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(54) **Clothes dryer with lint cleaning mechanism**

(57) The invention relates to a clothes tumble dryer (10) comprising a rotating drum (12) and a closed processing air duct adapted to circulate processing air (14) through the drum. The dryer further comprises a heater or first heat exchanger adapted to heat the processing air before it enters the drum (12) and a second heat exchanger adapted to remove moisture from the processing air (14) after it has passed through the drum (12). Further, a lint filter (18) is positioned in the duct to remove lint from the process air (14). Furthermore, the dryer (10) comprises an accumulator tank adapted to collect condense water from the second heat exchanger and a water pump (20) adapted to pump the water from the accumulator tank. The invention is characterized in that the water pump (20) is fluidly connected to a nozzle means (24) via a cleaning circuit (26, 28, 30a-d), wherein the circuit is adapted to hold a water pressure generated by the pump (20) and guide the condense water from the pump (20) to the nozzle means (24) in order to spray condense water onto the lint filter (18).

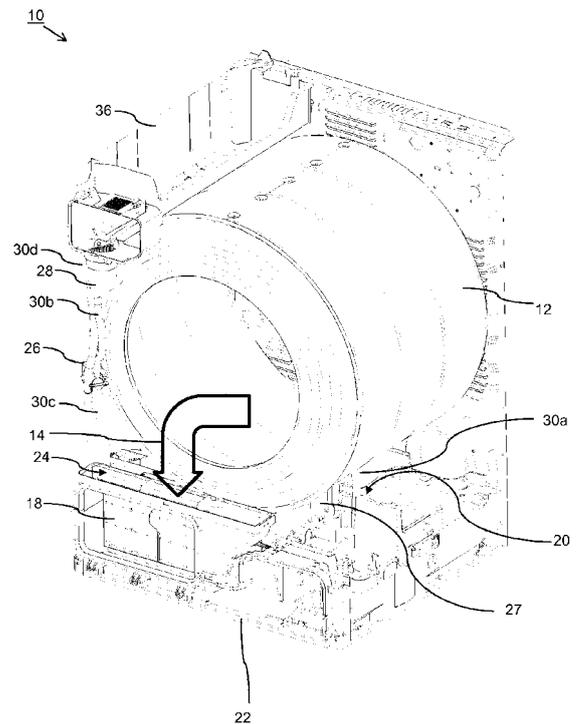


FIG. 1A

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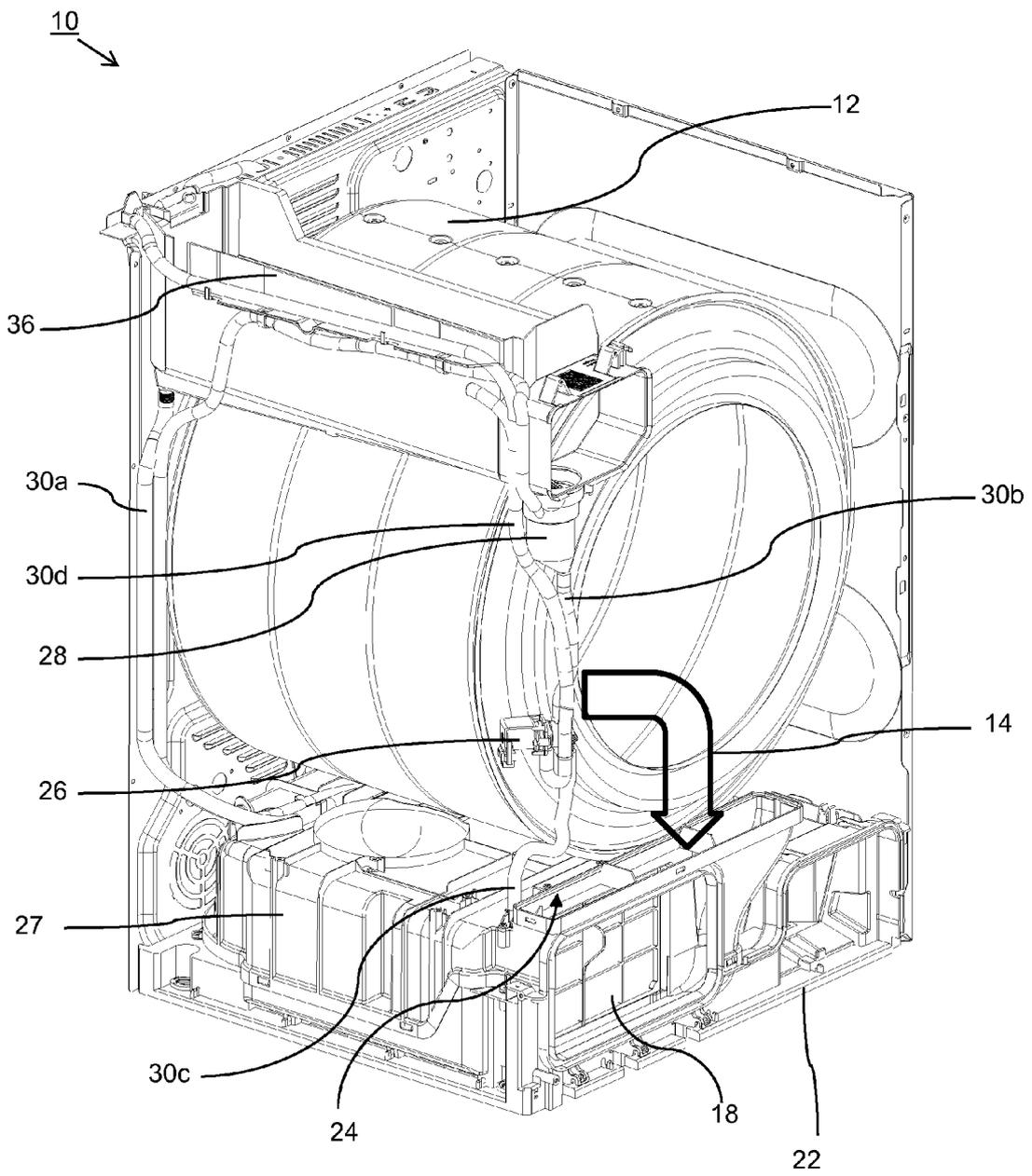


