(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 September 2006 (28.09.2006)

PCT

(10) International Publication Number
WO 2006/100016 A1

(51) International Patent Classification:
E03F 1/00 (2006.01) *B64D 11/02* (2006.01)

(21) International Application Number:
PCT/EP2006/002530

(22) International Filing Date: 20 March 2006 (20.03.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10 2005 013 566.8 23 March 2005 (23.03.2005) DE
60/664,329 23 March 2005 (23.03.2005) US

(71) Applicant *(for all designated States except US)*: **AIRBUS DEUTSCHLAND GMBH** [DE/DE]; Kreestlag 10, 21129 Hamburg (DE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **MÜLLER, Hannes** [DE/DE]; Bredkamp 24, 22589 Hamburg (DE). **SCHNEIDER, Frank** [DE/DE]; Alvenslebenstr. 5, 10783 Berlin (DE). **OHLFEST, Carsten** [DE/DE]; Hermannstr. 15, 25524 Itzehoe (DE). **RAHN, Frank** [DE/DE]; Im Hülsenbusch 3, 21614 Buxtehude (DE).

(74) Agent: **KOPF, Korbinian**; Maiwald Patentanwalts GmbH, Elisenhof, Elisenstr. 3, 80335 München (DE).

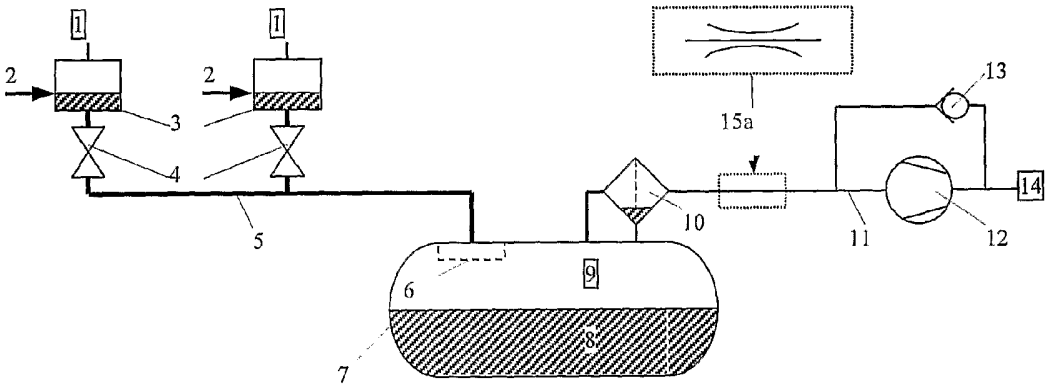
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *with amended claims*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** ARRANGEMENT FOR NOISE REDUCTION IN VACUUM SYSTEMS



(57) **Abstract:** The present invention relates to an arrangement for adapting the transportation behaviour of material to be conveyed, which arrangement comprises a first container, which is coupleable to a first pressure level; a second container, which is coupleable to a second pressure level; a connecting line for transporting material to be conveyed from the first container to the second container; and a pressure reduction device by means of which a pressure difference between the first container and the second container is controllably variable.

WO 2006/100016 A1

Arrangement for noise reduction in vacuum systems

This application claims the benefit of the filing date of the German Patent Application No. 10 2005 013 566.8 filed March 23, 2005 and of the United States Provisional Patent Application No. 60/664,329 filed March 23, 2005, the disclosures of which are hereby incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to an arrangement and a method for adapting the transportation behaviour of material to be conveyed; to a means of locomotion; and to the use of an arrangement for adapting the transportation behaviour of material to be conveyed in an aircraft.

TECHNOLOGICAL BACKGROUND

The term "vacuum systems" refers to special pneumatic conveyors. Generally speaking, in such conveyors transportation takes place in that a pressure difference is applied to the material to be conveyed, i.e. the material to be conveyed is entrained in the fluid flow generated as a result of the pressure difference, wherein generally air is used as the transport medium.

Especially in aircrafts, vacuum systems are used for the transportation of waste from the cabin, for example from toilets or galleys, to a central collecting tank. In this arrangement the material to be conveyed is conveyed to the collecting tank by way of a pipeline network. Negative pressure in the collecting tank in relation to the cabin pressure provides the required pressure difference.

In aircraft with pressurised cabins the pressure difference between the cabin and the environment is used directly to generate the negative pressure for pneumatic

conveyance. When this pressure difference is insufficient, e.g. on the tarmac or at low altitudes, the required pressure difference is generated by a compressor.

In the case of toilets with a pneumatic conveyor system in aircraft systems, often a loud noise level arises. This noise is even noticed by the passengers in the cabin and is perceived by passengers to be uncomfortable.

Conventional measures to reduce the noise level at the feed-in location consist of closing the lid of the conveyance system prior to the flushing procedure so as to thereby keep the noise in check. Furthermore, attempts are made to instruct passengers by way of specific signage to take noise reduction measures such as for example to close the toilet lid. Up to now the kinetic energy of the material to be conveyed has been reduced at the inlet to the tank by means of tank inlet protection devices so as to prevent damage and wear.

However, up to now the above-described noise reduction measures have returned only moderate success, without effectively improving passenger comfort.

SUMMARY OF THE INVENTION

There may be a need to reduce noise generation in a pneumatic system for transporting a material to be conveyed.

