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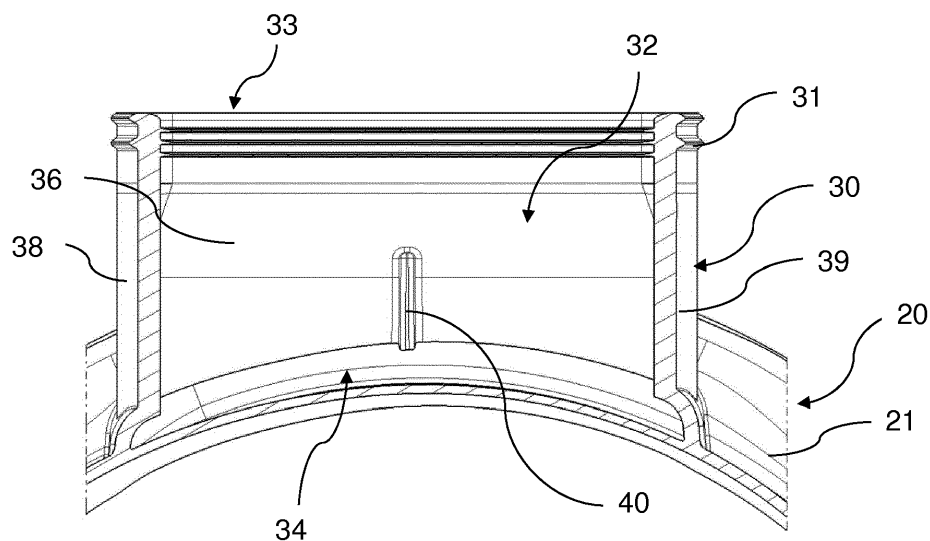
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(54) **Laundry washing-drying machine and bellow for a laundry washing-drying machine**

(57) A laundry washing-drying machine (1) comprising: a casing (10); a tub (11) suspended in the casing; an elastically deformable bellow (20) having a ring shaped main portion (21) sealingly connected to the casing and to the tub, at a door of the machine; a projection portion (30), made in one piece with the main portion and radially extending from the main portion to a distal end; a dry air duct (18), supported in the casing and fixedly connected to an air drying unit, and having a downstream end; a bellow duct (32) 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 dry air duct, to an outlet mouth, formed in the main portion of the bellow, at the projection portion, and open into the tub. The projection portion (30) of the bellow (20) has a substantially flat shape, with two major sides and two minor sides, and the bellow duct (32) comprises at least a protrusion (40; 40'), internally formed in one of the major sides. Thus, the risk of obstructions of the bellow duct because of deformations induced by vibrations is avoided, thanks to the protrusion.



**Fig. 5**

**Description****FIELD OF THE INVENTION**

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

**BACKGROUND ART**

**[0002]** Laundry washing-drying machines (i.e. laundry washing machines which can also dry laundry) are well known and widespread.

**[0003]** The washer-dryer comprises an air circuit for carrying out drying operation by circulating hot air through a laundry container, like a drum rotatably mounted in a tub. Air circulating means and heating means are provided in the air circuit for circulating and heating drying air, respectively. In a known configuration, the air circuit includes a dry air duct that receives hot and dry air from an air drying unit and delivers it to the laundry container, 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.

**[0004]** The bellow duct -thanks to its own elasticity- acts as a vibration-isolating section in the air circuit, thus preventing that the inevitable vibrations of the tub due to rotation of the drum possibly damage the elements that are fixedly, i.e. stationarily, mounted on the casing, such as the dry air duct and all the air drying unit.

**DISCLOSURE OF INVENTION**

**[0005]** The Applicant has noted that in certain conditions the bellow duct can be so deformed by vibrations of the tub that the passage of air results to be obstructed, partially or even totally; when obstruction occurs, the efficiency of the drying operation is worsened or even -in the worst case- the air drying unit can be damaged. This can happen in particular when the structure of the bellow duct is very soft: a very soft bellow duct can perform very well its fundamental vibration damping functions, but it is also more subject to the above described risk of obstruction.

**[0006]** The Applicant has thus thought to address this problem not by carefully designing the bellow duct, so as to limit its deformability to an extent that obstruction is not risked, rather by providing the bellow duct with something preventing that a deformation results in an obstruction.

**[0007]** Therefore, in a first aspect, the present invention relates to a laundry washing-drying machine according to claim 1, as well as to a bellow for a laundry washing-drying machine according to claim 6. Preferred characteristics of the laundry washing-drying machine and of the bellow are set forth in dependent claims.

