlet end 23, for example, the flattened portion has a substantially trapezoidal shape (Figure 8). This allows to give the free outlet end 23 an elongated and narrow slit shape such as to produce a flow or jet of liquid in the shape of a tent or blade which improves the effectiveness of the soaping of the laundry contained in the laundry drum 11.

Detailed description of the intake passage 17

[0042] According to an embodiment, the intake passage 17 has an inner shape substantially complementary to the outer shape of the intake nozzle 18. This further improves the watertight sealing of the seal 8 and the positioning of the intake nozzle 18.

[0043] According to an embodiment (Figures 2, 5, 11), the annular seal 8 forms, in addition to one or more sealing lips 58 intended to be engaged by the inner surface 10 of the door 9, a first rib or bellow fold 39 protruding radially inwards and extending circumferentially, as well as a second lip 40 protruding radially inwards and extending circumferentially and covering a gap between

the washing tub 5 and the laundry drum 11, in which the intake passage 17 is formed directly in the second lip 40, and the second lip 40 is separated from the first rib or fold 39 by a groove (not a through groove!) or circumferential counter fold 59. This prevents the intake nozzle 18 from undesirably stiffening the first rib or fold 39 and, therefore, reducing the elastic bending capacity thereof.

[0044] With a further advantage, at the intake passage 17 the first rib or fold 39 has a recess 41, for example, in the shape of an arch. Such recess 41 obviates a violation of space between the first rib or fold 39 and the outer contour of the intake passage 17 during the injection molding of the seal 8.

[0045] According to an embodiment (Figure 11), the lower end portion 28 of the fall duct 16 is inserted or fitted (externally) over the tubular seat 24 of the intake passage 17 which, in turn, internally accommodates the tubular portion 19 of the intake nozzle 18, and a tightening clip 43 (or band) is externally applied about the lower end portion 28 of the fall duct 16.

Detailed description of the fall duct 16

[0046] According to an embodiment, the fall duct 16 has a substantially tubular and cylindrical upper portion 42, for example, with an oval or circular section, for a connection of the fall duct to the detergent container 13, the aforesaid lower end portion 28, also preferably cylindrical and tubular, as well as an intermediate bellow-shaped portion 44, or with a corrugated or wavy wall, to facilitate the correct orientation of the lower end portion 28 independently of the position and configuration of the detergent container 13.

[0047] According to a further embodiment, between the upper portion 42 and the lower end portion 28 a deviation (offset) portion 45 may be formed, which realizes a transverse deviation of the flow trajectory in a direction tangent with respect to the annular seal 8 or, in other words, a double deviation of the flow trajectory, for example, by means of a transverse tubular section connecting to each other two pipe sections oriented in predominantly radial directions (with respect to the annular seal 8) and spaced apart with respect to each other in a circumferential direction with respect to the annular seal 8 or with respect to an axis of rotation of the laundry drum 11 (Figures 2, 4, 6).

[0048] This particular geometry brings the fall duct 16 closer to the washing tub 5 and favors a further saving of space. Furthermore, the geometry with a transverse deviation of the flow trajectory forms an internal accumulation sink 49 whose function will be described below.

[0049] Preferably, the deviation portion 45 is formed between the bellow portion 44 and the lower end portion 28.

[0050] According to a further embodiment (Figures 6, 12) and according to a further independent aspect of the invention, the fall duct 16 forms an auxiliary opening 46, in a higher position with respect to the position of a lower

end portion 28 and forming an overflow wall 47 for a safety overflow which allows a safe and controlled emptying of the fall duct 16 in the event of obstruction of the intake nozzle 18.

[0051] According to an embodiment, the auxiliary opening 46 with the overflow wall 47 is formed in an upper part of the deviation portion 45, while a lower part of the deviation portion 45 forms an accumulation space 49, in other words a lowered sink, such as not to cause the level of the liquid to rise beyond the overflow wall 47 during the operation of the intake nozzle 18 without obstructions. Such accumulation space or lowered sink 49 may also be made with geometries different with respect to that of the deviation portion 45 shown in the Figures.

[0052] According to a further aspect, the deviation portion 45 is oriented so as to guide the flow of water and detergent, during operation without obstructions, at a distance from the overflow wall 47, to avoid unwanted overflows of liquids in the absence of liquid accumulation.

[0053] According to a further embodiment, the auxiliary opening 46 may form a connection flange for a connection to a corresponding receiving opening 48 formed in a front wall of the washing tub 5 (Figure 12). Thereby, the overflowed liquid is unloaded in a controlled manner directly into the washing tub 5.

The auxiliary opening 46 and the overflow wall 47 are positioned at the receiving opening 48 of the (fore wall of the) washing tub 5, for example, the position of the auxiliary opening 46 coincides with the position of the receiving opening 48 and the overflow wall 47 may be formed or positioned inside the receiving opening 48 and, possibly, on the same plane of the fore wall of the washing tub 5.

Figure 6 shows, for example, that the fall duct forms a single or double connection flange 61 externally about the auxiliary opening 46 and the overflow wall 47, in which the connection flange 61 engages an edge of the receiving opening 48 of the washing tub 5.

Advantageously, the level of a free overflow edge 62 of the overflow wall 47 is below: a lower bottom wall of the detergent container 13 or an intermediate bellow-shaped portion (44) of the fall duct (16), and above:

- the lower end portion of the fall duct 16 or the intake passage 17 or the free outlet end 23 of the intake nozzle 18. A vertical distance between the free overflow edge 62 and the lower end portion of the fall duct 16 or the intake passage 17 or the free outlet end 23 of the intake nozzle 18 is shorter than a vertical distance between the free overflow edge 62 and the lower bottom wall of the detergent container 13. The fall duct 16 extends from the detergent container 13 downwards, to the intake passage 17, so as to feed the intake nozzle 18 by virtue of the gravitational effect of the water.

