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(54) **Top-loading clothes washing and drying machine with substantially horizontal-axis rotating drum**

(57) Clothes washing and drying machine having an oscillating tub (9) which is substantially formed by a cylindrical enclosure and a pair of vertical head pieces, and which encloses a single perforated drum (7) capable of being loaded from the top and rotating about a sensibly horizontal axis. One of said head pieces (10) consists substantially of a first portion (11) and a second

portion (12) that are separably joined to each other so as to form, on the outside of the seat (30) provided for at least a bearing of the drum (7), a channel (28) for the drying air, in which there are accommodated all means (15, 22, 25, 29, 31) needed to create a flow of heated drying air in a closed-loop circuit through the rotating drum (7).

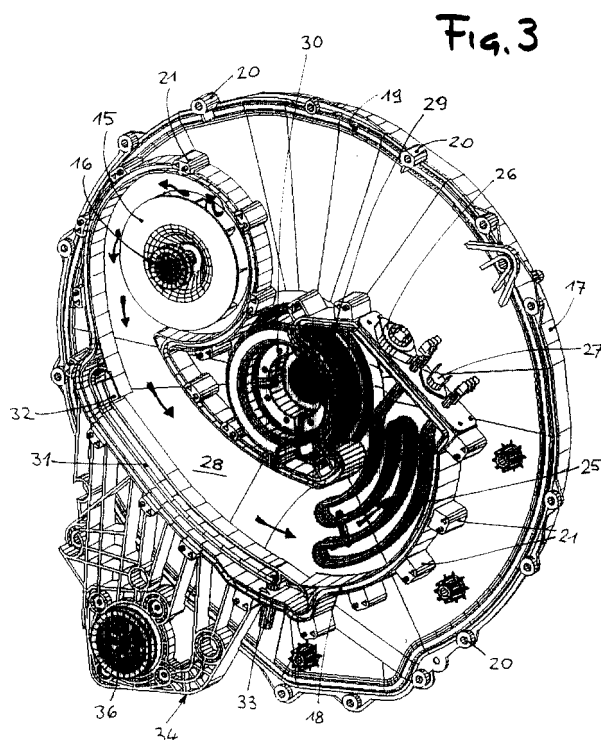


Fig. 3

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Description

[0001] The present invention refers to a household clothes washing and drying machine, generally known as a washer-dryer in the art, in which the clothes are loaded into a substantially horizontal-axis rotating drum from the top thereof.

[0002] The internal architecture of a washer-dryer is inherently more complex than the one of a simple clothes washing machine. Within its outer casing, further to the means that are intended to ensure the inlet, the recirculation and the outlet of the washing liquor to, in and from the oscillating tub enclosing the rotating drum, there must in fact be provided, and appropriately arranged, the means that are needed to create a flow of air in a closed-loop circuit during the clothes drying phases. To such means belong, among other things, the arrangements needed to heat up the air before it comes into contact with the clothes to be dried, along with the arrangements required to condense the moisture being gradually removed from the clothes

[0003] Unlike the models in which the clothes are loaded from the front, ie. the so-called front-loaders, top-loading clothes washing and drying machines are rather unfrequent, owing also to the difficulty that is found, from an industrial engineering and manufacturing point of view, in making such a complex machine with an outer casing that must be ensured rather small dimensions, particularly as far as its width is concerned, and an adequate capacity in terms of amount of clothes loadable therein for treatment. Even the specific patent literature dealing with such machine models appears to be quite scarce.

[0004] To the best knowledge of the Applicant, the closest state-of-the-art is in fact represented in this case by the document EP-A-0 427 610, which however refers to a so-called tumble dryer, that is a machine that is adapted to solely dry the clothes. In this machine, the means provided to create a forced flow of the drying air (by the way, in a seemingly open-loop circuit) are accommodated partly in the first one and partly in the second one of the two stationary disks that are fixed to the seats of the bearings of the rotating drum, which is provided on top with a lid for loading the clothes therein. More precisely, in the first disk, which is relatively flat, there is accommodated an electric heating element extending in a uniform manner over the whole surface thereof, whereas in the second disk, which is on the contrary convex, ie. domed towards the interior of the drum, there is accommodated the impeller of a motor-driven fan.

