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(54) **Laundry drying machine**

(57) The present invention relates to a laundry drying machine (1) comprising a casing (10), a laundry container (6) suitable for receiving the laundry to be dried, an air circulating device for circulating hot air through the laundry container (6), a condensing device for removing moisture of moist air coming from the laundry container (6) and a basement portion comprising a water collecting

housing (11) for the collection of condensation water formed by the condensing device. A water-removing unit (12) is associable to the water collecting housing (11) for the removal of water therein and comprises a supporting body (21) suitable for receiving a pumping unit (22). The supporting body (21) is obtained in a single piece construction with the basement (14).

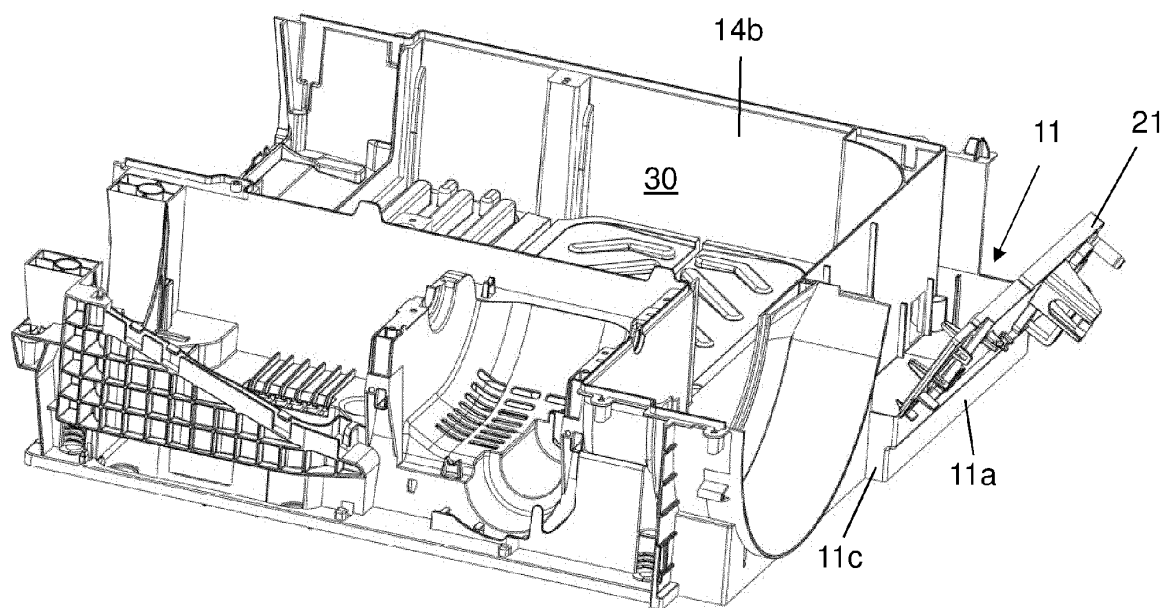


FIG. 4

Description

FIELD OF THE INVENTION

[0001] The present invention concerns the technical field of laundry drying machines.

[0002] In particular, the present invention refers to laundry drying machines of the condenser type.

BACKGROUND ART

[0003] Nowadays the use of laundry drying machines, both "simple" laundry drying machines (i.e. laundry machines which can only dry laundry) and laundry washing-drying machines (i.e. laundry washing machines which can also dry laundry), is widespread.

[0004] In the present description the term "laundry drying machine" or "dryer" will refer to both simple laundry drying machines and laundry washing-drying machines. Dryers capable of carrying out a drying process on laundry generally comprise a casing that houses a laundry container, like a rotating drum, where laundry to be dried is received.

[0005] The dryer comprises an air circuit for carrying out drying operation by circulating hot air through the laundry container. Air circulating means and heating means are provided in the air circuit for circulating and heating drying air, respectively.

[0006] In condenser type dryers, condensing means are further provided in the air circuit for removing moisture from drying air passing through articles thereby allowing said air to be recirculated cyclically in the container through the air circuit. Condensing means of the known type are usually arranged in the lower part of the dryer. In known condenser type laundry dryers, said means for condensing the moist air coming from the laundry container are configured in many different ways. For example the condensing means may comprise an air-air heat exchanger arranged in a basement portion of the dryer. The moist air coming from the laundry container flows through the heat exchanger and condensation water is formed therein.

[0007] Other type of dryers belonging to the art may comprise a heat pump which both dehumidifies and heats the air. The heat pump typically comprises a closed circuit formed by an evaporator, a condenser and a compressor.

[0008] The heat pump is typically arranged in the basement portion of the dryer and the moist air coming from the laundry container passes the evaporator so that moisture of the moist air is removed. Like in the air-air heat exchanger, condensation water is formed therein.

[0009] Condensation water formed in said condensing means is typically collected in a collecting housing of said basement.

[0010] The water in the collecting housing is then conveyed to a moisture tank arranged on the upper side of the dryer so that it can be easily and periodically emptied by a user.

[0011] The moisture tank is preferably in the form of a drawer slidably arranged on said upper side of the dryer.

[0012] In order to convey the water from the collecting housing to the tank, a water-removing unit is provided at said collecting housing.

[0013] The water-removing unit preferably comprises pumping means which are advantageously activated on the base of the water level inside the collecting housing. For this purpose a level sensor is also preferably provided at said collecting housing. Pumping means typically comprises an electric pump and a conveying pipe connecting the pump to the tank.

[0014] Furthermore, an overflow pipe is usually provided between the tank and the collecting housing which permits the water from the tank to be re-admit into the collecting housing when the tank is full.

[0015] However, the removing unit above described belonging to the known art poses some drawbacks.

[0016] A first drawback posed by this known technique is constituted by the fact that the removing unit is composed by a great number of pieces.

[0017] This determines a complex structural construction for the unit which increases the manufacturing costs of the unit and of the dryer.

[0018] A further drawback posed by this known technique is constituted by the high failure rate due to the complex structural construction.

[0019] The aim of the present invention is therefore to solve the noted drawbacks and thus providing a dryer having an improved water-removing unit arrangement.

