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Level-dependent pump control

The invention relates to a device having a liquid container with one or more pumps, a control device which switches one or more pumps on or off as a function of the level of the liquid in the container, and one or more sensors, connected to the control device, for sensing one or more liquid levels, in particular switch-on and switch-off levels of the pumps, and to a method for operating such devices or systems equipped therewith.

Such devices are used in wastewater lifting systems that have to convey water accumulating below the backflow level of a pipe system and are usually arranged in residential buildings. They are used primarily to convey faeces-containing wastewater that collects in the basements of such residential buildings. They are therefore often also referred to as sewage lifting systems.

A generic device is known from DE 199 13 530 A1. One or more pumps are switched on or off depending on the level of the liquid in a container. Sensor modules connected to the control device are used to detect the liquid levels and are arranged on the outer side of a container wall. Here, the evaluation of the sensor modules is fixed at one or more predefined liquid levels. A sensor module that is arranged on the surface of the collection container emits waves that are reflected by the surface of the liquid located in the collection container. The distance of the liquid level from the sensor module is calculated from the propagation time of the waves. Alternatively, sensor modules arranged at different heights on the side wall of the collection container are used. Large inflows create swirling in the container. The switch-off points have to be set accordingly high so that the pumps do not suck in any air. Usable volume is lost as a result.

EP 1 559 841 A2 discloses a wastewater collection well and a method for installation thereof and/or for operation thereof, in which a period of time between the detection of two different heights of the wastewater level is

measured by means of a time measuring device. Since the desired switch-off level of the pump is located outside the detection range of the sensor, the necessary pumping time of the pump is determined as a function of the measured period of time. The pumping time after which a certain predefined switch-off level of the pump is reached is calculated by means of a time multiplier on the basis of this period of time measured when the pump is switched on. An extrapolation of this type of the necessary pumping time of the pump is afflicted by uncertainties, and there is the risk that the liquid level will fall below the predefined switch-off level. Such a method cannot be used in applications with small container volumes, as are conventional in wastewater pump systems.

DE 101 32 084 A1 discloses a wastewater lifting system that is to have the greatest possible switching volume in the sense of an optimal mode of operation. Since the base area of the wastewater container and the highest possible switch-on level are generally predefined or limited by the dimensions of the system, a design with a very low switch-off level is provided. For this purpose a flexible, bendable pipe piece is fixed in a sealed manner via the first end thereof on the suction opening of the pump, and the second or free end of said pipe piece is located closer to the base of the wastewater container than the suction opening. The flexible, bendable material of the pipe piece has the disadvantage that, when liquids containing solid additions are conveyed during the pumping process, it folds on account of the negative pressure or a bending caused by solid materials, and this can lead to an obstruction of the suction opening.

EP 0 580 558 A1 presents a device for controlling lifting pumps in a drainage system comprising a pressure-actuated switch, which generates a control signal for the pumps in accordance with the liquid level in the system, and comprising a tight, flexible chamber, which contains a fluid and which is to be arranged below the level of the liquid to be lifted. By means of a temporally periodic, complete emptying of the pump tank, a periodic removal of the deposits formed in the tank is provided.

The invention thus addresses the problem of creating a device of the type mentioned in the introduction that provides a safer switch-off level for the pumps using less complex means, with better utilization of the available container volume, and under changing operating conditions.

In accordance with the solution to the problem, during operation the device adapts the switch-off level of at least one of the pumps as a function of the inflow quantity of the liquid which is to be held by the container. Due to the flexible adaptation of the switch-off levels of one or more pumps provided during operation, the device is suitable for changing operating conditions. The switch levels, also referred to hereinafter as switching points, are adapted as a function of conditions in a device according to the invention or in a system equipped with the device. These levels are shifted towards or away from the container base during operation as appropriate. A predefined, available container volume is thus better utilized. As an additional advantage, the same device or a system equipped with the device can be used for different applications.