**[0008]** In particular, the laundry washing-drying 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 a door of the 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 dry air duct, supported in the casing and fixedly connected to an air drying unit, 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 dry air 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 projection portion of the bellow has a substantially flat shape, with two major sides and two minor sides, and the bellow duct comprises at least a protrusion, internally formed in one of the major sides.

**[0009]** 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.

**[0010]** In such a machine, the risk of obstructions of the bellow duct because of deformations induced by vibrations is avoided, thanks to the protrusion, that provides a separation effect: in case of very large deformation, the protrusion rests against the opposite side of the bellow duct, avoiding that the two facing sides of the bellow duct contact directly one against the other, thus obstructing the passage of air. Having avoided this risk, the bellow duct can be advantageously made flat, even very flat: a 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 bellow 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 protrusion is not an additional part: it is formed together with the bellow, as a single piece.

**[0011]** Preferably, the protrusion is fin shaped, oriented longitudinally along the bellow duct. By "fin shaped" it is meant that the front section of the protrusion in the

sense of the flow of air within the duct is minimal, while its length can be much longer. With this configuration the protrusion affects only minimally the flow of air, while still having a significant dimension in one direction, this being important to avoid the contact of the facing sides of the bellow duct along the full length of the duct.

**[0012]** Preferably, the protrusion is formed at a central location of the major side. Central position maximises the separation effect between the facing sides.

**[0013]** Preferably, the protrusion is extended from one to the other of the major sides. This can result in a better capability of withstanding deformations, as the protrusion is already in contact with both facing sides; its action is immediately available upon deformation of the bellow duct, without having to wait that the two facing sides get closer enough to have the protrusion contact the opposite side.

**[0014]** In a preferred embodiment, the protrusion is in form of a wall extending from and solid to both the major sides. In this way, the further advantage is achieved of having a structure of the projection portion of the bellow that is more efficient in dampening vibrations, thanks to the wall between the major sides.

**[0015]** The bellow for a laundry washing-drying 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-drying machine and a second, internal rim intended to be sealingly mounted to a tub of the laundry washing-drying machine;
- 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 dry air duct connected to an air drying unit of the laundry washing-drying 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-drying machine;

#### characterised in that

the projection portion of the bellow has a substantially flat shape, with two major sides and two minor sides, and the bellow duct comprises at least a protrusion, internally formed in one of the major sides.

**[0016]** The advantages of this bellow are those already presented with reference to the laundry washing-drying machine.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0017]** 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-drying machine according to the invention, with some parts removed to better show the inside of the machine, in particular the tub, the air drying unit and the bellow;
- fig. 2 is a perspective view of parts of the machine of fig. 1, including the tub, the air drying unit and the bellow;
- fig. 3 is a side view of the parts of the machine of fig. 2;
- fig. 4 is a perspective view of the parts of the machine of fig. 2, in an enlarged view and with the projection portion of the bellow and the dry air duct in section, in order to show the inside of the bellow duct;
- fig. 5 is a longitudinal section view of the bellow, at the projection portion, in a plane substantially parallel to the front of the machine;
- fig. 6 is a longitudinal section view of the bellow, at the projection portion, in a plane substantially perpendicular to the front of the machine;
- fig. 7 is a view from above of the bellow, at the projection portion;
- fig. 8 is a longitudinal section view similar to fig. 6, showing a different embodiment of the invention;
- fig. 9 is a view from above similar to fig. 7, of the embodiment of fig. 8.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

**[0018]** In the drawings, a laundry washing-drying machine 1 made according to the present invention is shown.

**[0019]** 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-drying 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.

**[0020]** Laundry washing-drying 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 10 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 and/or dried.

**[0021]** Access to the drum 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 drum and a corresponding opening (not shown) in the casing **10**, according to design options per se well known in the art.

**[0022]** 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.

**[0023]** Laundry washing-drying 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 an air drying unit **17** where dry warm air is produced and a dry air duct **18**, fixedly connected to the air drying unit **17** and receiving warm dry air therefrom; the air drying unit **17** is fixedly mounted to the casing **10**, so is the dry air duct **18**. Water and detergent dispensing devices are also provided within the casing **10**. The casing **10**, the drum, the door, the motor, the air drying unit **17**, the dry air duct **18**, water and detergent dispensing devices are common parts in the technical field and are considered to be known; therefore they will not be described in further details.

**[0024]** 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.

**[0025]** 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**.

**[0026]** 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 dry air duct **18**; the outlet mouth **34** is open towards the tub **11** of the laundry washing-drying machine **1**.

**[0027]** 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 **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 7.

