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(54) Dry toilet system.

(57) This publication discloses a dry toilet system particularly suited for multi-storey buildings. The system has the toilet seats (4) of each apartment connected via a check valve (19) and a connection branch (5) to a vertical waste stack (1). The lower end of the waste stack (1) is connected via a control valve (8) to an automatically replaced collection container (10). The toilet and household wastes are removed via the toilet seat (4), whereby they are allowed to freely fall to the lower end of the waste stack (1), and therefrom further into the collection container (10) at the opening of the cyclicly operating control valve (8). The backflow of odours from the waste stack (1) via the toilet seat (4) to the toilet space is prevented with the help of a venting duct (6) and a roof fan (7). The suction by roof fan (7) produces a vacuum in the venting duct (6) and the waste stack (1), thereby venting the odours to the roof of the building.

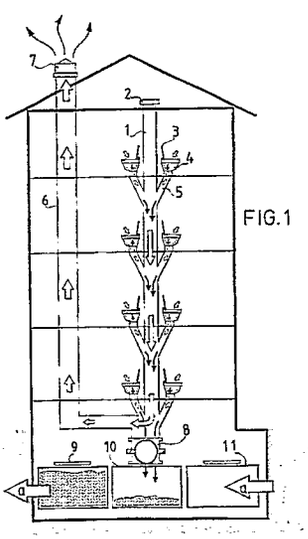

FIG.1

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DRY TOILET SYSTEM

The present invention relates to a dry toilet system in accordance with the preamble of claim 1.

The disclosed system is particularly suitable for multi-storey buildings in urban areas; yet the system design permits its installation in all types of apartment buildings as well as residences.

In conventional toilet systems the toilet wastes are removed from the toilet bowl and transferred in the sewer network using sizable volumes of flushing water. Water from the sewer network must be processed at waste water treatment plants prior to its release into a waterway. The quantities of treated water easily become massive, thereby requiring large, high-capacity treatment plants in addition to high-capacity sewer networks. The construction and maintenance of such systems imposes high costs on the communities. Further, the water used for transfer of wastes also contributes to increased drinking water consumption.

The removal of wastes causes costs also for the users of the system, that is, the tenants or the building cooperative shareholders. The operating costs of the toilet system derive from the consumption charge of drinking water and the waste handling charge of sewage water.

The removal of toilet wastes by means of water via the sewer system could as well be replaced by the use of dry toilets. Prior-art dry toilets have, however, a low capacity which necessitates their frequent emptying. In multi-storey buildings the removal of fermented waste from dry toilets is cumbersome. Therefore, the prior-art dry toilets are applicable only to a relatively temporary and cyclic use in, e.g., campers, boats and recreational buildings.

In a multi-storey apartment house, a dry toilet system has earlier been implemented by concentrating the toilets of all apartments in a single storey and by solving the removal of wastes through composting. This construction has, however, been neglected, since the remote location of toilets from the apartments has been considered excessively awkward and even annoying to the apartment inhabitants.

It is an object of the present invention to achieve such a dry toilet system capable of replacing the conventional water-flushed toilet and suitable to be designed into the construction of individual apartments in a building.

The invention is based on constructing a waste stack in the building so that said stack is connected via a valve to a waste collection container. The individual toilets are connected to the stack via branch pipes and valves. Backflow of odours to the toilet space is prevented by the use of a vacuum in the system.

More specifically, the system in accordance with the invention is characterized by what is stated in the characterizing part of claim 1.

The invention provides outstanding benefits.

With the help of the present system it is possible to achieve a substantial reduction of the waste handling costs imposed on the community and the inhabitants of the premises. Large volumes of water are not needed for the transfer of toilet wastes, as is the case with systems releasing wastes in a sewer network. So, appreciably smaller volumes of waste water are generated, and the exclusion of toilet wastes from waste water makes waste water treatment operations easier. Then, the sewer network and treatment plants can be designed for smaller loads, and the lesser total waste water volume reduces environmental impact. Because the system can manage without flushing water, also lower consumption of drinking water results, thus reducing the environmental loading on surface and ground water resources. Lower waste water and drinking water consumption charges resulting from the reduced water consumption also benefit the premise owners or tenants.