According to an aspect of the invention there is provided an arrangement and a method for adapting the transportation behaviour of material to be conveyed; a means of locomotion; and a use of an arrangement for adapting the transportation

behaviour of material to be conveyed in an aircraft according to the independent claims.

According to an exemplary embodiment of the invention an arrangement for adapting the transportation behaviour of material to be conveyed is provided. The arrangement comprises at least one first container, which is coupleable to a first pressure level; at least a second container, which is coupleable to a second pressure level; and a connecting line for transporting material to be conveyed from the first container, of which there is at least one, to the second container, of which there is at least one. Furthermore, the arrangement comprises a pressure reduction device by means of which a pressure difference between the first container, of which there is at least one, and the second container, of which there is at least one, is controllably variable.

According to another exemplary embodiment of the invention a method for adapting the transportation behaviour of material to be conveyed is created. In this method at least one first container is coupled to a first pressure level, at least one second container is coupled to a second pressure level, and material to be conveyed is transported from the first container, of which there is at least one, to the second container, of which there is at least one. Furthermore, a pressure reduction device for varying a pressure difference between the first container, of which there is at least one, and the second container, of which there is at least one, is controlled.

According to yet another exemplary embodiment of the invention a means of locomotion with an arrangement with the characteristics described above is created.

According to yet another exemplary embodiment of the invention an arrangement for adapting the transportation behaviour of material to be conveyed, with the characteristics described above, is used in an aircraft.

According to an embodiment of the invention the noise level during a conveyance procedure can be reduced to such an extent that users (for example passengers of an aircraft) no longer perceive it negatively. With the arrangement and the method according to embodiments of the invention noise reduction, in particular as far as aircraft are concerned, is made possible by an economical and light-weight solution. Further, due to an adaptation of the pressure differences and accordingly of the transportation velocity, because of a deceleration of the fluid there occur less damages caused by the kinetic energy of the material to be conveyed. Keeping aircraft weight to a minimum is a very special objective.

In that according to one embodiment of the invention a pressure reduction device is provided in a pneumatic conveyance system, by means of which pressure reduction device a pressure difference between two containers can be controlled in a targeted way and can in particular be reduced, the transport characteristics can be influenced in a defined manner, in particular the transport speed can be attenuated, as a result of which noise generation is also reduced to a surprising degree.

The speed of the air at the feed-in location, which air entrains the material to be conveyed, largely depends on the position of the receiving tank in the pipe system and on the pressure in the collecting tank. At the same time this air speed determines the noise that is generated. By means of the reduction in the pressure difference noise development that arises can effectively be reduced.

The large pressure difference between the interior cabin pressure and the exterior ambient pressure at cruising altitude, which pressure difference in conventional systems can result in the fluid attaining enormous speeds, can be reduced in a targeted way such that the noise development at the feed-in location is significantly reduced.

Due to the reduction of the fluid velocity damages in particular at the container walls of the receiving container may be avoided effectively, because the material to be conveyed impinges at the container walls with an accordingly reduced kinetic energy.

It can be achieved that the generated noise level at the feed-in position and the kinetic energy of the material to be conveyed is reduced by influencing and adapting pressure differences in a conveyance system.

In a further exemplary embodiment the pressure reduction device comprises at least one ventilation unit between the first container and the second pressure level. This makes it possible to hold a pressure difference constant or to compensate any excessive pressure difference in that the pressure in the second container is increased. This ventilation unit can optionally be designed so as to be regulable or non-regulated. Furthermore, the ventilation device can comprise noise reduction devices, in particular sound absorbers, so as in this way to reduce the inflow noise from the cabin. In an exemplary embodiment a ventilation unit can be installed between the second container and the second pressure level and can be controlled in such a way that the material to be conveyed can flow from the second pressure level back to the second container.

In a further exemplary embodiment the pressure reduction device comprises at least one throttle element between the first container and the second pressure level, wherein the throttle element can be designed so as to be either regulable or non-regulated. The throttle element can regulate, i.e. reduce, the fluid speed, and can be installed either between a ventilation unit and the second pressure level in order to reduce the inflow speed at that location. Alternatively, it can be located between the second container and the second pressure level in order to reduce the speed at which the fluid flows out into the surroundings.

In a further exemplary embodiment the arrangement comprises a compressor element between the second pressure level and the second container in order to generate negative pressure in the second container, so that in the case of a high second pressure level there is nonetheless a pressure difference between the first container and the second container is provided, in that for example the pressure in the second container is reduced. Parallel to the compressor element there is the additional option of installing a regulable or non-regulated throttle element in a parallel branch so as not to influence the operation of the compressor as a result of the reduction, in other words without causing a throttling effect.

In a further exemplary embodiment a nonreturn valve or a check valve is attached in the connecting line between the second pressure level and the second container so as to prevent the fluid from flowing in from the second pressure level to the second container. The nonreturn valve can also be installed parallel to the compressor, and furthermore it can comprise an integrated throttle device.

In a further exemplary embodiment a separator is installed between the second container and the pressure level for separating the material to be conveyed from a fluid.

In a further exemplary embodiment the first container is connected to the connecting line by means of an actuating valve, wherein after actuation of the actuating valve transport of the goods to be conveyed can be started or stopped.

In a further exemplary embodiment noise reduction devices are provided, in particular are installed on the first container.

