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(54) **Laundry washing machine and bellow for a laundry washing machine**

(57) A laundry washing machine (1) comprising: a casing (10); a tub (11) suspended in the casing (10); an elastically deformable bellow (20), having a ring shaped main portion (21) sealingly connected to the casing (10) and to the tub (10), at an opening (12) thereof, and a projection portion (30), made in one piece with the main portion (21) and radially extending from the main portion (21) to a distal end (31); a detergent tank (17) adapted to receive detergents to be mixed to water before being supplied to the tub (11); a tank duct (18) connected upstream to the detergent tank (17) and having a downstream end (19); a bellow duct (32) formed within the projection portion (30) of the bellow (20), from an inlet mouth (33), formed at the distal end (31) of the projection

portion (30) and connected to the downstream end (19) of the tank duct (17), to an outlet mouth (34), formed in the main portion (21) of the bellow (20), at the projection portion (30), and open into the tub (11). The tank duct (18) comprises at least two separate and parallel tank sub-ducts (41, 42), suitable for receiving different detergent mixtures from different areas in the detergent tank (17); and the bellow duct (32) comprises at least two separate and parallel bellow sub-ducts (51, 52, 58, 59), suitable for receiving different detergent mixtures from different sub-ducts (41, 42) of the tank duct (18). Thus, different detergent mixtures are collected and supplied in different sub-ducts, first in the tank duct (18), then in the bellow duct (32).

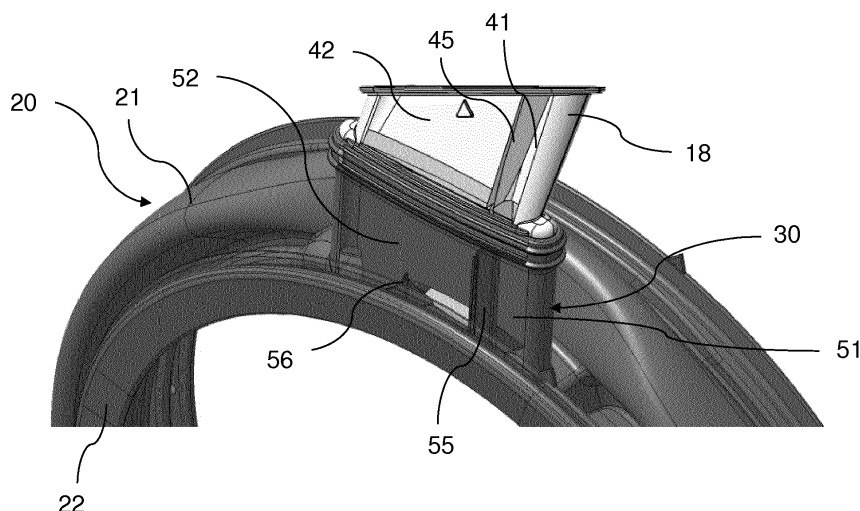


Fig. 7

Description**FIELD OF THE INVENTION**

[0001] The present invention concerns the technical field of laundry washing machines.

BACKGROUND ART

[0002] Laundry washing machines, both "simple" laundry washing machines (i.e. laundry machines which can only wash laundry) and laundry washing-drying machines (i.e. laundry washing machines which can also dry laundry) are well known and widespread.

[0003] In the present description the term "laundry washing machine" or "washer" will refer to both simple laundry washing machines and laundry washing-drying machines. Washers capable of carrying out a washing process on laundry generally comprise a casing that houses a tub with a drum rotatably mounted therein for containing laundry to be washed.

[0004] The washer comprises a water circuit for supplying water and detergents to the tub. The mixture of water with the required detergents (or in short: detergent mixture) is formed in a detergent tank, supported by the casing. In a known configuration, the water circuit includes a tank duct that receives the detergent mixture from the detergent tank and delivers it to the tub, through a duct formed in the bellow (or bellow duct) that is normally provided at the door of the machine, sealingly engaged to both the casing and the tub.

[0005] The bellow duct, thanks to its own elasticity, acts as a vibration-isolating section in the water circuit, thus preventing that the inevitable vibrations of the tub due to rotation of the drum possibly damage the elements that are fixedly mounted on the casing, such as the tank duct and the detergent tank.

DISCLOSURE OF INVENTION

[0006] The Applicant has noted that it might be desirable to deliver the detergent mixture differently according to the different detergent and/or the different washing phases. In addition, improving the bellow duct vibration dampening would be also desirable.

[0007] The Applicant has thus thought to address this issue by dividing the water ducts in sub-ducts.

[0008] Therefore, in a first aspect, the present invention relates to a laundry washing machine according to claim 1, as well as to a bellow for a laundry washing machine according to claim 11. Preferred characteristics of the laundry washing machine and of the bellow are set forth in dependent claims.

[0009] In particular, the laundry washing machine according to the first aspect of the invention comprises:

- a casing;
- a tub suspended in the casing;

- an elastically deformable bellow, having

- a ring shaped main portion sealingly connected to the casing and to the tub, at an opening thereof, and
- a projection portion, made in one piece with the main portion and radially extending from the main portion to a distal end;

- a detergent tank adapted to receive detergents to be mixed to water before being supplied to the tub;
- a tank duct connected upstream to the detergent tank and having a downstream end;
- a bellow duct formed within the projection portion of the bellow, from an inlet mouth, formed at the distal end of the projection portion and connected to the downstream end of the tank duct, to an outlet mouth, formed in the main portion of the bellow, at the projection portion, and open into the tub;

characterised in that

- the tank duct comprises at least two separate and parallel tank sub-ducts, suitable for receiving different detergent mixtures from different areas in the detergent tank; and
- the bellow duct comprises at least two separate and parallel bellow sub-ducts, suitable for receiving different detergent mixtures from different sub-ducts of the tank duct.

