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(54) **TUB OF A CLOTHES DRYING APPLIANCE**

(57) A tub (4) of a clothes drying appliance (5) comprises a rear tub section (1) comprising an air outlet opening (17), at least one lid attached to the rear tub section (1), an air duct (15) connected to the air outlet opening (17) and bounded by the rear tub section (1) and at least

one lid, wherein at least one lid bounding the air duct (15) is a lid assembly (2, 3) comprising an inner rib (14) structure. A clothes drying appliance (5) comprises a tub (4). The invention is particularly useful for washer-dryers.

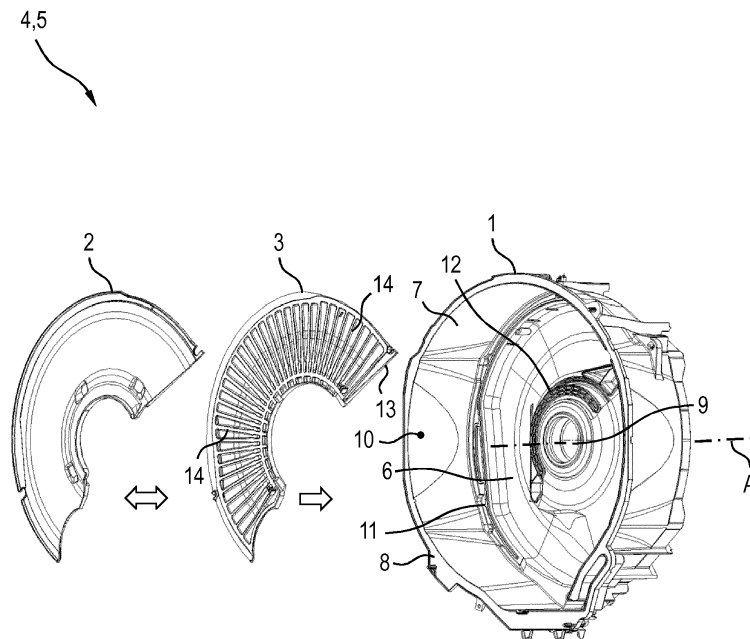


Fig.1

Description

[0001] The invention relates to a tub of a clothes drying appliance comprising a rear tub section. The invention also relates to a clothes drying appliance comprising such a tub. The invention is particularly useful for washer-dryers.

[0002] It is known to place a condenser in a process air channel downstream a clothes drum of a washer-dryer. The condenser is used to cool down the warm and wet process air coming from the clothes drum. The condenser may be a water spray device or a process air/fluid heat exchanger using cold water or a working fluid of a heat exchanger as the fluid. The rain-out condensate can be discharged and/or re-used. Typically, the condenser is placed apart from the drum and from a washing tub surrounding the drum. For example, the condenser may be a component of a floor assembly. A disadvantage of such constructions is that the condenser needs to be fluidically connected to the drum or washing tub using connecting parts like pipes. The connecting parts may cause additional air flow resistance, increased risk of water and air leakage and additional material costs. Also, this placement consumes design space.

[0003] It is the object of the present invention to at least partially overcome the problems associated with the prior art. It is a particular object of the present invention to provide a compact and more effective construction to cool down process air of a clothes drying appliance, in particular of a washer-dryer.

[0004] The object is achieved according to the features of the independent claims. Advantageous embodiments can be found, for example, in the dependent claims, in the subsequent description and in the attached drawing.

[0005] The object is achieved by a tub of a clothes drying appliance, comprising a rear tub section comprising an air outlet opening, at least one lid attached to the rear tub section, an air duct connected to the air outlet opening and bounded by the rear tub section and the at least one lid, wherein the at least one lid bounding the air duct is a lid assembly comprising an inner rib structure.

[0006] Thus the rear tub section and the at least one lid assembly form walls of the air duct. The air duct is integrated into the tub and can be used to cool down the air flowing within the air duct. This avoids using connecting parts like pipes etc. to connect the drum to an external condenser thus reducing air flow resistance, risk of water and air leakage and material costs. This also allows for a very compact design. The lid assembly gives a light-weight and strong mechanical re-enforcement to the rear tub section to compensate for a possible reduction of its bending stiffness caused by the integration of the air duct. Another advantage is that the materials of the rear tub section and the lid assembly can be freely chosen, e.g. individually for the rear tub section and the lid assembly. The inner ribbed or rib structure in particular includes that ribs do not protrude from the lid assembly. This gives the additional advantage that clothes cannot get stuck at or

ripped by the ribs and that the ribs do not cause a flow resistance within the air duct.

[0007] The clothes drying appliance may be a household appliance.

[0008] The tub ("washing tub") surrounds a clothes drum. The tub and the clothes drum may be aligned in a horizontal or near horizontal direction. In particular, the clothes drum may be a horizontally rotatable drum while the tub is stationary.

[0009] The tub may comprise the rear the section and a front tub section. The tub may have a generally cylindrical form, a longitudinal axis of which may coincide with a rotational axis of the clothes drum. The front tub section may have an opening for inserting and removing clothes.