In accordance with the invention the device adapts switch-off levels of the pumps as a function of the inflow quantity of the liquid to be held by the container. By taking into consideration the inflow quantity, i.e. the volume per unit of time, the device is also suitable for large inflow quantities. Here, it is possible that when there is a large inflow quantity the device raises the switch-off levels of the pumps and/or when there is a small inflow quantity the device lowers the switch-off levels of the pumps. Reliable operation of a device according to the invention or of a system equipped therewith is thus ensured, even when there is swirling in the container caused by the inflow and even when there are resultant inclusions of air in the conveyed liquid. Excessively large safety reserves in the design of the switch-off point of a pump must not be held available during operation phases or in applications in which small inflow quantities occur primarily. A device according to the invention, with its control device, is able during operation to lower the switch-off points of the pumps when there are small inflow quantities and to thus utilize the container volume

optimally. When there are large inflow quantities pre-set switch-off levels are maintained and/or the switch-off levels of the pumps are raised. The control device and/or algorithms stored therein can be parameterized accordingly for this purpose.

The device is able to determine the throughflow of the inflowing liquid. This is performed continuously during operation of the device, the throughflow being determined continuously, at previously definable intervals, or with certain events.

It has proven to be expedient that the device determines the inflow quantity by measuring the rise time of the liquid level between at least two measuring levels. The inflow quantity is calculated as inflow volume per unit of time by the rise time measured in a time measuring device of the control device and by the known container volume. The switch-off points are adapted as a function of the determined inflow quantity.

Ideally, a switch-on level of a pump is selected as a first measuring level, and a second measuring level is arranged below it. The inflow quantity is advantageously determined when the pumps are stationary and before each switching on of a pump. The inflow quantity is thus determined with rising liquid level immediately before a pumping process, whereby the conditions before a pumping process can be used promptly for a direct adaptation of the switching levels.

The control device is able to select the switch-off levels of the pumps from a plurality of different switching levels as a function of the inflow quantity. It is advantageous when the switching levels and/or measuring levels are provided by means of sensors with one or more individual switching positions. A control device can thus use the appropriate sensor for evaluation as a function of the inflow quantity and in accordance with the desired switch-off level and can determine a switching condition on the basis of the switching signals of said

sensor. Here, different level sensors having different measurement principles are suitable as sensors. The sensors can be arranged in the container or outside the container.

Alternatively, the control device is connected to a sensor for sensing a plurality of liquid levels. Such a sensor enables the sensing of individual or all necessary levels, i.e. switch-on levels of the pumps, levels for measuring the rise time of the liquid in the container, and all switch-off levels of the pumps. Besides a lower connection effort, such a solution allows a more flexible and finer gradation of switching levels and/or measuring levels.

Here, the use of a sensor with a continuous output signal has proven its worth. This sensor can sense the liquid level in the container continuously and can provide this to the control device by an output signal corresponding to the liquid level. This is a standardized, industrial-suited output signal where appropriate. This means that a raising and/or a lowering of switch-off levels and also a fixing of the measuring levels or measuring points for measuring the rise time can be implemented continuously.

Here, the control device forms simply one or more switching levels and/or measuring levels. The limit values of individual and/or all switching levels and/or measuring levels are defined in the control device. For this purpose switching levels and/or measuring levels are stored and/or can be configured in the control device and are used depending on the system condition. An assignment can be made by means of a stored table. By way of example, different alternative switch-off levels are thus stored in a table as a function of the inflow quantity. The desired switching levels can be determined just as well by means of stored formulas. The measured values sensed by the sensor and transmitted in the form of a sensor output signal are monitored continuously in the control device for an overshoot or undershoot in order to control the necessary switching on and off of the pumps and also in order to identify the start and stop level of measurements.

Alternatively, the inflow quantity is measured by a measuring device which is arranged at the inflow pipe. The inflow quantity can be measured continuously by such a measuring device. It has proven to be advantageous to take the measurement of the inflow quantity at any time and independently of any pumping processes of the pumps already taking place. A continuous consideration of the inflow quantity leads to an even more exact adaptability of the switch-off levels to the current conditions. By way of example, ultrasonic measuring devices or magnetically inductive flowmeters are suitable as measuring devices arranged at the inflow pipe.

Sensors having different measurement principles are suitable as sensors for sensing the liquid level, the measuring signals of said sensors forming the basis of conclusions regarding the container level. The invention is not fixed to a specific measurement principle. By way of example, a sensing of the liquid level is possible by means of a hydrostatic pressure measurement, an ultrasonic measurement, by means of optical or capacitive principles, or by means of guided microwave. The sensors can be arranged wholly or partially in the container. The liquid level can also be measured by one or more sensors arranged outside on the container. A measurement of the liquid level by a float arranged in the container, the lifting movement of said float being converted into an output signal which corresponds to the liquid level, has also proven its worth. Such level sensors, in which a floating body performs a detectable stroke depending on the liquid level in the container, additionally constitute an economical solution.

