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(71) Applicant: **Electrolux Home Products Corporation N.V.**
1130 Brussel (BE)

(72) Inventors:
- **Bondi, Martino**
  33080 Porcia (PN) (IT)
- **De Michieli, Enrico**
  33080 Porcia (PN) (IT)
- **Maueri, Marco**
  33080 Porcia (PN) (IT)

(74) Representative: **Nardoni, Andrea**
Electrolux Italia S.p.A.
Corso Lino Zanussi, 30
33080 Porcia (PN) (IT)

(54) Washing machine

(57) The invention relates a washing machine comprising a tub (10) delimited by a wall (25) and including at least a ballast weight (31) connected to said wall (25). The washing machine comprises an insert (30) realized in a material having a thermal conductivity lower than the thermal conductivity of the material forming the wall (25), the insert being located between the wall (25) and the ballast weight (31).

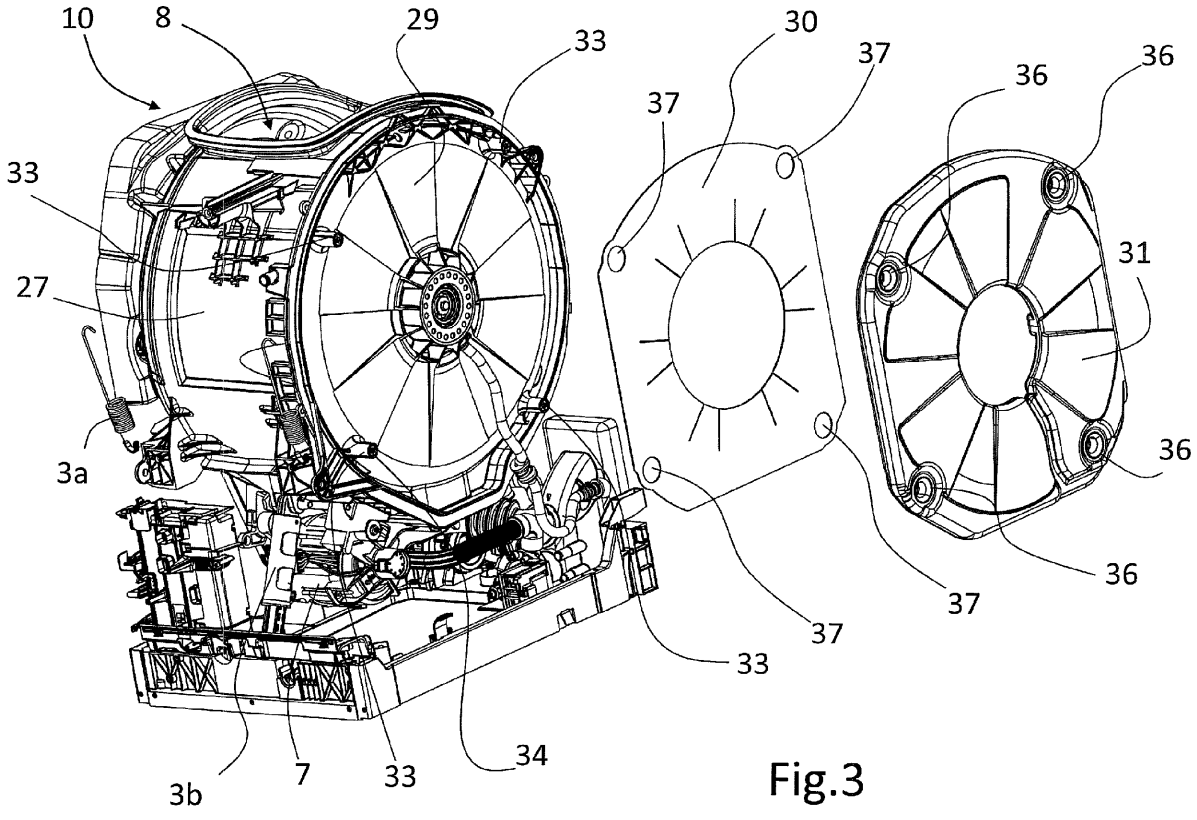

Fig.3

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Description

DESCRIPTION

[0001] The present invention relates to a laundry washing machine including a tub adapted for housing a rotating drum inside which the washing/drying load is placed.

[0002] In the present application the expression "washing machine" is referred both to a "standard" washing machine, adapted only for washing and rinsing the laundry, and to a washer-drier, which is adapted for washing, rinsing, and also for drying the laundry.

[0003] In the field of household appliances, the need of energy saving and lowering the consumption is extremely felt. Indeed, it is important for manufacturers that their appliances are classified as belonging to a low consumption category, such as the European A, A+ or A++, due to the increasing awareness of customers on the impact that household appliances have on total energy consumption.

[0004] Therefore, in the field of the washing machines, producers are generally trying to suitably modify their products in order to meet the above mentioned needs.

