



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
16.04.2014 Bulletin 2014/16

(51) Int Cl.:
D06F 39/02 (2006.01) **D06F 39/08 (2006.01)**
D06F 35/00 (2006.01) **D06F 37/26 (2006.01)**

(21) Application number: **12425164.6**

(22) Date of filing: **09.10.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(72) Inventor: **Fumagalli, Aldo**
20900 Monza (MB) (IT)

(74) Representative: **Sgobba, Marco et al**
Perani & Partners
Piazza San Babila, 5
20122 Milano (IT)

(71) Applicant: **Candy S.p.A.**
20900 Monza (MB) (IT)

(54) **Laundry washing machine with enhanced detergent activation**

(57) A laundry washing machine comprises a washing tub (2) containing a rotatable drum (3), a detergent compartment (5) in fluid communication with a liquid source, a supply pipe for liquid and detergent to flow into the tub (2), a recirculation circuit (10) for drawing liquid from the bottom of the tub (2) and feed it back into said drum (3), a control and monitoring unit (22) designed to cause liquid and detergent to flow into the tub (2) and to recirculate the mixture for a period of time T by rotating said drum (3) at a speed V. The control and monitoring unit (22) is designed to increase the rotation speed of the drum (3) during the period of time T to a value sufficient to cause the laundry to be at least partially wrung out for a time t shorter than the time T, the control and monitoring unit (17) actuating the recirculation circuit (10) during the period t to spray the interior of the drum (3) with recirculated liquid through a plurality of nozzles (11).

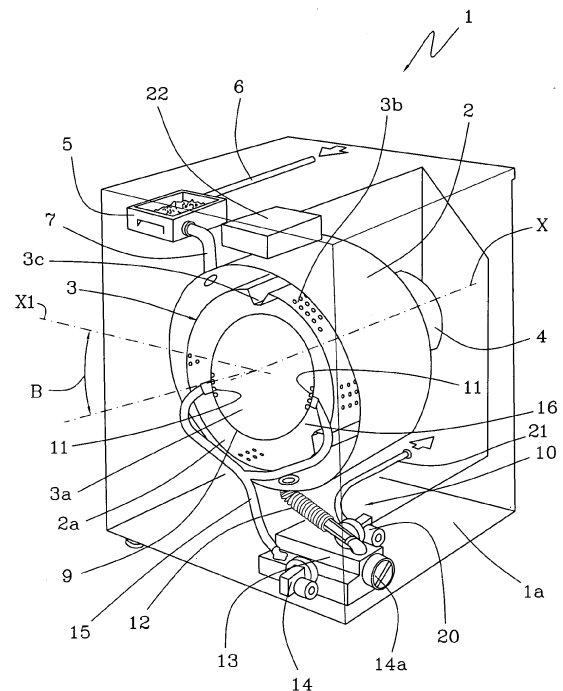


FIG 1

Description

[0001] The present invention relates to a laundry washing machine with enhanced detergent activation.

[0002] As used herein, the term laundry washing machine is intended to designate any machine adapted to perform washing operations on laundry, irrespective of the possibility of also drying the washed laundry or not. Therefore, in the present disclosure and annexed claims, combination washer/dryer machines are also intended to be covered by the definition of laundry washing machines.

[0003] The laundry washing machine of the present invention is of the type that comprises a tub containing a drum for receiving the laundry to be washed, which is rotated about an axis of rotation, a detergent compartment in fluid communication with a liquid source, a supply pipe extending between the detergent compartment and the tub, for a mixture of liquid and detergent to flow into the tub, a recirculation circuit extending between a bottom area of the tub and a plurality of delivery nozzles facing into the drum to draw liquid from the bottom of the tub and feed it back into the drum, a control and monitoring unit designed to cause a given amount of liquid and detergent mixture to flow into the tub and to recirculate the mixture for a period of time T by rotating the drum at a speed V.

[0004] In laundry washing machines, the operating cycle is known to comprise a starting step of duration T, in which a flow of detergent is created, one dose of such detergent, in powder, granule or liquid form, being loaded in the detergent compartment. A first, relatively small amount of liquid, typically water, is fed to such compartment, to cause the detergent dose to flow from the detergent compartment to the tub of the machine.

[0005] Additional amounts of liquid will be later added to the first amount of detergent-carrying liquid, according to the laundry load in the machine, to ensure full dissolution of the detergent dose.

[0006] According to the prior art, the total amount of liquid in the tub, in the preliminary step of the washing cycle, also known as detergent activation step, does not generally exceed 5 liters. Considering that the detergent dose used with a conventional laundry load of 5 kg is typically about 150 g, the concentration of detergent in the liquid in this step of the cycle reaches 30 g/liter.