[0005] Quite apparent is the need, in a machine of this kind, for the functional parts ensuring the flow of drying air to be tested separately, owing to them being mounted in said separate stationary disks, as well as relatively long and complex cable harnesses to be used for the mutual connection thereof. The result is a certain extent of irrationality from an industrial manufacturing point of

view. It should furthermore be noticed that, according to the drawing accompanying the above cited patent publication, the outer casing has a width in the order of 45 cm, which is therefore larger than the width (40 cm) of the most recent top-loading washing machine models.

[0006] It therefore is a main purpose of the present invention to provide a top-loading machine of the afore indicated kind that is capable of being manufactured in a more rational manner, is capable of ensuring a useful clothes-loading capacity in the order of 4.5 kg (ie. practically equal to the one of front-loading models) in an outer casing that does not exceed a width of just 40 cm, and is of course also capable of ensuring top performance levels in both washing and drying, in accordance with the energy-conservation labelling scheme of the European Union.

[0007] According to the present invention, these and further aims are reached in a clothes washing and drying machine, or washer-dryer, having the characteristics as recited in the appended claims.

[0008] Anyway, features and advantages of the present invention will be more readily understood from the description of an embodiment of the invention that is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is an overall view of a top-loading clothes washing and drying machine having the drum rotating about a horizontal axis;
- Figure 2 is an exploded view of a disk-shaped part, which forms one of the head pieces of the tub of the washer-dryer and constitutes the core element of the present invention, enabling the functional parts accommodated therein to be best illustrated;
- Figure 3 is a three-dimensional view of the same head piece illustrated in Figure 2, upon said functional parts having been assembled therein.

[0009] As illustrated in Figure 1, a clothes washing and drying machine of the kind considered here comprises an outer casing 1 in the shape of substantially a parallelepiped, in which the width $L = 40$ cm forms definitely the shortest side in comparison with the height $H = 85$ to 90 cm and the depth $P = 60$ cm. Most of the top face of the casing 1 is occupied by a clothes loading aperture 2, wherein a rectangular lid 3 is hinged on along the rear side adjacent to a control panel 4 carrying the various control and display or indicating devices 5 of the machine. Within the thickness of the lid 3 there are housed some compartments 6 intended for containing the chemical aids to be filled in for use in the washing phases of the operating cycles of the machine.

[0010] The interior of the casing 1 accommodates an oscillating tub 9 which is essentially constituted by a cylindrical enclosure and two vertical head pieces on the front and the rear side thereof, wherein said tub houses

a single perforated drum 7 provided with a double-shutter lid 8 for loading and removing the clothes through the aperture 2. The drum 7, therefore, is of the type rotating about a sensibly horizontal axis, parallel to the width dimension L of the casing 1, as driven by an electric motor mounted below the tub 9.

[0011] As it may be noticed, many of the parts of the washer-dryer that have been mentioned hitherto, are not shown, for reasons of greater simplicity, in the accompanying drawing, since they are assumed to be largely known to all those skilled in the art and, furthermore, are not directly involved by the present invention.

[0012] In the above cited Figures 2 and 3 there is on the contrary illustrated, in a detailed manner, one of the afore mentioned head pieces of the tub 9. According to an essential feature of the present invention, this head piece, which is generally indicated at 10, substantially consists of a first portion 11 and a second portion 12, preferably made of metal and separably joined to each other.

[0013] The first such portion 11, which is flat in substantially the shape of a volute, is provided with a plurality of perforated tabs 13 along the whole periphery thereof, as well as a circular seat 14 that is perforated on the bottom to accommodate the pulley 16 of the impeller 15 of a fan, as this will be described in greater detail further on - see Figure 2.

[0014] In turn, the second such portion 12 (which is preferably made by die-casting) is substantially in the shape of a pan with a disk-shaped bottom, an outer peripheral edge 17 and an inner peripheral edge 18, both of them provided in a raised form, between which the place is provided for arranging the seat 30 for at least one of the bearings (not shown) of the drum 7.