[0020] It is a first object of the invention to implement a dryer that makes it possible to reduce manufacturing time and costs.

[0021] It is a further object of the invention to implement a dryer that makes it possible to increase reliability of the dryer.

[0022] Another object of the present invention is to provide a dryer that lasts longer than dryers of known type.

[0023] A further object of the present invention is to provide a dryer that makes it possible to simplify maintenance.

[0024] Advantages, objects, and features of the invention will be set forth in part in the description and drawings which follow and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention.

DISCLOSURE OF INVENTION

[0025] The applicant has found that by providing a laundry drying machine comprising a casing, a laundry container suitable for receiving the laundry to be dried, an air circulating device for circulating hot air through said laundry container, a condensing device for removing moisture of moist air coming from said laundry container, a basement portion comprising a water collecting housing for the collection of condensation water formed by said condensing device, a water-removing unit associa-

ble to said water collecting housing for the removal of water therein comprising a supporting body suitable for receiving a pumping unit and wherein said supporting body is obtained in a single piece construction with said basement it is possible to reduce manufacturing time and costs and increase reliability of the laundry drying machine itself.

[0026] The present invention relates, therefore, to a laundry drying machine comprising:

- a casing;
- a laundry container suitable for receiving the laundry to be dried;
- an air circulating device for circulating hot air through said laundry container;
- a condensing device for removing moisture of moist air coming from said laundry container;
- a basement portion comprising a water collecting housing for the collection of condensation water formed by said condensing device;
- a water-removing unit associable to said water collecting housing for the removal of water therein comprising a supporting body suitable for receiving a pumping unit;

wherein said supporting body is obtained in a single piece construction with said basement.

[0027] Preferably the supporting body is hingedly connected to the basement by means of at least one hinge obtained in a single piece construction with the supporting body and the basement in such a way that the supporting body is at least moveable between an opened operating condition to a closed operating condition. In a preferred embodiment of the invention, the at least one hinge comprises at least a portion of reduced thickness suitable to enhance the flexibility of the at least one hinge.

[0028] Preferably the supporting body and said basement are made with a plastic material, preferably by moulding, more preferably by injection moulding. Opportunely, the supporting body, the basement and the at least one hinge are obtained in a single piece construction.

[0029] Advantageously the water-removing unit further comprises a water level sensing device.

[0030] Preferably the supporting body of the water-removing unit receives the water level sensing device.

[0031] In a preferred embodiment of the invention, the water level sensing device comprises a housing element suitable to receive a floating element therein, the floating element being suitable to move according to the water level inside the collecting housing.

[0032] In a further preferred embodiment of the invention, the dryer comprises a tank and a pipe connecting the water-removing unit to the tank, the pipe being suitable to convey water from the collecting housing to the tank by means of the pumping unit or being suitable to convey over flow water from the tank to the collecting housing.

[0033] In another preferred embodiment of the invention, the dryer comprises a pipe connectable to the water-removing unit, the pipe being suitable to convey water from the collecting housing to an external waste water net.

[0034] Preferably the dryer further comprises a cover element for covering the water-removing unit.

[0035] Preferably the basement portion comprises an upper shell and a lower shell connected one to the other.

[0036] Advantageously the condensing device are received between the upper and the lower shells.

[0037] Preferably the machine of the invention is a combined laundry washing and drying machine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate a possible embodiment of the invention and together with the description serve to explain the principles of the invention. In the drawings, corresponding characteristics and/or components are identified by the same reference numbers. In particular:

- Figure 1 shows a perspective front view of a laundry drying machine according to the invention with an upright side wall removed;
- Figure 2 shows a perspective rear view of the laundry drying machine illustrated in Figure 1 with part of the water-removing unit in an opened operating condition;
- Figure 3 shows a perspective view of the lower part of the basement of the laundry drying machine of Figure 2;
- Figure 3A shows an enlarged detail of Figure 3;
- Figure 3B shows a lateral plan view of the detail of Figure 3A;
- Figure 4 shows the lower part of the basement of Figure 3 with part of the water-removing unit in a different operating condition;
- Figure 5 shows the lower part of the basement of Figure 3 with part of the water-removing unit in a closed operating condition;
- Figure 6 shows a perspective view of the basement of the laundry drying machine of Figure 2 with the water-removing unit in the closed operating condition.

DETAILED DESCRIPTION OF THE INVENTION

[0039] The present invention has proved to be particularly successful when applied to laundry drying machines of the condenser type. It should in any case be underlined that the present invention is not limited to this type of application. On the contrary, the present invention can be usefully applied to all the machines requiring a drying phase for wetted clothes with a condensation

phase, such as a combined laundry washing and drying machine.

[0040] In the present detailed description the term "laundry drying machine" or "dryer" will refer to both simple laundry drying machines and combined laundry washing and drying machines.

[0041] In Figures 1 and 2 a dryer 1 according to the invention is illustrated. The dryer 1 comprises a casing 10 formed by two couples of upright side walls 2a-2d arranged perpendicularly one another, i.e. on the front and the rear side and on the lateral sides of the dryer 1. An upper wall 2e and a bottom portion 4 close the ends of the box-like structure formed by the upright side walls 2a-2d. In Figure 1 the lateral side wall 2d has been removed for showing some of the dryer parts accommodated within casing 10.

[0042] A laundry container 6, preferably comprising a rotatable drum, is provided within the casing 10.

[0043] In case of a combined clothes washing and drying machines, the rotatable drum is opportunely contained in a washing tub.

[0044] A front door 8 pivotally coupled to the front upright side wall 2a is provided for allowing access to the drum interior region to place laundry to be dried therein. A user control interface 5 is preferably arranged on the top of the casing 10 for input of laundry drying programs and displaying machine working conditions. The dryer 1 further comprises an air circulating system adapted to circulate a flow of drying air into the drum 6. The air circulating system advantageously comprises a fan, non illustrated, which blows a flow of drying air through the drum 6. The air circulating system preferably comprises a heating device, not illustrated, adapted to heat up the air at a location upstream of the drum 6. Preferably the heating device comprises an electric heating element arranged upstream of the drum 6 along the air flow.

