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(54) **Washing machine**

(57) Washing machine comprising a tub provided with a rear base and a lateral surface, the rear base com-

prising an internal surface substantially smooth and substantially convex.

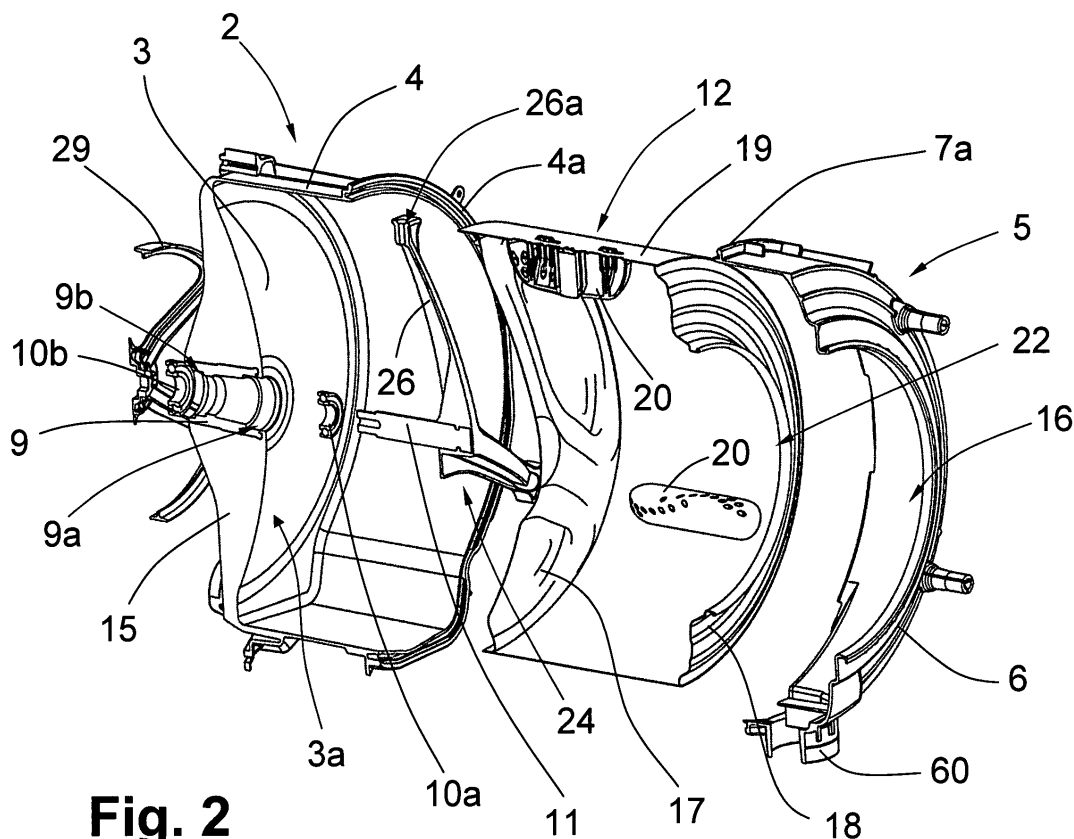


Fig. 2

Description

[0001] The present invention refers to a laundry washing machine.

[0002] Nowadays washing machines, both "simple" washing machines (i.e. washing machines which can only wash and rinse the laundry) and washing-drying machines (i.e. washing machines which can also dry the laundry), usually comprise an external casing provided with a loading/unloading door which allows the access to a washing tub containing a rotary perforated drum in which the laundry to be washed can be loaded.

[0003] The tub is typically substantially cylindrical, and is provided with an opening for loading/unloading the laundry.

[0004] In the front-loading washing machines the opening for loading/unloading the laundry is provided on a frontal base of the tub, and the drum is associated to the tub by means of a rotating shaft which is supported by suitable bearings associated to a rear base of the tub. The shaft typically protrudes out of the tub, so as to be connected, directly or by means of a suitable belt pulley, to an electric motor adapted to rotate the drum.

[0005] Usually the washing tub of a front-loading washing machine is produced in a two-pieces construction, i.e. a front shell (comprising the frontal base and part of the lateral surface of the tub) and a rear shell (comprising the rear base and the rest of the lateral surface of the tub), by injection moulding of plastic material; the two shells are joined together by using known means, e.g. screws.

[0006] Usually, in correspondence of the rear base of the rear shell, reinforcing ribs are integrally provided, so as to increase the strength of the structure; typically the ribs are arranged both circularly and radially in respect to the central portion of the rear wall.

[0007] A passing through hub (which may be metallic or plastic) is provided at the centre of the rear base for supporting the bearings of the rotating shaft; in many cases the hub is made with a core of cast iron, and is over injected by the plastic material.

[0008] In the case of top-loading washing machines, the opening for loading/unloading the laundry is provided on a lateral surface of the tub, and the rotatable drum is supported by bearings usually distributed between the front base and the rear base of the tub.

[0009] For example EP 1 538 252 discloses a plastic tub for a clothes washing machine, in particular a washing machine of front-loading type, comprising a front shell and a rear shell, the rear shell being formed by a cylindrical envelope (or lateral surface) and a rear wall (or base) provided with reinforcing ribs. A passing through hub is provided at the centre of the rear wall for supporting the bearing of a central shaft by means of which a clothes containing drum is driven into rotation within the tub; the hub is made by cast iron over injected by plastic material. The rear circular wall of the rear shell is shaped with a plurality of ribbed circular sectors alternatively oriented

in opposite axial direction, and at least one circular crown of radial ribs is provided around the hub. The tub structure results with a reduced and constant thickness of the rear part of the tub, so as the injection moulding cycle for producing it is correspondingly reduced.

[0010] This solution has however a drawback; in fact the ribbed circular sectors, inwardly and outwardly directed with respect to the axis of symmetry of the tub, define, on the inner surface of the rear wall of the tub, an alternation of concave and convex areas, which create, during the rotation of the drum, a considerable turbulence of the washing liquid; this turbulence increases the vibrations (and therefore the noise level), and increases also the formation of foam in the washing liquid, which requires more rinsing water and/or a longer rinsing phase to be removed, increasing in this way the water consumption and also the power consumption of the washing machine.

[0011] Moreover the convex and concave areas present at the rear wall of the tub generates turbulence also in the air movement during the spinning phase, which results in an increasing of the noise also during such a phase, and in an higher energy consumptions in the electric motor which rotates the drum.

[0012] Furthermore the washing liquid tends to collect in the concave areas present on the rear wall, and there is the risk that the rinsing water can't remove such liquid; these washing residues favour the proliferation of bacteria and/or scale, with the consequent production of bad odours.

[0013] The aim of the present invention is therefore to increase the mechanical resistance of the tub of a washing machine, assuring at the same time a low level of noise and a reduced risk of formation of washing residues.

[0014] Within this aim, another object of the invention is to increase the volume internal to the drum of a washing machine without excessively increasing the external dimensions of the washing machine.

[0015] Another object of the invention is to reduce the weight of a washing machine without reducing the mechanical performances.

[0016] It is therefore an object of the present invention to solve the above-noted problems, thereby doing away with the drawbacks of the cited prior art.