[0010] The air outlet opening connects the tub with components of an external section of a process air channel. The other end of the air duct may open into the tub towards the drum. The process air channel in full - including the drum and the condenser - may be a closed loop that also comprises at least one heater and a fan. The fan may be placed near the air outlet opening to suck out air from the air duct.

[0011] The air duct is provided for guiding process air and may thus also be called a process air duct. The air duct may be regarded as a section of the process air channel.

[0012] In particular, the lid assembly is unbroken in the sense that it does not comprise holes through which a parasitic flow of process air can enter the air duct outside the air inlet opening.

[0013] It is an embodiment that the inner rib structure is sandwiched between two unbroken cover layers. The two unbroken cover layers prevent parasitic air flows into the air duct and that clothes can enter the air duct and be stuck there. In particular, the unbroken cover layers provide an outer smooth surface of the lid assembly. The interior or internal space of the lid assembly may comprise hollow spaces or cavities between ribs of the inner rib structure to achieve a particularly light-weight lid assembly.

[0014] In one variant, the ribs are associated with one of the cover layers before the two cover layers are assembled or connected. This enables a particularly easy assembly, e.g. by welding. In another variant, ribs are associated with both of the cover layers before the two cover layers are assembled. In this case the ribs may be positioned adjacent to each other in the finished lid assembly or the ribs are shallow ribs that are to be connected together for assembly of the lid assembly (i.e., the ribs of one cover lid are to be brought in contact with opposite ribs of the other cover lid).

[0015] It is an embodiment that the rear tub section comprises a circular end wall or section and a side wall or section. This form (which may also be called a bowl-like or shell-like form) gives the advantage that the tub may be positioned within the rear tub section in a particularly compact manner. The rear tub section may have a generally circular or disk-like form.

[0016] It is an embodiment that the at least one lid assembly covers part of the end wall in a spaced manner. Thus, the air duct is formed by the space between at least the cooling lid cover, the end wall, and the side wall.

[0017] It is an embodiment that the rear tub section comprises a central bushing. This gives the advantage that a shaft for rotating the drum can be led through the rear tub section. The bushing may be used as a wall (inner side wall) of the air duct. The bushing may be a bearing.

[0018] It is an embodiment that the lid assembly has a ring segmental form (i.e. only a section or segment of a fully circular form, e.g. approximately a half-ring form). This gives the advantage that a large air inlet opening into the air duct can be provided in an easy manner. In particular, the ring segmental form may be placed such that the air inlet opening is positioned below the air outlet opening. This gives the advantage that water entering the air duct during a washing cycle will not reach the air outlet opening. Also, any water present in the air duct (e.g. water spray or condensate) flows down towards and leaves the air inlet opening. To the same effect, the air outlet opening is positioned in a top half, in particular in a top third, in particular in a top quarter of the end wall. To achieve a long air duct for high cooling effectiveness, the air inlet opening may be positioned in a lower half, in particular in a lower third, in particular in a lower quarter of the end wall.

[0019] It is an embodiment that at least one lid assembly covers at least part of an inner side of the end wall. The inner side is a side facing into the tub and the drum, respectively.

[0020] Alternatively or additionally, at least one lid assembly covers at least part of an outer side of the end wall. The outer side is a side facing away from the tub and the drum, respectively.

[0021] It is an embodiment that the lid assembly is welded together from two parts each comprising one of the cover layers. Welding gives the advantage of a particularly robust connection. Depending on the material of the cover layer and the heat exchanger layer, the welding may comprise metal welding and/or plastic welding. However, other connection methods can be used alternatively or additionally, e.g. gluing, pressing, screwing, riveting etc. The welding may be friction welding, laser welding, ultrasound welding etc. It is another advantage that the material of the two parts may be identical or different. Different materials enable a particularly effective lid assembly.

[0022] It is an embodiment that the cooling lid assembly is welded to the rear tub section. This gives the advantage of a particularly robust connection. Depending on the material of the lid assembly to be used for welding and the rear tub section, the welding may comprise metal welding and/or plastic welding. However, other connection methods can be used alternatively or additionally, e.g. gluing, pressing, screwing, riveting etc. The welding may be friction welding, laser welding, ultrasound weld-

ing etc.

[0023] It is an embodiment that the tub further comprises at least one open ribbed part ("lid") that is attached to an area of the rear tub section bounding the air duct.

5 This provides a lightweight means to improve a structural strength of the rear tub section at the air duct. The open ribbed lid may only have one cover layer. An open ribbed lid may comprise a ribbed structure protruding from one side of a support layer, in particular a unbroken support layer. It is a variant that the open ribbed lid is connected to the rear tub section with its ribs first, i.e., the ribs are to be connected to the rear tub section. Advantageously, this enables a smooth outer surface.

10 **[0024]** It is an embodiment that the open ribbed lid is welded to the rear tub section. This gives the advantage of a particularly robust connection. Depending on the material of the open ribbed lid and the rear tub section, the welding may comprise metal welding and/or plastic welding. However, other connection means can be used alternatively or additionally, e.g. gluing, pressing, screwing, riveting etc. The welding may be friction welding, laser welding, ultrasound welding etc.