**[0028]** The bellow duct **32** comprises at least a protrusion **40**, internally formed in the bellow duct **32** on one of the major sides, e.g. the major side **36**. The protrusion **40** is preferably fin shaped (in the sense define above), oriented longitudinally along the bellow duct **32**. Preferably, the protrusion **40** is formed at a central location of

the major side **36**, both in a transverse direction (between the minor sides **38**, **39**) and in a longitudinal direction (between the inlet mouth **33** and the outlet mouth **34**).

**[0029]** It should be noted that more than one protrusion **40** can be provided in the bellow duct **32**, e.g. two or more protrusions **40** distributed between the two major sides **36** and **37**.

**[0030]** Preferably, the protrusion **40** is extended from the major side **36** to the opposing major side **37**, or is just minimally spaced therefrom (as can be seen in figure 7).

**[0031]** In figs. 8 and 9, a different preferred embodiment of the protrusion is shown; the rest of the laundry washing-drying machine is the same, so in figs. 8 and 9 only the -different- protrusion is provided with a reference number, **40'**, being intended that the other elements are the same.

**[0032]** Protrusion **40'** is in the form of a wall extending from and solid to both the major sides **36** and **37** of the projection portion **30**.

**[0033]** In use of the laundry washing-drying machine **1**, like in any laundry washing-drying machines, the tub **11** vibrates, with respect to the casing **10**. Vibrations could in principle be particularly dangerous for the dry air duct **18**, which upstream is fixedly connected to the casing **10**, while downstream has to deliver the dry air to the vibrating tub **11**. The bellow duct **32** according to the invention, thanks to its high flexibility also due to its flat shape, prevents that the vibrations of the tub **11** reach the dry air duct **18** with a dangerous magnitude. At the same time, this high flexibility does not introduce any risk of obstruction of the bellow duct **32**, thanks to the presence of the protrusion **40** (or **40'**). Thus, the invention allows improving lifetime of the machine and efficiency of the drying operations.

## Claims

1. Laundry washing-drying 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 dry air duct (18), supported in the casing (10) and fixedly connected to an air drying unit (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 dry air 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 projection portion (30) of the bellow (20) has a substantially flat shape, with two major sides (36, 37) and two minor sides (38, 39), and the bellow duct (32) comprises at least a protrusion (40; 40'), internally formed in one of the major sides (36, 37).

2. Laundry drying machine (1) according to claim 2, wherein the protrusion (40; 40') is fin shaped, oriented longitudinally along the bellow duct (32).

3. Laundry drying machine (1) according to claim 1 or 2, wherein the protrusion (40; 40') is formed at a central location of the major side (36, 37).

4. Laundry drying machine (1) according to any of preceding claims, wherein the protrusion (40; 40') is extended from one to the other of the major sides (36, 37).

5. Laundry drying machine (1) according to claim 4, wherein the protrusion (40') is in form of a wall extending from and solid to both the major sides (36, 37).

6. Bellow (20) for a laundry drying 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 drying machine (1) and a second, internal rim (23) intended to be sealingly mounted to a tub (11) of the laundry drying machine (1);

- 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 (33), formed at the distal end (31) of the projection portion (30) and intended to be connected to a downstream end (19) of a dry air duct (18) connected to an air drying unit (17) of the laundry drying 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 drying machine (1);

**characterised in that**

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), and the

bellow duct (32) comprises at least a protrusion (40; 40'), internally formed in one of the major sides (36, 37).

7. Bellow according to claim 6, wherein the protrusion (40; 40') is fin shaped, oriented longitudinally along the bellow duct (32).

8. Bellow according to claim 6 or 7, wherein the protrusion (40; 40') is formed at a central location of the major side (36, 37).

9. Bellow according to any of claims 6 to 8, wherein the protrusion (40; 40') is extended from one to the other of the major sides (36, 37).

10. Bellow according to claim 9, wherein the protrusion (40') is in form of a wall extending from and solid to both the major sides (36, 37).

