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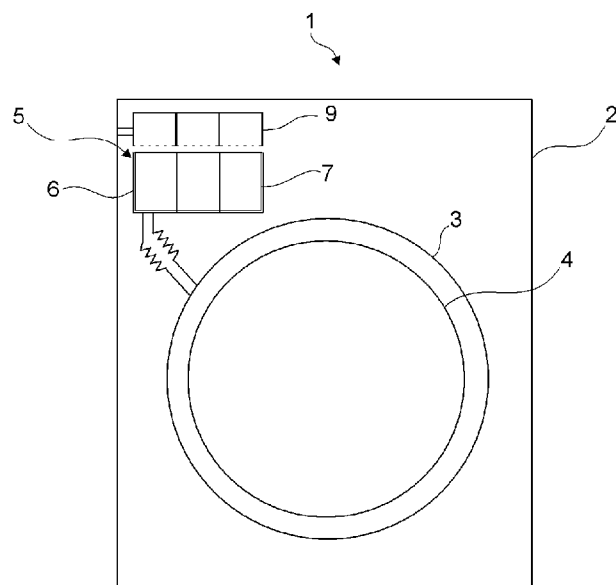
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(54) Title: A WASHING MACHINE COMPRISING A DETERGENT BOX ASSEMBLY AND A METHOD OF OPERATING A
WASHING MACHINE

Figure 1



(57) Abstract: The present invention relates to a washing machine (1) as well as to a method of operating the same, whereby said washing machine (I) comprises a detergent box assembly (5) comprising a detergent box (7) having at least one compartment (8) wherein a cleaning agent is placed and wherein the cleaning agent is mixed with water and a flushing device (9) disposed over the detergent box (7) which provides the water received from the mains to be directed into the at least one compartment (8) of the detergent box (7), said detergent box (7) further comprising at least one additional flushing element (II) provided with a fluid oscillator (12) producing a sweeping jet of fluid for removing the cleaning agent placed in the detergent box (7).

Description**A WASHING MACHINE COMPRISING A DETERGENT BOX ASSEMBLY AND A METHOD OF OPERATING A WASHING MACHINE**

- [0001] The present invention relates to a washing machine comprising a detergent box assembly wherein cleaning agents are put and a method of operating such washing machine.
- [0002] Washing machines, such as washing or washing/drying machines, comprise detergent boxes wherein cleaning agents such as detergent, softener etc. are put. The cleaning agents placed in the detergent box are transferred to the tub after being mixed with water received from the mains. To this aim washing machines generally further comprise flushing devices that are arranged over the detergent boxes. A flushing device is designed to receive water from the main and to distribute it into the different compartments of the detergent box. More in detail, the flushing device comprises one or more channels through which water received from the mains is guided and a plurality of holes provided on the bottom of each channel allowing water to pass into the correspondent detergent box compartment.
- [0003] The cleaning agents put into the detergent box often cannot be entirely swept by the water poured into the compartments through the flushing device, particularly when the pressure of the water received from the mains is low and hence cleaning agent residues remain on the detergent box which are difficult to be removed and that cause the formation of harmful bacteria over the time. This situation not only affects adversely the washing/rinsing performance of the washing machine but also affects the customer satisfaction negatively. The above mentioned problem has been largely addressed and various designs of the flushing device and of the detergent box have been proposed over the years aimed to improve the rinsing of the detergent box and hence to avoid as much as possible the formation of cleaning agents deposits in the detergent box.
- [0004] In the state of the art European Patent Document No EP0318070 discloses a detergent flushing device having a cross-sectional narrowing on the channels aimed to favor the uniform feeding of the detergent box

compartments and thus hinder the formations of detergent residues on them.

[0005] The aim of the present invention is the realization of a washing machine comprising a detergent box assembly which allows the cleaning agents to effectively participate in the washing process and which thus hinders the formation of cleaning agent deposits in the detergent box while being cost effective.

[0006] A further aim of the present invention is to provide a method of operating such washing machine which ensures an optimal rinsing of the detergent box compartments even in case of low pressure of the water fed into the flushing device.

[0007] These objectives have been achieved by the washing machine as defined in claim 1 and by the operating method as defined in claim 11. Further achievements have been attained by the subject-matters respectively defined in the dependent claims.

[0008] The washing machine of the present invention comprises, in addition to the flushing device, one or more additional flushing elements which are interposed between the detergent box and the flushing device for providing water to be directed into the detergent box. Each flushing element comprises a fluidic oscillator which allows to sweep the base and the walls of a correspondent compartment of the detergent box in a satisfactory manner even in case of low pressure of the water received from the mains.

[0009] In an embodiment, the flushing element is attached below the flushing device, so that it can be easily installed in the washing machine.