[0054] Alternatively, the fall duct 16 feeds the intake

nozzle 18 due to the pressure of the mains water or the effect of pumping means of the washing machine 1 which act on the mains water or on the mixture of detergent and mains water.

Detailed description of the washing machine 1

[0055] A drain duct 51, associated with a drain pump 52, is connected to the bottom 50 of the washing tub 5, to remove the washing liquid from the tub 5 and to control, together with the one or more supply solenoid valves 14, 14' the level of liquid inside the tub 5.

[0056] To heat the washing liquid contained in the tub 5, an electrical resistor 53 may be provided, arranged inside the tub 5, in particular, on the bottom of the tub 50, in the gap between the wall of the tub 5 and the laundry drum 11.

[0057] For shaking and mixing the laundry with the washing liquid, the laundry drum 11 may be activated in rotation by means of an electric motor 54 and a transmission 55, for example, a belt transmission.

[0058] The operation of the washing machine 1 is controlled by an electronic control unit 56, operatively connected to a user control interface 57 positioned on an outer wall of the housing 2, and which allows to select the washing cycles and the features thereof. In response to the selection made by the user by means of the user interface 57, the control unit 56 controls the various components of the washing machine 1 to automatically wash the laundry.

[0059] In one embodiment, the control unit 56 is configured so as to rotate the laundry drum 11 and simultaneously introduce or spray the mixture of water and detergent through the intake nozzle 18 inside the laundry drum 11.

[0060] Thereby, the rotary motion and the centrifugal force arrange and distribute the laundry in an annular area along the side wall (cylindrical or conical) of the drum 11 and continuously pass it under the jet of the water-detergent mixture which thus reaches in a direct manner a large laundry surface.

[0061] In addition to the first supply duct 15, a further supply duct 15' may be provided, connecting a second supply valve 14' in flow communication with the detergent container 13 so as to direct a further flow of mains water in the detergent container 13 and, by selecting and combining the two independent flows (e.g., only the flow from the first duct, only the flow from the second duct or a cross flow from the first and second ducts), rinse detergents and additives from different detergent compartments of the detergent container 13.

[0062] The washing machine 1 may also comprise a system for recirculating the washing liquid from the bottom of the tub to the laundry drum, similarly to the recirculation systems described with reference to the background art.

[0063] Finally, the present invention also relates to the washing method described with exemplary reference to

the washing machine 1, the features of which are not repeated herein for the sake of brevity.

[0064] Obviously, in order to meet contingent and specific needs, further changes and variations to the washing machine and the washing method according to the present invention may be introduced by a person skilled in the art without thereby departing from the scope of the invention as defined by the following claims.

Claims

1. A washing machine (1) comprising:

- a housing (2) forming a front opening (3) delimited by a front annular edge (4),
- a washing tub (5) adapted to contain a washing liquid, arranged in the housing (2) and forming a fore opening (6) delimited by a fore annular edge (7),
- an annular elastomeric seal (8), extending about the front opening (3) and about the fore opening (6) and fixed to the fore (7) and front (4) edges,
- a door (9) which is constrained to the housing (2) and movable from an open position to a closed position, wherein an inner surface (10) of the door engages the annular seal (8),
- a laundry drum (11) supported inside the washing tub (5) and forming a drum opening (12) at the fore opening (6) of the washing tub (5),
- a detergent container (13) adapted to contain a detergent,
- a first supply valve (14) which is connectable to the water supply system and a first supply duct (15) which connects the first supply valve (14) in flow communication to the detergent container (13), so as to supply mains water to the detergent container (14),
- a fall duct (16) which connects the detergent container (14) to an intake passage (17) extending through the annular seal (8), between the front edge (4) and the fore edge (7), so as to convey a mixture of said mains water and said detergent from the detergent container (13), through the intake passage (17), directly into the laundry drum (11),

characterized in that the fall duct (16) forms an auxiliary opening (46) forming an overflow wall (47) for an overflow of liquid bypassing the intake passage (17) in the event of a blockage in the fall duct (16).

2. A washing machine (1) according to claim 1, wherein the auxiliary opening (46) is connected to a corresponding receiving opening (48) formed in a wall of the washing tub (5).

3. A washing machine (1) according to one of the preceding claims, comprising an intake nozzle (18) inserted into the intake passage (17), and which forms:

- a tubular portion (19) having an inlet end (20),
- a flattened portion (21) connected to the tubular portion (19) in a transition region (22), opposite to the inlet end (20), and having a free outlet end (23) facing the interior of the drum (11),

wherein the flattened portion (21) is folded, or inclined with respect to the tubular portion (19), away from the inner surface (10) of the door (9) in the closed position,

wherein the intake passage (17) is formed by the annular seal (8) and forms:

- a tubular seat (24) protruding towards a radially outer side of the annular seal (8) and having an inlet opening (25) on said radially outer side,
- a flattened seat (26) bordering with the tubular seat (24) in a transition area (27), opposite to the inlet opening (25), and having an outlet opening (60) on a radially inner side of the seal (8),

wherein the tubular seat (24) accommodates the tubular portion (19) and the flattened seat (26) accommodates the flattened portion (21),

wherein a lower end portion (28) of the fall duct (16), the tubular seat (24) of the intake passage (17) and the tubular portion (19) of the intake nozzle (18) are inserted into each other and tightened together.