In a further exemplary embodiment an inlet protection device is affixed in the second container in order to reduce the kinetic energy of the material to be conveyed when said material enters the second container.

In a further exemplary embodiment the pressure reduction device comprises at least one component with integrated throttle and ventilation function between the second pressure level and the second container.

According to an exemplary embodiment of the invention, in an emergency the ventilation devices are closed essentially without any auxiliary energy, and/or the throttle elements are opened essentially without any auxiliary energy.

According to a further exemplary embodiment of the method, for the purpose of controlling the ventilation device and/or the throttle element the pressure difference between the first container and the second container is used as a command variable.
In a further exemplary embodiment of the method, the command variable for controlling the ventilation unit and/or for controlling the throttle element can be set depending on the position of the first containers and/or of the second containers.

According to a further exemplary embodiment of the method the compressor element and the ventilation device can vary and set the pressure in a manner offset in time before and after conveying the material to be conveyed.

According to an exemplary embodiment of the method, for the purpose of controlling and regulating the ventilation device and/or the throttle elements, sensor data such as for example cabin pressure, ambient pressure, pressure and fill level of the second container, flight altitude or temperature can be used. This data also makes it possible to diagnose the vacuum system. For example by means of a flushing procedure that only involves air, and by measuring the resulting tank-pressure gradient, a comparison of the desired values with actual values for pressure losses can take place and in this way any malfunctions can be detected reliably and early.

The designs of the arrangement also apply to the method and to the means of locomotion as well as or their use, and vice versa.

The described arrangement and the described method provide effective noise reduction of transported material to be conveyed, so that the comfort, for example of passengers, is enhanced enormously. The kinetic energy can be optimally set with a controllable pressure ratio, as a result of which optimal setting, damage and noise are prevented or reduced. Furthermore, this arrangement is extremely light in weight and economical to implement.

The means of locomotion according to the invention can for example be an aircraft, a rail carriage, a truck, a passenger motor vehicle, a caravan, a boat or ship, or a zeppelin.

BRIEF DESCRIPTION OF THE DRAWINGS

Below, for further explanation and to provide a better understanding of the present invention, several embodiments of the invention are described in more detail with reference to the drawings, as follows:

Fig. 1 a diagrammatic view of a vacuum system according to an exemplary embodiment of the invention;

Fig. 2 a diagrammatic view of a vacuum system according to another exemplary embodiment of the invention with variants for regulating the through-flow speed;

Fig. 3 a diagram showing the influence which ventilation and throttling have on the speed of transportation and on the noise level at the feed-in location, depending on the magnitude of the air volume in the tank.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Identical or similar components in different figures have the same reference characters.

The illustrations in the figures are diagrammatic and not to scale.

Fig. 1 shows an arrangement of a vacuum system for aircraft with a pressurised cabin.

In each case first containers 3 to accommodate a material 2 to be conveyed are connected by means of an actuating valve 4 to a connecting line 5 leading to a central second container 7. At the inlet to the second container 7 there is a special tank inlet protection device 6, which among other things is designed to reduce the kinetic energy of the material 2 to be conveyed, so as to protect the second container 7. By means of a further connecting line 11 the collecting tank 7 is connected, by way of a separator 10 which includes a tank return and by way of a compressor element 12, to the second pressure level 14, here the environment outside the aircraft. Parallel to the compressor element 12 a return valve 13 is arranged.

If the pressure difference between the first pressure level 1 (ambient pressure at the feed-in location 3, for example cabin pressure) and the second pressure level, i.e. between the cabin 1 and the environment 14, is inadequate, the system is operated with the compressor element 12 (operating mode I). In this way the compressor 12 starts at the latest when a flushing procedure is requested. During the time interval of a few seconds until the opening of the actuating valve 4, negative pressure is already generated in the second container 7. Thus, as soon as the flush valve 4 is opened, conveyance to the tank, of the material 2 to be conveyed, commences. The compressor element 12 continues to run at least until the actuating valve 4 is closed again, thus maintaining negative pressure in the tank 7 for continuous conveyance. The separator 10 prevents any material 2 to be conveyed from escaping from the collecting container 7, and protects the compressor 12 and the environment 14 from contamination. The nonreturn valve 13 remains closed in this operating mode.

In an alternative operating mode II with sufficient pressure difference between the cabin 1 and the environment 14 the compressor element 12 remains switched off. When the actuating valves 4 are closed, the tank 7 is subjected to the same low

pressure as in the environment 14 outside the aircraft. If the flush valve 4 is open, negative pressure in the tank 7 is maintained in that the air flows out by way of the nonreturn valve 13.

Up to now the compressor elements 12 have mostly been designed so as to provide just adequate conveyance behaviour when the aircraft is on the ground. The nonreturn valve can already fully open at a small pressure difference, and the airflow through it can take place with minimum loss of pressure. Downstream of the separator 10 a non-regulated throttle device 15a is provided for easy adaptation of the conveyance behaviour. However, generally speaking, this throttling position cannot be considered optimal for all forms of application because part of the expensively generated pressure difference is degraded during compressor operation 12.

In Fig. 2 a further arrangement for reducing noise at the feed-in locations of the material 2 to be conveyed has been provided by limiting the driving pressure difference to an extent necessary for the flushing procedure, preferably in operating mode II.