[0005] A drawback of modifying/designing an appliance in order to minimize its consumption is that generally the same becomes more expensive due to the extra process steps generally required for its production and/or to a more complex structure of the appliance, and consequently the final price to be paid by the customer is higher. It is therefore critical to find a suitable compromise between the need of lowering the consumption and the final cost of the appliance, in particular it is very important that the cost should not result too high compared to the market's standards.

[0006] In DE 4332684, a washing machine with a tub for receiving a rotatably arranged washing drum is disclosed. In order to provide a tub having optimum thermal insulation, the tub is made hollow-walled or double-walled. The inner wall of the tub hollow body consists of a lye-resistant material. The thermal insulation is introduced into the cavity of this tub body.

[0007] Applicant has noted that, although in the washing machine disclosed in DE 4332684 energy saving is achieved due to the insulation sheet present around the whole tub when compared to the energy consumption of washing machine without such a layer, the tub itself is extremely complex (being hollow and formed by a multi-layered structure) and thus requires several expensive manufacturing steps.

[0008] In DE 10160788 a tub for a water-bearing household appliance is described, such as those used in drum washing machine. The outer drum which contains the wash process liquids has a heat insulating coating lining the inside surface with a sheet covering the surface to protect against damage by foreign bodies.

[0009] DE 102008056555 describes a washing machine which has a drum rotatably supported in a plastic studs tub, which is provided with thermal insulation unit. The thermal insulation unit has shell elements forming outside hollow chambers at the suds tub, and the hollow chambers for the insulation unit are evacuated. The shell elements are sectionally positioned at a casing and in a lower region of the suds tub relating to an operation-appropriate position of the suds tub. The shell elements and/or the tub are comprised of polypropylene-glass fiber material.

[0010] Applicant has noted that the construction of the insulating inserts of this latter document is relatively complex.

[0011] It is known in the art that washing machines generally include counterweights, called also ballast weights, connected to the tub to increase the inertia force of the latter in order to compensate for the forces to which the tub is subjected during rotation of the drum in the washing and spin phases.

[0012] In EP 1918445, it is described a washing solution tub for a drum-type washing machine, which includes a ballast weight which includes an elongated opening at least on the outer side ends and in the region of the apex. In the operating position of the washing solution tub, the openings on the outer side ends of the ballast weight are orientated horizontally, and the opening in the region of the apex is orientated vertically. A cavity between each spigot formed on the tub wall and the respective opening enables positioning of the ballast weight on the tub wall.

[0013] US 2009229317 describes a domestic appliance including a detergent solution container having at least one first contact surface; and at least one ballast weight having at least one second contact surface mechanically connected to the first contact surface wherein the first contact surface and the second contact surface are glued to one another. At least one depression is formed on the first contact surface or the second contact surface for collecting a certain supply of adhesive mass, in order for it to be possible for a sufficient supply of adhesive to be kept available during joining.

[0014] Applicant has realized that the addition of ballast weights fixed on the tub of the appliance increases the thermal energy dissipation of the tub, due to their relatively high mass. This aspect has been non fully considered and appreciated in the known appliances' construction design.

[0015] Applicant has found that providing an insert of insulating material between the tub and the ballast weight considerably saves energy in the heating and maintenance phases of the washing cycle by reducing thermal energy dispersions.

[0016] With the wording "a washing machine tub", a tub suitable to be installed on a washing machines is meant, more generally machines in which in at least a phase of their working cycle heat dissipation takes place. In addition, the washing machine according to the present invention can be either of the front-loading type or of the top-loading type.

[0017] The washing machine considered in the present invention are those provided with a tub on which at least

a ballast weight is connected to. The tub can be realized in any material, preferably it is realized in polymeric materials; even more preferably the tub is a molded polymeric tub formed generally by several parts, for example shells, which are joined together by any suitable means forming substantially a hollow cylinder.

[0018] The tub therefore defines a front side and a back side which corresponds substantially to the two bases of the hollow cylinder. Additionally, the tub is delimited by an outer wall defining an inner and an outer surface which are opposite to each other.

[0019] The ballast weight is also realized in any desired material, which preferably has a relatively high mass density. Preferred examples of the material(s) in which the ballast weight(s) is(are) realized are concrete or cast iron. The tub of the invention comprises one or more ballast weights, which are preferably located on the outer surface of the tub itself, more preferably in correspondence of the back and/or front side of the hollow cylinder defined by the tub.

[0020] It is to be understood that - in addition to the ballast weight - additional elements can be attached to the tub, such as elements having a mechanical functions (e.g. a bearing to which the drum shaft is rotatably connected, etc), advantageously components generally made in metallic material or cast iron. These elements can be for example co-molded with the shell or attached to it after the molding process.

[0021] Applicant has found that energy is saved when an insert realized in a thermal insulating material is associated to the tub between the wall of the tub and the ballast weight so that the thermal energy dissipation due to the high ballast mass is minimized thanks to the presence of an insulating material which substantially reduces heat exchange between the tub's wall and the ballast mass.

[0022] Therefore, according to the invention, the washing machine includes at least an insert of thermal insulating material, positioned in correspondence of the ballast weight and preferably it is sandwiched between the ballast weight and a portion of the wall of the tub. Preferably, the tub of the invention comprises a number of insert(s) equal to the number of ballast weight(s), so that an insert is associated to each ballast weight and it is located between the weight and the tub's wall.

