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(54) Hydraulic system for a laundry washing machine detergent dispenser

(57) 1. A hydraulic system (4) for a laundry washing machine detergent dispenser (1), the detergent dispenser (1) comprising a tank (2) with a number of compartments (3); the hydraulic system (4) comprising: two delivery pipes (6); two solenoid valves (12) located upstream from the delivery pipes (6) to regulate water flow along the delivery pipes (6); three feed pipes (5) terminating in the tank (2); and a cross mixer (7) interposed between the two delivery pipes (6) and the three feed pipes (5) to direct to a central feed pipe (5) a stream of water produced by intersection of the two streams of water from both the delivery pipes (6); wherein, at the cross mixer (7), the central feed pipe (5) is "bulb-shaped"; from an inlet (8) facing the cross mixer (7), the cross section area starts out at a first minimum value, increases gradually to a maximum value, and finally decreases gradually to a second minimum value smaller than the first minimum value.

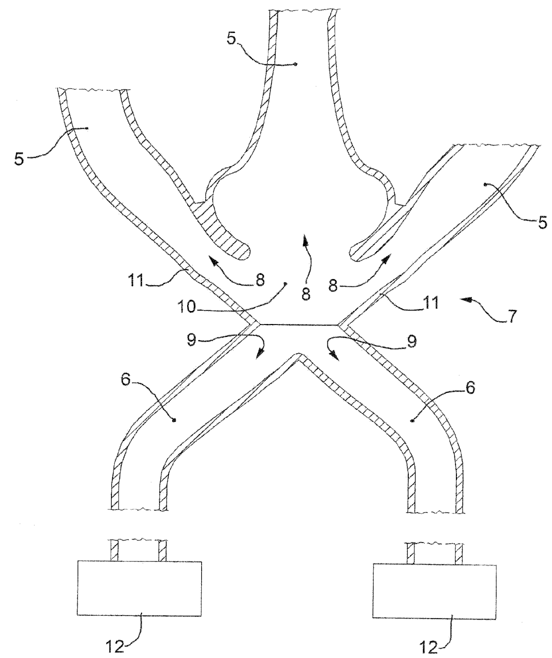

FIG.3

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Description

TECHNICAL FIELD

[0001] The present invention relates to a hydraulic system for a laundry washing machine detergent dispenser.

BACKGROUND ART

[0002] A standard laundry washing machine comprises a detergent dispenser having a tank with a number of compartments connected at the bottom to the wash tub housing the rotating laundry drum. The detergent dispenser also comprises a hydraulic system for feeding a stream of water downwards into each compartment to gradually dilute and flush the detergent/softener from the compartment into the wash tub.

[0003] In a modern washing machine, the tank normally requires three separate streams of water fed selectively into three different compartments, so the hydraulic system comprises three separate feed pipes terminating inside the tank; and, to regulate water flow along the three feed pipes independently, three solenoid valves were formerly used, each located upstream from a respective feed pipe.

[0004] Solenoid valves are fairly expensive, so, to reduce the cost of the hydraulic system, it has been proposed to use two delivery pipes, each fitted with a respective solenoid valve; and a cross mixer interposed between the two delivery pipes and the three feed pipes, and which, when fed with respective incoming streams of water from both the delivery pipes, directs an outgoing stream of water, generated by intersection of the two incoming streams, into a central feed pipe. In other words, the outgoing streams of water from the two delivery pipes intersect at the cross mixer, so, when both delivery pipes feed respective streams of water into the cross mixer, the two incoming streams of water intersect to form an outgoing stream of water, which is directed into a central feed pipe.

[0005] International regulations governing the manufacture of laundry washing machines demand an air break space to interrupt the continuity of a mains water supply pipe, and which acts as a hydraulic non-return valve to prevent contaminated (e.g. detergent-containing) or dirty water from flowing back along the pipe and mixing with drinking water in the mains in the event of a malfunction. In currently marketed laundry washing machines, the air break space is formed at the cross mixer, which is therefore open at the bottom, i.e. has no bottom boundary wall.

[0006] Currently used hydraulic systems of the type described above work fairly well when actual performance of the two solenoid valves regulating the two delivery pipes is the same, i.e. when water flow along the two delivery pipes is substantially the same. Such an ideal condition, however, is fairly rare, on account of manufacturing tolerances, which often result in even substantial differences in performance of the two solenoid valves. As a result, in currently used hydraulic systems, actual water flow along the central feed pipe is often much less than expected; and the desired water flow along the central feed pipe is also accompanied by undesired, harmful dispersion from the lateral feed pipes. Finally, currently used hydraulic systems comprise a large number of mechanically and hydraulically connected component parts, which therefore make them expensive and complicated to assemble.