FIG. 1B

Description

TECHNICAL FIELD

[0001] The invention relates in general to a clothes tumble dryer used for drying damp laundry wherein the dryer is a standalone unit or in combination with a washing machine comprising a clothes washing function. More particularly, the invention relates to an improved lint filter cleaning mechanism positioned inside the clothes tumble dryer or washing machine/ clothes tumble dryer combination unit.

BACKGROUND ART

[0002] Condense tumble dryers comprise a rotating drum called a tumbler, an air heating/cooling means and a process air supply duct among others. The process air is cooled and reheated. One common type of condense dryer has a heat exchanger that uses ambient air to cool the process air and an electrical heater for reheating. The electric heater then could be replaced by a heat exchanger using hot water. Another type of condense dryer uses a heat pump where the evaporator cools and condensates the process air and the condenser reheats the air.

[0003] The hot process air is channelled to the tumbler containing the damp laundry via the process air duct. The hot air evaporates the moisture present in the laundry and subsequently aids in the drying of the clothes. The evaporated moisture interacts with the process air and thus carries the moisture. The moisture in the air is extracted as condensation and thereafter the process air is reheated and fed back into the rotating drum. This condensation or condensate water collected is channelled and stored in a tank provided in the base plate of the machine. A water pump is then used to pump the condensate to a condense water tank in the upper part of the machine.

[0004] The condensation and reheating of the process air in condense dryers normally consumes more energy than in traditional dryers, where the air is not re-circulated. However, the waste energy in the condense dryers heats the ambient air in the building where the dryer is located, which increases the total efficiency of the machine.

[0005] During the drying cycle small fibres are released from the clothes because of the tumble action of the machine. These small fibres are known as lint or fluff and are light enough to be carried by the process air. During the condensation process, it is common that lint present in the process air sticks to the heat exchanger and other parts of the machine. This built up of lint can create several problems inside the machine such as clogging of machine parts, which causes impact on the function and performance of the machine.

[0006] Several solutions have been devised to overcome the phenomenon of lint deposition. One such solution describes the placement of a lint filter in the path

of the process air in order to capture the lint in the air. Further, the lint filter can be positioned at many places in the process air duct such as the point where process air is exhausted from the dryer. Another solution that aims at curbing lint deposition is washing the surface of the heat exchanger periodically by spraying the condensate on to the heat exchanger body.

[0007] However, the above mentioned solutions are marred by many drawbacks. Despite the fact that multiple lint filters are provided, lint still reaches the heat exchanger because of leaks and poor filtration of the filters. Further, the absence of proper cleaning mechanism for the filters or dependency on manual cleaning alone results in the filters getting clogged and affecting the overall efficiency of the dryer. In case of clogging, a huge pressure drop is created in the process air circuit and pumping air through highly clogged lint filters becomes very difficult.

[0008] Furthermore, there are known solutions for heat pump condense dryers where the heat exchangers are sprayed off with condensate. This is also not very effective as all lint attached to the heat exchanger is not washed of properly. Also, as the height of fall of the condensate to the heat exchanger is limited as proper cleaning force cannot be achieved. Moreover, the outlay of the heat exchanger is very complex as it comprises numerous delicate components such as fins and thus washing the body might also cause damage to these components.

SUMMARY OF THE INVENTION

[0009] The object of the present invention is therefore to provide a clothes tumble dryer with a new and improved automatic cleaning mechanism.

[0010] The clothes tumble dryer according to the invention comprises a rotating drum and a closed processing air duct adapted to circulate processing air through the drum. The dryer comprises a heater or first heat exchanger adapted to heat the processing air before it enters the drum and a second heat exchanger adapted to condense moisture from the processing air after it has passed through the drum. A lint filter is positioned in the duct to remove lint from the process air. Further, the dryer comprises an accumulator tank adapted to collect condense water from the second heat exchanger and a water pump adapted to pump the water from the accumulator tank.

