



Europäisches Patentamt
European Patent Office
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(11) **EP 1 321 559 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
25.06.2003 Bulletin 2003/26

(51) Int Cl.7: **D06F 37/26**

(21) Application number: **02425373.4**

(22) Date of filing: **07.06.2002**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

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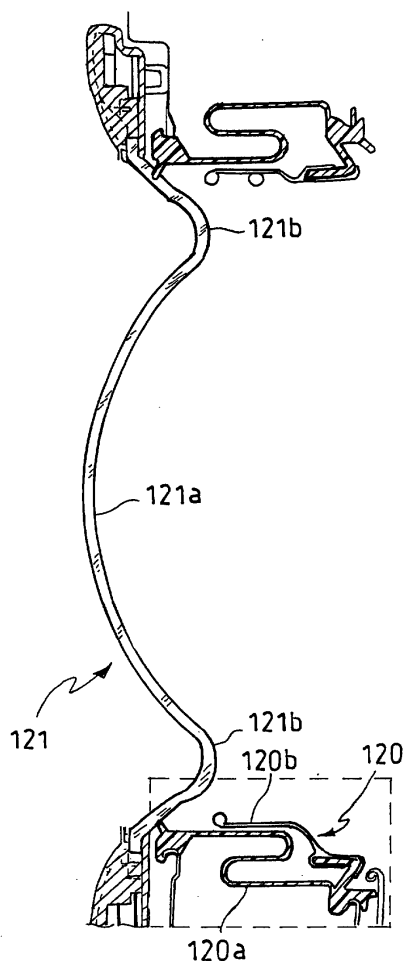
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(30) Priority: **20.12.2001 EP 01830785**

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(54) **Front-loading clothes washing machine**

(57) Front-loading clothes washing machine comprising a container having a front wall with a loading aperture (111), a removable door (121) able to close the loading aperture, a washing tub (112) mounted inside the container and having an aperture (117) facing towards the front wall of the container, a loading drum (15) for the clothes to be washed, the drum being mounted in the washing tub (112) in such a way that it can rotate about a horizontal axis and having an aperture (16) aligned with the aperture of the tub (117) and with the loading aperture (111), a connecting duct (120) between the aperture (117) of the washing tub and the loading aperture (111) comprising a bellows-like elastic joint (120a). The machine can take a larger load because of the fact that the space comprised within the connecting duct (120) can be used as an extension of the loading space because it includes at least one substantially rigid annular band (120b) that at least partly covers the elastic joint (120a).



Description

[0001] The present invention relates to a front-loading clothes washing machine as defined in the preamble of Claim 1.

[0002] As is known, a front-loading clothes washing machine, shown schematically in Figure 1, has a supporting and containing structure 10 with a front wall in which an aperture 11 allows the clothes to be loaded and unloaded. A tub 12 is mounted inside the structure on suitable supporting and suspension means 13 and can contain a washing solution 14. A perforated drum 15 rotates inside the tub. The drum and the tub have respective apertures 16, 17 substantially aligned with the aperture 11 of the front wall so that the washing can be inserted into the loading space within the drum 15. An electric motor 18 drives suitable mechanisms 19 which turn the drum with the washing in the washing solution in accordance with preset speeds, times and directions of rotation. A connecting duct 20, typically a bellows-like annular elastic joint, is mounted between the aperture 17 of the tub 12 and the loading aperture 11. The loading aperture is sealed shut by a door 21 hinged to the front wall. The door 21 is shaped in such a way that its inside surface delimits the loading space inside the drum 15. More precisely, it forms a re-entrance which, when the door is shut, closes practically the entire aperture of the tub, preventing the clothes from coming out of the loading space during washing and coming into contact with the joint. If this were not the case, friction between the moving clothes and the joint would cause rapid wear of the joint, which is usually made of rubber or other elastomeric material having very good elasticity but poor abrasion resistance.

[0003] The chief object of the present invention is to provide a clothes washing machine with a larger loading space.

[0004] Another object of the invention is to produce the said loading space in such a way as to improve the efficiency of the washing action.

[0005] This object is achieved by making the clothes washing machine defined and characterized in general in Claim 1.

[0006] A clearer understanding of the invention will be gained from the following detailed description of certain embodiments thereof given by way of example, no limitation being intended, with reference to the attached drawings, in which:

Figure 1 shows diagrammatically in cross section a known type of clothes washing machine, Figure 2 shows in cross section a detail of a clothes washing machine in a first embodiment of the invention, Figure 2a shows an enlarged detail of Figure 2, Figures 3a and 3b, Figures 4a and 4b and Figures 5a and 5b show, in plan and in cross section respectively, a projection formed on a band designed to protect the elastic joint, in three embodiments of the

invention,

Figures 6, 6a and 7 show in cross section a detail of a clothes washing machine in further embodiments of the invention,

Figure 8 is a sectional side view of a detail of the clothes washing machine according to the invention;

Figure 9 is a diagrammatic front view of the detail of Figure 8; and

Figure 10 is a diagrammatic perspective view of the detail of Figure 8.

[0007] Figure 2 shows only certain parts of a clothes washing machine according to the invention. Parts not illustrated are of known type, for instance exactly like the corresponding parts of the known machine shown in Figure 1. As the drawing shows, the connecting duct 120 between the aperture 117 of the washing tub 112 and the aperture 111 of the front wall of the container consists not just of a bellows-like elastic joint 120a as in the known machine, but comprise also an annular band 120b of a substantially stiff material that is resistant to abrasion and to the action of water and detergents, e.g. polycarbonate or polypropylene, with surfaces of appropriate roughness, i.e. smooth, which covers the elastic joint 120a, protecting it from the inside of the duct. In this example the band 120b is fixed to a limb 120c of the elastic joint located near the rim 16 of the drum 15 and near the rim of the aperture 117 of the tub 112.

[0008] The aperture in the front wall of the container is closed by a door 121 made of for example moulded glass with a steel frame. In this embodiment the door 121 has an inside surface presenting a central concave part 121a that joins a peripheral convex part 121b. The annular band 120b in this example has a width, that is a dimension in the direction of the horizontal axis of the tub, which is constant; however, its width could be greater at the bottom, where contact with clothes during washing is continuous, and less at the top, where there is no or very sporadic contact with the clothes.

[0009] In accordance with one embodiment of the invention, the band 120b has an interruption at the top where the clothes do not touch the elastic joint.

