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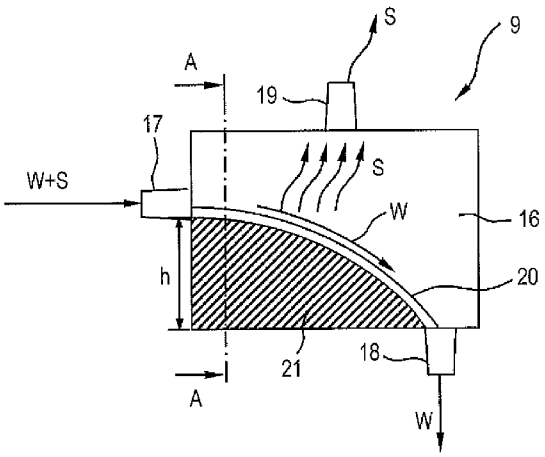
(54) **Title**: STEAM SEPARATOR AND METHOD OF SEPARATING STEAM AND WATER IN A LAUNDRY APPLIANCE

Fig. 2



(57) **Abstract**: The steam separator (9) according to the present invention comprises an inlet (17) for a water/steam mixture W+S, a water outlet (18) and a steam outlet (19), wherein the inlet (17) and the water outlet (18) are connected by an open drain channel (20). The method of separating steam S and water W in a steam separator (9) comprises that a mixture of steam and water S+W is fed into an inlet (17) of a steam separator (9); within the steam separator (9), the water W is flowed along an open drain channel (20) to a water outlet (18) of the steam separator (9); and within the steam separator (9), the steam S is risen up to a steam outlet (19) of the steam separator (9). In particular, the inventive steam separator (9) is dedicated to use in a laundry appliance, preferredly a refresher dryer (1).

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Steam Separator and Method of Separating Steam and Water in a Laundry Appliance

The invention relates to a steam separator, comprising an inlet for a mixture of water and steam, a water outlet and a steam outlet. The invention also relates to a method of separating steam and water in a laundry appliance, in particular a refresher dryer.

WO 1996/032607 A1 relates to a steam generator, in particular to supply steam for housework, and concerns a method and a device for automatically carrying out a replenishment of a tank of the steam generator during normal operation thereof. In particular, it is disclosed that by means of a temperature detector, a temperature is measured inside a cell box which is in communication with the tank. When the level of liquid, e.g. water, inside the cell box reaches a minimum level, the temperature detector is surrounded by steam, the temperature of which is higher with respect to the temperature of the liquid, and enables liquid supply by means for feeding liquid to the cell box, thus replenishing the tank up to an operational level, when the liquid enters the cell box, it cools the temperature detector which disables the liquid feeding means, cutting off inflow of cold liquid to the cell box.

EP 1 026 306 B1 relates to a automatic refill steam generator for use in conjunction with steam cleaning equipment, a clothes iron, a fan-assisted ironing board with refill function, a coffee or similar brewing machine. The automatic refill steam generator is provided with at least one electric heating element attached to the outside of the steam generator and equipped with a control thermostat, said steam generator being connected on one side to a water reservoir via a pump and at least a pipe, and being further connected on the other side to the steam using apparatus via a pipe.

U. S. Patent 4,207,683 relates to a clothes dryer having a touch-up spray for removal of wrinkles from clothing and fabrics and permanent press clothing, in particular without removing possibly present factory set creases. The clothes dryer may include a water heating unit for spraying water of a selected temperature or steam. The steam is applied to remove undesired wrinkles or odours from the laundry being treated and thus provides refreshment to the laundry. Accordingly, this clothes dryer may be designated to be a

"refresher dryer". It should be remarked that such nomination is not reserved to an appliance which is designed merely to dry laundry besides the refreshing function; instead, it will also be applied to a washer/dryer with a refreshing function.

It is an object of the present invention to provide a more effective separation of steam and water, in particular for application in a laundry appliance like a refresher dryer.