The device according to the invention advantageously has means for detecting unacceptably large inflow quantities and/or means for generating alarms.

In accordance with a method for operating a device according to the invention or a system which is equipped therewith the switch-off level of at least one of the pumps is adapted during operation. This is implemented as a function of the inflow quantity of the liquid to be held by the container.

When there is a large inflow quantity switch-off levels of the pumps are raised, and/or when there is a small inflow quantity switch-off levels of the pumps are lowered.

It has proven to be expedient that the throughflow of the inflowing liquid is determined. The inflow quantity is advantageously determined by measuring the rise time of the liquid level between at least two measuring levels.

Here it is advantageous when a switch-on point of a pump is selected as a first measuring level, and a second measuring level is arranged below it. The inflow quantity is calculated as inflow volume per unit of time by the rise time measured in a time measuring device of the control device and by the known container volume. The switch-off points are adapted depending on the currently determined inflow quantity.

Here, an adaptation of the switching points on the basis of a previous measurement may lead to a complete and greatest possible adaptation of the switching points already for the next pumping process, which leads to a quick availability of the optimal container volume. A number of previous measurements, weighted accordingly, are also included in the adaptation of the switching points, and for example only a sustained trend towards lower inflow quantities causes a lowering of the switch-off points, or a trend towards greater inflow quantities is identified and a corresponding reaction is only then initiated.

An advantageous method allows the inflow quantity to be determined when the pumps are stationary and before each switching on of a pump. The switch-off levels of the pumps are selected from a plurality of different switching levels as a function of the inflow quantity.

Here, it is advantageous when the switching levels and/or measuring levels are provided by sensors with one or more individual switching positions.

In addition, it is proposed that a plurality of liquid levels are sensed by a sensor which is connected to a control device. A method in which a sensor with a continuous output signal is used has proven its worth.

A method in accordance with which one or more switching levels and/or measuring levels are formed by the control device is particularly flexible. The limit values of individual to all necessary levels can thus be defined depending on the system and operating conditions.

An alternative method uses a measuring device arranged at the inflow pipe to measure the inflow quantity.

The liquid level can be measured by one or more sensors arranged on the outside of the container and/or by a float which is arranged in the container and the lifting movement of which is converted into an output signal which corresponds to the liquid level.

In applications for which a monitoring is provided, a method in accordance with which unacceptably large inflow quantities are detected and/or alarms are generated has proven its worth. Additional monitoring and diagnosis functions, such as pump propagation time monitoring, are provided.

The device according to the invention is recommended for lifting systems, in particular for liquids containing solid additions, i.e. for example for wastewater lifting systems.

It is indeed known in principle from DE 39 18 294 A1 to determine a container inflow by measuring the filling period during a stationary period of a pump. For this purpose a method for monitoring the functioning and the output of a wastewater pumping station is disclosed, wherein a monitoring device continuously monitors the pump output values and compares the values at a

certain, predefined moment in time to measured reference values. The determination of the container inflow is used in this instance only for a determination of the throughput of the pump taking into consideration the container inflow. The current pump values are compared with those values of a new pump, and a value deterioration is an indicator for pump wear. An adaptation of the switch-off points as a function of the measured inflow quantity is not provided.

Exemplary embodiments of the invention are presented in the drawings and will be described in greater detail hereinafter. In the drawings:

Figure 1 shows a conventional structural arrangement of a lifting system for polluted liquids,

Figure 2 shows a lifting system according to the prior art,

Figure 3 shows a lifting system that is equipped with a device according to the invention and that is operated using a method according to the invention, and

Figure 4 shows a further system, which is equipped with an alternative device likewise corresponding to the invention and is suitable for operation with a method according to the invention.