[0010] In the embodiment shown in Figure 2a, the band 120b curves away at the bottom to form a part 120e sloping towards the aperture of the washing tub 112 in order to encourage the clothes to slide down towards the loading drum 15.

[0011] This slope may vary circumferentially, e.g. reducing to diameter at the top.

[0012] As can be seen, the annular band 120b and the inside surface of the door 121 delimit, when the door is shut, a space that represents an extension of the loading space formed by the drum 15. With a rotating drum of given volume, therefore, the load of clothing to be washed can be greater than with a machine of known type. During washing, the band 120b efficiently protects the elastic joint 120a, preventing the clothes from con-

tacting the joint itself and, owing to its smooth and resistant surface, gives the clothes a low-friction bearing surface during washing.

[0013] The protection of the elastic joint 120a is supplemented, in the embodiment of the invention shown in Figure 2, by the convexity of the peripheral part 121b of the inside surface of the door 121. This convexity also contributes to hermetic sealing of the door, which can be easily ensured by giving the elastic joint an annular lip 120d which is in firm contact with the door when the door is closed.

[0014] The annular band 120b has an essentially cylindrical uniform inside surface. However, in other embodiments of the invention it may have at least one radial projection at the bottom. For instance, good results have been obtained with two projections separated by 40-60° from each other symmetrically on either side of the vertical plane passing through the axis. There are two reasons for the projection or projections 340, firstly to encourage the clothes to move back into the drum and secondly to induce a secondary local rotation of the clothes about an axis along the direction of the projection. To fulfil these purposes as well as possible, the projections may be shaped and positioned in a variety of different ways. For example, they may substantially be in the shape of a suitably attached isosceles triangle whose height and base decrease towards the interior, that is towards the aperture of the tub, and may extend in the axial direction, as shown in cross section and in plan in Figures 3a and 3b, respectively, or may extend at a sloping angle relative to the axial direction, as shown in Figures 4a and 4b, or may be shaped like straight or curved fins with asymmetrical leading and trailing edges. One embodiment with curved fins that are asymmetrical with reference both to the radial direction and to the axial direction is shown in cross section and in plan in Figures 5a and 5b, respectively. Naturally, any combination of projections with different profiles is possible. If using asymmetrical and/or curved fin-type projections, these are arranged on the band in such a way that their interference with the clothes during rotation of the loading drum is such as to encourage them to slide inwards into the drum and give them a local secondary rotation.

[0015] In accordance with one embodiment of the invention, a central projection is arranged centrally in the lower portion of the annular band and two lateral projections, smaller than the central projection, are arranged on each side of the central projection at an angle of about 60°.

[0016] In the embodiment shown in Figure 6 there are two annular bands, one marked 320b, similar to the band 120b of Figure 2 and fixed in the same way, but narrower than the latter, and another, marked 320e, fixed to the front wall of the container 10, specifically to the rim of the loading aperture. This latter annular band may be made of the same smooth, anti-wear material as the band 320b and may be fixed by a restrained joint, as shown in the drawing, but may also be made of stain-

less steel and fixed to the wall by welding or other means of fixing.

[0017] In this embodiment the elastic joint, here marked 320a, is fixed on the one hand to the rim of the aperture of the washing tub, as in the example of Figure 2, and on the other to the free edge of the band 320e.

[0018] Both bands may have continuous cylindrical surfaces or may have projections similar to those described above in relation to Figures 3a, 3b, 4a, 4b, 5a and 5b. In the example shown in Figure 6, each of the two bands includes at least one projection, lower on band 320b, marked 320f, and higher on band 320e, marked 320g, the profiles of which connect up with each other and with the profile of the concave part 321a of the inside surface of the door 321.

[0019] An elastomeric annular insert 330 is applied to the band 320e to ensure sealed closure of the door.

[0020] The embodiment indicated in Figure 6a is particularly advantageous because it provides a continuous elastic seal between the inside surface of the door 321 and the tub 112, the seal extending without interruption underneath the band 320e.

[0021] In this context it is also possible to make the annular band in the form of a low-friction coating applied directly to the seal. Naturally, in this case the seal would have to be stiff enough to resist the mechanical stresses to which it would be subject.

[0022] The advantages of the invention compared with the prior art are numerous and substantial. In particular:

- the load volume, for equal volume of the loading drum, is greater because the space delimited by the connecting duct can be used, together with the drum, to contain the load,
- loading ergonomics are noticeably better because the door, which is usually hinged to the front wall, does not when open have projecting parts to get in the way of inserting or removing the clothes,
- the forces exerted by the clothes on the door during washing are reduced, and therefore the size and weight of the door can also be reduced,
- washing efficiency is better, owing to the additional mechanical action of the clothes being drawn over the annular band.

[0023] Furthermore, the features of the invention are easily applicable to many clothes washing machines of known type with few and simple modifications. The invention can therefore be carried out without requiring expensive modification to the production lines.

[0024] With reference to Figures 8, 9 and 10, the advantageous washing effects obtainable with the washing machine according to the invention will now be described.

[0025] Because of the technical characteristics described above, a load container 22 for the clothes that are to be washed comprises, within the most general

meaning of the invention, at least one first containment portion 23 and one second containment portion 24 communicating with each other via an interface aperture 25 for the clothes, in which at least one of the containment portions 23, 24 can be driven by suitable drive means to set up a preferably rotary relative movement between the said containment portions 23, 24.

[0026] In accordance with the embodiment described earlier, the first containment portion 23 is formed by the loading drum 15 and the second containment portion 24 is formed by the protective band 120b and by the window 121. The containment portions 23 and 24 are advantageously, but not necessarily, of an approximately cylindrical shape and, to greater advantage, are coaxial with respect to the axis of relative rotation.

[0027] In accordance, as before, with the embodiment described and illustrated, the first containment portion 23, and more specifically the loading drum 15, and the second containment portion 24, and more specifically the annular band 120b, are of different diameters, in order to locate the effect of agitation created by the relative movement in an area of limited tangential velocity of the washing, that is to say outside of the periphery of the larger-diameter containment portion.

[0028] The projections 26 placed on the annular band 120b and optionally also on the inside surface of the window act as static agitators, while the known propelling projections 27 on the inside surface of the cylindrical wall of the loading drum 15 act as dynamic agitators that agitate and propel the washing during the relative movement of the containment portions 23 and 24.