[0007] While liquid with detergent recirculation lasts an adequately long time T, typically 10 or 12 minutes, with the drum rotating at a speed V for laundry distribution in the drum, also known as satellizing speed, typically ranging from 75 revolutions/minutes to 120 revolutions/minutes, not all the parts of the laundry are reached by the recirculated liquid with detergent. Since most of the recirculated liquid is retained by the laundry being wetted, the amount of recirculated liquid is smaller and is increasingly reduced as the cycle is being executed during the time T, which will limit detergent distribution through the laundry.

[0008] Due to the above, in the prior art, the detergent would be distributed through the laundry mainly during the next steps of the washing cycle.

[0009] Nevertheless, during these steps, an additional amount of liquid is added to the initial amount, which increases the total amount to about 15 liters, and decreases detergent concentration from the initial 30 grams/liter to about 10 grams/liter.

[0010] Detergent distribution on the laundry is completed at a concentration well below the concentration that would be available initially, as detergent is being fed into the tub, which will lead to a lower detergent effectiveness on any spots on the laundry to be washed.

[0011] The present invention is based on the problem of optimized utilization of detergent effectiveness on laundry fabrics starting from the first step of the operating cycle of the machine, i.e. when the detergent is dissolved in its compartment in a relatively small amount of water and is recirculated while its concentration in the liquid is relatively higher than the concentration found in the later washing steps of the machine.

[0012] This problem is solved as defined in one or more of the annexed claims. The laundry washing machine with enhanced detergent activation of the present invention will be now described in greater detail with reference to the accompanying drawings, given by way of illustration and without limitation, in which:

- Figure 1 is a schematic view of the tub and drum of a laundry washing machine of the present invention, with its detergent compartment and the main hydraulic connections for liquid recirculation;
- Figure 2 is a sectional view of a detail of the machine of Figure 1, and
- Figure 3 is a further view of the detail of Figure 2.

[0013] Referring to the annexed figures, numeral 1 generally designates a laundry washing machine with enhanced detergent activation of the present invention.

[0014] The machine 1 comprises a washing tub 2 containing a drum 3 for holding the laundry to be washed, which is designed to rotate about an axis of rotation X. An electric motor 4 (schematically shown in the figures) is operatively connected to the drum 3 to rotate it about the axis X. The drum 3 is mounted to the frame 1a of the machine in a conventional manner to be able to rotate at various speeds and in various directions, as is peculiar to a laundry washing machine. The drum 3 conventionally has a cylindrical wall with through holes 3b and ribs 3c for satellite-like motion and distribution of the laundry load during drum rotation.

[0015] A detergent compartment 5, in which a dose of detergent in powder, tablet or liquid form is loaded, is put in fluid communication with a source of liquid, preferably mains water, through a supply pipe 6. A supply pipe 7 extends between the detergent compartment 5 and the tub 2 to feed a mixture of liquid and detergent to the tub 2.

[0016] The drum 3 and the tub 2 have respective open-

ings 3a, 2a for introduction and removal of the laundry into and from the machine. These openings 2a, 3a are engaged by a door 8, which is pivotally joined to the frame 1a of the machine, to be opened and closed, thereby opening and closing the openings 2a, 3a.

[0017] In order to ensure fluid tightness between the door 8 and the tub 2, an elastic coupling 9 is constrained between the structure 1a and the tub 2. The elastic coupling (see Figure 2) operates between the door 8 and the tub 2, such that when the door is closed it will sealingly contact the elastic coupling 9. The elastic coupling 9 has a series of loops, allowing it to fit the opening 2a of the tub 2, thereby ensuring the required fluid tightness.

[0018] A recirculation circuit 10 extends between a bottom area of the tub 2 and a plurality of delivery nozzles 11 facing into the drum 3, for drawing liquid from the bottom of the tub 2 and reintroduce it into the drum 3.

[0019] The recirculation circuit 10 comprises a discharge line 12 extending from the bottom area of the tub 2 to a liquid collecting tank 13 and a pump 14 in fluid communication with the tank 13 for drawing the fluid therefrom and conveying it into an inflow line 14 extending between the pump 14 and the delivery nozzles 11. The recirculation pump 14 is further equipped with a filter 14a of conventional type for stopping any solid body (but- tons, coins and the like) that flow out of the tub 2 and prevent reintroduction thereof into the drum 3. A drain pump 20 is put in fluid communication with the tank 13 and with a drain line 21. The recirculation pump 14 is constantly flooded (due to its fluid connection with the tank 13). The recirculation pump 14 and the drain pump 20 operate alternately, which means that they never operate simultaneously. Particularly, when the recirculation pump 13 operates to reintroduce fluid into the drum 3, the drain pump 20 is idle, whereas when the drain pump 20 operates for fluid drainage, the recirculation pump 13 is idle. In the embodiment of Figure 1, for simplicity, the recirculation pump 14 and the drain pump 20 are shown as being integrated in a single body, but the two pumps may form two distinct bodies.