For reliable operation, this design point should be above the behaviour with compressor operation. This still leaves sufficient potential to reduce noise at cruising altitude, at which normally the maximum pressure difference occurs. This applies in particular since in most cases this state represents the main share of the time vacuum systems in aircraft are used.

Essentially the air volume 9 in the collecting tank 7 causes a non-stationary pressure gradient in the second container 7 during the flushing procedure. Thus, most of the time, the pressure in the collecting tank 7 increases until the stationary state has been reached. This increase in pressure is determined by the flow losses from 9 to 14 in

the stationary case. The pressure difference between the cabin 1 and the collecting tank 7 induces a corresponding time gradient of the air entry speed, and thus of the generated noise level at the first container 3.

In order to limit noise emission, an essentially constant pressure difference from 1 to 7 has to be ensured. Generally speaking an additional ventilation valve 16a-16d according to Fig. 2 can handle this task before, during and after the flushing procedure. However, this can be associated with high speeds or high volume flows between the connecting lines 5 or 11 or the tank 7 and the ventilation valve 16a-16d. This can be compensated for by using a further regulable throttle valve 17a or 17b downstream of the ventilation valve 16a-16d. If a throttle valve 15, 17 is used on its own, its influence is however limited to the duration of the flushing process.

The greater the air volume 9 in the tank, the stronger the effect the initial tank pressure has on the flushing process. In this case a stationary state only occurs after a relatively long opening time of the flush valve 4 (compare Fig. 3). Thus in this case ventilation assumes decisive importance.

In such a cases where a small second container 7 is used, the air volume 9 is small. It may thus be possible to abandon a ventilation valve 16a-16d. In the case of a small number of connected receiving containers 3, which are installed at similar distances from the tank 7, it is also possible to provide a non-regulated throttling element, for example at position 15b. At this position, compressor operation 12 is not affected by the reduction. Reduced conveyance performance at low flight altitudes, i.e. at small pressure differences, without compressor operation 12 can also be compensated for by extending compressor operation if need be. Moreover, the use of the system in this boundary region does not represent a typical application case.

In principle the actuating valve 16 can be installed at positions 16a - 16d. Immediately after a request of a flushing procedure said actuating valve 16 sets the required tank pressure until the flush valve 4 is opened. This procedure can be interpreted as a counterpart to the evacuation phase during compressor operation 12. Subsequently, for example, the throttle valve keeps the tank pressure constant at position 17a or 17b during the flushing procedure.

Since the loss of pressure 1 - 9 depends on the length and the gradient of the connecting line 5, the pressure difference to be set should be implemented depending on the position of the first container 3. In this way the often very different transportation behaviour of receiving containers 3 with different distances from the collecting tank 7 can be made to be uniform.

In the case of malfunction a ventilation valve 16 should assume a fully closed state, while a regulable throttle valve 17 should assume a fully open state, both without any auxiliary energy. In this way the system remains functional.

Also of interest is the combination of ventilation function and throttle function at positions 16d and 17a to a component.

As far as regulation is concerned, access to data that is already available in the aircraft system presents itself; such data being for example cabin pressure, ambient pressure and tank fill level (to determine the air volume in the tank). Furthermore, fill level determination based on two absolute pressure sensors directly provides information on the pressure in the tank 7. The use of additional sensors can thus be minimised by suitable system linkages.

From the regulating deviations for a flushing procedure that only involves air, it is furthermore possible to obtain information concerning possible blockages in the regions 1-9 and 9-14. This diagnostic function can also be transferred to conventional vacuum systems.

In addition it should be pointed out that "comprising" does not exclude other elements or steps, and "a" or "one" does not exclude a plural number. Furthermore, it should be pointed out that characteristics or steps, which have been described with reference to one of the above embodiments can also be used in combination with other characteristics or steps of other embodiments described above.

It should also be noted that reference signs in the claims shall not be construed as limiting the scope of the claims.

Claims

1. An arrangement for adapting the transportation behaviour of material (2) to be conveyed, wherein the arrangement comprises:

- at least one first container (3), which is coupleable to a first pressure level (1);
- at least one second container (7), which is coupleable to a second pressure level (14);
- a connecting line (5, 11) for transporting material to be conveyed from the first container, of which there is at least one, to the second container (7), of which there is at least one;
- a pressure reduction device (15, 16, 17) by means of which a pressure difference between the first container (3), of which there is at least one, and the second container (7), of which there is at least one, is controllably variable.

2. The arrangement of claim 1, wherein the pressure reduction device comprises at least one ventilation unit (16a-16d) between the first container (3), of which there is at least one, and the second pressure level (14).

3. The arrangement according to claim 2, wherein the ventilation unit (16a-16d), of which there is at least one, is designed so as to be regulable or non-regulated.

4. The arrangement according to claim 2, wherein the ventilation device (16a-16d) comprises a noise reduction device, in particular a sound absorber.

5. The arrangement according to claim 1, wherein the pressure reduction device comprises at least one throttle element (15a, 15b) between the first container (3), of which there is at least one, and the second pressure level.

6. The arrangement according to claim 5, wherein the throttle element (15a, 15b), of which there is at least one, is designed so as to be either regulable or non-regulated.

7. The arrangement according to claim 2, wherein at least one throttle element is installed between the ventilation unit (16a-16d) on the one hand, and the second container (7), of which there is at least one, or the connecting line (5, 11) on the other hand.