[0023] According to an embodiment, more insert made of insulating material than ballast weights are connected to the tub of the washing machine, to enhance insulation.

[0024] A material having thermal insulating properties means in the following a material having a thermal conductivity which is lower than the thermal conductivity of the material forming the tub. Preferably, the material having a thermal insulating property has a thermal conductivity which is also lower than the thermal conductivity of the material forming the ballast weight.

[0025] According to a first aspect, the invention relates to washing machine comprising a tub delimited by a wall and including at least a ballast weight, the tub comprises also an insert, said insert being realized in a material having a thermal conductivity lower than the thermal conductivity of the material forming the wall, said insert being located between said wall and said ballast weight

[0026] The presence of the insert allows a local insulation of the wall, in particular in those areas where the heat dissipation is greater due to the presence of the ballast weight.

[0027] In the aforesaid aspect, the present invention can have at least one of the following preferred characteristics.

[0028] Preferably, the insert is coupled to the wall of the tub by means of the same connection mechanism that fastens the ballast weight to the wall.

[0029] Preferably, the ballast weight is fixed to the tub by means of the connection mechanism which is a mechanical fastening device. Preferably the mechanical connection mechanism is a clamping device that fixes the ballast weight to the wall of the tub. According to an embodiment of the invention, the clamping device includes a protrusion, or bushing, protruding from the wall of the tub, a hole realized into the ballast weight on which the protrusion is inserted, and a screw engaging in the bushing to fix the ballast weight.

[0030] According to a preferred embodiment, the insert is coupled to the wall of the tub by the clamping device which fixes the ballast weight to the wall of the tub. Preferably, according to an embodiment of the invention, the ballast weight includes a hole through which the protrusion is inserted.

[0031] According to a preferred embodiment, the insert might cover a portion of the outer surface of the tub's wall which is smaller than the portion of the wall covered by the ballast weight. According to an alternative embodiment, the insert might cover a portion of the outer surface of the wall which is larger than the portion of the wall covered by the ballast weight.

[0032] Preferably, the thermal conductivity of the material forming the insert is comprised between 0.25 and 0.001 W/(mK).

[0033] Preferably, the materials forming the insert are:

- EPDM (ethylene propylene diene monomer) 0,25 W/mK.
- FELT 0,22 W/mK.

[0034] The invention will be better described below on the basis of the appended drawings. The figures show:

- fig. 1a is a schematic cross-section of a front loading washing machine including a tub realized according to the invention including a tub;
- fig. 1b is a schematic cross-section of the tub of fig. 1a;
- fig. 2 is a perspective view of the tub of the washing machine of figure 1;
- fig. 3 is a perspective exploded view of the tub of fig. 2;

- fig. 4 is an enlarged perspective view of a detail of the tub of fig. 2.

[0035] In the figures, elements that are identical or that fulfill the same function bear the same reference numeral. In addition, the figures are in some cases oversimplified and elements are removed in order to enhance clarity of the same to better show and describe the present invention.

[0036] With initial reference to fig. 1a, a washing machine including a tub 10 is globally indicated with reference numeral 1. Although in the appended figures a tub of a top loading washing machine is depicted, it is to be understood that the teaching of the invention applies also to a front loading washing machine, and to a combined washer-dryer, both in the front loading and top loading configuration.

[0037] The washing machine 1 includes a housing 2 which contains the tub 10 preferably supported by springs 3a and dampers 3b, in order to allow oscillations of the tub during the normal functioning of the washing machine. The tub 10 includes a drum 4 supported horizontally within the tub and driven by an electric motor 7, as better detailed below. Tub and drum have an opening 8 (shown in figures 2 and 3, only the tub aperture is depicted) through which clothing to be washed/dried can be introduced and/or removed.

[0038] The user can operate the washing machine 1 via a control panel 11, for example located on top of housing 2.

[0039] The above mentioned parts of the washing machine 1 of the invention, besides tub 10, are considered to be known in the art and therefore not further detailed. In addition, some of the above mentioned parts can be substituted by others know in the art or not present.

[0040] Tub 10 has preferably a substantially cylindrical hollow shape and in its interior, preferably coaxially with the cylinder so defined, the tub 10 bears and houses the drum 4 which is adapted to rotate around its axis and to contain the cloths to be washed/dried in the working cycle of the machine. Drum and motor assembly 7 for the rotation of the same are commonly known parts in the industry and therefore not further described.

[0041] As better shown with reference to fig. 2, the tub 10 additionally is delimited by a wall 25 which defines an inner surface 21 which is facing the drum, not illustrated, during operation and an outer surface 22 opposite to the inner one. Wall 25 comprises a envelope 27, preferably substantially cylindrical, having the two ends closed by two bases 28, 29 which results one opposite to the other.

