(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 031 971 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
15.06.2016 Bulletin 2016/24

(51) Int Cl.:
D06F 39/08 *(2006.01)* ***A47L 15/42*** *(2006.01)*

(21) Application number: **15197586.9**

(22) Date of filing: **02.12.2015**

(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
Designated Validation States:
MA MD

(30) Priority: **04.12.2014 IT TO20141009**

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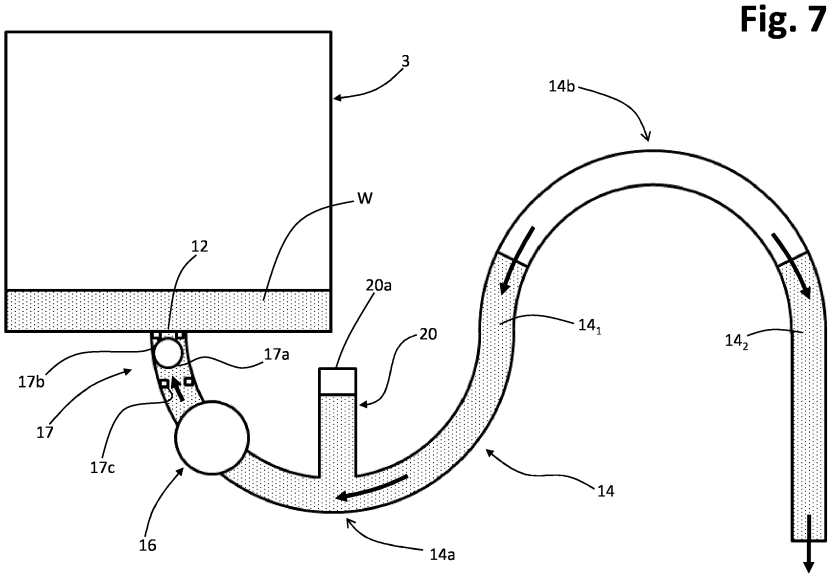
(54) WASHING MACHINE

(57) A washing machine has a control system, a treatment tub (3) with a discharge opening (12), a washing-agent dispenser device, an arrangement for loading liquid into the tub (3), a discharge duct (14) having an inlet connected to the discharge opening (12) of the tub (3),and a pump (16) along the discharge duct (14). The discharge duct (14) has a substantially S-shaped development, with a lower transition region (14a) and an upper transition region (14b), the transition regions (14a, 14b) being in an intermediate position with respect to the inlet and to an outlet of the discharge duct (14). One of the discharge duct (14) and the tub (3) has a valve arrangement (17) that includes a buoyant body (17a) and that is operative substantially at the discharge outlet (12) of the tub (3).

The control system (6) is pre-arranged for controlling activation of the pump (17) in the course of a process of loading of liquid (W) into the tub (3), and the valve arrangement (17) is pre-arranged for preventing outflow of liquid from the discharge opening (12) of the tub (3) when the level of the liquid (W) in the discharge duct (14) is at a height that is greater than the level of the liquid (W) in the tub (3) and that is comprised between the lower transition region (14a) and the upper transition region (14b).

In the lower transition region (14a), branching off upwards from the discharge duct (14) is an auxiliary duct (20) that is closed at its upper end (20a).

Fig. 7



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Description

[0001] The present invention relates to washing machines, such as laundry-washing machines and washer-dryers, and has been developed with particular reference to the systems for discharge of liquid of these machines.

Prior art

[0002] Washing machines usually comprise a treatment tub and means for delivering a certain amount of water, drawn from a water mains, into the tub. The machine further comprises a device for dispensing washing agents, which are introduced into the tub in order to form with the water the treatment liquid that is to exert the cleaning action on the laundry.

[0003] The tub has a discharge opening, through which the liquid used for carrying out a washing or rinsing step can be emptied out of the machine. Connected to this opening is a discharge duct, the second end of which is usually connected to the drains. The discharge duct usually comprises a siphon-shaped pipe, i.e., a pipe having a substantially S-shaped development, in order to prevent any possible reflux of liquid from the drains back into the machine. The pipe usually has at least one portion that rises along the body of the washing machine, almost up to its top, which is followed by an upper transition region, basically consisting of a curvature downwards of the pipe. The outlet end of the pipe, downstream of the transition region, is connected to the drains. Along the discharge duct, in particular in a position underneath the tub, a discharge pump is operative.

[0004] At start of a treatment step, the water is loaded into the tub. In the case where the treatment step implies the use of a washing agent, the water is frequently made to pass through the corresponding dispenser device in such a way that it entrains the washing agent. During loading of the tub with water, part of the latter reaches the discharge outlet, and then the initial stretch of the discharge duct. In this step, it is thus possible for the water to entrain into the discharge duct a part of the washing agent introduced into the tub, for example washing powder that has not yet dissolved (arrangements of this type are described for instance in WO 00/50684 A1 e GB 2090382 A, upon which the preamble of claim 1 is based).

[0005] In order to solve this problem, the use of valve arrangements has been proposed, which comprise a buoyant open/close element, substantially operative at the discharge opening of the tub. During normal operation, when the water is loaded into the tub, a portion thereof is free to flow through the discharge opening, thereby pushing the buoyant open/close element downwards, into a position of opening of a corresponding upper valve seat. In this step, the buoyant open/close element rests in general on a lower valve seat, which has peripheral passages suitable for enabling in any case a seepage of the water.

[0006] A volume of water occupies part of the discharge duct, in particular its portion that extends underneath the tub. At the end of loading of the water into tub the level of the water in the discharge pipe is at a height that is equal to that of the level of the water contained in the tub. In this condition, the buoyant open/close element is in any case maintained by hydrostatic thrust at the lower valve seat, i.e., in a position such as not to obstruct the discharge opening of the tub.

[0007] To cause the buoyant open/close element to rise and obstruct the upper valve seat, thereby preventing further exit of liquid from the tub, it is necessary to activate briefly the discharge pump, for example for a couple of seconds, to cause part of the liquid to rise further in the discharge pipe up to a level higher than that of the water contained in tub. In this condition, the thrust of the water present in the discharge duct, which tends to return towards the tub, causes the buoyant open/close element to rise as far as the position of closing of the upper valve seat. Consequently, when then the laundry drum of the washing machine is operated, agitation of the water due to rotation of the drum does not bring about any further passage of detergent, or of water with high concentration of detergent, towards the discharge duct.

[0008] In an arrangement of this type, it may, however, happen that the discharge pump remains active for a few instants beyond the time strictly necessary to obtain the rise in level of the liquid in the discharge duct. This lengthening of the predefined time of activation of the pump may be due to a wide range of reasons, such as for example sudden changes in voltage or drifts of the control electronics of the pump.