The object is achieved according to the features of the independent claims. Preferred embodiments can be derived, inter alia, from the dependent claims and the subsequent disclosure.

The object is achieved, according to the invention, by a steam separator comprising an inlet for a water/steam mixture, a water outlet and a steam outlet, wherein the inlet and the water outlet are connected by an at least partially open drain channel.

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The open drain channel allows letting the water entering through the inlet to flow within the steam separator without major disturbances. This, in turn, suppresses an accumulation of water within the steam separator that could lead to part of this accumulated water leaving the steam separator via the steam outlet. This water going through the steam outlet would then drip into the drum and impair a drying result.

It is one preferred embodiment that the steam outlet is positioned adjacent to an open side of the drain channel. This causes an unobscured and potentially short distance between the inlet and the steam outlet and helps to suppress condensation of the steam inside the steam separator.

It is another preferred embodiment that the drain channel is a curved drain channel. In other words, the drain channel has a curved gradient along the flow direction. This allows a sufficient gradient to ensure a continuous flow of the water in the open drain channel.

It is still another preferred embodiment that the drain channel is a basically U-shaped drain channel. The accompanied increased steepness of the gradient in the flow direction particularly ensures the continuous flow of the water in the open drain channel and prevents backup of the water.

It is yet another preferred embodiment that the steam outlet is positioned higher than the inlet. Thus, steam can directly rise to the steam outlet. A condensation of steam in a region higher than the steam outlet and subsequent dripping down, in particular towards the steam outlet, is largely prevented.

It is yet another preferred embodiment that the inlet and the water outlet have the same cross sectional area, e.g. diameter. This provides an improved performance of the steam separator.

It is yet another preferred embodiment that the steam outlet has a larger cross sectional area than the inlet to minimize a pressure build-up inside the steam separator.

It is also a preferred embodiment that the inlet, the water outlet, and the steam outlet open into a housing of the steam separator ("steam separator housing").

It is a further preferred embodiment that the steam outlet is connected to a nozzle via a hose, the nozzle opening into a drum of a laundry appliance, in particular a refresher dryer. By this embodiment, the steam injection into the drum can be directed. The steam injection may comprise an injection of steam and /or a fine mist of water droplets. Furthermore, the hose and the nozzle may be dimensioned such that a steam pressure at the nozzle is selectively adjusted. Additionally, the flexible hose allows positioning of the steam separator at a different location from the steam insertion position which in turn achieves greater design flexibility.

It is also a preferred embodiment that the water outlet is located at a bottom of the steam separator to be able to act as a drain for water condensing from the steam within the steam separator, in particular at the side walls and a top wall. This suppresses water to accumulate within the steam separator.

The object is also achieved by a method of separating steam and water in a steam separator, preferredly associated to a laundry appliance, in particular a refresher dryer, wherein a mixture of steam and water is fed into an inlet of the steam separator; within the steam separator, the water is flowed along an open drain channel to a water outlet of the

steam separator; and within the steam separator, the steam is risen up to a steam outlet of the steam separator.

This also allows the water to flow within the steam separator without major disturbances.

It is one preferred embodiment that steam condensing within the steam separator flows down to the water outlet. This suppresses water to accumulate within the steam separator.

It is another preferred embodiment that the steam flows through the steam outlet and a hose to a nozzle opening into a drum of the laundry appliance. By this embodiment, the steam injection into the drum can be directed. Furthermore, the hose and the nozzle may be dimensioned such that a steam pressure at the nozzle is selectively adjusted. Additionally, the flexible hose allows positioning of the steam separator at a different location from the steam insertion position which in turn achieves greater design flexibility.

In the following disclosure, particularly preferred embodiments of the invention are described in greater detail with reference to the Figures of the attached drawing.