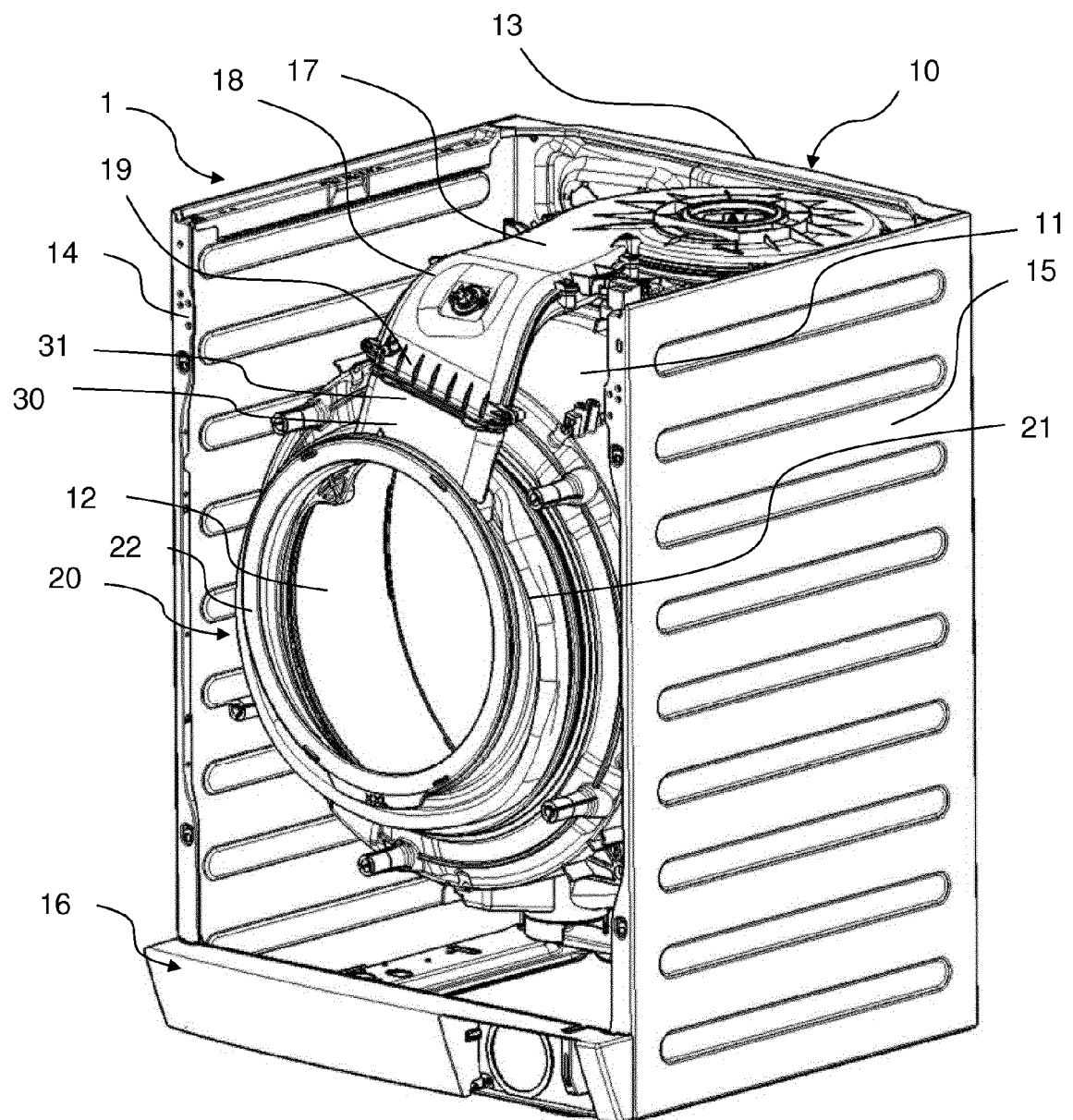


Fig. 1

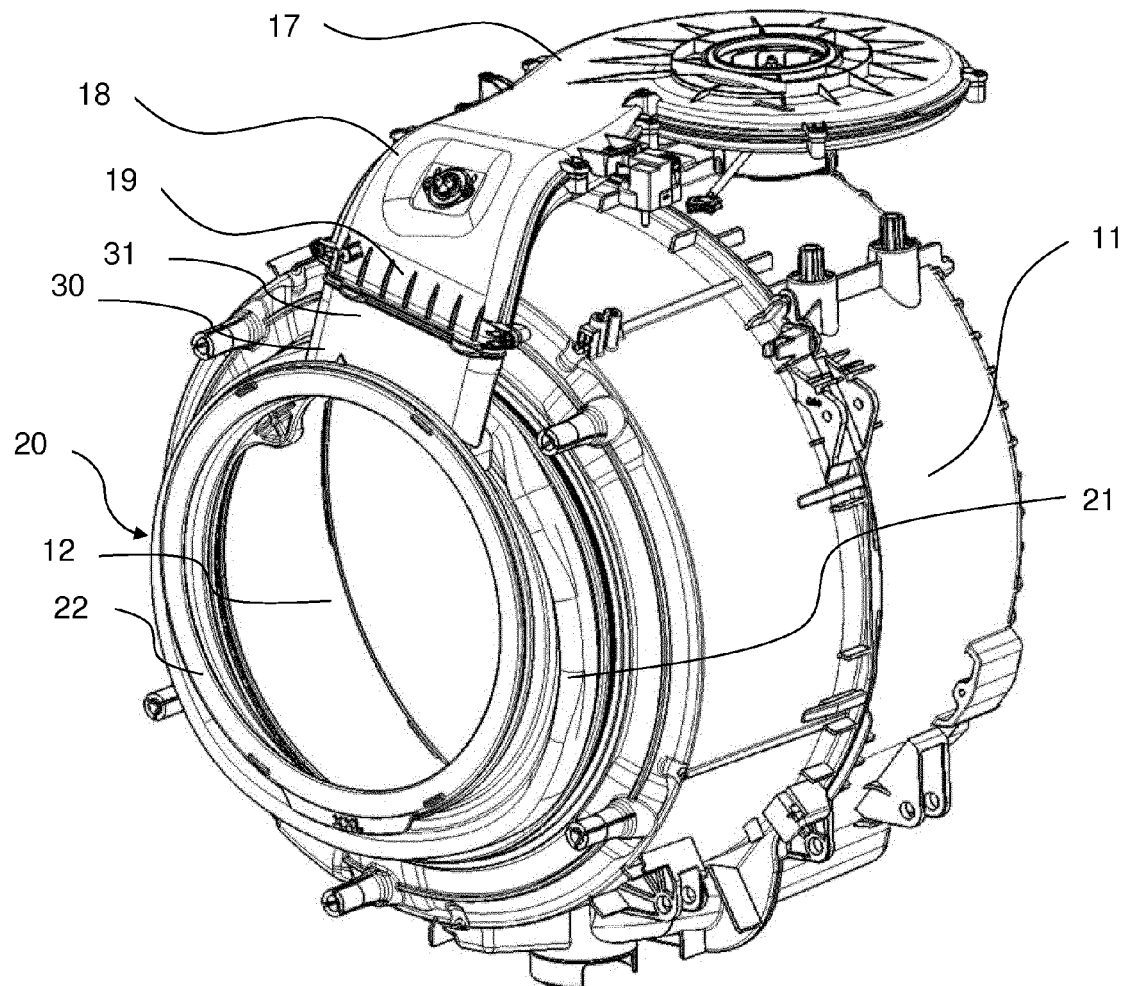