20 **[0025]** It is an embodiment that the ribbed structure of the lid assembly comprises at least one channel for working fluid. This gives the advantage that the lid assembly can be actively cooled to enhance a condensation effectiveness in the air duct. In particular, the heat exchanger layer may comprise a meandering or a lattice-like pathway for the working fluid. This gives the advantage of a high channel density and thus a particularly high cooling effectiveness. The working fluid may be water or working fluid of a heat pump of the clothes drying appliance, in particular a compressor heat pump. Alternatively, a heat exchanger may be placed within the air duct.

25 **[0026]** The object is also achieved by a clothes drying appliance comprising a tub as described above. The clothes drying appliance may be embodied in analogy to the tub and gives the same advantages. For example, the clothes drying appliance may be a washer-dryer.

30 **[0027]** It is an embodiment that clothes drying appliance comprises a water spray device for spraying water into the air duct. This enables an especially cost-effective cooling of the process air.

35 **[0028]** The above described features and advantages of the invention as well as their kind of implementation will now be schematically described in more detail by reference to at least one embodiment in the context of one or more figures of the attached drawing. In the drawing,

40 **Fig.1** shows an exploded view of a rear tub section, a cover layer and a heat exchanger layer according to a first embodiment;
Fig.2A shows the components of Fig.1 in a frontal view onto an inner side;
Fig.2B shows the rear tub section of Fig.1 in a frontal view onto an outer side of the rear tub section;
Fig.3 shows a cross-sectional side view of compo-

- nents to be connected to a rear tub section and a related assembly process according to a second embodiment;
- Fig.4 shows a cross-sectional side view of components to be connected to a rear tub section and a related assembly process according to a third embodiment; and
- Fig.5 shows a cross-sectional side view of components to be connected to a rear tub section and a related assembly process according to a fourth embodiment.

[0029] Fig.1 shows an exploded view drawing of the rear tub section 1, a first cover layer 2 and an open ribbed second cover layer 3 which are part of a washing tub 4 of a household washer-dryer 5.

[0030] The rear tub section 1 has a bowl-like shape comprising a circular end wall 6 and a side wall 7 extending in a rectangular fashion from the circular end wall 6. The free edge of the side wall 7 is constructed as a flange 8 that is used to contact a front tub section (not shown) of the washing tub 4. The rear tub section 1 and the front tub section accommodate a rotatable clothes drum (not shown). The circular end wall 6 comprises a central bushing 9 through which a shaft for rotating the drum can be led. The rear tub section 1 is stationary.

[0031] The inner side 10 of the rear tub section 1 - which faces the drum and the front tub section, respectively - comprises a circular front-facing seating 11 extending inwards from the side wall 7 and a circular front-facing seating 12 extending outwards from bushing 9. In a plan view, the seatings 11, 12 form segments of concentric rings centered on a longitudinal axis A of the rear tub section 1.

[0032] A lid assembly 2, 3 is provided to be seated on the seatings 11, 12. The lid assembly 2, 3 is made from the two cover layers 2 and 3 which have been produced separately (e.g. as plastic parts, e.g. by injection moulding) and which have then been connected to each other. The second cover layer 3 has an unbroken surface 13 that has a ring segmental form and that fits onto the seatings 11, 12. Protruding or extending towards the first cover layer is a ribbed ("open ribbed") structure that comprises a multitude of radially aligned ribs 14. The ribs 14 are straight ribs. The space between the ribs 14 is hollow but may generally be filled with a filling material.

[0033] The first cover lid 2 is attached to the second cover layer 3 such that it connects with the ribs 14. This forms a lid assembly 2, 3 comprising an inner rib structure, i.e., the ribs 14 are sandwiched between the first cover layer 2 and the unbroken surface 13 of the second cover layer 3. In a variant, the first cover layer 2 may comprise ribs facing towards the second cover layer 3. These ribs may be connected to the ribs 14 (rib-on-rib connection) which also gives an inner rib structure.

[0034] Fig.2A shows the components of Fig.1 in a frontal view on an inner side 10, i.e. facing the drum. When the lid assembly 2, 3 is seated onto seatings 11, 12, it

covers a ring segment-like part of the rear tub section 1 in a spaced manner, forming an air duct 15. At the lower end of the lid assembly 2, 3 an opening at a lower half of the rear tub section 1 is created which serves as an air inlet opening 16 to the air duct 15. Process air P may enter the air duct 15 through the air inlet opening 16 and flow upwards within the air duct 15 (as indicated by the dotted arrows) to an air outlet opening 17. The air outlet opening 17 is shown in Fig.2B at the outer side of the rear tub section 1. Within the air duct 15, the process air P can be e.g. sprayed with water to cool it down, as indicated by a spray outlet position of a respective water spraying device W. In a variant, the water may be sprayed through the air outlet opening 17.

[0035] Fig.3 shows a cross-sectional side view of components to be connected to a rear tub section 21, and a related assembly process. Only a half of the rear tub section 21 is shown. This rear tub section 21 can also be used as a component of the washing tub 4 of the household washer-dryer 5.