[0045] In further embodiments the heating device may be of different type, such as the condenser of the heat pump in a heat pump dryer.

[0046] Circulation of the drying air inside the drum 6 evaporates the moisture from the wetted laundry so as to form a moisture-laden hot air, or moist air.

[0047] The dryer 1 advantageously comprises a moist air outlet circuit.

[0048] The outlet circuit is preferably arranged at the front side of the dryer 1.

[0049] The moist air outlet circuit advantageously comprises an outlet conduit, not illustrated, arranged downstream of the drum 6 through which the moist air may flow.

[0050] The moist air is advantageously conveyed by the outlet conduit to a condensing device, not illustrated, which cool and dehumidifies the moist air.

[0051] In the preferred embodiment of the invention here described the condensing device comprises an air-air heat exchanger. The moist air passing through the condensing device is cooled by a separate air cooling flow passing through the condensing device itself. The cooled and dehumidified air is then conveyed again to

the drum 6 through the air circulating system in a closed loop circuit. Therefore, the condensing device condenses the water vapour of the moist air and the water formed therein is collected in a housing 11.

[0052] In a further preferred embodiment of the invention the condensing device may comprise an evaporator of a heat pump. In this case moist air passes the evaporator and is cooled by the evaporator itself. The evaporator condenses the water vapour of the moist air and the water formed therein is collected in a housing, as for the above described embodiment.

[0053] Condensation water from the collecting housing 11 is preferably conveyed to an extractable moisture tank 9 located at the upper portion of the dryer 1.

[0054] The moisture tank 9 is preferably in the form of a drawer slidably arranged in a box-shaped housing on said upper portion of the dryer 1 so that it can be easily and periodically emptied by a user.

[0055] Condensation water from the collecting housing 11 is conveyed to the extractable moisture tank 9 by means of a water-removing unit 12 associated to the collecting housing 11.

[0056] The collecting housing 11 is preferably arranged in the lower part of the bottom portion 4 of the dryer 1. The collecting housing 11, therefore, may be easily inspected from the rear of the dryer 1 without removing any part of the dryer 1, in particular without removing the upright rear side wall 2b.

[0057] More preferably the collecting housing 11 is arranged at the rear side of a basement 14 of the dryer 1. Said basement 14 is shown in Figure 6 separated from all the rest.

[0058] The basement 14 is preferably made by two portions, an upper shell 14a and a lower shell 14b, which are properly connected one to the other, preferably by means of screws.

[0059] In figures 3, 4 and 5 only the lower shell 14b of the basement 14 is illustrated. The collecting housing 11 is preferably realized in the lower shell 14b of the basement 14. More preferably the collecting housing 11 is obtained in a single piece construction with the lower shell 14b of basement 14.

[0060] The collecting housing 11 is therefore defined by lateral walls 11a-11d and a bottom wall 11e which are part of the lower shell 14b of the basement 14.

[0061] The air-air heat exchanger, or generally the condensing device, is opportunely received in a seat 30 between the two shells 14a, 14b.

[0062] Furthermore, on the basement 14 are preferably arranged other operational devices, like air pumping means or electric motors (not illustrated).

[0063] Advantageously, the basement 14 is opportunely shaped so as to create air paths wherein the air is opportunely conveyed, for example an air path for the moist air conveyed to the air-air heat exchanger or an air path for the cooling air to the air-air heat exchanger or an air path for the cooling air leaving the air-air heat exchanger.

[0064] The water-removing unit 12 preferably comprises a supporting body 21, a pumping unit 22 and a water level sensing device 23, as shown in Figure 6

[0065] In figures from 2 to 5 the water-removing unit 12 is shown with the pumping unit 22 and the water level sensing device 23 removed.

[0066] The supporting body 21 comprises a first receiving seat 25 for the pumping unit 22 and a second receiving seat 26 for the sensing device 23.

[0067] The pumping unit 22 and the sensing device 23 are preferably associated to the first supporting body 21 in a removably way so that they can be easily mounted or removed during either manufacturing or maintenance.

[0068] A conveying pipe, not illustrated, connects the pumping unit 22 to the tank 9. The water is conveyed from the collecting housing 11 to the tank 9 through said conveying pump.

[0069] Further, an overflow pipe, not illustrated, preferably connects the box-shaped housing of the tank 9 to the collecting housing 11. When the tank 9 is full, the water flows from the tank 9 to the box-shaped housing and from there to the collecting housing 11 through the overflow pipe. A "full tank" warning alarm is then advantageously emitted for the user, for example an acoustic and/or a visual alarm.

[0070] In further embodiments, the water may be conveyed outside through a pipe connected to an external waste water net. In this case, only one pipe is provided.

[0071] The pumping unit 22 preferably comprises a water sucking portion suitable to be disposed in contact with the condensation water collected in the housing 11. The sucking portion comprises an output connecting duct 46 which is connectable to the conveying pipe.

[0072] The water level sensing device 23 preferably comprises a housing portion 50 wherein a floating element is slidably received. The housing element 50 and the floating element are preferably cylindrically shaped.

[0073] The floating element advantageously moves inside the housing element 50 according to the level of the water inside the collecting housing 11. The position and/or the entity of movement of the floating element is advantageously detected by means of a detection unit arranged at the top of the housing element 50.

[0074] The water level sensing device 23, therefore, generates a signal which corresponds to a predetermined level of the water inside the collecting housing 11. The detected signal may be used by a central control unit for the actuation of the pumping unit 22.

[0075] In further embodiments, the detection unit may be different, such as an analogue sensor which generates a linear output signal based on the position of the floating element. The linear output signal is then properly elaborated by the central control unit for the actuation of the pumping unit 22.

[0076] The water level sensing device 23 is advantageously received in the second receiving seat 26 of the supporting body 21.

[0077] According to the invention, the supporting body

21 is obtained in a single piece construction with the basement 14.

[0078] Preferably the supporting body 21 is preferably hingedly connected to the basement 14 and may rotate around it.