The system illustrated in Figure 1 is arranged below the backflow level 1, which is indicated here by a triangle. The system comprises a liquid or collection container 2, which is connected to a wastewater line 3, and a conveying line 4, which opens out into a wastewater channel 5. A centrifugal pump (not illustrated) is arranged in the collection container 2 and conveys the faeces-containing and faeces-free wastewater flowing from the wastewater line 3 into the wastewater channel 5 via a check valve 6.

Figure 2 shows a lifting system according to the prior art. This is equipped with a centrifugal pump 7, of which the electric motor 8 is provided with a control device 9. The centrifugal pump 7 with electric motor 8 can be switched on and off by the control device 9. The centrifugal pump 7 is arranged upstream of a check valve 10. The lifting system has a collection container 11 with an inflow pipe 12, through which liquid can flow into the container. A float switch 13 is provided in the collection container 11 and responds to three different previously set liquid levels: with a minimum liquid level it gives the signal to stop pumping operation "Pump OFF", with a normal maximum water level it gives the signal to start pumping operation "Pump ON", and with a water level exceeding the maximum water level it signals "High water ALARM". The position of the minimum liquid level "Pump OFF" must take into consideration all inflow conditions and offer an accordingly high safety reserve, in order to prevent the centrifugal pump 7 from sucking in air and no longer conveying liquid.

With the operation of the lifting system, liquid flows through the flow pipe 12 into the collection container 11. With an accordingly high liquid level in the collection container 11, the control device 9 receives the command "Pumping operation ON" from the float switch 13 by means of a switching signal. The centrifugal pump 7 is now switched on by the control device 9. Consequently, the liquid level in the collection container 11 falls. As soon as the minimum liquid level is reached, the centrifugal pump 7 is switched off.

Figure 3 shows a lifting system that is equipped with a device according to the invention. This lifting system also has a centrifugal pump 14 with electric motor 15, and also a collection container 16 and an inflow pipe 17. The centrifugal pump 14 can be switched on or off by a programmable control device 18 connected to the electric motor 15. The control device 18 is equipped with a time measuring device 19 and a memory device 20. The control device 18 is provided with a display and/or operating means, which are not illustrated here. A plurality of sensors 21, 22, 23 and 24 are arranged on the collection container 16 at different heights externally on the container wall, in each case for detection of a

liquid level. The sensors 21, 22, 23 and 24 are connected to the control device 18. Compared with the lifting system known from Figure 2, a plurality of switch-off levels, here two, are now provided for the centrifugal pump 14 and are designated by "Pump OFF 1" and by "Pump OFF 2". The sensor 22 detects the liquid level "Pump OFF 2" and the sensor 21 arranged therebelow detects the liquid level "Pump OFF 1". The sensors 23 and 24 detect a measurement level "Measurement START" and a measurement level "Measurement END" respectively for measuring a rise time of the liquid level in the collection container 16. The sensor 24 is used at the same time to measure a liquid level "Pump ON", i.e. the switch-on level of the centrifugal pump 14, which in this exemplary embodiment coincides with the liquid level "Measurement END". However, other positions of the selected measurement levels are also possible.

During operation of the lifting system equipped with the device according to the invention, liquid flows through the inflow pipe 17 into the container 16. If the pump 14 is switched off, a liquid level in the container 16 rises. As soon as the liquid level "Measurement START" is reached, the measurement of the rise time of the liquid level in the container 16 is started in the control device 18 using the time measuring device 19. As soon as the liquid level "Measurement END" is reached, the measurement of the rise time is concluded. The inflow quantity can be determined as inflow volume per unit of time from the rise time and the known container volume. As soon as the liquid level "Pump on" is reached, the centrifugal pump 14 is switched on by the control device 18. The pumping process causes the liquid level in the container 16 to fall. The pumping process is continued as far as the liquid level "Pump OFF 2" or as far as the level "Pump OFF 1" depending on the determined inflow quantity. The control device 18 in this case selects the switch-off level of the pump from the various switching levels as a function of the inflow quantity. If the inflow quantities are not so great, the switch-off level will correspond to the liquid level "Pump OFF 1". If the inflow quantities are high, a greater safety reserve in relation to the container base is necessary so that swirling created in the container and associated inclusions of air do not lead to a suction of air at the centrifugal pump 14. The

control device 18 can use the appropriate sensor 21 or 22 for evaluation as a function of the inflow quantity and in accordance with the desired switch-off level, and, on the basis of the switching signal of said sensor, can determine a switching condition whereupon the centrifugal pump 14 is switched off.

