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(54) Front-loading washing machine and method for positioning a tub of such washing machine

(57) The invention relates to a washing machine 1 of a front-loading type comprising a housing 2 with a frontal opening 21 for the insertion of laundry 3, a tub 4 having a frontal orifice 41 facing the frontal opening 21 and hanging oscillatingly within said housing 2, a drum 5 mounted in the interior of said tub 4, in which the laundry 3 is insertable and which is rotatable around a horizontal axis 51, and said tub 4 arranged in a working position H in absence of laundry 3 and washing liquid in said tub 4, and a gasket 6 arranged in a relaxed state when said tub 4 is in said working position H, which gasket 6 is coupled between said housing 2 and said tub 4 with a frontal flange 62 connected to said frontal opening 21 and a rear flange 64 connected to said frontal orifice 41. Said washing machine 1 also has a positioning device 71, 72 which can displace said tub 4 to a position within a pre-defined position range, in which said working position H is included, to carry out a washing process, with laundry 3 placed in said drum 5 and washing liquid introduced in said tub 4, in said position. The invention also relates to a method for positioning a tub 4 in such washing machine 1.

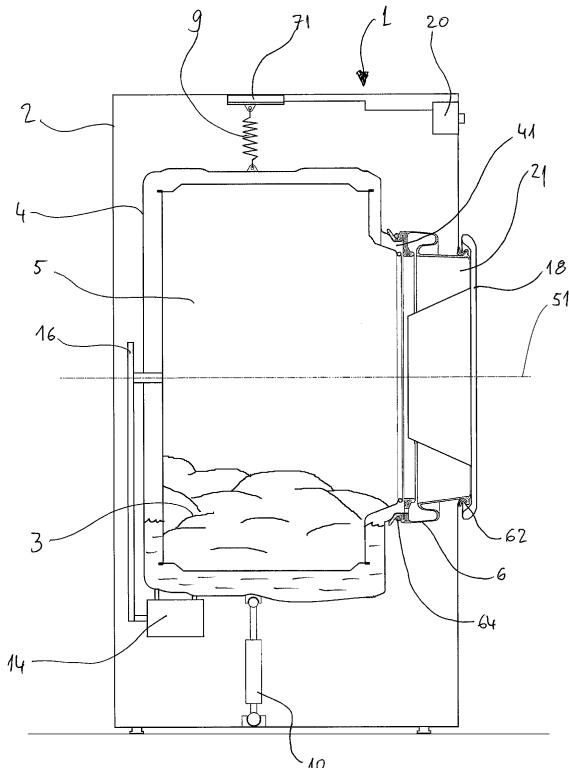


FIG.3

Description

[0001] The invention relates to a washing machine of a front-loading type comprising a housing with a frontal opening for the insertion of laundry, a tub having a frontal orifice facing the frontal opening and hanging oscillatingly within said housing, a drum mounted in the interior of said tub, in which the laundry is insertable and which is rotatable around a horizontal axis, and said tub arranged in a working position in absence of laundry and washing liquid in said tub, and a gasket arranged in a relaxed state when said tub is in said working position, which gasket is coupled between said housing and said tub with a frontal flange connected to said frontal opening and a rear flange connected to said frontal orifice. Likewise, the invention relates to a method for positioning a tub of such washing machine.

[0002] In a known front-loading drum-type washing machine, a frame or housing forms an exterior of the washing machine and has a frontal opening for loading and unloading the laundry by means of a door. A tub is suspended in the interior of the frame to hold the water and detergent used to wash the laundry. Inside the tub, a drum is installed for mixing the laundry with the water and detergent, which drum rotates about an axis of rotation when it is set in motion by a motor during a normal operating process (for example, washing or rinsing operations). To prevent the water from seeping through or laundry that sticks or is pressed into a space between the tub and the housing, and to reduce vibration caused by the high rotational speed of the drum and the tub ensemble while operating, a ring-shaped gasket of plastic material is used between the tub and the housing as described in the document US 2005/0178169 A1.

[0003] The gasket in the above-mentioned patent includes a shock cushion that is ring-shaped corresponding to the shape of the gasket, where a curved portion is formed with a length greater than that of the gasket as a U-shaped curve. Nevertheless, over the long term this U-shaped curve is bent until it breaks, especially in its lateral sections according to what has been detected, due to the uneven vibration in the gasket perimeter. This gasket is mounted in a relaxed state, which is without prior tensions between the tub and the housing. When the drum is loaded with laundry, the tub is displaced downward forcing the gasket into a position that is under tension, and while the laundry cycle is carried out in this position the gasket sustains even more vibrations. To minimize the tension, the gasket mounting in some commercial washing machines has been planned so that it will be in this relaxed state in a position where the drum is maximally loaded, or in the lowest possible working height/position. Thus, when the washing machine drum doesn't contain any laundry or water, it will be in the highest possible working position, and when it contains laundry although the wash water has been pumped out and the centrifugation is being done, it will be in a working position that is intermediate between the highest and low-

est. This is done so that the gasket will be as close as possible to its relaxed state during the time of the washing process in which the most vibrations are produced.

[0004] Consequently, an object of the present invention is to offer a washing machine in which the gasket mounted between the tub and the housing suffers less from the vibrations produced by the movement of the tub in the interior of the housing during the washing cycle.

[0005] According to the present invention, the above-mentioned object is achieved with a front-loading washing machine and a method according to the respective independent claim attached. Preferred embodiments of the invention are subject of dependent claims and the subsequent description.