4. A washing machine (1) according to claim 3, wherein the tubular portion (19) extends along a longitudinal direction (29), the flattened portion (21) has a length (30) in said longitudinal direction (29), a width (31) in a first transverse direction (32) perpendicular to the longitudinal direction (29), and a height (33) in a second transverse direction (34) perpendicular to the longitudinal direction (29) and to the first transverse direction (32),

wherein, in a view in the first transverse direction (32), the height (33) of the flattened portion is tapered from the transition region (22) to the free outlet end (23) and the flattened portion (21) is folded or inclined in a divergent manner from the longitudinal direction (29).

5. A washing machine (1) according to claim 4, wherein the flattened portion (21) forms an outer wall (35) facing the front opening (3) and an opposite inner wall (36) facing the interior of the laundry drum (11), wherein the outer wall (35) has an externally convex shape, curved in a continuous manner, while the opposite inner wall (36) has an externally concave shape, consisting of two substantially planar portions

- (36', 36") mutually oriented at an obtuse angle.
6. A washing machine (1) according to claim 5, wherein, on the side of the outer wall (35), the tubular portion (19) terminates at the start of the flattened portion (21), while, on the side of the inner wall (36), the tubular portion (19) extends beyond the start of the flattened portion (21), overlapping the latter by more than 30% of the length (30) thereof.
7. A washing machine (1) according to one of the claims from 3 to 6, wherein:
- in the transition region (22), the intake nozzle (18) forms an outer widening step (37) from the tubular portion (19) to the flattened portion (21), and
 - in the transition area (27), the intake passage (17) forms an inner step (38) having a substantially complementary shape to the shape of the outer step (37).
8. A washing machine (1) according to one of the claims from 4 to 7, wherein, in a view in the second transverse direction (34), the flattened portion (21) widens from the transition region (22) to the free outlet end (23) and the free outlet end (23) forms an elongated and narrow slit.
9. A washing machine (1) according to one of the preceding claims, wherein:
- the annular seal (8) forms a bellow fold (39) protruding radially inwards and extending circumferentially, as well as a lip (40) protruding radially inwards and extending circumferentially, which covers a gap between the washing tub (5) and the laundry drum (11),
 - the intake passage (17) is formed directly in the second lip (40) and the second lip (40) is separated from the first rib or fold (39) by means of a circumferential groove or counter fold (59),
 - at the intake passage (17), the first bellow fold (39) has a recess (41) which eliminates a violation of space between the bellow fold (39) and an outer contour of the intake passage (17).
10. A washing machine (1) according to one of the preceding claims, wherein the fall duct (16) forms an intermediate bellow-shaped portion (44).
11. A washing machine (1) according to one of the preceding claims, wherein the fall duct (16) forms a deviation portion (45) which achieves a transverse deviation of the flow trajectory in a tangent direction with respect to the annular seal (8).
12. A washing machine (1) according to claim 11, wherein
- in the auxiliary opening (48) with the overflow wall (47) is formed in an upper part of the deviation portion (45), while a lower part of the deviation portion (45) forms an accumulation space (49), or wherein the deviation portion (45) is oriented so as to guide the flow of water and detergent, during operation without obstructions, at a distance from the overflow wall (47).
13. A washing machine (1) according to claim 2, wherein:
- the auxiliary opening (46) and the overflow wall (47) are positioned at the receiving opening (48) in a fore wall of the washing tub (5),
 - the overflow wall (47) is positioned inside the receiving opening (48),
 - the fall duct (16) forms a connection flange (61) extending externally about the auxiliary opening (46) and the overflow wall (47), and the connection flange (61) engages an edge of the receiving opening (48) of the washing tub (5).
14. A washing machine (1) according to claim 2, wherein:
- the level of a free overflow edge (62) of the overflow wall (47) is below a lower bottom wall of the detergent container (13) and above a lower end portion (28) of the fall duct (16),
 - a vertical distance between the free overflow edge (62) and the lower end portion of the fall duct (16) is shorter than a vertical distance between the free overflow edge (62) and the lower bottom wall of the detergent container (13).
15. A washing method, comprising the steps of providing a washing machine (1) according to one of the preceding claims and rotating the laundry drum (11) while simultaneously introducing the mixture of water and detergent through the intake nozzle (18) into the laundry drum (11).