[0010] By "radially extending" as referred to the projection portion of the bellow it is meant that it extends from the main portion in a direction away from the axis of the bellow, or away from the axis of the tub (that may be the same). This does not imply that the extension of the projection portion is exactly and fully radial, be intended that it can slightly depart from an exactly radial direction.

[0011] In such a machine, different detergent mixtures are collected and supplied in different sub-ducts, first in the tank duct, then in the bellow duct. Different detergent mixtures might be mixture of water with different detergents, such as washing detergent, bleach, softener, or mixture of water with the same detergent in different proportions, such as during different phases of the washing cycle.

[0012] Preferably, the projection portion of the bellow has a substantially flat shape, with two major sides and two minor sides.

[0013] The flat shape confers high flexibility to the bellow duct, which means improved capability of absorbing vibrations. Also, another considerable advantage of the flat shape of the below duct is the reduction of the space that is needed to accommodate the duct within the casing; this advantage is very important particularly in domestic appliances, where dimensions have to be limited or standardized. It is also to be noticed that all these

advantages are achieved without having complicated the assembly process of the machine, as the bellow duct does not include additional parts: it is formed together with the bellow, as a single piece.

[0014] Also, the risk of obstructions of the bellow duct because of deformations induced by vibrations is avoided, thanks to the structure with at least two sub-ducts: in case of very large deformation, the sides of the bellow duct cannot contact directly one against the other, thus avoiding obstruction of the passage of water.

[0015] Preferably, the bellow sub-ducts are separated by fins, and more preferably the fins that separate the bellow sub-ducts are extended from one to the other of the major sides. Thus, the bellow sub-ducts are arranged side by side, in the sense of the width of the flat shaped projecting portion of the bellow; this arrangement allows to shape and size properly the bellow sub-ducts more easily.

[0016] Preferably, the fins have a curved shape, when seen in a cross section of the bellow duct. The curved shape proved to be effective in dampening vibrations: the magnitude of vibration transferred to the tank duct originating from the same vibration at the tub is less when the fins are curved than when the fins are straight. Without being bound to any specific interpretation, it is believed that this effect is due to the enhanced ability to deform by bending in the transversal direction, by vibration components that tend to push the major sides of the projection portion one towards the other.

[0017] Preferably, the bellow sub-ducts are three, separated by two fins, the two fins having opposing curvature, when seen in a cross section of the bellow duct. Three ducts allow managing the flow of three different detergent mixtures, which is a typical occurrence in normal laundry washing machines. The opposing curvatures improve the ability of damping vibrations.

[0018] The opposing curvatures can be obtained with fins having either convexly or concavely opposing curvature. The two alternatives differ in that the latter provides for a central sub-duct the section of which is totally convex, the two lateral sub-ducts having at least a concave side, while the former provides for two lateral sub-ducts the section of which is totally convex, the central sub-duct having two concave sides. It is believed that a totally convex section helps the flow of the detergent mixture, thus the former solution (fins having convexly opposing curvature) will be generally preferred as it provides two easy-flow sub-ducts, while the latter solution (fins having concavely opposing curvature) provides only one easy flow sub-duct.

[0019] In a preferred embodiment, the outlet mouth has at least two outlet regions, one for each of the bellow sub-ducts, each of the outlet regions being suitable to supply detergent mixture to the tub under different specific supply conditions, such different supply conditions more preferably including any one or more of different supply direction, different supply speed, different supply width, different supply location. Once the flow of the de-

tergent mixture is differentiated by the different sub-ducts in the tank duct and in the bellow duct, it is then possible and normally preferred to define specific, different condition under which the detergent mixture is delivered to the tub. For example, it is possible to have a sub-duct that delivers the detergent mixture in a concentrated way, or a sub-duct that delivers the detergent mixture over a wide angle around the axis of the tub. The specific characteristics of the delivery conditions will be selected according to the behaviour of the detergent mixture on the laundry to be washed.

[0020] The bellow for a laundry washing machine according to the second aspect of the invention, in particular, is made of an elastically deformable material and comprises:

- a ring shaped main portion with a first, external rim intended to be sealingly mounted to a casing of the laundry washing machine, and a second, internal rim intended to be sealingly mounted to a tub of the laundry washing machine, and
- a projection portion, made in one piece with the main portion and radially extending from the main portion to a distal end,
- a bellow duct formed within the projection portion of the bellow, extending from an inlet mouth, formed at the distal end of the projection portion and intended to be connected to a downstream end of a tank duct connected to a detergent tank of the laundry washing machine, to an outlet mouth, formed in the main portion of the bellow, at the projection portion, and open towards the tub of the laundry washing machine,

characterised in that

the bellow duct comprises at least two separate and parallel bellow sub-ducts, suitable for receiving different detergent mixtures from different sub-ducts of the tank duct.