In the system according to the invention, organic wastes from households are composted, whereby they produce biogas, and the solid waste remaining can be used for landfill, or alternatively, when complemented with proper fertilizing additives, as a fertilizer. All organic waste generated in the premises can be removed via the described system, which reduces the waste handling costs of the premises. The remaining wastes are easier to sort either prior to transportation or at the dump site, which makes the reclaiming of recyclable material such as glass and metals easier.

A toilet connected to said system in accordance with the invention, said toilet being located in each separate apartment, is used in a closely similar manner as a conventional toilet, which makes the use of the toilet easy to learn and its acceptance threshold low. The system is quieter than a conventional sewer system. Said system is applicable to all types of buildings, and it can also easily be constructed in premises to be refurbished.

The invention is next examined in detail with the help of the attached drawings.

Figure 1 shows diagrammatically the system in accordance with the invention in a multi-storey building.

Figure 2 shows a sectional view of an embodiment of the toilet seat to be used in the system in accordance with the invention.

Figure 3 shows a sectional view of another embodiment of the toilet seat.

The waste removal system comprises a waste stack 1 and toilet seats 4, which are joined with connecting branches 5 to the waste stack 1. The lower end of the waste stack has a control valve 8, via which the waste stack 1 is connected to a waste collection container 10. The control valve 8 in the described embodiment is a ball valve. To the waste stack 1, above the control valve 8, is connected the upper end of a venting duct 6. The venting duct 6 is routed to the roof of the building, and the upper end of the duct is provided with a roof exhaust fan 7. The roof exhaust fan 7 provides for a vacuum applied to the waste stack 1 via the venting duct 6. With the help of the vacuum, the odours from the waste stack are prevented from reaching the toilet space via the toilet seat 4. The upper end of the waste stack 1 has a venting valve 2. The passage of the wastes in the system is designated in Fig. 1 by solid arrows, while the passage of the air stream sucked by the roof fan 7 is designated by the larger outline arrows.

One possible embodiment of the toilet seat used in the described toilet system is illustrated in Fig. 2. The seat comprises a bowl 4, a seat cover 3, and a check valve 19. The lower side of the cover is provided with a bag cassette 12. The cassette 12 is filled with folded bags 20 manufactured from coated paper. The check valve 19 is placed to the lower part of the bowl 4, and the seat is connected via the valve 19 to the branching union 5. The stack of the spindle in the check valve 19 is provided with a cogwheel mechanism 16, 17, and one of the cogwheels has a rod 14 connected to it. The rod has a return spring 15 adapted about the valve shaft. The check valve 19 in this embodiment is a ball valve. When lifted to its upper position, the cover 3 of the toilet seat reaches the position indicated by dashed lines.

The seat functions as follows: When the toilet is not used, the cover 3 of the seat is in its closed position. When the seat is to be used, the cover 3 is lifted to its upper position. Lifting the cover 3 makes grippers 24 at the sides of the seat catch the lowermost bag 20 in the cassette 12 and hold the bag to the sides of the seat. The bags are folded to the center of the cassette 12, and when the cover 3 with its cassette 12 is lifted to its upper position, the mid-part of the bag 20 sinks into the bowl 4 of the seat.

Next to the lifting of the cover 3, the check valve 12 is opened by pulling a knob 13 adapted to the rod 14. The other end of the rod 14 is attached to a large cogwheel 16. The motion of the rod 14 rotates the cogwheel 16, which further rotates the spindle of the check valve 19 by the valve shaft. The motion of the rod 14 is stopped when the valve is fully open, and the rod 14 is latched to its end position, whereby the valve 19 is also latched open. The valve 19 is dimensioned so as to make its throat diameter as large, or preferable, slightly larger than the diameter of the lower part of the bowl 4 in the seat. When the valve 19 is opened, the vacuum in the waste stack 1 sucks the bag 20 down against the inner surface of the bowl 4. The air flow induced by the vacuum further provides an augmented ventilation of the toilet space, thus removing the resulting odours and preventing the odours of the waste stack from reaching the toilet space. The toilet seat is now ready for use.

After toilet use, the cover 3 is closed, whereby the cover 3 pushes the grippers 24 aside, whereby they release allowing the bag 20 to fall through the valve 19 and the connecting branch 5 to the waste stack 1. Next to the closing of the cover 3, the rod 14 is released from its latched position, whereby the rod is allowed to fall to its lower position under the force imposed by the spring 15 and the rod thereby closes the valve 19 by turning it via the cogwheel mechanism 16, 17. The disposal of household wastes takes place in a similar manner, except that the wastes can be placed in the bag even prior to their dropping into the toilet bowl.

