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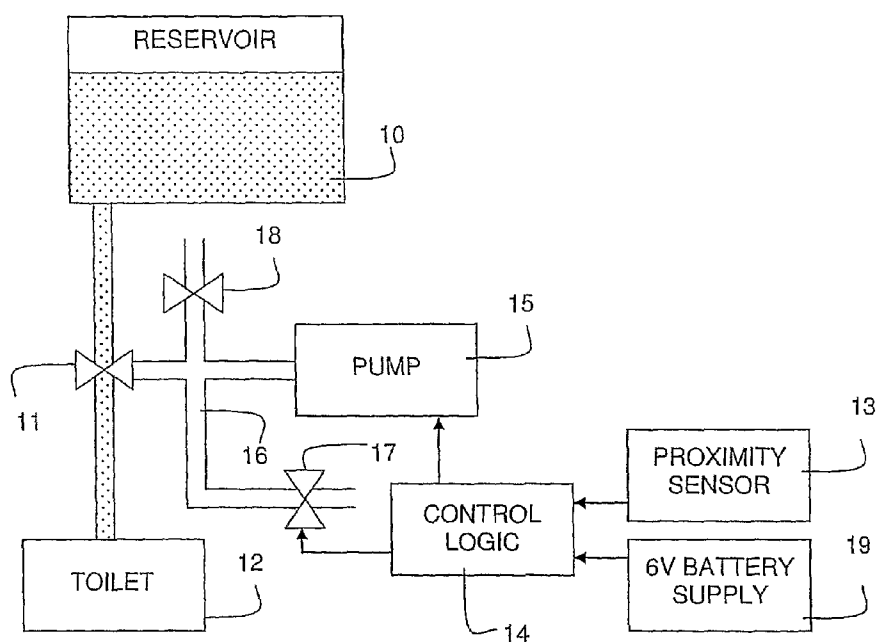
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(54) Title: SYSTEM FOR CONTROLLING FLUSHING OF A CISTERN



(57) Abstract: A control system for a cistern, the control system comprising a user activated sensor (13), a controller (14), a pump (15) and a pneumatic line (16) connected to the pump (15) and adapted to be connected to the drain valve (11) of a cistern (10), wherein the user activated sensor (13) and controller (14) are adapted to interpret a plurality of signals and operate the pump (15) in a pre defined manner associated with a detected signal, thereby enabling a plurality of flushing actions to be effected using a single user activated sensor.

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## **System for Controlling Flushing of a Cistern**

This invention relates to a cistern for a toilet, urinal or the like. In particular, the invention relates to a control system for controlling the flushing of such a cistern.

Various forms of flushing mechanism exist. Conventionally, flushing of a cistern is effected by operating a drain valve. It is known to use a pneumatic or hydraulic actuator to operate the drain valve. Actuation is typically effected externally of the cistern.

Dual flushing cisterns are known. These typically comprise two actuators each causing the flushing of a different volume of water through the cistern. For example, this may be a small volume (sometimes described as "partial") flush if flushing fluids and a large volume (sometimes described as "full") flush if flushing solids. The actuators are typically controlled by manually operated activators positioned externally of the cistern, for example, the actuators may be a handle, push button or sensor which responds to some form of signal provided by a user.

An example of an existing dual flush cistern is described in EP 1 582 637 of Valsir S.p.A. In that cistern, a drain valve has associated with it two pneumatic actuators each comprising a bellows. The bellows are of different proportions and control respectively a partial or a full flush of the cistern. Each bellow has an inlet sleeve and a connecting member acting on the drain valve. The inlet sleeve of each bellows connects with a distributor which in turn connects with two buttons, each of which when depressed, actuates an associated pneumatic pulse generator. Each button and pulse generator is connected with a single one of the pneumatic actuators via the distributor.

The user makes a choice as to which is an appropriate flushing action and presses the appropriate button which actuates the appropriate bellows causing the required flushing action.

The present invention seeks to provide a control system for controlling flushing of a cistern which is less intrusive than the prior art system and which has improved functionality.

In accordance with the present invention there is provided a control system for a cistern, the control system comprising a user activated sensor, a controller, a pump and a pneumatic line connected to the pump and adapted to be connected to the drain valve of a cistern, wherein the user activated sensor and controller are adapted to interpret a plurality of signals and operate the pump in a pre defined manner associated with a detected signal, thereby enabling a plurality of flushing actions to be effected using a single user activated sensor.