[0006] Thereby, according to the invention, in a washing machine of a front-loading type comprising a housing with a frontal opening for the insertion of laundry, a tub having a frontal orifice facing the frontal opening and hanging oscillatingly within said housing, a drum mounted in the interior of said tub, in which the laundry is insertable and which is rotatable around a horizontal axis, and said tub arranged in a working position in absence of laundry and washing liquid in said tub, and a gasket arranged in a relaxed state when said tub is in said working position, which gasket is coupled between said housing and said tub with a frontal flange connected to said frontal opening and a rear flange connected to said frontal orifice, said washing machine also has a positioning device which can displace said tub to a position within a pre-defined position range, in which said working position is included, to carry out a washing process, with laundry placed in said drum and washing liquid introduced in said tub, in said position.

[0007] In this way, the tub is placed in a position within a pre-defined position range that comprises the working position, implying that the tub is placed in a position near the working position prior to initiating any washing process, thus ensuring that gasket operates in an essentially relaxed state during the washing process, which is when vibrations are produced in the tub due to laundry being off-center inside the drum during its rotation. The relaxed state of the gasket refers to a state in which it is not submitted to substantial tensions expected to deform it. Rather it is connected to the frontal opening of the housing and to the frontal orifice of the tub substantially maintaining the same form as before its installation. Therefore, being designed to absorb only dynamic vibrations without any substantial static displacement, the gasket can be of smaller size because it is folded in an S-shape between the rear flange and the rear flange. It is advantageous if the predefined position range is as small as possible and will depend on the precision of the positioning device.

[0008] In the same way, if the tub is brought within the predefined position range, particularly the working position, the static distance between the tub and the housing is maintained constant or much reduced at all times because in the design of the tub, it can be dimensioned within the housing so that only the dynamic vibration

movements need to be considered, with a gain in the tub volume. Moreover, the maximum separation distance between the frontal opening of the tub and the frontal orifice of the housing during the washing cycle will be reduced because the risk of introducing a clothing element into the intermediate space is minimized.

[0009] The invention is moreover advantageous in that since the tub is always positioned in more or less the same location, the cabling and hydraulic connections can be dimensioned for a smaller travel path of the tub, which can increase the lifetime and reduce costs. The same is true for the suspension system, the cushions and springs from which the tub is hung, which can be re-dimensioned for a smaller travel path of the tub.

[0010] As a preferred embodiment of the invention, the washing machine is envisioned to have a position sensor provided to measure a position value of the tub and is connected to a positioning device, and which additionally emits a signal to the positioning device if the tub is not within the predefined position range. In this way, the positioning device recognizes the incorrect tub position immediately and can correct it immediately. The connection between the sensor and the positioning device can be any type of connection, in particular by cabling or cordless.

[0011] In another preferred embodiment of the invention, the position sensor is a weight sensor that measures the position value depending on the weight of laundry and washing liquid present in the tub, and which emits a signal to the positioning device if the position value is outside the predefined position range. The position sensor can be a type of scales that measures the weight of the drum and tub ensemble and compares this with the position value for the working position predefined at the factory. If any load is inserted into the interior of the drum or the tub, the values will not be equal and the sensor will send a signal to the displacement device to bring the tub within the predefined range for the working position.

[0012] In another preferred embodiment of the invention, the displacement sensor measures the position value depending on the distance to the tub and emits a signal to the positioning device if the position value is outside a predefined position range. When the tub is loaded with some laundry and washing liquid, its position varies since the tub is displaced downward; then the sensor detects the position value and compares it with the working position, and when these are not equal it sends a signal to the displacement device to displace the tub to or sufficiently near the working position.

[0013] The predefined position range is a range within a scale of possible values for permitting tolerance to the system. The sensor can sample position values constantly and send signals to the positioning device to displace the tub at any time during the laundry cycle until the drum is emptied. As well, the position sensor may measure the position value during any laundry wash cycle or washing process after the washing liquid has been introduced and emits a signal to the positioning device, and the position-

ing device displaces the tub to or near the working position. Likewise, the position sensor measures the position value during the laundry wash cycle after the washing liquid has been emptied and emits a signal to the positioning device, and the positioning device displaces the tub back again to the working position. Both particular features are times when the tub position changes upon gaining or losing weight of laundry and/or washing liquid.

[0014] Preferredly the tub is hung from a minimum of one spring, the minimum of one spring is hung from the positioning device, and the positioning device raises the tub by means of the spring to the working position depending on the operating parameters of the spring. The positioning device can be a system that is pneumatic, mechano-hydraulic, or any kind of servo system.

[0015] Preferredly as well the tub rests on a minimum of one cushion or damper or suspensor, the minimum of one cushion rests on the positioning device, and the positioning device raises the tub by means of a minimum of one cushion to the working position depending on the operative parameters of the cushions. Likewise, commonly used are cushioning systems with springs including those in which the tub rests or is hung, and to which the positioning device can be connected.

[0016] In another preferred embodiment of the invention, the positioning device has a reservoir coupled with the tub and connected to a water intake for introducing washing liquid, which increases the weight of the ensemble formed from the reservoir and the tub, and to a reservoir drainage for draining wash water, which decreases the weight of the ensemble formed from the reservoir and the tub, to displace the tub to the working position. With a reservoir joined to the tub and which is fillable with washing liquid, the increase or decrease in weight of the tub during the washing cycle can be counteracted. Then, it is envisioned that when at rest, the reservoir will be at its maximum fill level for positioning the tub in the working position. At the beginning of the washing cycle, to insert laundry, the reservoir drains a portion of the liquid from

its interior equivalent to the weight of the laundry; to introduce the washing liquid, it drains the equivalent of the liquid introduced into the drum; for centrifuging the machine, it drains the water from inside the tub and the positioning device opens the water intake of the reservoir and fills liquid that is an equivalent amount to the liquid drained. Both the intake of water as well as the reservoir drainage can be controlled by electric valves that, in turn, receive the order to open and close from a positioning device controller according to the signal received from

the position sensor. The water drained by the reservoir can be drained to the tub when the reservoir drainage is connected hydraulically to the tub and used profitably for washing, and alternatively can be connected to the general drainage for the tub if the introduction of water to the tub during the washing cycle is unnecessary.