The connecting branches 5 and the waste stack 1 are dimensioned so that the diameter of the piping increases at each branching joint so as to avoid throttling points of the piping at which the bag 20 to be removed could adhere to, thus making it possible for the wastes packed in the bag to freely fall via the connecting and stack piping 5, 1 onto the control valve 8. The control valve 8 is typically held closed and opened cyclicly under a timer control, then releasing the waste accumulated to the lower end of the waste stack 1 to fall into the collection container 10 placed below. The cyclic and generally closed operation of the control valve 8 is because thereby the odours of the waste collected in the container is prevented from escaping to the surroundings. The valve 8 is controlled to automatically open at approx. 10...30 min intervals.

The roof fan 7 is dimensioned so as to maintain a sufficient vacuum in the stack 1 even when all toilet seats connected to the same waste stack 1 are used simultaneously. Notwithstanding the use of the bag, the bowl 4 of the toilet seat must be cleaned at regular intervals. The bowl can be cleaned by flushing with water in the same manner as is done for a conventional toilet seat. The required flushing water is taken from the faucets of the toilet space. This small volume of water entering the system from flushing does not impair the toilet system function; by contrast, water promotes the further handling of waste.

The collection containers are removable. The containers are placed on rails along which they are transferred. A full container 9 is detached from the control valve 8 and withdrawn from below it. An empty

container 10 is pushed under the control valve 8 and attached to the valve 8. The next empty container 11 to be used remains waiting on the rails. In Fig. 1 the transfer direction of the containers is designated by arrows a. The transfer and replacement of the containers is handled by a garbage hauling service, and a timer is used for the replacement and the actuation of the control valve 8. The containers are transported to the site of further treatment by trucks equipped with a lift-off container system. A full container 9 is lifted onto a truck and transported to the site for further treatment, where the waste collected into the container is transferred to a larger composting container. The volume of the collection containers varies according to the tenants in the building. In multi-storey buildings the appropriate container volume is approx. 2...5 m^3, while in family dwellings a container of approx. 1 m^3 will suffice. The containers have necessary connections for water discharge or addition. During further treatment, chemicals are added if necessary to the container, and if the waste has insufficient moisture content, also water is added. Oxygen is removed from the container by suction, and the container contents are left to ferment, whereby the metabolism of anaerobic bacteria produces methane during the fermentation of the waste. This methane gas can then be used as fuel in, e.g., district heating or thermal power plants. After the addition of appropriate fertilizing compounds, the composted waste is finally applicable as a fertilizer or landfill.

Illustrated in Fig. 3 is another embodiment of the toilet seat suitable for use in the system in accordance with the invention. This seat design has not a bag cassette 12 similar to that used in the toilet seat shown in Fig. 2. Instead, the spindle 23 of the check valve 19 is shaped to include a recess into which a bag 22 similar to a coffee filter is placed. Under the upper rim of the bowl 4 of the seat is mounted a water pipe 21 with holes. In other aspects, the seat has a similar construction to that of the seat shown in Fig. 2.

During the use of this seat, the cover 3 is opened and the bag 22 is placed in the recess of the spindle 23 of the valve 19. After use of the seat, the valve 19 is opened by pulling from the knob 13, whereby the waste bag 22 is automatically closed and dumped via the connection branch 5 to the waste stack 1. After the closing of the valve, water is sprinkled to the bowl from the water pipe 21 and the bowl is flushed clean. The flushing water and urine waste are routed to the sewer in this embodiment. The use of the above-described toilet seat is no fashion different from the use of a conventional toilet seat.

In addition to the exemplifying embodiments described above, the invention can be implemented in alternative ways. For instance, the control and check valves 8 and 19 can have the form of any suitable valve type such as, e.g., disc or slide valve. The above-described actuator mechanism 13...17 of the valve 19 can be replaced by, e.g., an electric motor. In systems designed for family household use with only a single toilet seat, the seat is directly connected to the waste stack 1, thus making the use of connection branches unnecessary. The bags 20 used in the system can be manufactured from different grades of paper or degradable plastics.