The user activated sensor may take any of a variety of forms; for example but without limitation, it may be responsive to pressure, light, touch or motion. In another alternative, the sensor may be sound sensitive. The controller is configured not only to recognise that a signal has been detected by the sensor but to monitor the duration or other extent of the signal. Having recognised a pre defined signal, the controller interprets this signal into a previously defined pneumatic pulse action which causes an appropriate degree of opening of the drain valve.

The system may be adapted to respond to a variety of hand signals. For example but without limitation, waving hand, still hand, single touch, touch and hold, push, push and release, or push and hold. Alternatively, it may

respond to certain noises, including but not limited to speech, hand clapping, whistles and the like.

One embodiment of the user activated sensor comprises a PCB which incorporates an infra red sensor and a plurality of light emitting indicators. The light emitting indicators can be displayed in any pre defined manner to give an indication of the current status of the system. For example, but without limitation, a blue light may be used to indicate a whole flush is being performed and a green light to indicate that a partial flush is being performed, a flashing light in any colour may indicate the system is resetting after flushing or that the system is monitoring other parts of the flushed system, for example the water level. In this embodiment, the various light emitting indicators and the infra red sensor are housed behind a bespoke, multi-layer lens, each layer comprising an emulsion selected to transmit a frequency of light which corresponds to a frequency emitted by one or more of the light emitting indicators and the infra red transmitter/receiver. This arrangement is advantageous in that it permits all signalling/sensing components to be housed collectively on a compact PCB and protected from external environmental influences.

In another embodiment the user activated sensor is associated with a mechanical device which is operated by a user. For example, the sensor may be associated with a Victorian style pull chain flush or rotary handle flush. In such an embodiment, the user operates the pull chain or handle which in turn causes interaction with the sensor and performs an appropriate flush. Since the extent of any action on the pull chain or handle is transferred to the sensor and monitored by the controller. A system traditionally not configured to perform ecologically efficient flushing actions can be made to perform more ecologically efficient flushing actions, i.e. a system designed

with a single flushing action can be adapted to perform multiple flushing actions.

The control system may further include sensors for monitoring the water volume in a lavatory bowl or cistern. With an appropriately configured controller, the system can then be adapted to intelligently perform the most economical flush irrespective of the extent of a detected signal, i.e. to use a minimum appropriate amount of water to provide an effective flush given the current condition of the water in a lavatory system. Optionally, the controller may be configured not to permit flushing unless certain conditions are present. Optionally also the controller may be configured to perform a partial flush if more appropriate, even if signal is for a full flush. In another option, the controller may be adapted to cause reverse as well as forward action of the pump; this may be useful in addressing blockages or water shortages in the system.

Optionally, a plurality of pumps may be associated with the single user activated sensor. Each pump being effective to cause a different flush, for example, there may be two flushes, one to cause a partial flush and the other a full flush. In the manner previously described, the controller elects the most appropriate flush in reaction to sensor inputs and activates the appropriate one of the plurality of flushes.

Ideally, the system is powered by a low voltage supply. 4V and 6 volt DC supplies have been found quite adequate for powering some embodiments of the invention. Consequently the system is very economical to use. The power supply can optionally be selected from a battery or transformed mains electricity, thereby minimising the risk of electrocution in the event of malfunction.

In another option, the controller is configured to counteract a reduction in power supply by increasing the duration of a pneumatic pulse to the pump, thus, irrespective of the power of the pulse, the volume of air and consequent volume of water in a given type of flush are maintained fairly constant.

An optional additional feature to the embodiments described involves incorporating a clock within the controller which monitors a predefined period of time since the last flush of the system. For example but without limitation, the timer may be programmed at 12 hours. In such an embodiment, say in an office toilet facility, if the last flush was at about 6pm as the last office worker left the building, the system would automatically flush at around 6 am, freshening the system before the arrival of the first office worker the next morning.

It will be appreciated the proposed system is particularly portable and adaptable and can be quickly and easily retrofitted to existing drain tanks. The controller can be programmed to a user's specification enabling the user to choose his preferred mode of signalling for a full or partial flush and even to elect the specific parameters of a full or partial flush.

It will be appreciated that the system of the invention may have wider application in any apparatus where periodic sharp injections of pressurised air may be used to perform or effect a desired function.