[0029] The effects, both single and combined, of the static and dynamic agitators, and the effects of the relative movement and of the dimensional differences of the containment portions 23 and 24, make it possible to give the washing the following movements and combinations thereof:

main movement of alternating revolution caused by the movement of the loading drum and further augmented by the propelling projections (dynamic agitators);

main movement of relative revolution, opposite to that of the drum 15, caused by the projections on the annular band 120b (static agitators);

secondary movements of rotation about a plurality of approximately radial axes in the zone of transition between the containers A and B, more specifically in the interface aperture 25, these movements being caused by the opposing tangential pushing on the inside of the two containment portions 23 and 24;

local movements and deformations of the washing about the axes defined by the projections 26 and 27, caused by the differences of velocity between the projections 26, 27 and the washing in suspension;

transitional movement of the clothes between the

containment portions 23 and 24, preferably in the direction of the loading drum 15, due to the inclination of the annular band 120b with respect to the axis of rotation of the drum 15, by the shape of the projections 26, 27, and by gravity, in which the trajectories of the transitional movement intersect advantageously with the trajectories of the main movements of revolution, setting up an unusual uniformity and intensity of agitation of the clothes during washing and rinsing.

[0030] Furthermore, the said axial movement of transition between the portions 23 and 24 encourages frequent immersion of the clothes in the central part of the portion 23, that is the drum 15, where the depth of water is relatively greater.

[0031] Consequently, given the same effective volume of the loading drum, washing efficiency is improved, making it possible, for example, not only to save energy but also to achieve better standards of washing, without the need to make heavy modifications to the structure of the clothes washing machine.

[0032] Although only a few embodiments of the invention have been illustrated and described, it is clear that numerous variants and modifications are possible within the scope of the same inventive concept.

Claims

1. Front-loading clothes washing machine comprising:

- a container having a front wall with a loading aperture (111),
- a removable door (121) able to close the loading aperture,
- a washing tub (112) mounted inside the container and having an aperture (117) facing towards the front wall of the container,
- a loading drum (15) for the clothes to be washed, the drum being mounted in the washing tub (112) in such a way that it can rotate about an essentially horizontal axis and having an aperture (16) substantially aligned with the aperture of the tub (117) and with the loading aperture (111),
- a connecting duct (120) between the aperture (117) of the washing tub and the loading aperture (111) comprising a bellows-like elastic joint (120a),

characterized in that the connecting duct (120) includes at least one substantially rigid annular band (120b) that at least partly covers the elastic joint (120a) and delimits, with the inside surface of the door (121) when the latter is closed, a space that forms an extension of the loading space of the

drum (15).

2. Clothes washing machine according to Claim 1, in which the inside surface of the door (121) is essentially flat. 5
3. Clothes washing machine according to Claim 1, in which the inside surface of the door (121) includes at least one concave part (121a). 10
4. Clothes washing machine according to any one of Claims 1 to 3, in which the connecting duct (120) includes a single substantially rigid annular band (120b) fixed to the rim of the aperture (117) of the washing tub (112). 15
5. Clothes washing machine according to any one of Claims 1 to 3, in which the connecting duct (120) includes two substantially rigid annular bands (320b, 320e), one fixed to the rim of the aperture of the washing tub and the other to the rim of the loading aperture. 20
6. Clothes washing machine according to Claim 5, in which the elastic joint (320a) is fixed on the one hand to the rim of the aperture of the washing tub and on the other to the free edge of the annular band (320e) fixed to the rim of the loading aperture. 25
7. Clothes washing machine according to any one of the preceding claims, in which one or more annular bands (120b, 320b, 320e) are fixed to the said elastic joint (120a, 320a). 30
8. Clothes washing machine according to any one of the preceding claims, in which at least one annular band is shaped in such a way as to include, at least at the bottom portion, a part (120e) that slopes towards the aperture of the washing tub. 35
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9. Clothes washing machine according to any one of the preceding claims, in which at least one annular band includes at least one projection.
10. Clothes washing machine according to Claim 9, in which the projection extends substantially in the direction of the axis of rotation of the loading drum with a height profile that decreases towards the tub aperture. 45
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11. Clothes washing machine according to Claim 10, as dependent on Claim 3, in which the profile of the projection connects up with the concave part of the inside surface of the door.
12. Clothes washing machine according to Claim 11, as dependent on Claim 5, in which the two annular bands include respective projections (320f, 320g)

whose axial profiles connect up with each other.

13. Clothes washing machine according to any one of Claims 9 to 12, in which two or more projections are formed at a distance from each other on the annular band or bands at the bottom of the connecting duct.
14. Clothes washing machine according to Claim 13, in which two projections are formed at a distance from each other on the annular band or bands at the bottom of the connecting duct.
15. Clothes washing machine according to Claim 9, in which the projection extends in a direction that slopes relative to the direction of the axis of rotation of the loading drum with a height profile that decreases towards the tub aperture.
16. Clothes washing machine according to any one of Claims 10 to 15, in which at least one projection is shaped as a fin with asymmetrical leading and trailing edges.
17. Clothes washing machine according to any one of the preceding claims, in which the said annular band is made from a low-friction coating applied directly to the seal.
18. Clothes washing machine comprising a load container (22) for the clothes to be washed, mounted at least partly inside a washing tub (112), the said load container (22) comprising at least one first containment portion (23) and one second containment portion (24) communicating with each other via an interface aperture (25) for the clothes, in which at least one of the containment portions (23, 24) can be driven by drive means (18, 19) to set up a preferably rotary relative movement between the said containment portions (23, 24).
19. Clothes washing machine according to Claim 18, in which the first containment portion (23) is formed by a loading drum (15) and the second containment portion (24) is formed by a protective band (120b) and a window (21) for closing a loading aperture for the said load container (22).
20. Clothes washing machine according to Claim 18 or 19, in which the containment portions (23, 24) are of an approximately cylindrical shape and are coaxial with respect to an axis of relative rotation between the first (23) and second (24) containment portions.
21. Clothes washing machine according to any one of Claims 18 to 20, in which the containment portions (23, 24) are of different diameters.

- 22.** Clothes washing machine according to any one of Claims 18 to 21, in which the containment portions (23, 24) have projections (26, 27) suitable for agitating the clothes during the relative movement of the containment portions (23, 24).