[0042] According to a non-depicted embodiments, tub 10 can be formed by two (or more) shells fixed together, or it can be formed by several pieces such as a first piece defining the cylindrical envelope to which other two pieces forming the bases are fixed. The various pieces/shells forming the tub are connected to each other for example by welding. Preferably, the connection of the various pieces/shells is watertight so that leaks do not appear during the washing or drying process of the machine in which the tub of the invention is mounted. Alternatively, tub 10 can be a single en bloc element, for example realized by a single molding step.

[0043] Preferably tub 10, in particular wall 25, is formed in plastic material, more preferably in a polymeric material. The plastic wall 25 is preferably realized in a thermoplastic polymer, and even more preferably in polypropylene, to which mechanical reinforcing agents or fillers (for example mineral or glass fibers) might be added. A material present in the market in which the shell 20 of the invention can be realized is for example Carboran®. The thermal conductivity of the material forming the wall 25 of the tub 10 of the invention is generally comprised between 0.2 and 0.6 W/(mK).

[0044] In the case, illustrated in the enclosed figures, of a top loading washing machine, the tub 10 comprises the opening 8 in correspondence of its cylindrical envelope 27 to load and unload the clothes to be washed/dried.

[0045] In the case, not illustrated, of a front loading washing machine, the opening 8 for the loading/unloading of the clothes is instead advantageously obtained in one of the bases 28, 29 of the tub 10.

[0046] With now reference to fig. 1b and fig. 2, the tub 10 includes a ballast weight 31. Although in the appended drawings two ballast weights are depicted, the tub 10 of the invention can include any number of ballast weights according to the characteristics of the washing machine 1. Also the presence of a single ballast weight is encompassed by the present invention.

[0047] Additionally, the ballast weight(s) 31 can be positioned in any region of the tub 10. Preferably, ballast weight 31 is connected to the wall 25 of the tub 1, even more preferably to its outer surface 22. According to a preferred embodiment of the invention depicted in figs. 1b and 2-3, ballast weight(s) 31 is preferably located in correspondence of the base(s) 28, 29 of the hollow cylinder defined by the tub 10.

[0048] In case of more than one ballast weight 31, they can be realized in the same material or in different materials, they can have the same shape or different shapes one with respect to the other. For example, ballast weight 31 can have a plate-like shape and its boundaries substantially follows the boundaries of the wall 25 at least for a portion of the same.

[0049] Preferably, ballast weight 31 is realized in concrete or cast iron.

[0050] Ballast weight 31 is connected to the tub 10 by a connection mechanism 32, which preferably mechanically connects the ballast weight 31 to the wall 25. The connection mechanism 32 preferably comprises one or more protrusions, or bushings, 33, located advantageously on the wall 25 of the tub, more preferably projecting from the outer wall 22 of the same. According to a preferred embodiment, protrusions 33 can be manufactured via plastic injection so that they form a single piece with wall 25. In the depicted embodiment, protru-

sions 33 project from the base 29 of the cylinder defined by the tub 10.

[0051] Protrusion 33 advantageously includes a screw hole 34 where a screw 35 fits into, in order to fasten the ballast weight 31 to the tub 10 as explained in the following.

[0052] It is to be understood that with the term connection mechanism 32 the whole mechanism to connect the ballast weight to the wall is meant, i.e. in the depicted drawings it includes four protrusions and four screws, however it can include an arbitrary number of protrusions and screws, or a single pair one protrusion - one screw.

[0053] With now reference to the enlarged detail of fig. 4 that corresponds to an enlarged view of the portion of fig. 2 contoured by a circle, ballast weight 31 includes a through hole 36 having a preferably tapered end, i.e. the diameter of the entrance of the hole is preferably wider than the diameter inside the same. In order to fasten the ballast weight 31 to wall 25, the screw 35, having a head 38 the diameter of which is advantageously larger than the diameter of at least a portion of through hole 36, is inserted into the through hole 36 of ballast weight 31 and then it is screwed into threaded screw hole 34. In this way, the screw 35 is screwed till the head 38 is in abutment to the hole 36 entrance and a pressure is applied to the ballast weight 31 in order to tighten the same against the wall 25.

[0054] According to the invention, the tub 10 includes at least one insert 30 realized in a material having a thermal conductivity which is lower than the thermal conductivity of the material forming the tub 10. Preferably said thermal conductivity is comprised between 0.001 and 0.25 W/(mK). Preferred materials for the realization of the insert 30 are any one, or any combination, of the following: expanded or foamed polymers such as polyurethane, expanded polyolefins, expanded polystyrene, etc; or Vacuum Insulation Panels (VIP); or felts such as mineral/glass fibers, synthetic fibres, cellulosic materials, aerogels, etc; or bubble fils; or wood, etc, as long as they have insulating properties.

[0055] The tub 10 may include a single insert 30, or a plurality of inserts of the same type (i.e. realized in the same material) or a plurality of inserts of different types (i.e. realized in different materials possibly having different thermal conductivities).

[0056] The insert 30 is sandwiched between the wall 25 and the ballast weight 31. In other words, between wall 25 and ballast weight 31 an insert 30 is interposed.