Some embodiments of the invention will now be further described with reference to the following figures in which:

Figure 1 shows a first embodiment of a cistern embodying a control system in accordance with the present invention.

Figure 2 shows second and third embodiments of a cistern embodying a control system in accordance with the present invention.

Figure 3 illustrates schematically a printed circuit board PCB suitable for use as a controller and user activated sensor in a control system in accordance with the invention.

Figure 1 shows a cistern composed of a reservoir of water 10 connected via conduit and a pneumatically actuated valve 11 to a toilet 12. The cistern is provided with an infrared proximity and motion sensor 13 which detects the presence of a user's waving hand (not shown) signifying a desire to flush the toilet. Upon receiving a corresponding signal from the sensor, control logic 14 supplied with a 6V battery power supply causes the pneumatically actuated valve to open, thereby causing the toilet to flush. As previously mentioned a 4V battery power supply has also been found to be effective.

Specifically, the control logic 14 outputs the power supply to a pump 15 which in turn pumps air in to flexible pneumatic lines 16 connected between the pump and the pneumatically actuated valve 11. The pneumatically actuated valve 11 is then caused to open when the static pressure in the pneumatic lines reaches a threshold. Depending on the duration of the increased pressure in the pneumatic line, partial or full flushes may be achieved.

Connected to the pneumatic lines 16 is a solenoid valve 17 which in an unpowered state allows release of pressure in the pneumatic lines. In a powered state, which occurs when the pump is powered, the solenoid valve is closed.

Also connected to the pneumatic lines 16 is a safety valve 18 which opens when the static pressure in the pneumatic lines exceeds a particular threshold (in excess of that necessary to cause the pneumatic actuator valve 11 to open).

The above embodiments use an infrared proximity and motion sensor but other modes of control are contemplated including the use of a timer and manual switching. In the present embodiment, the infrared sensor is responsive to a hand waving signal and a stationary hand signal. When a waving hand signal is detected, the controller prompts actuation of a pneumatic pulse of short duration causing a partial flush of the system. In response to a stationary hand signal, the controller prompts a pneumatic pulse of longer duration and a full flush of the system.

As previously discussed, the system may include other sensors and a suitable adaptation of the controller which enables the controller to intelligently determine whether the instructed flush is necessary or the most ecologically efficient flush given the current condition of the water in the lavatory system. The controller is thus enabled to override instructions for inappropriate flushes.

Figure 2 shows an alternative embodiment of the invention. As can be seen from Figure 2,

In common with Figure 1, Figure 2 show a cistern composed of a reservoir of water 10 connected via a conduit and a pneumatically actuated valve 211 to a toilet 212. The cistern is provided with a user activated sensor 213 which detects a user provided signal signifying a desire to flush the toilet in an elected manner (e.g. full flush or partial flush). The sensor may be a motion sensor, pressure or touch sensitive, light sensitive or sound sensitive. Upon

receiving a corresponding signal from the sensor, the controller 214, powered by a battery supply with of 4 to 6V determines an appropriate flushing action and operates the appropriate one of pumps 215a and 215b, thereby causing the toilet to flush.

Specifically, the controller 214 outputs the power supply to one of the pumps 215a and 215b which in turn pumps an appropriate volume of air in to flexible pneumatic lines 216 connected between the pumps and the pneumatically actuated drain valve 211. The drain valve 211 is then caused to open when the static pressure in the pneumatic lines reaches a threshold. Duration of the increased pressure in the pneumatic line and consequent volume of air transferred differs for each pump allowing a partial or full flush as appropriate.

Connected to the pneumatic lines 216 and associated with each pump 215a, 215b is a solenoid valve 217 which in an unpowered state allows release of pressure in the pneumatic lines. In a powered state, which occurs when the associated pump is powered, the solenoid valve is closed.

The broken line illustrates an optional additional sensor and its communication with the controller. As previously discussed the optional sensor monitors water levels in the cistern and the controller may override a flushing instruction provided manually via the user activated sensor to ensure flushing is ecologically efficient.

As can be seen from the Figure 3, a PCB includes a control chip 30 communicating with an infra red transmitter 31, infra red receiver 32, first coloured LED 33 and second coloured LED of different colour 34. The dotted line shows the position of a suitably configured lens 35 which allows transmission of infra red and lights of the frequencies emitted by the LED s.

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the design and use of pneumatic control systems and component parts thereof and which may be used instead of or in addition to features already described herein.

