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(54) **VACUUM WASTE EVACUATION SYSTEM FOR A TOILET MODULE IN A PUBLIC TRANSPORTATION VEHICLE AND TOILET MODULE IN A PUBLIC TRANSPORTATION VEHICLE COMPRISING SAID EVACUATION SYSTEM**

(57) Vacuum waste evacuation system (1) for a toilet module in a public transportation vehicle, comprising a sanitary appliance (2) connected to a wastewater tank, and means of depressing said tank for vacuum evacuating the waste when a user actuates a discharge button of the sanitary appliance (2), which is characterized in that it comprises a pinch tube (5) valve (3) to communicate the sanitary appliance (2) with the wastewater tank,

and a first control valve (9) of said pinch tube (5) valve (3) which is configured to allow, in a first resting position, the inlet of air or gas to actuate the pinch tube (5) to a closed position, and to allow, in a second active position, the outlet of the air or gas with the aim of returning the pinch tube (5) to an open position, when the user actuates the discharge button of the sanitary appliance (2).

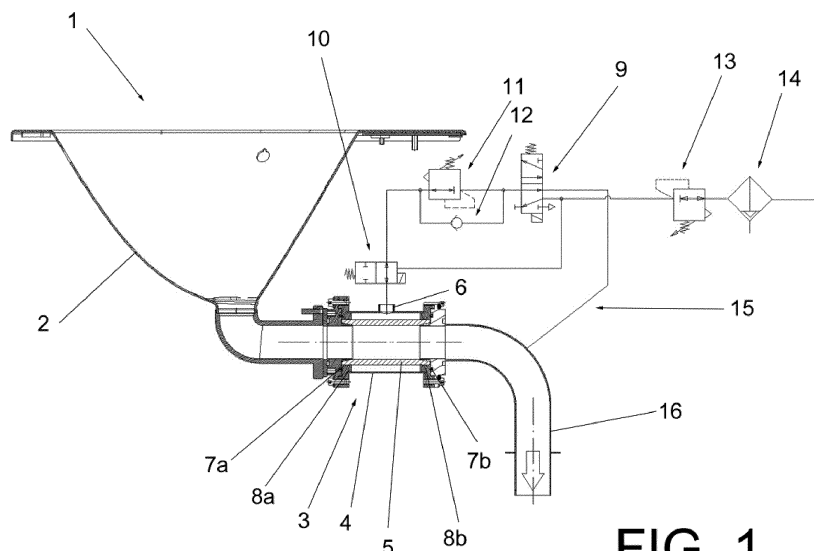


FIG. 1

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Description

[0001] The present invention relates to a vacuum waste evacuation system for a toilet module in a public transportation vehicle and to a toilet module in a public transportation vehicle, e.g. a rail vehicle, comprising said evacuation system

Background of the invention

[0002] Some means of public transportation, such as railways, include toilet modules or sanitary facilities comprising a toilet connected to a vacuum device designed to suction the waste deposited in the toilet to a wastewater tank, and a cut-off valve arranged between the toilet and the wastewater tank, which allows the passage of the waste towards said tank when a user actuates the vacuum device.

[0003] The cut-off valve of the vacuum evacuation systems is normally closed preventing the conduction of the toilet waste to the wastewater tank, so that the wastewater tank may maintain the vacuum level generated by an ejector. Furthermore, the cut-off valve only changes its status, from normally closed to open, when a processing and control unit detects that a user has actuated a waste discharge button of the toilet. Said unit gives the opening signal to the cut-off valve during a configurable time, generally from 0.6 to 1 second, with said cut-off valve returning to its resting state (normally closed) until the discharge button of the toilet is again pressed by the next user.

[0004] This type of cut-off valves basically comprise a main body which includes an inlet and an outlet for the passage of the waste from the toilet and a ball valve or knife gate valve, which is housed inside the main body. Two seals housed each one on both sides of the valve aim to guarantee the air-tightness of the system.

[0005] Often, the users of the toilets of public transportation vehicles deposit foreign bodies in the toilet such as syringes, sanitary towels, tampons, disposable razors, among others which may damage or even break said seals as they are pinched between the seals and body of the valve. The main drawback of the existing vacuum evacuation systems lies in the fact that if the seals of the cut-off valve are damaged, these seals no longer guarantee the air-tightness of the system, which leads to problems of bad odours and a high maintenance cost of the toilet module.

Description of the invention

[0006] The objective of the present invention is to resolve the mentioned drawbacks providing a vacuum waste evacuation system which resolves said drawbacks and which has the advantages described below.