[0010] In an embodiment, the flushing element is arranged over the detergent box with its fluidic oscillator equidistant from the lateral walls delimiting the compartment of the detergent box and, in a further embodiment, with its fluidic oscillator arranged in proximity of the front wall of the compartment, in order to allow the water emitted by the fluidic oscillator to reach, as much as possible, also the lateral and front walls delimiting the compartment thus ensuring a better removal of the cleaning agents.

[0011] The flushing element of the washing machine according to the invention can be connected to the mains for receiving water from the latter

according to a first and a second embodiment.

- [0012] In the first embodiment the conveying conduit of the flushing element delivering water to the fluidic oscillator is independent from the other conduits delivering water to the flushing device and it is connected directly to the distribution valve which selectively deliver water to the different conduits attached to the flushing device. This first embodiment allows to selectively deliver water to the detergent box only through the flushing element if the pressure of the water from the mains detected by the pressure detection means is lower than a preset threshold value.
- [0013] In the second embodiment, the conveying conduit of the flushing element is connected to the main conduit delivering water to the channel of the flushing device discharging water over the main compartment of the detergent box. This second embodiment is constructionally simple to be realized.
- [0014] In order to ensure a relatively high speed of the water flowing in the conveying conduit of the flushing element, in an embodiment the cross-section of the conveying conduit is smaller than the cross-section of the main conduit and/or of the pre-washing conduit. In a different embodiment the flushing element comprises a local pressure drop element arranged on the conveying conduit.
- [0015] The method of operating a washing machine as above specified according to the present invention comprises delivering water to the detergent box by means of the flushing element, in addition or in alternative to the flushing device and it is particularly useful in case of low pressure of the water from the mains.
- [0016] The washing machine realized in order to attain the aim of the present invention is illustrated in the attached figures, where:
- [0017] Figure 1 – is the schematic view of a washing machine.
- [0018] Figure 2 – is the cross-sectional view of a detail of the detergent box assembly of the washing machine according to the present invention relative to a fluidic oscillator.
- [0019] Figure 3 – is a partially exploded perspective view of a particular of a detergent box assembly of the washing machine according to the present

invention.

[0020] Figure 4 – is a rear exploded perspective view of a detergent box assembly of the washing machine according to a first embodiment of the present invention.

[0021] Figure 5 – is a rear exploded perspective view of a detergent box assembly of the washing machine according to a second embodiment of the present invention.

[0022] The elements illustrated in the figures are numbered as follows:

1. Washing machine
2. Cabinet
3. Tub
4. Drum
5. Detergent box assembly
6. Casing
7. Detergent box
8. ,108, 208 Compartments
9. Flushing device
10. Holes
11. Flushing element
12. Fluidic oscillator
13. Bottom part
14. Cover
15. Lateral walls
16. Front wall
17. Rear wall
18. Main conduit
19. Valve
20. Pre-washing conduit
21. Conveying conduit

[0023] The washing machine 1 comprises a cabinet 2, a tub 3 arranged in the cabinet 2 and aimed to receive the water for performing a cleaning cycle and a drum 4 rotatably placed inside the tub 3 and aimed to receive the laundry to be cleaned. The washing machine 1 further comprises a

detergent box assembly 5 having a casing 6, preferably arranged in an upper front portion of the cabinet 2 as illustrated in Figure 1, a detergent box 7 removably placed in the casing 6 and having one or more compartments 8 wherein cleaning agents, such as detergent, softener etc., are placed and mixed with water received from the mains. According to a preferred embodiment illustrated in the attached figures, the detergent box 7 comprises at least a main compartment 8 aimed to receive the detergent for the main washing phase of the cleaning programs, a softener compartment 108 aimed to receive the softener and a pre-washing compartment 208 aimed to receive the detergent for the pre-washing phase of the cleaning programs.

[0024] The detergent box assembly 5 further comprises a flushing device 9 which is disposed over the detergent box 7 and which provides the water received from the mains to be directed into the compartments 8, 108, 208 of the detergent box 7 (Figure 1 and Figures 3-5).

[0025] In particular the flushing device 9 is disposed above the casing 6 and completely closes the detergent box 7 from above when the detergent box 7 is disposed into the casing 6 and has one or more channels along which water flows, each associated to a correspondent compartment 8, 108, 208 of the detergent box 7, and a plurality of holes 10 disposed on the base of the channels, allowing water to pass into the detergent box 7.

[0026] According to the present invention, the detergent box assembly 5 further comprises one or more additional flushing elements 11 which are interposed between the detergent box 7 and the flushing device 9 for providing water received from the mains to be directed into the detergent box 7. Each flushing element 11 comprises a fluidic oscillator 12. A fluidic oscillator is a device having a specially designed flow chamber that produces a sweeping jet of fluid having high exit velocity, as for instance the fluidic oscillator 12 illustrated in the attached Figure 2.