DISCLOSURE OF THE INVENTION

[0007] It is an object of the present invention to provide a hydraulic system for a laundry washing machine detergent dispenser, designed to eliminate the aforementioned drawbacks, and which, in particular, is cheap and easy to implement.

[0008] According to the present invention, there is provided a hydraulic system for a laundry washing machine detergent dispenser, as claimed in the accompanying Claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

- Figure 1 shows a schematic view in perspective of a detergent dispenser hydraulic system;
- Figure 2 shows a schematic plan view of the Figure 1 hydraulic system;
- Figure 3 shows a section of a cross mixer of the Figure 1 hydraulic system;
- Figure 4 shows a section along line IV-IV of the Figure 2 hydraulic system.

PREFERRED EMBODIMENTS OF THE INVENTION

[0010] Number 1 in Figure 1 indicates as a whole a laundry washing machine detergent dispenser. Detergent dispenser 1 comprises a tank 2 having three compartments 3 with holes at the bottom for connection to the wash tub housing the rotating laundry drum. More specifically, two compartments 3 for a measure of detergent or softener are arranged side by side at the front, and the third compartment 3 is located at the rear.

[0011] Detergent dispenser 1 also comprises a hydraulic system 4 for feeding a stream of water downwards into each compartment 3. The two front compartments 3 are supplied with water by hydraulic system 4 to gradually dilute and flush the detergent/softener from front compartments 3 into the wash tub, while the water supplied by hydraulic system 4 to rear compartment 3 flows directly into the wash tub for rinsing.

[0012] As shown in Figure 2, to feed three separate streams of water into the three different compartments, the hydraulic system comprises three separate feed pipes 5 terminating inside tank 2 at respective compartments 3. More specifically, one feed pipe 5 supplying water to rear compartment 3 is located centrally, and the other two feed pipes 5 supplying water to front compartments 3 are located on opposite sides of the central feed pipe 5.

[0013] The three feed pipes 5 are supplied with water by two delivery pipes 6 via a cross mixer 7 interposed between the two delivery pipes 6 and the three feed pipes 5. As shown more clearly in Figure 3, in cross mixer 7, the two delivery pipes 6 intersect at a 90° angle, the two lateral feed pipes 5 form extensions of the two delivery pipes 6 (and therefore also form a 90° angle), and the central feed pipe 5 is located between the two lateral feed pipes 5. In other words, an inlet 8 of each lateral feed pipe 5 is located facing and parallel to an outlet 9 of a respective delivery pipe 6, and an inlet 8 of the central feed pipe 5 is located opposite outlets 9 of the two delivery pipes 6, and forms a 45° angle with outlet 9 of each delivery pipe 6.

[0014] Cross mixer 7 comprises a closed central chamber 10 (i.e. completely isolated from the outside), into which outlets 9 of the two delivery pipes 6 and inlets 8 of the three feed pipes 5 debouche. As stated, chamber 10 is closed, i.e. completely isolated from the outside, and is therefore bounded by lateral, top, and bottom walls 11. The fact that chamber 10 is closed is important, in that intersection of the two streams of water from the two delivery pipes 6 produces a centrally-directed main stream that tends to swell vertically. Chamber 10 being closed, however, the top and bottom walls 11 of chamber 10 retain and direct the top- and bottommost portions of the main stream towards inlet 8 of central feed pipe 5.

[0015] Each delivery pipe 6 is regulated by a respective solenoid valve 12 located upstream from delivery pipe 6, and which can be set to a closed setting cutting off water supply to delivery pipe 6, and an open setting permitting water supply to delivery pipe 6.

[0016] In actual use, when only one delivery pipe 6 is supplied with water, water flows straight through cross mixer 7 into the corresponding lateral feed pipe 5 only; conversely, when both delivery pipes 6 are supplied with water, the respective streams of water intersect to form a main stream, which flows solely into central feed pipe 5.

[0017] As shown in Figure 3, at cross mixer 7, central feed pipe 5 is "bulb-shaped": from inlet 8 facing cross mixer 7, the cross section area starts out at a first minimum value, increases gradually to a maximum value, and finally decreases gradually to a second minimum value smaller than the first. The ratio between the first and second minimum value of the cross section area of central feed pipe 5 normally ranges between 1.5 and 2.5, and preferably between 1.9 and 2.1; the ratio between the maximum value and the first minimum value normally ranges between 1.3 and 2.1, and preferably between 1.6 and 1.8; and the ratio between the maximum value and the second minimum value normally ranges between 2.5 and 4, and preferably between 3.1 and 3.5.