Fig.1 shows an oblique view onto a refresher dryer comprising a steam generator;

Fig.2 sketches a cross-sectional side view of the steam separator;

Fig.3 sketches a cross-sectional front view of the steam separator; and

Fig.4 sketches a transparent top view of the steam separator;

Fig.5 shows a steam injection arrangement comprising the steam separator in a first view;

Fig.6 shows the steam injection arrangement in a second view;

Fig.7 shows a rear side view from the outside of a section of a bearing shield of the refresher dryer comprising the steam injection arrangement;

Fig.8 shows a cross-sectional side view of the bearing shield section of Fig.7; and

Fig.9 shows a front side view of the bearing shield section of Fig.7.

Fig.1 shows a laundry appliance 1 designed as a refresher dryer 1 that is a clothes dryer that incorporates a clothes or laundry refreshing and de-wrinkling function by applying steam to the clothes. The refresher dryer 1 is shown without housing. In particular, the refresher dryer 1 is embodied as a tumble dryer comprising a rotatable drum 2 which holds the clothes to be dried and which may be operated by being rotated in reversing rotational directions. The drum 2 can be loaded and unloaded through an opening 3. The opening 3 is typically closed by a door (further described in Fig.2 and Fig.3). The operation of a tumble dryer as such is well-known.

To implement the refreshing function, the refresher dryer 1 comprises a steam generator 4 which is located at a bottom of the refresher dryer 1 and mounted on top of a cover 5 of a heat exchanger 6 and of which a front side F (see also Fig.2) is visible. The steam generator 4 is used to generate steam from water. Water is supplied to the steam generator 4 via a condensate container shell 7 through a flexible filling hose 8. The water supplied to the steam generator 4 is thus the condensate that is extracted from the damp clothes during the drying process. The condensate container shell 7 may additionally be filled by fresh water, e.g. at the beginning of a drying cycle, if there is not yet enough condensate to supply the steam generator 4.

The output generated by the steam generator 4 usually contains a mixture of steam and hot water and is led to a steam separator 9. The steam separator separates the steam from the hot water. The steam is fed into the drum 2 via a hose 10 that leads to a nozzle 11. The nozzle 11 opens into the drum 2 and may inject the steam directly onto the clothes or laundry. To this end, the nozzle 11 may have a shape, e.g. angular shape, that allows orientation of the steam flow. The hot water is returned to a T-connector 12 located in a dryer pump reservoir via a flexible hot water return hose. Thus, the steam separator 9 ensures that only steam with a low or very low liquid content is fed into the drum 2. The steam separator 9 and the nozzle 11 are attached to a bearing shield 22 of the refresher dryer 1.

The steam generator 4 further comprises or is connected to a flexible de-aeration hose 13 that connects to a water tank (see fig.3 for further detail) of the steam generator 4. The steam generator 4 further comprises a siphon fixation 14 for holding or fixing a siphon 15.

Fig.2 sketches a cross-sectional side view of the steam separator 9. **Fig.3** sketches a cross-sectional front view of the steam separator. **Fig.4** sketches a transparent top view of the steam separator.

Referring now to Fig.2 to Fig.4, the steam separator 9 comprises a separator housing 16. The separator housing 16 may, for example, be box-shaped or cylinder-shaped. A water / steam inlet 17, a water outlet 18, and a steam outlet 19 lead or open into the separator housing 16. The water / steam inlet 17 is provided to feed a mixture of water and steam coming from the steam generator 4 of Fig.1, as indicated by arrow W+S. The mixture of water and steam entering the separator housing 16 is separated in the housing, because the water W flows to the water outlet 18, leaving the separator housing 16 through the water outlet 18, while the steam rises up to the steam outlet 19, leaving the separator housing 16 through the steam outlet 19.

To provide a substantially disturbance-free flow of the water W through the separator housing 16, the water / steam inlet 17 is connected to the water outlet 18 by an open drain channel 20. The open drain channel 20 is formed on an upper surface of a plate-like insert 21. The open drain channel 20 may, for example, have a cross-sectional shape resembling a half-pipe. Along its flow direction, the drain channel 20 is curved, in particular basically U-shaped, to achieve a high flow velocity. A height h between the water / steam inlet 17 and the water outlet 18 can be designed according to needs.