8. The arrangement according to claim 5, wherein the throttle element (15a, 15b, 17a, 17b) is installed between the second container (7), of which there is at least one, and the second pressure level (14).

9. The arrangement according to claim 1, further comprising a compressor element (12) between the second pressure level (14) and the second container (7), of which there is at least one, in order to generate negative pressure in the second container (7), of which there is at least one.

10. The arrangement according to claim 9, wherein a regulable or non-regulated throttle element (15a, 15b, 17a, 17b) is connected parallel to the compressor element (12).

11. The arrangement according to claim 1, further comprising a nonreturn valve (13) in the connecting line (11) between the second pressure level (14) and the second container (7), of which there is at least one.

12. The arrangement according to claim 9, wherein the nonreturn valve (13) is connected parallel to the compressor element (12).

13. The arrangement according to claim 10, wherein the nonreturn valve (13) comprises an integrated throttle element.

14. The arrangement according to claim 1, wherein a separator (10) is installed between the second container (7), of which there is at least one, and the second pressure level (14), which separator (10) is designed to accommodate material (2) to be conveyed, so that transport of material (2) to be conveyed from the second container (7), of which there is at least one, to the second pressure level is prevented.

15. The arrangement according to claim 1, further comprising an actuating valve (4) between the first container (3), of which there is at least one, and the connecting line (5, 11).

16. The arrangement according to claim 1, wherein noise reduction devices are installed, in particular on the first container (3), of which there is at least one.

17. The arrangement according to claim 1, wherein an inlet protection device (6) is affixed in a boundary region between the connecting line and the second container (7), of which there is at least one.

18. The arrangement according to claim 1, wherein the pressure reduction device (15, 16, 17) comprises a component with integrated throttle and ventilation function between the second pressure level and the second container (7), of which there is at least one.

19. The arrangement according to claim 1, wherein the pressure reduction device (15, 16, 17) is designed such that by means of it a pressure difference between the first container (3) and the second container (7) for transporting the material (2) to be conveyed is controllably variable at reduced noise emission.

20. The arrangement according to claim 1, further comprising a sensor which is designed to detect at least one transport characteristic of material (2) to be conveyed between the first container (3), of which there is at least one, and the second container (7), of which there is at least one.

21. The arrangement according to claim 20, further comprising a monitoring device which is coupled to the sensor and which, based on at least one transport characteristic detected by the sensor, determines the functionability of the arrangement.

22. A method for adapting the transportation behaviour of material to be conveyed, wherein the method comprises the following steps:

- coupling at least one first container (3) to a first pressure level (1);
- coupling at least one second container (7) to a second pressure level (14);

- transporting material (2) to be conveyed, from the first container (3), of which there is at least one, to the second container (7), of which there is at least one;
- controlling a pressure reduction device (15, 16, 17) for altering a pressure difference between the first container (3), of which there is at least one, and the second container (7), of which there is at least one.

23. The method according to claim 22, wherein the pressure difference between the first container (3), of which there is at least one, and the second container (7), of which there is at least one, is kept constant.

24. The method according to claim 23, wherein the pressure in the second container (7), of which there is at least one, is increased.

25. The method according to claim 22, wherein by means of a ventilation device (16a-16d) the pressure difference between the first pressure level (1) and the second container (7), of which there is at least one, is increased or kept constant.

26. The method according to claim 22, wherein by means of a throttle element (15b, 17a, 17b) a transport speed of material (2) to be conveyed is regulated.

27. The method according to claim 22, wherein by means of a compressor element the pressure in the second container (7), of which there is at least one, is reduced.

28. The method according to claim 22, wherein by means of a ventilation device (16d) that is arranged between the second container (7), of which there is at least one, and the second pressure level (14), the pressure is controlled in such a way

that a flow of the material (2) to be conveyed, into the second container (7), of which there is at least one, is made possible.

29. The method according to claim 22, wherein in the case of a malfunction the ventilation device (16a-16d) is essentially closed without any auxiliary energy.

30. The method according to claim 22, wherein in the case of a malfunction the throttle element (15b, 17a, 17b) is essentially closed without any auxiliary energy.

31. The method according to claim 22, wherein for the purpose of controlling the ventilation device (16a-16d) and/or the throttle element (15b, 17a, 17b) the pressure difference between the first container (3), of which there is at least one, and the second container (7), of which there is at least one, is used as a command variable.

32. The method according to claim 31, wherein the command variable for controlling the ventilation device (16a-16d) and/or for controlling the throttle element (15b, 17a, 17b) is set depending on the position of the first container (3), of which there is at least one, and the second container (7), of which there is at least one.

33. The method according to claim 27, wherein the pressure is altered and set by means of the compressor element (12) and the ventilation device (16a-16d) in a manner offset in time before and after conveying the material (2) to be conveyed.

34. The method according to claim 27, wherein the sensor data that is required for regulating the ventilation device (16a-16d) and/or for regulating the throttle element (15b, 17a, 17b) is selected from the group comprising cabin pressure data; ambient pressure data; fill level data and pressure data of the second container (7), of which there is at least one; flight altitude data; and temperature data.

35. The method according to claim 34, wherein from the sensor data desired values and actual values, in particular from the measured tank pressure gradient, are compared and from this any malfunctions are diagnosed.