Fig. 2

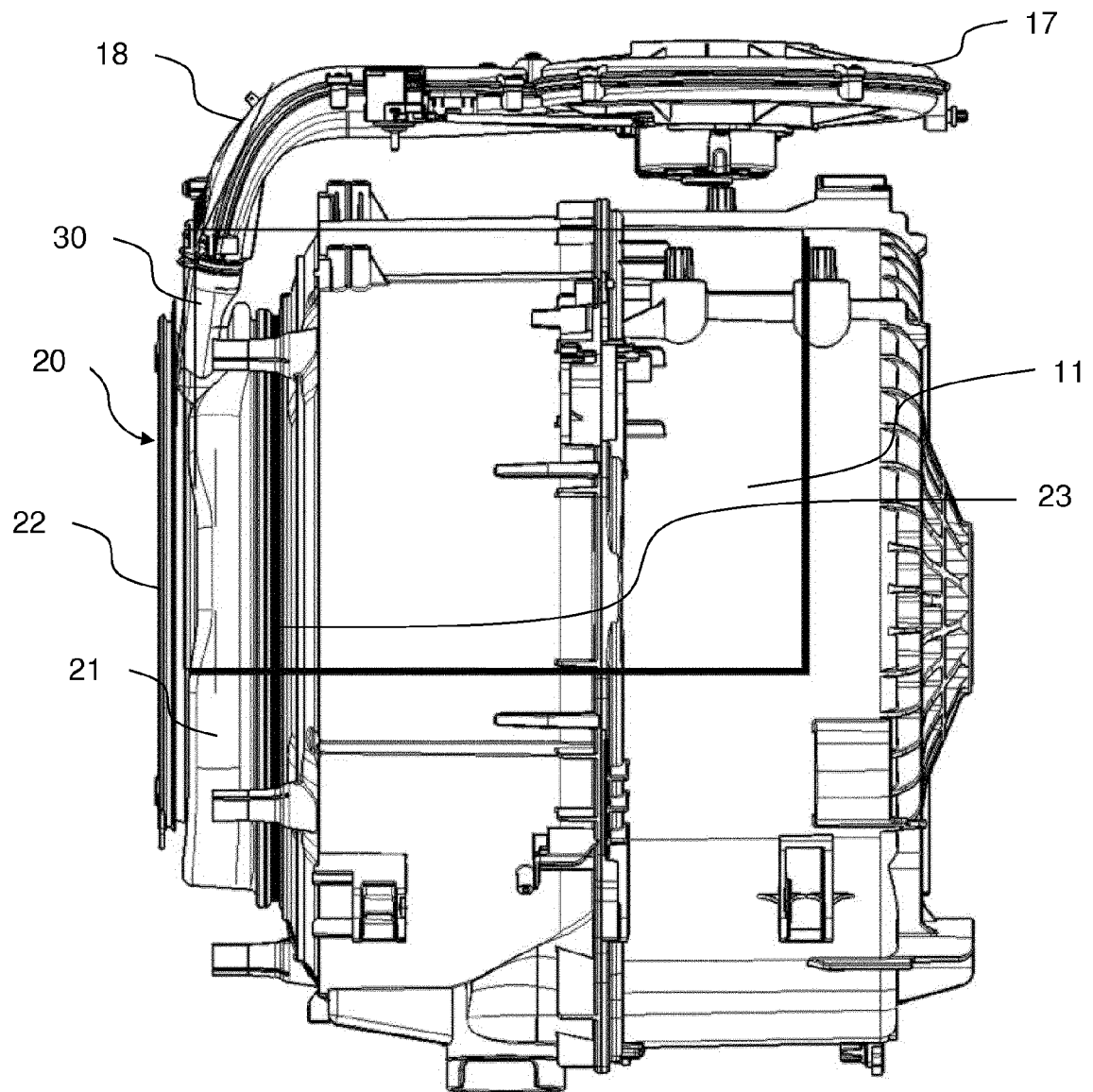


Fig. 3