[0009] The increase in duration of activation of the pump may bring about an excessive rise of the liquid in the discharge duct, i.e., its rise up to the upper transition region, to the point where it exceeds the uppermost point of the discharge duct. This circumstance may cause triggering of the so-called "siphon effect": in practice, after the water has exceeded the uppermost point of the duct, it starts to flow out along the descending stretch of the duct itself, entraining along with it the entire liquid content of the tub. The reason for this is the fact that, following upon activation of the pump and triggering of the siphon effect, the buoyant open/close element is brought to assume its lowered position, corresponding to the lower valve seat, and hence with the liquid that is free to flow through the discharge opening of the tub.

Object and summary of the invention

[0010] The object of the present invention is basically to overcome the aforesaid drawback in a simple and inexpensive way. This and yet further objects, which will emerge more clearly hereinafter, are achieved according to the present invention by a washing machine having the characteristics specified in the annexed claims. The claims form an integral part of the technical teaching provided herein in relation to the invention.

Brief description of the drawings

[0011] The characteristics and advantages of the invention will emerge clearly from the ensuing detailed description, with reference to the annexed drawings, which are provided purely by way of explanatory example and in which:

- Figure 1 is a schematic representation of a washing machine according to one embodiment of the invention; and
- Figures 2-7 are schematic views of a discharge arrangement of a washing machine according to one embodiment of the invention, in different operating conditions.

Description of preferred embodiments of the invention

[0012] Reference to "*an embodiment*" or "one *embodiment*" in the framework of this description is meant to indicate that a particular configuration, structure, or characteristic described in relation to the embodiment is comprised in at least one embodiment. Hence, phrases such as *"in an embodiment*", *"in one embodiment*", and the like that may be present in various points of this description do not necessarily refer to one and the same embodiment. Moreover, particular conformations, structures, or characteristics may be combined in any adequate way in one or more embodiments. The references used herein are only provided for convenience and hence do not define the sphere of protection or the scope of the embodiments. It is moreover pointed out that in what follows only the elements useful for an understanding of the invention will be described, taking for granted that the machine described hereinafter comprises all the other essential elements, in themselves known, necessary for carrying out programs of washing of laundry.

[0013] With initial reference to Figure 1, designated as a whole by 1 is a washing machine according to one embodiment of the present invention. In the case exemplified, the machine 1 is a laundry-washing machine comprising a cabinet 2 housed within which is a treatment tub 3. Rotatably mounted within the tub is a laundry drum 4, which can be driven in rotation via a motor 5. In the case exemplified, the machine 1 is a machine in which the drum 4 is rotatable about a substantially horizontal axis, but not excluded from the scope of the invention is the case of machines with vertical or inclined axis.

[0014] The machine 1 includes an arrangement for loading liquid into the tub. In the case exemplified, this arrangement comprises an electrical valve 6, controlled by a control system 7 of the machine. An inlet of the valve 6 is connected, for example via a loading pipe (not represented), to a water mains supply 8. The outlet of the valve 6 is connected - either directly or in derivation - to a washing-agent dispenser device, designated as a whole by 9. This device is of a conception in itself known and comprises, for example, a hopper container, slidably mounted in which is a drawer defining a plurality of compartments for containing various washing agents. The arrangement is such that the water entering via the valve 6 is made to flow selectively in the compartments of the aforesaid drawer so that the water - at least in some steps of the loading process - entrains the washing agent envisaged for the specific step of the treatment cycle. For this purpose, the dispenser device 9 is connected to a duct 10 for delivery of the water and of the washing agents into the tub. The loading system of course also includes water-dispensing means (not represented), comprising for example one or more pressure switches or a turbine volume flow meter.

[0015] In the case exemplified, the tub 3 has a lower sump, designated by 11, in the lowest point of which a discharge opening 12 of the tub is defined. In the example illustrated, positioned within the sump 11 is an electrical heating element 13 for heating the washing liquid.

[0016] Designated as a whole by 14 is a discharge duct, having an inlet that is connected to the discharge opening 12 of the tub 3. The opposite end of the duct 14 is connected to the drains, represented schematically and designated by 15. As may be noted, in the case exemplified, the discharge duct 14 has a substantially S-shaped development so as to present at least one ascending stretch 14_1 and one descending stretch 14_2, separated from one another by an upper transition region, which is generally arched. This transition region basically fulfils siphon functions, as explained in the introductory part of the present description.

[0017] Operative along the discharge duct 14 is a discharge pump 16, of a type in itself known, which is also controlled by the control system 7. Designated as a whole by 17 is a valve arrangement, including a buoyant body, of the type already mentioned previously. The discharge duct 14 may comprise, for example, a hose connected to the delivery section of the pump 16 and a sleeve - which may be bellows-shaped - that connects the discharge opening 12 to the intake section of the pump 16.

[0018] In Figures 2-7 the discharge arrangement of the machine according to one embodiment of the invention is represented schematically. It should be noted that in these figures the development in length of the discharge duct 14 has been reduced, in particular as regards its ascending stretch 14_1, for reasons of greater clarity of representation.

[0019] From Figure 2, it may be clearly noted how, in a preferred embodiment, the discharge duct 14 presents a lower transition region, designated by 14a, and an upper transition region, designated by 14b. Preferably, the transition regions 14a and 14b have a curved or arched profile so that the discharge duct 14 is as a whole S-shaped, with a lowermost point and an uppermost point, which are identified in the lower and upper transition regions, respectively. The transition region 14b is preferably comprised in a stretch of the duct 14 that extends between the outlet 12 of the tub and the ascending stretch 14_1 of the duct 14 and does not necessarily have to be

curved or arched in shape, provided that the lowermost point of the duct 14 is in any case comprised in this region.

[0020] Figure 2 shows schematically also a possible embodiment of the valve arrangement 17, the buoyant body of which is designated by 17a. This buoyant body, referred to hereinafter also as "open/close element", may, for example, be constituted by a hollow ball, made, in particular, of plastic material. The arrangement 17 then comprises an upper valve seat 17b, which is located substantially at the discharge opening 12, or basically at the interface between the duct 14 and the tub 3. The valve seat 17b may, for example, be defined by an annular body at which the open/close element 17a is able to position itself so as to close completely a port for passage of the liquid. The valve arrangement 17 further includes a lower valve seat 17c. Also the valve seat 17c may be defined by an annular body, made in a way similar to the annular body defining the seat 17b: in this case, however, the annular body has one or more peripheral passages, for example in the form of surface recesses defined in an area corresponding to the valve seat, which are designed to enable a seepage of liquid even when the buoyant open/close element 17a engages the seat itself.