[0017] Moreover, an object of the invention is to make available a method for washing that improves the dynamics of the oscillating unit of the front-loading washing ma-

chine, increases its useful lifetime and especially the useful lifetime of the gasket/bellows of the washing machine door.

[0018] This object is achieved with a method for positioning a tub in a washing machine of a front-loading type comprising a housing with a frontal opening for the insertion of laundry, the tub having a frontal orifice facing the frontal opening of the housing hanging oscillatingly within the housing, a drum in the interior of the tub, in which the laundry is insertable and which is rotatable around a horizontal axis, and the tub arranged in a working position in absence of laundry and washing liquid in said tub, and a gasket arranged in a relaxed state when the tub is in the working position, which gasket is coupled between the housing and the tub with a frontal flange connected to the frontal opening, and a rear flange connected to the frontal orifice. Further, a positioning device is provided in the washing machine, which after placing laundry to be subjected to a washing process into the drum and introducing washing liquid into the tub, displaces the tub to a position within a pre-defined position range in which the working position is included, to carry out the washing process in the position.

[0019] Thus the position of the tub may be managed and shifted at all times during the washing cycle and especially at those times when the load/weight in the interior of the drum changes.

[0020] In accordance with another preferred embodiment, a position sensor is included in the washing machine for measuring the position value of the tub, wherein the position sensor emits a signal to the positioning device if the tub is not within the pre-defined position range, and the positioning device displaces the tub if the tub is not within the pre-defined position range.

[0021] In the preferred case when the washing machine comprises an additional reservoir to support the tub, the positioning device introduces or drains the liquid of the reservoir until the tub is positioned within the working position range as explained above.

[0022] Other advantages of the invention are shown in the Figures of the attached drawing and explained in the following description of the Figures.

[0023] A preferred embodiment of the invention is shown in the Figures of the attached drawing. The Figures, the description and the claims contain combinations of numerous characteristics. One skilled in the art could advantageously consider the characteristics individually and recombine them in other reasonable combinations. In the drawing,

Figure 1 shows a side cross-sectional view of a washing machine of the invention without a load of laundry with the tub in the working position,

Figure 2 shows a side cross-sectional view of the washing machine of Figure 1 with a load of laundry in the interior of the tub displaced to a position below the working position,

Figure 3 shows a side cross-sectional view of the washing machine of Figure 1 and Figure 2 with a load of laundry in the interior of the tub displaced by the displacement device to the working position,

Figure 4 shows a side cross-sectional view of a washing machine according to the invention with a load of laundry in the interior of the tub displaced by the displacement device to the working position, and

Figure 5 shows a side cross-sectional view of the washing machine of Figure 4 without a load of laundry in the interior of the tub displaced by the displacement device to the working position.

[0024] Figure 1 shows a schematic cross-section of a front-loading washing machine 1 that has a tub 4 within which is arranged a drum 5 that is rotatable around a horizontal axis 51 into which laundry 3 can be inserted for washing. The front-loading washing machine is understood to be a washing machine with a frontal opening 21 in its housing 2. The tub 4 is arranged inside the housing 2, which in turn rests on the floor, and is suspended by a system of springs 9 and cushions 10 so that it can oscillate in the interior of the housing.

[0025] In the machine of Figure 1, the horizontal axis 51 is arranged essentially in parallel to the floor and passes through the center of gravity of the oscillating unit and when the washing machine 1 is in a resting phase, at a distance from the floor that is defined as the working position H. The resting phase is defined as when the machine is empty, without a load of laundry 3 or washing liquid. The oscillating unit is the ensemble of the tub 4 with the drum 5 and all elements for the intake and drainage of washing liquid such as the motor 14 and fan belt 16 for transmission of rotation to the drum. There are front-loading washing machines in which the horizontal axis forms a slight angle with the plane of the floor to make the laundry more accessible to the user. The invention can also be applied to this type of machine.

[0026] The washing machine 1 also has a gasket 6, arranged in a relaxed state when the tub 4 is in the working position H, and which is coupled between the housing 2 and the tub 4 with a frontal flange 62 connected to the frontal opening 21 of the housing, and a rear flange 64 connected to the frontal orifice 41 of the tub. The frontal opening 21 of the housing 2 is closable with a door 18.

[0027] A position sensor 8 is connected with a controller 20 of the machine 1 and sends a signal to the positioning device 71 when the tub 4 is not in the working position H or is in a position within a predefined range that can be one-half centimeter above or below the working position H, or more precisely one millimeter above or below. The position sensor 8 takes the position data with respect to the axis Z that is perpendicular to the floor and can position data regularly while the machine is operating, and in the case that the position value data is outside the predefined position range, it can send a signal to the

positioning device 71 to displace the tub 4 into the pre-defined position range, preferably at the working position H. The range is preferably defined in the controller 2 of the machine by the manufacturer.

[0028] As an example, in a machine such as that of the invention, the weight of the oscillating unit while washing is increased by the water and the laundry in the washing cycle. The maximum washing machine load is 7 kg, moreover the maximum load washes with approximately 7 liters of the washing liquid which is absorbed by the clothing and is equivalent more or less to the number of kg of laundry multiplied by 1.5. In a 7-kg washing machine there will be a maximum load of approximately 17 mg displacing the tub downward by 2 centimeters. However, during the centrifugation phase, the water is removed and only the weight of the laundry remains plus a mean moisture level of 60%. Estimating for a 7-kg washing machine, there will be a load of 12 kg. This will change the position of the tub during every washing cycle.