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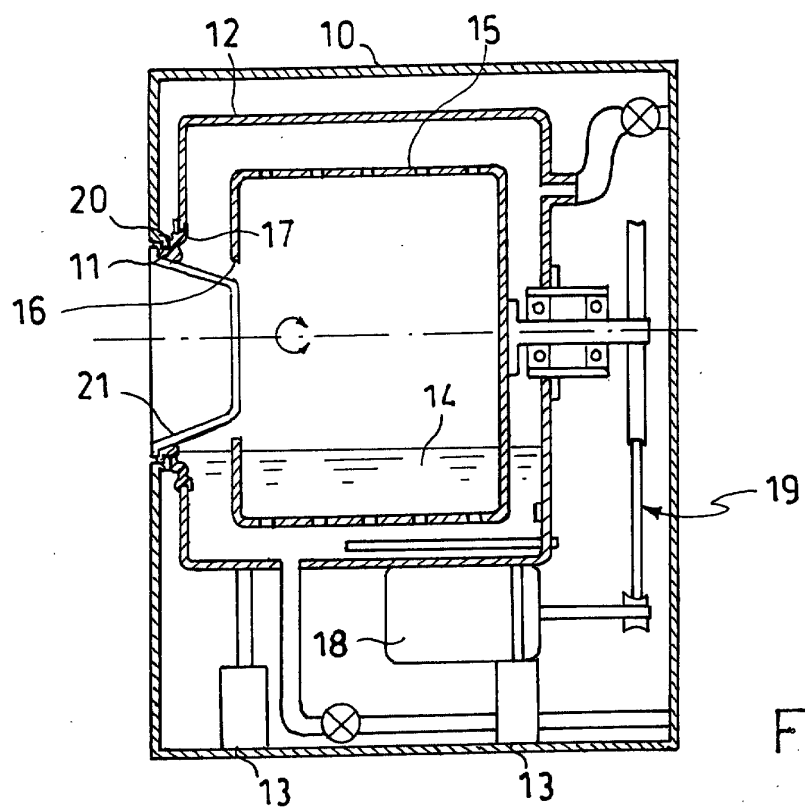
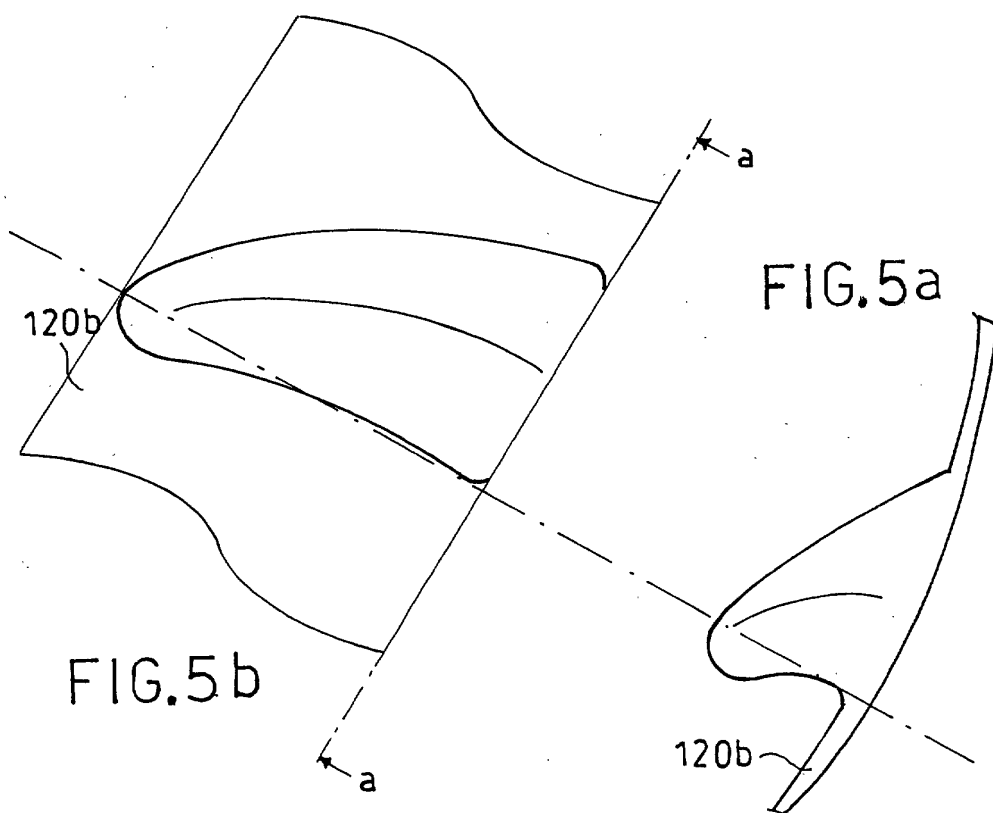