[0057] This interposition can be total or partial, i.e. the ballast weight can have no point of contact with the wall 25 (which is the preferred solution), or a contact can be present for a portion of the wall's surface.

[0058] The insert 30 may advantageously follow the contour of the portion of surface 22 of wall 25 and/or of the portion of surface of ballast weight 31 to which it is in abutment. For example insert 30 can have a plate-like shape.

[0059] The ballast weight 31 can have a surface extension broader than the surface extension of the insert 30, i.e. the insert 30 can be completely covered by the ballast weight when they are fixed to wall 25, or the insert 30 can protrude laterally from ballast weight 31.

[0060] According to a preferred embodiment of the invention, the insert 30 is clamped between ballast weight 31 and wall 25 via clamping means. These clamping means preferably correspond to the connection mechanism 32 fastening the ballast weight 31 to wall 25. In addition, in different embodiments of the invention, other connection mechanisms can be used, i.e. fastening means such as clamps, form-fitting coupling, snap-fitting means, hooks, etc. However according to a preferred embodiment of the invention, regardless of the type of connecting device, a single mechanism is used to connect both ballast weight and insert to the wall 25 of tub 10. In this way the number of parts in which the tub is realized is minimized, lowering costs and production time and complexity.

[0061] In the preferred embodiment in which a single connection mechanism 32 fixes both ballast weight 31 and insert 30 to wall 25, insert 30 includes an aperture 37 through which protrusion 33 is inserted, and then screw 34 is screwed in order to fix and tighten the insert between ballast weight 31 and wall 25.

[0062] It has to be understood that although in the appended drawings, inserts 30 are placed in correspondence of ballast weights only, additional insulating inserts 30 can be placed covering additional portions of the surface 21/22 of the wall 25. Additionally, according to a different embodiment of the invention, some ballast weights can be free of the insert 30.

[0063] Moreover, sandwiched between ballast weight 31 and the wall 25, additional elements can be present.

Claims

1. A washing machine (1) comprising a tub (10) delimited by a wall (25) and including at least a ballast weight (31) connected to said wall (25), **characterized by** comprising an insert (30) realized in a material having a thermal conductivity lower than the thermal conductivity of the material forming the wall (25), said insert (30) being located between said wall (25) and said ballast weight (31).

2. The washing machine (1) according to claim 1, wherein said insert (30) includes an expanded and/or foamed polymeric material.

3. The washing machine (1) according to claim 1 or 2, wherein said wall (25) includes a first and a second base (28, 29) and an envelope (27), said ballast weight (31) being located in correspondence of said first and/or second base (28,29).

4. The washing machine (1) according to any of the

preceding claims, wherein said ballast weight (31) is connected to said wall (25) via a clamping device (32), which clamps said ballast weight (31) to said wall (25).

5. The washing machine (1) according to any of the preceding claims, wherein said ballast weight (31) is connected to said wall (25) via a connection mechanism (32), said connection mechanism additionally connecting said insert (30) to said wall (25).

6. The washing machine (1) according to claim 5, wherein said connection mechanism (32) includes a protrusion (33) and said ballast weight (31) and said insert (30) comprises a first (36) and a second through hole (37), respectively, said protrusion (33) being inserted into said first and said second through hole (36,37).

7. The washing machine (1) according to claim 6, wherein said protrusion (33) includes a screw hole (34) onto which a screw (35) is fastened, said screw (35) including a head (38) which abuts on an aperture's boundaries of said second hole (36).

8. The washing machine (1) according to any of the preceding claims, wherein said wall (25) is realized in plastic material.

9. The washing machine (1) according to any of the preceding claims, wherein said insert (30) has a thermal conductivity lower than the thermal conductivity of the material forming said ballast weight (31).