[0021] The advantages of this bellow are those already presented with reference to the laundry washing machine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] These and other features and advantages of the invention will better appear from the following description of an exemplary and non-limitative embodiment, to be read with reference to the attached drawings, wherein:

- fig. 1 is a perspective view of a laundry washing machine according to the invention, with some parts removed to better show the inside of the machine, in particular the tub, the detergent tank and the bellow;
- fig. 2 is a perspective view of parts of the machine of fig. 1, including the tub, the detergent tank and the bellow;
- fig. 3 is a side view of the parts of the machine of fig. 2;

- fig. 4 is a partial side view of the bellow, at the projection portion, as viewed from the inside of the tub, in a plane substantially parallel to the front of the machine;
- fig. 5 is a partial top view of the bellow, at the projection portion, in a plane substantially perpendicular to the front of the machine;
- fig. 6 is a partial perspective view of the parts shown in fig. 2, in an enlarged view and with the projection portion of the bellow and the tank ducts in section, in order to show the inside of the bellow and the tank ducts;
- fig. 7 is a partial perspective view of the bellow and the tank duct with parts shown in transparency in order to show the inside of the bellow and the tank ducts

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0023] In the drawings, a laundry washing machine 1 made according to the present invention is shown.

[0024] In the following, with the terms "downstream" and/or "upstream", a position with reference to the direction of flow of a fluid inside a conduit or duct is indicated. Additionally, in the present context, the terms "vertical" and "horizontal" are referred to the positions of elements with respect to the laundry washing machine 1 in its normal installation and functioning position. Indeed, a horizontal plane (X,Y) formed by two horizontal X,Y perpendicular directions is defined, and a vertical direction Z, perpendicular to the horizontal plane, is defined as well in a 3-D space.

[0025] Laundry washing machine 1 comprises an outer box casing 10, preferably but not necessarily parallelepiped-shaped, and a tub 11 suspended in the casing 10. For example, the tub 11 has the shape of a hollow cylinder having horizontal axis. In the tub 11 a drum (not visible in the drawings) is rotatably mounted for housing the laundry and in general the clothes and garments to be washed.

[0026] Access to the tub 11 is provided via a front door (not shown in the drawings), preferably hinged to casing 10; the door can open and close an opening 12 formed in the tub 11 and a corresponding opening (not shown) in the casing 10, according to design options per se well known in the art.

[0027] Casing 10 generally includes a front panel (not shown), a rear panel 13 and two side panels 14, 15, all mounted on a basement 16. Panels 13-15 and basement 16 can be of metal sheet.

[0028] Laundry washing machine 1 also comprises typical components of a machine of this kind, such as an electric motor assembly (not shown) for rotating, on command, the drum about its axis in the tub 11, as well as a detergent tank 17 where detergent is mixed to the water and a tank duct 18, fixedly connected to the detergent tank 17 and receiving mixture of water and detergent

therefrom; the detergent tank 17 is fixedly mounted to the casing 10, so is the tank duct 18. The casing 10, the drum, the door, the motor, the detergent tank 17 and the tank duct 18 are common parts in the technical field and are considered to be known; therefore they will not be described in further details.

[0029] At the door, a bellow 20 made of elastically deformable material is provided. The bellow 20 includes a ring shaped main portion 21, sealingly connected to both the casing 10 and the tub 11, at the opening 12, by means of respective external and internal rims 22 and 23. The main portion 21 of the bellow 20 also offers an elastically deformable contact seat for the door itself.

[0030] The bellow 20 includes also a projection portion 30 that is made of the same material and in one and the same piece with the main portion 21. The projection portion 30 extends from the main portion 21, at an upper position of the opening 12, to a distal end 31, somewhat radially remote from the main portion 21.

[0031] A bellow duct 32 is formed within the projection portion 30 of the bellow 20. The bellow duct 32 extends from an inlet mouth 33, formed at the distal end 31 of the projection portion 30 to an outlet mouth 34, formed in the main portion 21 of the bellow 20, at the projection portion 30. The inlet mouth 33 is connected to a downstream end 19 of the tank duct 18; the outlet mouth 34 is open towards the tub 11 of the laundry washing machine 1.

[0032] The projection portion 30 of the bellow 20 has a substantially flat shape, with two major sides 36, 37 and two minor sides 38, 39; the major sides 36, 37 are substantially planar, while the minor sides 38, 39 are rounded, so the overall shape of the cross section of the projection portion 30 and of the bellow duct 32 formed therein is a flat rounded shape, as better visible in figure 5.

[0033] The tank duct 18 comprises at least two separate and parallel tank sub-ducts 41, 42 (see figures 6 and 7), suitable for receiving different detergent mixtures from different areas in the detergent tank 17. The sub-ducts 41, 42 can be equal or better different one another (like the sub-ducts 41, 42 shown in the figures) in accordance with the different amount of flow they have to receive.

[0034] The sub-ducts 41, 42 are separated by a fin 45, longitudinally extended in the tank duct 18.

[0035] The bellow duct 32 comprises at least two separate and parallel bellow sub-ducts 51, 52, suitable for receiving different detergent mixtures from different sub-ducts 41, 42 of the tank duct 18.

[0036] The sub-ducts 51, 52 are separated by a fin 55, longitudinally extended in the bellow duct 32. An additional fin 56, which extends only at the final section of the bellow duct 32, further divides the sub-duct 52 into two parallel sub-ducts 58, 59. Both fin 55 and fin 56 are extended from one to the other of the major sides 36, 37 of the projection portion 30 of the bellow 20.

[0037] It should be noted that more than one fin 45 can be provided in the tank duct 18, as well as more than two fins 55, 56 can be provided in the bellow duct 32, to have them divided into more parallel sub-ducts.