## CLAIMS

1. A control system for a cistern, the control system comprising a user activated sensor, a controller, a pump and a pneumatic line connected to the pump and adapted to be connected to the drain valve of a cistern, wherein the user activated sensor and controller are adapted to interpret a plurality of signals and operate the pump in a pre defined manner associated with a detected signal, thereby enabling a plurality of flushing actions to be effected using a single user activated sensor.
2. A control system as claimed in claim 1 wherein the user activated sensor is a motion detector.
3. A control system as claimed in claim 1 wherein the user activated sensor is a pressure or touch sensor.
4. A control system as claimed in claim 1 wherein the motion detector is an infra red proximity sensor.
5. A control system as claimed in any preceding claim wherein the system further comprises a pressure release valve incorporated in a pneumatic line and which is configured to close when the pump is powered and to open when the pump is not powered.
6. A control system as claimed in any preceding claim further including one or more sensors for monitoring the water volume in the water filled system which is to be flushed and wherein the controller is appropriately configured to determine and effect the most economical flush of the water filled system.

7. A control system as claimed in claim 6 wherein the controller is configured to override a received flush signal if the flush signal does not demand the most economical flush.

8. A control system as claimed in any preceding claim wherein the controller is adapted to cause reverse as well as forward action of the pump in response to appropriate signals.

9. A control system as claimed in any preceding claim which is powered by a low voltage DC supply.

10. A control system as claimed in claim 9 wherein the power supply is a 6V battery.

11. A control system as claimed in claim 9 wherein the power supply is a 4V battery.

12. A control system as claimed in any preceding claim which includes a plurality of pumps each configured to cause a specific and pre defined flushing action and wherein the controller associates each pump with a different signal received by the user activated sensor and elects an appropriate pump to operate in reaction to a detected signal.

13. A control system as claimed in any preceding claim wherein the controller is configured to compensate for any variation in the power supply by adjusting the duration of a pneumatic pulse to the pump, such that, irrespective of the power of the pulse, constancy of the volume of air and consequent volume of water in a flush are maintained.

14. A control system as claimed in any preceding claim wherein the user activated sensor comprises an infra red transmitter/receiver and is embodied with the controller in a PCB which also houses one or more light emitting indicators, the controller being configured to activate the or each light emitting indicator in a pre defined manner to give an indication of the current status of the system.

15. A control system as claimed in claim 14 wherein the infra red transmitter/receiver and one or more light emitting indicators are enclosed behind a multi-layer lens, each layer of the lens comprising an emulsion selected to transmit a frequency of light which corresponds to a frequency emitted by one or more of the light emitting indicators and the infra red transmitter/receiver.

16. A control system as claimed in claim 14 or 15 including two light emitting indicators and the controller being configured to display a first of the indicators during a partial flush and the second during a whole flush.

17. A control system as claimed in claim 16 wherein the light emitting indicators are blue and green LEDs.

18. A control system as claimed in any preceding claim wherein the controller incorporates a timer which monitors a pre defined period since the last flush of the system generates a flush at the expiry of the pre defined period and resets after each flush of the system.

19. A lavatory cistern incorporating a control system as claimed in any preceding claim.

20. A lavatory cistern as claimed in claim 19 wherein the user activated sensor is associated with a mechanical pull chain or handle and wherein operation of the pull chain or handle is translated into a signal to which the user activated sensor is receptive.