[0029] In Figure 2 is shown the same machine as in Figure 1, loaded with laundry 3 before the washing cycle and still with the door 18 open. With the weight of the laundry 3, the tub 4 is displaced downward by a gap of Δh . There will be a deformation in the gasket 6 relative to its relaxed position.

[0030] In Figure 3 is shown the same machine as in the previous figures, with the laundry 3 and the washing liquid introduced into the tub 4 during the washing cycle with the door 18 closed. The displacement device 71 is embodied as an elevator which is fitted to raise the ensemble of the tub 4 and drum 5 by means of a spring 9 to the working position H to operate in this position during the washing cycle.

[0031] Although it is not shown in the figures, a device similar to the foregoing can be arranged in the lower part of the machine in connection with the cushions 10 to raise or lower the tub according to need to situate it in the position range established about the working position.

[0032] In Figure 4 is shown the washing machine of the previous figures, but with another distinct positioning device 72. In this case, the positioning device has a reservoir 42 connected to a water intake 44 from the water mains. The machine in operation during a washing cycle is loaded with a load of laundry 3 and washing liquid at a maximum of that which is emptied from the reservoir 42. The reservoir is emptied of the liquid from its interior by means of a reservoir drainage 46 to the tub 4 for use during the cycle.

[0033] In its lower portion, the tub 4 has a general drainage 12 for the emptying of the washing liquid during the washing cycle and at the end of same.

[0034] Figure 5 shows the machine of Figure 4 once the washing cycle and the emptying of the interior of the drum 5 have been completed. In this case, the reservoir 42 from the positioning device 72 is filled with liquid and the reservoir drainage 46 is closed. In this way, the total weight is equilibrated to bring the tub 4 to the working position.

[0035] The embodiment of a positioning device with a mixture of the described positioning devices is also envisioned.

[0036] List of Reference Numerals

5	1	Front-loading washing machine
	2	Housing
	21	Frontal opening
	3	Laundry
10	4	Tub
	41	Frontal orifice
	5	Drum
	51	Horizontal axis
	6	Gasket
15	62	Frontal flange
	64	Rear flange
	71, 72	Positioning device
	8	Sensor
	9	Spring
20	10	Cushion
	42	Reservoir
	44	Water intake
	46	Reservoir drainage
	12	General drainage
25	14	motor
	16	Fan belt
	18	Door
	20	Controller
30	H	Working position
	Δh	Displacement

Claims

35 1. Washing machine (1) of a front-loading type comprising a housing (2) with a frontal opening (21) for the insertion of laundry (3), a tub (4) having a frontal orifice (41) facing the frontal opening (21) and hanging oscillatingly within said housing (2), a drum (5) mounted in the interior of said tub (4), in which the laundry (3) is insertable and which is rotatable around a horizontal axis (51), and said tub (4) arranged in a working position (H) in absence of laundry (3) and washing liquid in said tub (4), and a gasket (6) arranged in a relaxed state when said tub (4) is in said working position (H), which gasket (6) is coupled between said housing (2) and said tub (4) with a frontal flange (62) connected to said frontal opening (21) and a rear flange (64) connected to said frontal orifice (41), **characterized in that** said washing machine (1) also has a positioning device (71, 72) which can displace said tub (4) to a position within a pre-defined position range, in which said working position (H) is included, to carry out a washing process, with laundry (3) placed in said drum (5) and washing liquid introduced in said tub (4), in said position.

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2. Washing machine (1) according to claim 1, **characterized in that** it also has a position sensor (8) provided to measure a position value of the tub (4) and is connectable to said positioning device (71, 72), and to emit a signal to said positioning device (71, 72) if the position value falls out of said pre-defined position range.

3. Washing machine (1) according to claim 2, **characterized in that** said position sensor (8) is a weight sensor which measures the position value dependent on a weight of laundry (3) and washing liquid introduced into said tub (4), and which emits a signal to said positioning device (71, 72) if the position value falls out of said pre-defined position range.

4. Washing machine (1) according to claim 2, **characterized in that** said position sensor (8) is a displacement sensor which measures the position value dependent on a distance to the tub (4), and which emits a signal to said positioning device (71, 72) if the position value falls out of the pre-defined position range.

5. Washing machine (1) according to one of claims 2 to 4, **characterized in that** said position sensor (8) measures the position value during the washing process after introducing the washing liquid and emits the signal to said positioning device (71, 72), and said positioning device (71, 72) displaces said tub (4).

6. Washing machine (1) according to one of claims 2 to 5, **characterized in that** said position sensor (8) measures the position value during the washing process after draining the washing liquid, and emits the signal to said positioning device (71, 72), and said positioning device displaces said tub (4).

7. Washing machine (1) according to one of the preceding claims, **characterized in that** said tub (4) hangs from at least one spring (9), said spring (9) hangs from said housing (2), and said positioning device (71, 72) is arranged between said tub (4) and said housing (2).

8. Washing machine (1) according to one of the preceding claims, **characterized in that** said tub (4) rests on at least one cushion (10), said at least one cushion (10) rests on said housing (2), and said positioning device (71, 72) is arranged between said tub (4) and said housing (2).

9. Washing machine (1) according to one of the preceding claims, **characterized in that** said positioning device (71, 72) has a reservoir (42) coupled with said tub (4), a water intake (44) for introducing washing liquid into said reservoir (42), and a reservoir drainage (46) for draining washing liquid from said reservoir (42) by displacing said tub (4) as a weight of said reservoir (42) increases or diminishes.