[0027] The flushing element 11 having a fluidic oscillator 12 allows to optimally rinse the detergent box 7 even in case of low pressure of the water coming from the main. At low pressures particularly, in fact, by using only the flushing device 9 water has to be conveyed to the front end of the flushing

device 9 and has to be discharged from the holes 10 there into the detergent box 7, in order to effectively sweep the cleaning agent in the detergent box 7, which often can result difficult.

- [0028] The sweeping jet created by the fluidic oscillator 12 allows to better remove the cleaning agent placed in the detergent box 7.
- [0029] A further advantage resides on the fact that the fluidic oscillator 12 comprises no moving parts or electromechanical components, so that the flushing element 11 is cost effective and operationally secure, since it does not require maintenance interventions.
- [0030] In an embodiment, illustrated in the attached Figures 3-5, only a flushing element 11 is provided on the detergent box assembly 5. In particular the flushing element 11 is arranged over the main compartment 8 of the detergent box 7, for sweeping out the detergent therein contained.
- [0031] In different embodiments, not illustrated, the detergent box assembly 5 comprises more than one flushing element 11, i.e. further flushing elements 11 arranged over the softener compartment 108 and/or the pre-washing compartment 208.
- [0032] According to an embodiment, the flushing element 11 is attached on the bottom of the flushing device 9. More in detail, the flushing device 9 comprises a bottom part 13, wherein the holes 10 for the distribution of the water are arranged, and a cover 14. The flushing element 11 is attached to the bottom part 13 of the flushing device 9 toward the detergent box 7.
- [0033] The compartments 8, 108, 208 of the detergent box 7 are laterally delimited by lateral walls 15 and extend each between a front wall 16 and a rear wall 17. An outlet for the cleaning agent and the water to be discharged from the detergent box 7 toward the tub 3 of the washing machine 1 is arranged at the rear wall 17 of the detergent box 7, provided either on the bottom or on the rear wall 17 of the detergent box 7.
- [0034] In an embodiment, when the detergent box 7 is inserted in the casing 6, the flushing element 11 is disposed over a correspondent compartment of the detergent box 7, like for instance the main compartment 8 as illustrated in the attached figures, with its fluidic oscillator 12 arranged substantially equidistant from the side walls 15 laterally delimiting the compartment 8,

108, 208. This allows to more efficiently rinse the entire compartment.

[0035] In particular, the bottom part 13 of the flushing device 9 is provided in each channel with two rows of holes 10 extending along the lateral walls 15 of the correspondent compartment when the flushing device 9 is placed over the detergent box 7 and the fluidic oscillator 12 is attached to the bottom part 13 of the flushing device 9 so as to result substantially equidistant from the two rows of holes 10.

[0036] In a further embodiment, the flushing element 11 is disposed over a correspondent compartment of the detergent box 7, like for instance the main compartment 8 as illustrated in the attached figures, with its fluidic oscillator 12 arranged in proximity of the front wall 16 of the compartment, i.e. it is arranged enough close to the frontal wall 16 to rinse it with the emitted water. This ensures that the compartment is efficiently rinsed in its entirety, from the front wall 16 to the rear wall 17 where the cleaning agents and water are expelled.

[0037] The detergent box assembly 5 further comprises a main conduit 18 connected at one end to the flushing device 9 for delivering water from the mains to the detergent box 5 through the flushing device 9 and a valve 19 connected to the other end of the main conduit 18 and intended to be connected to the mains in order to selectively introduce water from the mains into the main conduit 18. Advantageously the detergent box assembly 5 comprises also a pre-washing conduit 20 connected at one end to the flushing device 9 for delivering water from the mains to the detergent box 7 through the flushing device 9 and at the other end to the valve 19.

[0038] By selectively introducing water into the main conduit 18 and/or the pre-washing conduit 20 by means of the valve 19, water can be delivered to the selected compartment 8, 108 or 208 of the detergent box 7.

[0039] According to a first embodiment, illustrated in the attached Figure 4, the flushing element 11 comprises a conveying conduit 21 connected at one end to the fluidic oscillator 12 and at the other end to the valve 19 for selectively receiving water from the mains. In particular the valve 19 is a three-way valve for selectively deliver water to one or more of the conduits

18, 20 and 21. This allows to select if the water should be delivered to the detergent box through the flushing device 9 and/or through flushing element 11.

[0040] In a version of this embodiment, the washing machine 1 further comprises pressure detection means for detecting the pressure of the water received from the mains. The pressure detection means could be for instance a pressure sensor on the tap where through water from the main is delivered to the washing machine 1, or the water level sensor or a flow meter provided in the tub 3 of the washing machine 1. The washing machine 1 comprises also a control unit connected to the pressure detection means, to receive from them inputs related to the pressure of the water from the mains, and to the valve 19 and programmed to activate the valve 19 so as to deliver water to the detergent box 7 only through the flushing element 11 if the pressure of the water from the mains detected by the pressure detection means is lower than a preset threshold value. In particular it has been verified that for values of pressure of the water coming from the mains lower than 1 bar and especially lower than 0,5 bar, the water delivered through the flushing device 9 to the detergent box 7 does not ensure an effective rinsing of the detergent box 7, so that the formation of cleaning agents deposits is highly probable. The use of the flushing element 11, i.e. of the fluidic oscillator 12, ensures an optimal rinsing effect also in case the water pressure is lower than 0,5 bar.

