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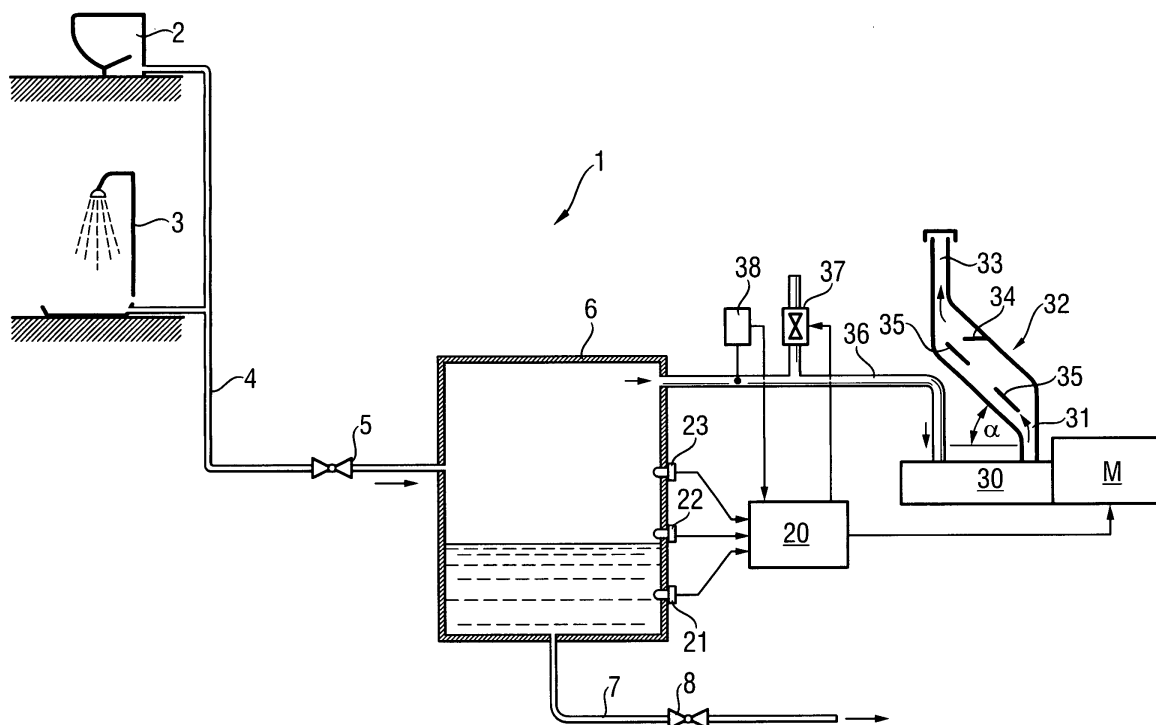
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(54) **Vacuum sewer system**

(57) The invention relates to a vacuum sewer system comprising a source of sewage (2,3), a first sewer pipe (4), a sewage receptacle (6), and means (30) for generating vacuum in the sewage receptacle and first sewer pipe. In order to provide an integrated and self-

sufficient means for generating vacuum, said means comprises a liquid ring pump (30) provided with an integrated water reservoir, whereby the air exhaust conduit (31) of said pump is provided with a water trap means (32), which is in fluid communication with the integrated water reservoir.



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Description

[0001] The present invention relates to a vacuum sewer system according to the preamble of claim 1.

[0002] This type of vacuum sewer systems are generally known. In such systems dry vane pumps have often been used as means for generating vacuum. Dry vane pumps are, however, easily susceptible to corrosion from water and moisture as well as from harmful gases emanating from the waste handled and the solvents used in the system. Various protective measures have been used to eliminate the problems which has led to more components in the system and rising costs, e.g. as disclosed in EP 0 644 299. Liquid ring pumps have also been used for vacuum generation. In the previously known arrangements, however, the cooling systems necessary for such pumps have been complex and expensive, and most of reliant on cooling water from an outside source.

[0003] The object of the present invention is to avoid the above mentioned disadvantages and to provide a vacuum sewer system, in which vacuum generation is achieved by a reliable and simple means. This objective is attained by a vacuum sewer system according to claim 1.