[0011] The inventive clothes tumble dryer is characterized in that the water pump is fluidly connected to a nozzle means via a cleaning circuit, wherein the circuit is adapted to hold a water pressure generated by the water pump and guide the condense water from the pump to the nozzle means in order to spray condense water onto the lint filter.

[0012] The improved lint filter cleaning mechanism efficiently deals with the problem of lint deposition on the surface of the lint filter and thus prevents lint reaching the surface of the second heat exchanger and other parts of the dryer. Also, the improved cleaning assembly allows

the condensate to be sprayed off at a high pressure and therefore achieving a higher mechanical cleaning action. The solution is especially suitable for tumble dryers where the heat exchangers and/or other parts clogged by lint are not removable since they are connected to a refrigerant circuit, a heating water circuit or similar.

[0013] Said cleaning circuit comprises a control element and a water filter wherein the control element and the water filter are connected to each other and to the pump and nozzle means via water pipes.

[0014] Further, the control element consist of a two-way valve adapted to guide the water towards the nozzle means or to a condense water tank outside the cleaning circuit. The two-way valve acts to control the amount of water that is supplied to the filter and the surplus water is redirected to the condense water tank that is present outside the cleaning circuit.

[0015] Furthermore, the water filter is substantially sealed to maintain the water pressure in the cleaning circuit and is also removable from the dryer to allow the user to clean it.

[0016] Preferably, the accumulator tank is formed in a base plate of the dryer. This enables for an easy and efficient collection of water as gravity drives the water flow. Further, this arrangement overcomes the need of supplying any additional equipment for collecting and channelizing the water.

[0017] Further, the nozzle means is adapted to spray off lint collected on the lint filter, wherein the condense water with the lint is drained to the accumulator tank.

[0018] In one advantageous embodiment of this invention, the lint filter is positioned before the second heat exchanger in the flow direction of the processing air so that the lint is collected by the lint filter before the air reaches the second heat exchanger. This advantageous positioning of the lint filter before said heat exchanger and other parts exposed by the lint result in that the filter acts as a mechanical barrier and thus aids in preventing any lint reaching the second heat exchanger and other parts preventing subsequent lint deposition and built up.

[0019] Preferably, the lint filter is removable from the dryer which aids in easy manual cleaning in case of failed spraying function or replacement in case of any extensive damage. Further, such an arrangement facilitates overall easy cleaning of the machine by means of a tap wash.

[0020] Further, the nozzle means consist a lance with openings along at least one edge of the lint filter to substantially spray water onto the filter along the whole edge. This arrangement ensures that the total outlay of the lint filter is washed in one cycle.

[0021] In another advantageous embodiment of this invention, the lint filter is electrically chargeable to be able to attract lint from the process air. This arrangement develops a static charge in the filter body and thus helps to attract the lint present in the process air. Further, the static charging also ensures that the lint keeps sticking to the filter and is not flown away by the pressure of the incoming process air.

[0022] In another advantageous embodiment of this invention, at least one more lint filter is positioned in the process air duct in order to aid proper removal of lint from the process air.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] In the following section, the invention will be described in a greater detail with reference to embodiments shown by the enclosed figures. It should be emphasised that the embodiments shown are used for example purposes only and should not be used to limit the scope of the invention.

15 Fig. 1A shows a perspective view of a clothes tumble dryer according to an embodiment of the invention;

20 Fig. 1B shows another perspective view of a clothes tumble dryer according to an embodiment of the invention;

25 Fig. 2 shows a perspective view of a clothes tumble dryer without the tumbler according to an embodiment of the invention; and

30 Fig. 3 shows in detail the lint filter and the nozzle means according to an embodiment of the invention.

35 **[0024]** A person skilled in the art will readily appreciate that various features disclosed in the description may be modified, and that various embodiments disclosed and/or claimed may be combined without departing from the scope of the invention.

DETAILED DESCRIPTION

40 **[0025]** Figure 1A and Figure 1B show a clothes tumble dryer 10 according to one embodiment of this invention. The clothes tumble dryer 10 comprises a rotating drum 12, a closed processing air duct (not shown) and a first and second heat exchanger. The heat exchangers are arranged inside a compartment 27 and therefore not visibly shown in the view.

45 **[0026]** The person skilled in the art would realize that the second heat exchanger may be cooled by ambient air or water, or constituting an evaporator being part of a heat pump. The person skilled in the art would further realize that the first heat exchanger may be an electrical heater, a heat exchanger where hot water or air is used to heat the process air, or a condenser being part of said heat pump. The present invention consequently directs to both types of dryers. In the following, the heat exchanger/evaporator will be named second heat exchanger and the heater/heat exchanger/condenser named second heat exchanger.

[0027] The process air 14 flows from the drum through

the duct to the second heat exchanger via the lint filter. The air duct consequently connects the drum with the filter. The duct is not an essential part of the invention and therefore removed in order to illustrate the dryer parts behind. As shown in figure 4, the process air flows vertically into a filter space 35 and then turns horizontally and passes through the filter 18. The space is closed in the front of the machine by a cover piece (not shown).