[0020] The nozzles 11 are in such an arrangement that the projection of the delivery directions E in a vertical plane containing the axis of rotation X of the drum 3 are inclined at an angle A ranging from 30° to 80°, preferably from 40° to 60°, more preferably about 50° from the axis of rotation X of the drum 3 (see Figure 2 that shows a section of the elastic coupling on a plane that passes through the center of the drum and one of the nozzles). The projections of the delivery directions E on a plane perpendicular to the axis of rotation X of the drum 3 (i.e. the plane substantially containing the door 8) substantially converge into a point placed in a central area of the drum 3.

[0021] Thus, the nozzles 11 spray liquid to a central and deep portion of the drum 3. It shall be noted that the term delivery direction, related to nozzles is intended to indicate the bisector of the angle of the nozzle jet. Such jet has a spray angle ranging from 10° to 30°, preferably

about 20°.

[0022] Advantageously, the nozzles 11 are directly formed in the elastic coupling 9. Particularly, the nozzles 11 are formed in a loop of the elastic coupling 9. The nozzles 11 are arranged in two sets 11a of nozzles, each comprising a plurality of nozzles 11. Preferably, each set 11a of nozzles 11 comprises four nozzles. The two sets of nozzles are placed in symmetric positions with respect to a vertical axis passing through the center of the drum 3. Particularly, each set 11a of nozzles 11 is placed on the elastic coupling 9 at an angular distance B ranging from 0° to 45°, preferably about 15°, from a horizontal axis X1 passing through the elastic coupling 9 and contained in a plane passing through the center of the drum 3 (see Figure 1). The two sets 11a of nozzles are placed in the half of the elastic coupling 9 that faces the recirculation pump 14.

[0023] In order to form a set 11a of nozzles, the elastic coupling comprises an opening 16 that puts the inner side of the elastic coupling 9, i.e. the part facing the interior of the tub 2, in fluid communication with the outer side of the elastic coupling 9, i.e. the side facing toward the environment external to the tub 2. At the inner side of the elastic coupling 9, a plurality of partitions 17 are arranged in each opening 16, to form a plurality of channels 18 through which the recirculated fluid is fed into the drum 3. The number of channels 18 is equal to the number of nozzles 11, whereas the number of partitions is equal to the number of channels less one (see Figure 3, showing a plan view of one portion of the elastic coupling). A connecting sleeve 19 is provided, for each set of nozzles, at the outer portion of the elastic coupling 9, and is preferably integral with the elastic coupling 9. The connecting sleeve 19 is engaged by the inflow line 15 such that the recirculation fluid flows through the elastic coupling 9 and is delivered into the drum 3. The inflow line 15 has a Y shape, and has an inlet connected to the recirculation pump 14 and two outlets each connected to a connecting sleeve 19 at the corresponding set of nozzles.

[0024] In one embodiment of the invention, not shown, a substantially curved manifold is provided, in fluid communication with the recirculation circuit, the nozzles being arranged on such manifold. The manifold is joined at least at one point to the elastic coupling 9 and conforms with its profile. The manifold has the shape of a sector of a circle and extends along the elastic coupling through about 270°. The nozzles are arranged along the manifold in nozzle sets.

[0025] The machine 1 further comprises a control and monitoring unit 22 (as schematically shown in the annexed figures), which is operatively connected to the recirculation pump 14, the drain pump 20 and the electric motor 4 for controlled actuation thereof.

[0026] Particularly, the control unit 22 is designed to feed a given amount of mixture of liquid and detergent into the tub 2, and to recirculate the mixture for a period of time T, by rotating the drum at a speed V, thereby

carrying out a detergent distribution and actuation step, during which the laundry is wetted. It shall be noted that, after the time T, the control and monitoring unit 22 executes a conventional washing cycle.

[0027] During the period of time T, a preliminary amount of water, to about five liters, is caused to reach the compartment 5 that contains the detergent dose to dilute the latter to a concentration of about 30 g/liter.

[0028] During recirculation of liquid and detergent, the drum 3 is rotated at the speed V, usually ranging from 75 revolutions/minute to 120 revolutions/minute, to allow laundry distribution within the drum 3 and separation of the pieces that form the laundry load to be washed.