[0004] The basic idea of the invention is to provide an integrated vacuum generation arrangement, which has a basically independent and self-sufficient cooling system. This is achieved by using a liquid ring pump as the vacuum generation means, which pump is provided with an integrated water reservoir. Further, the exhaust air conduit of the pump is provided with a water trap means, which is in fluid communication with the integrated water reservoir. An advantage of this arrangement is that outside cooling arrangements, often provided with heat exchangers and other components, are avoided. Furthermore, it is not necessary to have an additional outside supply of water. Outside water, depending on the source, may be contaminated or otherwise unsuitable to be used directly, whereby water treatment units and specific valves would be necessary as in previously known solutions. The invention provides a further advantage, even if high quality water would be available, for instance from a water mains in a house, and that is a saving in overall water consumption.

[0005] The water trap means may advantageously be in the form of a condensate collecting container provided with a ventilation means, whereby the saturated air arising at the exhaustion process may be effectively retrieved.

[0006] In order to enhance the collection of condensate and the feeding of the condensate back to the pump, the condensate collection container is advantageously provided with a substantially elongated configuration, whereby it is arranged in an inclined position. The inclined position ensures that the condensate can be retrieved and does not escape from the condensate collection container.

[0007] In view of condensate back-flow, it has shown to be advantageous that the angle of inclination is in the range of about 30° to 60°.

[0008] The collecting of condensate can further be enhanced by providing the condensate collecting container with internal drop separation means, e.g. deflector means or guide plates.

[0009] Further advantageous features of the vacuum sewer system are given in the independent claims 6 to 10.

[0010] In the following the invention will be describe more in detail, by way of example only, with reference to the attached schematic drawing, which shows an embodiment of a vacuum sewer system.

[0011] In the drawing the vacuum sewer system is generally indicated by reference numeral 1. The system comprises a source of sewage, in this embodiment shown as a toilet unit 2 and a shower arrangement 3, which are connected to a sewage receptacle 6 through a first sewer pipe 4 provided with a first valve means 5, advantageously a check valve. The sewage receptacle 6 is connected to a sewage discharge space, indicated by an arrow in the drawing, through a second sewer pipe 7 provided with a second valve means 8, advantageously a check valve.

[0012] The sewage receptacle 6 is provided with a lower level sensor 21, an upper level sensor 22 and a high level sensor 23 for monitoring the level of the sewage collected in the sewage receptacle 6. The level sensors 21, 22 and 23 are connected to a control center 20.

[0013] The system is provided with a vacuum generation means in the form of a liquid ring pump 30 with a drive motor M, which also is connected to the control center 20. The liquid ring pump 30 has an integrated water reservoir. The exhaust air conduit 31 of the liquid ring pump 30 is provided with a water trap, in this embodiment a condensate collecting container 32 provided with a first ventilation means 33. The condensate collecting container 32 retrieves the saturated air arising from the exhaustion process of the liquid ring pump 30 during the generation of vacuum. The condensate collecting container 32 has a substantially elongated configuration and it is arranged in an inclined position, whereby it has shown to be advantageous that the angle α of inclination is in the range of about 30° to 60°, or around 45° as schematically shown. The retrieval of condensate would not be sufficiently successful, if the condensate collecting container would be in a vertical position. The condensate collecting container 32 may further be provided with internal deflector means 34 and guide plates 35, i.e. drop separation means, for enhancing the collection of condensate.

[0014] The suction side of the liquid ring pump 30 is in fluid communication with the sewage receptacle 6 through a vacuum conduit 36 provided with a second ventilation means 37 and a pressure switch 38. The second ventilation means 37 and the pressure switch 38 are connected to the control center 20.

[0015] In the following the functioning principle of the system will shortly be described.

[0016] Vacuum is generated by the liquid ring pump 30 through the vacuum conduit 36 in the sewage receptacle 6 and the first sewer pipe 4. The vacuum level is controlled by the pressure switch 38, whereby a favourable vacuum level would be about -0.3 to -0.7 bar, preferably about -0.4 to -0.5 bar. The hysteresis of the pressure switch maintains the vacuum at a desired level. Due to the pressure difference between the ambient pressure in the toilet unit and the shower arrangement and the vacuum level in the first sewer pipe and the sewage receptacle, the sewage is pushed into the sewage receptacle in a manner known per se.