[0041] According to a second embodiment, illustrated in the attached Figure 5, the conveying conduit 21 of the flushing element 11 is connected at one end to the fluidic oscillator 12 and at the other end to the main conduit 18 for receiving water from the mains through the main conduit 18. This allows to introduce minimal design changes in the traditional washing machines for the installation of the flushing element 11.

[0042] In an embodiment, the cross-section of the conveying conduit 21 is smaller than the cross-section of the main conduit 18. This ensures a higher velocity of the water delivered through the flushing element 11 and hence a better rinsing efficiency of the latter, both in the first and in the second embodiment illustrated respectively in Figures 4 and 5.

- [0043] In a further embodiment, in case the detergent box assembly 5 comprises also a pre-washing conduit 20, the cross-section of the conveying conduit 21 is smaller than the cross-section of the pre-washing conduit 20.
- [0044] In order to increase the water velocity in the conveying conduit 21, in an alternative embodiment the flushing element 11 comprises a local pressure drop element arranged on the conveying conduit 21, such as for instance an orifice, a check valve or a Venturi.
- [0045] It is an object of the present invention also a method of operating a washing machine 1 as above described. The method comprises delivering water from the main to the detergent box 7 through one or more flushing elements 11 provided on the detergent box assembly 5. As previously underlined, using one or more flushing elements 11 in alternative or together with the flushing device 9 ensures to accurately rinse the detergent box 7 and hence to avoid the formation of cleaning agents residuals in it.
- [0046] In a version of the method according to the present invention, aimed to be used for operating a washing machine 1 according to the first embodiment above specified and illustrated in the attached Figure 4 and having pressure detection means for detecting the pressure of the water received from the mains, the method comprises detecting the pressure of the water from the mains by means of the pressure detection means, comparing the detected value of pressure of the water from the mains with a preset threshold value of pressure, such as for instance 1 bar or 0,5 bar, and activating the valve by means of the control unit so that water is delivered to the detergent box 7 only through the flushing element 11 if the detected value of pressure of water from the mains is lower than the preset threshold value of pressure. In case the pressure of the water from the mains is lower than the threshold value, in fact, introducing the water through the flushing device 9 or through the flushing device 9 and contemporarily through the flushing element 11 could result in a poor rinsing of the detergent box 7. Differently by using only the fluidic oscillator 12 of the flushing element 11, the water, although with low pressure, is accurately spread onto the detergent box 7 correspondent compartment 8,

108, 208 with a sufficient velocity to ensure the removal of the detergent from the walls and base of the compartment.

[0047] In a further version, in case the detected value of pressure of water from the mains is higher than the preset threshold value of pressure, the method comprises activating the valve by means of the control unit so that water is delivered to the detergent box 7 through the main conduit 18 or through the main conduit 18 and additionally through the flushing element 11.

[0048] By means of the flushing element 11 in the washing machine 1 of the present invention, the cleaning agents effectively participate in the washing process and the washing/rinsing efficiency of the washing machine 1 is increased even in case of low pressure of the water coming from the mains.

Claims

1. A washing machine (1) having a detergent box assembly (5) comprising:
 - a detergent box (7) having at least one compartment (8) wherein a cleaning agent is placed and wherein the cleaning agent is mixed with water;
 - a flushing device (9) disposed over the detergent box (7) which provides the water received from the mains to be directed into the at least one compartment (8, 108, 208) of the detergent box (7), **characterized in that** the detergent box assembly (5) further comprises at least one additional flushing element (11) which is interposed between the detergent box (7) and the flushing device (9) for providing water received from the mains to be directed into the detergent box (7) and which comprises a fluidic oscillator (12).
2. A washing machine (1) as in Claim 1, **characterized in that** the at least one flushing element (11) is attached on the bottom of the flushing device (9).
3. A washing machine (1) as in Claim 1 or 2, **characterized in that** the at least one compartment (8) of the detergent box (7) is laterally delimited by lateral walls (15) and the at least one flushing element (11) is disposed over a correspondent of the at least one compartment (8, 108, 208) of the detergent box (2) with its fluidic oscillator (12) arranged substantially equidistant from the side walls (15) delimiting the compartment (8, 108, 208).
4. A washing machine (1) as in any one of the above Claims, **characterized in that** the at least one compartment (8, 108, 208) of the detergent box (7) extends between a front wall (16) and a rear wall (17), an outlet for the cleaning agent and the water to be discharged from the detergent box (7) being arranged at the rear wall (17) of the detergent box (7), and the at least one flushing element (11) is disposed over a correspondent of the at least one compartment (8, 108, 208) of the detergent box (2) with its fluidic oscillator (12) arranged in proximity of the front wall (16) of the compartment (8, 108, 208).
5. A washing machine (1) as in any one of the above Claims, **characterized in that** the detergent box assembly (5) further comprises:
 - a main conduit (18) connected at one end to the flushing device (9) for delivering water from the mains to the detergent box (7) through the flushing device (9); and
 - a valve (19) connected to the other end of the main conduit (18) and intended