[0029] By combining rotation of the drum 3 at the speed B and recirculation, the liquid with detergent is distributed over the laundry which is initially dry and absorbs it, thereby reducing the amount of liquid available for recirculation.

[0030] According to the invention, during distribution and activation of the detergent, i.e. during the time T, the control and monitoring unit 22 is designed to increase the rotation speed of the drum 3 to a speed $V1 > KV$ for a time t shorter than the time T, where K is a multiplication factor whose value is sufficient to cause the laundry to be at least partially wrung out by centrifugal effect.

[0031] It shall be noted that the at least partial wringing out of the laundry by centrifugal effect requires the drum 3 to rotate at such a speed as to allow at least a part of liquid retained by the wetted laundry to be wrung out of it.

[0032] For this purpose, the multiplication factor K is a number, not necessarily an integer, greater than 2. Preferably, the rotation speed of the drum is higher than 300 revolutions/minute.

[0033] Furthermore, as mentioned above, during the time T and particularly during the time t, the control unit 22 is designed to actuate the recirculation circuit 10 to spray the interior of the drum 3, and hence the laundry, with recirculated liquid through the plurality of delivery nozzles 11.

[0034] The time t preferably ranges from 5 to 20 seconds. Preferably, during the time T in which laundry wetting recirculation and detergent distribution occur, the drum 3 runs through a plurality of periods $t1, t2, \dots, tn$, during which the rotation speed is increased to the speed $V1$ and then dropped back to the speed V.

[0035] Also preferably, the steps through which the drum speed is changed to the value $V1$ may be proximate in time, and form a pair, or distant.

[0036] When they form a pair, the first step may be at a speed $V1$ and the following step at a speed $V2$, the speeds $V1$ and $V2$ being different although fulfilling the condition of being both higher than the speed V multiplied by the factor K greater than 2.

[0037] Particularly, the speed $V2$ of the succeeding rotation step of the pair of steps may be lower than the speed $V1$ of the preceding rotation step.

[0038] The high speed pulses imparted to the drum during the detergent dissolution and liquid recirculation

step cause the laundry to be wrung out, although for a limited time, thereby causing partial recovery of the recirculated liquid. Furthermore, such high speed pulses, having a higher speed than conventional satellite-like distribution of laundry in the drum, cause a mechanical action on the laundry load, that will more effectively separate the pieces that form it, thereby exposing a larger surface of the fabrics to the recirculated detergent.

[0039] The plurality of nozzles 11 allows highly uniform and effective wetting of the laundry so arranged. Such effect is maximized by the particular arrangement and configuration of the nozzles 11.

[0040] Due to the combined effect of the plurality of nozzles and the high speed pulses, the activity of the detergent on the laundry in the tub is enhanced when its concentration is higher than that of the later steps of the washing cycle, thereby involving advantages in terms of overall performance of the machine, including power saving performance.

Claims

1. A laundry washing machine with enhanced detergent activation, a washing tub (2) containing a drum (3) for receiving the laundry to be washed, which is designed to be rotated about an axis of rotation (X), a detergent compartment (5) in fluid communication with a liquid source, a supply pipe (7) extending between said detergent compartment (5) and said tub (2), for a mixture of liquid and detergent to flow into the tub (2), a recirculation circuit (10) extending between a bottom area of the tub (2) and a plurality of delivery nozzles (11) facing into said drum (3) to draw liquid from the bottom of the tub (2) and feed it back into said drum (3), a control and monitoring unit (22) designed to cause a given amount of liquid and detergent mixture to flow into said tub (2) and to recirculate said mixture for a period of time T by rotating said drum (3) at a speed V, **characterized in that** said monitoring and control unit (22) is designed to increase the rotation speed of the drum (3) during the period of time T to a speed $V1 > KV$ for a time t shorter than the time T, wherein K is a multiplication factor, whose value is sufficient to cause the laundry to be at least partially wrung out by centrifugal effect, said control and monitoring unit (22) being designed to actuate said recirculation circuit (10) during said time t, to spray the interior of the drum (3) with recirculated liquid through the plurality of delivery nozzles (11), said delivery nozzles being stationary relative to said tub (2), and arranged along at least part of the circumference of said drum (3) and have a plurality of delivery directions (E) toward a central region of the drum (3).
2. A machine as claimed in claim 1, wherein said multiplication factor K is a number, not necessarily an

integer, greater than 2.