[0007] In accordance with this objective, according to a first aspect, the present invention provides a vacuum waste evacuation system for a toilet module in a public

transportation vehicle, comprising a sanitary appliance connected to a wastewater tank, and means of depressing said tank for vacuum evacuating the waste when a user actuates a discharge button of the sanitary appliance, and is characterized in that it comprises a pinch tube valve or pinch valve to communicate the sanitary appliance with the wastewater tank, and a first control valve of said pinch tube valve which is configured to allow, in a first resting position, the inlet of air or gas to actuate the pinch tube to a normal closed position, and to allow, in a second active position, the outlet of the air or gas for returning the pinch tube to an open position when the user actuates the discharge button of the sanitary appliance.

[0008] According to a second aspect, the present invention provides a toilet module in a public transportation vehicle, e.g. a rail vehicle, comprising the vacuum evacuation system claimed.

[0009] In the present invention, the pinch tube provides, in an open position, a pipe of great length and through capacity to allow the evacuation of all type of waste or objects without any problems. Furthermore, in the case of presence of foreign bodies, the pinch tube remains closed adapting to the form of the object, without significant risk of puncture, breakage or loss of air-tightness. When the user actuates the discharge button, the pinch tube returns to its open position to allow the evacuation of the waste or foreign bodies without said pinch tube suffering any type of deterioration. Thanks to this, a vacuum evacuation system is obtained of long useful life and low maintenance cost that also safely guarantees air-tightness, avoiding the problems of bad odours.

[0010] Advantageously, the pinch tube valve comprises a main body associated to a pinch tube of elastomeric material which includes an inlet and an outlet for the passage of the waste from the sanitary appliance, two covers arranged at the inlet and the outlet of the main body which incorporate, each one, a support part for the ends of the pinch tube, the body of said valve including an inlet pipe associated to supply means of compressed air or gas to be able to displace the pinch tube until the closed position.

[0011] This pinch-tube-type cut-off valve has the advantage that it does not require seals, since the ends of the pinch tube are joined, each one to a support part which is integrally joined to one of the covers, so that the ends of the pinch tube act as seal of the valve.

[0012] The pinch tube comprises, preferably, an elastomeric material, such as, for example, a pinch tube of natural rubber, and advantageously, said elastomeric material is of a thickness equal to or greater than 5 mm, preferably, equal to or greater than 8 mm, to provide suitable rigidity and resistance to tearing of the pinch tube.

[0013] According to a preferred embodiment, the first control valve of the pinch tube valve is configured to allow, in a first resting position, the inlet of air or gas to actuate the pinch tube to a normal closed position, and to allow, in a second active position, the inlet of a vacuum level

from the vacuum line of the wastewater tank with the aim of returning the pinch tube to its open position, when the user actuates the discharge button of the sanitary appliance.

[0014] Advantageously, said control valve is connected to the vacuum line of the wastewater tank, so that, in its active position, said valve allows the inlet of a vacuum level from said vacuum line. When the vacuum enters, the air or gas is suctioned from the body of the valve which actuates the pinch tube.

[0015] This preferred embodiment has the advantage that it uses the vacuum level generated by an ejector associated to the wastewater tank to guarantee the outlet of the air or gas and the complete return of the pinch tube to its open position, when it is necessary to evacuate the waste or wastewater. In this way, the system guarantees optimal operation of the pinch tube valve and the correct evacuation of the waste or foreign bodies.

[0016] Preferably, said first control valve is a dual-position five-way monostable valve, which is configured to allow an air or gas inlet channel in a first resting position, and an inlet channel of a vacuum level in a second active position.

[0017] Again preferably, said system comprises a second control valve of the pinch tube valve configured to prevent, in a first resting position, the outlet of air or gas of the pinch tube valve with the object of maintaining the pinch tube valve closed when the system remains without air and/or energy, this same control valve being susceptible of allowing, in an active position, the inlet of air or gas to actuate the pinch tube in the normal closed position.

[0018] This second control valve enables guaranteeing the air-tightness when the evacuation system remains without compressed gas or air and/or without energy (degraded mode of operation of the toilet module). This securely prevents the outlet of bad odours, since the pinch tube valve remains closed to prevent the outlet of the compressed air or gas that is housed inside the body of the valve.

[0019] Advantageously, said second control valve is a dual-position two-way monostable valve, which is configured to allow, in an active position, an air or gas inlet channel, or an air or gas outlet channel, and to prevent, in a resting position, the outlet of the air or gas when the system remains without compressed air or gas and/or without energy

[0020] Preferably, said system comprises a regulation device arranged between the first and the second control valve to regulate the pressure of the supply of compressed air or gas to the inlet of the pinch tube valve or pinch valve.