[0018] At cross mixer 7, the area of inlet 8 of central feed pipe 5 is 2 to 4 times the area of inlet 8 of each lateral feed pipe 5.

[0019] The cross section area of each lateral feed pipe 5 has a minimum value at inlet 8 facing cross mixer 7, and increases gradually from inlet 8 to a maximum value; the ratio between the maximum and minimum value of the cross section area of each lateral feed pipe 5 normally ranges between 1.2 and 2, and preferably between 1.5 and 1.7; and the ratio between the maximum value of the cross section area of each lateral feed pipe 5 and the cross section area of outlet 9, facing cross mixer 7, of each delivery pipe 6 normally ranges between 1 and 1.6, and preferably between 1.2 and 1.4.

[0020] The cross section area of each delivery pipe 6 decreases gradually to a minimum value at outlet 9 facing cross mixer 7, so that the ratio between the cross section area of outlet 9, facing cross mixer 7, of each delivery pipe 6 and the cross section area of inlet 8 of each lateral feed pipe 5 normally ranges between 1 and 1.6, and preferably between 1.2 and 1.4.

[0021] The edges separating inlet 8 of central feed pipe 5 from inlets 8 of lateral feed pipes 5 are preferably rounded.

[0022] The particular shape and size of central feed pipe 5 at cross mixer 7 provides for maximizing inflow into central feed pipe 5 of the main stream of water produced by the two intersecting streams from the two delivery pipes 6.

[0023] Outlets 9 of the two delivery pipes 6 have a relatively small cross section with respect to feed pipes 5, so that water flows out of outlets 9 of the two delivery pipes 6 at relatively high speed and therefore with greater direction to reduce dispersion.

[0024] As shown in Figure 2, respective air break spaces 13 are located along feed pipes 5, downstream from cross mixer 7, and are each defined by a portion of the pipe having no bottom wall. Air break spaces 13 are provided to comply with international regulations governing the manufacture of laundry washing machines and requiring interruption of the continuity of mains water supply pipes, and act as hydraulic non-return valves to prevent contaminated (e.g. detergent-containing) or dirty water from flowing back from tank 2 to the mains via hydraulic system 4, in the event of a malfunction.

[0025] The air break spaces 13 of the two lateral feed pipes 5 also provide for cutting off any dispersion accidentally flowing into the two lateral feed pipes 5 as the main stream, produced by intersection of the two streams from the two delivery pipes 6, is formed in cross mixer 7. The flow and speed, in fact, of any dispersion accidentally flowing into the two lateral feed pipes 5 are so low as to prevent it from getting past air break spaces 13, thus ensuring against any undesired flow from lateral feed pipes 5 to front compartments 3.

[0026] In the preferred embodiment in Figure 4, at air break space 13, each feed pipe 5 has a bulge, which extends both upwards and laterally, and, at the top, preferably has a semicircular cross section with its axis of symmetry parallel to feed pipe 5. To allow for the effect of gravity on the water flowing through air break space 13, feed pipe 5 comprises, at air break space 13, an inlet 14 (into which water flows from air break space 13) located lower down and larger vertically than an outlet 15 (from which water flows into air break space 13).

[0027] Central feed pipe 5 terminates at air break space 13, this being located over rear compartment 3 supplied by central feed pipe 5. In other words, air break space 13 of central feed pipe 5 constitutes both an interruption in the continuity of the pipe, and an outlet into rear compartment 3.

[0028] Downstream from air break space 13, each lateral feed pipe 5 preferably has a sloping portion 16, which slopes downwards and preferably has an S-shaped vertical section. The water flowing along each lateral feed pipe 5 undergoes a considerable loss in pressure as it flows through respective air break space 13, and each sloping portion 16 provides, downstream from air break space 13, for increasing the pressure of the water flowing along feed pipe 5, so as to at least partly compensate for the pressure loss caused by air break space 13.

[0029] As shown in Figure 2, each lateral feed pipe 5 comprises an end portion 17 located over a respective front compartment 3 of tank 2 and having a number of through outlet holes 18 underneath. In a preferred embodiment, each end portion 17 is curved and forms at least one "U", and outlet holes 18 are located asymmetrically on the outer side of the curve to reduce the swirl produced inside feed pipe 5 by outlet holes 18, and so reduce load losses inside feed pipe 5, and air intake into feed pipe 5 through outlet holes 18. A given total outflow from outlet holes 18 is therefore achieved with a lower feed pressure to delivery pipes 6, and the noise level is also greatly reduced.