[0036] The rear tub section 21 is formed similar to the rear tub section 1. However, an open-ribbed first cover layer 22 now comprises the unbroken surface 13 and the ribs 14. The ribs 14 face a second cover layer 22 that has no ribs.

[0037] The plastic cover layers 22 and 23 are welded together by a welding process W1 to form the lid assembly 22, 23 that comprises an inner ribbed structure. The lid assembly 22, 23 may be similarly formed to the lid assembly 2, 3, e.g. having a segmental ring-like form.

[0038] The lid assembly 22, 23 is then welded to the seatings 11, 12 of the plastic rear tub section 21 by a welding process W2 to form the air duct 15. The air duct 15 is bounded or confined by the rear tub section 21 and the lid assembly 22, 23. The lid assembly 22, 23 is positioned on an inner side 10 of the rear tub section 21.

[0039] Optionally, an additional open ribbed lid 24 having ribs 14 facing an outer side of the end wall 6 of the rear tub section 21 may be attached to the rear tub section 21, more precisely to an area of the end wall 6 bounding the air duct 15. The open ribbed lid 24 may be welded to the end wall 6 of the rear tub section 21 by a welding process W3. This may give an inner rib structure sandwiched between an unbroken surface of the open ribbed lid 24 and the unbroken covered area of the end wall 6. Therefore, the walls of the air duct 15 are doubly reinforced.

[0040] Fig.4 shows a cross-sectional side view of components to be connected to a rear tub section 31 and a related assembly process. Only a half of the rear tub section 31 is shown. This rear tub section 31 can also be used as a component of the washing tub 4 of the household washer-dryer 5. In contrast to the rear tub section 1, the lid assembly 32, 33 now covers the end wall 6 of the rear tub section 31 on its outer side.

[0041] An open-ribbed first cover layer 32 comprises the unbroken surface 13 and the ribs 14. The ribs 14 face a second cover layer 32 that has no ribs. The cover layers

32 and 33 are welded together by a welding process W1 to form the lid assembly 32, 33 that comprises an inner ribbed structure. The lid assembly 32, 33 may have a segmental ring-like form.

[0042] The lid assembly 32, 33 is then welded to seatings 34 of the plastic rear tub section 31 by a welding process W2 to form the air duct 15. The air duct 15 is bounded or confined by the rear tub section 31 and the lid assembly 32, 33. The lid assembly 32, 33 is thus securely positioned on an outer side of the end wall 6 of the rear tub section 31.

[0043] Fig.5 shows a cross-sectional side view of components to be connected to a rear tub section 41 and a related assembly process. Only a half of the rear tub section 41 is shown. This rear tub section 41 can also be used as a component of the washing tub 4 of the household washer-dryer 5.

[0044] The rear tub section 41 is similar to the rear tub section 31 but is adapted to be additionally reinforced at its inner side 10. To this effect, an open ribbed lid 42 comprises ribs 14 facing an inner side of the end wall 6 of the rear tub section 41, more precisely an area of the end wall 6 bounding the air duct 15. The open ribbed lid 42 may be welded to seatings 43 of the end wall 6 by a welding process W3. This may give an inner rib structure sandwiched between a preferably unbroken surface of the open ribbed lid 42 and the unbroken covered area of the end wall 6.

[0045] Then, similar to the rear tub section 31, covers 32 and 33 can be welded together by a welding process W1 to form the lid assembly 32, 33, and the lid assembly 32, 33 can then be welded to the outer side of the rear tub section 41 by a welding process W2 to cover the air duct 15. Therefore, the walls of the air duct 15 are doubly reinforced.

[0046] Of course, the invention is not restricted to the described embodiments.

LIST OF REFERENCE NUMERALS

[0047]

- | | |
|----|------------------------------------|
| 1 | Rear tub section |
| 2 | First cover layer |
| 3 | Second cover layer |
| 4 | Washing tub |
| 5 | Washer-dryer |
| 6 | End wall |
| 7 | Side wall |
| 8 | Flange |
| 9 | Bushing |
| 10 | Inner side of the rear tub section |
| 11 | Seating |
| 12 | Seating |
| 13 | Surface |
| 14 | Rib |
| 15 | Air duct |
| 16 | Air inlet opening |

- | | |
|-------|--------------------|
| 17 | Air outlet opening |
| 21 | Rear tub section |
| 22 | First cover layer |
| 23 | Second cover layer |
| 5 24 | Open ribbed lid |
| 31 | Rear tub section |
| 32 | First cover layer |
| 33 | Second cover layer |
| 34 | Seating |
| 10 41 | Rear tub section |
| 42 | Open ribbed lid |
| 43 | Seating |
| W | Water spray device |
| W1 | Welding process |
| 15 W2 | Welding process |
| W3 | Welding process |

Claims

1. A tub (4) of a clothes drying appliance (5), comprising

- a rear tub section (1; 21; 31; 41) comprising an air outlet opening (17),
- at least one lid attached to the rear tub section (1; 21; 31; 41),
- an air duct (15) connected to the air outlet opening (17) and bounded by the rear tub section (1; 21; 31; 41) and at least one lid,

wherein

- at least one lid bounding the air duct (15) is a lid assembly (2, 3; 22, 23; 32, 33) comprising an inner rib (14) structure.