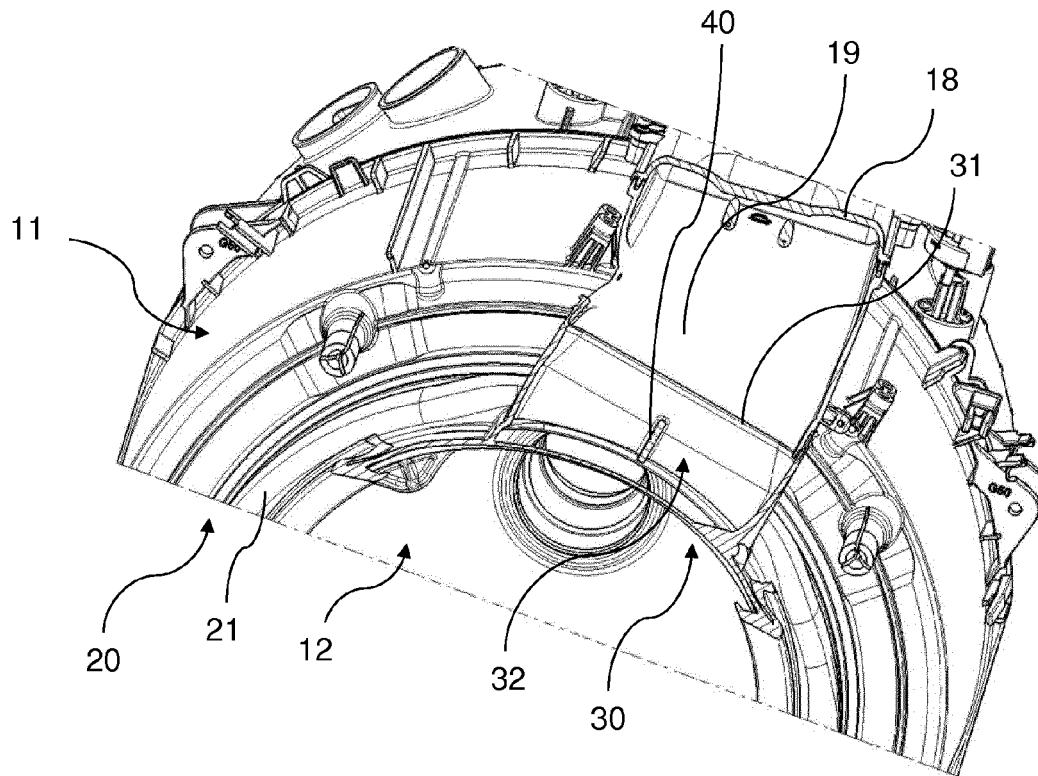


Fig. 4

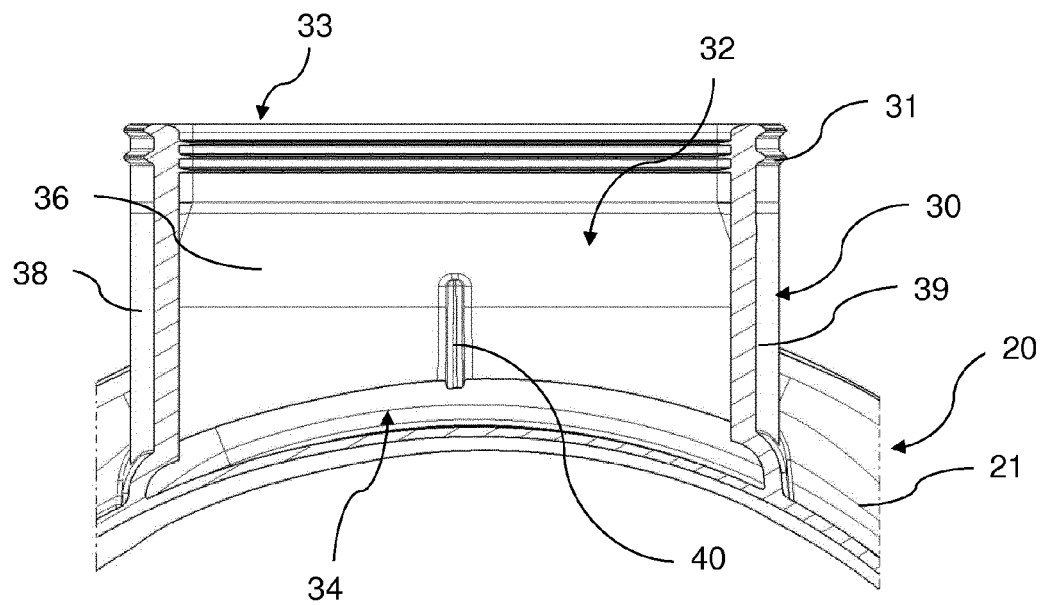


Fig. 5