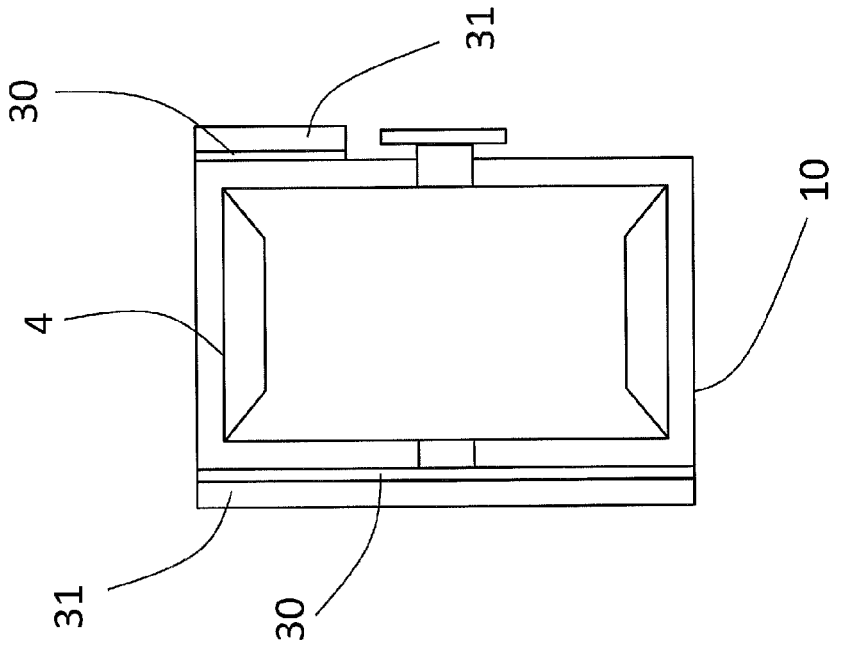

Fig.1b

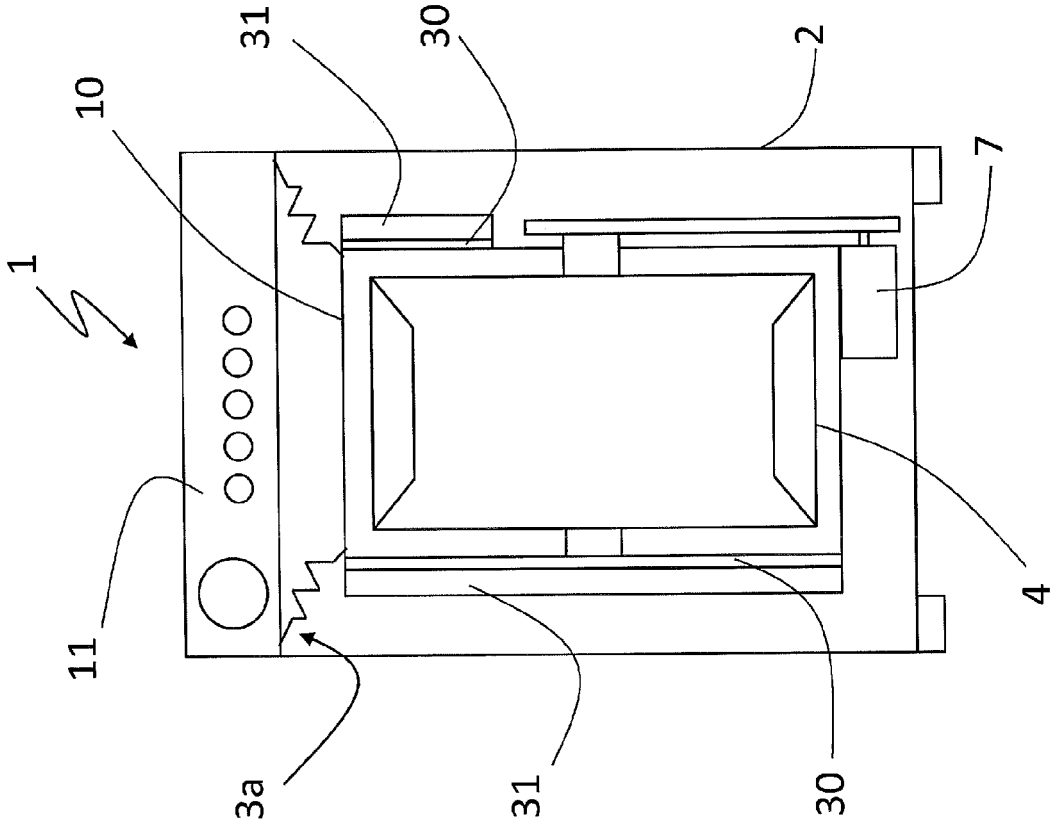

Fig.1a

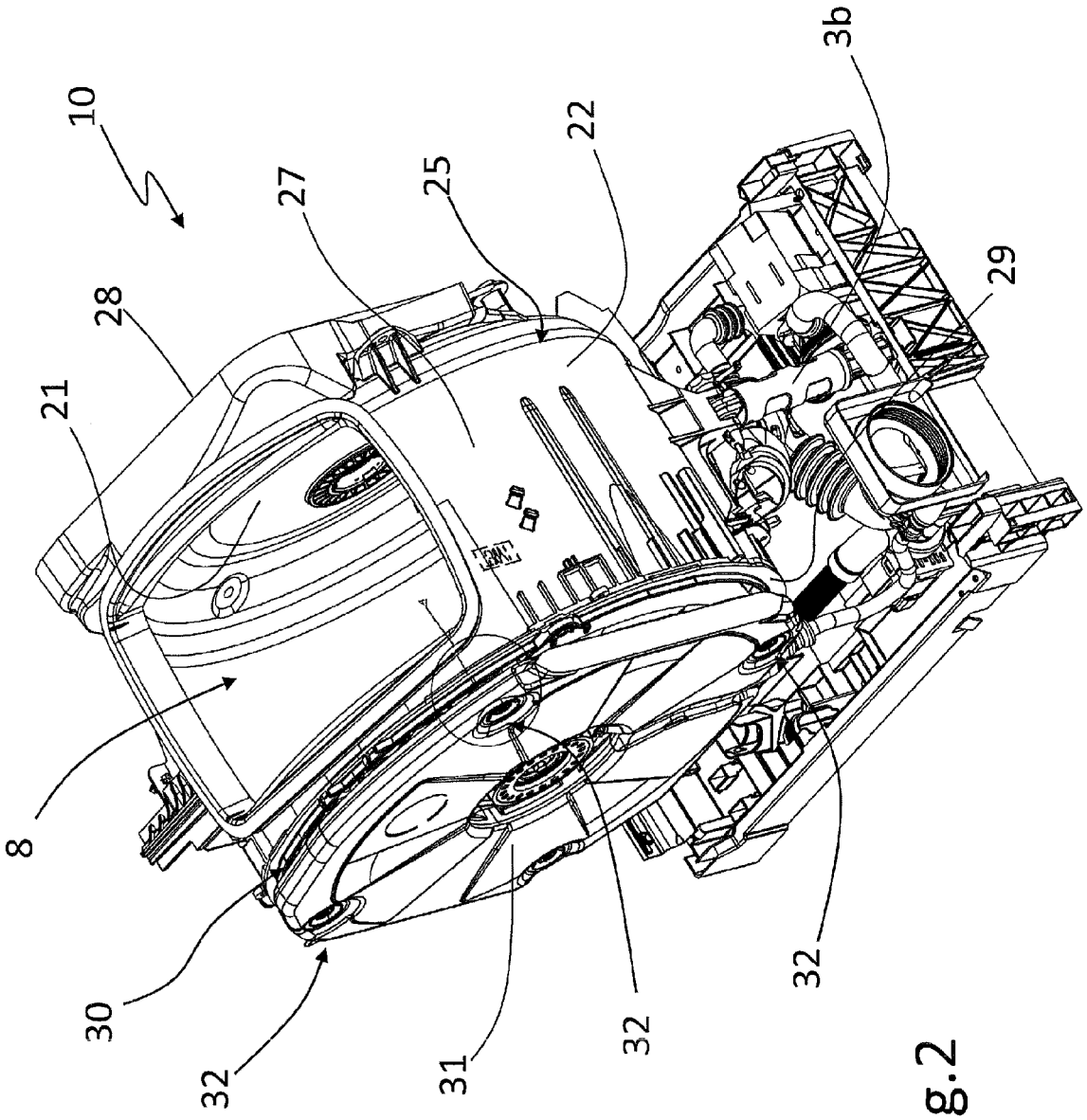

Fig.2

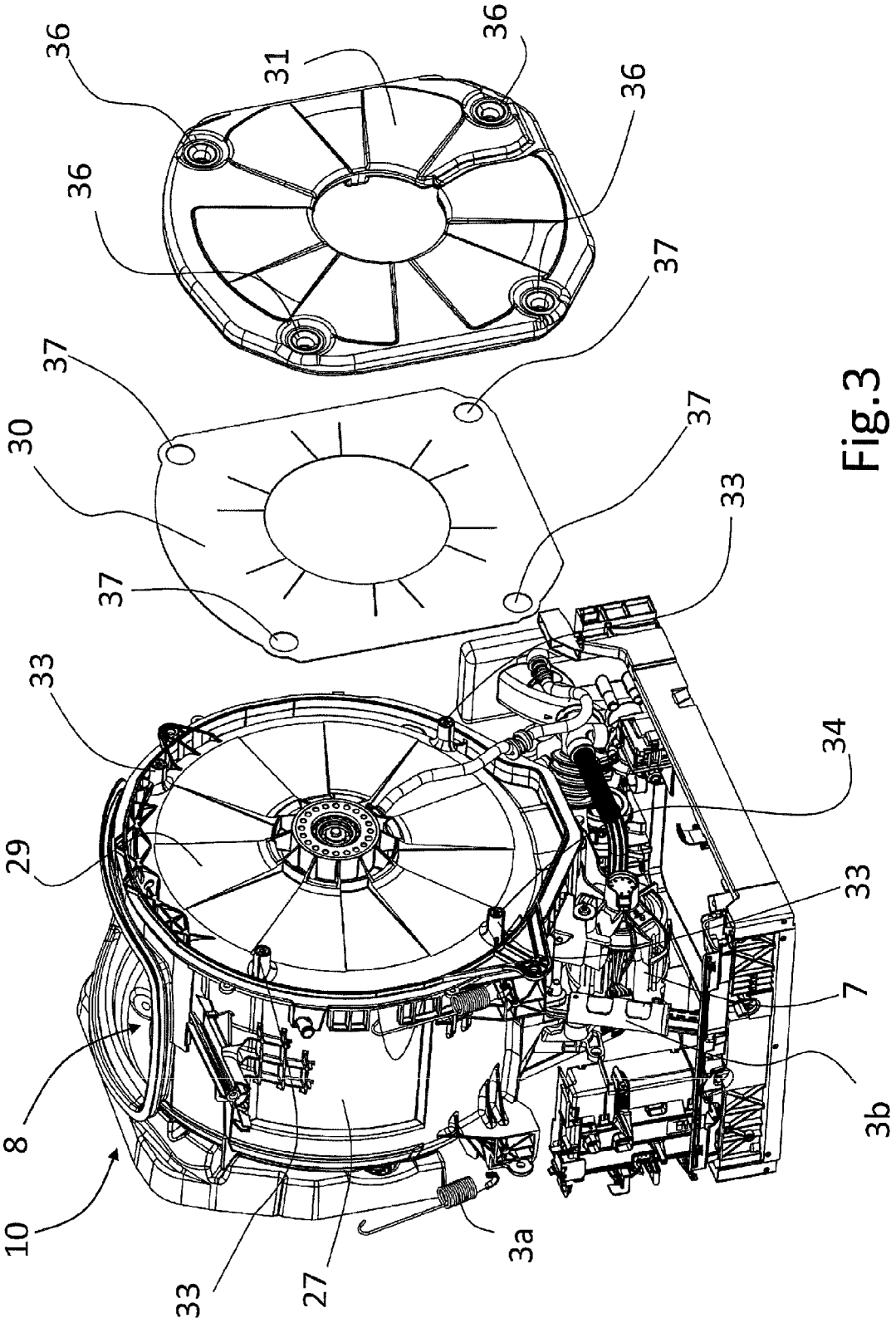