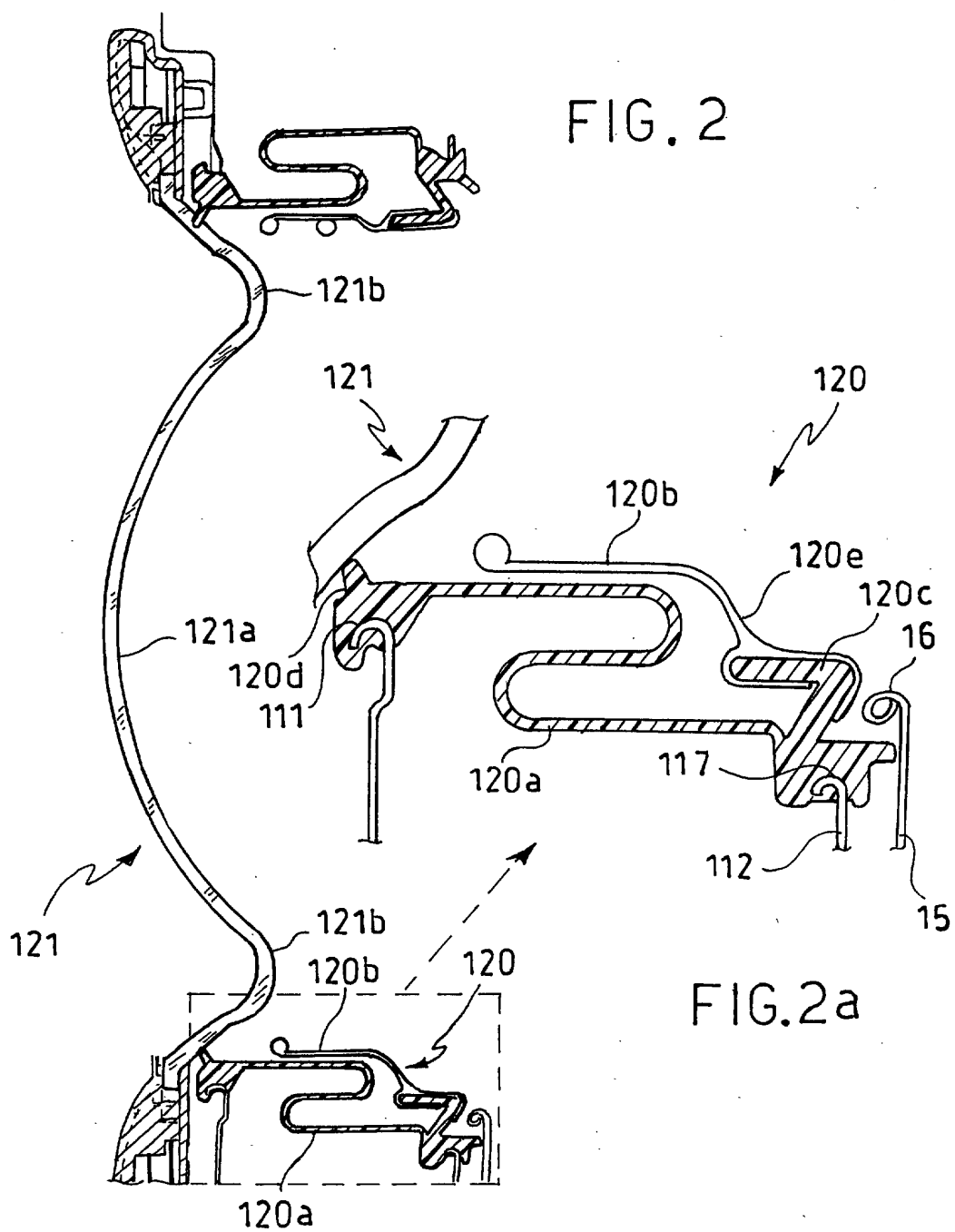
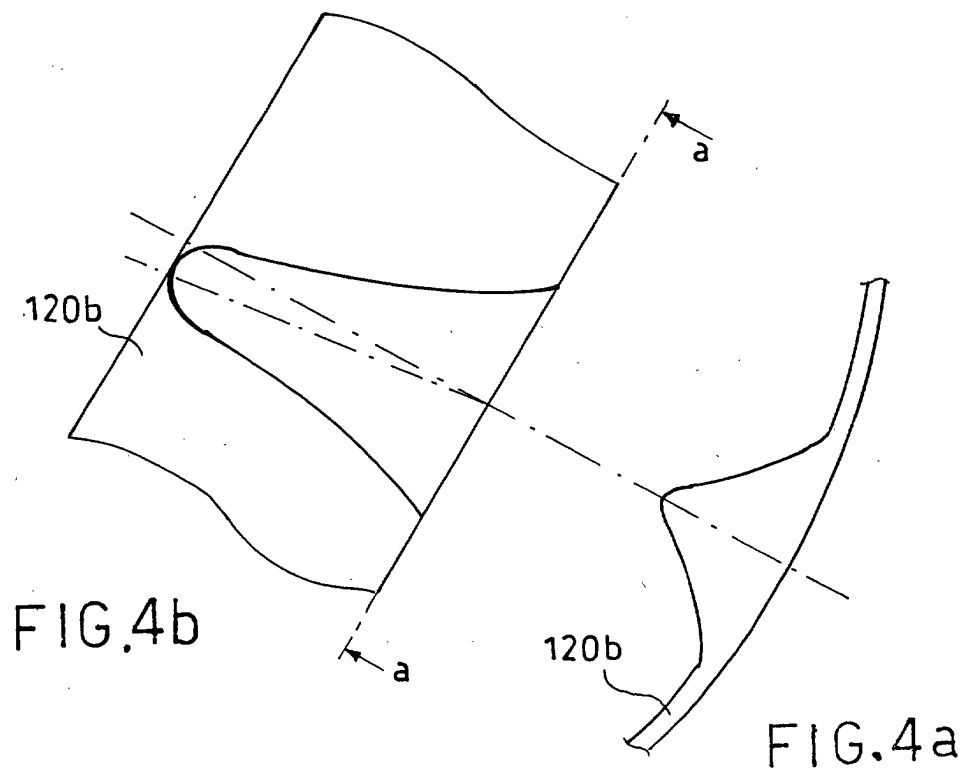
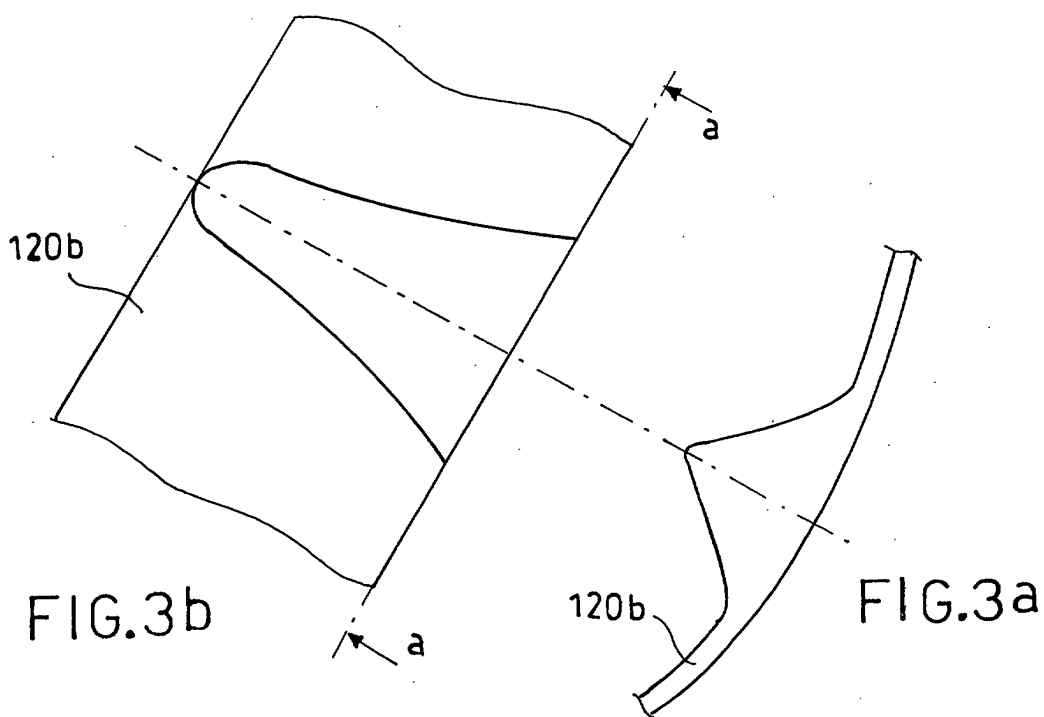