By means of such operation in accordance with the method according to the invention, a reliable operation of the device and of the lifting system equipped therewith is ensured also with inflow-induced swirling in the container 16 and resultant inclusions of air in the conveyed liquid.

Alternatively, the inflow quantity is measured by a measuring device (not illustrated here) arranged at the inflow pipe 17. The flow quantity can be measured continuously by a measuring device of this type, for example an ultrasonic flowmeter or a magnetically inductive flowmeter. The inflow quantity can therefore be measured at any moment and independently of any pumping processes of the pump 14 currently taking place. A continuous consideration of the flow quantity leads to an even more exact adaptability of the switch-off levels to the current conditions.

Figure 4 shows a further system, which is equipped with an alternative device likewise corresponding to the invention. Here, a control device 18 is connected to just one level sensor 25 for sensing the liquid level. The sensor 25 is able to detect a plurality of different liquid levels in the collection container 16. The sensor 25 thus enables the sensing of all necessary levels for controlling the centrifugal pump 14. The illustration shows a switch-on level of the pump 14 “Pump ON”, a plurality of different switch-off levels “Pump OFF 1”, “Pump OFF 2”, “Pump OFF 3” and “Pump OFF 4” and also two measurement levels “Measurement END” and “Measurement START” for measuring a rise time of the liquid level in the container 16. The level sensor 25 consists of a float 26, of which the lifting movement (caused by a change in the liquid level in the container 16) causes a shaft 28 to rotate via a rod 27, and also consists of a sensor electronics unit 29, which converts the rotary movement of the shaft 28

into an output signal. This can be implemented for example by means of a potentiometer connected to the shaft 28. The sensor electronics unit 29 is connected to the control device 18 and provides this with an output signal, which is standardized where necessary.

During operation liquid flows through the inflow pipe 17 into the collection container 16, whereupon, if the centrifugal pump 14 is switched off, the liquid level in the collection container 16 rises. The measured values sensed by the level sensor 25 and transmitted in the form of a sensor output signal to the control device 18 are monitored continuously in the control device 18 for an overshoot or undershoot of certain, predefinable limit values in order to control the necessary switch on and switch-off actions of the centrifugal pump 14 and also in order to identify start and stop levels of a rise time measurement. As soon as the liquid level has reached "Measurement START", the measurement of the rise time of the level in the container 16 is started in the control device 18 using the time measuring device 19. As soon as the liquid level has reached "Measurement END", the measurement of the rise time is concluded. Since, in the shown exemplary embodiment, the liquid level "Pump ON" is reached at the same time, the centrifugal pump 14 is switched on by the control device 18. The pumping process then causes the liquid level in the collection container 16 to fall. The control device decides, as a function of the determined inflow quantity, which of the predefined switch-off levels "Pump OFF 1" to "Pump OFF 4" is relevant, the centrifugal pump 14 being switched off once the liquid level reaches or falls below this level.

Besides a lower connection effort, the presented solution allows a more flexible and finer gradation of switching levels and/or measuring levels. A raising and/or a lowering of switch-off levels or also a fixing of measurement levels for measuring the rise time can be implemented by a plurality of individual specific liquid levels (as presented here for the sake of clarity), but can also be implemented continuously using a level sensor of this type. The control device 18, specifically with its algorithms, is able to form any switching levels and/or

measuring levels. Here, the limit values of individual and/or all switching and/or measuring levels are defined in the control device 18. For this purpose different switching levels and/or measuring levels are stored and/or can be configured in the control device 18 and memory device 20 thereof and are used depending on the system condition. An assignment can be made by means of a stored table, wherein, by way of example, different alternative switch-off levels are stored in a table as a function of the inflow quantity. Stored formulas can also be used to determine the desired switching levels in another way. A switch-off level is provided particularly easily as a function of the measured rise time. For this purpose a polynomial is stored ex works in the control device 18 in the memory device 20 and, during operation of the device according to the invention, allows a determination of a switch-off level by means of the stored formula correlation or polynomial. A long measured rise time leads to a relatively lower switch-off level located closer to the container base, and a short rise time leads to a relatively higher switch-off level. A "High water ALARM" can also be provided with the level sensor 25. In addition, combinations with sensors having one or more individual switching positions are provided.