[0017] The Applicant has found that by making the internal surface of the rear base of the tub substantially smooth and substantially convex, it is possible to increase the mechanical resistance of the tub, assuring at the same time a low level of noise and a reduced risk of formation of washing residues.

[0018] In particular, the above-mentioned aim and objects, as well as others that will become better apparent hereinafter, are achieved by a washing machine comprising a tub provided with a rear base and a lateral surface, the rear base comprising an internal surface substantially smooth and substantially convex.

[0019] Features and advantages of the present invention will anyway be more readily understood from the

description that is given below by way of nonlimiting example with reference to the accompanying drawings, in which:

- **Figure 1** is a prospective view of the tub of a washing machine according to the invention;
- **Figure 2** is a first prospective and exploded view of the tub, the drum, and the spider of a washing machine according to the invention, sectioned along a longitudinal section plane;
- **Figure 3** is a second prospective and exploded view of the tub, the drum, and the spider of Figure 2, sectioned along a longitudinal section plane;
- **Figure 4** is a lateral section of the tub, the drum, and the spider of Figures 2 and 3;
- **Figure 5** is a prospective and sectioned view of the tub, the drum, and the spider of Figures 2, 3 and 4;
- **Figure 6** is a lateral exploded section of the tub, the drum, and the spider illustrated in the previous Figures;
- **Figure 7** is a first prospective view of the rear shell of the tub illustrated in the previous Figures;
- **Figure 8** is a second prospective view of the rear shell of the tub of Figure 7;
- **Figure 9** is a first prospective view of the drum of a washing machine according to the invention;
- **Figure 10** is a second prospective view of the drum of Figure 9;
- **Figure 11** is a first prospective view of the spider of a washing machine according to the invention;
- **Figure 12** is a second prospective view of the spider of Figure 11.

[0020] With reference to the enclosed Figures, number 1 indicates the washing tub 1 of a washing machine, not illustrated, according to the invention.

[0021] Preferably the washing tub 1 comprises a rear shell 2 (i.e. a box shaped body, opened at one end), provided with a rear base 3 (or wall or surface), substantially cylindrical, and with a lateral surface 4; advantageously the tub 1 also comprises a frontal shell 5 provided with a frontal base 6 (or wall or surface), substantially cylindrical, and with a lateral surface 7.

[0022] Advantageously the rear shell 2 is substantially cylindrical, and it is preferably obtained in a single-piece construction by moulding of a plastic material; also the frontal shell 5 is opportunely substantially cylindrical, and it is preferably obtained in a single-piece construction by moulding of a plastic material.

[0023] Advantageously, the rear and/or the frontal shells are provided with liquid adduction/extraction means, adapted to allow the inlet and/or the outlet of washing/rinsing liquid (i.e. water or water mixed with washing products) in/from the tub 1; these adduction/extraction means comprise, for example, one or more pipe couplings, numbered 50 and 60 in the enclosed Figures, adapted to be connected to one or more pipes or ducts, not illustrated, fluidly connected to the washing/

rinsing circuit of the washing machine, also not illustrated.

[0024] The rear shell 2 and the frontal shell 5 are joined together, in correspondence respectively of their lateral surfaces 4 and 7, by suitable joining means; advantageously the joining means comprise, for example, a first flange 4a, protruding radially from the free border of the lateral surface 4 of the rear shell 2, and a second flange 7a, protruding radially from the free border of the lateral surface 7 of the frontal shell 5, designed in order to fit one another. The first and second flange can be advantageously fixed one another by suitable fixing means, comprising, for example, screws 8 or rivets, and/or gluing and/or welding, and/or snap-fitting.

[0025] A hub 9 is opportunely provided at/to the rear base 3, in which one or more bearings 10a, 10b are placed, preferably substantially cylindrical, adapted to bear a rotating shaft 11 associated to a rotatable drum 12 contained in the tub 1, which will be described in the following.

[0026] Advantageously the hub 9 may be metallic (preferably it is made with a core of cast iron) and it may be over injected by the plastic material during the moulding of the rear shell 2. In a further embodiment the hub 9 is made of plastic.

[0027] Advantageously the hub 9 is substantially cylindrical, it is placed substantially in correspondence of the central portion of the rear base 3, and it is provided, preferably at its ends, with one or more seats 9a, 9b, adapted to lodge respectively the one or more bearings 10a, 10b.

[0028] Advantageously the rear base 3 comprises an internal surface 3a which is substantially smooth (i.e. it is substantially free from irregularities, roughness, or projections) and is substantially convex.

[0029] Opportunely the internal surface 3a of the rear base 3 is curved.

[0030] In a preferred embodiment the internal surface 3a of the rear base 3 is part of a substantially spherical surface, a portion of which is illustrated in Figure 6 and is numbered 13.

[0031] In other words the shape of the internal surface 3a substantially coincides with a part of a substantially spherical surface 13.

[0032] Advantageously, the rear base 3 comprises reinforcing ribs 15, adapted to increase the strength of the structure, protruding from the rear base 3 towards the external of the tub 1, and preferably obtained in a single-piece construction with the rear base 3; the reinforcing ribs 15 are preferably arranged both circularly and radially with respect to the central portion of the rear base 3.

[0033] In the embodiment illustrated in the enclosed figured, the washing machine, not illustrated, is of the front-loading type, and therefore the frontal base 6 of the frontal shell 5 is provided with a first opening 16 adapted for allowing the loading/unloading of the laundry in/from the tub 1.

[0034] However, as will be explained in the following, the present invention can be applied, with few modifica-

tions, also to a top-loading washing machine.

[0035] Advantageously the washing machine according to the invention comprises a drum 12, rotatably housed in the tub 1, substantially cylindrical and preferably metallic; advantageously the drum 12 comprises a rear base 17 (or wall or surface), and a frontal base 18 (or wall or surface), substantially circular, connected by a lateral surface or envelope 19.

[0036] Advantageously the drum 12 is provided with a plurality of holes, not illustrated, obtained on the lateral surface or envelope 19 and/or on the rear and/or frontal bases 17, 18, in order to allow a washing liquid contained in the tub 1 to flow into and out of the drum 12.

[0037] Preferably, but not necessarily, the drum 12 comprises one or more lifters 20 (or elevators or diverter), adapted to improve the stirring of the laundry during the rotation of the drum 12; the lifters 20 are substantially prismatic elements fixed to the internal face of the lateral surface or envelope 19 of the drum 12, and positioned with their longitudinal axis substantially parallel to the rotation axis 21 of the drum 12.

[0038] In the embodiment illustrated in the enclosed Figure, the washing machine, not illustrated, is a front-loading washing machine, and therefore on the frontal base 18 of the drum 12 a second opening 22 is obtained, allowing the loading/unloading of the laundry in/from the drum 12.

[0039] However, as will be explained in the following, the present invention can be applied, with few modifications, also to a top-loading washing machine.

[0040] Advantageously the rear base 17 of the drum 12 comprises an external surface 17a, facing the rear base 3 of the tub 1; in the embodiment illustrated in the enclosed Figures, on the rear base 17 of the drum 12 a plurality of concave and convex regions are defined, having different curvatures, which increase the mechanical strength of the rear base 17.