[0028] The lint filter 18 is removably attached in front of the second heat exchanger in order to remove lint from the incoming process air 14. As will be evident to a person ordinarily skilled in the art, the lint filter 18 is any standard lint filter and is generally a screen/mesh made up of nylon. The lint filter is positioned before the second heat exchanger in the flow direction of the processing air so that the lint is collected by the lint filter before the air reaches the second heat exchanger. This advantageous positioning of the lint filter before said heat exchanger and other parts exposed by the lint result in that the filter acts as a mechanical barrier and thus aids in preventing any lint reaching the second heat exchanger and other parts preventing subsequent lint deposition and built up.

[0029] Further, attached to the lint filter 18 is nozzle means 24 that is fluidly connected to a water pump 20 through a cleaning circuit. The water pump is located in an accumulator tank. The pump is not visibly shown in the figures but is placed in the end of pipe 30a, close to the base plate. The accumulator tank is arranged on a conventional base plate 22 of the clothes tumble dryer 10 and not visible in the figures.

[0030] The pump is placed in or close to the accumulator tank in order to be able to pump water collected in the tank. If the pump is not placed in the water a pipe is used to pump the water from the accumulator tank via the pump to the nozzle means 24.

[0031] The cleaning circuit comprises a control element 26 and a water filter 28, wherein the control element 26 and the water filter 28 are fluidly connected with each other to the water pump 20, and the nozzle means 24 via a group of water pipes 30 (a, b, c & d). Figure 2 shows another alternate view of the clothes tumble dryer 10 wherein the tumbler 12 is not shown. The pipe 30a leading from the water pump 20 to the water filter 28 is seen clearly in this view.

[0032] Fig. 3 shows in detail the lint filter 18 and the nozzle means 24 according to an embodiment of the invention. The nozzle means 24 consists of a lance 32 wherein the lance 32 has small downward slits/holes/openings 34. The lance 32 is positioned along the upper edge of the lint filter 18. Water for cleaning the lint filter 18 is conveyed through these slits/holes/openings 34 to spray the lint filter 18. The person skilled in the art would realize that the lance may be positioned along any edge or edges (more than one) of the lint filter.

[0033] The cleaning circuit is closed between the water pump 20 and the nozzle means 24. This means that a high pressure can be built up, which allows the condensate to be sprayed at a high pressure and therefore

achieving a higher cleaning action. This is essential improvement compared to a solution where the open condense water tank 36 is part of the circuit.

[0034] In operation, whenever a user activates the clothes tumble dryer 10 to dry damp laundry, ambient air 14 is sucked inside the process air duct and is heated by the first heat exchanger. This hot process air is supplied to the rotating drum 12 to de-humidify and dry the damp laundry clothes. The process air is continuously exhausted and re-circulated. The lint particles carried by the process air are filtered by the lint filter 18.

[0035] Thereafter, the humidity present in the process air is condensed at the second heat exchanger and the condensate or condensed water is collected in the accumulator tank in the base plate 22. The continuous working of the clothes tumble dryer 10 gives rise to a gradual deposition of lint on the lint filter 18 and thus a cleaning mechanism is needed to clean the lint filter 18 and maintain the overall efficiency of the clothes tumble dryer 10.

[0036] In order to clean the lint filter 18, the condensate collected in the accumulator tank is pumped by the water pump 20 through pipe 30a to a water filter 28 and from the water filter 28 the condense water is provided via pipe 30b to a control element 26, wherein the control element 26 is a two-way valve. As will be evident to a person ordinarily skilled in the art, the two-way valve/control element 26 used is a standard two way valve and is controlled/actuated by a servo or solenoid or is motor driven.

[0037] The two-way valve/control element 26 channels the condensate either to a lance 32 via a pipe 30c or to another condensate tank 36 provided outside the cleaning circuit via a pipe 30d. The two-way valve/control element 26 acts to control the amount of condense water that is supplied to the lint filter 18 and the surplus condense water is redirected to the condense water tank 36. Further, the condensed water accumulated in the condensate tank 36 can be disposed manually by the user at the end of the drying cycle.

[0038] Whenever a need for cleaning the lint filter 18 arises, condensed water is pumped by the water pump 20 and the two way valve/control element 26 is actuated to channel the condensate to the nozzle means 24. Condensed water is guided from the nozzle means 24 to the lance 32 wherein the water passes through small downward slits/holes/openings 34 present on the lance 32 on to the lint filter 18.

[0039] The lance 32 is positioned along the edge or edges of the lint filter 18. This construction allows for substantially spraying the condensate water onto the lint filter 18 along its whole edge. Further, these small downward slits/holes/openings 34 help to create even water spray over the entire lint filter 18. Further, the lint removed along with the used water from the above spraying is conveyed in a channel (not shown) to the accumulator tank.

[0040] As the cleaning cycle of the lint filter 18 continues, the condensed water is pumped and circulated from the accumulator tank in the base plate 22 to the nozzle

means 24 in a manner as described above. As lint sprayed off previously from the lint filter 18 is collected in the accumulator tank, the lint is also now pumped along with the condensed water. The water filter 28 serves to filter and collect the lint that is circulated in conjunction with the condensed water.