[0015] The outer edge 17 comprises both a continuous groove 19 to accommodate a sealing material and a first set of bushes 20 for the screws (not shown) used to fix the head piece 10 to the cylindrical enclosure of the tub 9. The inner edge 18, which is higher than the outer edge 17, is provided with a second set of threaded bushes 21 for the engagement of bolts (not shown, either) that get inserted in the perforations in the tabs 13 - see Figure 2. In this way, when the head piece 10 is being assembled, the first portion 11 thereof is joined along its periphery to the second portion 12 thereof, in such a manner as to form a volute-shaped channel 28, according to a feature of the present invention.

[0016] At a first end portion of the channel 28, the same second portion 12 of the head piece 10 is provided with a circular aperture 22 having a diameter that is just slightly smaller than the outer diameter of the impeller 15 which is mounted inside the same channel 28 in such a manner as to enable the pulley 16 to be fixed, on the outside of the head piece 10 of course, on to the shaft 15A thereof protruding through the perforation on the bottom of the recessed seat 14.

[0017] At a second end portion of the channel 28 on the inner edge 18 there are provided a first aperture 23

having a rectangular shape and a second aperture 29 having a falcate shape. The rectangular aperture 23 (see Figure 2) is arranged to face the outer edge 17 and accommodates the flange 24 of a sheathed-type resistance heating element 25 for heating up the air intended for drying the clothes, wherein on said flange 24 there are furthermore attached in a conventional manner two temperature adjusting or temperature limiting devices 26 and 27. The falcate aperture 29, which is situated on a side of the seat 30 provided for at least one of the bearings (not shown) of the drum 7 (see Figure 3) upon completion of the assembly work, comes to be in communication with the interior of the tub 9, as this will be explained in greater detail further on.

[0018] According to another basic feature of the present invention, in correspondence of the lower portion of the arcuate channel 28, namely after the ending point of the sheathed heating element 25, a surface-type steam condenser 31 is provided integrally in the second portion 12 of the head piece 10. In the preferred embodiment being described here, and illustrated specifically in Figure 3, in view of maximizing the efficiency of the heat-exchange process between the water used as a cooling medium and the moisture removed in its vapour phase from the clothes by the drying air, the condenser 31 has a meandering shape. The water flowing in from the mains through an inlet 33 in the lowest point, is in this way able to follow a relatively long course before mixing up with the condensate liquid starting at a point 32 in a higher position on the edge 18. At the end of a course along which such a mixing up is brought to completion, the water and the condensate liquid are conveyed, through an appropriate outlet (not shown), directly to the bottom of the tub 9.

[0019] On the outside of the position occupied by the steam condenser 31, the same second portion 12 of the head piece 10 of the tub 9 comprises an appendix 34 that is roughly radial with respect to the axis of the seat 30 (which at the same time is the axis of rotation of the drum 7). Such an appendix 34 is particularly strong owing to the provision of structural reinforcing ribs and terminates with a circular aperture 35 adapted to accommodate a pulley 36 associated to the electric motor (not shown in the Figures, but situated below the cylindrical enclosure of the tub 9) that, through a belt (not shown, either), drives the pulley 16 of the impeller 15 of the fan.

[0020] As this may be inferred from the illustrations in Figures 2 and 3, all component parts that are housed in the head piece 10 between the portions 11 and 12 thereof, are substantially flat in their shape and this enables the overall thickness of the tub 9, ie. the space required by it axially, to be minimized. In other words, this practically means that, thanks to the present invention, the possibility is given for a washer-dryer to be provided with an outer casing having a width L of just 40 cm, ie. a width that is equal to the one featured by the narrowest top-loading washing machines that are currently to be found on the marketplace.

[0021] As far as the operation of the washer-dryer according to the present invention is concerned, during clothes drying phases the perforated drum 7 enclosed in the tub 9 is kept rotating about the horizontal axis thereof by the afore mentioned driving motor. At the same time, the clothes drying air is circulated in a closed-loop circuit that comprises, in a logic sequence, the sheathed heating element 25, the falcate aperture 29, the tub 9 and then the drum 7, where the so heated-up air collects, ie. takes on the moisture removed in its vapour phase from the clothes, the aperture 22 in the portion 12 of the head piece 10, the impeller 15 and, finally, the channel 28, following the direction shown by the arrows in Figure 3, until the flow of said drying air eventually reaches again the sheathed heating element 25.