The water outlet 18, which in general is located lower than the water / steam inlet 17, is preferably located at a bottom of the steam separator 9 at the lowest point of the separator housing 16. Therefore, the water outlet 18 may also act as a drain for condensate formed on the walls of the separator housing 16 by the steam S wherein the condensate trickles or drips down to the water outlet 18.

The open drain channel 20 allows the water W to flow through the steam separator 9 without major disturbances or turbulences. This, in turn, suppresses an accumulation of water W within the steam separator 9 that could lead to part of this accumulated water leaving via the steam outlet 19. This water going through the steam outlet 19 would then drip into the drum 2 and impair a drying result.

The steam outlet 19 is positioned directly above the drain channel 20. Thus, the steam S being injected into the separator housing 16 and / or being emitted from the hot water W can rise up uninhibited to the steam outlet 19.

For a substantially turbulence-free flow of the water W, the inlet 17 and the water outlet 18 have at least roughly the same cross sectional area. For a high output of the steam S, the steam outlet 19 has a larger cross sectional area than the inlet 17.

The steam outlet 19 is connected to the nozzle 11 via the flexible hose 10, as shown in Fig.1, the nozzle 11 opening into the drum 2.

Fig.5 and **Fig.6** show the steam injection arrangement 9, 10, 11 for the refresher dryer 1 from different angles. The steam injection arrangement 9, 10, 11 comprises the steam separator 9, wherein its steam outlet 19 is connected to the nozzle 11 via the flexible silicone hose 10. The steam S leaving the steam outlet 19, as indicated by the respective arrow S, flows through the hose 10 and to the nozzle 11. The nozzle 11 opens into the drum 2 of the refresher dryer 1, i.e. comprises a steam injection opening 23 or window through which the steam S is injected into the drum 2, as indicated by the respective arrow. As described in greater detail in Fig.2 to Fig.4, the steam separator 9 is fed with water and steam W + S through the water / steam inlet 17, and water W exits the steam separator 9 through the water outlet 18.

The water outlet 18 is located at the lowest point of the steam separator and attached to a cone-shaped part 25 of the steam separator 9 to drain as much as possible water from the steam separator 9.

The steam separator 9, at the outside of its housing 16, comprises only one fixation element or fixation point 26 to screw the steam separator 9 to the bearing shield 22.

At the rear side of the nozzle 11 that is facing the bearing shield 22 there are located several engagement means embodied as clips 24 to clip the nozzle 11 at the bearing shield 22. This ensures a secure fastening. On the other hand, the nozzle 11 can be taken off, e.g. for cleaning the nozzle 11. To this end, the bearing shield 22 comprises an opening (not shown) to insert the nozzle 11 and/or the hose 10.

In particular, the nozzle 11 can a two-part nozzle 11, with a nozzle head 11a comprising the clips 24 and a nozzle support part 11b. The nozzle support part 11b may be attached to an outside of the bearing shield 22, as described in Fig.7 to Fig.9, to provide a fixed and immovable connection for the hose 10. The nozzle support part 11b is thus adapted to attach the hose 10 thereon. The nozzle head 11a may then be plugged together with the nozzle support part 11b from the inside of the bearing shield 22 and be clipped to the bearing shield. In this case, cleaning of the nozzle 11 in particular includes cleaning of the nozzle head 11a.

Thus, the whole steam injection arrangement 9, 10, 11 can be fixed to the refresher dryer 1 by one screwing action to screw the steam separator 9 to the bearing shield 22 and one clipping action to clip the nozzle 11 to the bearing shield 22.

As indicated in Fig.6, the nozzle 11 is inclined with respect to the bearing shield 22, wherein the orientation of the bearing shield 22 is indicated by the dashed line. The inclination allows the steam S exiting from the nozzle 11 to be directed downwards to a lower region of the drum 2 and thus directly onto the clothes to be refreshed and/or de-wrinkled. This arrangement implies that the nozzle 11 is positioned at an upper half of the bearing shield 22, in particular at a region of the bearing shield 22 surrounding an upper half of the opening 3.