[0041] Opportunely, therefore, at least part of the external surface 17a of the rear base 17 of the drum 12 is substantially concave; in particular, with reference to the enclosed figures, the external surface 17a comprises three concave regions 100 adapted to be associated to the branches 26 of a spider 24, which will be described in the following.

[0042] Clearly the concave regions 100 are not necessarily three; in a further embodiment, not illustrated, they may be also two, four, five, or any suitable number.

[0043] Advantageously, at least part of the external surface 17a of the rear base 17 of the drum 12 is curved.

[0044] In a preferred embodiment, at least part of the external surface 17a is part of a substantially spherical surface, a portion of which is illustrated in Figure 6 and is numbered 23; with particular reference to the embodiment illustrated in the enclosed Figures, at least the concave regions 100 of the external surface 17a are curved and are part of a the spherical surface 23.

[0045] Preferably the substantially spherical surface 23 has substantially the same diameter of the substan-

tially spherical surface 13 which defines at least part of the internal surface 3a of the rear base 3 of the rear shell 2.

[0046] Advantageously, at least part of the external surface 17a is substantially parallel to the internal surface 3a of the rear base 3 of the rear shell 2; with particular reference to the embodiment illustrated in the enclosed Figures, at least the three concave regions 100 of the external surface 17a are substantially parallel to the internal surface 3a.

[0047] In a further embodiment, not illustrated, the whole external surface 17a is smooth and concave (i.e. not provided with convex and concave regions, but fully concave); in this case the whole external surface 17a (and therefore not only a part of the external surface 17a) is advantageously curved and is part of a substantially spherical surface and is substantially parallel to the internal surface 3a of the rear base 3 of the rear shell 2.

[0048] Opportunely the washing machine according to the invention comprises a spider 24 (or supporting star) supporting the shaft 11 and fixed to the external surface 17a of the rear base 17 of the drum 12; the spider 24 is advantageously metallic.

[0049] Advantageously the spider 24 comprises a central region 25, from which a plurality of branches 26 radially protrudes; the branches 26 are curved in such a way that they can be associated to the rear base 17 of the drum 12.

[0050] Opportunely the branches 26 are placed respectively substantially in correspondence to the concave regions 100 of the external surface 17a of the rear base 17 of the drum 12.

[0051] The branches 26 may be preferably fixed to the rear base 17 of the drum 12, in correspondence of their free end 26a, by suitable fixing means, comprising for example suitable screws or rivets, not illustrated, and/or by gluing and/or welding.

[0052] Advantageously the length of the branches 26 is such that the free ends 26a of the branches 26 is positioned substantially in correspondence to the external border of the rear base 17.

[0053] Advantageously the branches 26 of the spider 24 are provided with a rear surface 27, opposite to the drum 12 and facing the rear base 3 of the tub 1, at least part of which is substantially concave.

[0054] Opportunely the rear surface 27 of the branches 26 is at least partially curved.

[0055] In a preferred embodiment, at least part of the rear surface 27 of the branches 26 is part of a substantially spherical surface, a portion of which is illustrated in Figure 6 and is numbered 28.

[0056] Preferably, the substantially spherical surface 28 has substantially the same diameter of the substantially spherical surface 13 which defines at least part of the internal surface 3a of the rear base 3 of the rear shell 2.

[0057] Advantageously at least part of the rear surface 27 of the branches 26 of the spider 24 is substantially

parallel to the internal surface 3a of the rear base 3 of the rear shell 2.

[0058] As illustrated in Figure 11, the rear surface 27 of the branches 26 comprises a smooth curved region 27a, which is part of a substantially spherical surface 28, and a further hollow region defining a cavity 27b.

[0059] In another embodiment, not illustrated, the whole rear surface 27 of the branches 26 is smooth and curved, and it is part of the substantially spherical surface 28.

[0060] In a preferred embodiment, the internal surface 3a of the rear base 3 of the rear shell 2, at least part of the rear surface 27 of the branches 26 of the spider 24, and at least part of the external surface 17a of the rear base 17 of the drum 12, are opportunely substantially parallel one another.

[0061] In a preferred embodiment, the internal surface 3a of the rear base 3 of the rear shell 2, at least part of the rear surface 27 of the branches 26 of the spider 24, and at least part of the external surface 17a of the rear base 17 of the drum 12, are opportunely part of three spherical surfaces which have substantially the same diameter.

[0062] Advantageously the shaft 11 is fixed to the central region 25 of the spider 24, and protrudes perpendicularly to such a central region 25; preferably the shaft 11 is fixed to the spider 24 by burying one end of the shaft 11 inside the central region 25 during the moulding of the spider 24.

[0063] Advantageously the spider 24, and therefore the drum 12 fixed to the latter, is rotatably associated to the tub 1 by the insertion of the shaft 11 in one or more bearings 10a, 10b placed into suitable seats 9a, 9b provided in the hub 9.

[0064] As can be seen particularly in Figure 4, at least one of the one or more bearings 10a, 10b (with reference to the enclosed Figures, the bearing numbered 10a) is advantageously positioned at least partially between the drum 12 and a plane 300 passing through the contact regions of the free ends 26a of the branches 26 of the spider 24 and the external surface 17a of the rear base 17 of the drum 12.

[0065] This allows increasing the volume internal to the drum 12 without excessively increasing the external dimensions of the tub 1.

[0066] The particular positioning of the bearing 10a increases also the mechanical resistance of the structure.

[0067] The free end 11a of the shaft 11 exits the tub 1 through the hub 9, so as to be fixed to rotating means adapted to rotate the drum 12 with respect to the tub 1.

[0068] With reference to the enclosed Figures, the rotating means advantageously comprise a pulley 29, fixed to the free end 11a of the shaft 11, and connected, preferably by a belt, not illustrated, to a suitable electrical motor 30, associated, for example, to the tub 1.

[0069] In a further embodiment, not illustrated, an electric motor can be mounted directly on the shaft 11.

[0070] Clearly, by joining rear shells 2 with a fixed diameter to frontal shells 5 with the same fixed diameter

but with different lengths, it is possible to obtain washing tubs 1 of different volumes and with the same fixed diameter (and therefore with different lengths); for the same purpose it is alternatively possible to join frontal shells 5 with a fixed diameter to rear shells 2 with the same fixed diameter, but with different lengths.

[0071] The embodiment illustrated in the enclosed Figures and disclosed in the previous description refers to a "simple" washing machines, that is a washing machines which can only wash and rinse the laundry; it is however clear that the invention can be as well applied, substantially without any crucial modification, to a washing-drying machines, that is a washing machines which can also dry the laundry.

[0072] Moreover, even if the invention has been described with regard to a front-loading washing machine, it clear that this invention can be easily applied to a top-loading washing machine.

[0073] In the case, not illustrated, of a top-loading washing machine, the tub may be obtained, for example, by the joint of two shells, both of them being substantially equal to the rear shell 2 described with reference to the enclosed Figures. An opening for loading/unloading the laundry could be provided on the lateral surface of the tub.