[0022] In the surface condenser 31, the moisture that is removed in its vapour phase from the clothes by the action of the drying air is reduced, ie. condensed and the mixture of condensate liquid and cooling water, which then so forms, falls directly onto the bottom of the tub 9, below the drum 7. By means of a pump (not shown), such a mixture is duly let out of the washer-dryer, but can as well be stored in an appropriately provided reservoir (not shown, either) in view of a utilization thereof in a subsequent washing cycle performed by the machine.

[0023] From the above description, the main advantages of a clothes washing and drying machine according to the present invention can be inferred as being essentially constituted by:

- a) the feasibility of an outer casing of the machine being just 40 cm wide, without any penalty being put on the actual clothes loading capacity of the machine;
- b) the possibility for the entire head piece 10 of the tub 9 to be manufactured and tested as a single sub-assembly;
- c) a dramatic simplification of the operations concerning the electrical connections of the component parts housed in the channel 28 of the head piece 10 to each other, thanks to the short distance at which they are placed from each other;
- d) the energy efficiency deriving from the use of a surface condenser for condensing the moisture removed in its vapour phase from the clothes by the drying air, in particular when the mixture resulting from the eventual combination of the condensate liquid and the cooling water is collected and stored for use in a subsequent washing cycle.

Claims

1. Clothes washing and drying machine having an oscillating tub (9) which is substantially formed by a cylindrical enclosure and a pair of vertical head pieces, and which encloses a single perforated drum (7) capable of being loaded from the top and rotating about a sensibly horizontal axis, and comprising among other things means (15, 22, 25, 29, 31) for creating a flow of heated-up drying air in a closed-loop circuit across the rotating drum (7), **characterized in that** one of said head pieces (10) of the oscillating tub (9) consists substantially of a first portion (11) and a second portion (12) that are separably joined to each other so as to form, on the outside of the seat (30) provided for at least a bearing of the drum (7), a channel (28) in which there are accommodated all said means (15, 22, 25, 29, 31) needed to create said flow of heated drying air.
2. Clothes washing and drying machine according to claim 1, **characterized in that** said **characterized in that** said substantially volute-shaped first portion (11) of the head piece (10) is joined to said second portion (12) along the periphery thereof.
3. Clothes washing and drying machine according to claim 2, **characterized in that** said second portion (12) of the head piece (10) is provided with an outer peripheral edge (17) for fixing to the cylindrical enclosure of the tub (9), as well as an inner peripheral edge (18) for joining to the periphery of said first portion (11).
4. Clothes washing and drying machine according to any of the preceding claims, **characterized in that** on the head piece (10) of the tub (9), in correspondence of the lower portion of said channel (28), a surface-type steam condenser (31) is provided integrally to condense the moisture removed in its vapour phase from the clothes by the heated drying air, in which water flowing in from the mains is used as a cooling medium.
5. Clothes washing and drying machine according to claim 4, **characterized in that** in the condenser (31) the cooling water inlet (33) is situated in correspondence of the approximately lowest point of the head piece (10), and the condenser itself forms a meandering course before reaching the point (32) in a higher position at which the cooling water mixes up with the condensate liquid.
6. Clothes washing and drying machine according to claim 4, **characterized in that** in the head piece (10) there is provided an outlet into the interior of the tub (9) for said mixture formed by the cooling water and the condensate liquid.