Fig.7 shows a rear side view from the outside of a section of a bearing shield 22 of the refresher dryer 1 comprising the steam injection arrangement 9, 10, 11. The steam separator 9 is screwed to the bearing shield 22 at its fixation point 26, and the nozzle 11 is also fixed to the bearing shield 22 with the hose 10 connecting the steam separator 9 and the nozzle 11. Of the nozzle 11, only the nozzle support part 11b is visible which is

mounted to the outside of the bearing shield 22. The hose 10 is put on the nozzle support part 11b.

Fig.8 shows a cross-sectional side view of the bearing shield 22. The nozzle 11 or nozzle head 11a is inclined downwards with respect to the inside of the bearing shield 22 to directly inject the steam onto the clothes.

Fig.9 shows a front side view (looking from inside the drum 2) of the bearing shield 22. The nozzle head 11a is inserted into the respective opening 27 within the bearing shield 22. The engagement of the nozzle head 11a to the bearing shield by means of the clips may be effected by a pushing action and / or a rotating action. Thus, the nozzle head 11a may be removed by a simple pulling action and / or (counter-) rotating action.

There are special grooves 28 on a face of the nozzle head 11a in order to achieve drainage of condensate water that may form during injection of the steam S. The grooves 28 drain and channel the condensate in the direction of the bearing shield and thus away from the steam injection opening 23. This suppresses the dripping or dragging of water drops onto the clothes.

Of course, the invention is not restricted to the shown embodiment.

Generally, the nozzle can be a single piece or a multi-component nozzle.

List of Reference Numerals

1	refresher dryer
2	drum
3	opening
4	steam generator
5	cover
6	heat exchanger
7	container shell
8	filling hose
9	steam separator
10	hose
11	nozzle
11a	nozzle head
11b	nozzle support part
12	T-connector
13	de-aeration hose
14	siphon fixation
15	siphon
16	steam separator housing
17	water / steam inlet
18	water outlet
19	steam outlet
20	open drain channel
21	insert
22	bearing shield
23	steam injection opening
24	clip
25	cone-shaped part
26	fixation point
27	opening
28	groove

Claims

1. A steam separator (9), comprising an inlet (17) for a water / steam mixture (W+S), a water outlet (18) and a steam outlet (19), wherein the inlet (17) and the water outlet (18) are connected by an at least partially open drain channel (20).

2. The steam separator (9) according to claim 1, wherein the steam outlet (19) is positioned adjacent to an open side of the drain channel (20).

3. The steam separator (9) according to any of the preceding claims, wherein the drain channel (20) is a curved drain channel (20).

4. The steam separator (9) according to claim 3, wherein the drain channel (20) is a basically U-shaped drain channel (20).

5. The steam separator (9) according to any of the preceding claims, wherein the steam outlet (19) is positioned higher than the inlet (17).

6. The steam separator (9) according to any of the preceding claims, wherein the inlet (17) and the water outlet (18) have the same cross sectional area.

7. The steam separator (9) according to any of the preceding claims, wherein the steam outlet (19) has a larger cross sectional area than the inlet (17).

8. The steam separator (9) according to any of the preceding claims, wherein the inlet (17), the water outlet (18), and the steam outlet (19) open into a steam separator housing (16).

9. The steam separator (9) according to any of the preceding claims, wherein the steam outlet (19) is connected to a nozzle (11) via a hose (10), the nozzle (11) opening into a drum (2) of the refresher dryer (1).

10. The steam separator (9) according to any of the preceding claims, wherein the water outlet (18) is located at a bottom of the steam separator (9).

11. A method of separating steam and water in a steam separator (9), wherein
- a mixture of steam and water (S+W) is fed into an inlet of said steam separator (9),
- within the steam separator (9), the water (W) is flowed along an open drain channel (20) to a water outlet (18) of the steam separator (9), and
- within the steam separator (9), the steam (S) is risen up to a steam outlet (19) of the steam separator (9).