[0021] In a preferred embodiment, the discharge pump 16 is operatively arranged in a stretch of the discharge duct 14 that is comprised between the valve arrangement 17 and the lower transition region 14a, in particular, between the valve arrangement 17 and the lowermost point of the discharge duct 14. This positioning of the pump 16 is not essential for the purposes of implementation of the invention, but is preferable to prevent phenomena of cavitation given that, the higher the pump is located, the more the pressure of the water at the intake decreases, causing vaporization of the water itself: positioning of the pump 16 towards the bottom reduces the risk of cavitation to a minimum.

[0022] According to the invention, branching off upwards from a point of the lower transition region 14a is an auxiliary duct, designated by 20, which is closed to its upper end 20a. Merely indicatively, the auxiliary duct 20 may have a height of between 5 and 15 cm, preferably approximately 10 cm. Very preferably, the auxiliary duct 20 branches off upwards substantially at the lowermost point of the discharge duct 14, defined in the transition region 14a. Very preferably, the auxiliary duct 20 is substantially vertical.

[0023] The operative condition illustrated in Figure 2 is the one that typically exists at the start of a treatment cycle, when the tub 3 does not contain washing liquid and also the discharge duct is empty.

[0024] In this condition, the pump 16 is inactive and the open/close element 17a remains by gravity at the lower valve seat 17c. After start of a treatment cycle, the control system 7 of the machine 1 governs opening of the loading valve 6 of Figure 1: in this way, the water coming from the water mains 8 can reach the inside of the tub 3, flowing through the dispenser of washing agents 9, and hence entraining the detergent along with it into the tub 3.

[0025] In a variant embodiment, it may be envisaged that, in a first part of the process of loading of water, the latter is not made to pass immediately through the dispenser device 9 or through a compartment thereof containing a washing agent, until it reaches a certain level inside the tub, which may be detected, for example, via a pressure switch or a turbine meter (not represented). Next, the flow of water is diverted into one of the compartments containing the detergent to be delivered into the tub. This possible variant embodiment is not described herein in detail, in so far as it can be obtained according to modalities widely known in the field.

[0026] As exemplified in Figure 3, the tub then starts to fill up with water W, with part of it that can flow out of the discharge opening 12 into the duct 14. In this step, the buoyant open/close element 17a is kept at the lower valve seat 17c by the thrust of the water W leaving the tub. As explained previously, the valve seat 17c has one or more peripheral passages, which enable in any case seepage of the water along the duct 14. Of course, in this step, the water is free to flow through the pump 16, even if this is inactive. Seepage of water into the duct 14 hence occurs very slowly, with a pressure head such as not to enable filling of the auxiliary duct 20: the air present in the auxiliary duct 20 is thus pressurized. The preferred positioning of the auxiliary duct 20 substantially at the lowermost point of the discharge duct 14 causes the water to tend to compress immediately the air inside the duct 20 (in the case of a positioning of the duct further up, this compression of the air occurs with a certain delay).

[0027] After closing of the valve 6, the water W is in the duct 14 at a height equal to the level L of the water present in the tub 3, as exemplified in Figure 4. In this situation, the buoyant open/close element 17a remains in any case at the lower valve seat 17c, since the portion of its surface that is in contact with the water above of the valve seat 17c is higher than the portion of its surface that is in contact with the water via the valve seat 17c. As may be noted, also in the condition of Figure 4, the auxiliary duct 20 does not contain water, but only pressurized air.

[0028] In a preferred embodiment, the last step of the loading process entails a brief activation of the discharge pump 16, as represented schematically in Figure 5, controlled by the control system 7.

[0029] The purpose of this brief activation of the pump is to cause rise of the level of the water W in the discharge duct 14 above the level of the liquid present in the tub. As explained in the introductory part of the present description, in this way, after de-activation of the pump, a thrust should be obtained by the column of water present in the stretch of duct 14_1 that is sufficient to cause rise of the buoyant open/close element 17a until it occludes the upper valve seat 17b. As already explained, however, it may happen that an even slightly prolonged activation of the pump causes triggering of the siphon effect, with

consequent emptying-out of all the liquid present in the duct 14 and in the tub 3, notwithstanding the by now inactive condition of the pump.

[0030] In the case of the present invention, the presence of the auxiliary duct 20 enables this risk to be overcome. To return to Figure 5, the head of the pump 16 is such that the water W forced by the pump itself manages to penetrate into the auxiliary duct 20 downstream of the delivery section, and hence to cause at least part of the air present therein to come out. This air then passes into discharge duct 14, creating a bubble of pressurized air, represented schematically and designated by B in Figure 5, carried by the flow of water formed by the pump 16.

[0031] In the brief step of activation of the pump 16, the water in the duct 14 can rise in the ascending stretch 14_1, as far as the upper transition region 14b, and exceed the uppermost point of the duct 14. The water then starts to flow out into the descending stretch 14_2 of the duct 14, towards the drains, thus triggering the siphon effect. In this step, the flow of water in the duct 14 entrains along with it the pressurized air bubble B, with the latter that moves from the lower transition region 14a towards the upper transition region 14b, as exemplified in Figure 6. As the air bubble B rises along the ascending stretch 14_1 of the duct 14, its pressure decreases until it reaches atmospheric pressure. At a certain point, the pressure of the bubble B is substantially equal to the pressure at the outlet of the duct 14. It is precisely the presence of this air at atmospheric pressure inside the duct 14 that enables interruption of the siphon effect.

[0032] In fact, as exemplified in Figure 7, the flow of water present in the duct 14 is split into two parts by the air bubble B at atmospheric pressure, when this has reached the uppermost point of the discharge duct 14. In general terms, then, the brief period of activation of the pump 16 previously referred to is the minimum time necessary for enabling the air bubble B to rise in the discharge duct 14 up to its uppermost point or in the vicinity thereof, in the upper transition region 14b, in order to determine splitting of the flow. Indicatively, for this purpose, the pump 16 can be activated for a period shorter than 3 s, very preferably approximately 2 s.

[0033] A part of the water then proceeds along the descending stretch 14_2 of the duct 14, towards the outlet, and flows into the drains. The other part of the water tends, instead, to descend again backwards along the ascending stretch 14_1, starting from the upper transition region 14b towards the lower transition region 14a. In this way, given that the level of the water in the stretch of duct 14_1 will be now at a height greater than the level of the water present within the tub 3, the thrust exerted by the water towards the tub 3 will cause rise of the buoyant open/close element 17a, until it engages the upper valve seat 17b, as represented in Figure 7. The discharge opening 12 of the tub 3 is consequently obstructed in such a way that also in the first steps of agitation of the drum 4 of the machine 1, brought about by the motor 5 controlled by the control system 7, the risk of part of the washing agent or water with high concentration of washing agent is prevented from reaching the discharge duct, thus remaining unused.