to be connected to the mains in order to selectively introduce water from the mains into the main conduit (18);

- the flushing element (11) comprising a conveying conduit (21) connected at one end to the fluidic oscillator (12) and at the other end to the valve (19) for selectively receiving water from the mains.

6. A washing machine (1) as in Claim 5, **characterized in that** it further comprises pressure detection means for detecting the pressure of the water from the mains and a control unit connected to the pressure detection means and to the valve (19) and programmed to activate the valve (19) so as to deliver water to the detergent box (7) only through the flushing element (11) if the pressure of the water from the mains detected by the pressure detection means is lower than a preset threshold value.
7. A washing machine (1) as in any of the Claims 1 to 4, **characterized in that** the detergent box assembly (5) further comprises:
 - a main conduit (18) connected at one end to the flushing device (9) for delivering water from the mains to the detergent box (7) through the flushing device (9); and
 - a valve (19) connected to the other end of the main conduit (18) and intended to be connected to the mains in order to selectively introduce water from the mains into the main conduit (18);
 - the flushing element (11) comprising a conveying conduit (21) connected at one end to the fluidic oscillator (12) and at the other end to the main conduit (18) for receiving water from the mains through the main conduit (18).
8. A washing machine (1) as in Claim 5 or 6, **characterized in that** the cross-section of the conveying conduit (21) is smaller than the cross-section of the main conduit (18).
9. A washing machine (1) as in any of the Claims 5 to 7, **characterized in that** the detergent box assembly (5) further comprises a pre-washing conduit (20) connected at one end to the flushing device (9) for delivering water from the mains to the detergent box (7) through the flushing device (9) and at the other end to the valve (19), the cross-section of the conveying conduit (21) being smaller than the cross-section of the pre-washing conduit (20).
10. A washing machine (1) as in Claim 5 or 6, **characterized in that** the flushing

element (11) comprises a local pressure drop element arranged on the conveying conduit (21).

11. A method of operating a washing machine (1) according to any of the preceding claims, **characterized in that** it comprises delivering water from the main to the detergent box (7) through the at least one flushing element (11).
12. A method according Claim 11 of operating a washing machine (1) wherein the detergent box assembly (5) comprises a main conduit (18) connected at one end to the flushing device (9), a valve (19) connected to the other end of the main conduit (18) and intended to be connected to the mains, a conveying conduit (21) of the flushing element (11) connected at one end to the fluidic oscillator (12) and at the other end to the valve (19), pressure detection means for detecting the pressure of the water from the mains and a control unit connected to the pressure detection means, **characterized in that** the method comprises:
 - detecting the pressure of the water from the mains by means of the pressure detection means;
 - comparing the detected value of pressure of the water from the mains with a preset threshold value of pressure;
 - activating the valve (19) by means of the control unit so that water is delivered to the detergent box (7) only through the flushing element (11) if the detected value of pressure of water from the mains is lower than the preset threshold value of pressure.
13. A method of operating a washing machine (1) according Claim 12, **characterized in that** it comprises activating the valve (19) by means of the control unit so that water is delivered to the detergent box (7) through the main conduit (18) or through the main conduit (18) and the flushing element (11) if the detected value of pressure of water from the mains is higher than the preset threshold value of pressure.