[0038] Fin 45 is substantially planar, while fins 55, 56 have a curved shape, when seen in a cross section of the bellow duct 32, see in particular fig. 5. Preferably, the fins 55, 56 have opposing curvature, when seen in a cross section of the bellow duct 32; in the embodiment shown in the drawings, the fins 55, 56 have convexly opposing curvature, i.e. they are convex at the sides facing each other.

[0039] The outlet mouth 34 has preferably at least two outlet regions, indeed three outlet regions 61, 62, 63, in the embodiment shown in the drawings, one for each of the bellow sub-ducts 51, 58, 59 present at the outlet mouth 34. Each of the outlet regions 61, 62, 63 is suitable to supply detergent mixture to the tub 11 under different specific supply conditions.

[0040] In particular, as visible in fig. 4, at outlet region 61 the detergent mixture is supplied rather concentrated to the tub, at relatively high speed. This condition is suitable for very liquid detergent mixtures that are anyway able to spread quickly into the laundry.

[0041] At outlet regions 62 and 63, the same detergent mixture arrives, as sub-ducts 58 and 59 are divided only at the outlet mouth 34: upstream, there is only one and the same sub-duct 52 in the bellow duct 32, as well as only one sub-duct 42 in the tank duct 18. However, the detergent mixtures is delivered to the tub 11 under different conditions at the regions 62 and 63: at region 62, the detergent mixture is delivered in a substantial radial direction into the tub 11, while at region 63 the detergent mixture is delivered in a sharply inclined direction into the tub 11. The result is that the detergent mixture arriving through sub-ducts 42 and 52 is widely spread into the tub, at relatively low speed. This condition is suitable for more dense detergent mixtures that, by themselves, would spread into the laundry with difficulty.

[0042] Also, in use of the laundry washing machine 1, like in any laundry washing machine, the tub 11 vibrates, with respect to the casing 10. Vibrations are particularly intense during drum spinning steps of a washing process. Vibrations could in principle be particularly dangerous for the tank duct 18 that upstream is fixedly connected to the casing 10 and that may be rigid, while downstream has to deliver the detergent mixture to the vibrating tub 11. The bellow duct 32 according to the invention, thanks to its high flexibility, prevents that the vibrations of the tub 11 reach the tank duct 18 with a dangerous magnitude. Vibration dampening is particularly effective if fins 55, 56 are provided in the bellow duct. Curved fins 55, 56 further enhance vibration dampening.

[0043] Thus, the invention allows improving lifetime of the machine and efficiency of the washing operations.

Claims

1. Laundry washing machine (1), comprising:

- a casing (10);

- a tub (11) suspended in the casing (10);
- an elastically deformable bellow (20), having

- a ring shaped main portion (21) sealingly connected to the casing (10) and to the tub (11), at an opening (12) thereof, and
- a projection portion (30), made in one piece with the main portion (21) and radially extending from the main portion (21) to a distal end (31);

- a detergent tank (17) adapted to receive detergents to be mixed to water before being supplied to the tub (11);

- a tank duct (18) connected upstream to the detergent tank (17) and having a downstream end (19);

- a bellow duct (32) formed within the projection portion (30) of the bellow (20), from an inlet mouth (33), formed at the distal end (31) of the projection portion (30) and connected to the downstream end (19) of the tank duct (18), to an outlet mouth (34), formed in the main portion (21) of the bellow (20), at the projection portion (30), and open into the tub (11);

characterised in that

- the tank duct (18) comprises at least two separate and parallel tank sub-ducts (41, 42), suitable for receiving different detergent mixtures from different areas in the detergent tank (17); and

- the bellow duct (32) comprises at least two separate and parallel bellow sub-ducts (51, 52, 58, 59), suitable for receiving different detergent mixtures from different sub-ducts (41, 42) of the tank duct (18).

2. Laundry washing machine (1) according to claim 1, wherein the projection portion (30) of the bellow (20) has a substantially flat shape, with two major sides (36, 37) and two minor sides (38, 39).

3. Laundry washing machine (1) according to claim 1 or 2, wherein the bellow sub-ducts (51, 52, 58, 59) are separated by fins (55, 56).

4. Laundry washing machine (1) according to claim 2 and 3, wherein the fins (55, 56) that separate the bellow sub-ducts (51, 52, 58, 59) are extended from one to the other of the major sides (36, 37).

5. Laundry washing machine (1) according to claim 3 or 4, wherein the fins (55, 56) have a curved shape, when seen in a cross section of the bellow duct (32).