[0079] Therefore, the supporting body 21 may be displaced between a first operating condition or opened operating condition, as illustrated in Figure 2 or 3, and a second operating condition or closed operating condition, as illustrated for example in Figure 5 or 6.

[0080] In particular, the opened operating condition of the supporting body 21 corresponds to a condition just after the realization of basement 14 and of the supporting body 21 and before the installation of the pumping unit 22 and of the water level sensing device 23. Such condition is illustrated, in particular, in Figure 3.

[0081] From this opened condition, the supporting body 21 is then rotated around the basement 14, as illustrated in Figure 4, up to the final closed operating condition, as illustrated in Figure 5. In the final closed condition the pumping unit 22 and the water level sensing device 23 may be installed on the supporting body 21.

[0082] As said before, the supporting body 21 is obtained in a single piece construction with the basement 14, as better shown in Figures 3, 3A and 3B.

[0083] The supporting body 21 and the basement 14 therefore define a completed, integral, unitary member.

[0084] In particular, a first edge 21a of the supporting body 21 and a first edge 27 of the front lateral side 11a of the collecting housing 11 are preferably joined together by a hinge 28. The hinge 28 preferably extends for the entire length of the front lateral side 11a and of the supporting body 21, both having substantially the same length.

[0085] The hinge 28 is defined by a portion of material which connects the edges 21a, 27 of the supporting body 21 and of front lateral side 11a.

[0086] The hinge 28 is advantageously obtained in a single piece construction with the supporting body 21 and the front lateral side 11a.

[0087] The shape and/or the type of the material of such hinge 28 allow the supporting body 21 to be easily moved from the opened operating condition to the closed operating condition, and vice versa. Preferably the material of such hinge 28 is the same of the material of the supporting body 21 and of the front lateral side 11a, and hence of the basement 14. As shown in the enlarged detail of Figure 3B, the hinge 28 preferably comprises a central portion 28a of reduced thickness. Such a portion enhances the flexibility of the hinge 28 itself.

[0088] It is clear that the hinge may take any desired shape that allows the rotation of the supporting body 21 with respect to the basement 14 without departing from the intended scope of the invention.

[0089] In further embodiments, two or more hinges of different size may connect the edges of the supporting body and of the front lateral side, instead of only one hinge as in the preferred embodiment here described.

[0090] The basement 14 and the supporting body 21 are preferably made with a plastic material and are preferably obtained in a single step by moulding, more preferably by injection moulding.

[0091] In further embodiments, fastening means may be preferably provided between the supporting body 21 and the basement 14 to firmly maintain the supporting body 21 in its closed position.

[0092] In further embodiments, a cover element may be preferably arranged over the water-removing unit 12 so as to protect the pumping unit 22 and the water level sensing device 23.

[0093] According to the invention, the provision of a completed, integral, unitary member of the supporting body 21 and of the basement 14 makes it possible to reduce manufacturing time and costs of the dryer 1.

[0094] In fact, installation of the water-removing unit 12 where the supporting body 21 is integral with the basement 14 is simplified with respect to the known art where the two elements, namely the supporting body and the basement, are handled separately.

[0095] Furthermore, the integral, unitary member of the supporting body 21 and of the basement 14 reduces risks of failure and increases reliability of the dryer 1.

[0096] It should to be noted that after the supporting body 21 has been moved in the closed operating condition, the hinge 28 may not provide any successive advantage. It therefore follows that the integrity of the hinge 28 between the supporting body 21 and the basement 14 once the supporting body 21 has been moved in the closed operating condition, is not necessary. After the installation, therefore, the hinge 28 may be divided, or broken, without affecting the functionality of the water-removing unit 12.

[0097] The above mentioned advantages given by hinge 28 during installation are however maintained.

[0098] Conclusively it can be stated that a dryer according to the invention has an efficient construction for its water-removing unit.

[0099] It has thus been shown that the present invention allows all the set objects to be achieved. In particular, it makes it possible to obtain a laundry drying machine with reduced manufacturing time and costs with respect to the known technique.

[0100] While the dryer has been described with reference to a dryer of the condenser type provided with an air-air heat exchanger, it should be noted that the present invention is not limited to the specific embodiment illustrated and described herein; on the contrary, further variants of the embodiments described herein fall within the scope of the present invention, which is defined in the claims.

Claims

1. A laundry drying machine (1) comprising:

- a casing (10);
- a laundry container (6) suitable for receiving the laundry to be dried;
- an air circulating device for circulating hot air through said laundry container (6);
- a condensing device for removing moisture of moist air coming from said laundry container (6);
- a basement portion comprising a water collecting housing (11) for the collection of condensation water formed by said condensing device;
- a water-removing unit (12) associable to said water collecting housing (11) for the removal of water therein comprising a supporting body (21) suitable for receiving a pumping unit (22) ;
- characterized in that** said supporting body (21) is obtained in a single piece construction with said basement (14).

2. A machine (1) according to claim 1, **characterized in that** said supporting body (21) is hingedly connected to said basement (14) by means of at least one hinge (28) obtained in a single piece construction with said supporting body (21) and said basement (14) in such a way that said supporting body (21) is at least moveable between an opened operating condition to a closed operating condition.
3. A machine (1) according to claim 2, **characterized in that** said at least one hinge (28) comprises at least a portion (28a) of reduced thickness suitable to enhance the flexibility of said at least one hinge (28).
4. A machine (1) according to any preceding claim, **characterized in that** said supporting body (21) and said basement (14) are made with a plastic material, preferably by moulding, more preferably by injection moulding.
5. A machine (1) according to claim 2, **characterized in that** said supporting body (21), said basement (14) and said at least one hinge (28) are obtained in a single piece construction.
6. A machine (1) according to any preceding claim, **characterized in that** said water-removing unit (12) further comprises a water level sensing device (23).
7. A machine (1) according to claim 6, **characterized in that** said supporting body (21) receives said water level sensing device (23).
8. A machine (1) according to claim 6 or 7, **characterized in that** said water level sensing device (23) comprises a housing element (50) suitable to receive a floating element therein, said floating element being suitable to move according to the water level inside said collecting housing (11).