Design example for cost reductions available in different sizes of Finnish cities:

Design parameters:

The computation is based on treating the charges for raw water and waste water as costs of the balance sheet, while the price of produced biogas is considered as income.

Organic waste volume produced by a single person	0.767 m^3/a
Biogas volume generated by 1 m^3 of waste	200 m^3
Estimated sales market price of biogas	0.5 FIM/m^3
Raw water cleaning cost	3.37 FIM/m^3
Waste water cleaning cost	4.13 FIM/m^3

Population	Waste vol. [m³]	Biogas produced [m³]	Biogas sales [at 0.5 FIM/m³]	Reduction in water cons.[m³]	Savings [FIM]	Net profit [FIM]
2000	1534	306,800	153,400	29,200	219,000	372,400
5000	3835	767,000	385,000	73,000	547,000	933,000
10000	7670	1,534,000	767,000	146,000	1,095,000	1,862,000
20000	15340	3,068,000	1,534,000	292,000	2,190,000	3,720,000
30000	23010	4,602,000	2,301,000	438,000	3,285,000	5,586,000
40000	30680	6,136,000	3,068,000	584,000	4,380,000	7,448,000
50000	38350	7,670,000	3,855,000	730,000	5,475,000	9,330,000
60000	46020	9,204,000	4,602,000	876,000	6,570,000	11,172,000
70000	53690	10,738,000	5,369,000	1,022,000	7,665,000	13,034,000
80000	61360	12,272,000	6,136,000	1,168,000	8,760,000	14,896,000
90000	69030	13,806,000	6,903,000	1,314,000	9,855,000	16,785,000
100000	76700	15,806,000	7,670,000	1,460,000	10,950,000	18,620,000

Claims

1. A dry toilet seat comprising
   - at least one toilet seat comprised of a seat bowl (4), and a cover (3), and
   - at least one collection container (10) for the collection of wastes for removal by transportation

   characterized by
   - at least one essentially vertical waste stack (1) to which the toilet seats are connected,
   - at least one control valve (8) via which the lower end of the waste stack (1) is attached to the collection container (10),
   - at least one venting duct (6) connected to the waste stack (1) above the control valve (8), and
   - means (7) adapted to the venting duct (6), capable of producing to said duct (6) and therefrom to the waste stack (1) a vacuum and flow of air.

2. A system in accordance with claim 1, **characterized** in that the toilet seat has
   - a waste bag cassette (12) adapted below the cover (3) of the seat,
   - gripper elements (24) for picking a single bag (20) from said cassette (12) and attaching the bag (20) in a detachable manner to the rim of said bowl (4), and
   - a check valve (19) via which the toilet seat is connected at the lower part of said bowl (4) to said waste stack (1).

3. A system in accordance with claim 1, **characterized** in that the toilet seat has
   - a check valve (19) with a spindle, via which valve the toilet seat is connected at the lower part of said bowl (4) to said waste stack (1), and said check valve has its spindle (23) provided with a recess into which a waste bag (22) can be placed, and
   - a water pipe (21) with holes on it, said pipe being adapted below the upper rim of said bowl (4), whereby said pipe makes it possible to sprinkle flushing water into said bowl (4).

4. A system in accordance with claim 1, **characterized** in that the toilet seats are connected to the waste stack (1) via connection branches (5).

5. A system in accordance with claim 1, **characterized** in that the top of the venting duct (6) is routed to the roof of the building.