12. The method according to claim 11, wherein steam (S) condensates within the steam separator (9) and the condensed steam is flowed down to the water outlet (18).

13. The method according to any of the claims 11 or 12, wherein the steam (S) flows through the steam outlet (19) and a hose (10) to a nozzle (11) opening into a drum (2) of a laundry appliance (1).

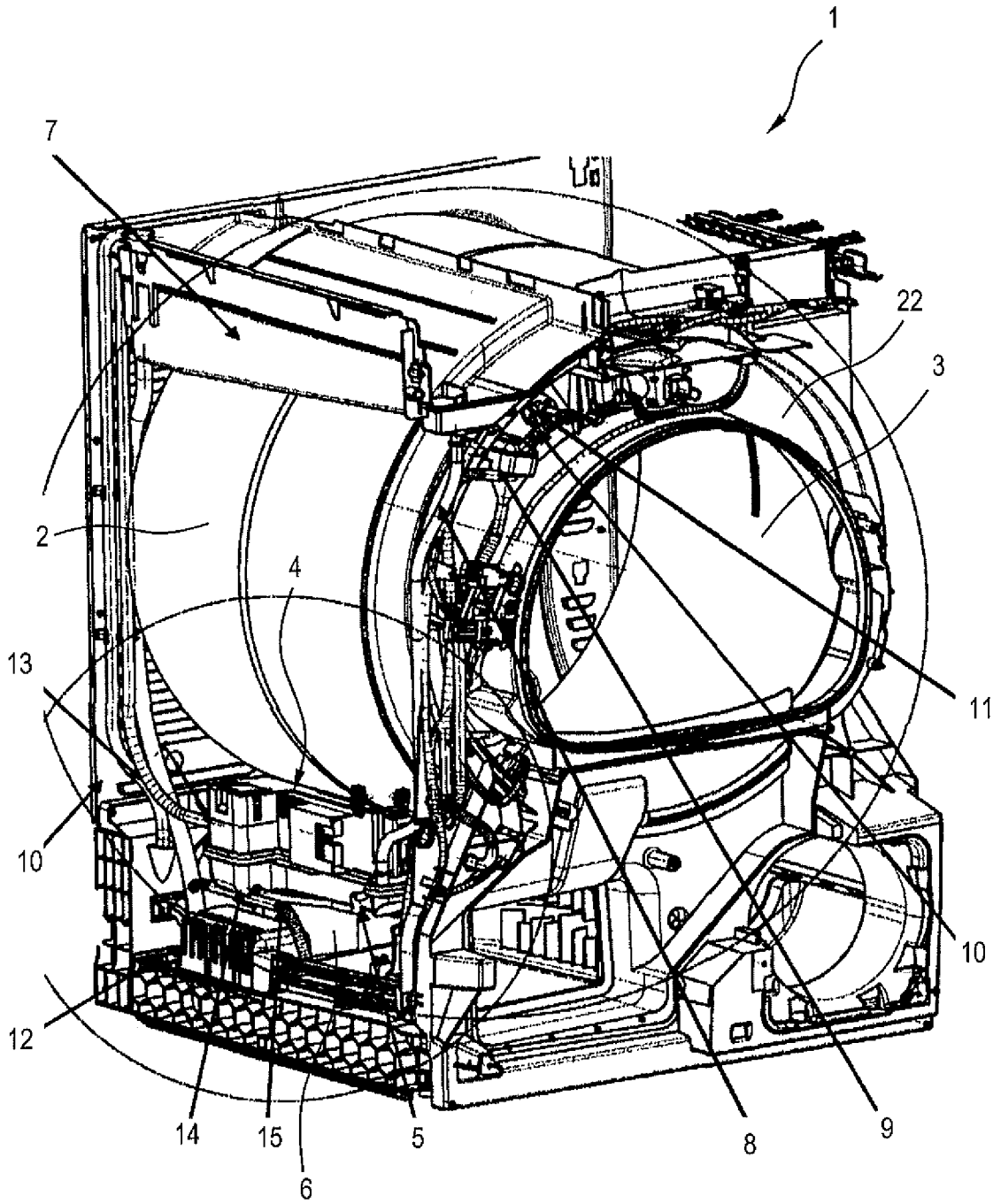


Fig. 1

Fig. 2

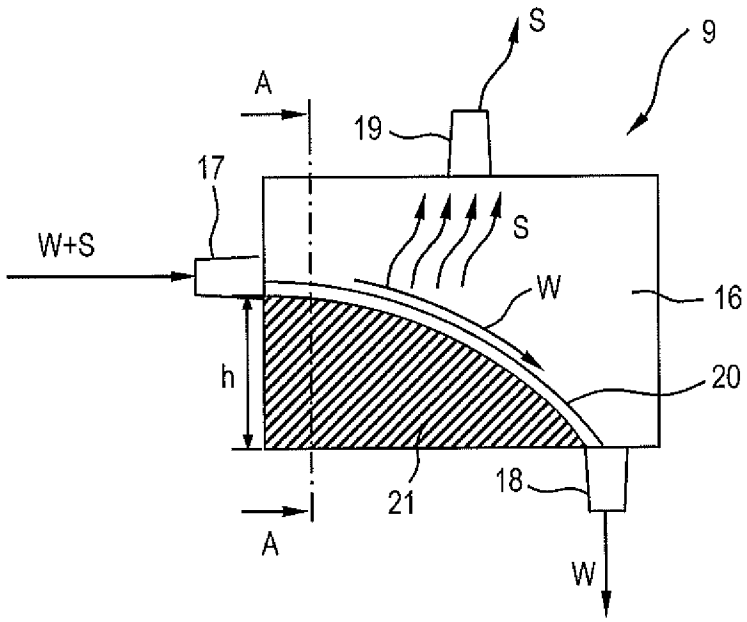


Fig. 3

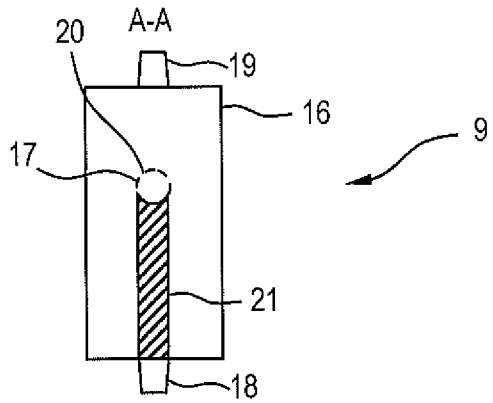


Fig. 4

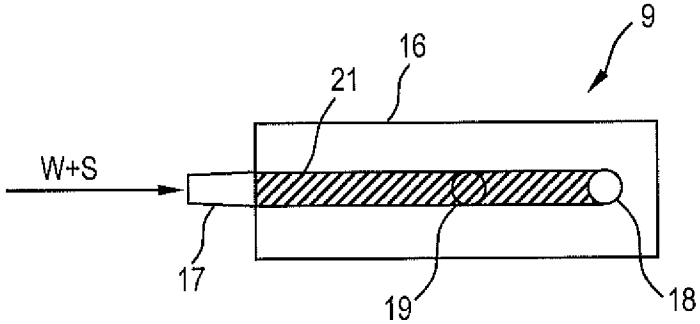


Fig. 5

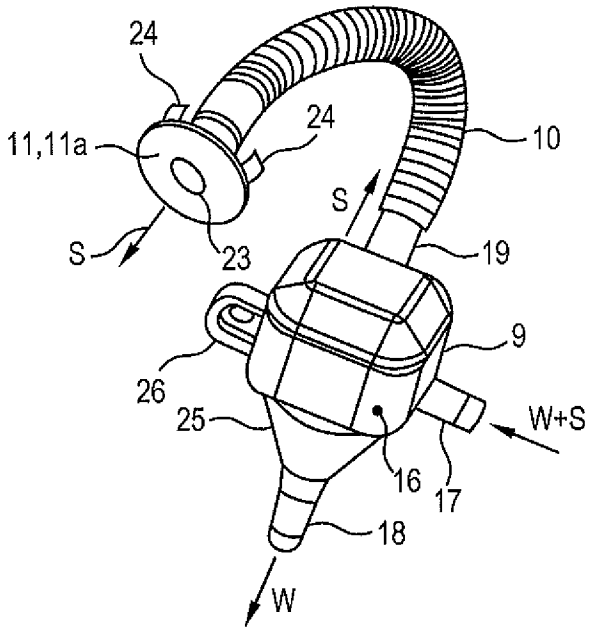