[0021] Again preferably, the system comprises a processing and control unit configured to provide an activation signal to the first control valve in accordance with a waste discharge order signal issued by means of detection of a discharge order of the sanitary appliance, said same control valve being susceptible of returning to

its resting position to allow the inlet of air or gas and close the pinch tube, when the discharge order signal stops.

[0022] Advantageously, said processing and control unit is configured to provide a deactivation signal to the second control valve in accordance with an operating signal in degraded mode due to lack of air or gas, issued by means of detection of the toilet module, said second valve being susceptible, in a deactivated resting position, of preventing the outlet of the air or gas of the pinch tube valve to maintain the pinch tube in the closed position. The same control valve may return to its active position when said operating signal in degraded mode stops due to lack of air or gas, or when the energy supply returns.

[0023] As commented above, in accordance with a second aspect, the present invention provides a toilet module in a public transportation vehicle comprising the vacuum evacuation system claimed.

[0024] In particular, the present invention provides a toilet module in a public transportation vehicle comprising a toilet connected to a wastewater tank, means of depressing said tank for vacuum evacuating the waste when a user actuates a discharge button of the toilet, a pinch tube valve or pinch valve to communicate the toilet with the wastewater tank, and a first control valve of said pinch tube valve. This control valve is configured to allow, in a first resting position, the inlet of air or gas for maintaining the pinch tube in a closed position, and to allow, in a second active position, the outlet of air or gas, to return the pinch tube to an open position when the user actuates the discharge button of the toilet.

[0025] Optionally, the outlet of air or gas may be carried out by connecting the inlet pipe of the pinch tube valve to the vacuum line of the tank.

Brief description of the figures

[0026] For a better understanding of all the aforementioned, drawings are attached wherein, schematically and only by way of non-limiting example, a practical case of embodiment is represented.

Figures 1 to 3 are diagrammatic views of the system showing a toilet and a pinch tube valve or pinch valve which communicates the toilet with a wastewater tank (the latter is not represented). The same figures show a diagram of the compressed air or gas supply circuit and vacuum that incorporates the control valves of the pinch tube valve.

Figure 1 shows the pinch tube valve in an open position, which allows the passage of waste when the user of the toilet actuates a discharge button of said toilet.

Figure 2 shows the pinch tube valve in a closed position, which prevents the passage of waste and, with this, the outlet of bad odours from the wastewater tank.

Figure 3 shows the pinch tube valve maintained in closed position in degraded operating mode of the toilet system or module (lack of air or gas and/or lack of energy in the system).

Description of a preferred embodiment

[0027] An embodiment is described below of the system claimed making reference to figures 1 to 3.

[0028] The vacuum waste evacuation system 1 of the present invention comprises a toilet 2 connected to a wastewater tank (not represented) and a pinch tube 3 valve 5 to communicate the toilet 2 with this tank when a user actuates the waste discharge button. The interior of the wastewater tank is maintained with a vacuum level comprised between -0.4 b and - 0.25 b due to an ejector (not represented), so that the waste from the toilet 2 can be vacuum evacuated when the user actuates the discharge button which opens the through-pipe of the pinch tube 5 valve 3.

[0029] As can be seen in the three figures, the pinch tube valve 3 comprises a main body 4 associated to a pinch tube 5 of elastomeric material, for example, a pinch tube 5 of natural rubber, and an inlet pipe 6 associated to means of supply of compressed air or gas.

[0030] In the embodiment described, the ends of the pinch tube are joined to support pieces 7a, 7b which are incorporated in covers 8a, 8b arranged at the inlet and outlet of the pinch tube valve 3. In this way, the ends of the pinch tube 5 act as seals of the pinch tube 5 valve 3.

[0031] The system 1 incorporates a first control valve 9 of the pinch tube 5 valve 3 which is configured to allow, in a first resting position, the inlet of compressed air or gas through the inlet pipe 6 of the body 4 of the pinch tube 5 valve 3, and to allow, in a second active position, the outlet of the compressed air or gas through the same inlet pipe 6.

[0032] The inlet of compressed air or gas through the inlet pipe 6 actuates the pinch tube 5 until a closed position of the valve 3, whilst the outlet of air through the same pipe 6 enables the return of the pinch tube 5 to an open position of free passage of waste.