6. A system in accordance with claim 1, **characterized** in that the control valve (8) is a timer-controlled valve.

7. A system in accordance with claim 1, **characterized** in that the control valve (8) is a ball valve.

8. A system in accordance with claim 2 or 3, **characterized** in that the check valve (19) is a ball valve.

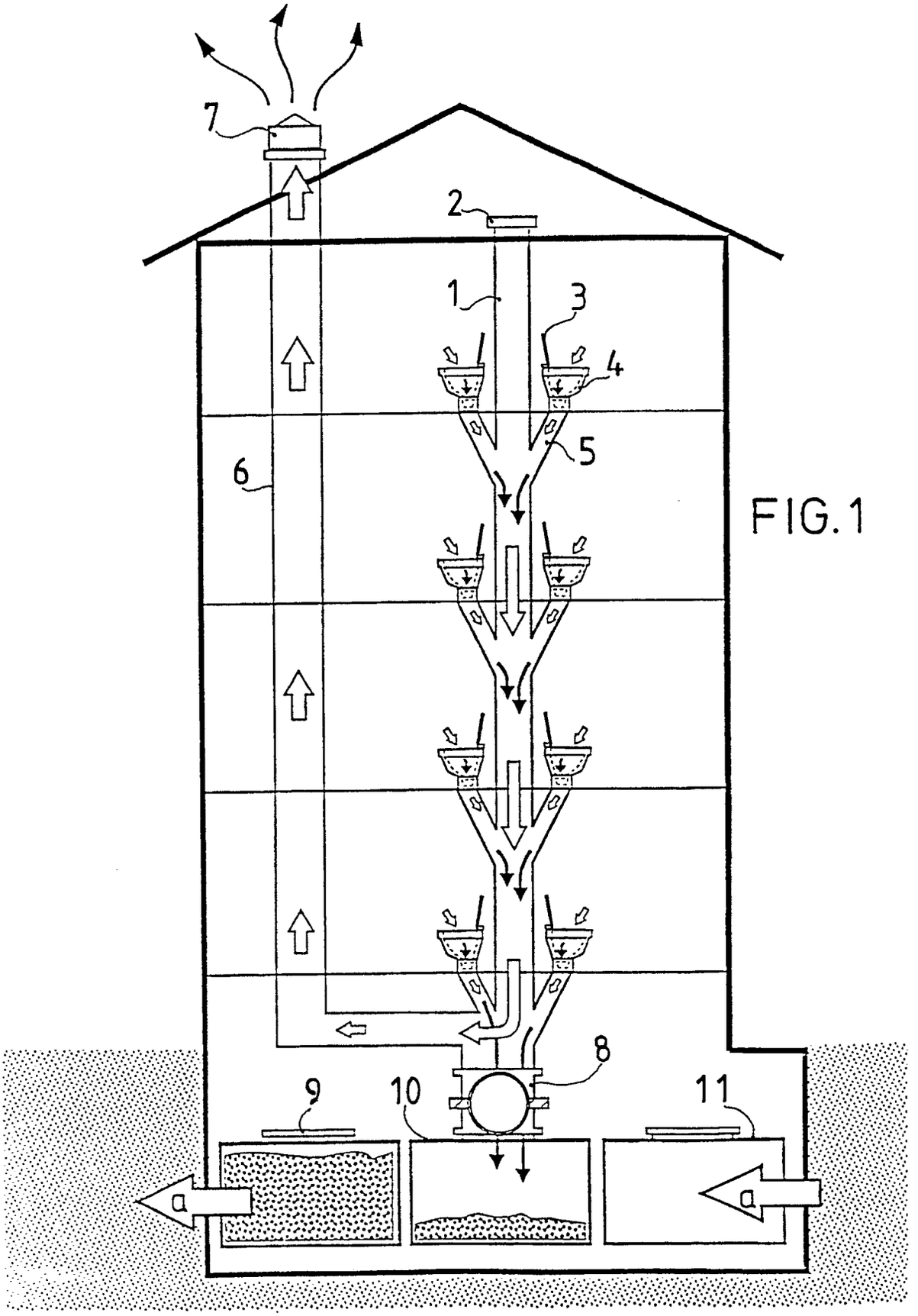

FIG.1

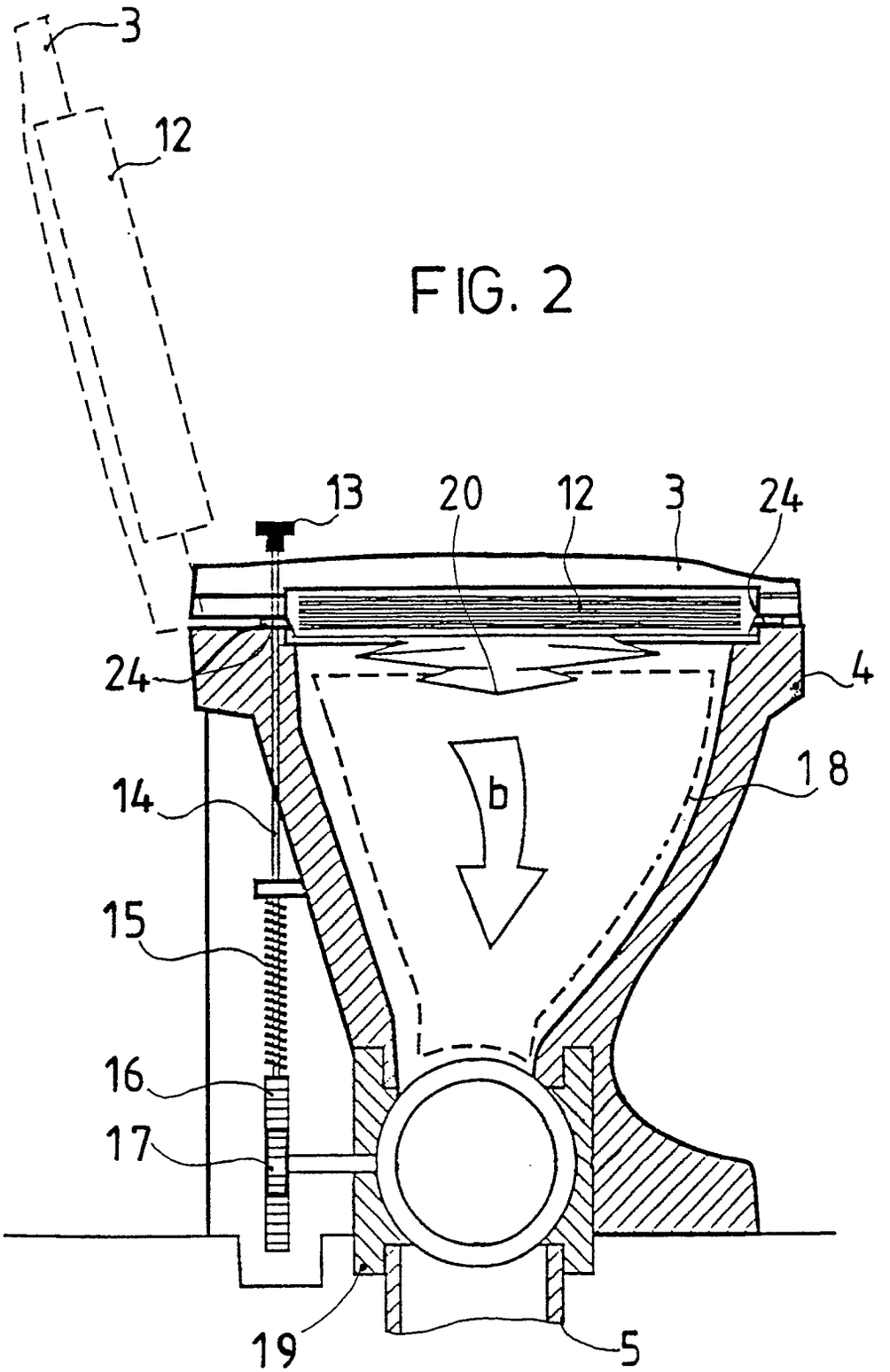

FIG. 2

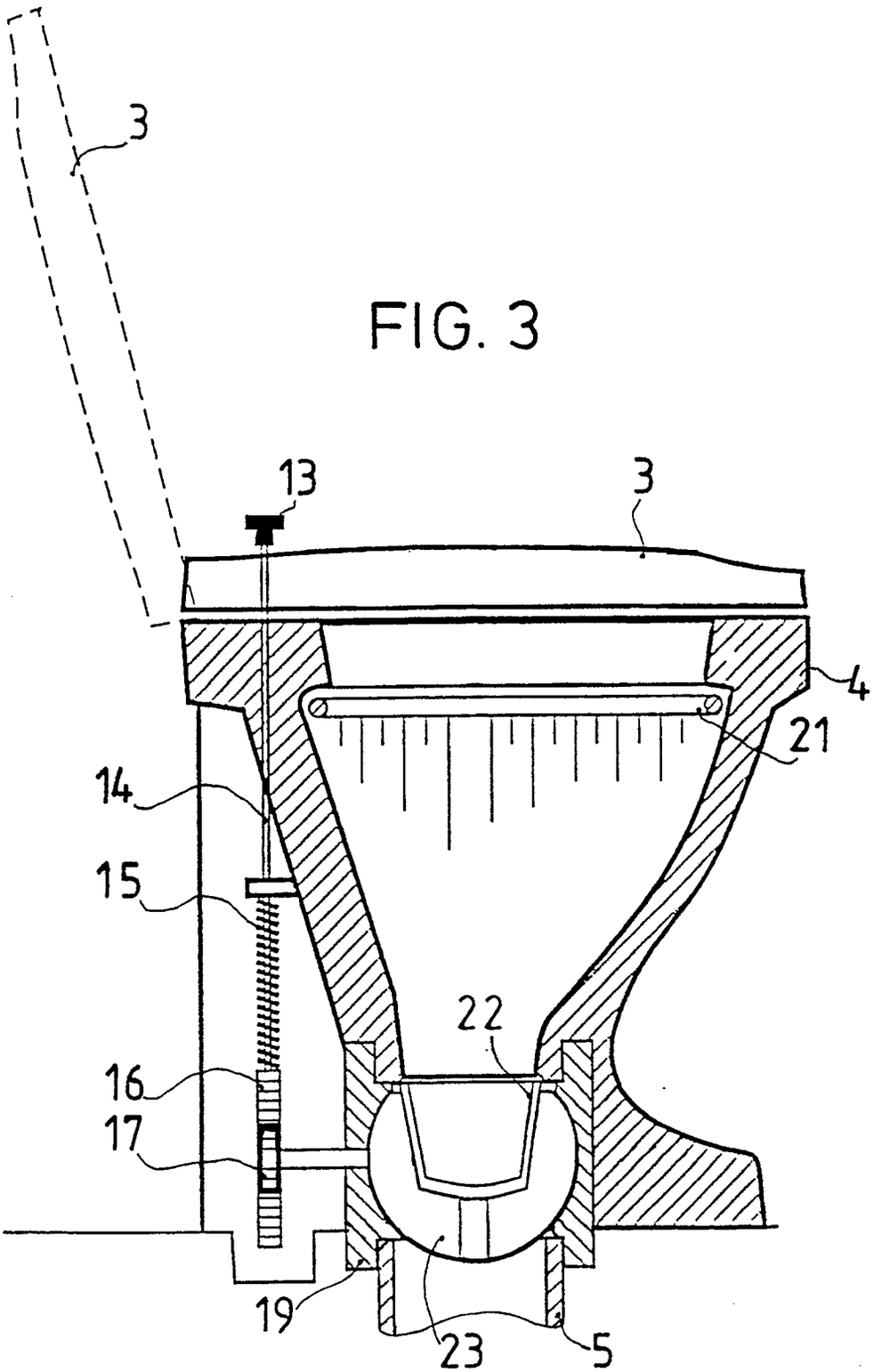

FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 10 1261