5 10. Washing machine (1) according to claim 9, **characterized in that** said reservoir drainage (46) is connected to said tub (4) and/or to a general drainage (12) of said washing machine (1).

10 11. Method for positioning a tub (4) in a washing machine (1) of a front-loading type comprising a housing (2) with a frontal opening (21) for the insertion of laundry (3), the tub (4) having a frontal orifice (41) facing the frontal opening (21) of the housing (2) hanging oscillating within the housing (2), a drum (5) in the interior of the tub (4), in which the laundry (3) is insertable and which is rotatable around a horizontal axis (51), and the tub (4) arranged in a working position (H) in absence of laundry (3) and washing liquid in said tub (4), and a gasket (6) arranged in a relaxed state when the tub (4) is in the working position (H), which gasket (6) is coupled between the housing (2) and the tub (4) with a frontal flange (62) connected to the frontal opening (21), and a rear flange (64) connected to the frontal orifice (41), **characterized in that** a positioning device (71, 72) is provided in the washing machine (1), which after placing laundry (3) to be subjected to a washing process into the drum (5) and introducing washing liquid into the tub (4), displaces the tub (4) to a position within a pre-defined position range in which the working position (H) is included, to carry out the washing process in the position.

15 20 25 30 35 40 45 50 55

12. Method according to claim 11, **characterized in that** a position sensor (8) is included in the washing machine (1) for measuring the position value of the tub (4), wherein the position sensor (8) emits a signal to the positioning device (71, 72) if the tub (4) is not within the pre-defined position range, and the positioning device (71, 72) displaces the tub (4) if the tub (4) is not within the pre-defined position range.

13. Method according to one of claims 11 and 12, **characterized in that** the positioning device (72) introduces or drains the washing liquid from a reservoir (42) until the tub (4) is arranged within the pre-defined position range, in particular in the working position (H).