[0033] In the embodiment described, the first control valve 9 is a dual-position five-way monostable electrovalve, which is configured to allow, in its active position, an inlet channel of a vacuum level from the vacuum line associated to the wastewater tank. The vacuum actively actuates the return of the pinch tube 5 to its open position, which provides an optimum operation of the pinch tube valve 3, and the complete opening of the pinch tube 5.

[0034] The system 1 incorporates a second control valve 10 of the pinch tube valve 3 which is configured to prevent, in a resting position, the outlet of air or gas through the pipe 6 of the body 4 of the valve 3, and to allow, in an active position, the inlet of compressed air or gas through the same inlet pipe 6.

[0035] As commented in the description of the invention, this second control valve 10 allows guaranteeing

the air-tightness when the system 1 remains without air and/or electrical energy (degraded mode of operation of the toilet module). In this way, it avoids the outlet of bad odours and guarantees the air-tightness, since the pinch tube 5 valve 3 remains closed to prevent the outlet of air through the inlet pipe 6.

[0036] In the embodiment described, the second control valve 10 is a dual-position two-way monostable electrovalve, which is configured to allow, in its active position, when the system operates without faults, an inlet channel of the air or gas which actuates the pinch tube 5 to its closed position, or an air outlet or vacuum inlet channel which returns the pinch tube 5 to its open position. In the resting position, the control valve 10 prevents the outlet of the air or gas which houses the body 4 of the valve 3, maintaining the pinch tube 5 in a closed position also when the toilet module is in degraded mode.

[0037] Among the control valves 9 and 10, the system 1 incorporates a device 11 to regulate the supply pressure of compressed air or gas, as well as a valve 12 to give fast outlet to the air or gas which exits the pinch tube 5 valve 3. The same system 1 incorporates a second device 13 to regulate the pressure of air or gas, and a filter 14 to purify the air or gas which enters the toilet module and the system 1. In the embodiment described, the compressed air or gas comes from the supply network of compressed air or gas of the transportation vehicle.

[0038] The mode of operation of the system 1 is described below making reference to the diagrams shown in figures 1 to 3.

[0039] When the user of the toilet module wants to discharge waste, this user presses a button which is associated to means of detection configured to send a discharge order signal to a processing and control unit. After receiving this signal, the processing and control unit provides an activation signal to the first control valve 9 of the pinch tube 5 valve 3 to allow the inlet of a vacuum level which actuates the return of the pinch tube 5 to an open position of passage of waste.

[0040] Figure 1 shows the open position of passage of the pinch tube 5, and the position of the control valve 9. In this figure 1, the connection 15 of the control valve 9 with the waste evacuation pipe 16, which forms part of the vacuum line that communicates with the wastewater tank, has been represented diagrammatically. The same figure 1 shows the second control valve 10 in an active position configured to allow the outlet channel of air and vacuum inlet channel that maintains the pinch tube 5 in its open position of passage.

[0041] The pinch tube 5 returns to its closed position in less than 1 second, when the evacuation cycle finalizes and the discharge order signal stops, which also entails the stoppage of the activation signal of the control valve 9, and the return of said valve 9 to its resting position to allow the inlet of compressed air and close the pinch tube 5 (see figure 2). In the closed position of the pinch tube 5, the second control valve 10 is maintained in an active positioned configured to allow the air or gas inlet channel

which maintains the pinch tube 5 closed.

[0042] When the toilet module remains without compressed air or gas due to a degraded operation of the system 1, the processing and control unit of the system 1 sends a deactivation signal to the second control valve 10 in accordance with an operating signal in degraded mode issued by means of detection of the system 1. In this deactivated position, the control valve 10 prevents the outlet of air or gas through the inlet pipe 6 of the body 4 of the pinch tube 5 valve 3 to maintain the pinch tube 5 in the closed position (see figure 3). The same control valve 10 may return to its active position when the operating signal in degraded mode stops, or when the energy supply returns.

[0043] As commented in the description of the invention, the present invention provides a system 1 of low maintenance cost, which optimally guarantees the air-tightness, avoiding the problem of bad odours.

[0044] When a user deposits a foreign body in the toilet 2, such as a syringe, a sanitary towel or a razor blade, the system 1 claimed makes it possible to evacuate this type of objects with no problem, since, unlike other cut-off valves, it provides a through-pipe of great length and diameter. Furthermore, if any of these foreign bodies remains inside the valve 3, the pinch tube 5 remains closed adapting to the form of the object, without significant risk of puncture, breakage or loss of air-tightness.