3. A machine as claimed in claim 1 or 2, wherein said control and monitoring unit (17) is designed to actuate at least a pair of increases of the rotation speed of the drum (3) during the period of time T; the rotation speed $V1 > KV$ of the first speed increase being higher than the rotation speed $V2 > KV$ of the second speed increase. 5
4. A machine as claimed in any of claims 1 to 3, wherein the rotation speed $V1$ is higher than 300 revolutions/minute. 10
5. A machine as claimed in any preceding claim, wherein the projection of the delivery directions of said nozzles (11) in a vertical plane containing the axis of rotation X of the drum (3) are inclined at an angle A ranging from 30° to 80° , preferably about 50° from the axis of rotation X of the drum (3). 20
6. A machine as claimed in any preceding claim, wherein said drum (3) and said tub (2) comprise respective openings (3a, 2a) for the passage of laundry; said openings (2a, 3a) being engaged by a door (8) for opening and closing said openings; a fluid-tight elastic coupling being placed between said door (8) and the opening (2a) of said tub (2); said plurality of nozzles (11) being formed in said elastic coupling (9). 25
30
7. A machine as claimed in any preceding claim, wherein said nozzles (11) are arranged in at least two sets (11a) of nozzles; each set (11a) comprising a plurality of nozzles (11). 35
8. A machine as claimed in claim 7, wherein the sets (11a) of nozzles (11) are situated in symmetric locations with respect to a vertical axis passing through the center of the drum (3); each set (11a) of nozzles (11) being placed on the elastic coupling (9) at an angular distance (B) ranging from 0° to 45° , preferably about 15° , from a horizontal axis (X1) passing through the elastic coupling (9) and contained in a plane passing through the center of the drum (3). 40
45
9. A machine as claimed in claim 7 or 8, wherein, at each set (11a) of nozzles (11), said elastic coupling (9) comprises an opening (16) that puts the side of the elastic coupling 9 facing the interior of the tub (2) in fluid communication with the side of the elastic coupling facing toward the environment external to the tub (2). 50
10. A machine as claimed in claim 9, wherein a plurality of partitions (17) are arranged in each opening (16), to form a plurality of channels (18) through which the recirculated fluid is fed into the drum (3), the number of channels (18) being equal to the number of noz-

zles (11).

11. A machine as claimed in claim 10, wherein the number of partitions (17) is equal to the number of channels (18) less one.
12. A machine as claimed in any claim from 1 to 11, wherein said recirculation circuit (10) comprises a discharge line (12) which extends from a bottom portion of the tub (2) to a collecting tank (13), a recirculation pump (14) in fluid communication with said tank (13) and an inflow line (15) extending between said recirculation pump (14) and said nozzles (11).
13. A machine as claimed in claims 7 and 12, wherein the elastic coupling (9) comprises a connecting sleeve (19) located at each set (11a) of nozzles; said connecting sleeve (19) being engaged by said inflow line (15) for the recirculated fluid to flow through the elastic coupling (9) and be delivered to the interior of the drum (3).