[0034] The loading process described can be carried out at any treatment step that entails delivery of a washing agent into the tub. In the case of treatment steps that do not entail use of washing agents, activation of the pump 16 may be omitted.

[0035] Emptying of the part of water that occupies the auxiliary duct 20 can be obtained with a step of total discharge, i.e., keeping the pump 16 active for the time necessary to obtain complete emptying of the liquid contained in the tub 3, with modalities in themselves known. During such a total discharge the pump 16 forces the water into the duct 14 as far as its outlet, in any case causing also triggering of the siphon effect, which makes it possible to obtain at the end complete emptying of the discharge duct, including the water still present in the auxiliary duct 20. The discharge system of the machine then returns into the condition of Figure 2.

[0036] From the foregoing description, the characteristics of the present invention emerge clearly, as likewise do its advantages. A basic advantage of the invention is represented by the simplicity of construction of the discharge system proposed. The problems typical of the prior art referred to in the introductory part of the present description are in fact solved by simply providing an auxiliary duct of a modest length, which branches off upwards starting from the discharge duct and is occluded at its upper end. The solution, in addition to being simple and reliable from a constructional standpoint, is evidently also very inexpensive.

[0037] It is clear that numerous variations may be made by the person skilled in the art to the washing machine described by way of example, without thereby departing from the scope of the invention as defined in the ensuing claims.

[0038] According to possible variant embodiments, the step of activation of the pump envisaged by the loading process described may be made also in the course of delivery of water into the tub, or in any case before the predetermined loading level for carrying out the treatment step has been reached. For example, in an embodiment of this type, in a first part of the process, the water is not made to pass through the dispenser device 9 or through a compartment thereof containing a washing agent. When a certain intermediate level is reached within the tub 3 - which can be detected for example via a pressure switch or a turbine meter, or else determined by a predefined time of opening of the valve 6 (which is typically with constant flow rate) - the brief activation of the pump 16 is driven, which creates the bubble B, as described previously. Then, the flow of water is diverted into the compartment of the dispenser 9 containing the washing agent envisaged for the specific treatment step, which is thus entrained into the tub 3 when the corresponding outlet 12 has in the mean time already been obstructed by the buoyant open/close element 17a, as described

above.

Claims

1. A washing machine having a control system (7), a treatment tub (3) with a discharge opening (12), a washing-agent dispenser device (9), an arrangement (6, 10) for loading liquid into the tub (3), a discharge duct (14) having an inlet connected to the discharge opening (12) of the tub (3), and a pump (16) on the discharge duct (14),
wherein the discharge duct (14) has a substantially S-shaped development, with a lower transition region (14a) and an upper transition region (14b), the transition regions (14a, 14b) being in an intermediate position with respect to the inlet and to an outlet of the discharge duct (14),
the washing machine (1) being **characterized in that**:

   - one of the discharge duct (14) and the tub (3) has a valve arrangement (17) which includes a buoyant body (17a) and which is operative substantially at the discharge opening (12) of the tub (3),
   - the control system (6) is pre-arranged for controlling activation of the pump (17) in the course of a process of loading of liquid (W) into the tub (3),
   - the valve arrangement (17) is pre-arranged for preventing outflow of liquid from the discharge opening (12) of the tub (3) when the level (L) of the liquid (W) in the discharge duct (14) is at a height that is greater than the level of the liquid (W) in the tub (3) and that is comprised between the lower transition region (14a) and the upper transition region (14b), and
   - in the lower transition region (14a), an auxiliary duct (20), which is closed at its upper end (20a), branches off upwards from the discharge duct (14).

2. The washing machine according to Claim 1, wherein the auxiliary duct (20) branches off from the discharge duct (14) substantially at the lowermost point of the latter.

3. The washing machine according to Claim 1 or Claim 2, wherein the auxiliary duct (20) branches off from the discharge duct (14) downstream of the pump (16).

4. The washing machine according to any one of the preceding claims, wherein the auxiliary duct (20) extends substantially vertically.

5. The washing machine according to any one of the preceding claims, wherein the pump (16) is operatively arranged in a stretch of the discharge duct (14) that is comprised between the valve arrangement (17) and the auxiliary duct (20).

6. The washing machine according to any one of the preceding claims, wherein the valve arrangement (17) comprises:

   an upper valve seat (17b), with which the buoyant body (17a) is able to co-operate in order to prevent outflow of liquid (W) from the discharge opening (12) of the tub (3); and
   a lower valve seat (17c), engageable by the buoyant body (17a) at least during said activation of the pump (16), the lower valve seat (17c) having one or more peripheral passages for enabling a seepage of liquid (W) into the discharge duct (14) even when the buoyant body (17a) engages the lower valve seat (17c).

7. The washing machine according to any one of the preceding claims, wherein the washing-agent dispenser device (9) belongs to the arrangement (6, 10) for loading liquid into the tub (3).

8. A process for the loading of a liquid into the treatment tub (3) of a washing machine according to one or more of the preceding claims, comprising:

   - loading the liquid (W) into the tub (3) with the buoyant body (17a) in a position of opening of the valve arrangement (17), in such a way that part of the liquid (W) is enabled to flow in the discharge duct (14) without filling the auxiliary duct (20);
   - activating the pump (16) for a predetermined time for forcing a flow of the liquid (W) in the discharge duct (14), in such a way that liquid forced by the pump (16) enters the auxiliary duct (20) and causes air previously present in the auxiliary duct (20) to pass into the discharge duct (14), forming an air bubble (B),
   wherein the predetermined time of activation of the pump (16) is a minimum time required for enabling the air bubble (B) to rise in the discharge duct (14) up to its uppermost point or in the vicinity thereof in the upper transition region (14b).