6. Laundry washing machine (1) according to any pre-

- ceding claim, wherein the bellow sub-ducts (51, 58, 59) are three, separated by two fins (55, 56), the two fins having opposing curvature, when seen in a cross section of the bellow duct (32).
7. Laundry washing machine (1) according to claim 6, wherein the two fins (55, 56) have convexly or concavely opposing curvature.
8. Laundry washing machine (1) according to any of the preceding claims, wherein the outlet mouth (34) has at least two outlet regions (61, 62, 63), one for each of the bellow sub-ducts (51, 58, 59), each of the outlet regions (61, 62, 63) being suitable to supply detergent mixture to the tub (11) under different specific supply conditions comprising any one or more of different supply direction, different supply speed, different supply width, different supply location.
9. Bellow (20) for a laundry washing machine (1), made of an elastically deformable material, comprising:
- a ring shaped main portion (21) with a first, external rim (22) intended to be sealingly mounted to a casing (10) of the laundry washing machine (1), and a second, internal rim (23) intended to be sealingly mounted to a tub (11) of the laundry washing machine (1), and
 - a projection portion (30), made in one piece with the main portion (21) and radially extending from the main portion (21) to a distal end (31),
 - a bellow duct (32) formed within the projection portion (30) of the bellow (20), extending from an inlet mouth (32), formed at the distal end (31) of the projection portion (30) and intended to be connected to a downstream end (19) of a tank duct (18) connected to a detergent tank (17) of the laundry washing machine (1), to an outlet mouth (34), formed in the main portion (21) of the bellow (20), at the projection portion (30), and open towards the tub (11) of the laundry washing machine (1),
- characterised in that**
- the bellow duct (32) comprises at least two separate and parallel bellow sub-ducts (51, 52, 58, 59), suitable for receiving different detergent mixtures from different sub-ducts (41, 42) of the tank duct (18).
10. Bellow (20) according to claim 9, wherein the projection portion (30) of the bellow (20) has a substantially flat shape, with two major sides (36, 37) and two minor sides (38, 39).
11. Bellow (20) according to claim 9 or 10, wherein the sub-ducts (51, 52, 58, 59) are separated by fins (55, 56).
12. Bellow (20) according to claim 10 and 11, wherein the fins (55, 56) that separate the bellow sub-ducts (51, 52, 58, 59) are extended from one to the other of the major sides (36, 37).
13. Bellow (20) according to claim 11 or 12, wherein the fins (55, 56) have a curved shape, when seen in a cross section of the bellow duct (32).
14. Bellow (20) according to any claim 9 to 13, wherein the bellow sub-ducts (51, 58, 59) are three, separated by two fins (55, 56), the two fins having opposing curvature, when seen in a cross section of the bellow duct (32).
15. Bellow (20) according to claim 14, wherein the two fins (55, 56) have convexly or concavely opposing curvature.
16. Bellow (20) according to any of claims 9 to 15, wherein the outlet mouth (34) has at least two outlet regions (61, 62, 63), one for each of the bellow sub-ducts (51, 58, 59), each of the outlet regions (61, 62, 63) being suitable to supply detergent mixture to the tub (11) under different specific supply conditions comprising any one or more of different supply direction, different supply speed, different supply width, different supply location.