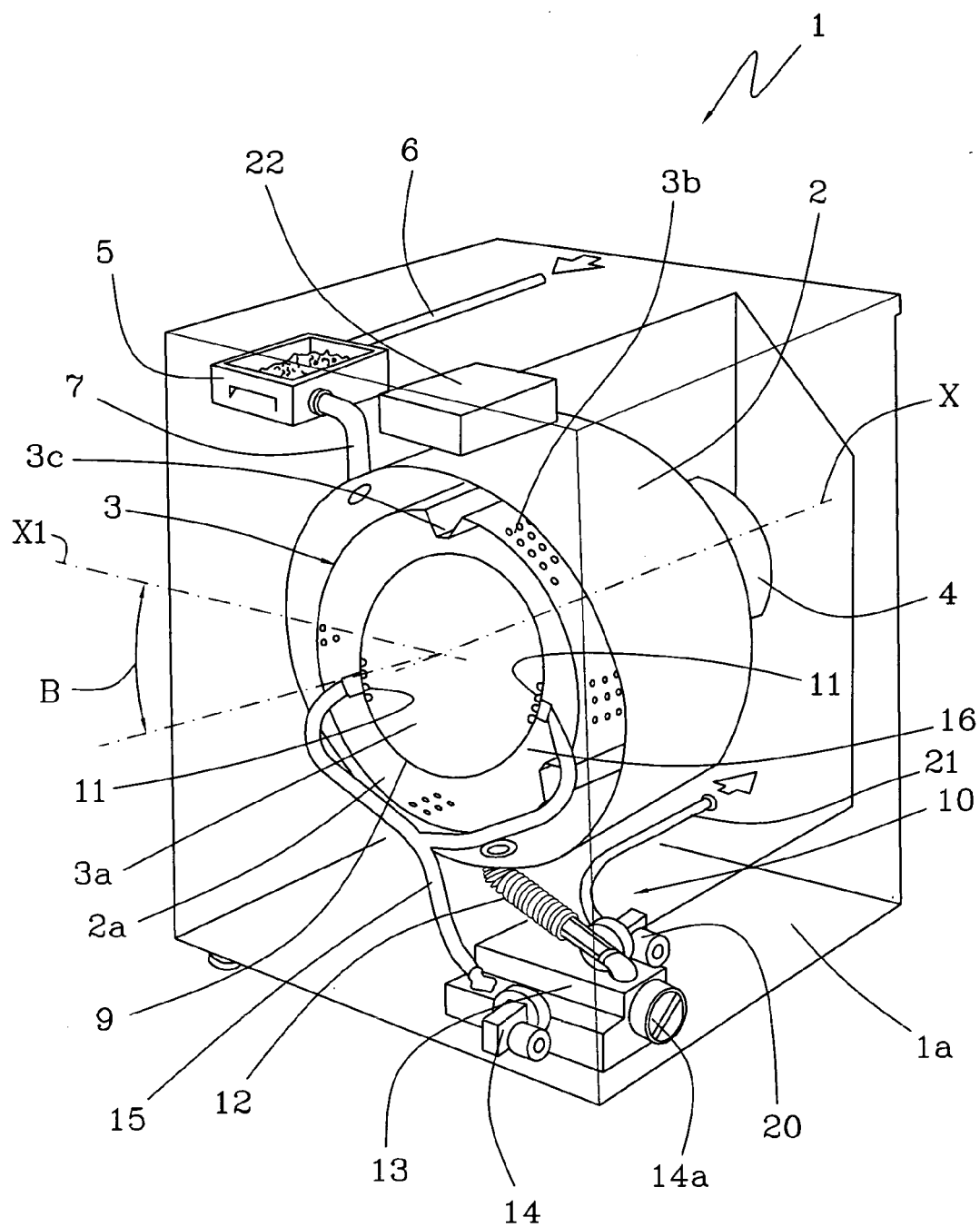


FIG 1

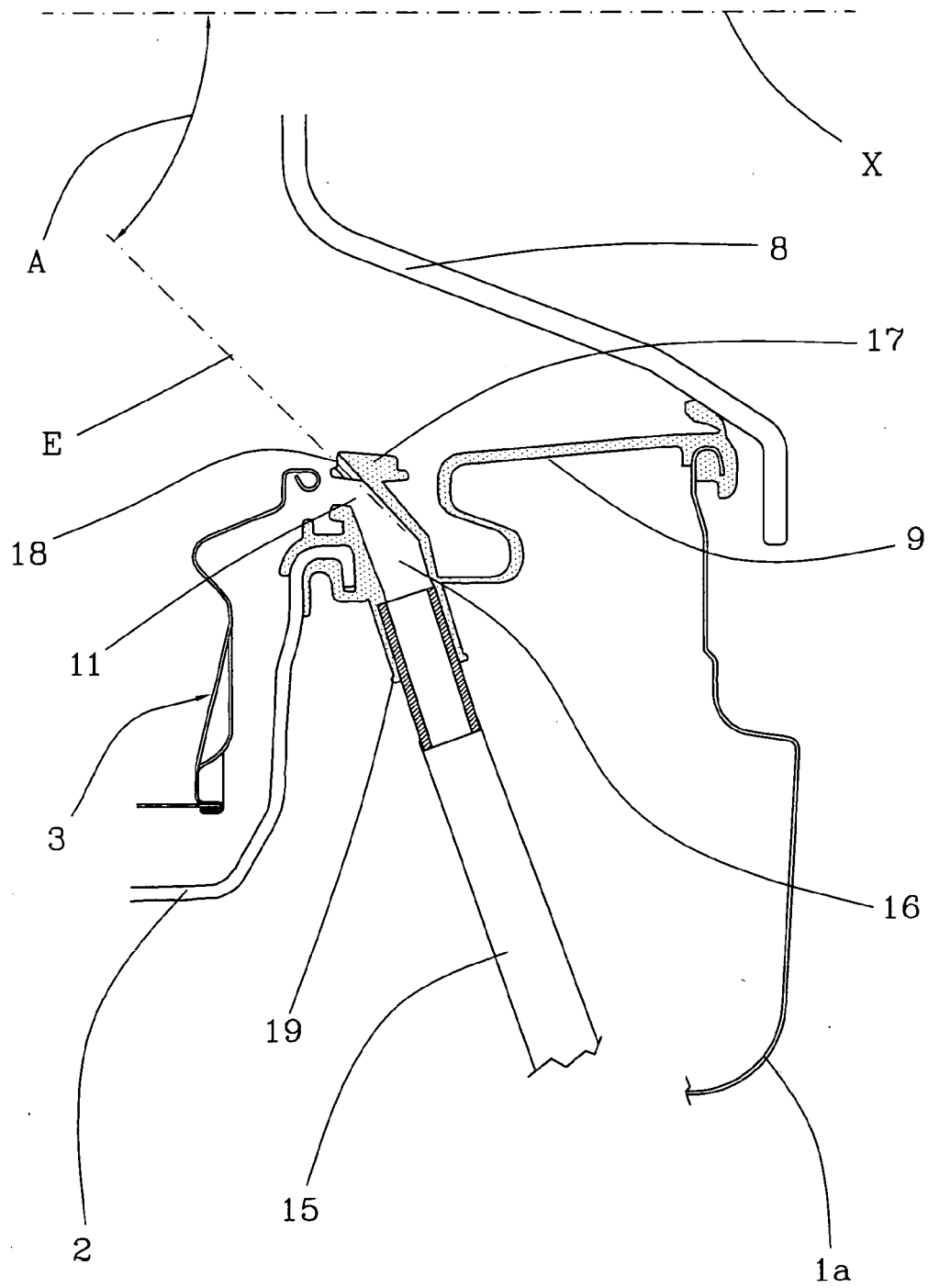


FIG 2

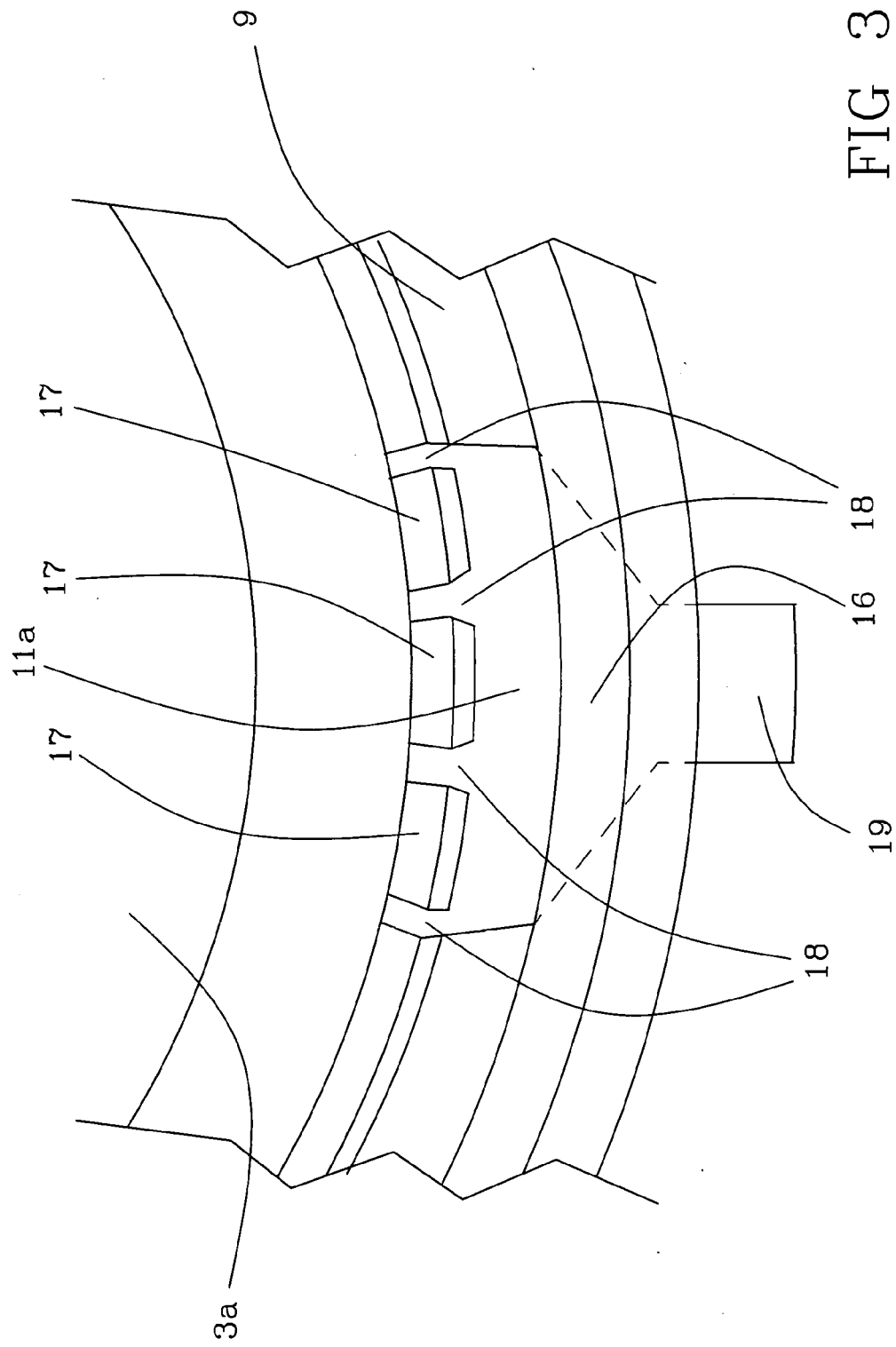


FIG 3



EUROPEAN SEARCH REPORT

Application Number
EP 12 42 5164

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	US 2009/249840 A1 (JO MIN-GYU [KR] ET AL) 8 October 2009 (2009-10-08) * the whole document *	1,2,5-9, 12,13	INV. D06F39/02 D06F39/08 D06F35/00 D06F37/26
Y	----- US 2007/283508 A1 (WONG NYIK SIONG [US] ET AL) 13 December 2007 (2007-12-13) * abstract * * paragraphs [0069] - [0072], [0075], [0076], [0091] - [0093]; figures *	3,4,10, 11	
Y	----- US 2007/283508 A1 (WONG NYIK SIONG [US] ET AL) 13 December 2007 (2007-12-13) * abstract * * paragraphs [0069] - [0072], [0075], [0076], [0091] - [0093]; figures *	3,4	
Y	----- WO 2011/046358 A2 (LG ELECTRONICS INC [KR]; KIM WOO YOUNG [KR]; HONG MOON HEE [KR]; WOO K) 21 April 2011 (2011-04-21) * the whole document *	10,11	
X	----- EP 0 726 349 A2 (CANDY SPA [IT]) 14 August 1996 (1996-08-14) * the whole document *	1,2,6-9, 12,13	