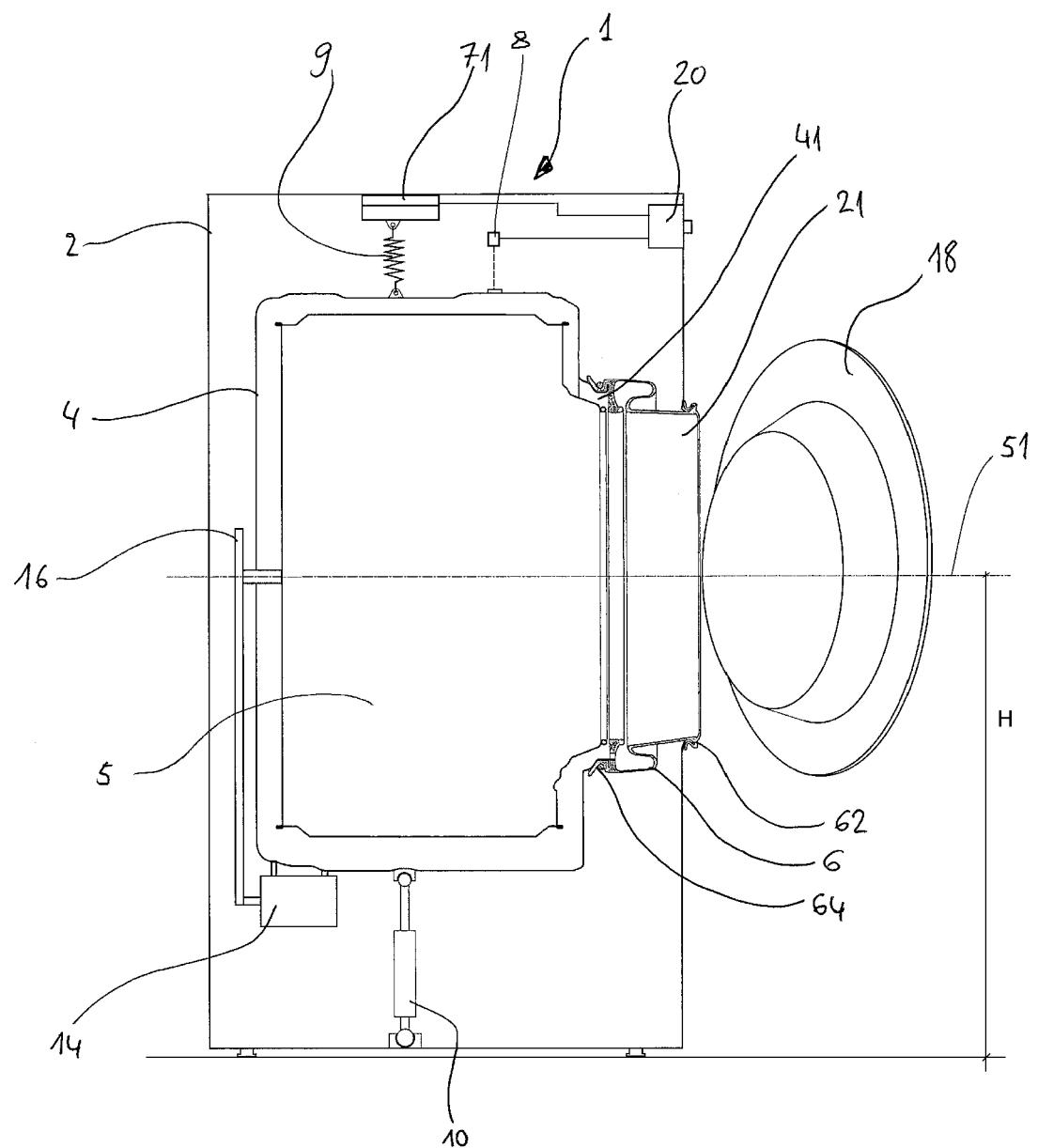


FIG.1

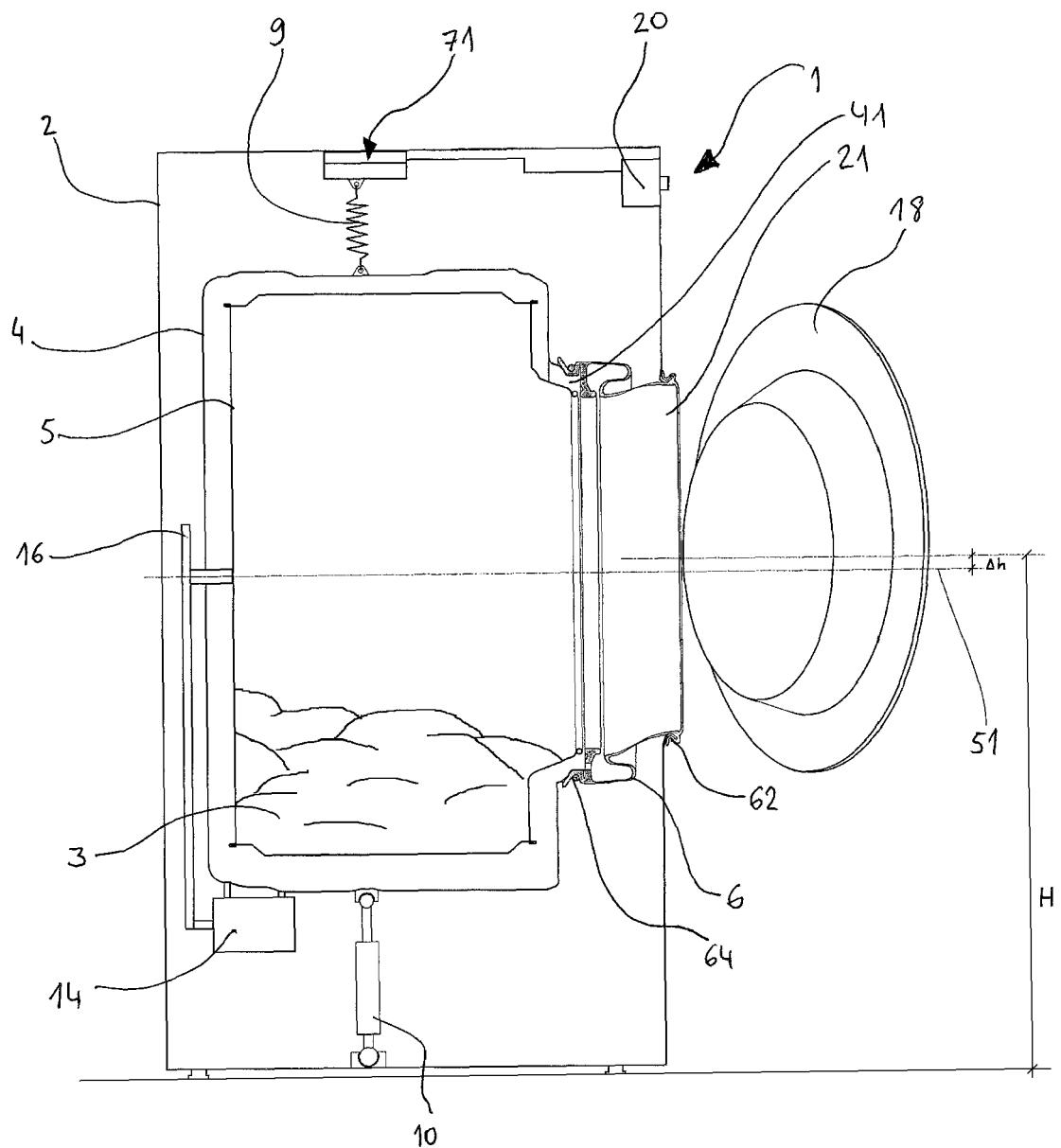


FIG.2

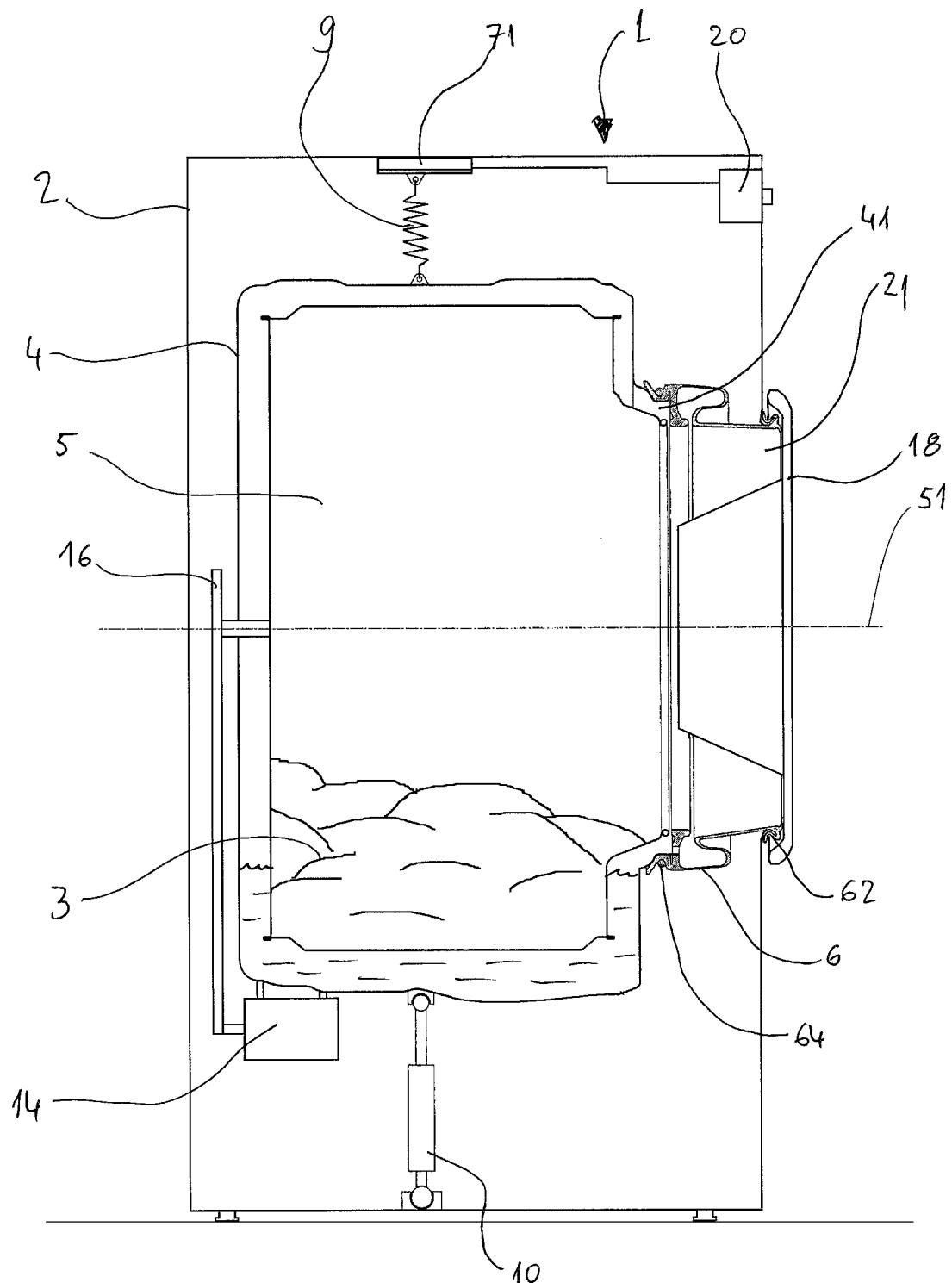


FIG.3

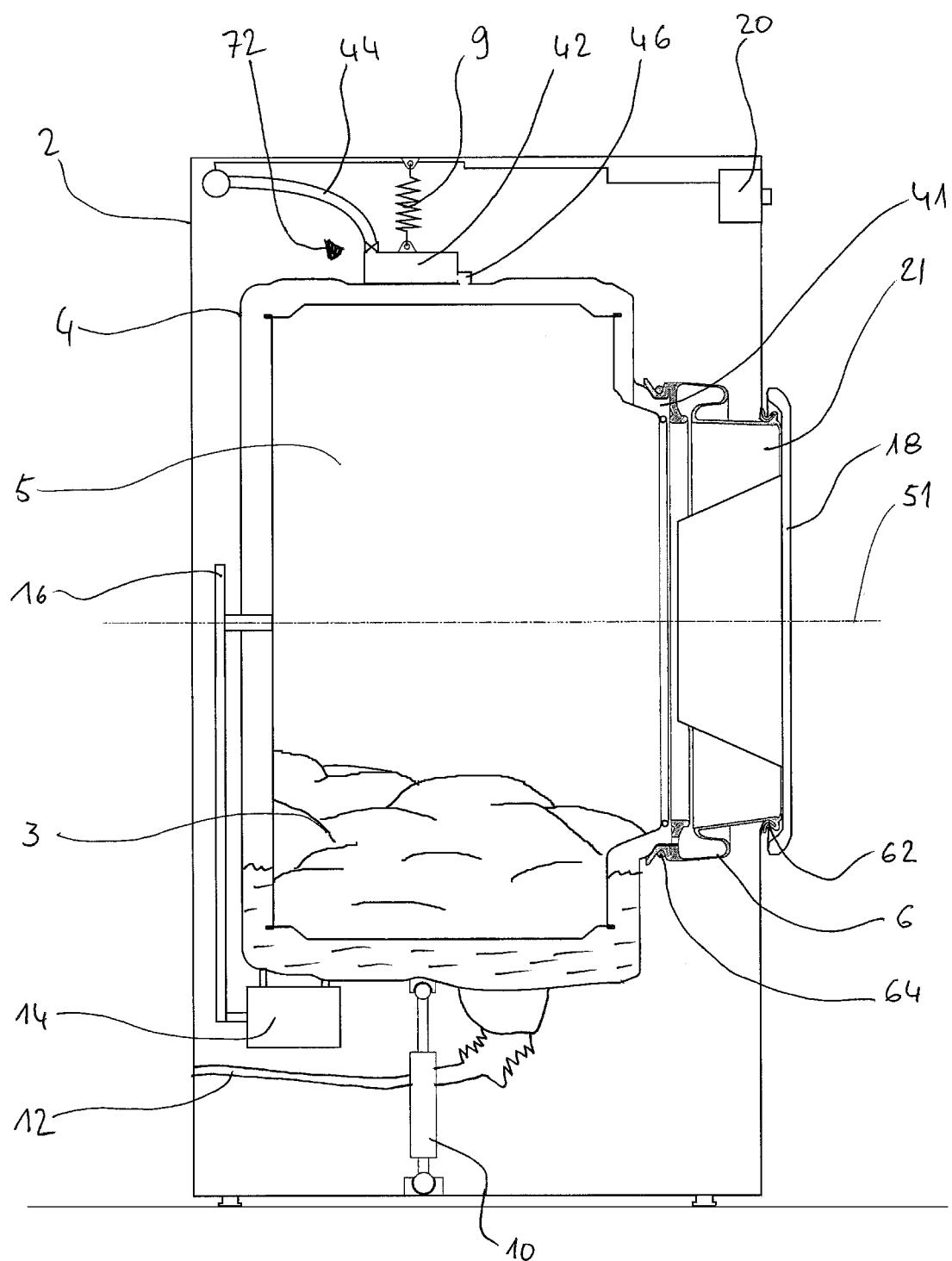


FIG.4

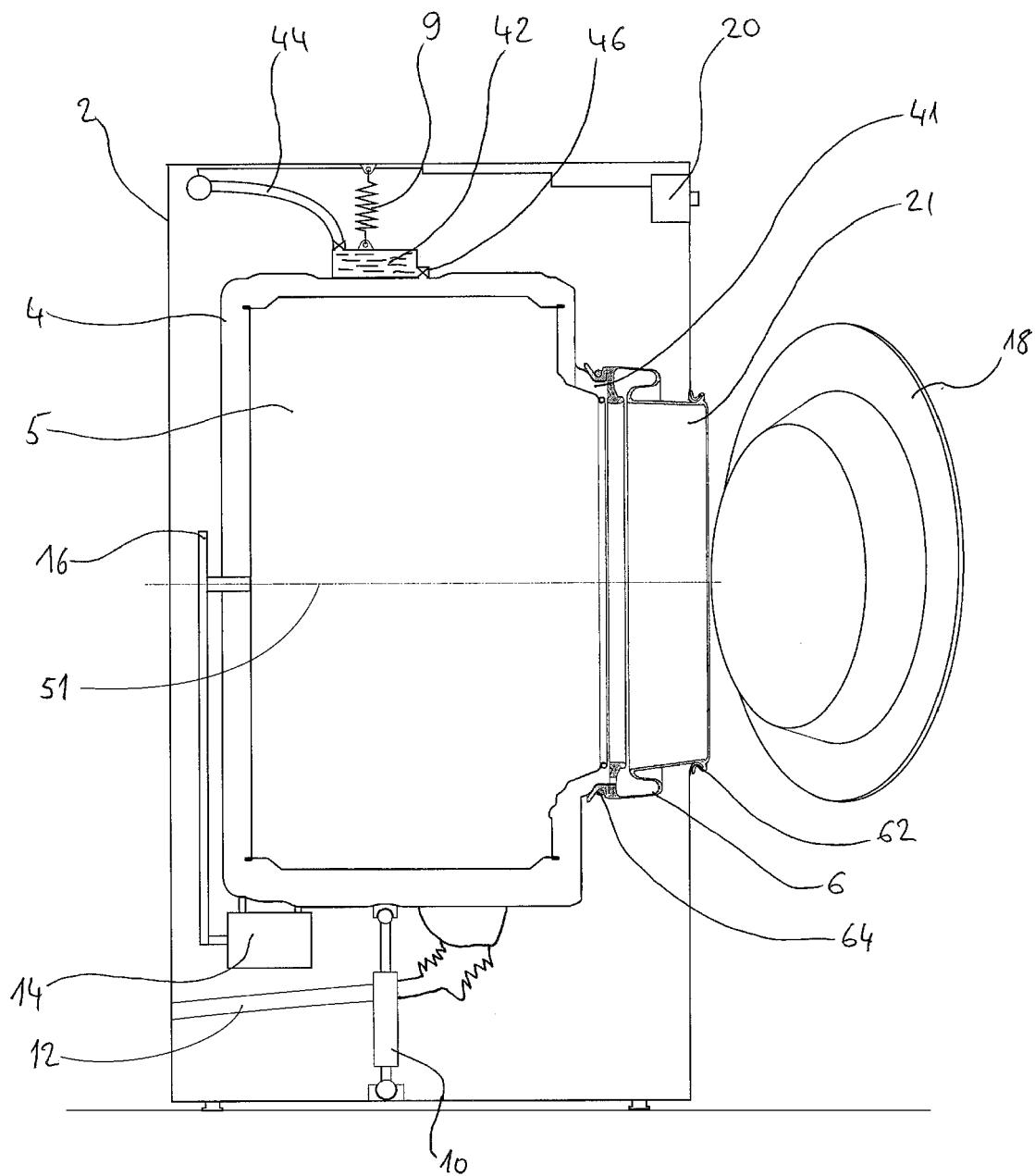


FIG.5



EUROPEAN SEARCH REPORT

Application Number

EP 10 18 6859

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (IPC)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	DE 10 2007 038672 A1 (MIELE & CIE [DE]) 26 February 2009 (2009-02-26) * paragraph [00190023]; claim 1; figures * -----	1,2,4,7, 11,12	INV. D06F37/26 D06F37/22
X	DE 44 39 153 A1 (MIELE & CIE [DE]) 9 May 1996 (1996-05-09) * column 2, lines 23-47; figure 1 * -----	1,2,4,7, 11,12	
A	US 2009/139273 A1 (KIM NA EUN [KR] ET AL) 4 June 2009 (2009-06-04) * the whole document * -----	1-13	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
1	Place of search	Date of completion of the search	Examiner
	Munich	22 February 2011	Stroppa, Giovanni
CATEGORY OF CITED DOCUMENTS <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>			

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

EP 10 18 6859

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-02-2011

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
DE 102007038672	A1	26-02-2009		NONE		
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REFERENCES CITED IN THE DESCRIPTION

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