[0017] When the sewage level in the sewage receptacle 6 reaches the upper level sensor means 22, vacuum generation is stopped by stopping the pump. After this the second ventilation means 37 is opened, whereby the first valve means 5 is closed, in order to let air into the sewage receptacle 6, which forces the sewage out of the sewage receptacle 6 and through the second sewer pipe 7 and the opened second valve means 8 to a sewage discharge space, which may be a main sewer, a sewage treatment plant, etc., depending on in which connection the invention is employed. As the first valve means 5 is closed, the upstream portion of the first sewer pipe 4 remains under vacuum.

[0018] When the lower level sensor means 21 of the sewage receptacle 6 is triggered as the sewage level in the sewage receptacle 6 reaches this level, the second ventilation means 37 is closed and vacuum generation is resumed, whereby the second valve means 8 is closed.

[0019] In case of a failure of the lower level sensor means 21 or the upper level sensor means 22, or in case of an overflow of the system, a high level sensor means 23 in the sewage receptacle 6 can advantageously be used for activating a closing down of the system.

[0020] The level sensors 21, 22 and 23 as well as the liquid ring pump drive motor M, second ventilation means 37 and the pressure switch 38 are advantageously connected to the control center 20, which can be programmed for an optimal running of the vacuum sewer system in question.

[0021] The liquid ring pump 30 is provided with an integrated cooling water reservoir. When the liquid ring pump 30 is running, the suction side of the pump is connected to the vacuum conduit 36 in order to draw air from the sewage receptacle 6 and the first sewer pipe 4. At the same time saturated air arising from the exhaust side of the pump is discharged through the exhaust air conduit 31 into the elongated condensate collecting container 32. The saturated air collects as water droplets in the container and on the internal deflector means 34 and guide plates 35, and can thus effectively be retrieved back into the integrated water reservoir of the liquid ring pump 30 during the rest periods of the pump. The separated air can leave through the first ven-

tilation means 33 of the condensate collecting container 32.

[0022] This means that the pump has an integrated and basically self-sufficient cooling arrangement, by which also the cooling water quality is under constant control.

[0023] The vacuum sewer system according to the invention described above would be typical for a house with a small number of toilets units and washing arrangements. However, a corresponding system can also advantageously be employed in connection with other vacuum sewer systems, such as vacuum sewer systems on vehicles, in supermarkets, etc.

[0024] Thus, the sewage handled by a vacuum sewer system according to the invention may be grey water, such as water from wash basins, showers, condensate from air-conditioning and refrigeration systems, etc., or black water, such as sewage from toilet units, meat or fish treatment facilities, or the like.

[0025] The above description and the thereto related drawing are only intended to clarify the basic idea of the invention. The vacuum sewer system according to the invention may in detail vary within the scope of the ensuing claims.

Claims

1. Vacuum sewer system comprising a source of sewage (2,3), a first sewer pipe (4), a sewage receptacle (6), and means (30) for generating vacuum in the sewage receptacle and first sewer pipe, **characterised in that** the means for generating vacuum comprises a liquid ring pump (30), the liquid ring pump (30) is provided with an integrated water reservoir, and **in that** the air exhaust conduit (31) of said pump is provided with a water trap means (32), which is in fluid communication with the integrated water reservoir.
2. Vacuum sewer system according to claim 1, **characterised in that** the water trap means comprises a condensate collecting container (32) provided with a first ventilation means (33).
3. Vacuum sewer system according to claim 2, **characterised in that** the condensate collecting container (32) has a substantially elongated configuration and **in that** the condensate collecting container (32) is arranged in an inclined position.
4. Vacuum sewer system according to claim 3, **characterised in that** the angle (α) of inclination is in the range of about 30° to about 60°.
5. Vacuum sewer system according to claim 3 or 4, **characterised in that** the condensate collecting

container (32) is provided with drop separation means (34,35).