36. A means of locomotion comprising an arrangement for adapting the transportation behaviour of material (2) to be conveyed, according to claim 1.

37. The means of locomotion according to claim 36, wherein the means of locomotion is an aircraft.

38. The use of an arrangement for adapting the transportation behaviour of material to be conveyed, according to claim 1 in an aircraft.

AMENDED CLAIMS
received by the International Bureau on 21 August 2006 (21.08.2006)

Amended Claims

1. An arrangement for adapting the transportation behaviour of material (2) to be conveyed, wherein the arrangement comprises:

- at least one first container (3), which is coupleable to a first pressure level (1);
- at least one second container (7), which is coupleable to a second pressure level (14);
- a connecting line (5, 11) for transporting material to be conveyed from the first container, of which there is at least one, to the second container (7), of which there is at least one;
- a pressure reduction device (15, 16, 17) by means of which a pressure difference between the first container (3), of which there is at least one, and the second container (7), of which there is at least one, is controllably variable; and
- a compressor element (12) between the second pressure level (14) and the second container (7), of which there is at least one, in order to generate negative pressure in the second container (7), of which there is at least one, if the pressure difference between the first pressure level (1) and the second pressure level (1) is not sufficient for transporting the material (2).

2. The arrangement of claim 1, wherein the pressure reduction device comprises at least one ventilation unit (16a-16d) between the first container (3), of which there is at least one, and the second pressure level (14).

3. The arrangement according to claim 2, wherein the ventilation unit (16a-16d), of which there is at least one, is designed so as to be regulable or non-regulated.

4. The arrangement according to claim 2, wherein the ventilation device (16a-16d) comprises a noise reduction device, in particular a sound absorber.

5. The arrangement according to claim 1, wherein the pressure reduction device comprises at least one throttle element (15a, 15b) between the first container (3), of which there is at least one, and the second pressure level.

6. The arrangement according to claim 5, wherein the throttle element (15a, 15b), of which there is at least one, is designed so as to be either regulable or non-regulated.

7. The arrangement according to claim 2, wherein at least one throttle element is installed between the ventilation unit (16a-16d) on the one hand, and the second container (7), of which there is at least one, or the connecting line (5, 11) on the other hand.

8. The arrangement according to claim 5, wherein the throttle element (15a, 15b, 17a, 17b) is installed between the second container (7), of which there is at least one, and the second pressure level (14).

9. The arrangement according to claim 1, wherein a regulable or non-regulated throttle element (15a, 15b, 17a, 17b) is connected parallel to the compressor element (12).

10. The arrangement according to claim 1, further comprising a nonreturn valve (13) in the connecting line (11) between the second pressure level (14) and the second container (7), of which there is at least one.

11. The arrangement according to claim 10, wherein the nonreturn valve (13) is connected parallel to the compressor element (12).

12. The arrangement according to claim 10, wherein the nonreturn valve (13) comprises an integrated throttle element.

13. The arrangement according to claim 1, wherein a separator (10) is installed between the second container (7), of which there is at least one, and the second pressure level (14), which separator (10) is designed to accommodate material (2) to be conveyed, so that transport of material (2) to be conveyed from the second container (7), of which there is at least one, to the second pressure level is prevented.

14. The arrangement according to claim 1, further comprising an actuating valve (4) between the first container (3), of which there is at least one, and the connecting line (5, 11).

15. The arrangement according to claim 1, wherein noise reduction devices are installed, in particular on the first container (3), of which there is at least one.

16. The arrangement according to claim 1, wherein an inlet protection device (6) is affixed in a boundary region between the connecting line and the second container (7), of which there is at least one.

17. The arrangement according to claim 1, wherein the pressure reduction device (15, 16, 17) comprises a component with integrated throttle and ventilation

function between the second pressure level and the second container (7), of which there is at least one.

18. The arrangement according to claim 1, wherein the pressure reduction device (15, 16, 17) is designed such that by means of it a pressure difference between the first container (3) and the second container (7) for transporting the material (2) to be conveyed is controllably variable at reduced noise emission.

19. The arrangement according to claim 1, further comprising a sensor which is designed to detect at least one transport characteristic of material (2) to be conveyed between the first container (3), of which there is at least one, and the second container (7), of which there is at least one.

20. The arrangement according to claim 19, further comprising a monitoring device which is coupled to the sensor and which, based on at least one transport characteristic detected by the sensor, determines the functionability of the arrangement.

21. A method for adapting the transportation behaviour of material to be conveyed, wherein the method comprises the following steps:

- coupling at least one first container (3) to a first pressure level (1);
- coupling at least one second container (7) to a second pressure level (14);
- transporting material (2) to be conveyed, from the first container (3), of which there is at least one, to the second container (7), of which there is at least one;

- controlling a pressure reduction device (15, 16, 17) for altering a pressure difference between the first container (3), of which there is at least one, and the second container (7), of which there is at least one; and
- reducing the pressure in the second container (7), of which there is at least one, by means of a compressor element, if the pressure difference between the first pressure level (1) and the second pressure level (1) is not sufficient for transporting the material (2).

22. The method according to claim 21, wherein the pressure difference between the first container (3), of which there is at least one, and the second container (7), of which there is at least one, is kept constant.

23. The method according to claim 21, wherein the pressure in the second container (7), of which there is at least one, is increased.