Fig. 1

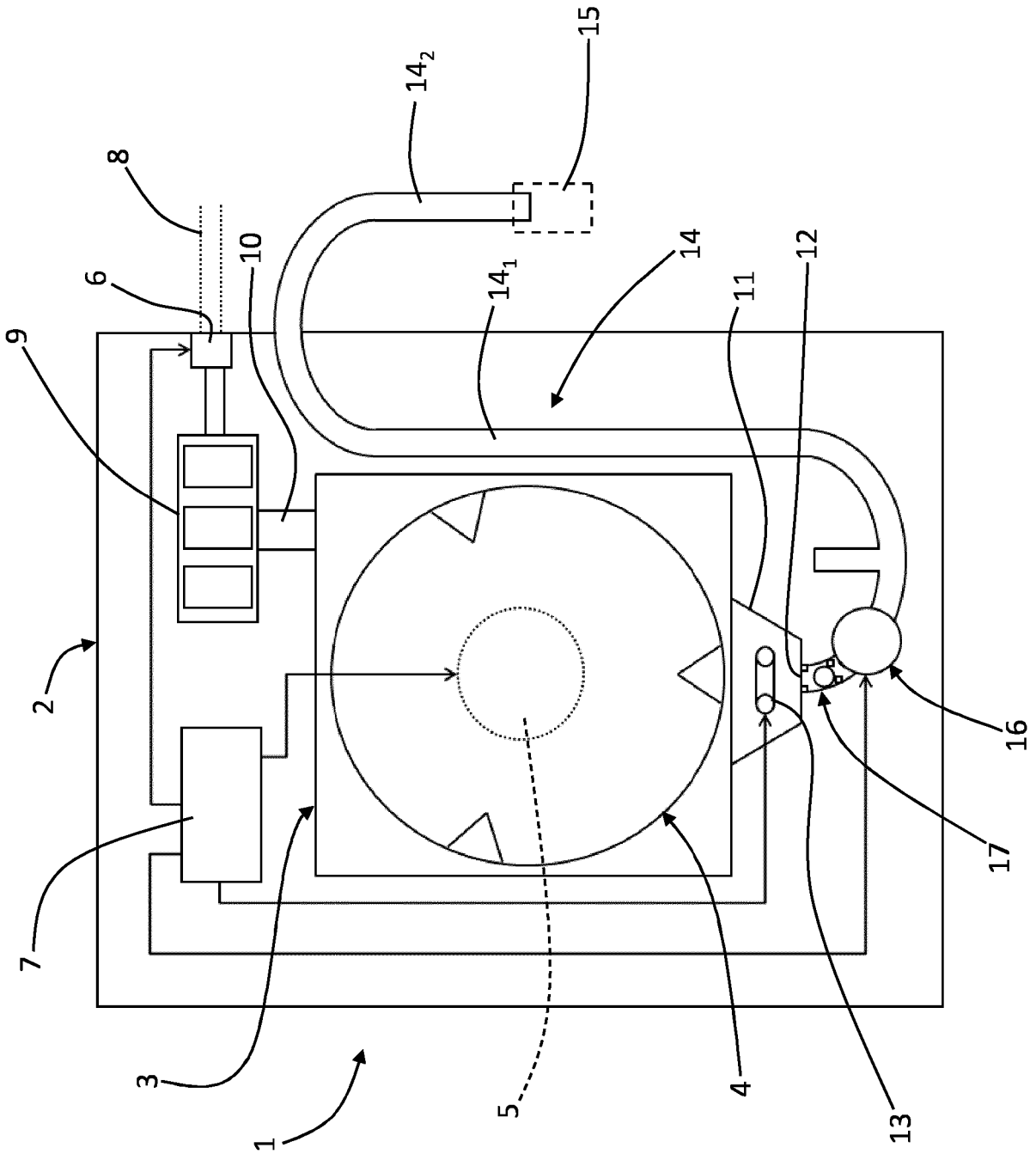


Fig. 2

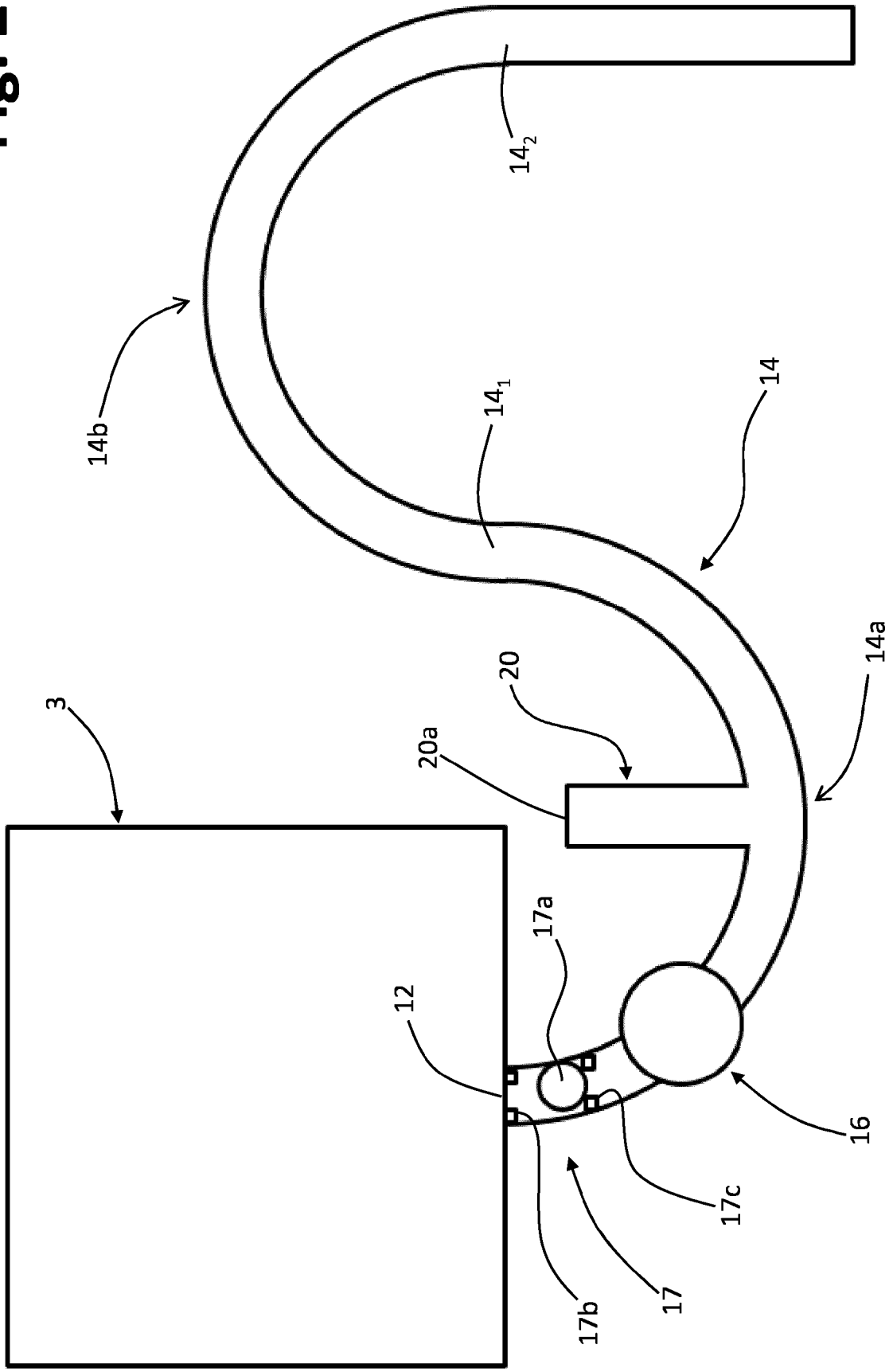


Fig. 3

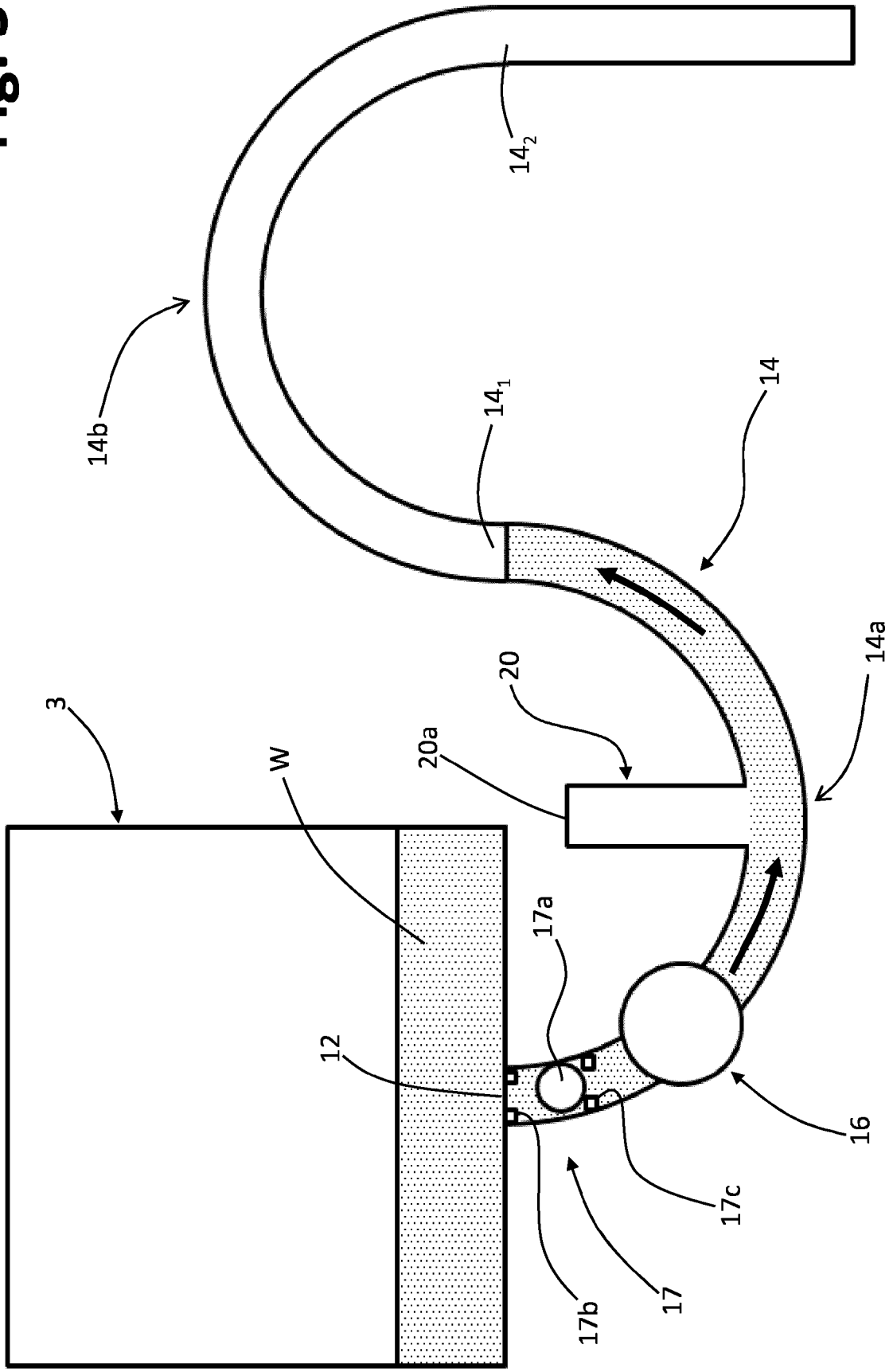


Fig. 4

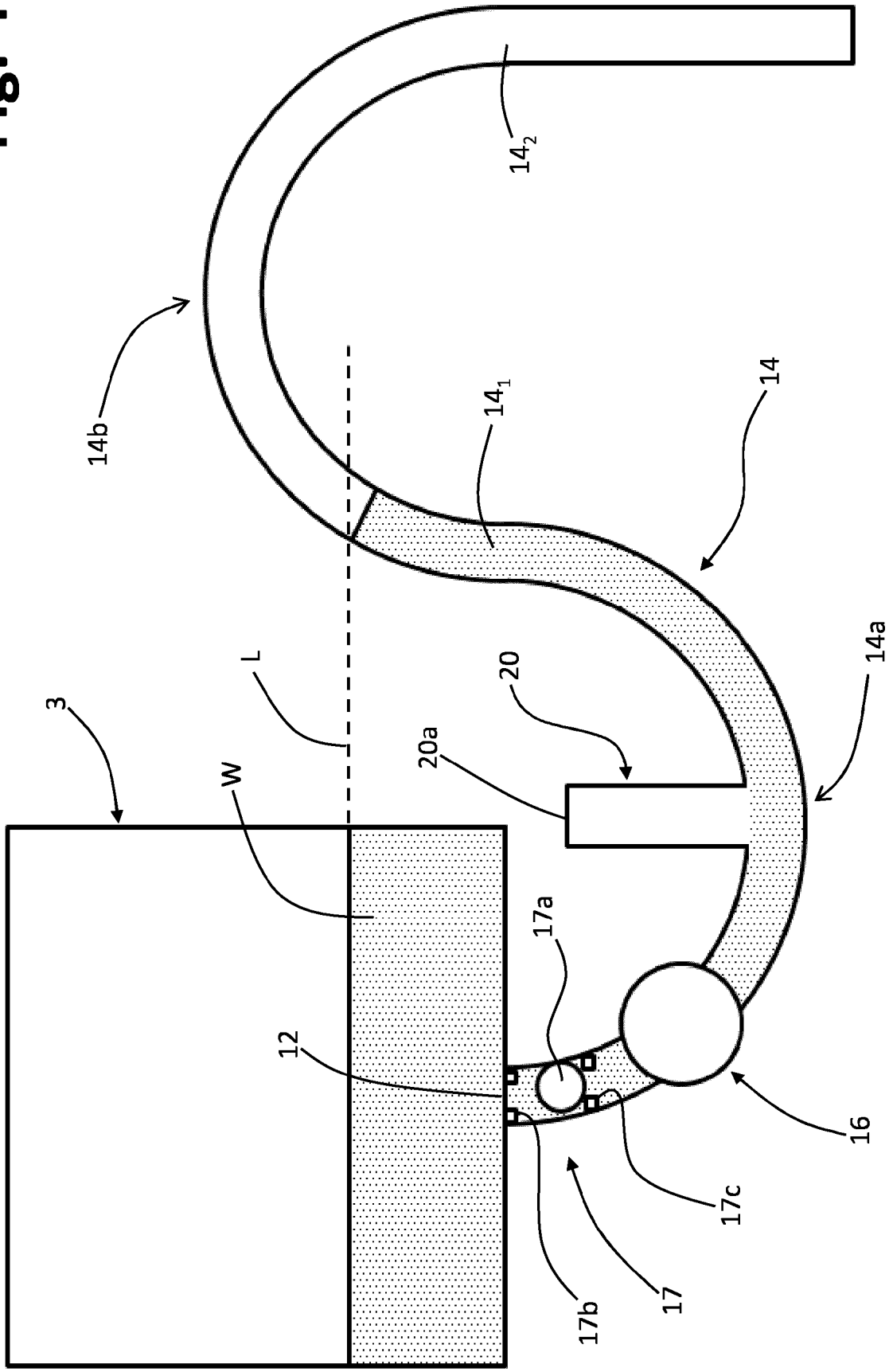


Fig. 5

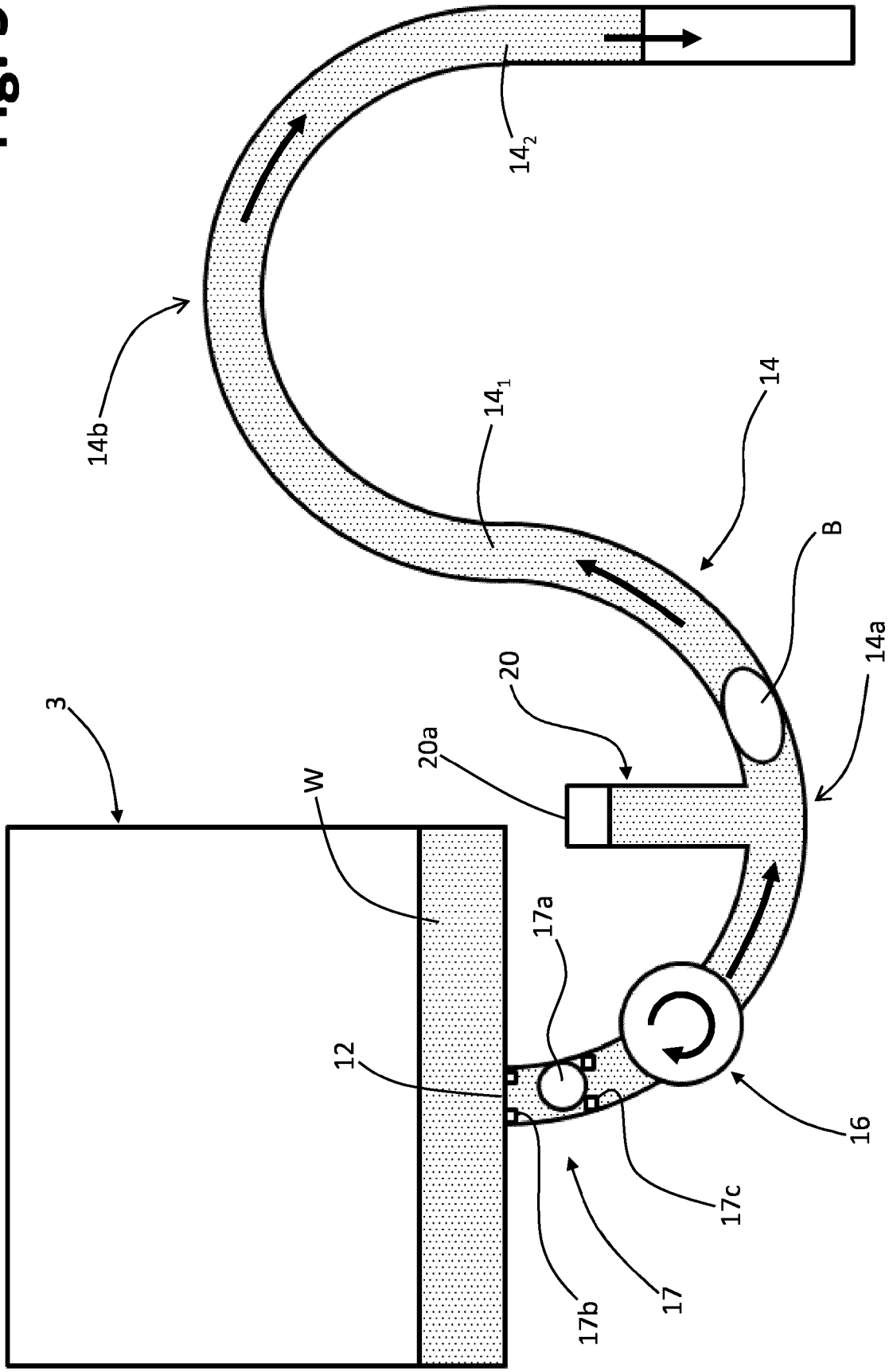