[0074] The drum could comprise, in this case, two bases substantially equal to the rear base 17 of the drum 12 described with reference to the enclosed Figures; each base is connected, preferably by a spider substantially equal to the one described with reference to the enclosed Figures, to a shaft rotatably associated respectively to one of the bases of the two shells of the tub. An opening for loading/unloading the laundry could be in this case provided on the lateral surface of the drum.

[0075] It is seen therefore how the invention achieves the proposed aim and objects, there being provided a washing machine which, thanks to the smoothness and to the particular shape (preferably substantially spherical) of the internal surface of the first base of the tub, assures a high mechanical resistance of the tub, coupled with a low level of noise and with a reduced risk of formation of washing residues which should favour the proliferation of bacteria and/or scale.

[0076] Moreover the particular positioning of the bearings with respect to the rear base of the drum and to the spider, allows increasing the volume internal to the drum without excessively increasing the external dimensions of the tub.

[0077] Furthermore, the particular shape (preferably substantially spherical) of the rear base of the rear shell, and the particular positioning of the bearings with respect to the rear base of the drum and to the spider, allows reducing the resistance to blending stress which must be provided by the hub, and therefore allow using a hub with a lower diameter, reducing in this way the weight and the costs of the washing machine.

Claims

1. Washing machine comprising a tub (1) provided with a rear base (3) and a lateral surface (4), **characterized in that** said rear base (3) comprises an internal surface (3a) substantially smooth and substantially convex.
2. Washing machine, according to claim 1, **characterized in that** said internal surface (3a) of said rear base (3) of said tub (1) is curved.
3. Washing machine, according to claim 2, **characterized in that** said internal surface (3a) of said rear base (3) of said tub (1) is part of a substantially spherical surface (13).
4. Washing machine, according to claim 1, 2 or 3, **characterized in that** said tub (1) contains a rotatable drum (12) provided with a rear base (17) comprising an external surface (17a) facing said rear base (3) of said tub (1), at least part of said external surface (17a) being substantially concave.
5. Washing machine, according to claim 4, **characterized in that** at least part of said external surface (17a) of said rear base (17) of said drum (12) is curved.
6. Washing machine, according to claim 5, **characterized in that** at least part of said external surface (17a) of said rear base (17) of said drum (12) is part of a substantially spherical surface (23).
7. Washing machine, according to one or more of the previous claims, **characterized in that** it comprises a spider (24) supporting a shaft (11) and fixed to said external surface (17a) of said rear base (17) of said drum (12), said spider (24) comprising a plurality of branches (26) associated to said rear base (17) of said drum (12) and provided with a rear surface (27), opposite to said drum (12) and facing said rear base (3) of said tub (1), at least part of said rear surface (27) being substantially concave.
8. Washing machine, according to claim 7, **characterized in that** at least part of said rear surface (27) of said branches (26) is curved.
9. Washing machine, according to claim 8, **characterized in that** at least part of said rear surface (27) of said branches (26) is part of a substantially spherical surface (28).
10. Washing machine, according to one or more of the preceding claims, **characterized in that** said internal surface (3a) of said rear base (3) of said rear shell (2), at least part of said rear surface (27) of said branches (26), and at least part of said external surface (17a) of said rear base (17) of said drum (12) are substantially parallel one another.
11. Washing machine, according to one or more of the preceding claims, **characterized in that** said internal surface (3a) of said rear base (3) of said rear shell (2), at least part of said rear surface (27) of said branches (26), and at least part of said external surface (17a) of said rear base (17) of said drum (12) are part of three spherical surfaces (13, 23, 28) which have substantially the same diameter.
12. Washing machine, according to one or more of the preceding claims, **characterized in that** the free end (26a) of said branches (26) of said spider (24) is fixed to said external surface (17a) of said rear base (17) of said drum (12), said washing machine comprising a hub (9), provided at/to said rear base (3) of said tub (1), housing one or more bearings (10a, 10b) adapted to bear said shaft (11), at least one of said one or more bearings (10a, 10b) being positioned at least partially between said drum (12) and a plane (300) passing through the contact regions of said free ends (26a) and said external surface (17a) of said rear base (17) of said drum (12).