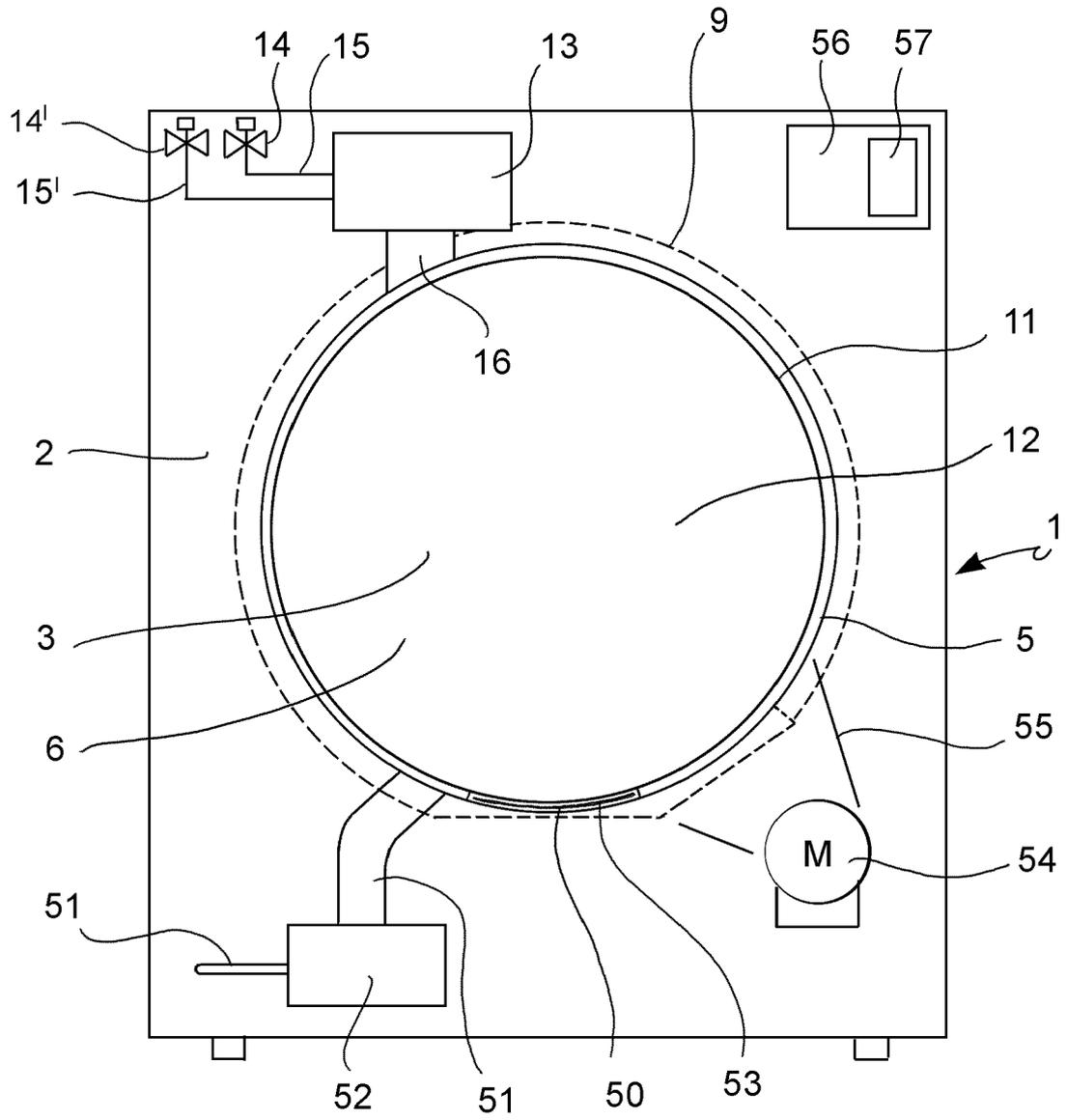


FIG. 1

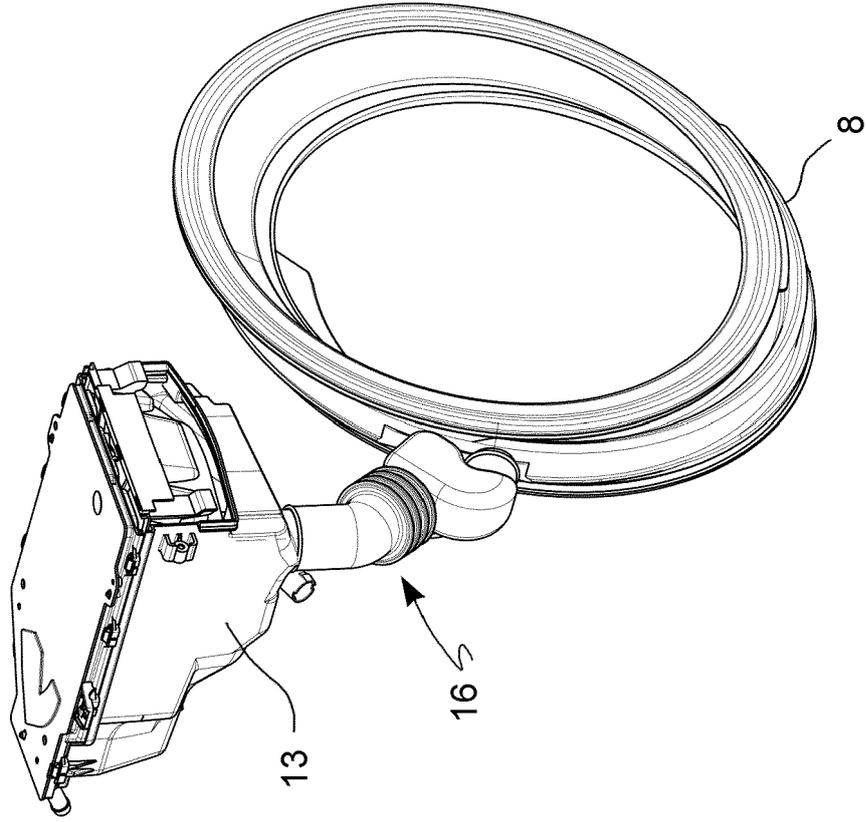