[0030] In a preferred embodiment, outlet holes 18 are also shaped to reduce load losses in feed pipe 5, and air intake into feed pipe 5 through outlet holes 18. More specifically, each outlet hole 18 is crescent-shaped with its concavity facing in the water flow direction along feed pipe 5. In the Figure 2 embodiment, the rear edge of each outlet hole 18 is circular (i.e. defined by an arc of a circle), whereas, in a different embodiment not shown, the rear edge of each outlet hole 18 is straight (i.e. defined by a straight segment).

[0031] In a preferred embodiment, delivery pipes 6, cross mixer 7, and feed pipes 5 are defined in a single one-piece body 19 (i.e. formed in one seamless, indivisible piece) injection-molded from plastic material (e.g. polypropylene or polyethylene). One-piece body 19 preferably comprises a flat reinforcing portion 20 surrounding feed pipes 5 on the inside and outside, and which has eyelets 21 on the outside for engaging respective teeth 22 projecting from an edge of tank 2. The function of reinforcing portion 20 is to increase the strength of one-piece body 19 and connect one-piece body 19 easily to tank 2.

[0032] Defining delivery pipes 6, cross mixer 7, and feed pipes 5 in a single one-piece injection-molded body 19 makes hydraulic circuit 4 cheaper to produce and cheaper and faster to assemble.

[0033] Hydraulic system 4 as described above has numerous advantages, by being cheap and easy to produce and assemble, by having only modest load losses as a whole, and by operating extremely well, even when actual performance of the two solenoid valves 12 regulating the two delivery pipes 6 differs as a result of manufacturing tolerances. In other words, actual water flow along central feed pipe 5 always equals the designed rated flow, even when actual performance of the two solenoid valves 12 regulating the two delivery pipes 6 differs as a result of manufacturing tolerances. Moreover, in addition to achieving the desired flow along central feed pipe 5, hydraulic system 4 as described above provides for totally eliminating harmful dispersion along lateral feed pipes 5.

Claims

1. A hydraulic system (4) for a laundry washing machine detergent dispenser (1), the detergent dispenser (1) comprising a tank (2) with a number of compartments (3); the hydraulic system (4) comprising:

   two delivery pipes (6);
   two solenoid valves (12) located upstream from the delivery pipes (6) to regulate water flow along the delivery pipes (6);
   three feed pipes (5) terminating in the tank (2); and
   a cross mixer (7) interposed between the two delivery pipes (6) and the three feed pipes (5) to direct to a central feed pipe (5) a stream of water produced by intersection of the two streams of water from both the delivery pipes (6); the hydraulic system (4) being **characterized in that**, at the cross mixer (7), the central feed pipe (5) is "bulb-shaped"; from an inlet (8) facing the cross mixer (7),
   the cross section area starts out at a first minimum value, increases gradually to a maximum value, and finally decreases gradually to a second minimum value smaller than the first minimum value.

2. A hydraulic system (4) as claimed in Claim 1, wherein the ratio between the first minimum value and the second minimum value of the cross section area of the central feed pipe (5) ranges between 1.5 and 2.5.

3. A hydraulic system (4) as claimed in Claim 1, wherein the ratio between the first minimum value and the

second minimum value of the cross section area of the central feed pipe (5) ranges between 1.9 and 2.1.

4. A hydraulic system (4) as claimed in Claim 1, 2 or 4, wherein the ratio between the maximum value and the first minimum value ranges between 1.3 and 2.1.

5. A hydraulic system (4) as claimed in Claim 1, 2 or 3, wherein the ratio between the maximum value and the first minimum value ranges between 1.6 and 1.8.

6. A hydraulic system (4) as claimed in any of Claims 1 to 5, wherein the ratio between the maximum value and the second minimum value ranges between 2.5 and 4.

7. A hydraulic system (4) as claimed in any of Claims 38 to 5, wherein the ratio between the maximum value and the second minimum value ranges between 3.1 and 3.5.

8. A hydraulic system (4) as claimed in any of Claims 1 to 7, wherein, at the cross mixer (7), the area of an inlet (8) of the central feed pipe (5) is 2 to 4 times the area of an inlet (8) of each lateral feed pipe (5).

9. A hydraulic system (4) as claimed in any of Claims 1 to 8, wherein the cross section area of each lateral feed pipe (5) has a minimum value at an inlet (8) facing the cross mixer (7), and increases gradually from the inlet (8) to a maximum value.