9. A machine (1) according to any preceding claim, **characterized in that** it comprises a tank (9) and a pipe connecting said water-removing unit (12) to said tank (9), said pipe being suitable to convey water from said collecting housing (11) to said tank (9) by means of said pumping unit (22) or being suitable to convey over flow water from said tank (9) to said collecting housing (11). 5
10. A machine (1) according to any preceding claim, **characterized in that** it comprises a pipe connectable to said water-removing unit (12), said pipe being suitable to convey water from said collecting housing (11) to an external waste water net. 10 15
11. A machine (1) according to any preceding claim, **characterized in that** it further comprises a cover element for covering said water-removing unit (12).
12. A machine (1) according to any preceding, **characterized in that** said basement portion (14) comprises an upper shell (14a) and a lower shell (14b) connected one to the other. 20
13. A machine (1) according to claim 12, **characterized in that** said condensing device are received between said upper (14a) and lower (14b) shells. 25
14. A machine (1) according to any preceding, **characterized in that** said machine is a combined laundry washing and drying machine. 30

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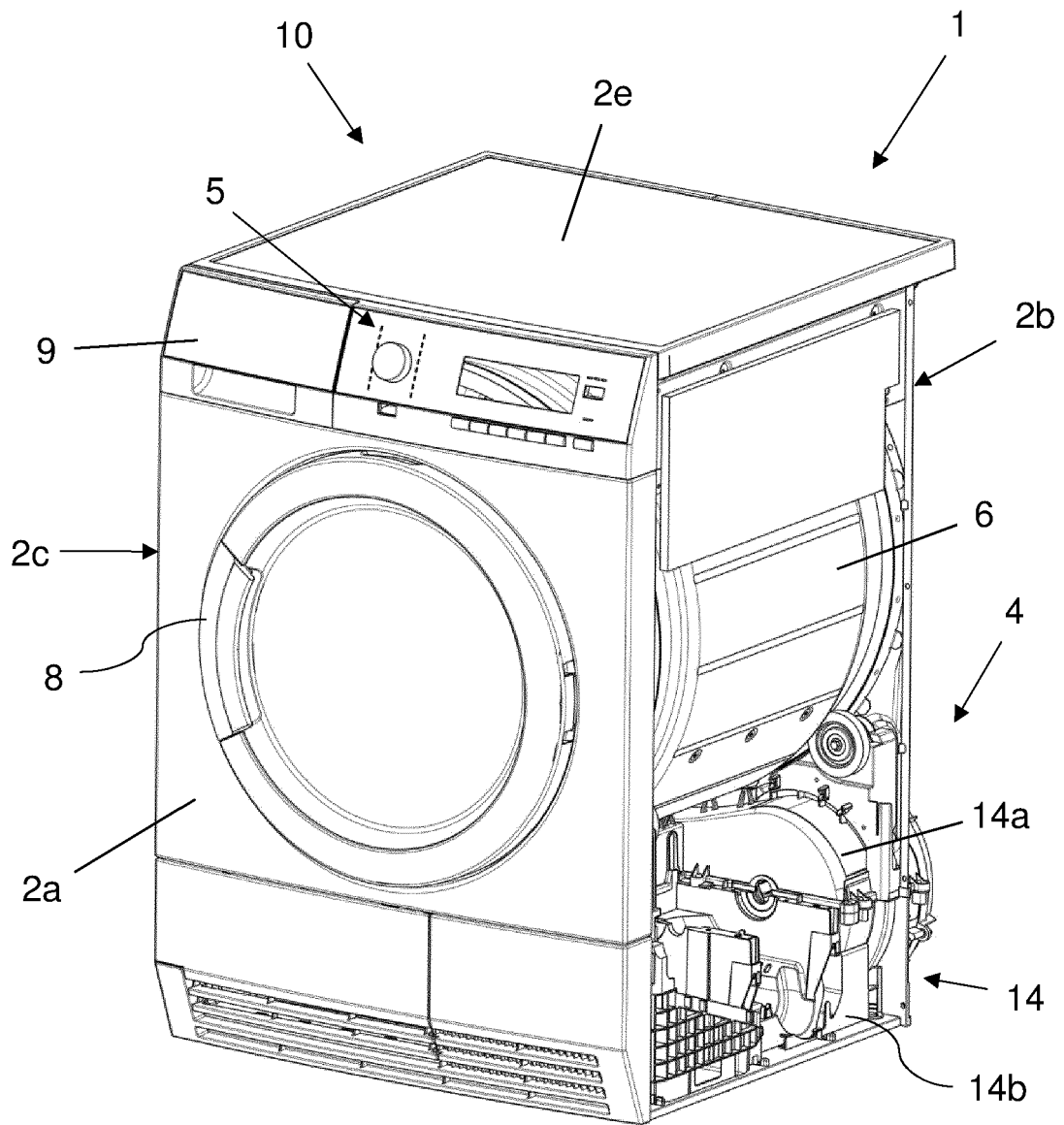