FIG. 3

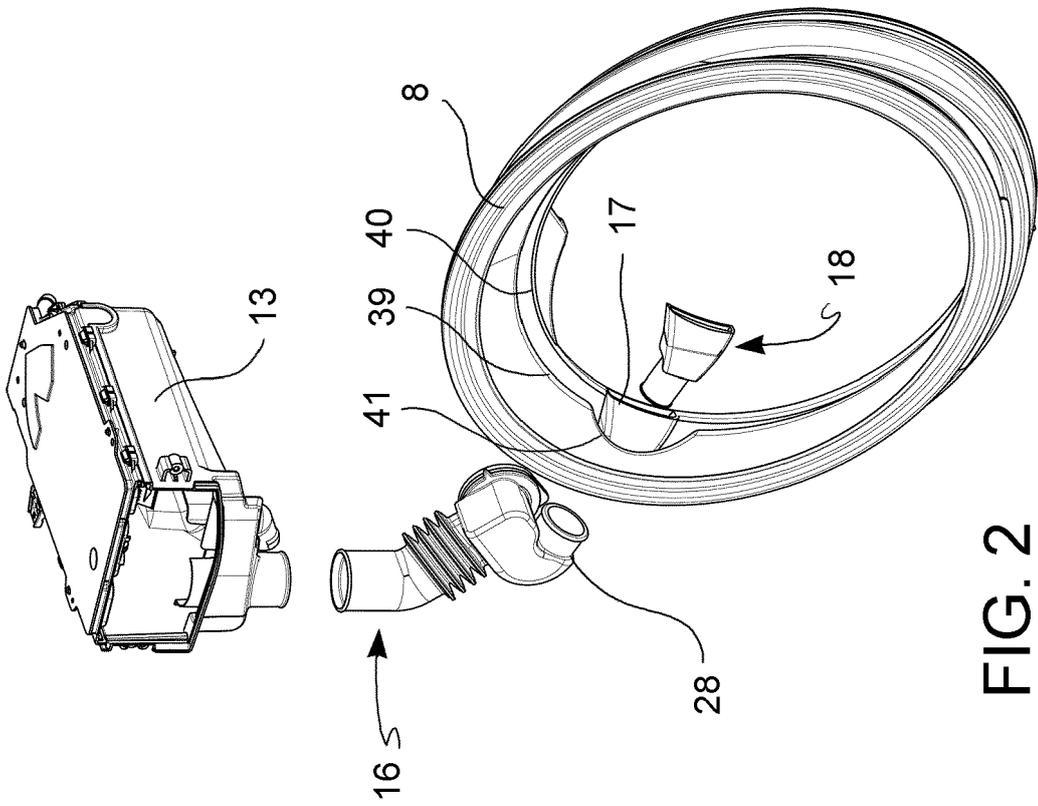


FIG. 2

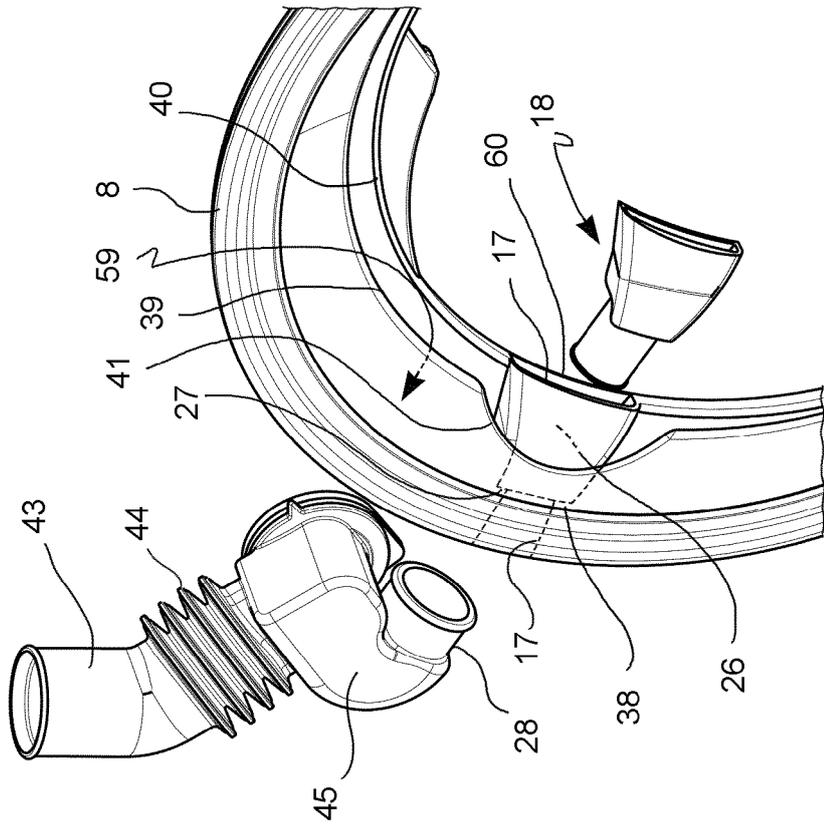