10. A hydraulic system (4) as claimed in Claim 9, wherein the ratio between the maximum value and minimum value of the cross section area of each lateral feed pipe (5) ranges between 1.2 and 2.

11. A hydraulic system (4) as claimed in Claim 9, wherein the ratio between the maximum value and minimum value of the cross section area of each lateral feed pipe (5) ranges between 1.5 and 1.7.

12. A hydraulic system (4) as claimed in Claim 9, 10 or 11, wherein the ratio between the maximum value of the cross section area of each lateral feed pipe (5) and the cross section area of an outlet (9), facing the cross mixer (7), of each delivery pipe (6) ranges between 1 and 1.6.

13. A hydraulic system (4) as claimed in Claim 9, 10 or 11, wherein the ratio between the maximum value of the cross section area of each lateral feed pipe (5) and the cross section area of an outlet (9), facing the cross mixer (7), of each delivery pipe (6) ranges between 1.2 and 1.4.

14. A hydraulic system (4) as claimed in any of Claims 1 to 13, wherein the cross section area of each delivery pipe (6) decreases gradually to a minimum value at the outlet (9) facing the cross mixer (7).

15. A hydraulic system (4) as claimed in any of Claims 1 to 14, wherein the ratio between the cross section area of an outlet (9), facing the cross mixer (7), of each delivery pipe (6) and the cross section area of an inlet (8) of each lateral feed pipe (5) ranges between 1 and 1.6.