[0041] Thus, water free from any impurity is supplied to aid in the washing of the lint filter 18. Furthermore, the water filter 28 is designed to have a sealing lid that facilitates to maintain a pressure in the cleaning circuit. This pressure aids to generate a substantial force while spraying the lint filter 18. Also, the lid ensures that there are no leakages in the cleaning circuit. Water filter 28 is further affixed by means of a bayonet or a thread to the body of the clothes tumble dryer 10. Moreover, the lint accumulated in the water filter 28 must be cleaned or emptied on a periodic basis by the user to prevent any bio-fouling or inefficient operation of the lint filter cleaning mechanism.

[0042] Further, it should be noted that the spraying of the lint filter 18 can be done at regular intervals or only once at the end of the drying cycle as most of the lint is released from the clothes during the last phase of operation. The duration and the timing of the cleaning cycle is pre-programmed and stored onto a PLC/Computer provided in the clothes tumble dryer 10. It is also possible that a user can initiate a lint filter cleaning cycle as per his/her needs

[0043] In one embodiment of this invention, the lint filter 18 could be electro statically charged in order to better attract lint particles. Further, the electro static charging also ensures that the lint particles keep sticking to the lint filter 18 despite the flow of the process air.

[0044] In one embodiment of this invention, the lint filter 18 is removable for periodic cleaning such as for a tap wash.

[0045] In one embodiment of this invention, in addition to the lint filter 18 the drum 12 will also retain the traditional dual filters (nylon net) in the dryer door, and possibly also an additional lint filter 18 in the channel under the door. Therefore, the drum 12 will also have at least one further lint filter 18 that is positioned elsewhere to remove the lint from the process air 14.

[0046] Reference signs mentioned in the claims should not be seen as limiting the extent of the matter protected by the claims, and their sole function is to make claims easier to understand.

[0047] As will be realised, the invention is capable of modification in various obvious respects, all without departing from the scope of the appended claims. Accordingly, the drawings and the description thereto are to be regarded as illustrative in nature, and not restrictive.

Claims

1. Clothes tumble dryer (10) comprising a rotating drum (12) and a closed processing air duct adapted to cir-

culate processing air (14) through the drum (12), the dryer comprising a heater or first heat exchanger adapted to heat the processing air (14) before it enters the drum (12) and a second heat exchanger adapted to condense moisture from the processing air (14) after it has passed through the drum (12), a lint filter (18) being positioned in the duct to remove lint from the process air (14),

the dryer (10) comprising an accumulator tank adapted to collect condense water from the second heat exchanger and a water pump (20) adapted to pump the water from the accumulator tank,

characterized in that

wherein the water pump is fluidly connected to nozzle means (24) via a cleaning circuit (26, 28, 30a-d), wherein the circuit is adapted to hold a water pressure generated by the water pump (20) and guide the condense water from the pump (20) to the nozzle means (24) in order to spray condense water onto the lint filter (18).

2. Clothes tumble dryer according to claim 1 wherein the cleaning circuit comprises a control element (26) and a water filter (28) being connected to each other and to the pump (20) and nozzle means (24) via water pipes (30a-d).
3. Clothes tumble dryer according to claim 2 wherein the control element (26) consist in a two-way valve being adapted to guide the water towards the nozzle means or to a condense water (36) tank outside the cleaning circuit.
4. Clothes tumble dryer according to any of the claims 2 - 3 wherein the water filter (28) is substantially sealed to remain the water pressure in the cleaning circuit and removable from the dryer (10) to be cleaned by a user.
5. Clothes tumble dryer according to any of the preceding claims wherein the accumulator tank is formed in a baseplate (22) of the dryer (22).
6. Clothes tumble dryer according to any of the preceding claims wherein the nozzle means (24) is adapted to spray off lint collected on the lint filter (18), wherein the condense water with the lint is drained to the accumulator tank.
7. Clothes tumble dryer according to any of the preceding claims wherein the lint filter (18) is positioned before the second heat exchanger in the flow direction of the processing air (14) so that the lint is collected by the filter (18) before the air reaches the second heat exchanger.
8. Clothes tumble dryer according to any of the preceding claims wherein the lint filter (18) is removable

from the dryer.

9. Clothes tumble dryer according to any of the preceding claims wherein the nozzle means (24) consist in a lance (32) with openings (34) along at least one edge of the lint filter to substantially spray water onto the filter (18) along the whole edge. 5
10. Clothes tumble dryer according to any of the preceding claims wherein the lint filter (18) is electrically chargeable to be able to attract lint from the processing air (14). 10
11. Clothes tumble dryer according to any of the preceding claims wherein at least one further lint filter is positioned in the duct to remove lint from the process air (14). 15