FIG. 4

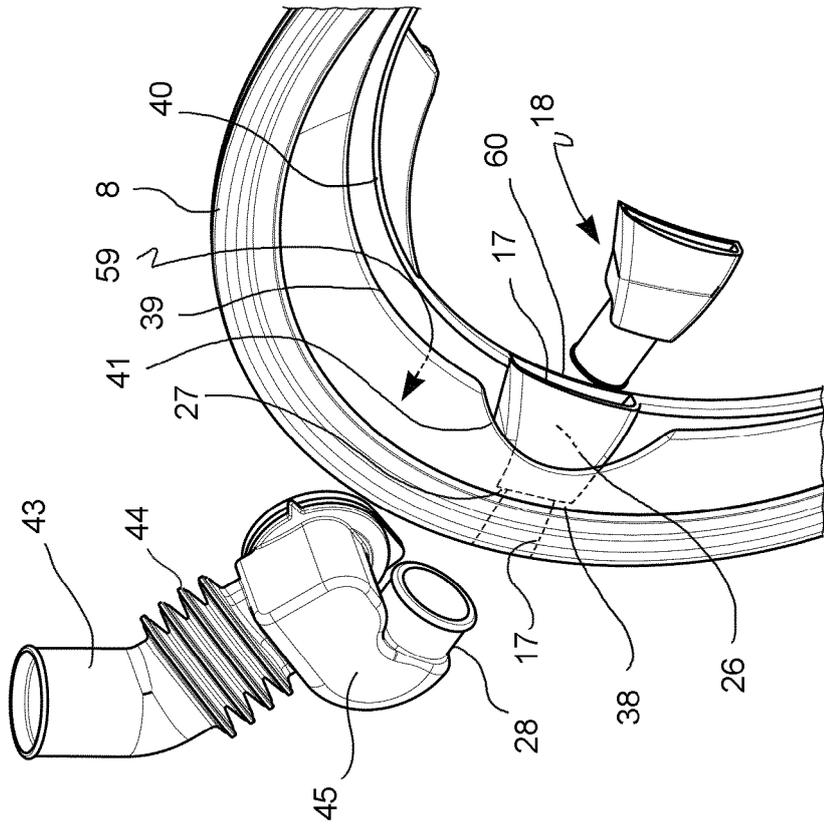
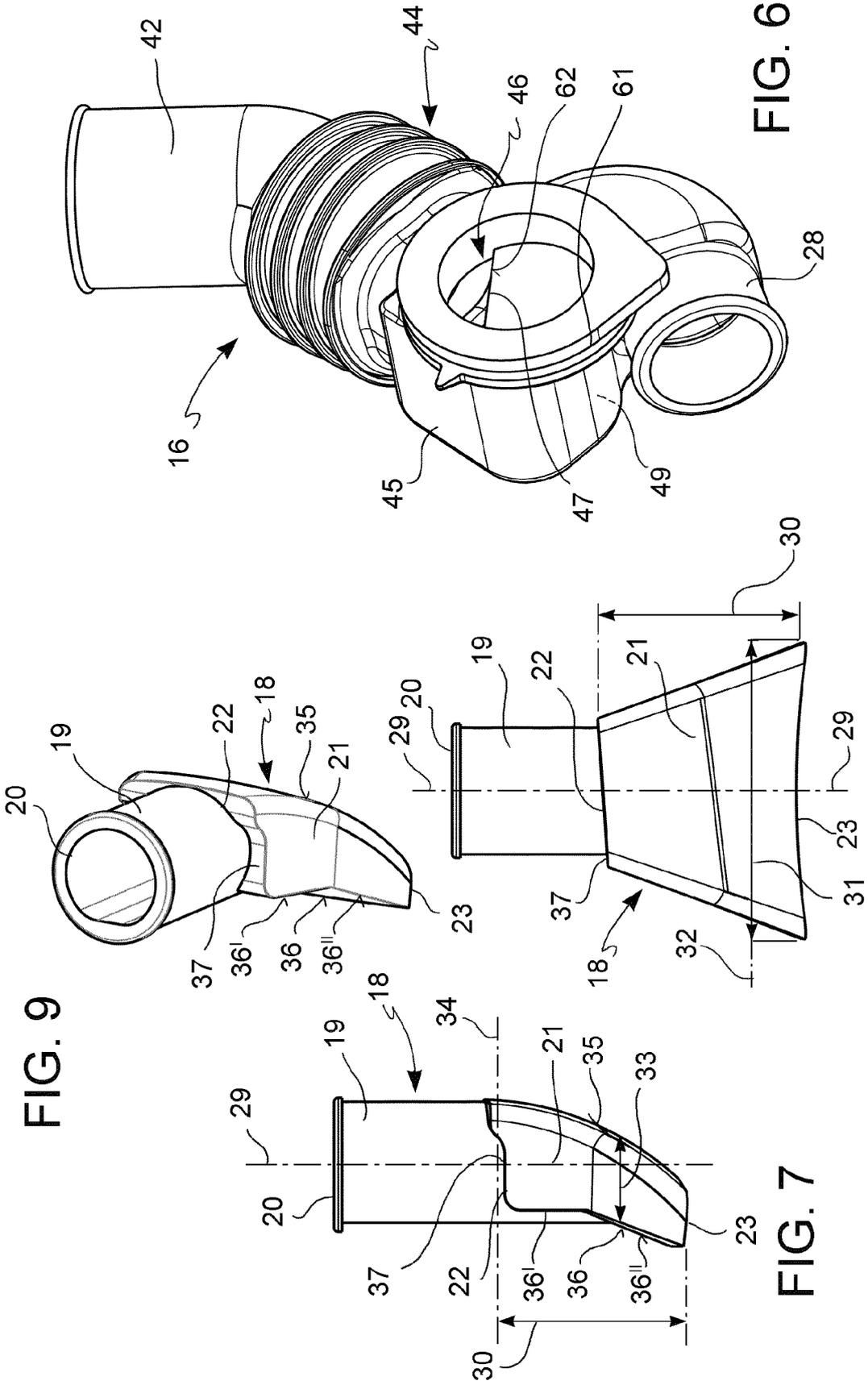