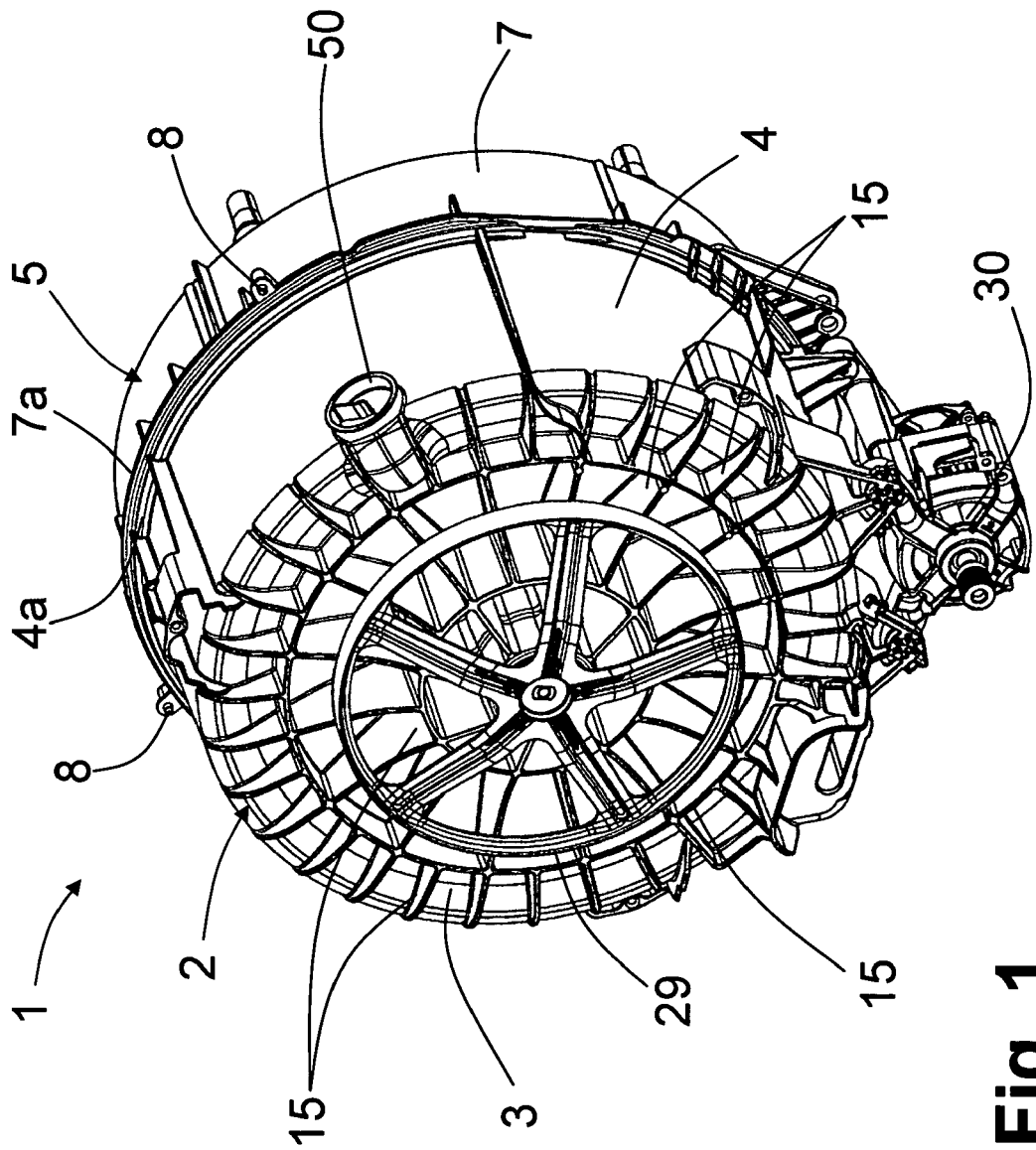


Fig. 1

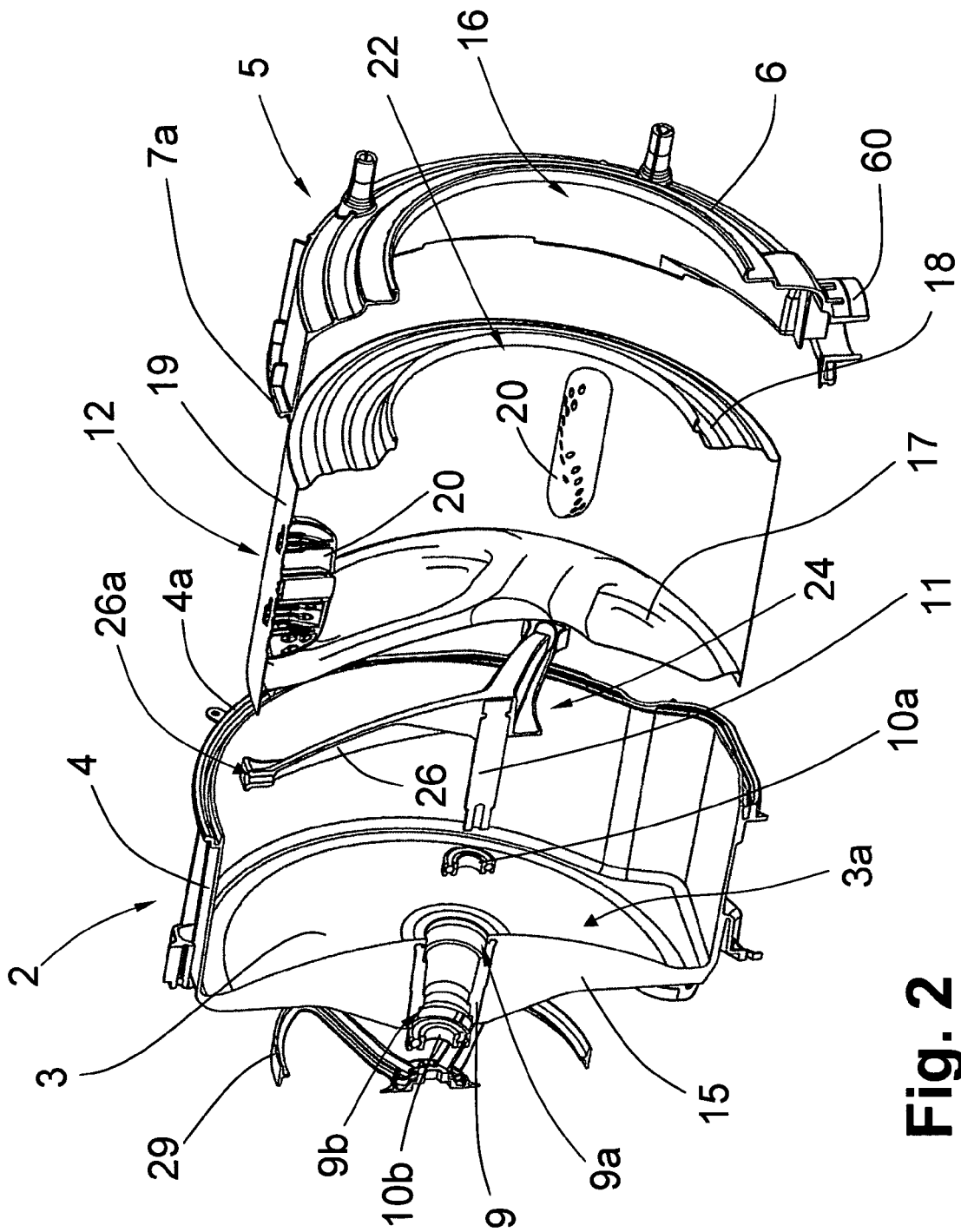


Fig. 2

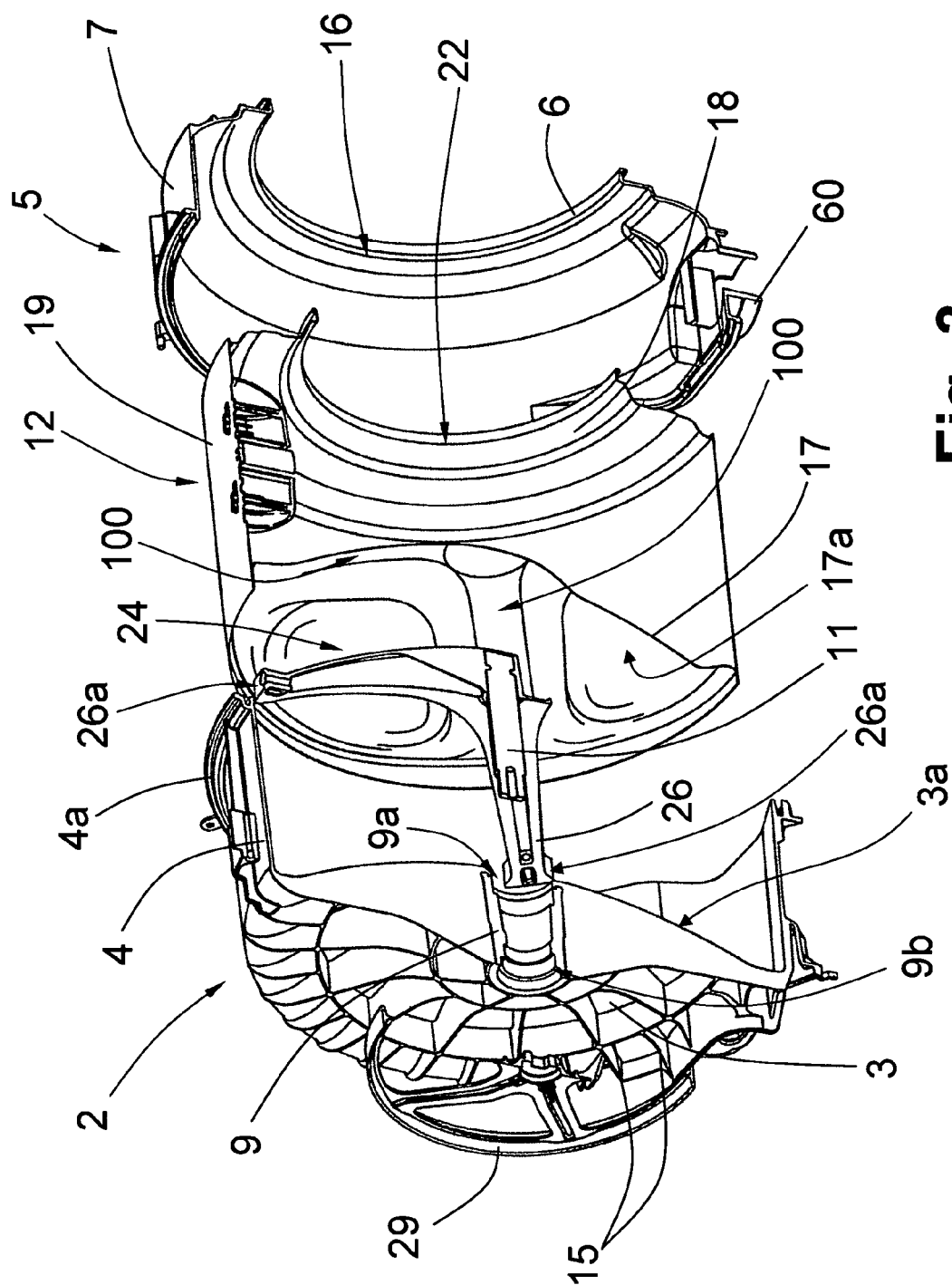


Fig. 3

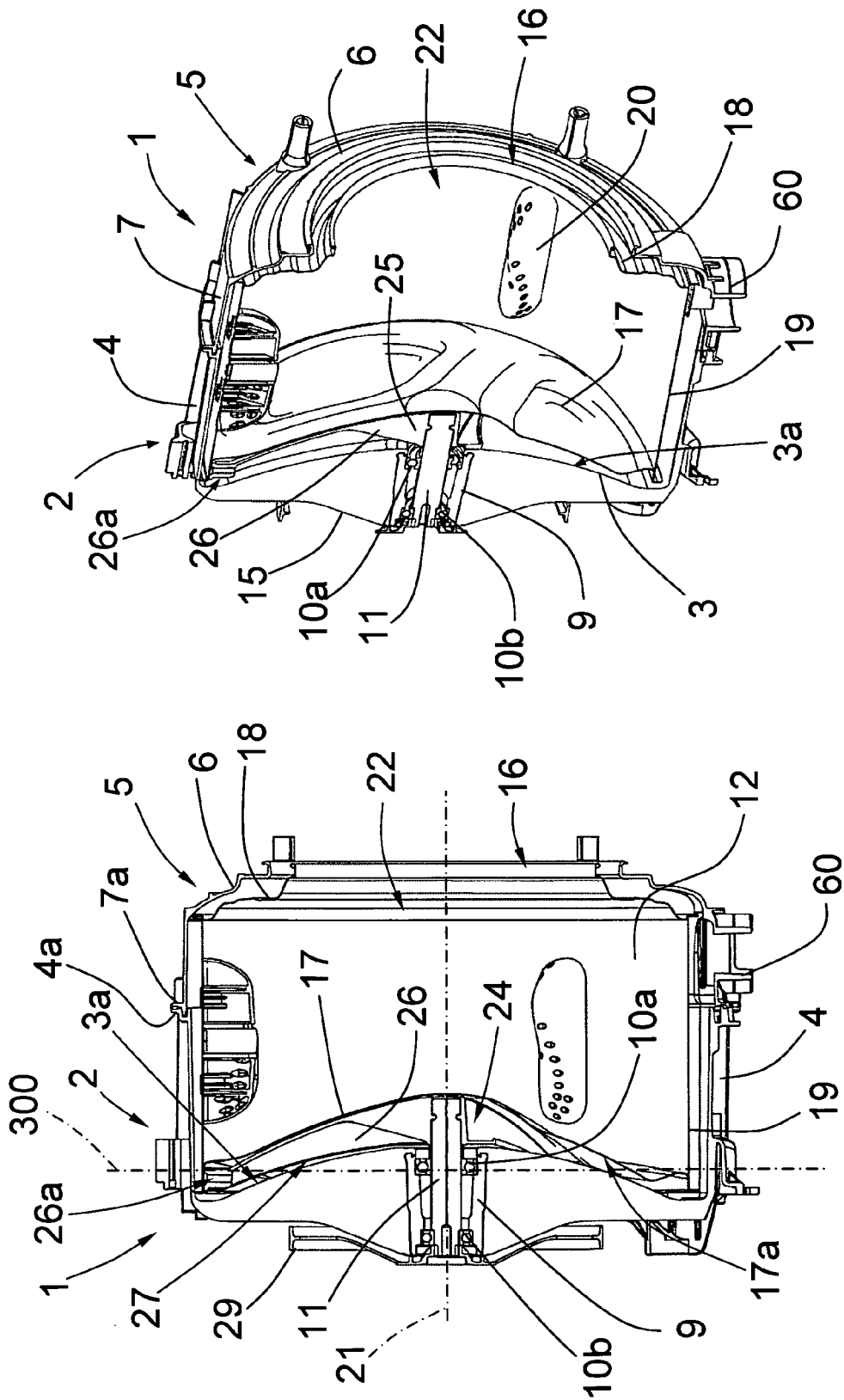


Fig. 5

Fig. 4

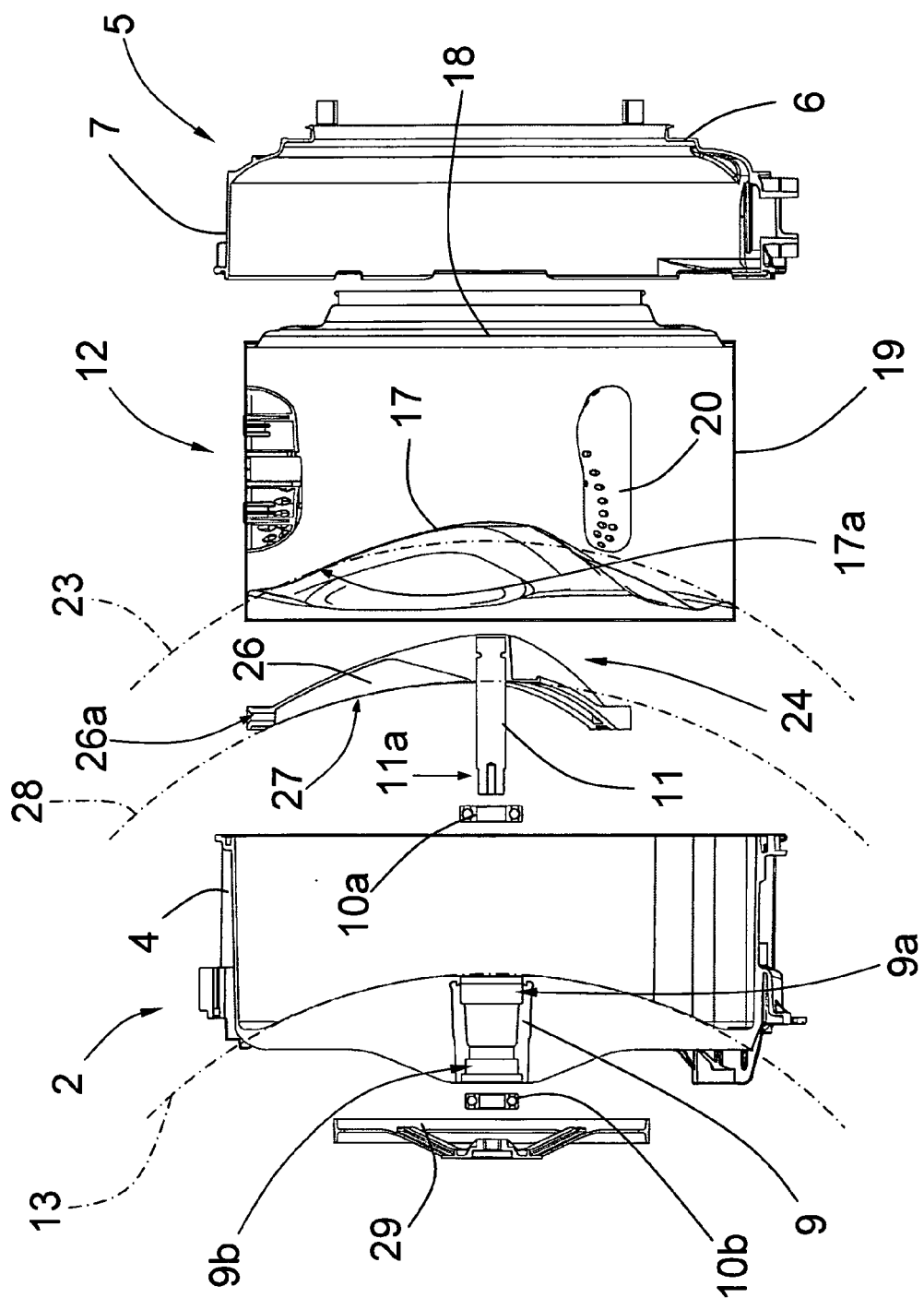


Fig. 6

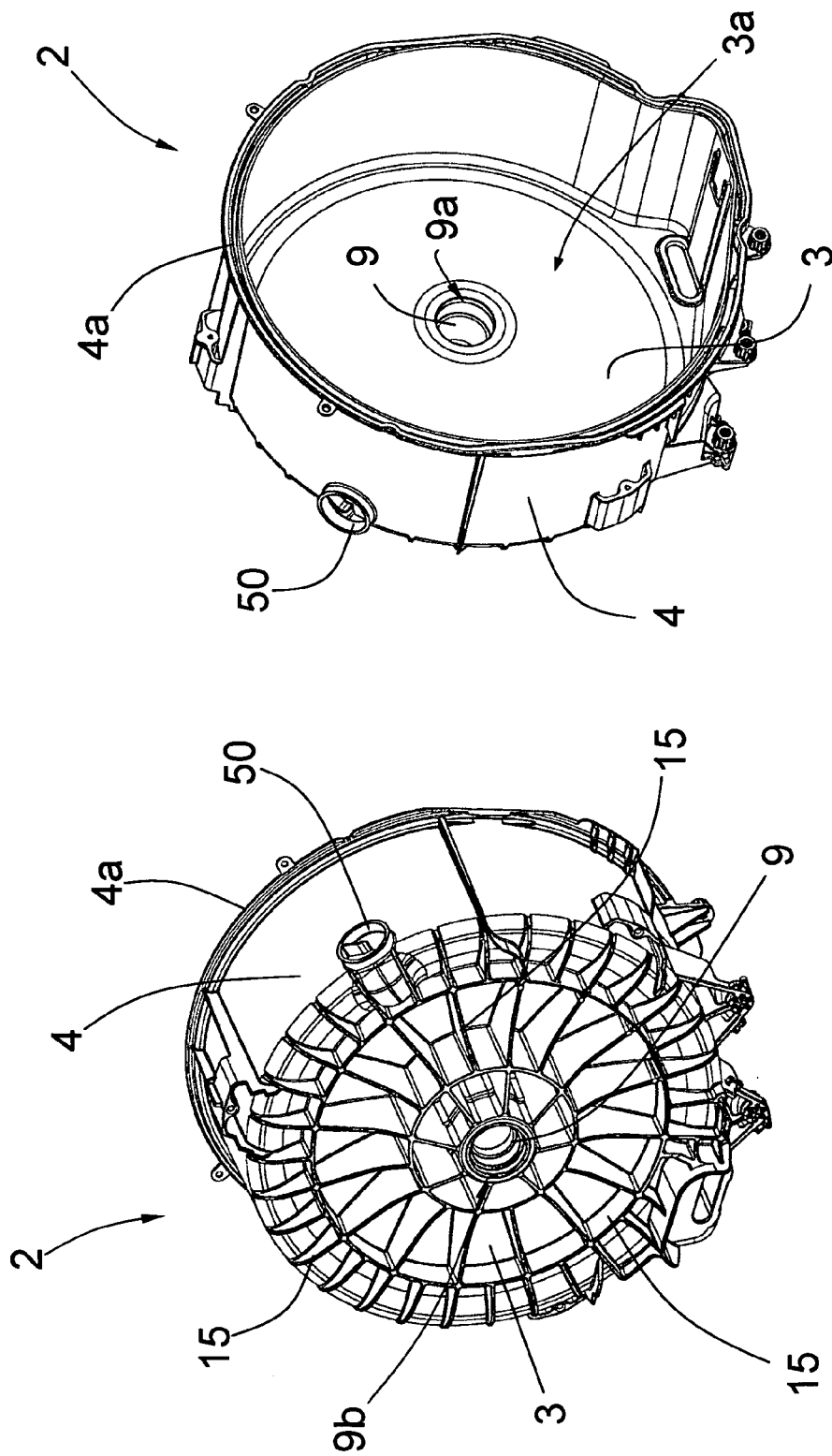