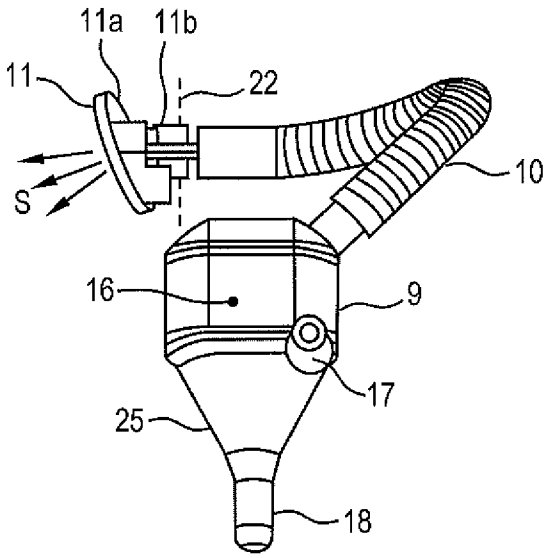

24
11,11a
24
10
S
S
23
19
9
26
25
W+S
16
17
18
W

Fig. 6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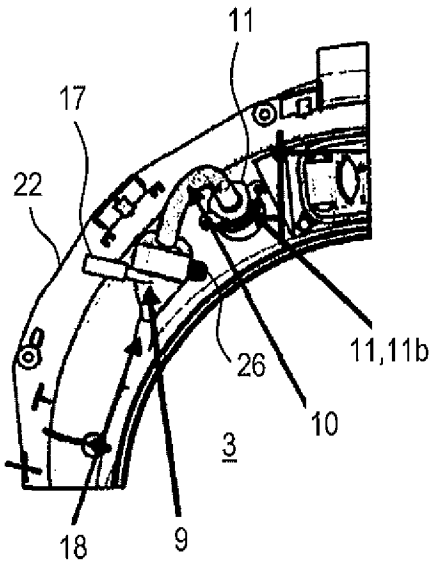

Fig. 7

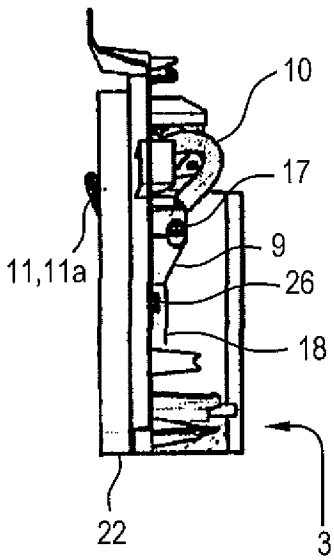

Fig. 8

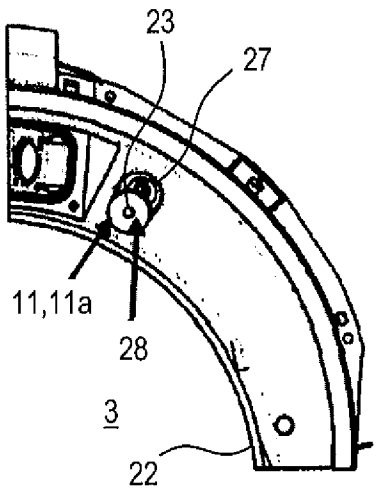

Fig. 9