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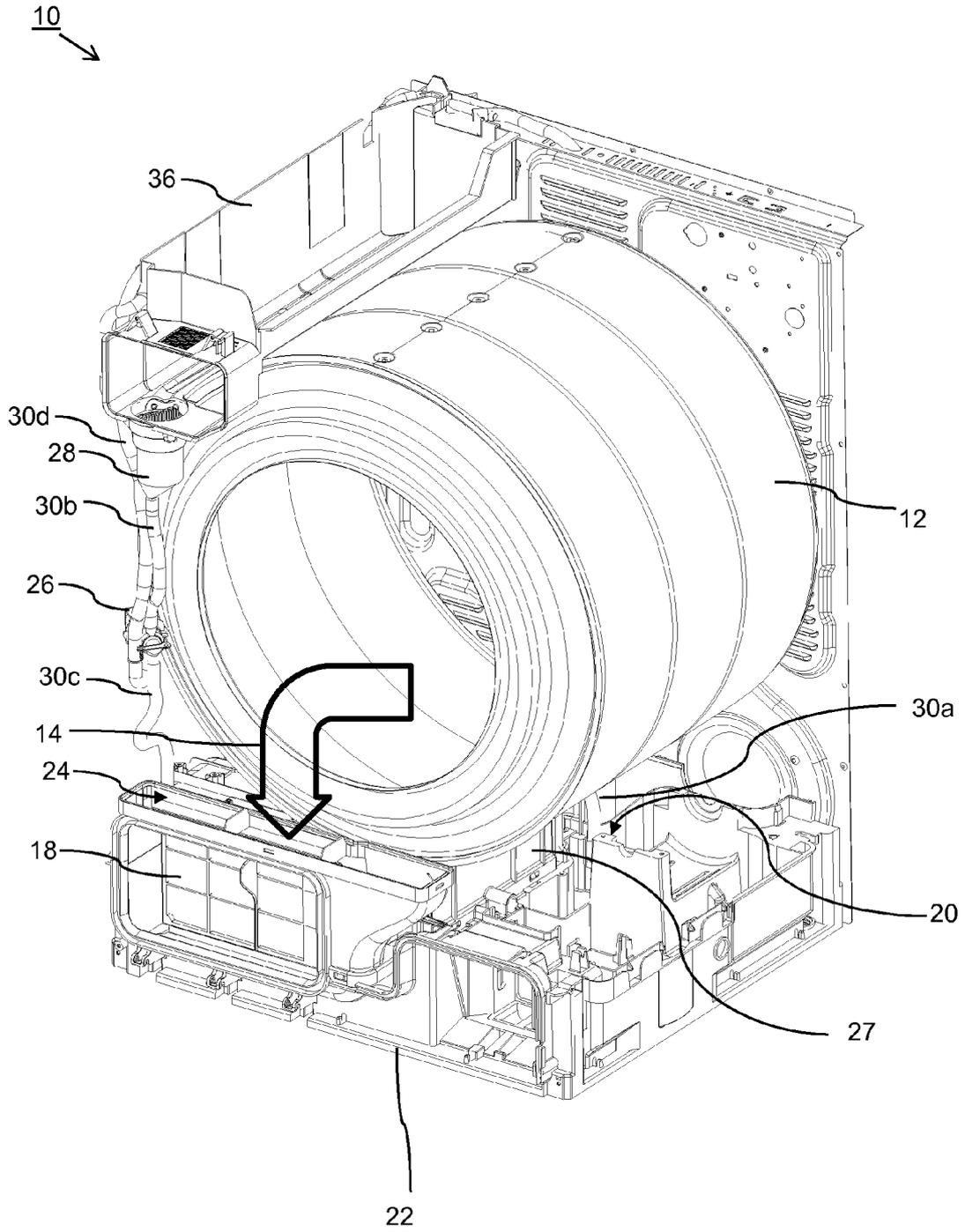