FIG. 5





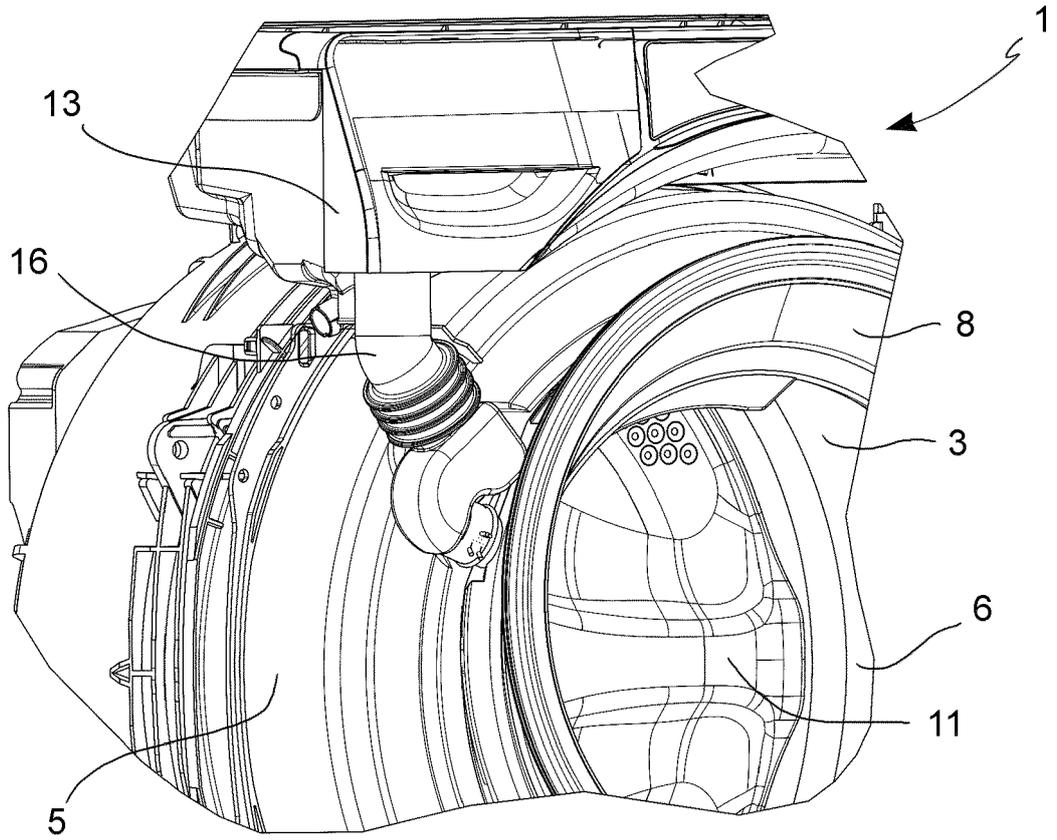


FIG. 10

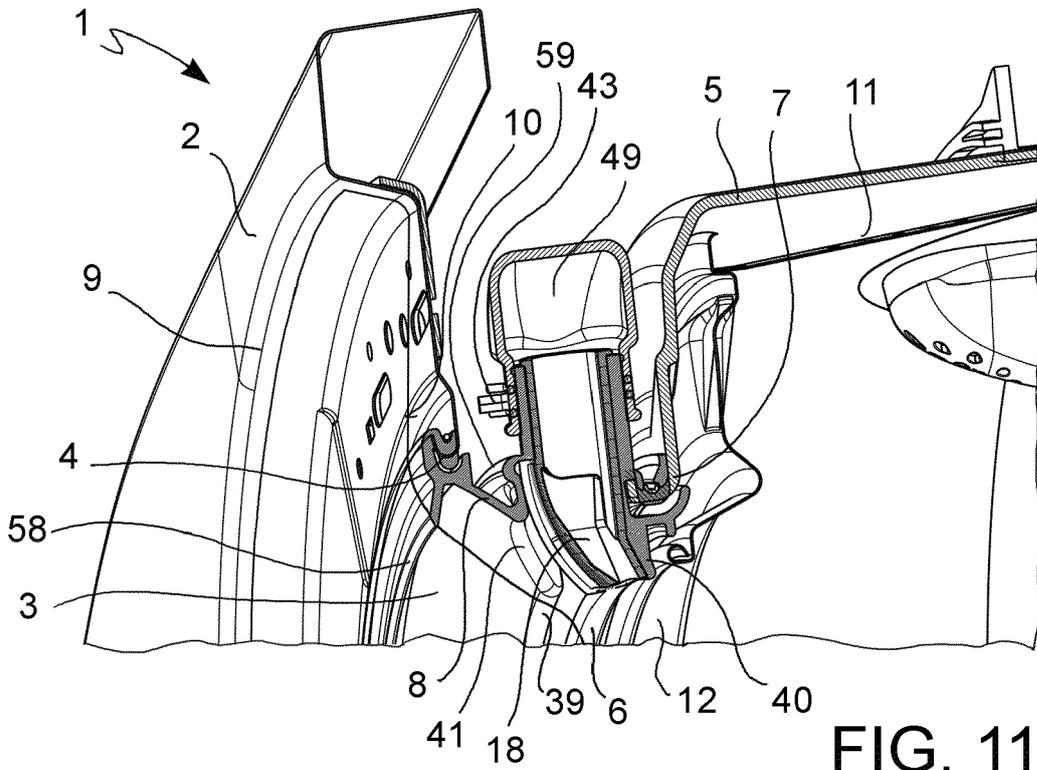


FIG. 11

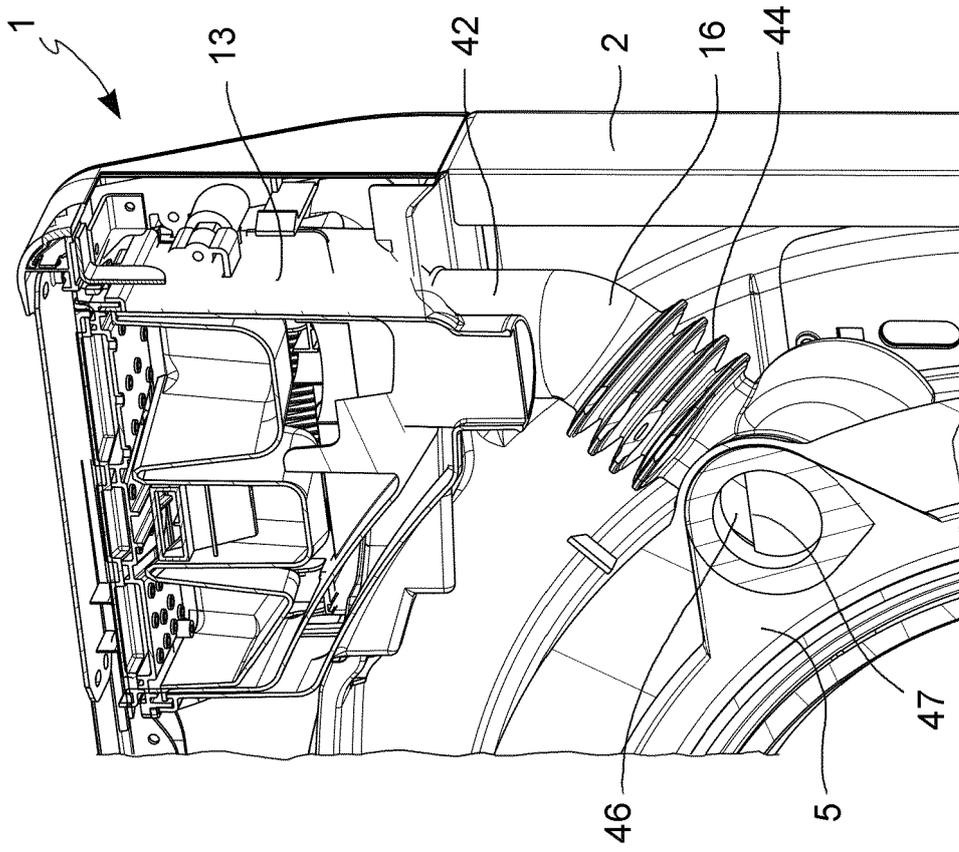


FIG. 12

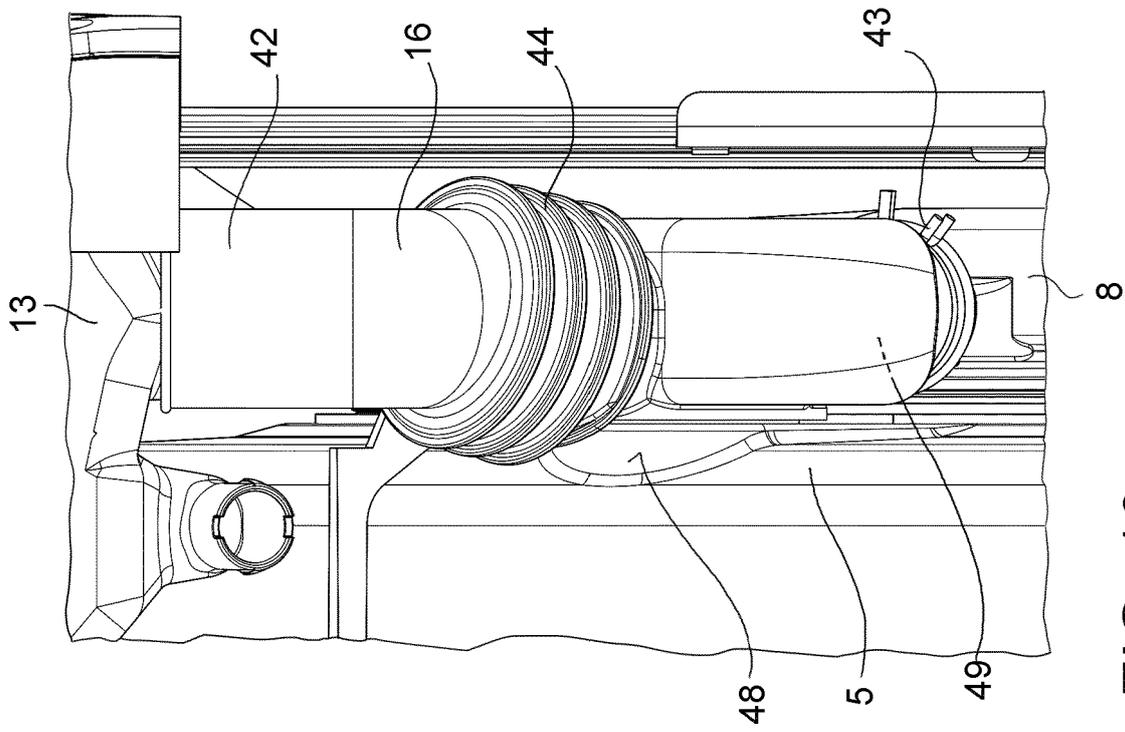


FIG. 13



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Place of search Munich		Date of completion of the search 30 October 2020	Examiner Prosig, Christina
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