2. The tub (4) according to claim 1, wherein the inner rib (14) structure is sandwiched between two unbroken cover layers (2, 3; 22, 23; 32, 33).

3. The tub (4) according to any of the preceding claims, wherein

- the rear tub section (1; 21; 31; 41) comprises a circular end wall (6) and a side wall (7) and
- the at least one lid assembly (2, 3; 22, 23; 32, 33) covers part of the end wall (6) in a spaced manner.

4. The tub (4) according to claim 3, wherein

- the rear tub section (1; 21; 31; 41) comprises a central bushing (9) and
- the lid assembly (2, 3; 22, 23; 32, 33) has a ring segmental form.

5. The tub (4) according to any of the claims 3 to 4, wherein at least one lid assembly (2, 3; 22, 23) covers

part of an inner side of the end wall (6).

6. The tub (4) according to any of the claim 3 to 5, wherein at least one lid assembly (32, 33) covers part of an outer side of the end wall (6). 5
7. The tub (4) according to any of the preceding claims, wherein the lid assembly is welded together from two parts each comprising one of the cover layers. 10
8. The tub (4) according to any of the preceding claims, wherein the lid assembly (2, 3; 22, 23; 32, 33) is welded (W2) to the rear tub section (1; 21; 31; 41). 15
9. The tub (4) according to any of the preceding claims, wherein the tub (4) further comprises at least one open ribbed lid (24; 42) that is attached to an area of the rear tub section (21; 41) bounding the air duct (15). 20
10. The tub (4) according to any of the preceding claims, wherein the open ribbed lid (24; 42) is welded to the rear tub section (21; 41).
11. A clothes drying appliance (5) comprising a tub (4) according to any of the preceding claims. 25
12. The clothes drying appliance (5) according to claim 11, wherein the clothes drying appliance (5) comprises a water spray device (W) for spraying water into the air duct (15). 30

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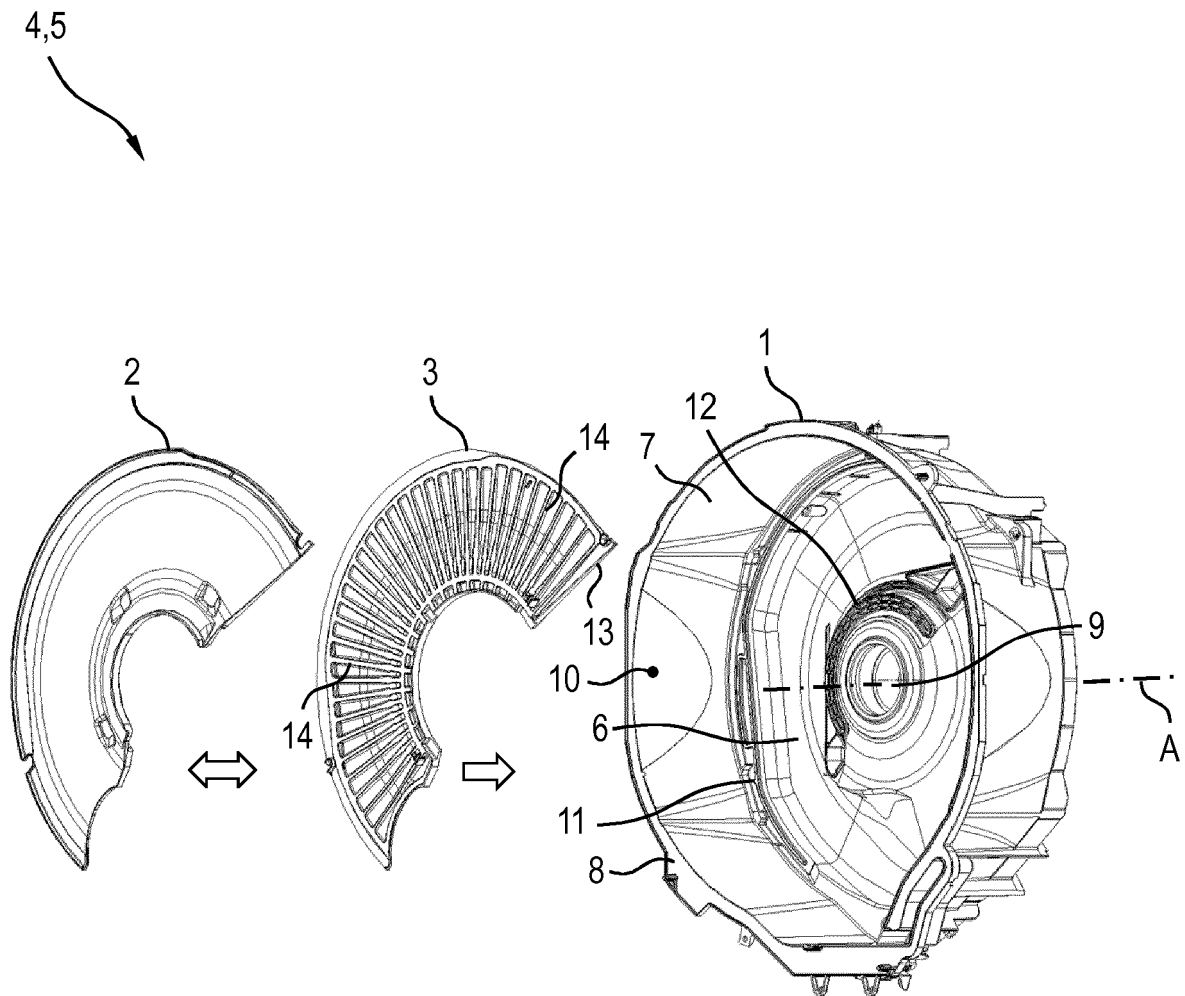