FIG. 1

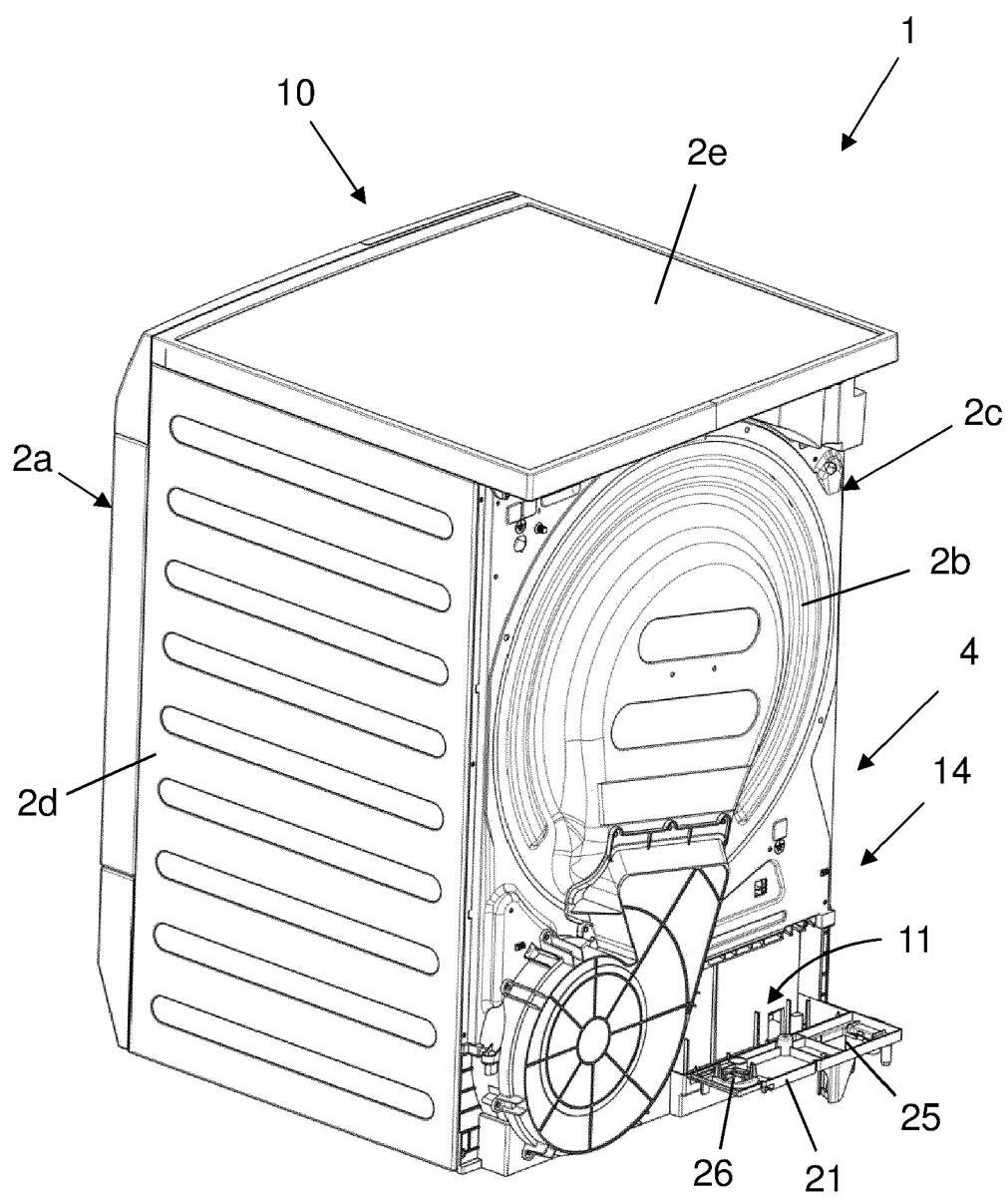
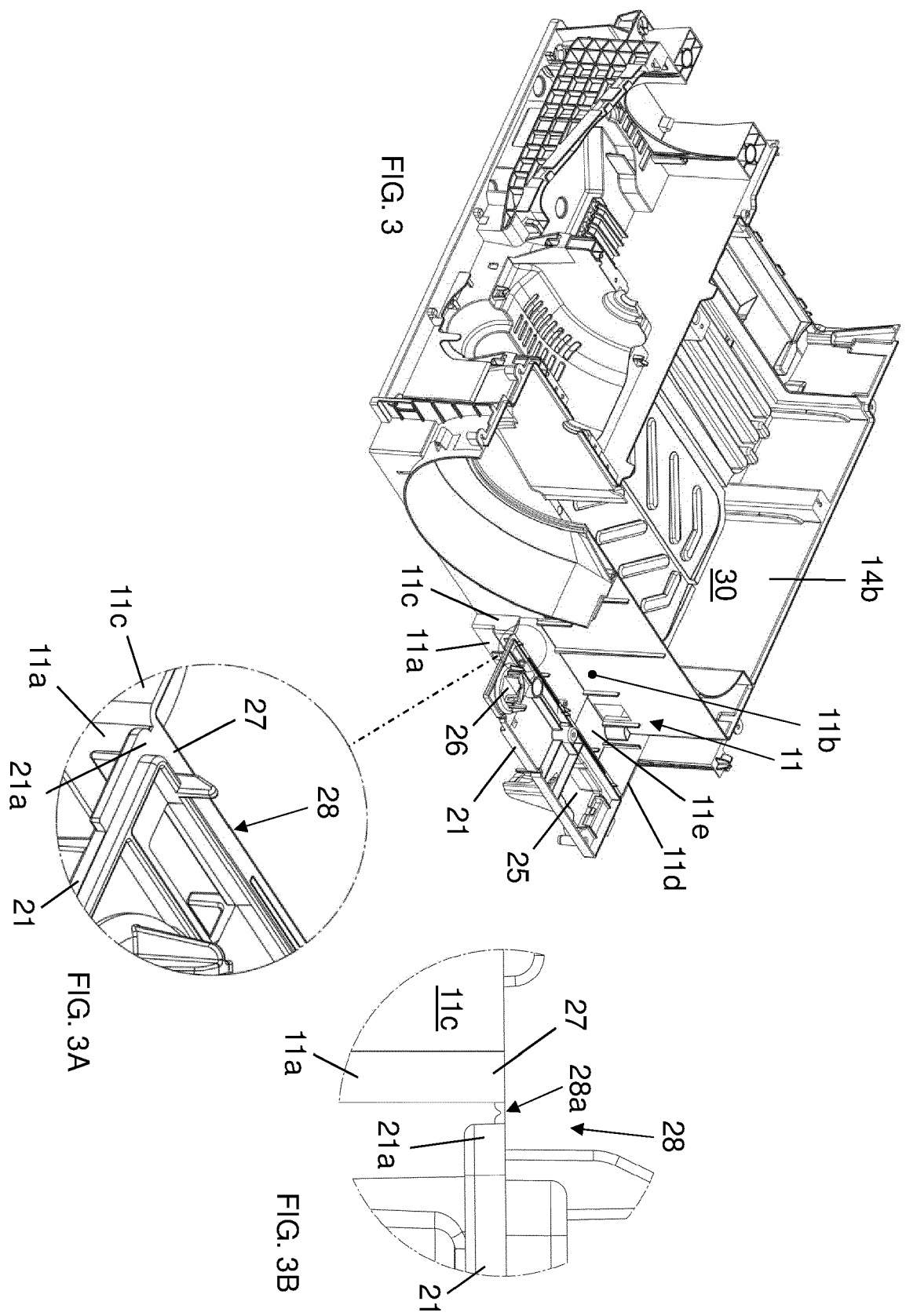