FIG. 1A

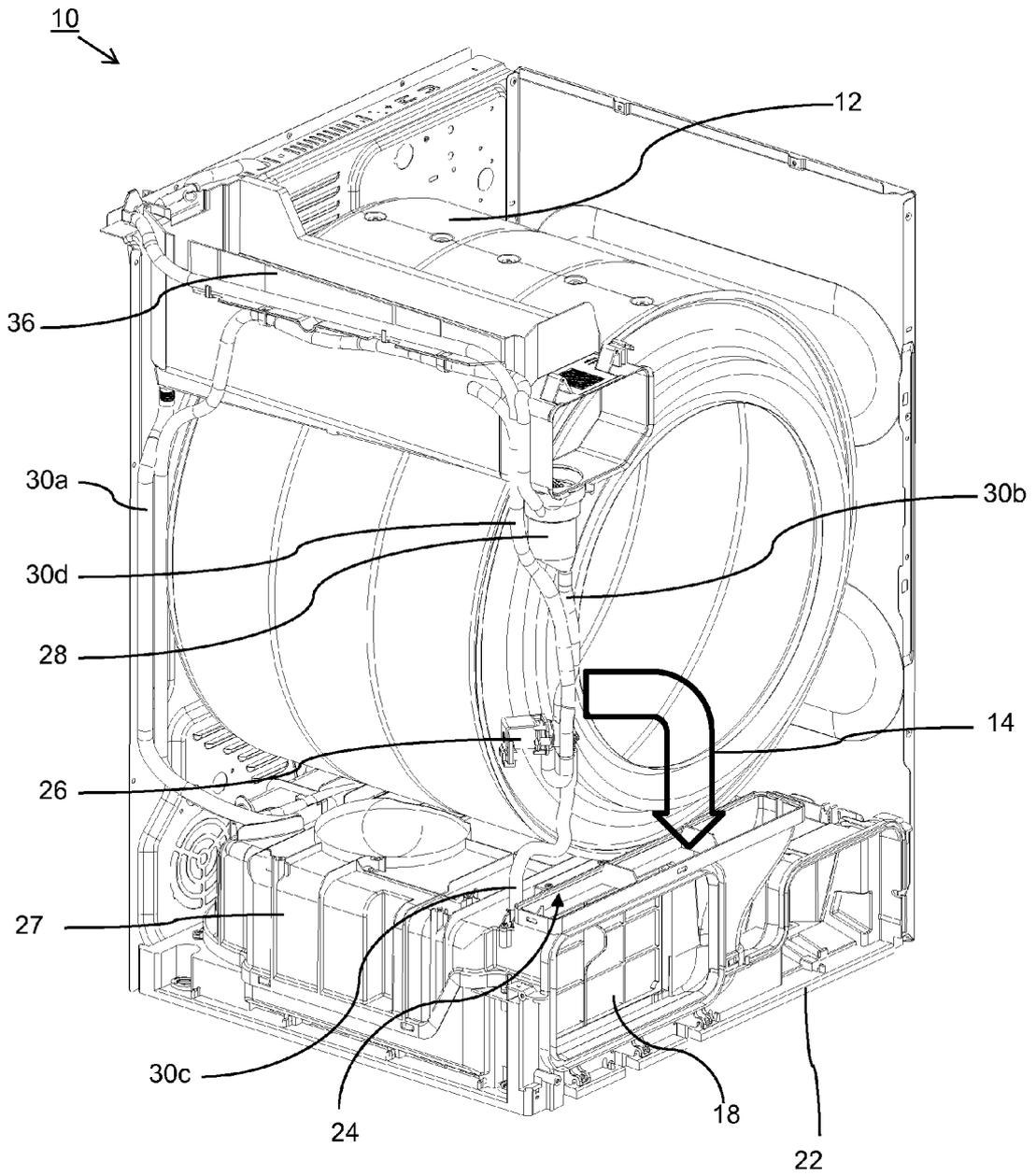


FIG. 1B

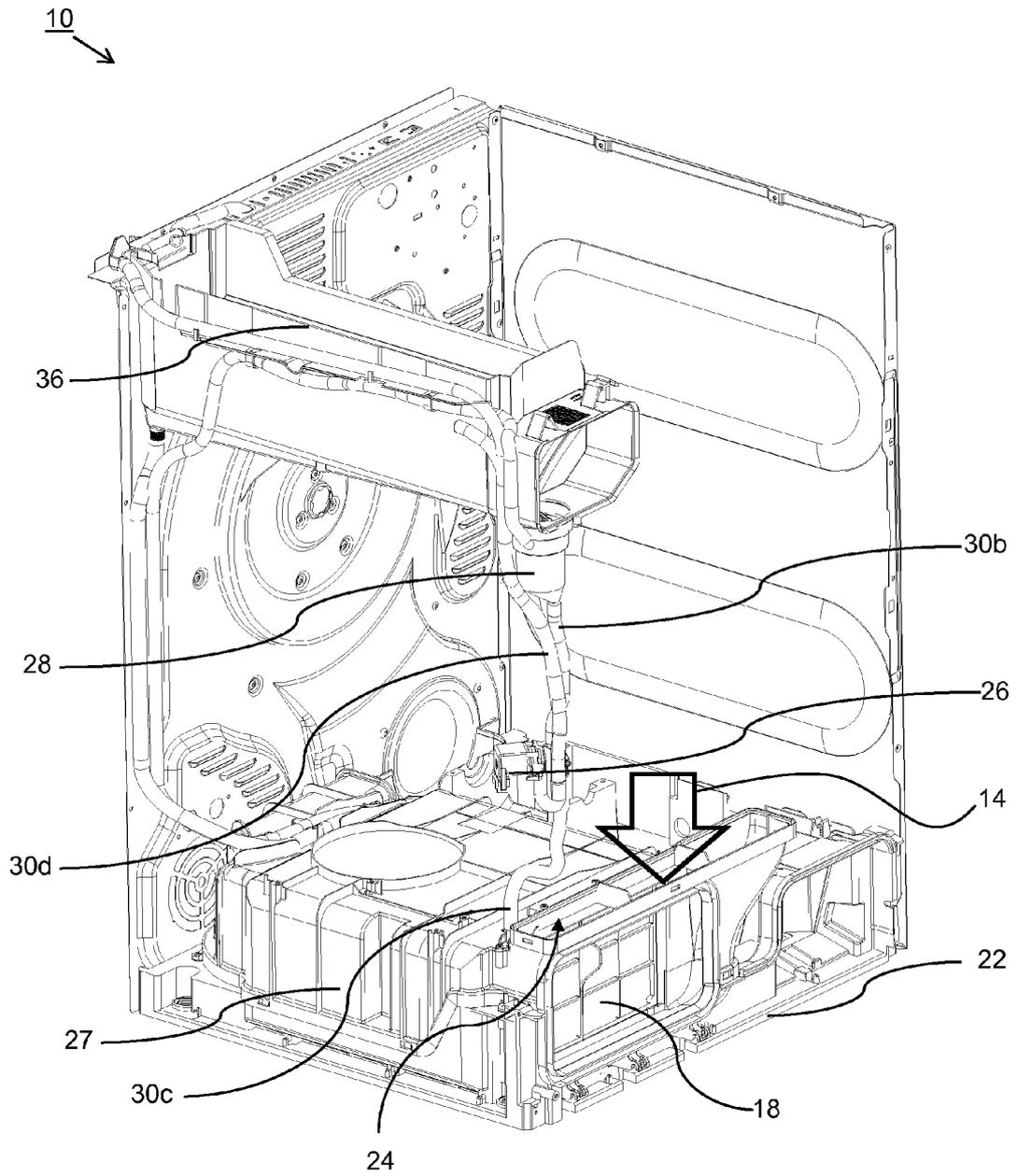


FIG. 2