Fig.1

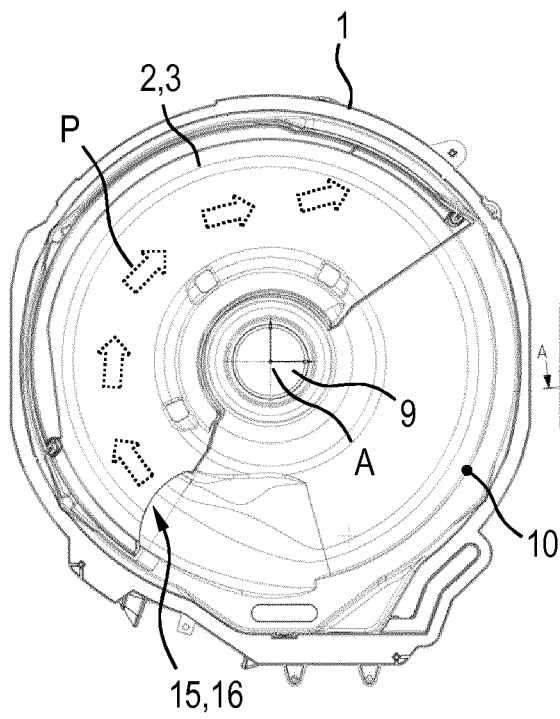


Fig.2A

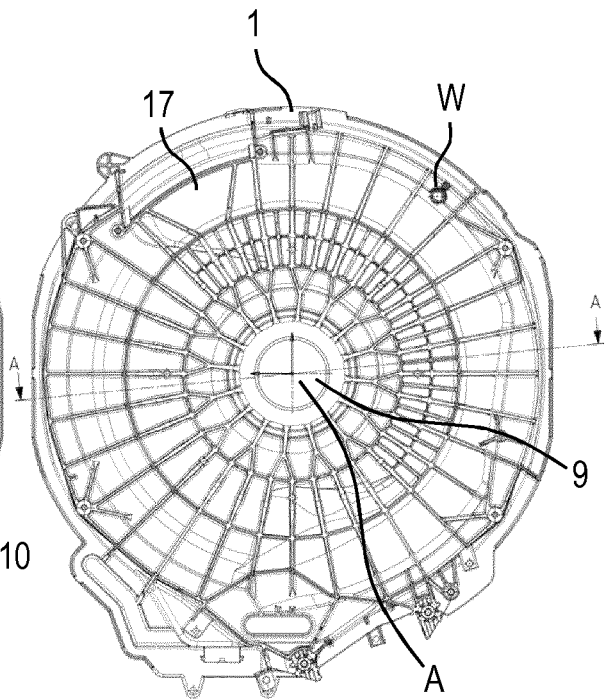


Fig.2B

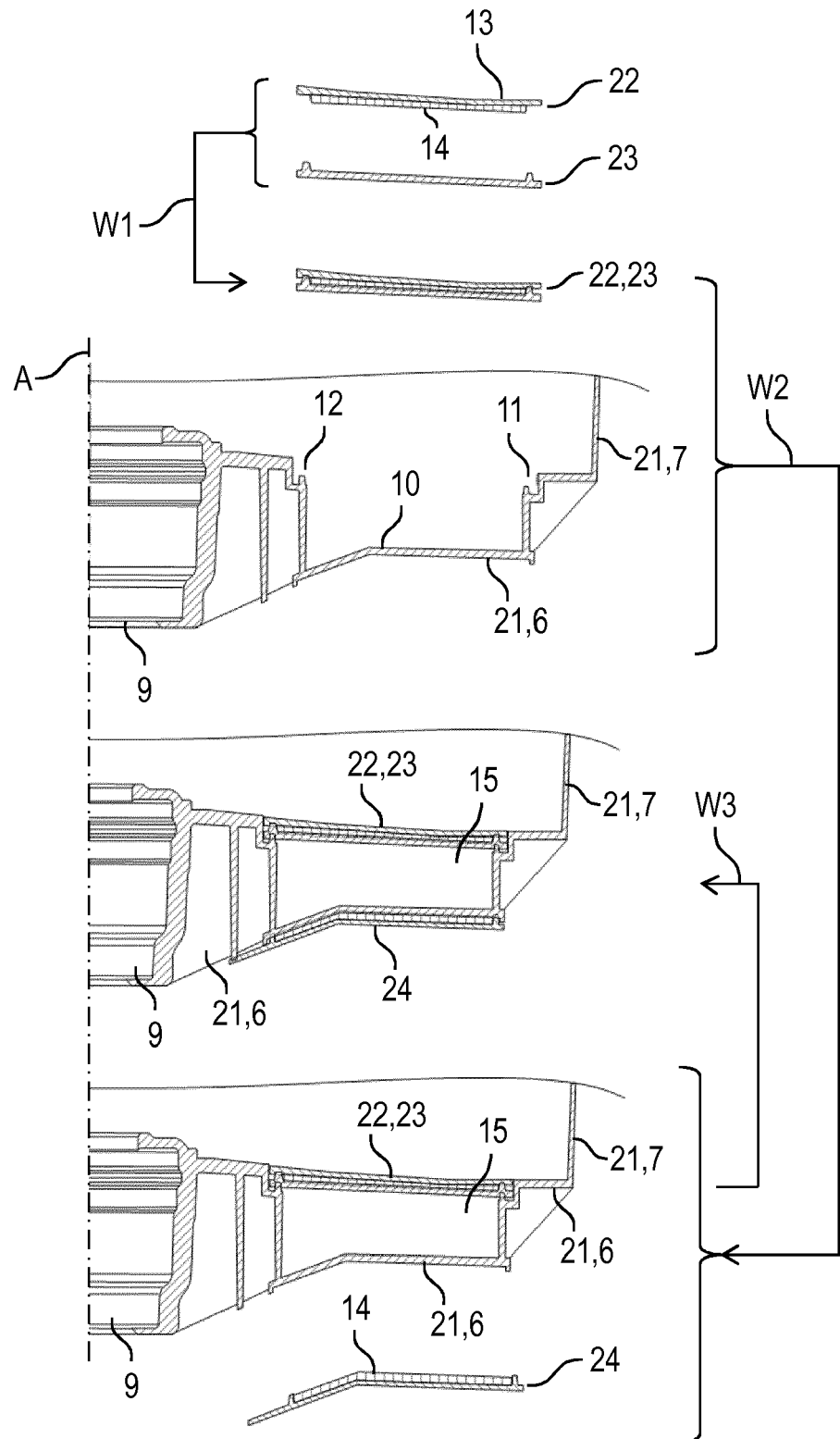


Fig.3