[0045] Despite the fact that reference has been made to a specific embodiment of the invention, it is evident for a person skilled in the art that the system 1 is susceptible to numerous variations and modifications and that all the details mentioned can be replaced by other technically equivalent ones, without departing from the scope of protection defined by the attached claims. For example, although an embodiment of the system has been described wherein the first control valve 9 is configured to allow, in its active position, the inlet of a vacuum level from the vacuum line of the wastewater tank, the same control valve 9 could be configured to allow, in its active position, the outlet of air, or any other type of gas, without vacuum inlet, or configured to allow the inlet of a vacuum level from a different vacuum line to that of the wastewater tank of the toilet module.

Claims

1. Vacuum waste evacuation system (1) for a toilet module in a public transportation vehicle, comprising a sanitary appliance (2) connected to a wastewater tank, and means of depressing said tank for vacuum evacuating the waste when a user actuates a discharge button of the sanitary appliance (2), **characterized in that** it comprises a pinch tube (5) valve (3) to communicate the sanitary appliance (2) with the wastewater tank, and a first control valve (9) of said pinch tube (5) valve (3) which is configured to allow, in a first resting position, the inlet of air or gas

to actuate the pinch tube (5) to a closed position, and to allow, in a second active position, the outlet of the air or gas with the aim of returning the pinch tube (5) to an open position, when the user actuates the discharge button of the sanitary appliance (2).

2. Evacuation system (1) according to claim 1, wherein the first control valve (9) of the pinch tube (5) valve (3) is configured to allow, in a first resting position, the inlet of air or gas to actuate the pinch tube (5) to a closed position, and to allow, in a second active position, the inlet of a vacuum level from the vacuum line (16) of the wastewater tank with the aim of guaranteeing the return of the pinch tube (5) to its open position, when the user actuates the discharge button of the sanitary appliance (2).

3. Evacuation system (1) according to any of claims 1 to 2, comprising a second control valve (10) of the pinch tube (5) valve (3) configured to prevent, in a resting position, the outlet of the air or gas of the pinch tube (5) valve (3) to maintain closed the pinch tube (5) valve (3) when the system (1) remains without air or gas and/or energy, the same control valve (10) being susceptible of allowing, in an active position, the inlet of gas or air with the aim of maintaining the pinch tube (5) in the closed position.

4. Evacuation system (1) according to any of claims 1 to 3, wherein said pinch tube (5) valve (3) comprises a main body (4) associated to a pinch tube (5) of elastomeric material which includes an inlet and an outlet for the passage of the waste from the sanitary appliance (2), two covers (8a,8b) arranged at the inlet and the outlet of the main body (4) which incorporate, each one, a support part (7a,7b) of the ends of the pinch tube (5), with the body (4) of said valve (3) including an air or gas inlet pipe (6) to be able to actuate the pinch tube (5) until the closed position.

5. Evacuation system (1) according to any of the preceding claims, wherein said first control valve (9) is a dual-position five-way monostable valve, which is configured to allow an air or gas inlet channel, in a first resting position, and an air or gas outlet channel, or inlet of a vacuum level, in a second active position.

6. Evacuation system (1) according to any of claims 1 or 5, wherein said second control valve (10) is a dual-position two-way monostable valve, which is configured to allow, in an active position, an air or gas inlet channel, or an air or gas outlet channel.

7. Evacuation system (1) according to any of the preceding claims, comprising a regulation device (11) arranged between the first (9) and the second control valve (10) to regulate the compressed air or gas pressure at the inlet of the pinch tube (5) valve (3).

8. Evacuation system (1) according to any of claims 1 to 7, wherein said first control valve (9) is connected to a waste evacuation pipe (16) associated to a vacuum line of said wastewater tank. 5
9. Evacuation system (1) according to any of claims 1 to 8, comprising a regulation device (11) arranged between the first (9) and the second (10) control valve to give fast outlet to the air or gas from the pinch tube (5) valve (3). 10
10. Evacuation system (1) according to any of claims 1 to 9, comprising a processing and control unit configured to provide an activation signal to the first control valve (9) in accordance with a discharge order signal of the sanitary appliance (2) issued by means of detection of a discharge order of the sanitary appliance (2), said same control valve (9) being susceptible of returning to its resting position to allow the inlet of air or gas, and closing the pinch tube, when the discharge order from the processing and control unit stops. 15
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11. Evacuation system according to claim 10, wherein said processing and control unit is configured to provide a deactivation signal of the second control valve (10) in accordance with an operating signal in degraded mode due to lack of air or gas, issued by means of detection of the toilet system or module, said second valve (10), in a deactivated resting position, being susceptible of preventing the outlet of gas or air of the pinch tube (5) valve (3) for maintaining the pinch tube (5) in the closed position. 25
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12. Evacuation system (1) according to any of the preceding claims, wherein the elastomeric material of the pinch tube (5) is natural rubber. 35
13. Evacuation system (1) according to any of the preceding claims, wherein the elastomeric material of the pinch tube (5) has a thickness equal to or greater than 5 mm. 40
14. Toilet module in a public transportation vehicle **characterized in that** it comprises the vacuum evacuation system (1) according to any of claims 1 to 13. 45
15. Toilet module in a public transportation vehicle according to claim 14, wherein said sanitary appliance (2) is a toilet. 50