X	----- EP 1 555 339 A2 (SAMSUNG ELECTRONICS CO LTD [KR]) 20 July 2005 (2005-07-20) * the whole document *	1,2,4, 6-9,12, 13	TECHNICAL FIELDS SEARCHED (IPC) D06F
X	----- US 2010/242186 A1 (KIM WOO YOUNG [KR] ET AL) 30 September 2010 (2010-09-30) * the whole document *	1,2,6-9, 12,13	
X	----- DE 42 10 782 A1 (LICENTIA GMBH [DE]) 7 October 1993 (1993-10-07) * the whole document *	1,5,6,12	
A	----- DE 10 2009 002782 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 11 November 2010 (2010-11-11) * the whole document *	1-13	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 March 2013	Examiner Prosig, Christina
CATEGORY OF CITED DOCUMENTS 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		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	

1
EPO FORM 1503 03.02 (P04C01)

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

EP 12 42 5164

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.

20-03-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009249840 A1	08-10-2009	CN 101925699 A	22-12-2010
		EP 2271800 A2	12-01-2011
		JP 2011509139 A	24-03-2011
		KR 20090107164 A	13-10-2009
		US 2009249840 A1	08-10-2009
		WO 2009125952 A2	15-10-2009
US 2007283508 A1	13-12-2007	NONE	
WO 2011046358 A2	21-04-2011	AU 2010307529 A1	03-05-2012
		CN 102575412 A	11-07-2012
		EP 2488689 A2	22-08-2012
		US 2011083477 A1	14-04-2011
		WO 2011046358 A2	21-04-2011
EP 0726349 A2	14-08-1996	DE 69616392 D1	06-12-2001
		DE 69616392 T2	27-06-2002
		EP 0726349 A2	14-08-1996
		IT MI950244 A1	12-08-1996
EP 1555339 A2	20-07-2005	CN 1637192 A	13-07-2005
		EP 1555339 A2	20-07-2005
		JP 3980585 B2	26-09-2007
		JP 2005192997 A	21-07-2005
		KR 20050072294 A	11-07-2005
		US 2005144735 A1	07-07-2005
US 2010242186 A1	30-09-2010	CN 102301053 A	28-12-2011
		EP 2414577 A2	08-02-2012
		US 2010242186 A1	30-09-2010
		WO 2010114316 A2	07-10-2010
DE 4210782 A1	07-10-1993	DE 4210782 A1	07-10-1993
		FR 2689527 A3	08-10-1993
		IT 1263886 B	04-09-1996
DE 102009002782 A1	11-11-2010	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82