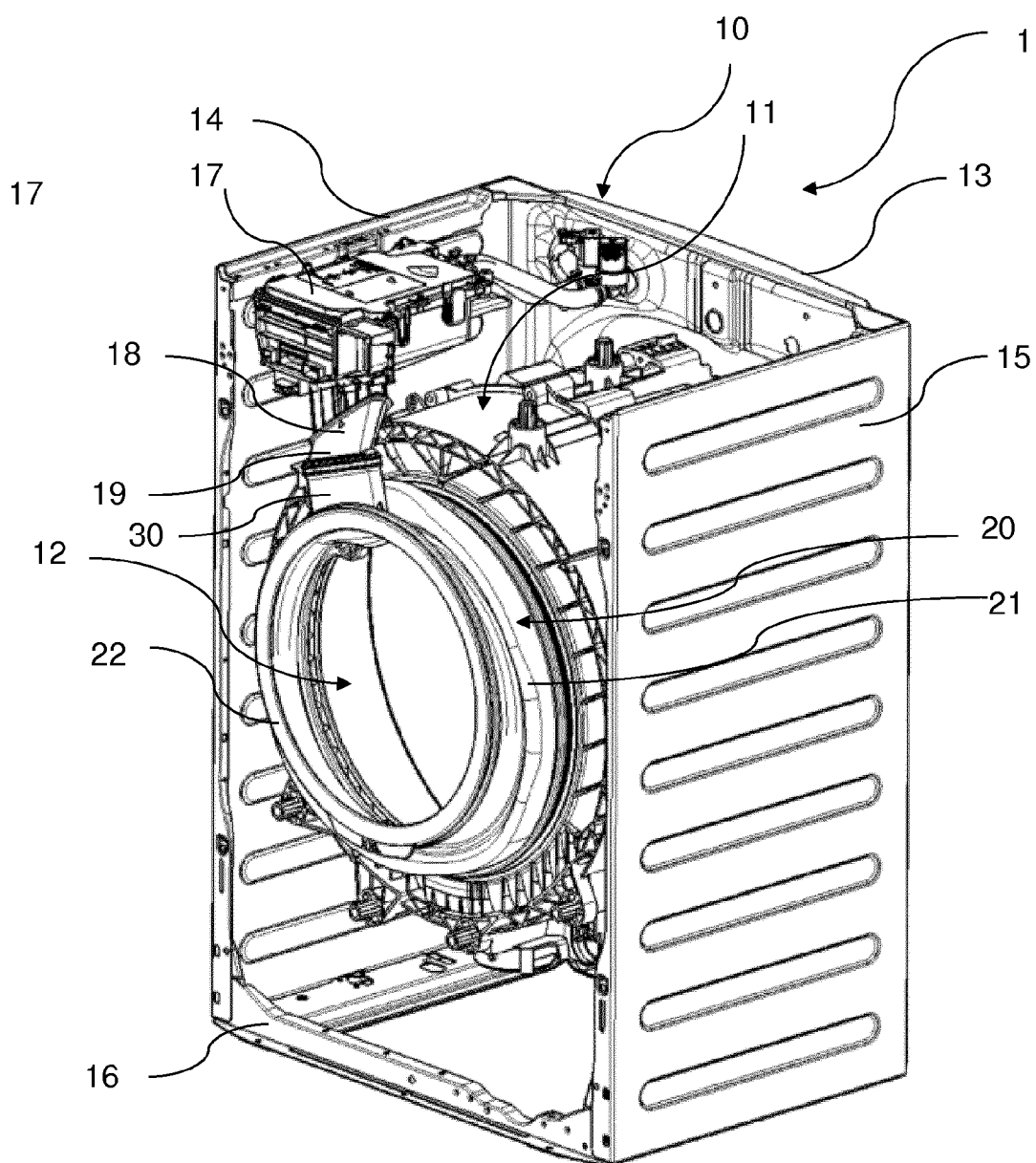


Fig. 1

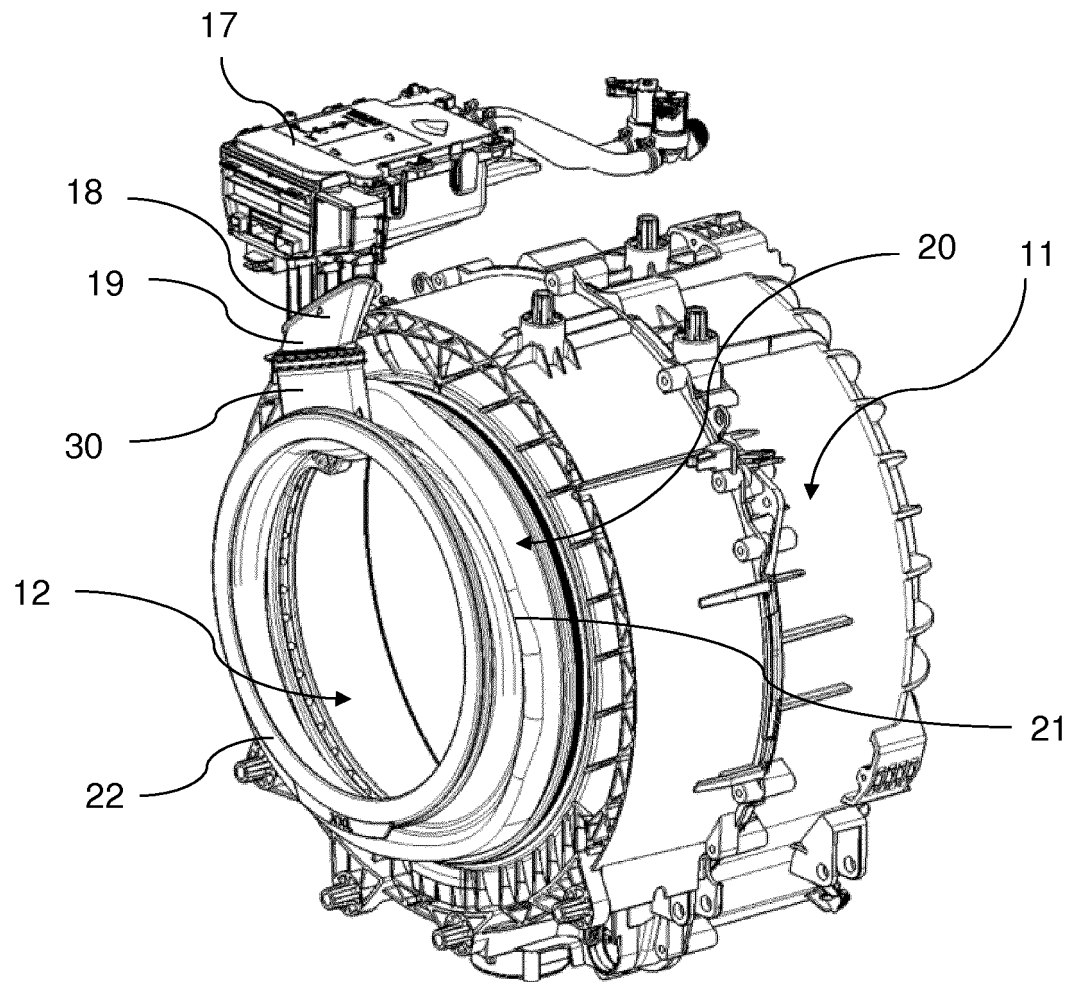


Fig. 2

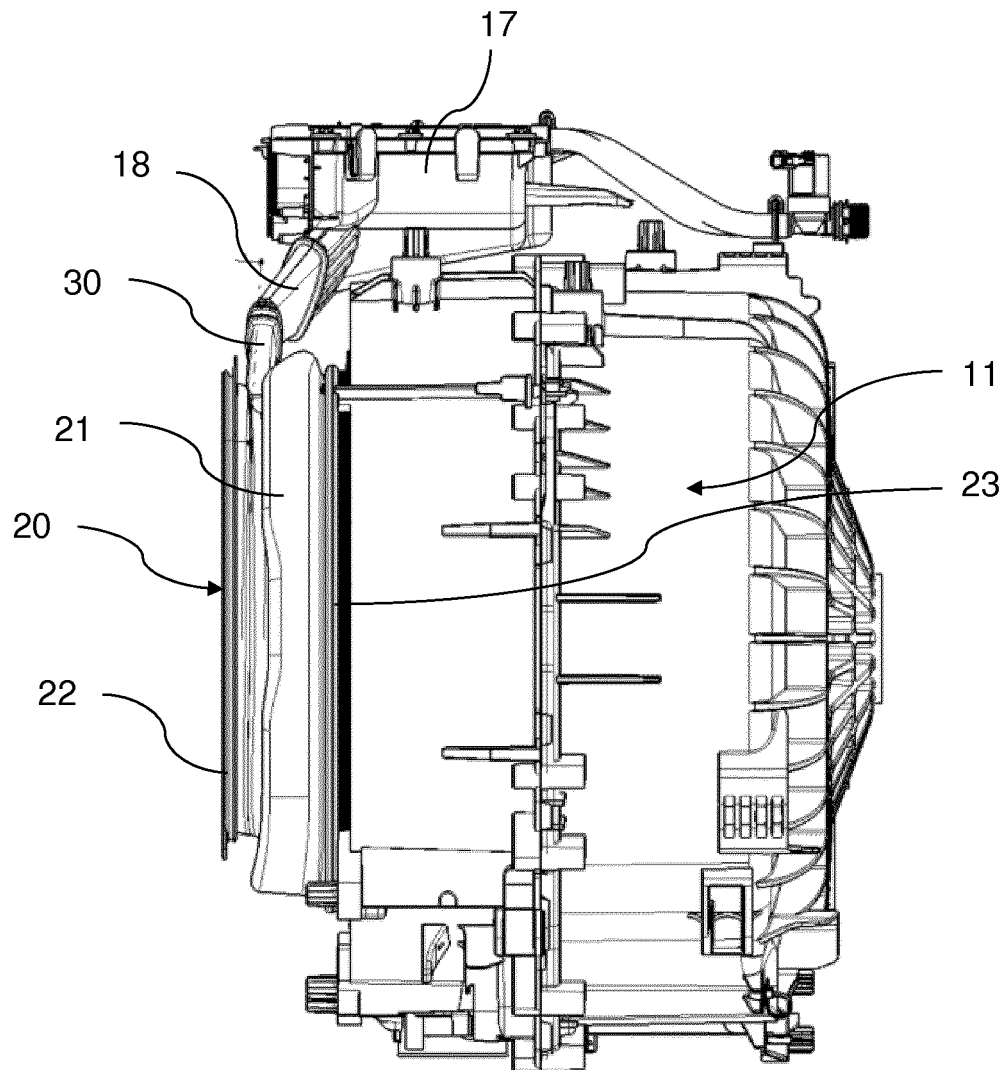


Fig. 3

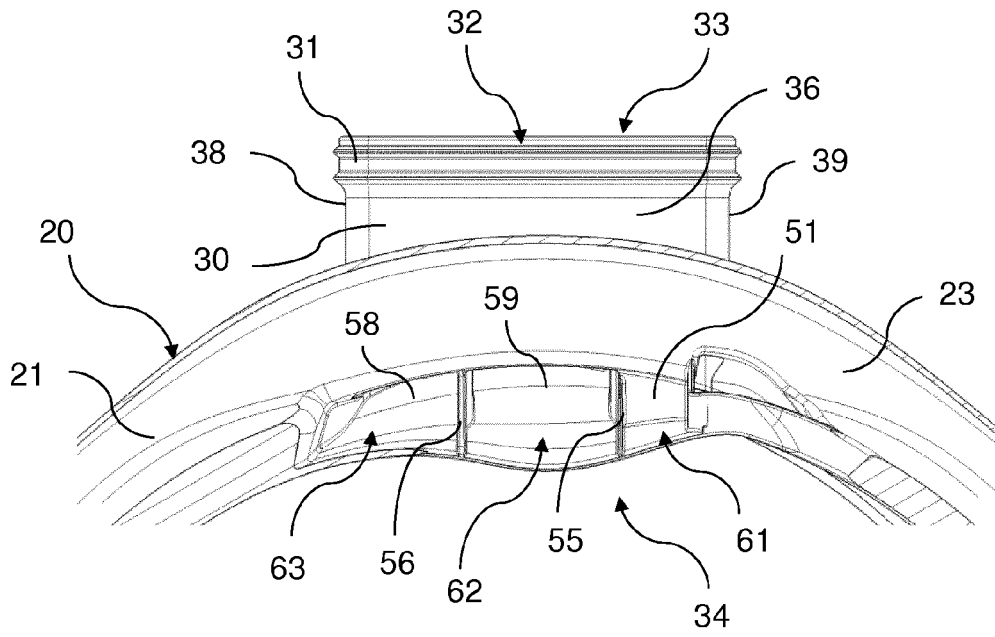


Fig. 4

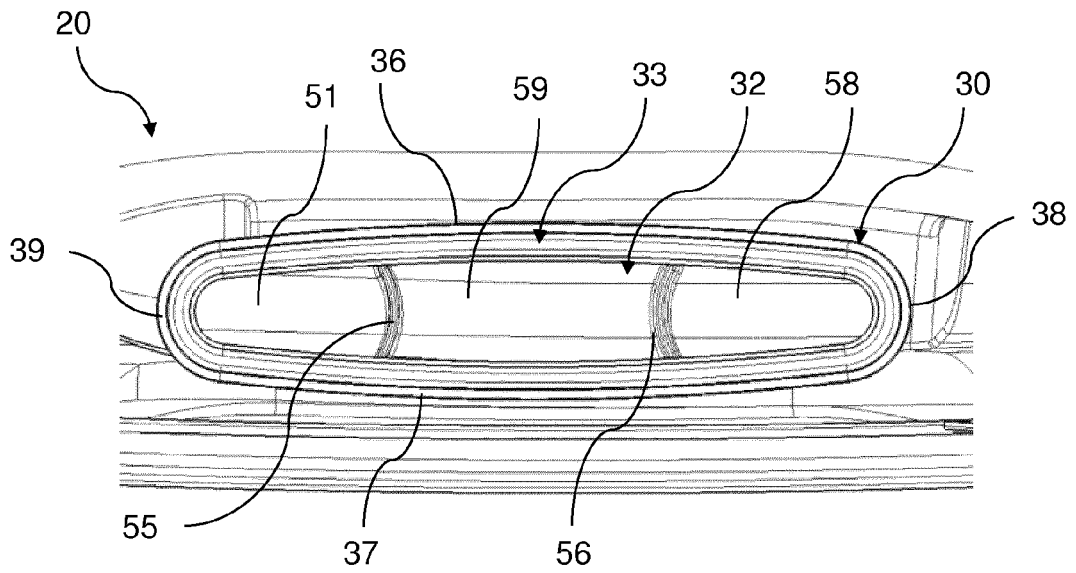


Fig. 5

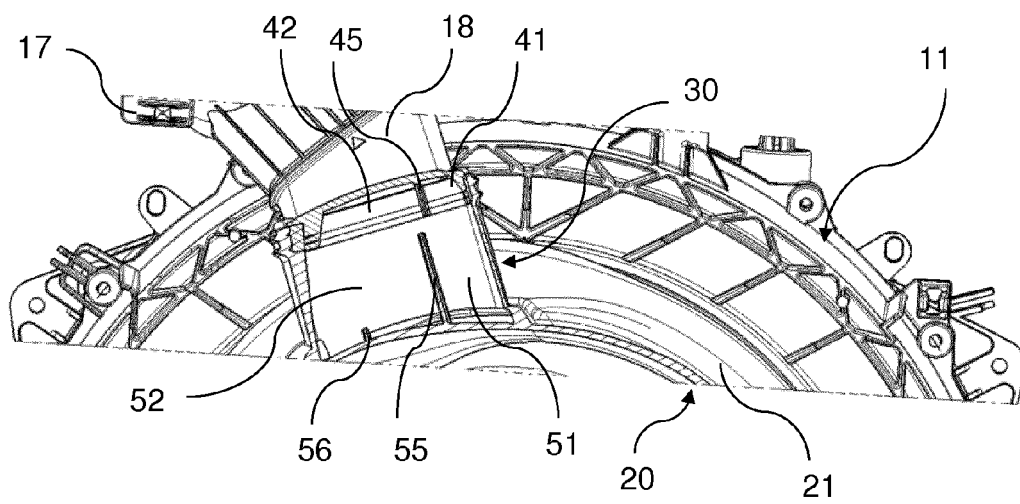


Fig. 6

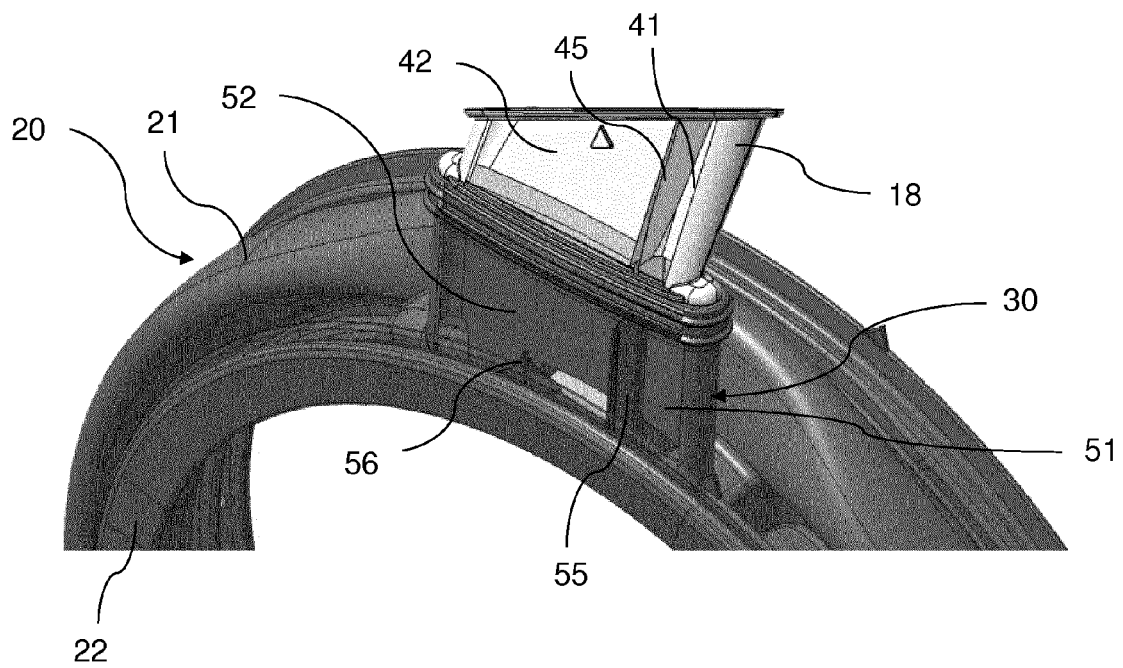


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 13 18 2324

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	EP 2 484 828 A1 (CANDY SPA [IT]) 8 August 2012 (2012-08-08) * figures *	1-16	INV. D06F37/26 D06F39/02
A	EP 2 239 363 A1 (ELECTROLUX HOME PROD CORP [BE]) 13 October 2010 (2010-10-13) * page 3 - paragraph 0006-0008 * * page 4, paragraph 0013 - paragraph 0013-0014 * -----	1-16	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 January 2014	Examiner Stroppa, Giovanni
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 13 18 2324

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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09-01-2014

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