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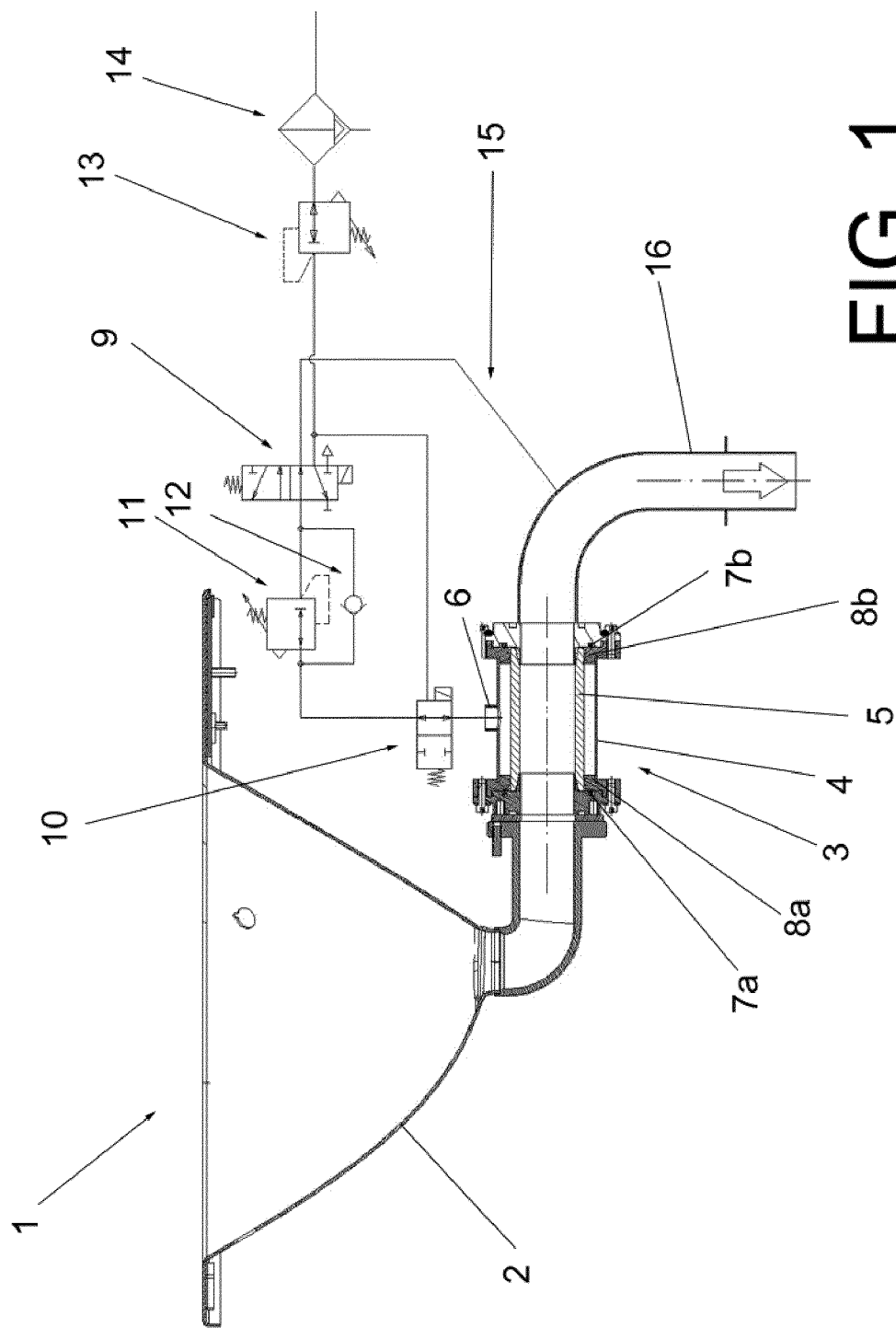