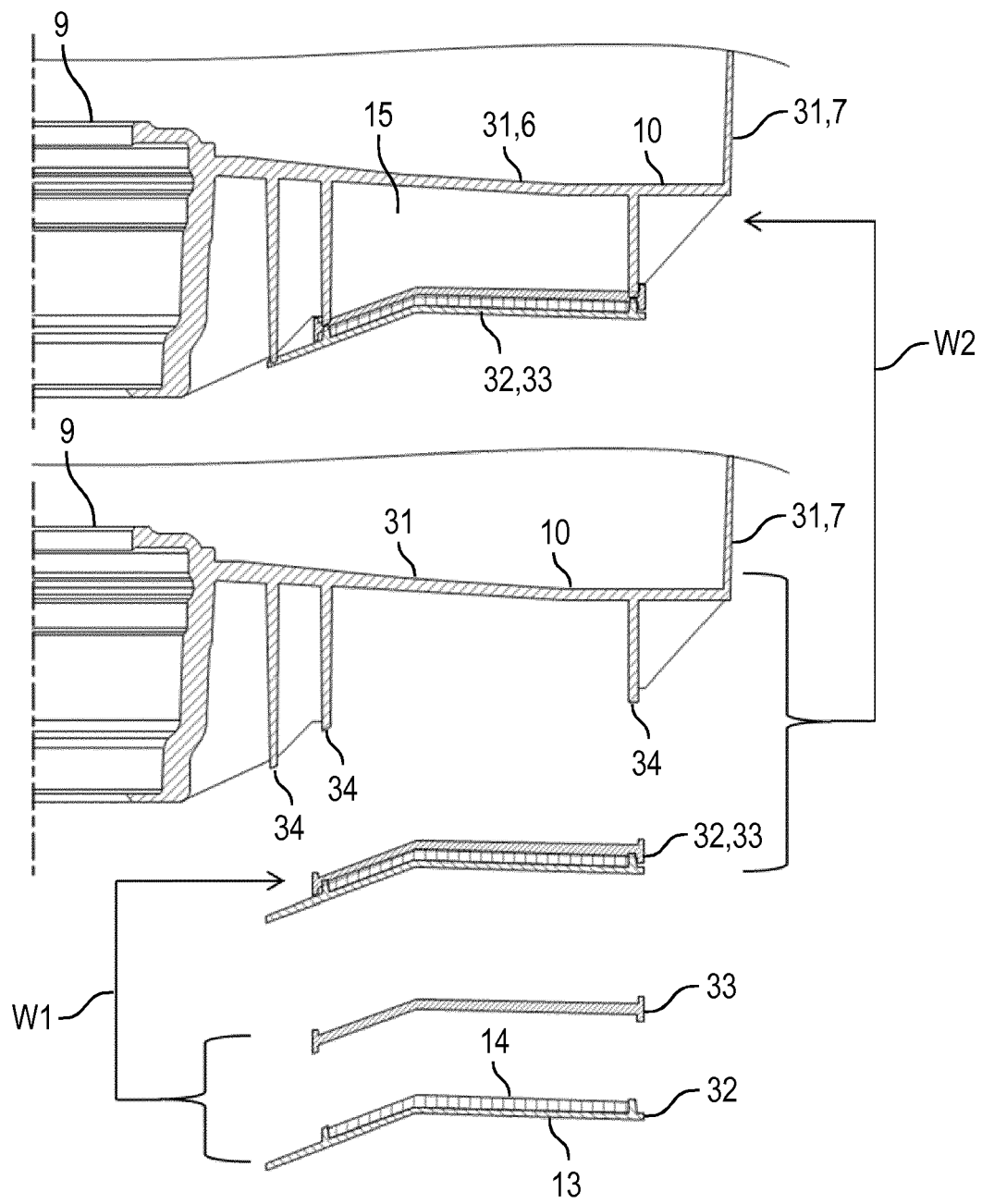


Fig.4

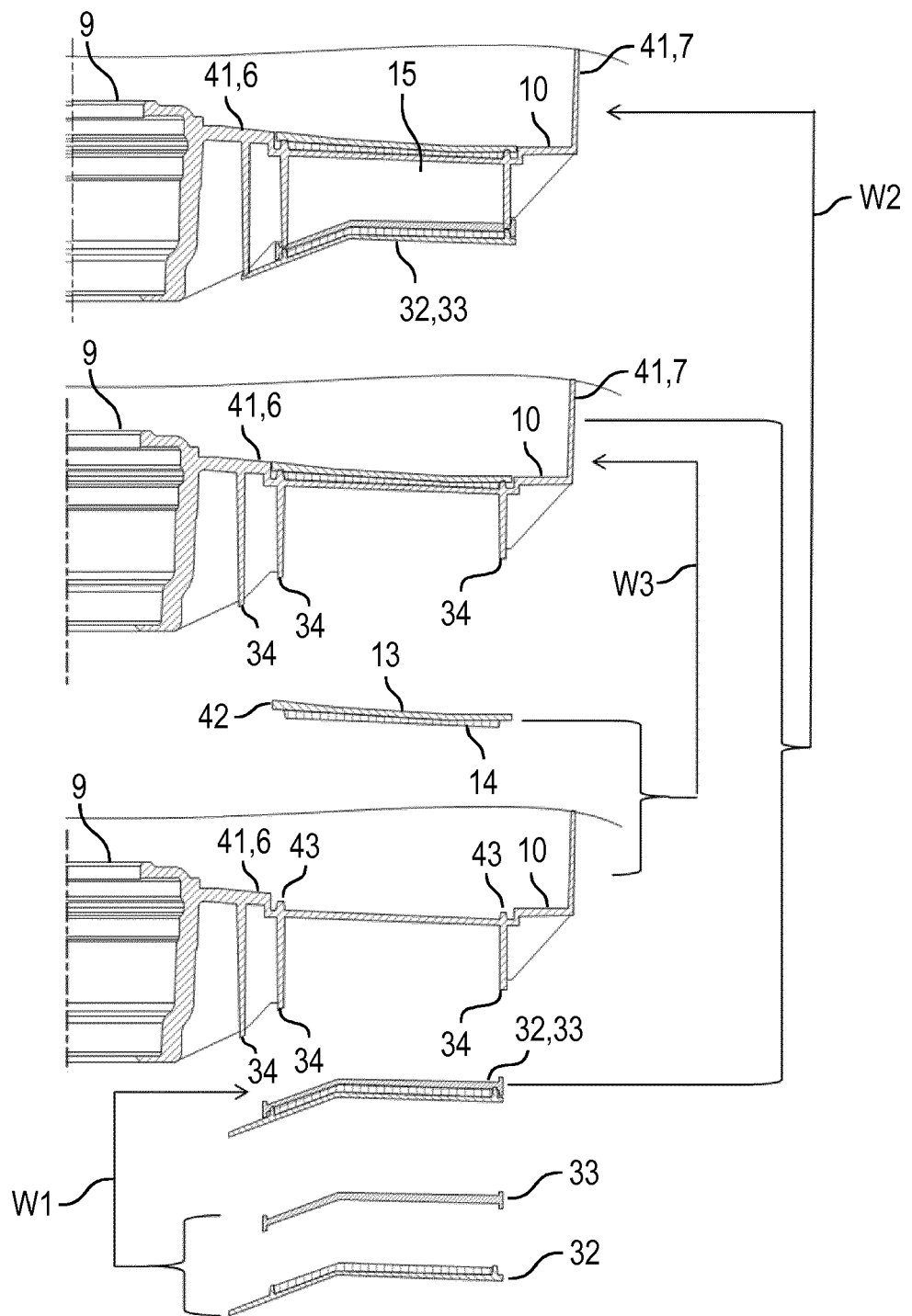


Fig.5



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 Application Number
 EP 16 20 1392

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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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