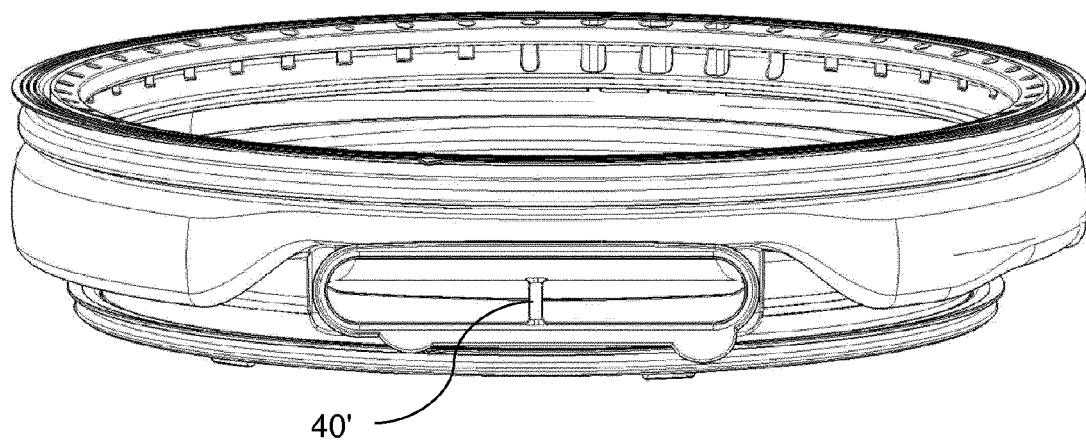
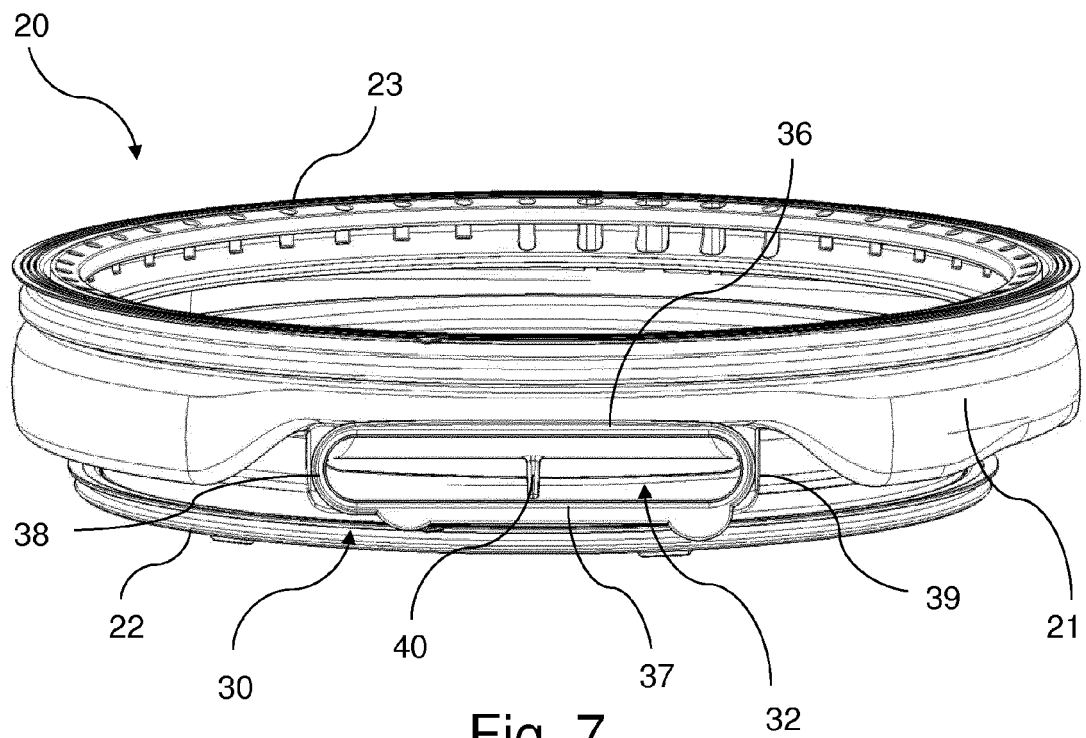