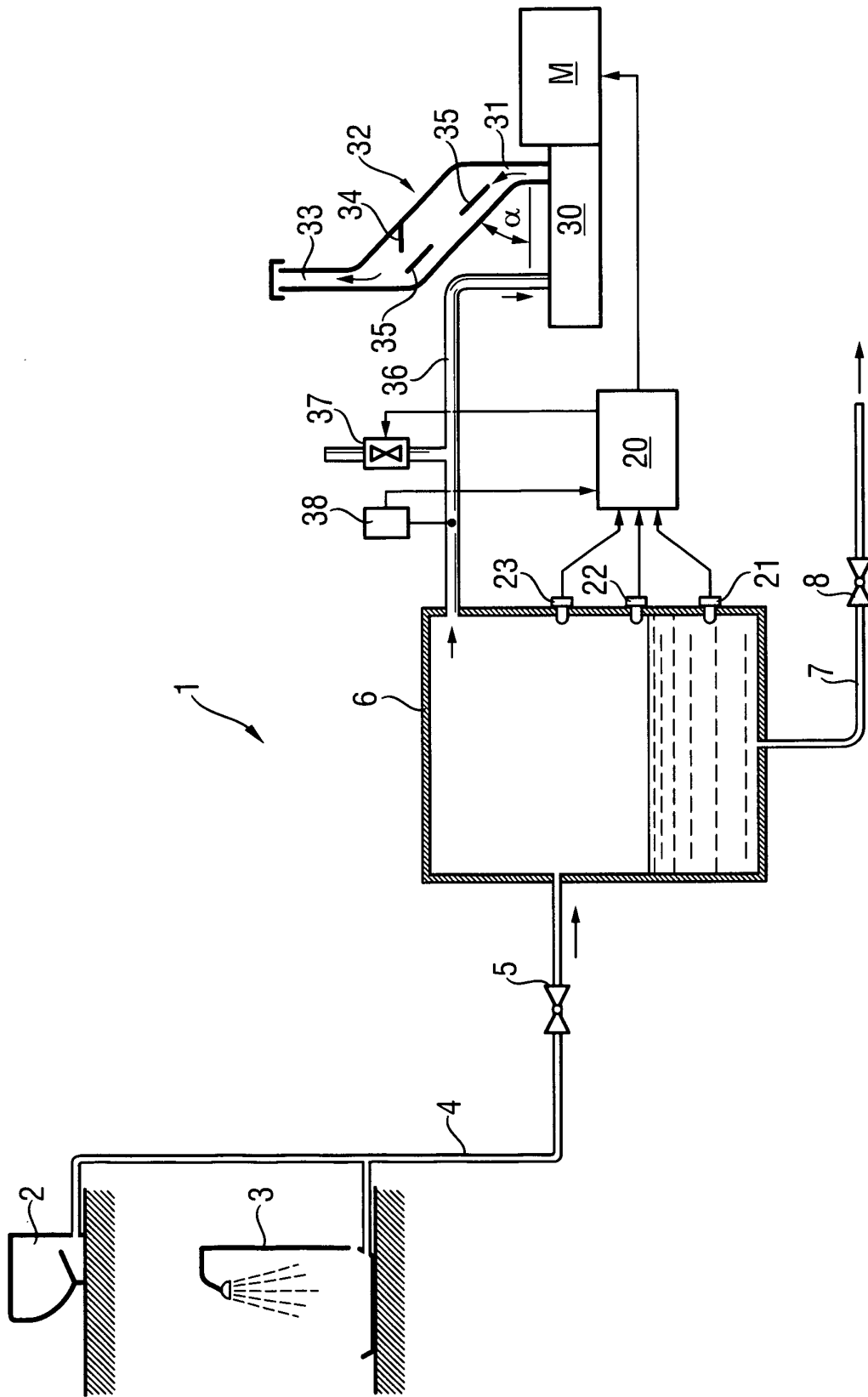
6. Vacuum sewer system according to claim 1, **characterised in that** a first valve means (5) is disposed between the source of sewage (2,3) and the sewage receptacle (6) and **in that** the sewage receptacle (6) is connected to a sewage discharge space through a second sewer pipe (7) provided with a second valve means (8). 5 10
7. Vacuum sewer system according to claim 6, **characterised in that** the first valve means (5) and the second valve means (8) comprise check valves. 15
8. Vacuum sewer system according to claim 1, **characterised in that** the liquid ring pump (30) is in fluid communication with the sewage receptacle (6) through a vacuum conduit (36) provided with a second ventilation means (37) and a pressure switch (38). 20
9. Vacuum sewer system according to claim 1, **characterised in that** the sewage receptacle (6) comprises an upper level sensor means (21), a lower level sensor means (22), and preferably also a high level sensor means (23). 25
10. Vacuum sewer system according to any of the preceding claims, **characterised in that** system is provided with a control center (20), to which the liquid ring pump drive motor (M), the ventilation means (37), the pressure switch (38) and the upper, lower and high level sensors (21,22,23) are connected. 30 35

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EUROPEAN SEARCH REPORT

Application Number
EP 02 01 4563

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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 9 September 2002	Examiner Flygare, E
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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