7. Clothes washing and drying machine according to any of the preceding claims, **characterized in that** at one end portion of the channel (28) formed between said two portions (11, 12) of the head piece (10) there are provided both the impeller (15) and apertures (22) communicating with the interior of the tub (9) in an upper portion thereof, for drawing out the moisture-laden drying air during the clothes drying phases. 5
8. Clothes washing and drying machine according to claim 7, **characterized in that** at the other end portion of the channel (28) formed between said two portions (11, 12) of the head piece (10) there are arranged both electric heating means (25) and apertures (29) for letting the drying air into the tub (9) as forced by the action of the impeller (15). 10 15
9. Clothes washing and drying machine according to any of the preceding claims, **characterized in that** on the outside of the channel (28) said second portion (12) of the head piece (10) is provided with a substantially radial appendix (34) with a receptacle (35) to accommodate the pulley (36) of the electric motor driving the pulley (16) of the impeller (15). 20 25

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Fig. 1

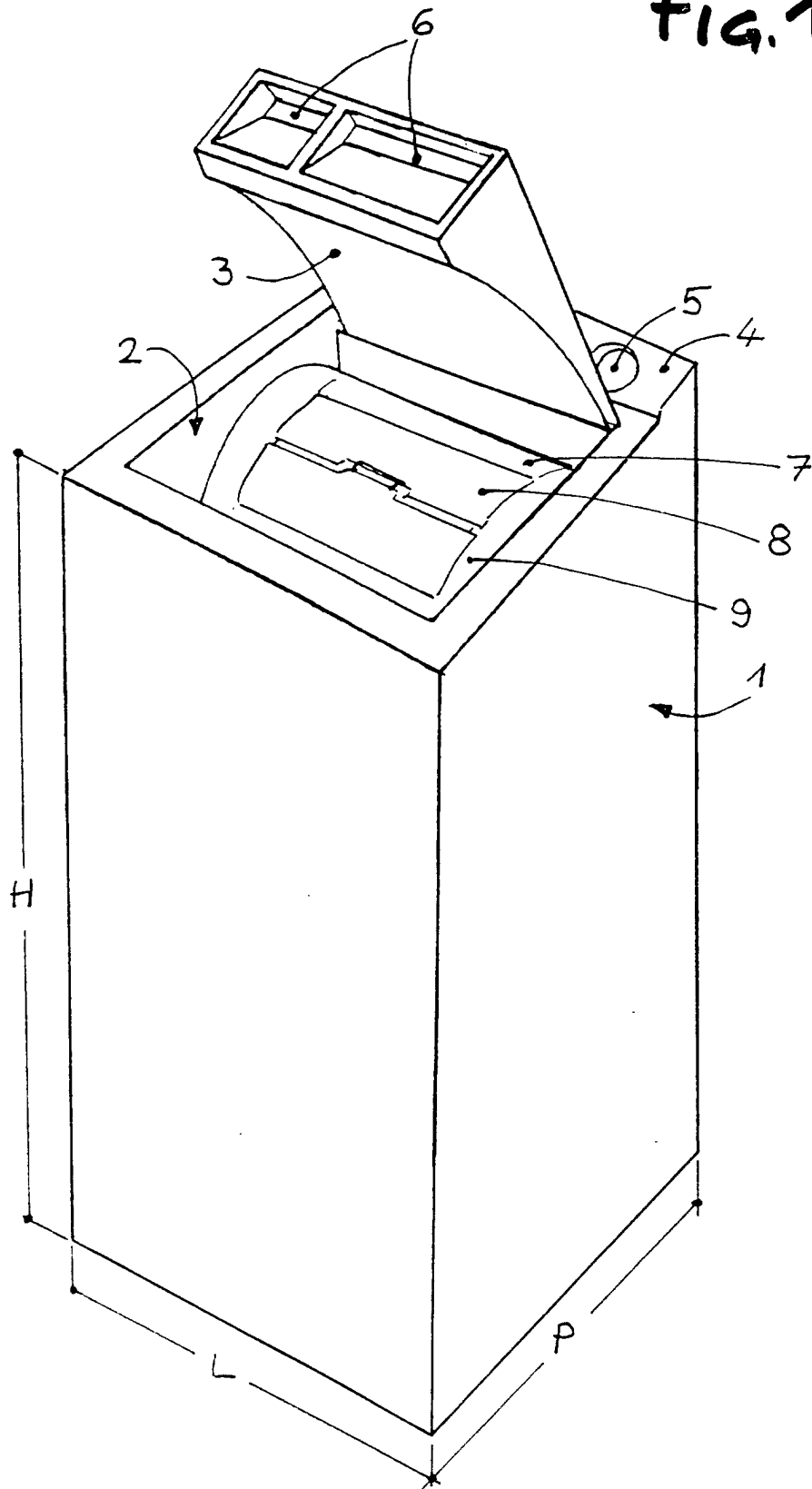


Fig. 2

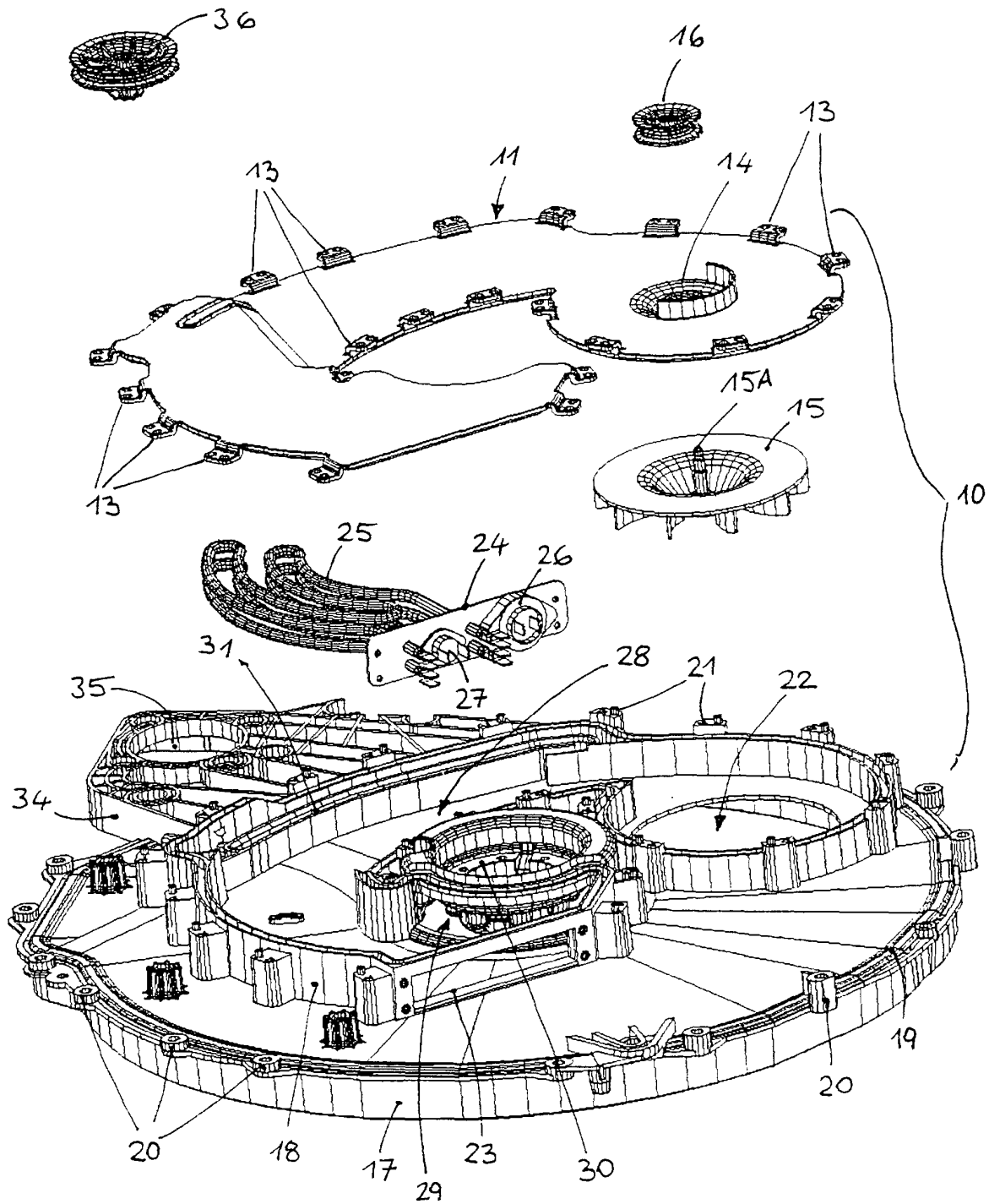


Fig. 3