FIG. 1







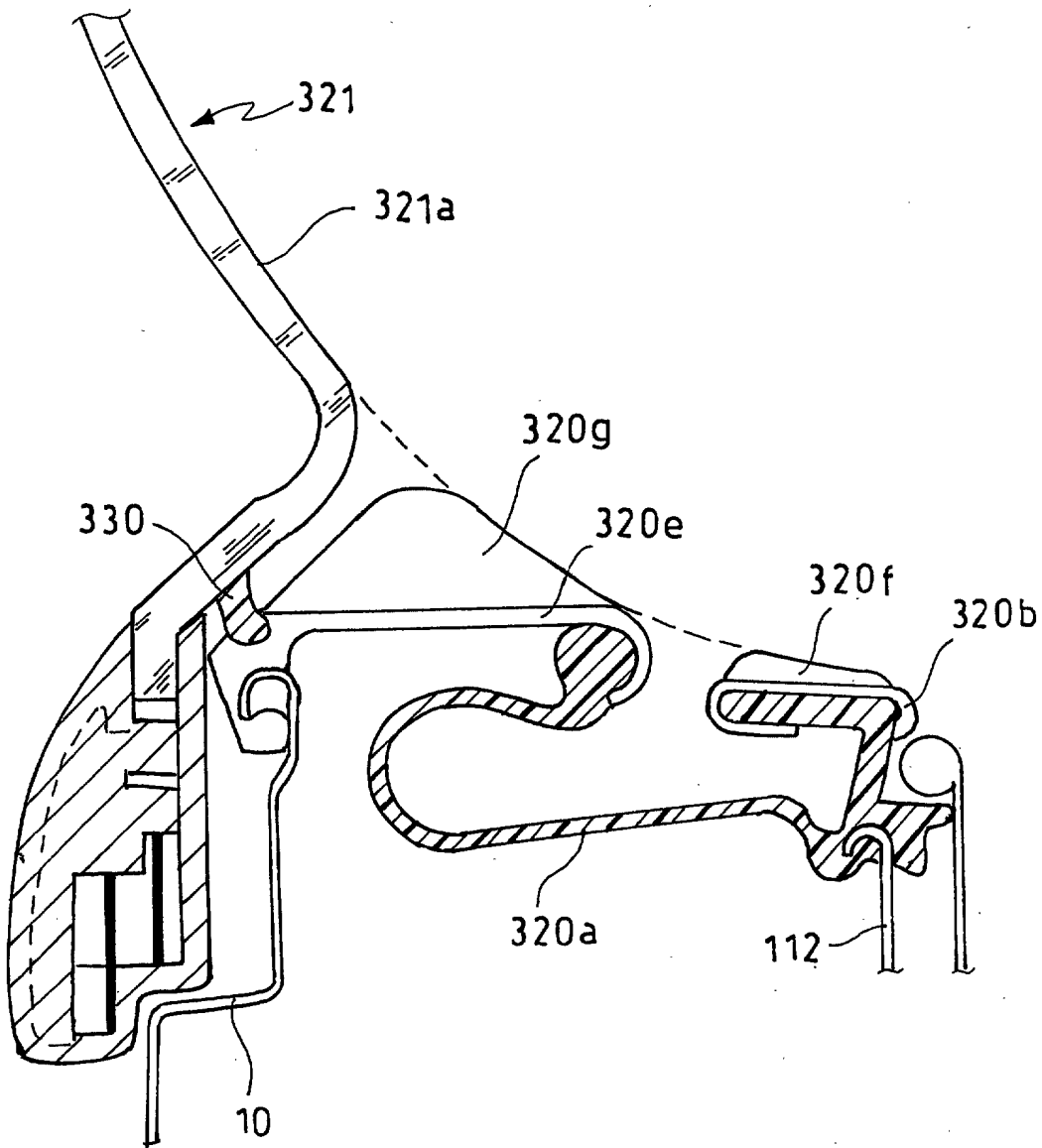


FIG. 6

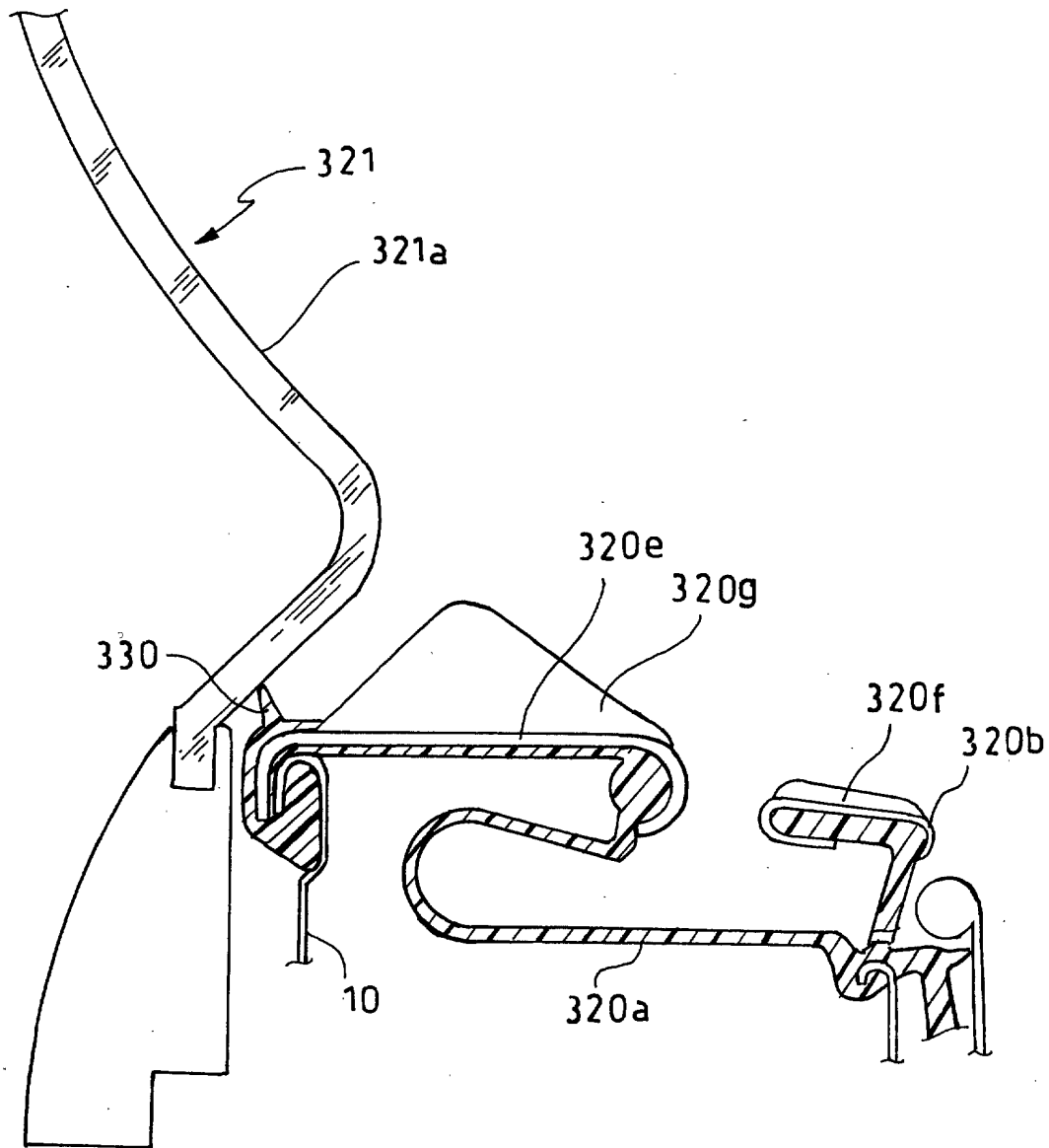


FIG. 6a

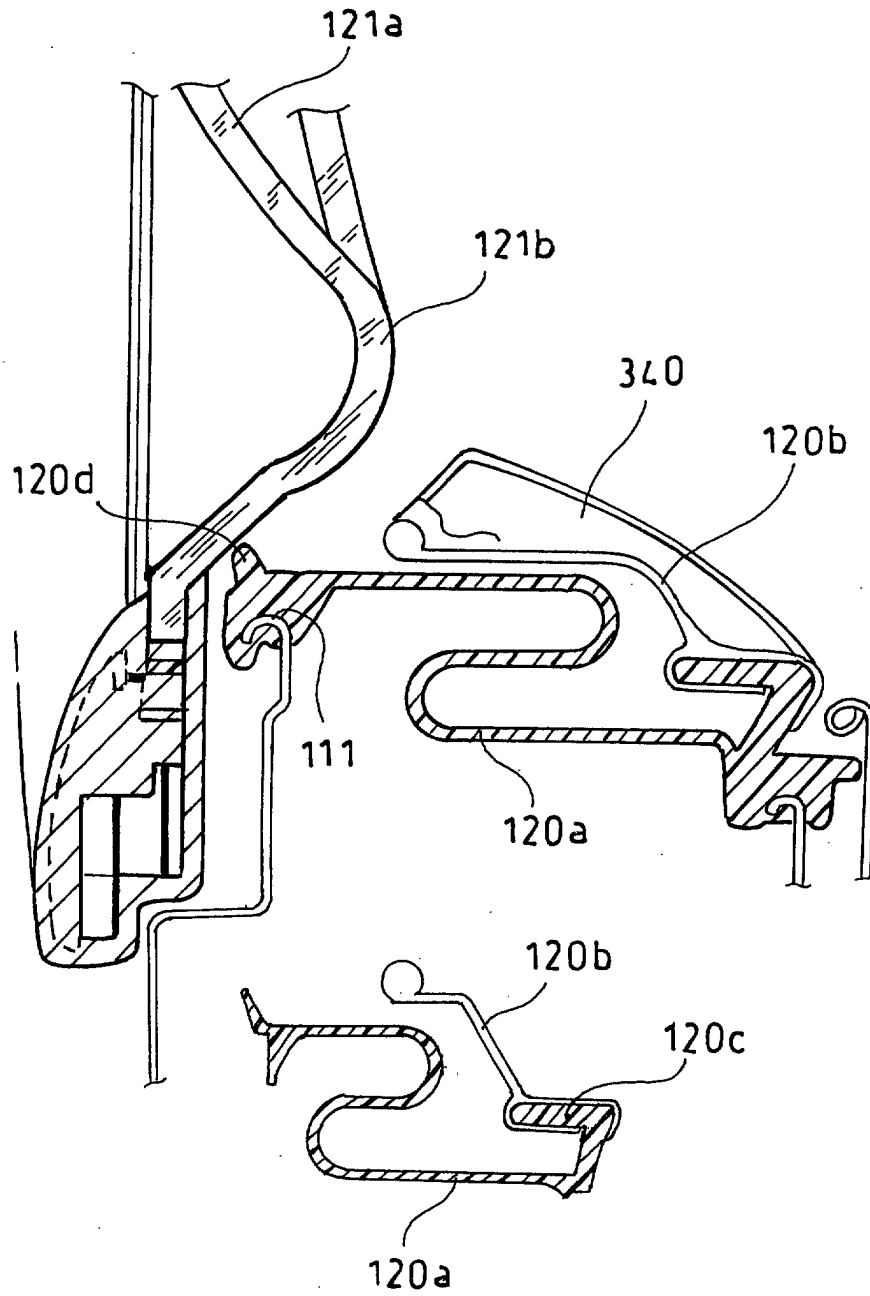


FIG. 7

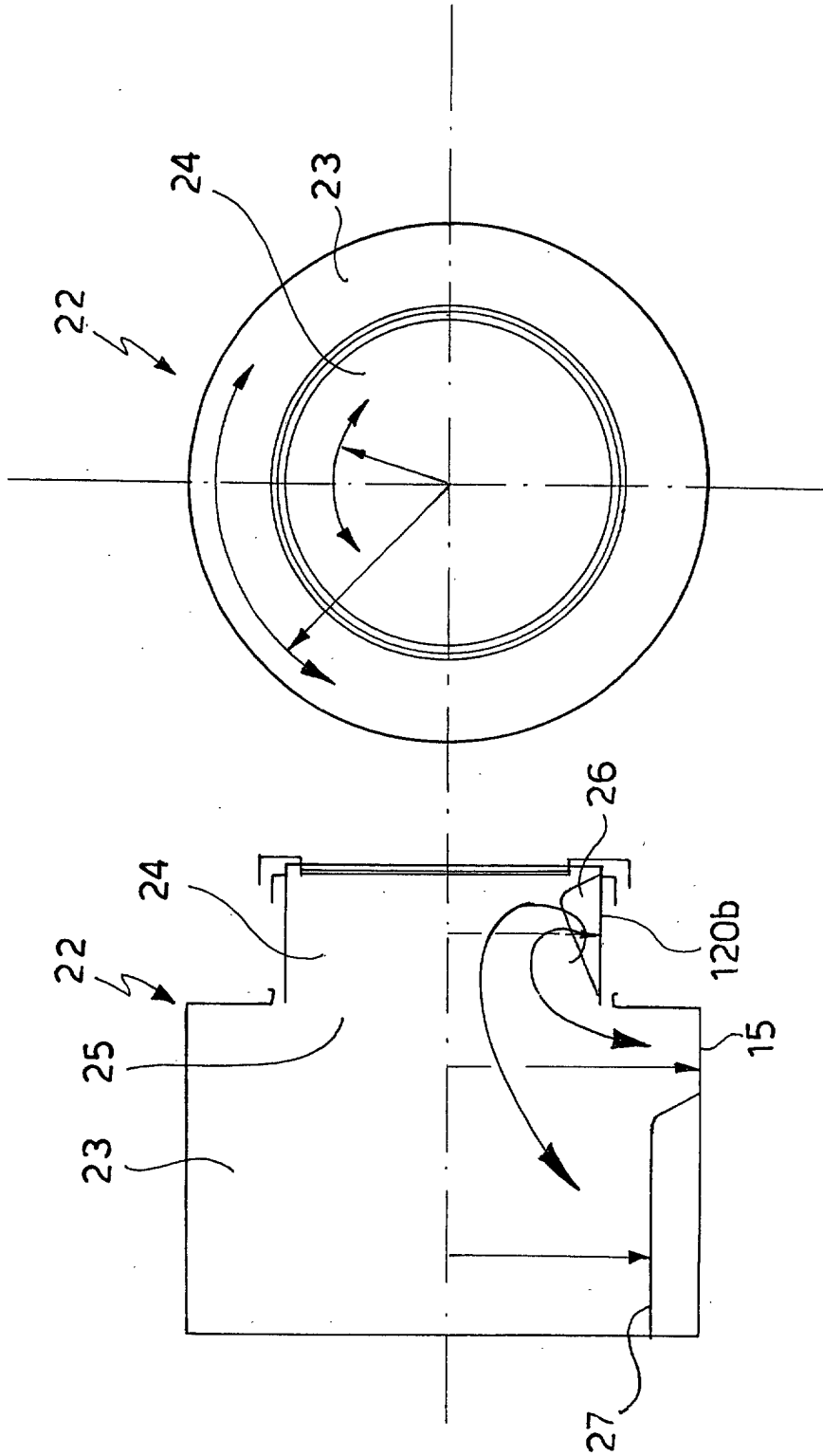


FIG. 9

FIG. 8