FIG. 2



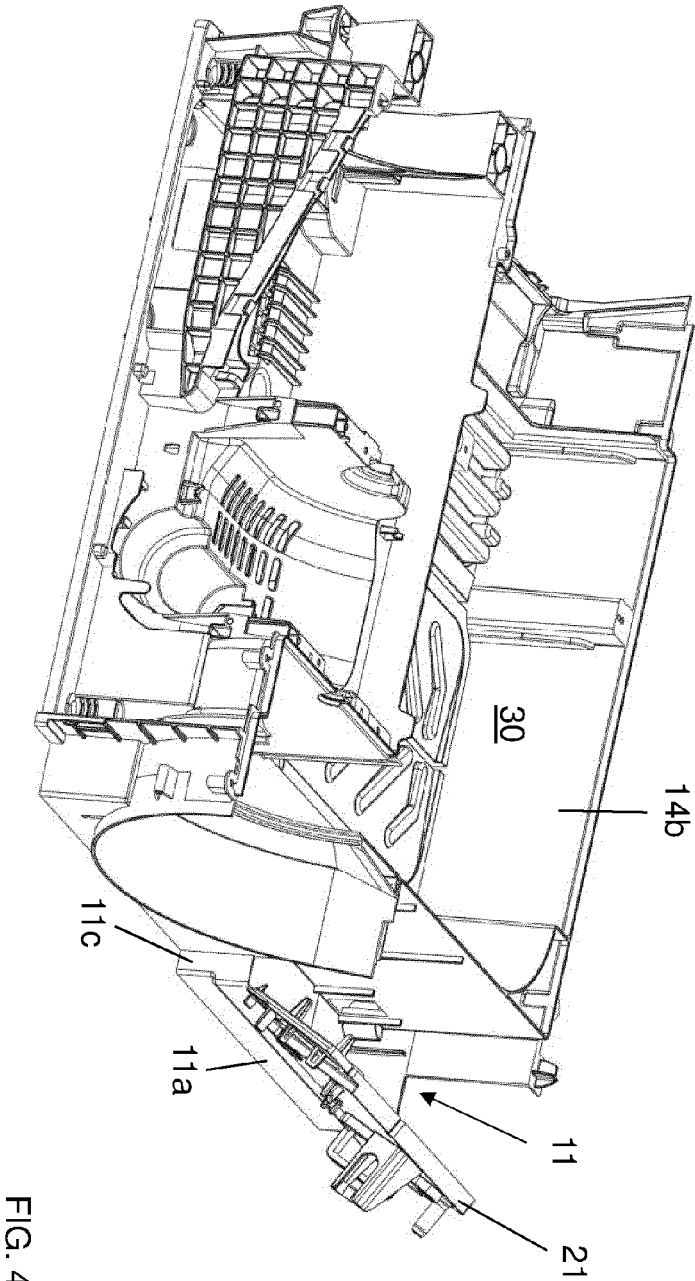


FIG. 4

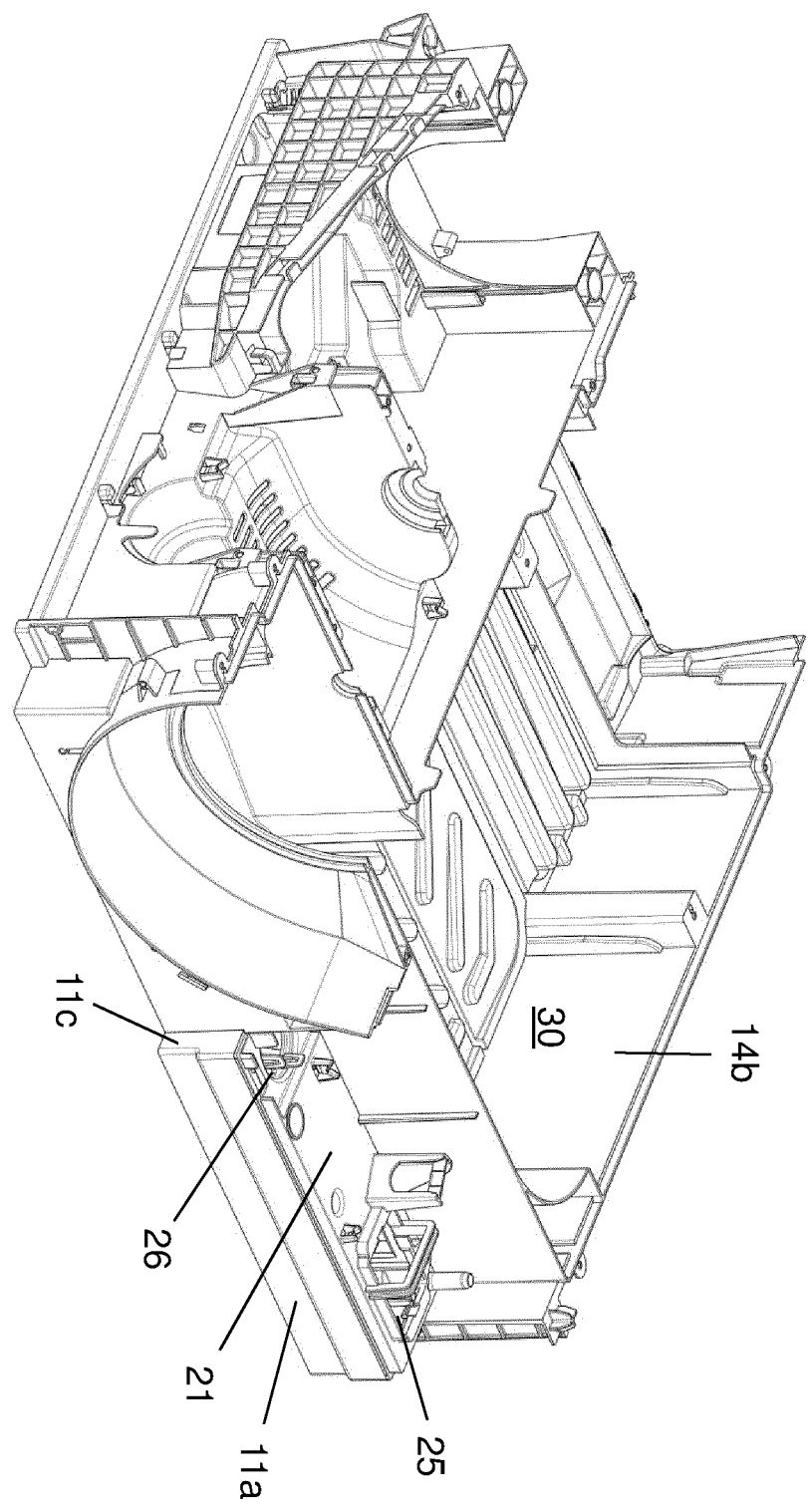
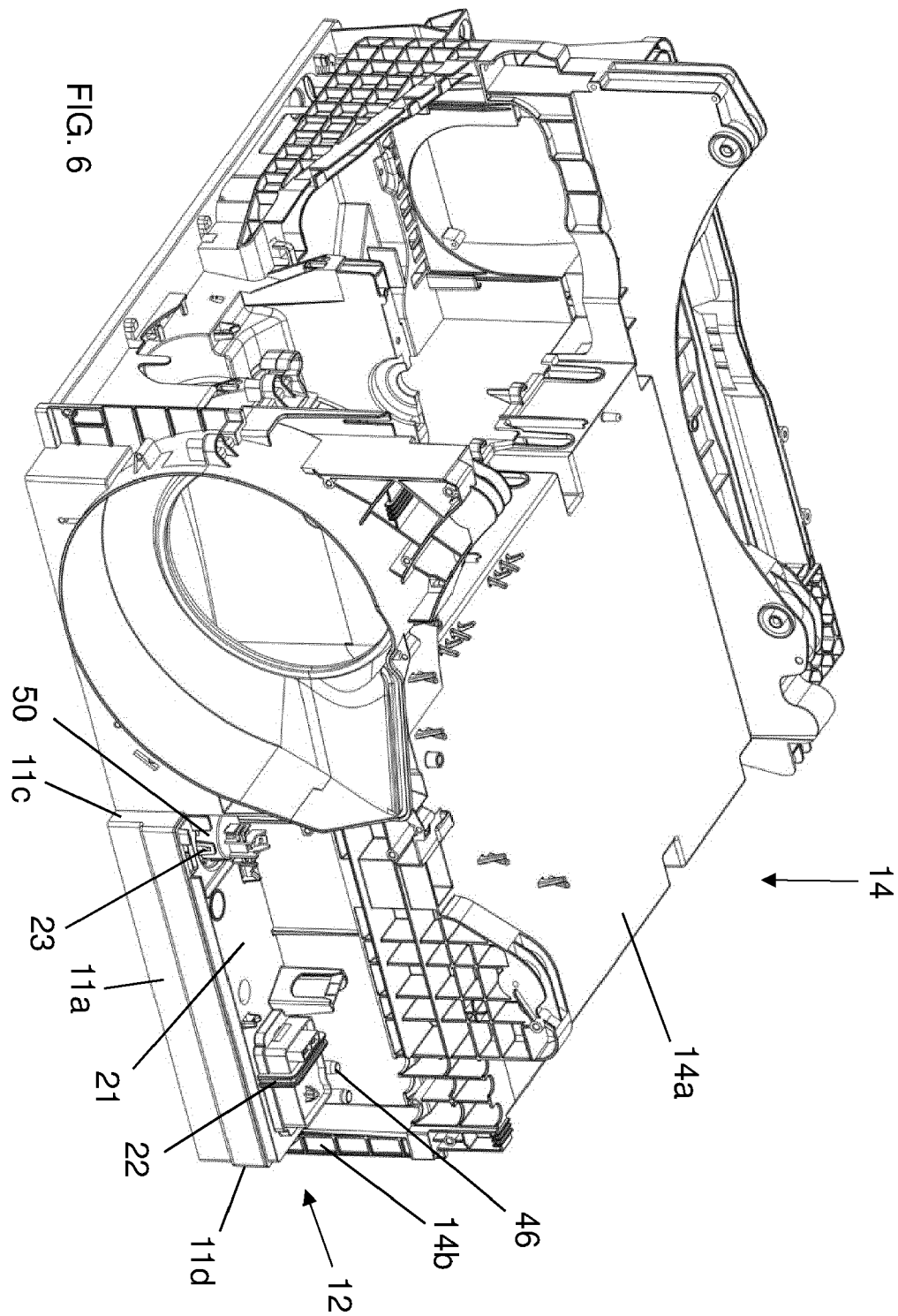


FIG. 5





EUROPEAN SEARCH REPORT

Application Number
EP 12 15 2588

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 31 35 292 A1 (LICENTIA GMBH [DE]) 24 March 1983 (1983-03-24)	1,4, 10-14	INV. D06F58/24
Y	* page 5, lines 1,2; claim 1 * * page 6, line 16 - page 8, line 28 * * figures 1-4 *	6-9	
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A	EP 0 434 169 A2 (OCEAN SPA [IT]) 26 June 1991 (1991-06-26) * abstract; figures 1,2 *	1	
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 June 2012	Examiner Kising, Axel
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 15 2588

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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