Figure 1

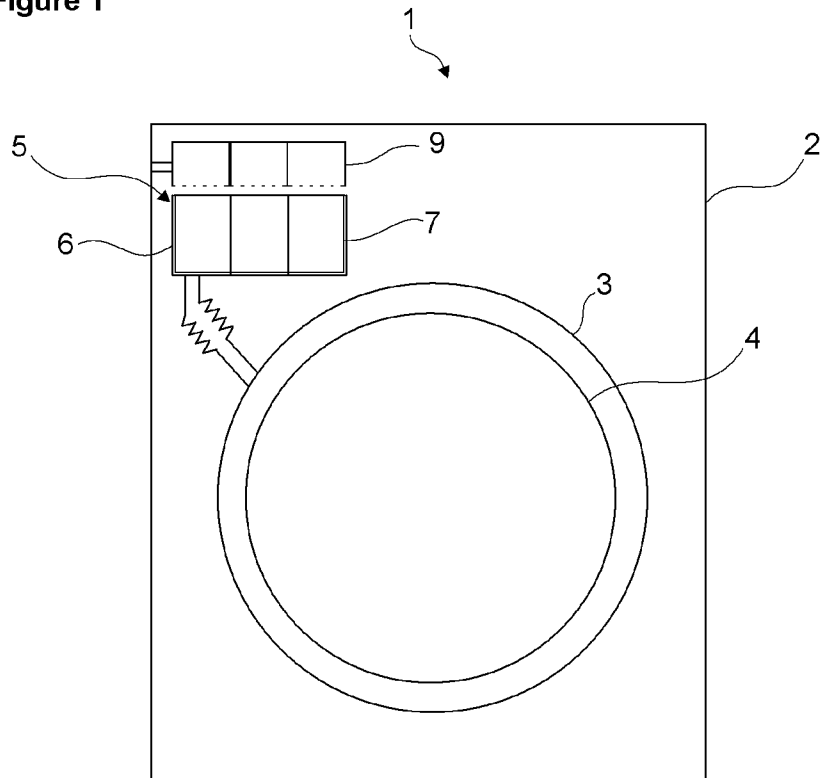


Figure 2

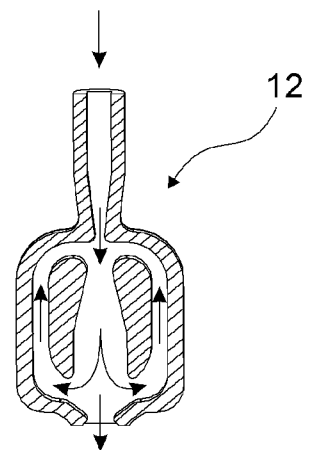


Figure 3

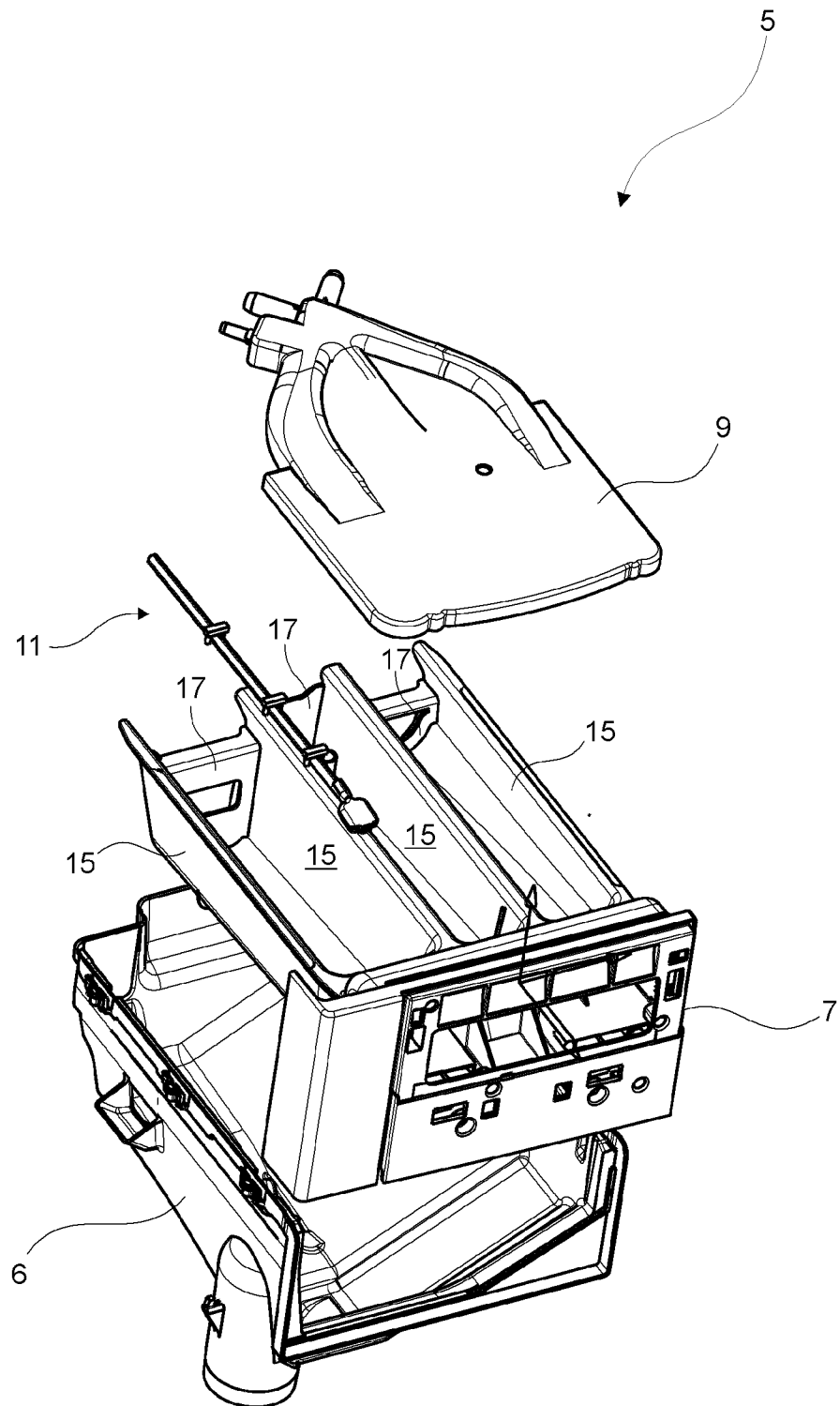


Figure 4

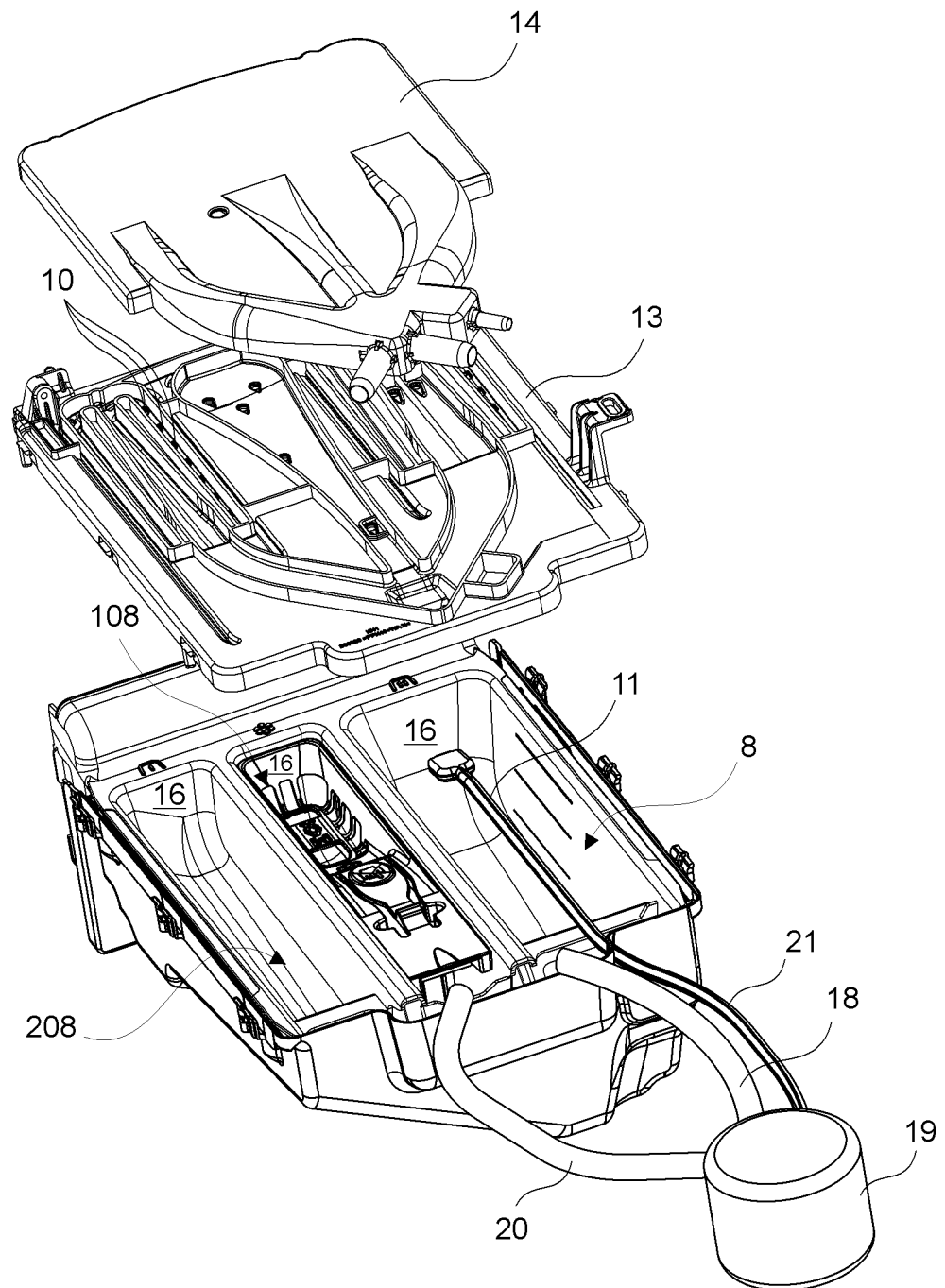
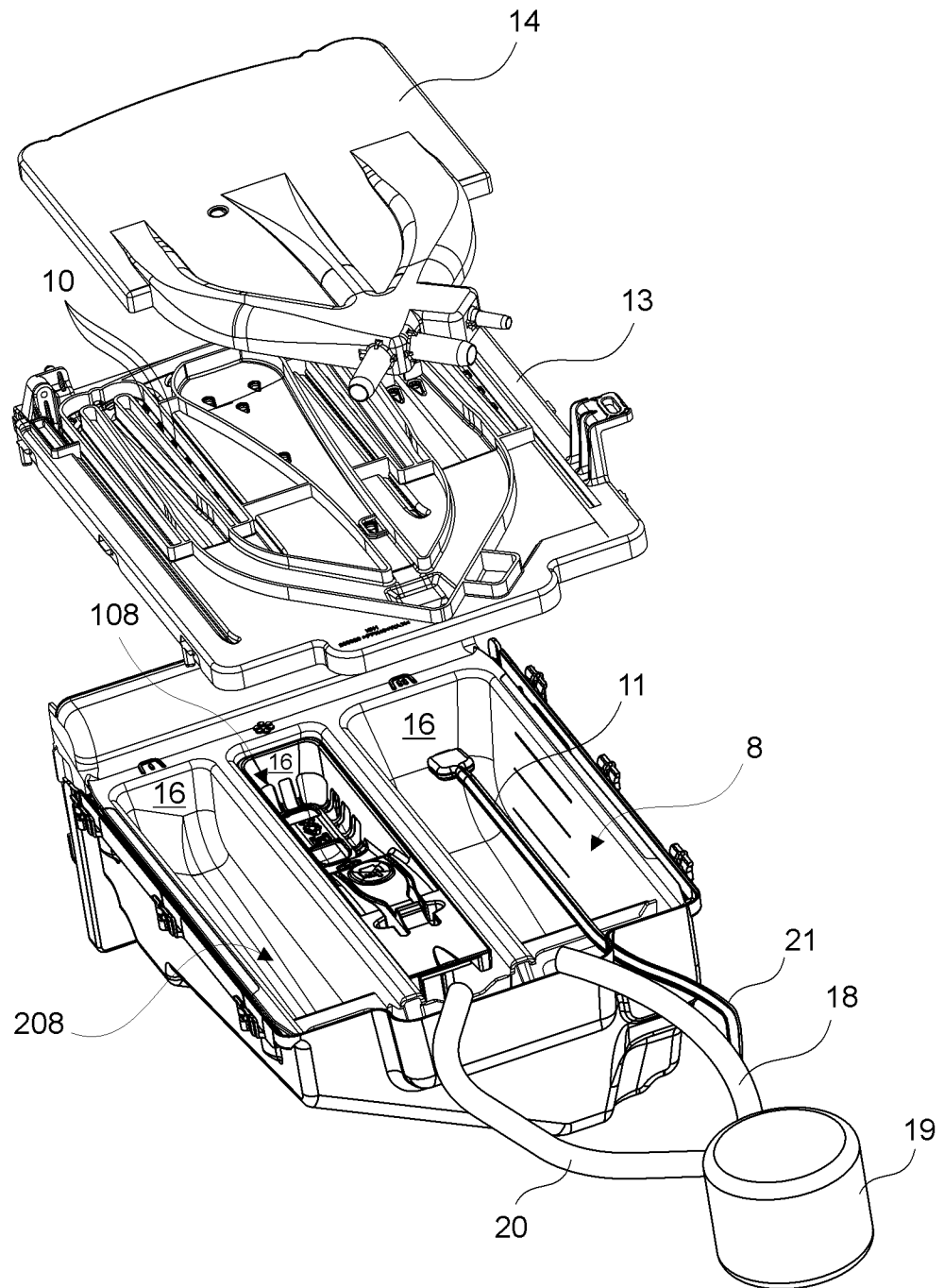


Figure 5



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/077812

A. CLASSIFICATION OF SUBJECT MATTER
 INV. D06F39/02
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 D06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 318 070 A1 (BAUKNECHT HAUSGERAETE [DE]; PHILIPS NV [NL]) 31 May 1989 (1989-05-31) cited in the application column 1, lines 1-37; column 4, line 14 - column 6, line 30; claims; figures -----	1-13
A	US 4 407 032 A (BAUER PETER [US] ET AL) 4 October 1983 (1983-10-04) column 1, lines 11-42; column 2, line 66 - column 6, line 36; claims; figures -----	1-13
A	US 3 620 050 A (GLASGOW PAUL J) 16 November 1971 (1971-11-16) column 1, line 54 - column 3, line 53; claims; figures -----	1-13



Further documents are listed in the continuation of Box C.



See patent family annex.

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Patent document cited in search report		Publication date		Patent family member(s)		Publication date
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