FIG. 1

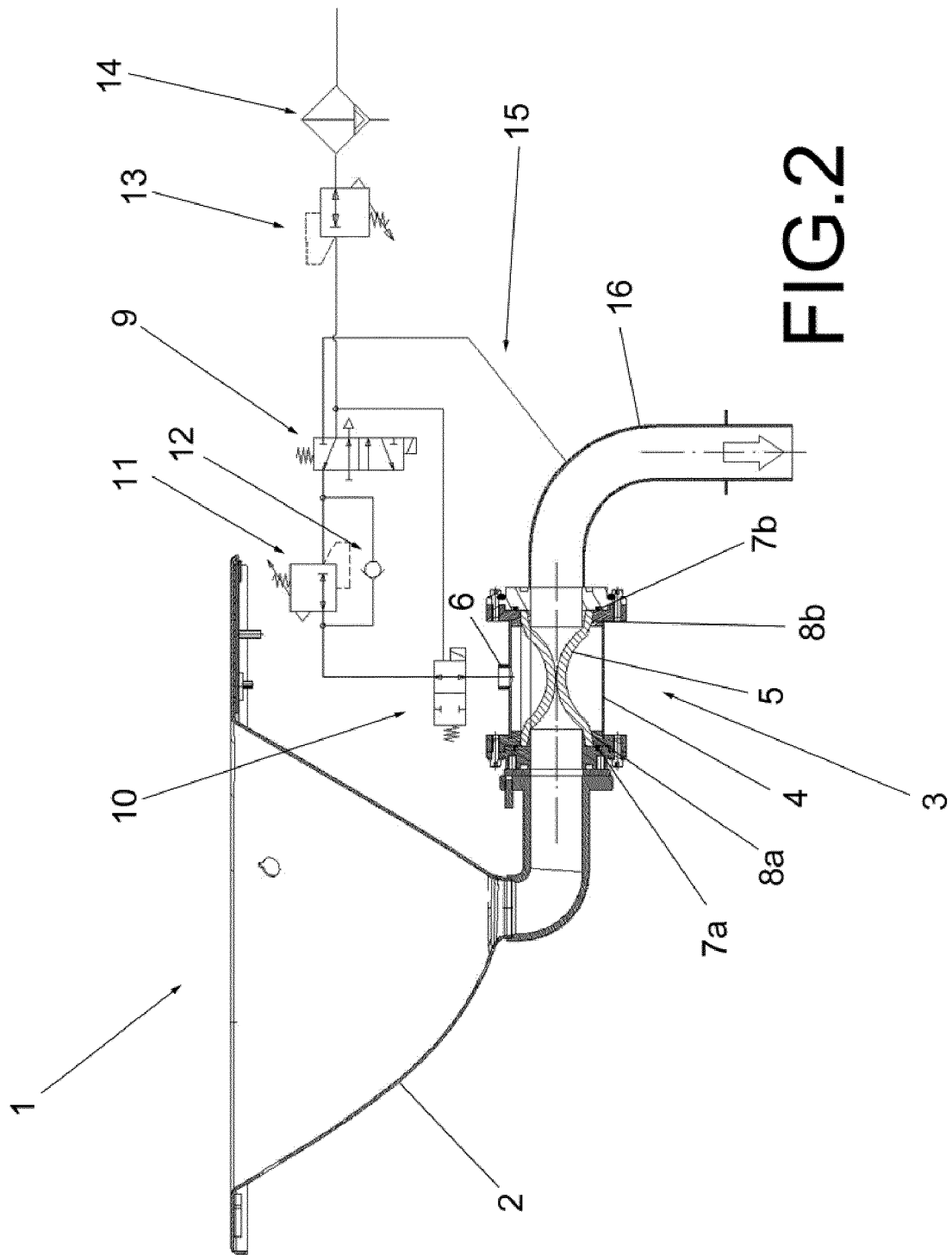


FIG. 2

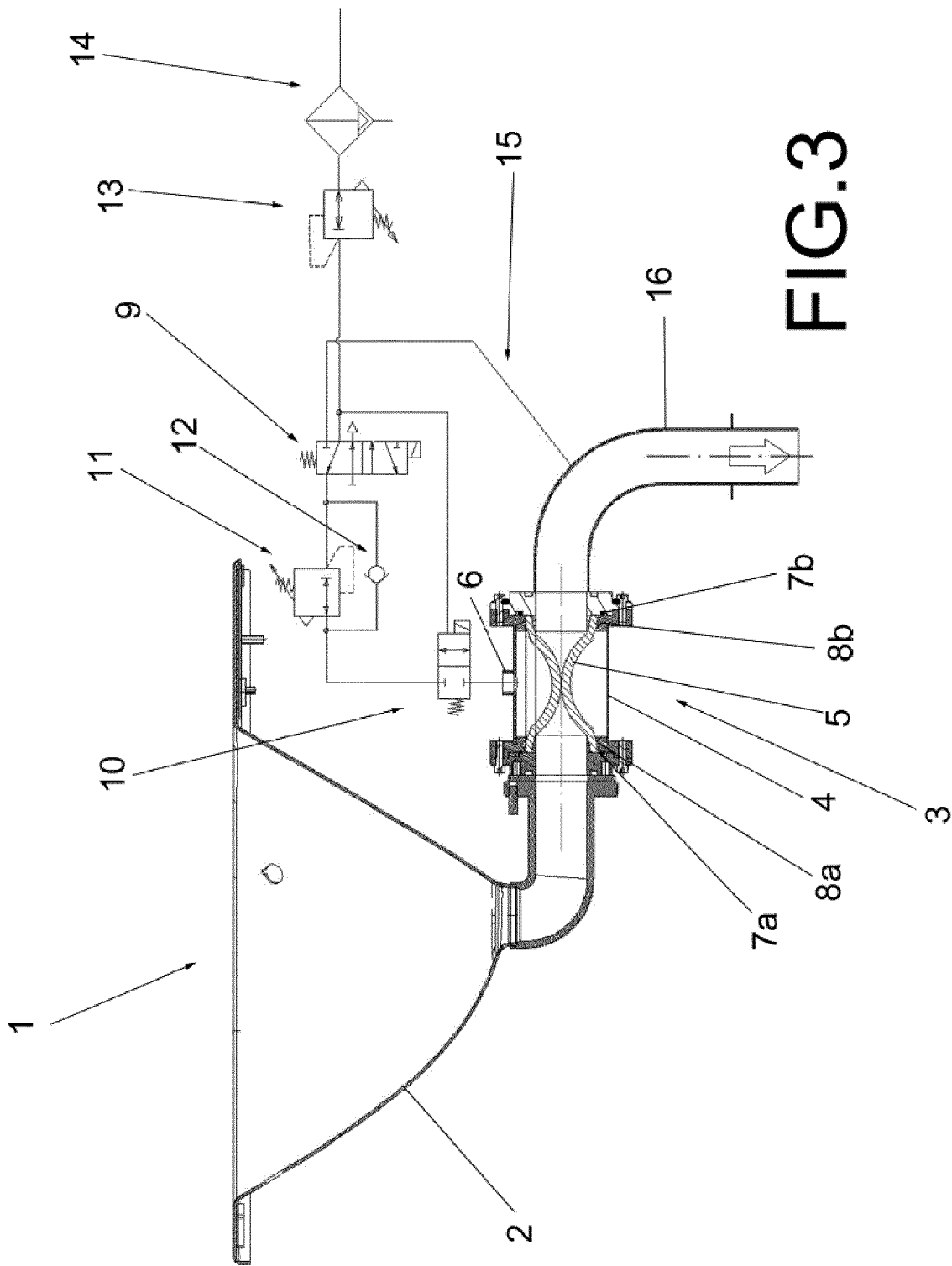


FIG.3



EUROPEAN SEARCH REPORT

Application Number
EP 15 38 2173

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			E03F
1 The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		15 September 2015	Geisenhofer, Michael
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			

EPO FORM 1503 03/02 (P04C01)



Application Number

EP 15 38 2173

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-3, 5-9, 14, 15

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 15 38 2173

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3, 5-9, 14, 15

Details of how the pinch tube valve is actuated pneumatically

STF: first and second control valve providing air or gas to the pinch tube valve; first control valve is dual-position five-way monostable valve, second control valve is dual-position two-way monostable valve; regulation device between control valves; waste evacuation pipe between first control valve and vacuum line

E: secure actuation of pinch tube valve

2. claims: 4, 12, 13

Details of the pinch tube valve

STF: main body with two covers; pinch tube made of elastomeric material/natural rubber; thickness greater than 5 mm

E: long-lasting life of pinch valve; possibility to exchange pinch tube

3. claims: 10, 11

Details of the control system of the first and second control valve

STF: processing and control unit providing signals to the control valves

E: possibility of stage actuation of flushing and discharge of the toilet

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

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5 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
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15-09-2015

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