Fig. 8

Fig. 7

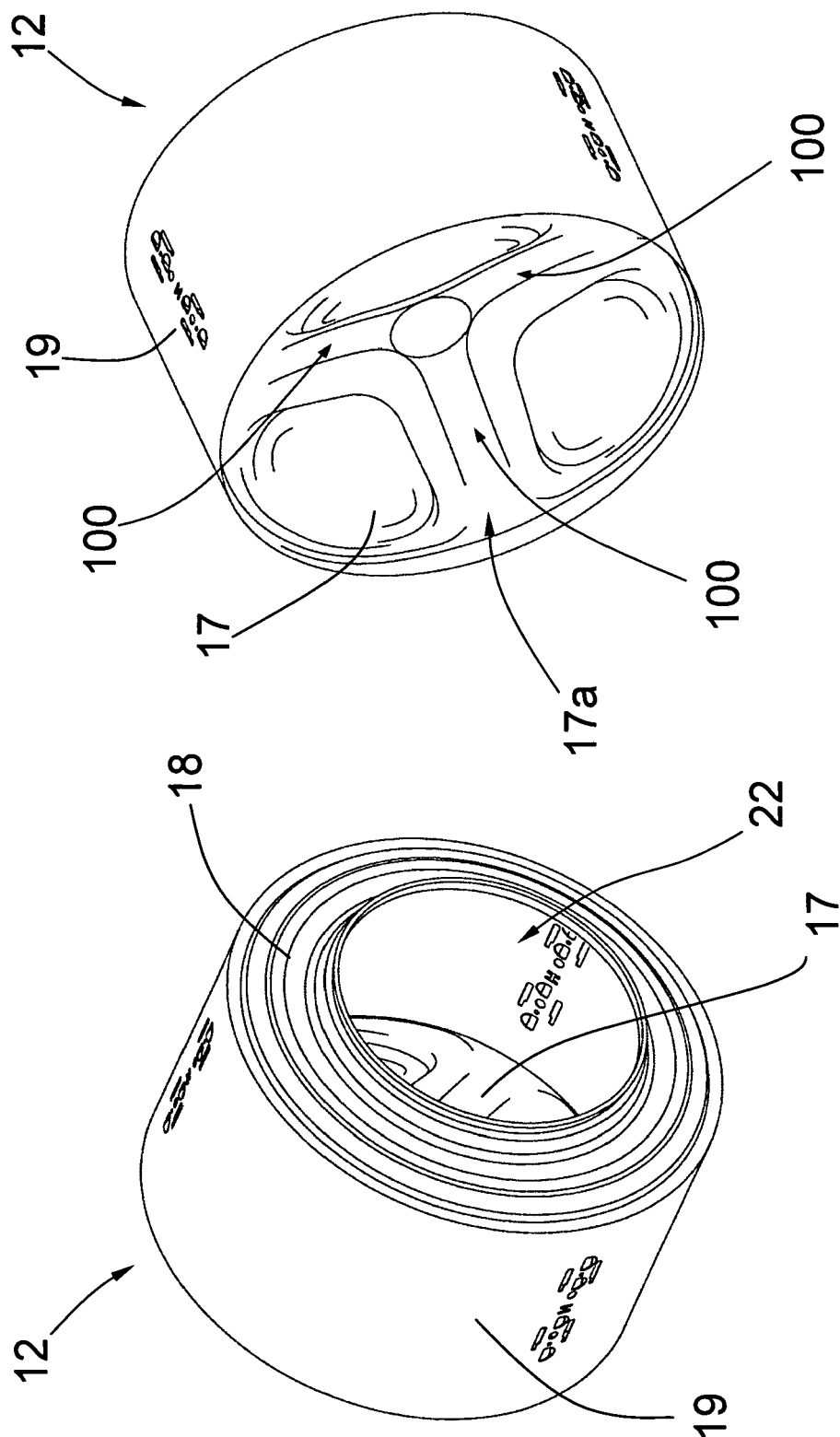


Fig. 10

Fig. 9

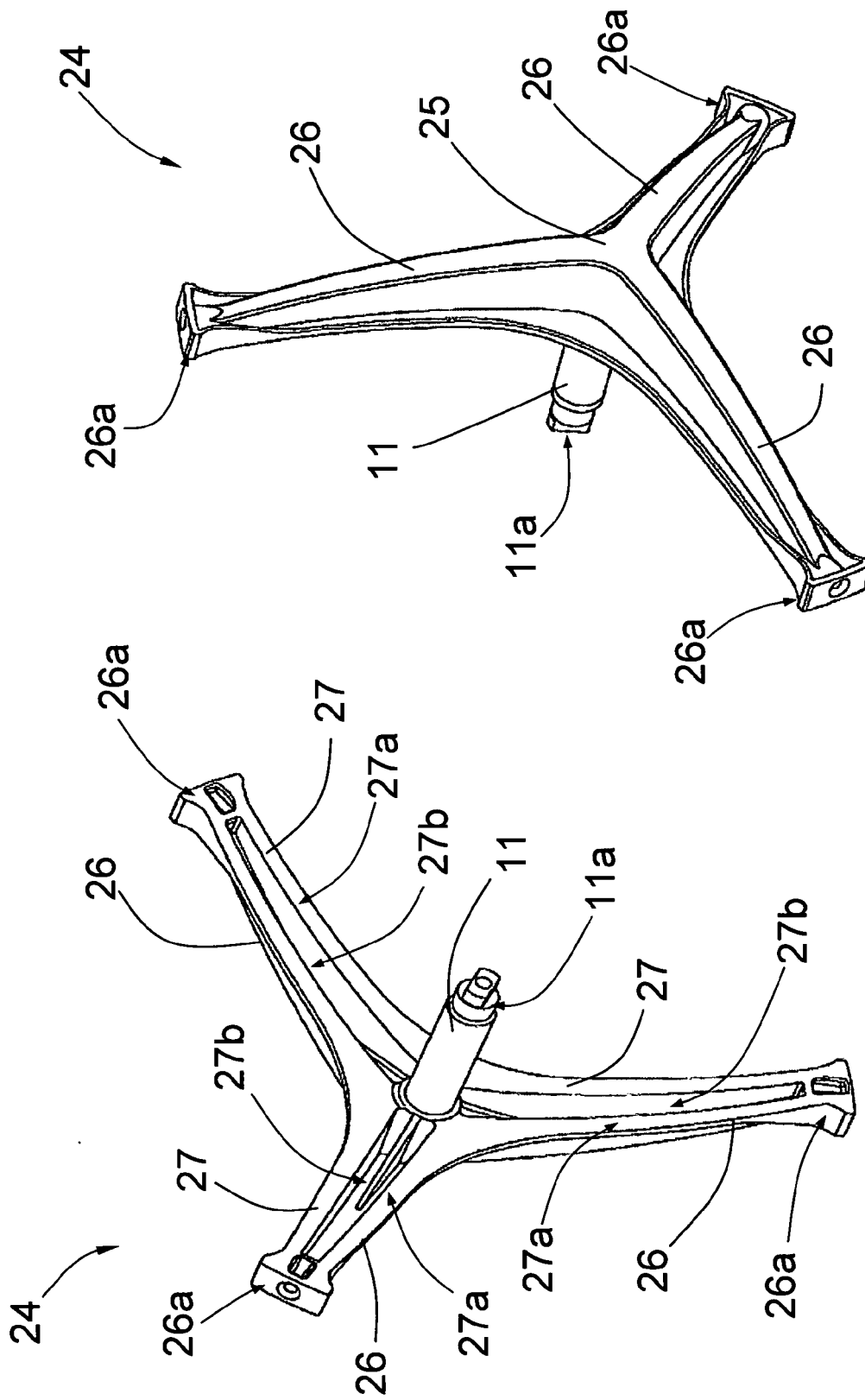


Fig. 12

Fig. 11



EUROPEAN SEARCH REPORT

Application Number
EP 09 00 8486

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 201 236 285 Y (NANJING LEJIN PANDA ELECTRIC) 13 May 2009 (2009-05-13) * figures 1-4 *	1-12	INV. D06F37/04 D06F37/20
X	EP 0 595 040 A1 (ZANUSSI ELETTRODOMESTICI [IT]; ARTESOPLA SRL [IT] ELECTROLUX ZANUSSI E) 4 May 1994 (1994-05-04) * abstract; figure 1 *	1-12	
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Place of search Munich		Date of completion of the search 16 October 2009	Examiner Dupuis, Jean-Luc
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document 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 09 00 8486

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16-10-2009

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