Fig. 9

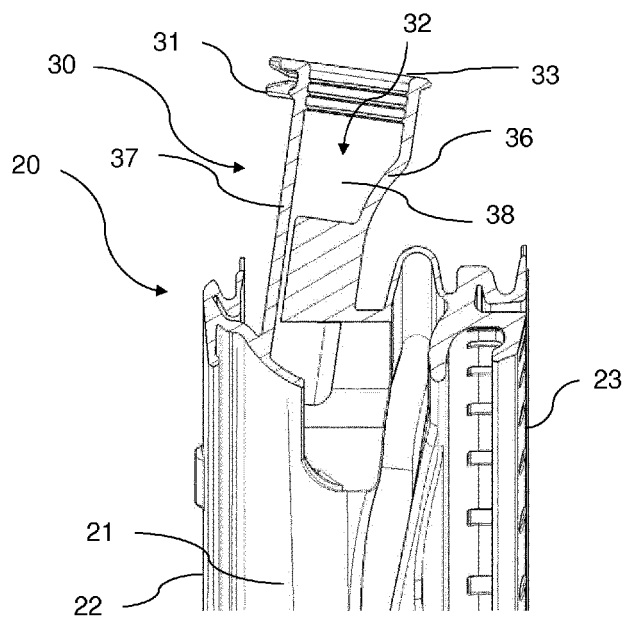


Fig. 6

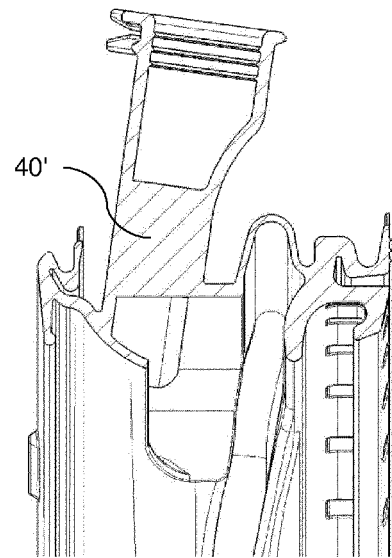


Fig. 8



## EUROPEAN SEARCH REPORT

Application Number  
EP 13 18 2329

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                                                                                                       |                                                                                                                                                                                                                                                                              |                                         |
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| Category                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                         | Relevant to claim                                                                                                                                                                                                                                                            | CLASSIFICATION OF THE APPLICATION (IPC) |
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| Place of search<br>Munich                                                                                                                                                                                                                              |                                                                                                                                                       | Date of completion of the search<br>13 January 2014                                                                                                                                                                                                                          | Examiner<br>Stroppa, Giovanni           |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                                       | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                         |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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