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	DE-A-3 442 565 (A. BLUM) * page 5, line 6 - line 13 * * page 6, line 20 - line 36 @ page 7, line 10 - line 13; figure 2 *	1,4,5,6	E 03 F 1/00 A 47 K 11/02 A 47 K 13/24
Y	DE-A-2 656 741 (ELECTROLUX) * page 6, paragraph 3 * * page 8, paragraph 4 - page 9, paragraph 3; figure *	1,4,5,6	
A	US-A-4 346 002 (M. PETZINGER) * column 1, line 47 - line 63 * * column 3, line 11 - line 57; figures 1,5 *	1	
A	FR-A-2 090 838 (VILLEROY & BOCH) * page 1, line 14 - page 2, line 2 * * page 6, line 8 - line 34; figures 1-4 *	2	
A	DE-B-2 654 437 (ELECTROLUX) * column 3, line 16 - line 25; figure 2 * * column 4, line 13 - line 16 *	2,3	
A	DE-U-8 522 862 (K. WEGNER) * page 3, paragraph 4 *	2	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	DE-A-1 948 485 (K. BHATIA) * page 5, paragraph 1; figures 1,2 *	2	E 03 F A 47 K E 03 D

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	14 May 91	KRIEKOUKIS S.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
A: technological background
O: non-written disclosure
P: intermediate document
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E: earlier patent document, but published on, or after the filing date
D: document cited in the application
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&: member of the same patent family, corresponding document