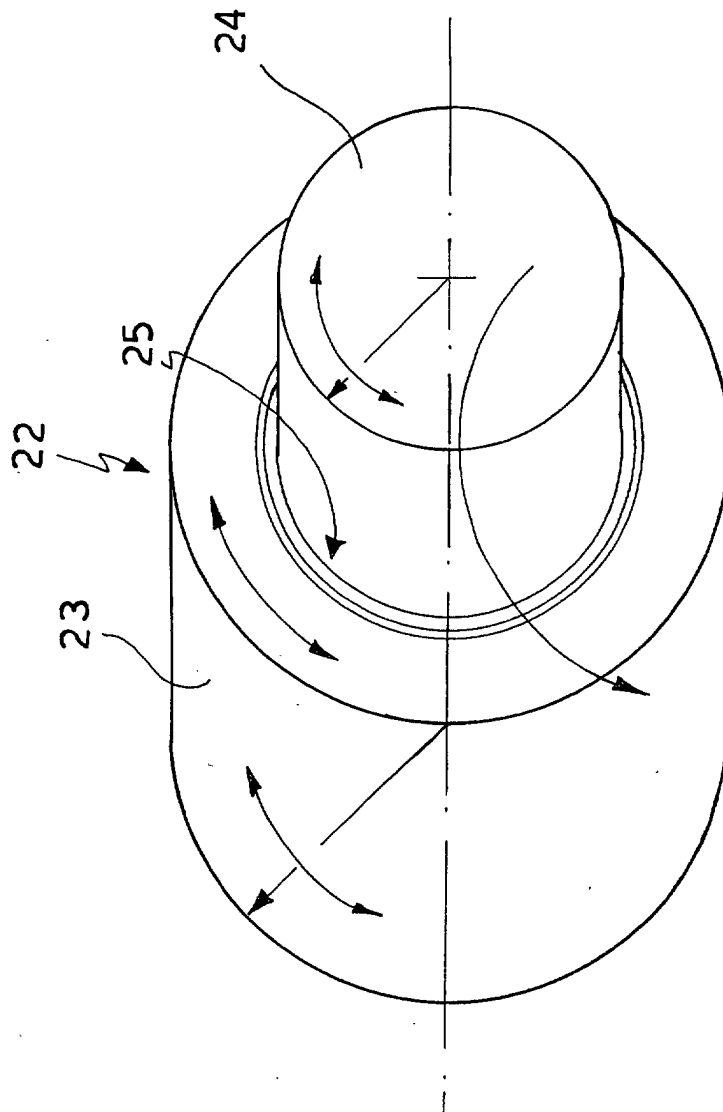


FIG.10



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5373

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Place of search THE HAGUE		Date of completion of the search 26 March 2003	Examiner Courrier, G
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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**ANNEX TO THE EUROPEAN SEARCH REPORT
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