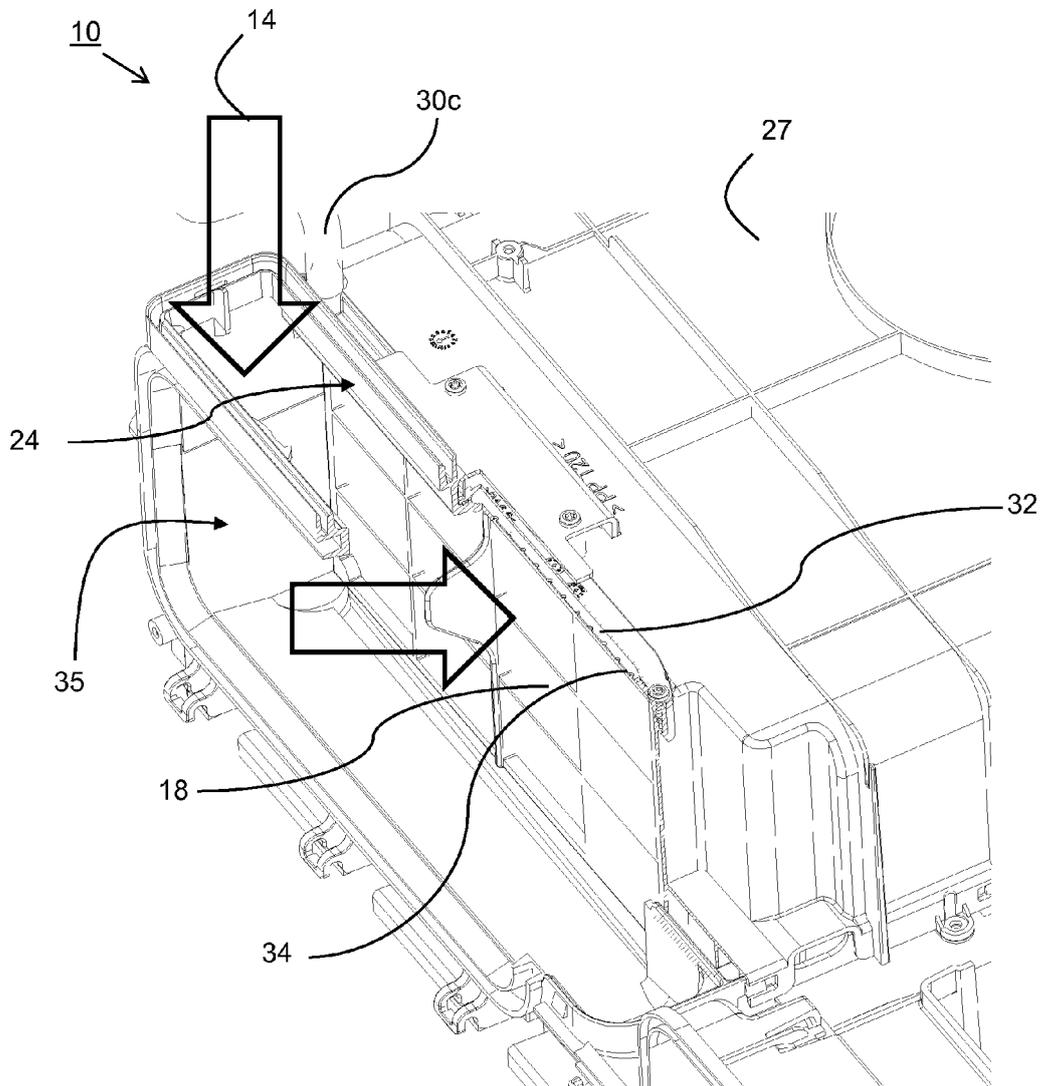


FIG. 3



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