Fig. 6

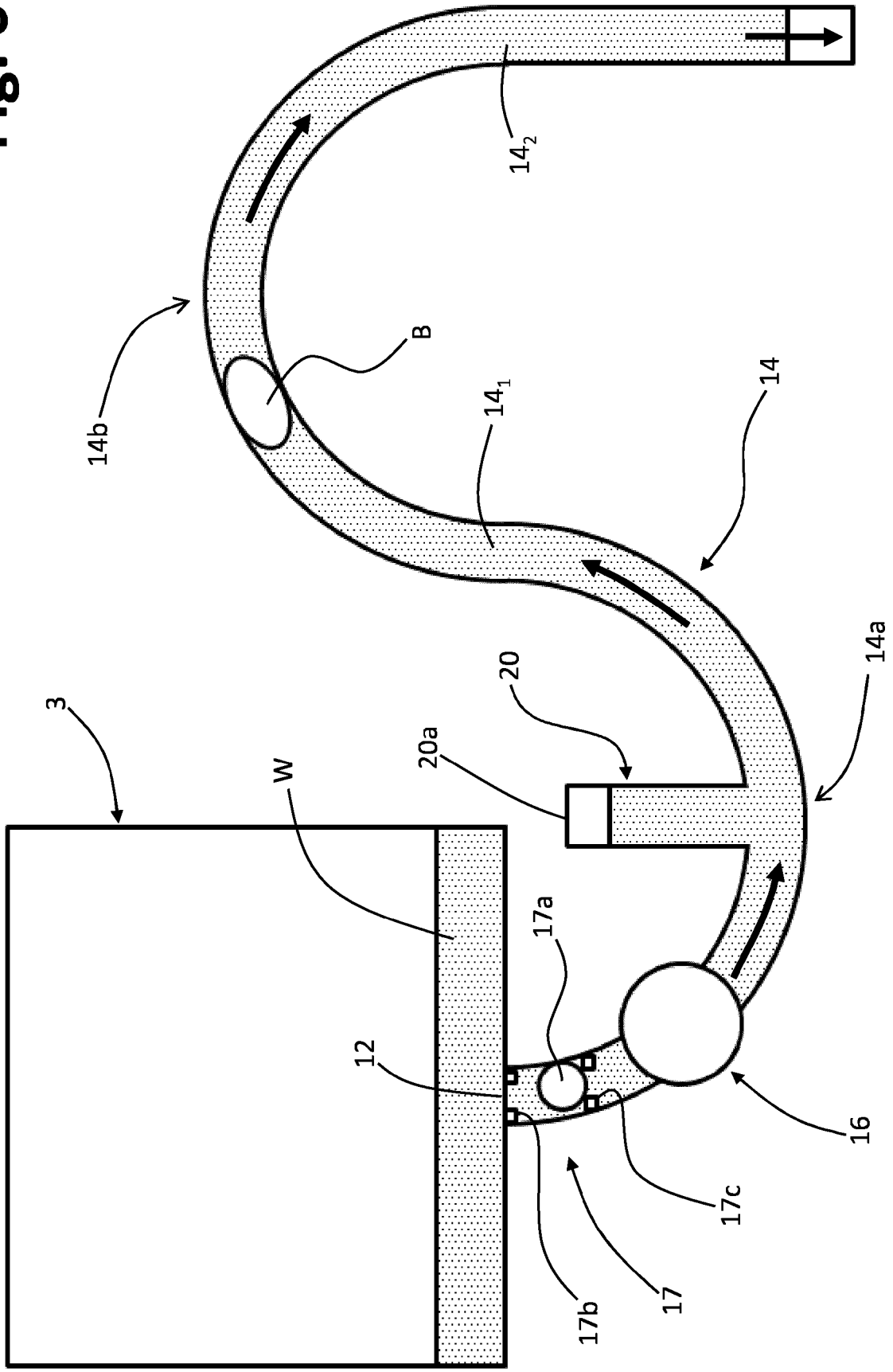
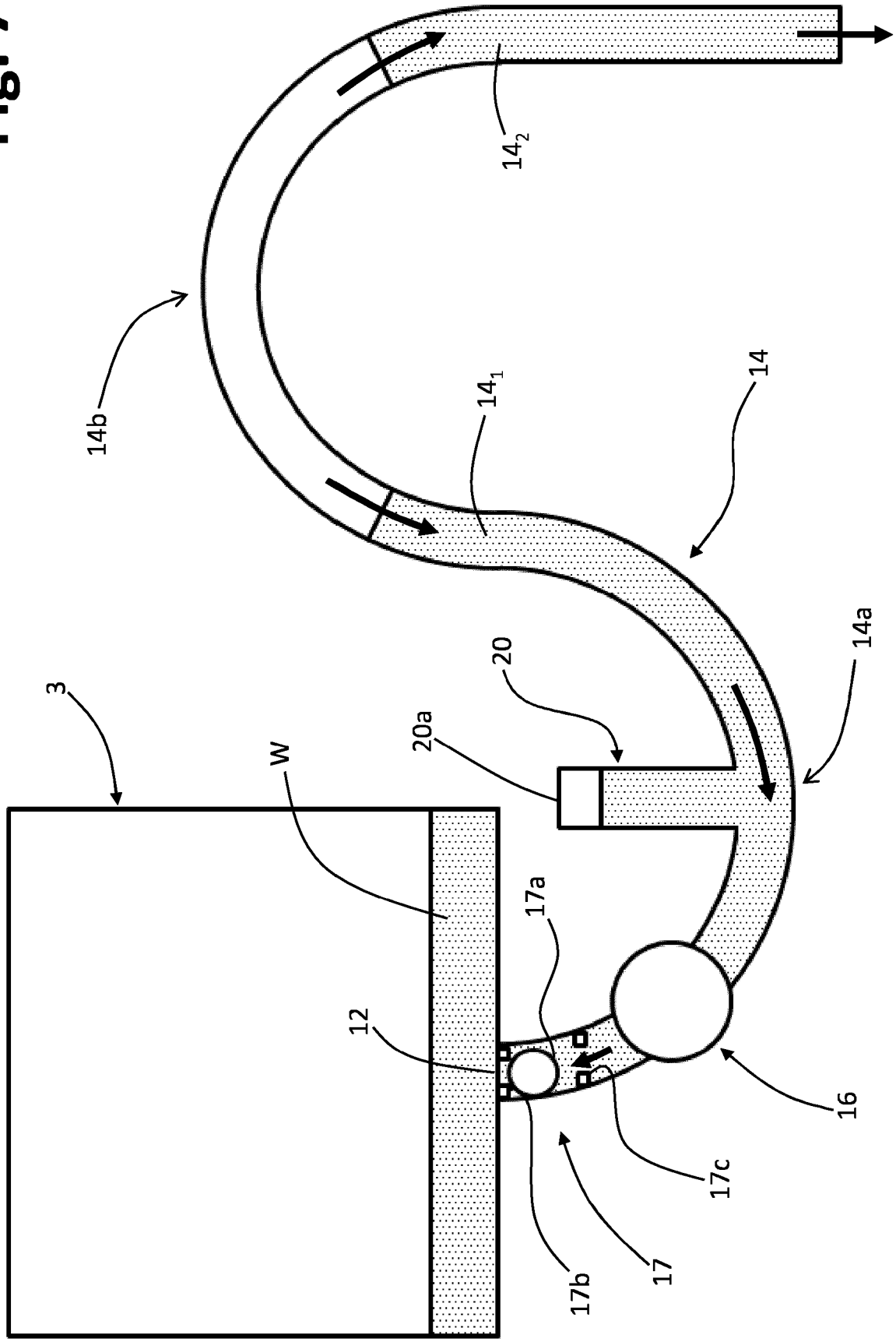


Fig. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 15 19 7586

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	GB 2 090 382 A (MCALPINE & CO LTD) 7 July 1982 (1982-07-07) * the whole document *	1-8	INV. D06F39/08 A47L15/42
A	WO 00/50684 A1 (ARCELIK AS [TR]; EKSERT SEMSETTIN [TR]) 31 August 2000 (2000-08-31) * the whole document *	1-8	
A	GB 1 123 789 A (COLSTON LTD C) 14 August 1968 (1968-08-14) * the whole document *	1-8	

TECHNICAL FIELDS SEARCHED (IPC)

D06F
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 May 2016	Diaz y Diaz-Caneja

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- WO 0050684 A1 **[0004]**
- GB 2090382 A **[0004]**