24. The method according to claim 21, wherein by means of a ventilation device (16a-16d) the pressure difference between the first pressure level (1) and the second container (7), of which there is at least one, is increased or kept constant.

25. The method according to claim 21, wherein by means of a throttle element (15b, 17a, 17b) a transport speed of material (2) to be conveyed is regulated.

26. The method according to claim 21, wherein by means of a ventilation device (16d) that is arranged between the second container (7), of which there is at least one, and the second pressure level (14), the pressure is controlled in such a way that a flow of the material (2) to be conveyed, into the second container (7), of which there is at least one, is made possible.

27. The method according to claim 21, wherein in the case of a malfunction the ventilation device (16a-16d) is essentially closed without any auxiliary energy.

28. The method according to claim 21, wherein in the case of a malfunction the throttle element (15b, 17a, 17b) is essentially closed without any auxiliary energy.

29. The method according to claim 21, wherein for the purpose of controlling the ventilation device (16a-16d) and/or the throttle element (15b, 17a, 17b) the pressure difference between the first container (3), of which there is at least one, and the second container (7), of which there is at least one, is used as a command variable.

30. The method according to claim 29, wherein the command variable for controlling the ventilation device (16a-16d) and/or for controlling the throttle element (15b, 17a, 17b) is set depending on the position of the first container (3), of which there is at least one, and the second container (7), of which there is at least one.

31. The method according to claim 21, wherein the pressure is altered and set by means of the compressor element (12) and the ventilation device (16a-16d) in a manner offset in time before and after conveying the material (2) to be conveyed.

32. The method according to claim 21, wherein the sensor data that is required for regulating the ventilation device (16a-16d) and/or for regulating the throttle element (15b, 17a, 17b) is selected from the group comprising cabin pressure

data; ambient pressure data; fill level data and pressure data of the second container (7), of which there is at least one; flight altitude data; and temperature data.

33. The method according to claim 32, wherein from the sensor data desired values and actual values, in particular from the measured tank pressure gradient, are compared and from this any malfunctions are diagnosed.

34. A means of locomotion comprising an arrangement for adapting the transportation behaviour of material (2) to be conveyed, according to claim 1.

35. The means of locomotion according to claim 34, wherein the means of locomotion is an aircraft.

36. The use of an arrangement for adapting the transportation behaviour of material to be conveyed, according to claim 1 in an aircraft.