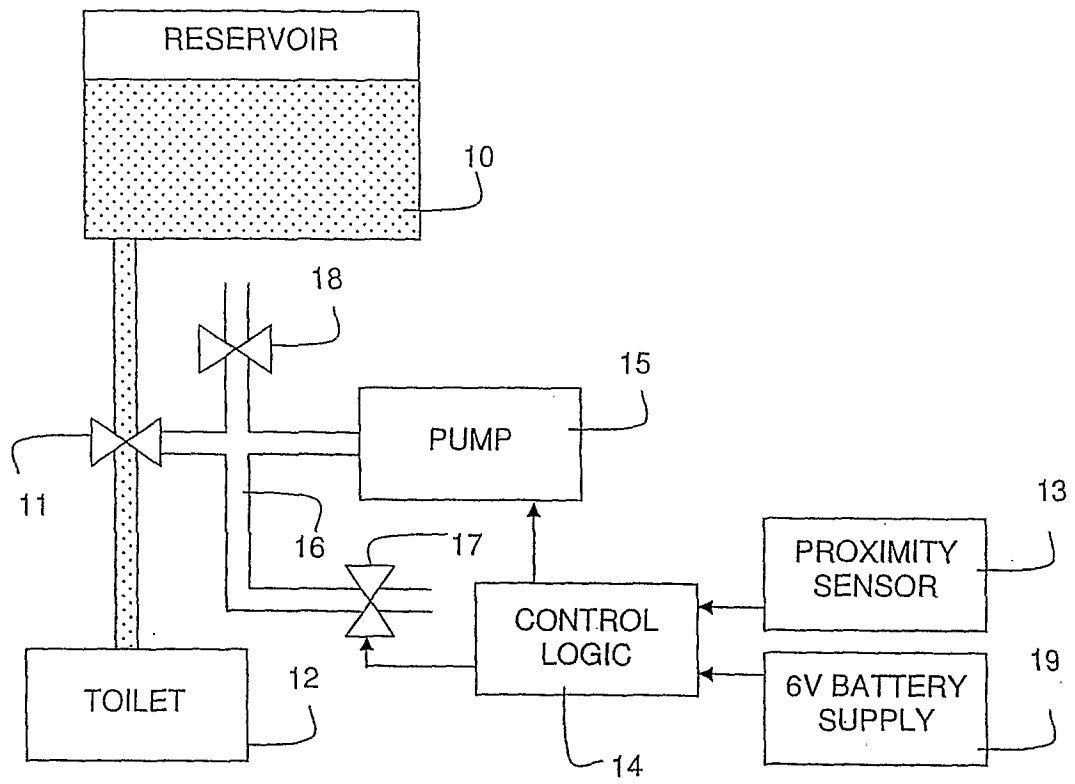


FIGURE 1

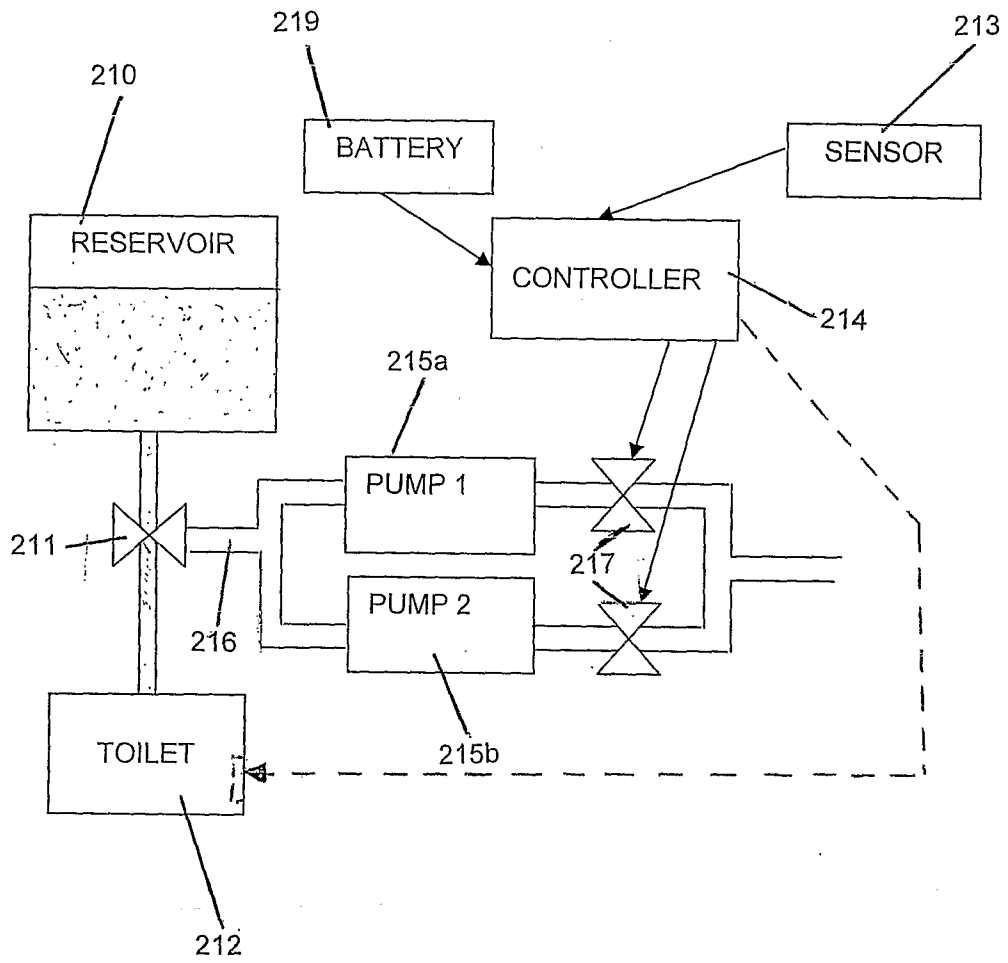
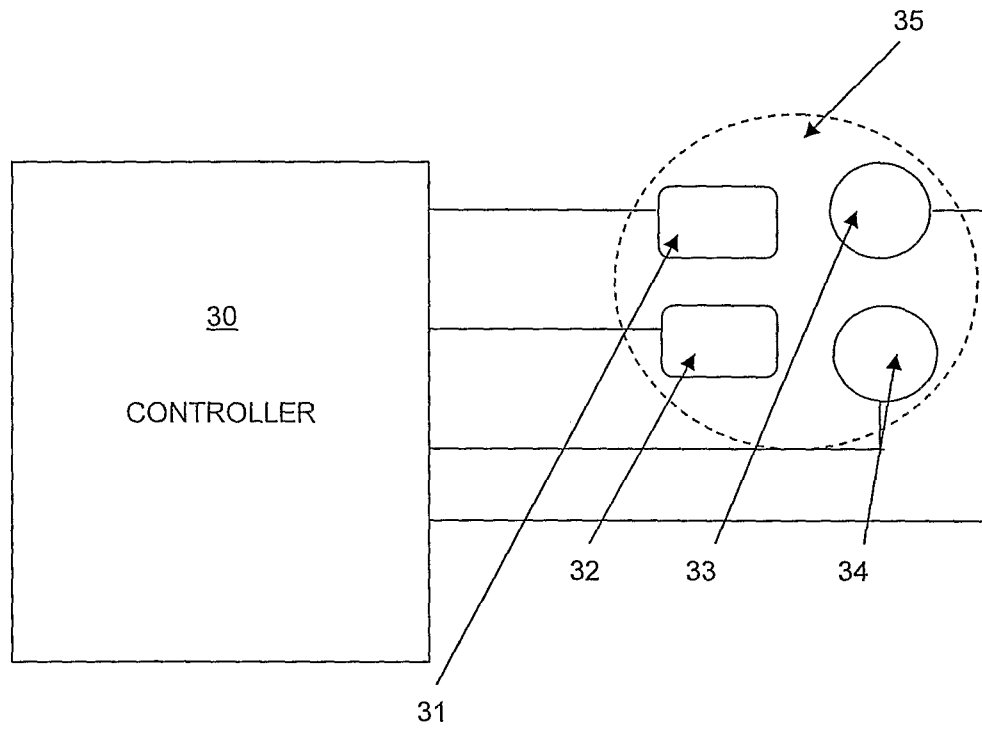


FIGURE 2

FIGURE 3



# INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2007/004075

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. E03D5/02		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) E03D		
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		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 201 17 432 U1 (GEORG FISCHER SCHWAB GMBH & CO [DE]) 24 January 2002 (2002-01-24) figure 1	1, 19
A	EP 1 127 987 A (AQUIS SANITAER AG [CH]) 29 August 2001 (2001-08-29) paragraph [0039] - paragraph [0044]; figures 3,4 claims 1-5,10-12,14-16	1, 19
A	EP 1 582 637 A (VALSIR S P A [IT]) 5 October 2005 (2005-10-05) cited in the application the whole document	1, 19
<input type="checkbox"/> Further documents are listed in the continuation of Box C.		
<input checked="" type="checkbox"/> 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	*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	
*E* earlier document but published on or after the international filing date	*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	
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Date of the actual completion of the international search  <p style="text-align: center;">5 March 2008</p>	Date of mailing of the international search report  <p style="text-align: center;">25/03/2008</p>	
Name and mailing address of the ISA/ 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	Authorized officer  <p style="text-align: center;">Isailovski, Marko</p>	

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2007/004075

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 20117432	U1	24-01-2002	NONE
EP 1127987	A	29-08-2001	AT 346194 T 15-12-2006 DE 10009253 A1 30-08-2001
EP 1582637	A	05-10-2005	NONE