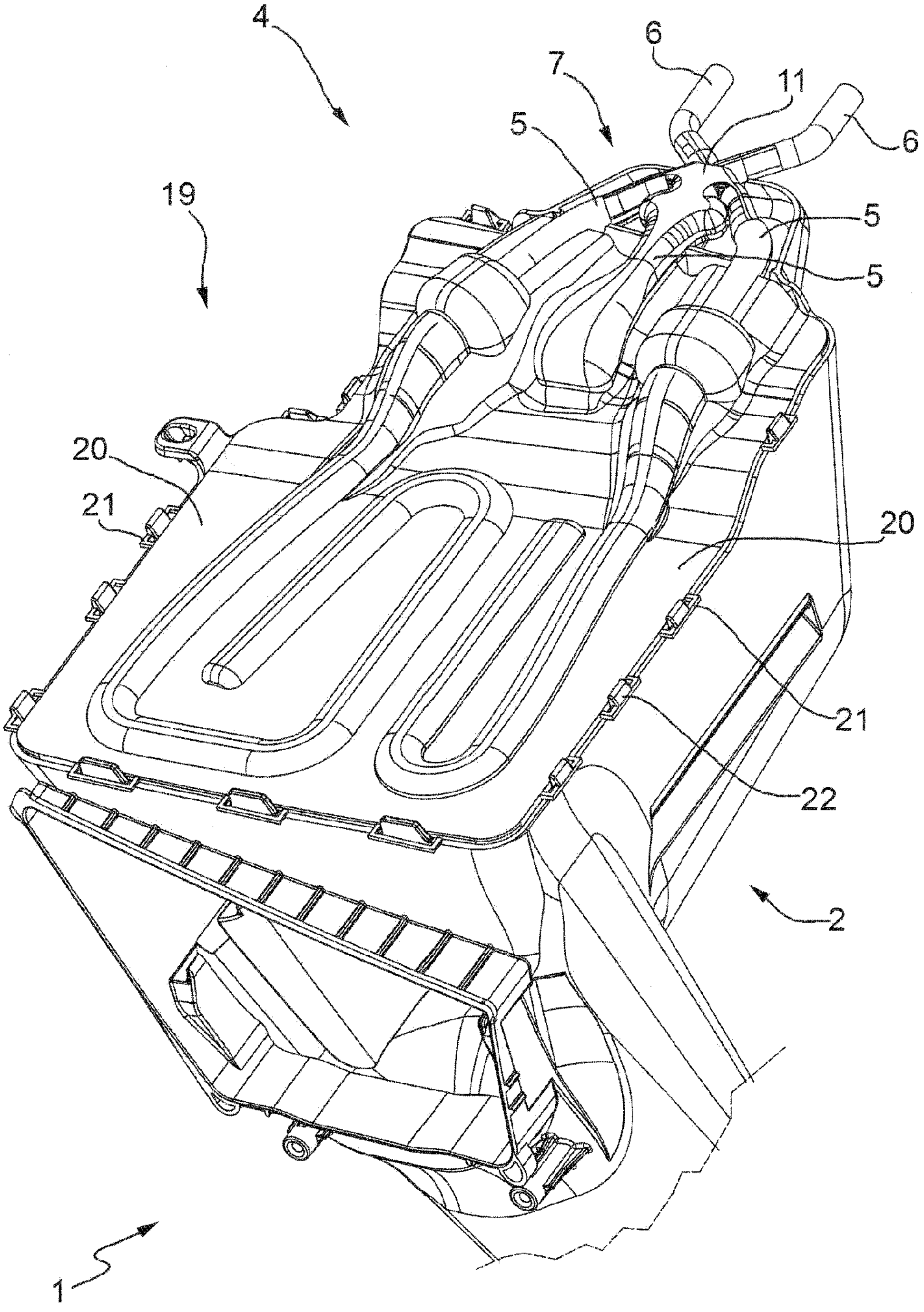

FIG.1

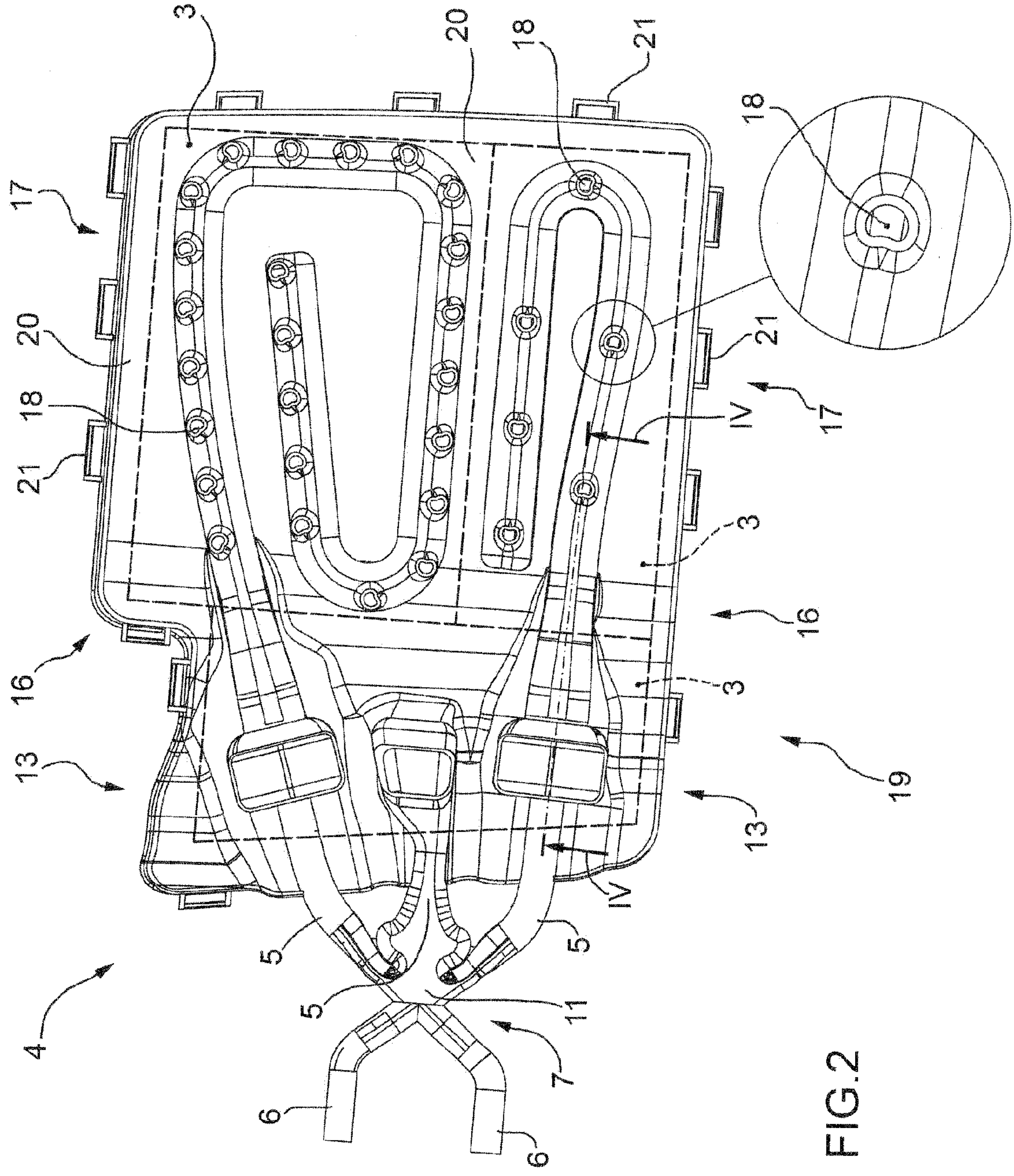

FIG.2

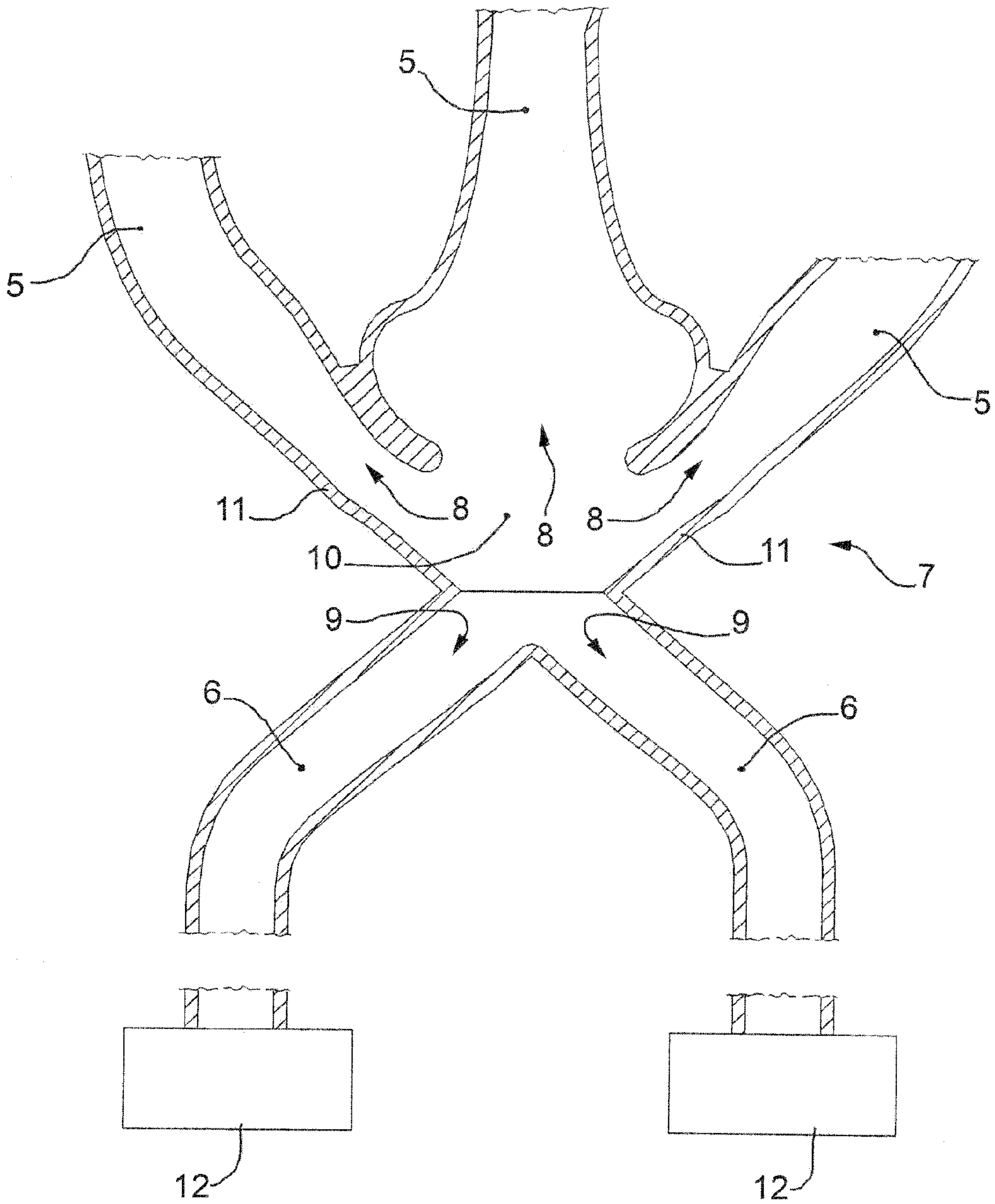

FIG.3

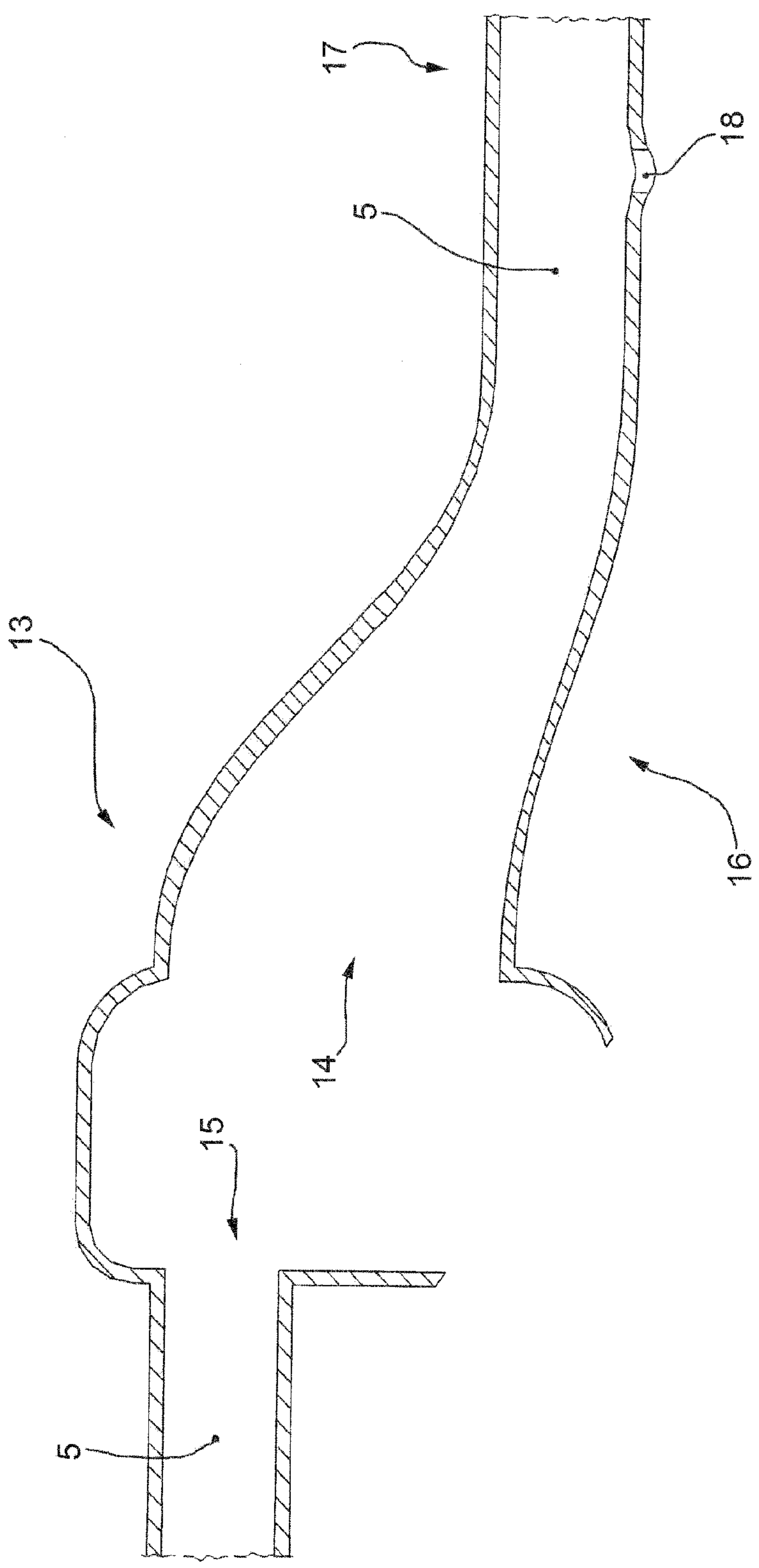

FIG.4

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EUROPEAN SEARCH REPORT

Application Number
EP 11 15 7515

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2004/106617 A (ELECTROLUX HOME PROD CORP [BE]; RIZZETTO PIETRO [IT]) 9 December 2004 (2004-12-09) * page 1, paragraph 1; page 4, paragraph 7 - page 5, paragraph 3, page 7, paragraph 3 - page 8, paragraph 1; claim 1; figure 5 * -----	1-15	INV. D06F39/02
A	EP 1 595 991 A (ELECTROLUX HOME PROD CORP [BE]) 16 November 2005 (2005-11-16) * paragraphs [0001], [0012] - [0017]; claim 1; figures * -----	1-15	
A	EP 0 244 900 A2 (PHILIPS NV [NL]; IRE SPA [IT]) 11 November 1987 (1987-11-11) * the whole document * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
Munich	30 May 2011	Clivio, Eugenio

CATEGORY OF CITED DOCUMENTS

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30-05-2011

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