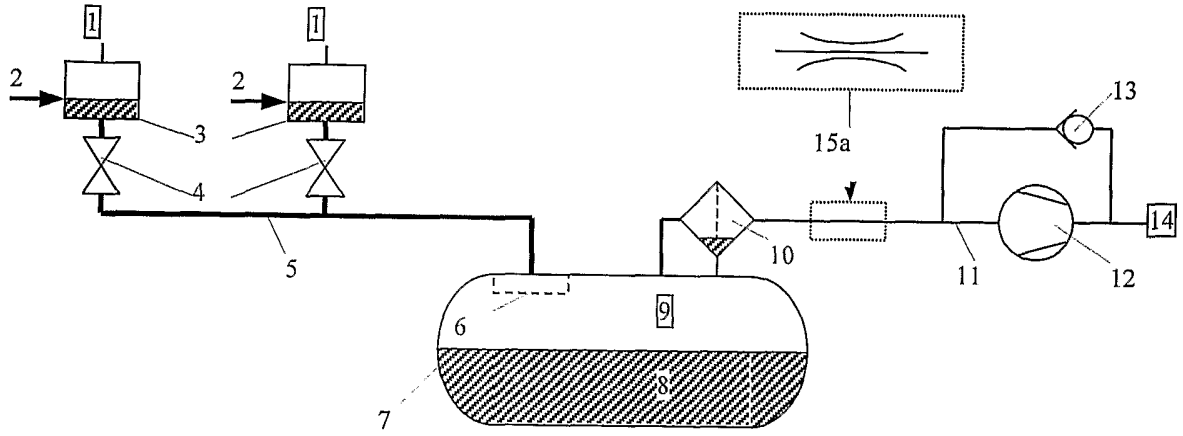

1
1
2
2
3
4
5
6
7
8
9
10
11
12
13
14
15a

Fig. 1

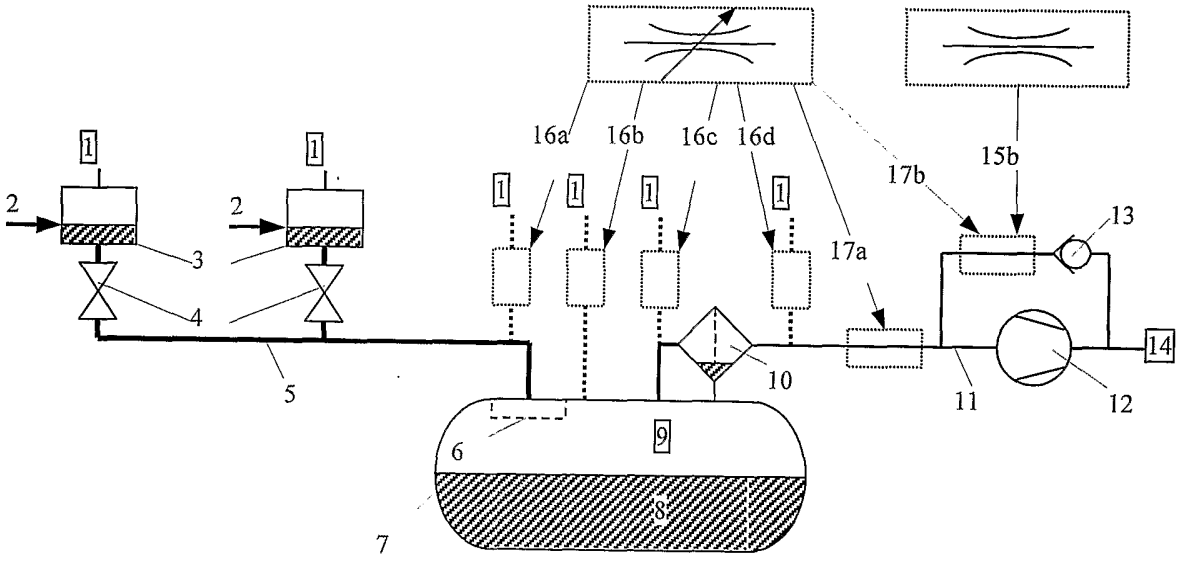
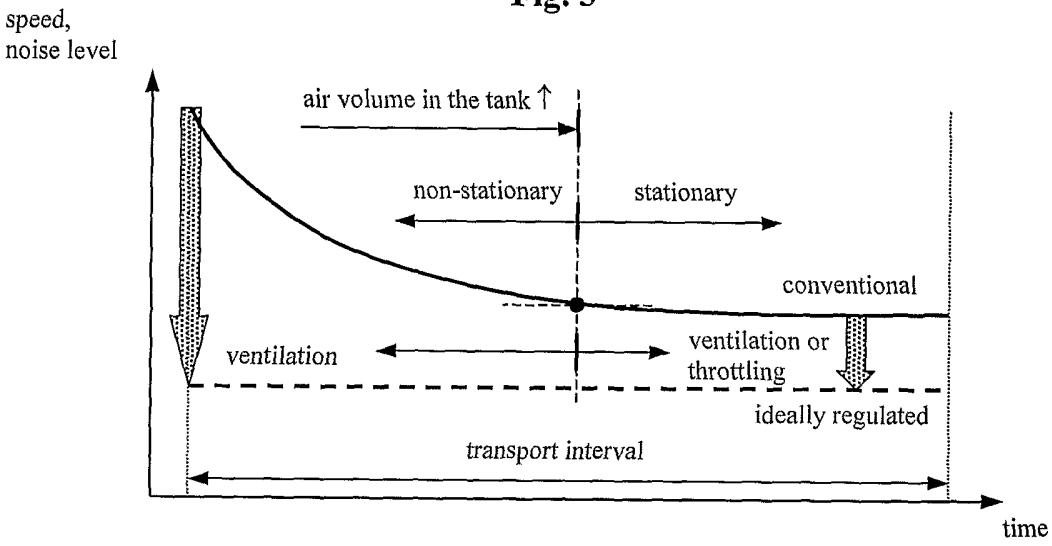

1
1
2
2
3
4
5
6
7
8
9
10
11
12
13
14
15b
16a
16b
16c
16d
17a
17b

Fig. 2

Fig. 3


speed,
noise level
air volume in the tank ↑
non-stationary
stationary
conventional
ventilation
ventilation or
throttling
ideally regulated
transport interval
time

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/002530

A. CLASSIFICATION OF SUBJECT MATTER
INV. E03F1/00 B64D11/02

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)
E03F B64D

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 practical, 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.
X	US 5 372 710 A (FRANK ET AL) 13 December 1994 (1994-12-13) column 5, line 14 - column 6, line 6; figures 2-4	1-3, 5-10, 12-14, 17-38
Y		4,11,15, 16
Y	US 5 317 763 A (FRANK ET AL) 7 June 1994 (1994-06-07) figures 1-5	4,11,15, 16
A	US 5 133 853 A (MATTSSON ET AL) 28 July 1992 (1992-07-28) figure 1	1,22

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 June 2006	30/06/2006

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	De Coene, P

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

The present claim 1 relates to an extremely large number of possible transportation arrangements for transportation of a material from a first to a second container.
Support and disclosure in the sense of Article 6 and 5 PCT is to be found however for only one specific type of the transportation arrangements claimed, see e.g. page 1, lines 24-28, i.e. a vacuum system for transportation of waste from at least one toilet to at least one collection tank.
The non-compliance with the substantive provisions is to such an extent, that the search was performed taking into consideration the non-compliance in determining the extent of the search of claim 1 (PCT Guidelines 9.19 and 9.23).

The search of claim 1 was restricted to those claimed transportation arrangements which appear to be supported as indicated above, i.e. to vacuum systems comprising a toilet and a collection tank.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2006/002530

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. [X] Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

see FURTHER INFORMATION sheet PCT/ISA/210

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2006/002530

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5372710 A	13-12-1994	NONE	
US 5317763 A	07-06-1994	DE 4201986 C1	15-04-1993
US 5133853 A	28-07-1992	DE 3932893 A1	12-04-1990
		FI 884581 A	06-04-1990
		FR 2637304 A1	06-04-1990
		IT 1231124 B	18-11-1991
		SE 469338 B	21-06-1993
		SE 8903184 A	06-04-1990