Fig.3

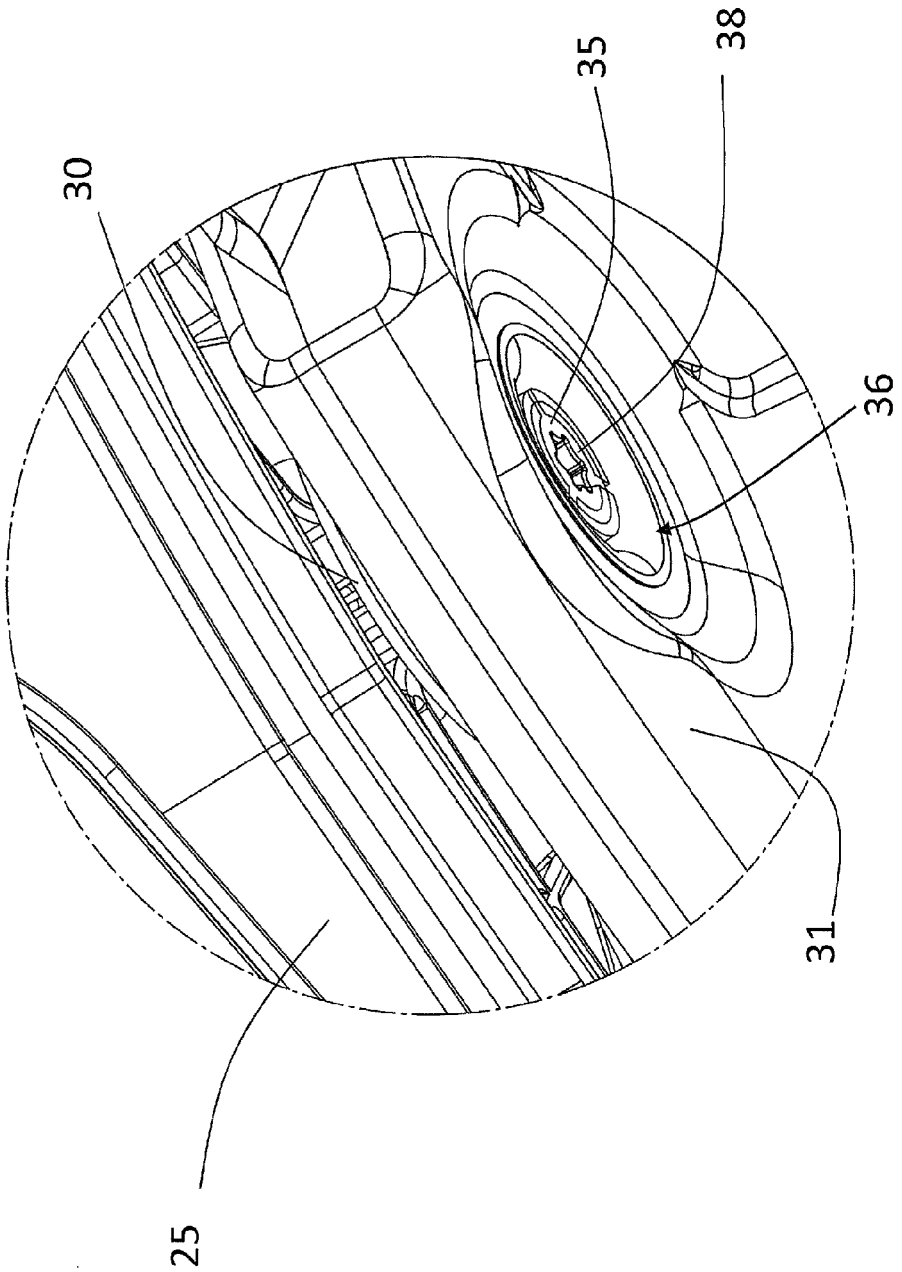

Fig.4

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EUROPEAN SEARCH REPORT

Application Number
EP 11 17 5579

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 December 2011	Weinberg, Ekkehard

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 17 5579

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