Sensors having other measurement principles, such as other float sensors, hydrostatic pressure sensors, ultrasonic sensors, or optical, capacitive or microwave sensors, are also suitable as sensors for sensing the liquid level. If the centrifugal pump 14 is connected to a frequency converter for speed regulation, the control device 18 can be integrated therein.

The devices and methods described in Figure 3 and Figure 4 can also be used with containers in which more than one centrifugal pump is arranged. Here, the switch-off level is adapted for just one pump, for a number of pumps, or for all pumps.

P A T E N T K R A V

1. Indretning med en væskebeholder (16) med en eller flere pumper (14), en styreindretning (18), som til- eller frakobler en eller flere pumper (14) afhængig af højden af væskestanden i beholderen (16), og en eller flere sensorer (21, 22, 23, 24, 25) forbundet med styreindretningen (18) til registrering af et eller flere væskeniveauer, navnlig pumpernes (14) tilkoblings- og frakoblingsniveauer, k e n d e t e g n e t v e d , at indretningen under drift tilpasser mindst en af pumpernes (14) frakoblingsniveau afhængig af tilløbsmængden af væsken, der skal rummes af beholderen (16).

2. Indretning ifølge krav 1, k e n d e t e g n e t v e d , at indretningen ved større tilløbsmængder hæver pumpernes (14) frakoblingsniveau og/eller ved mindre tilløbsmængder sænker pumpernes (14) frakoblingsniveau.

3. Indretning ifølge krav 1 eller 2, k e n d e t e g n e t v e d , at indretningen fastslår gennemstrømningen af den tilløbende væske.

4. Indretning ifølge krav 3, k e n d e t e g n e t v e d , at indretningen fastslår tilløbsmængden ved måling af væskeniveauets stigningstid mellem i det mindste to måleniveauer.

5. Indretning ifølge krav 4, k e n d e t e g n e t v e d , at der som første måleniveau er valgt en pumpes (14) tilkoblingsniveau, og et andet måleniveau er arrangeret derunder.

6. Indretning ifølge et af kravene 3 til 5, k e n d e t e g n e t v e d , at fastslåelsen af tilløbsmængden sker ved stilstand af pumperne (14) og før hver tilkobling af en pumpe (14).

7. Indretning ifølge et af kravene 1 til 6, k e n d e t e g n e t v e d , at styreindretningen (18) afhængig af tilløbsmængden udvælger pumpernes (14) frakoblingsniveauer blandt flere forskellige koblingsniveauer.

8. Indretning ifølge et af kravene 1 til 7, k e n d e t e g n e t v e d , at koblings- og/eller måleniveauerne ved hjælp af sensorer (21, 22, 23, 24) er givet ved en eller flere individuelle koblingspositioner.

9. Indretning ifølge et af kravene 1 til 8, k e n d e t e g n e t v e d , at styreindretningen (18) er forbundet med en sensor (25) til registrering af flere væskeniveauer.

10. Indretning ifølge krav 9, k e n d e t e g n e t v e d en sensor (25) med kontinuerligt udgangssignal.

11. Indretning ifølge krav 9 eller 10, k e n d e t e g n e t v e d , at styreindretningen (18) danner et eller flere koblings- og/eller måleniveauer.

12. Indretning ifølge et af kravene 1 til 11, k e n d e t e g n e t v e d , at målingen af tilløbsmængden sker ved et måleapparat arrangeret på tilløbsrøret (17).

13. Indretning ifølge et af kravene 1 til 12, k e n d e t e g n e t v e d , at målingen af væskeniveauet sker ved en eller flere sensorer (21, 22, 23, 24) arrangeret uden på beholderen (16).

14. Indretning ifølge et af kravene 1 til 13, k e n d e t e g n e t v e d , at målingen af væskeniveauet sker ved en svømmer (26) arrangeret i beholderen (16), hvilken svøm-

mers løftebevægelse omdannes til et udgangssignal, der svarer til væskeniveauet.

15. Indretning ifølge et af kravene 1 til 14, k e n d e t e g n e t v e d et middel til identifikation af utilladeligt store tilløbsmængder og/eller et middel til frembringelse af alarmer.

16. Fremgangsmåde, navnlig til drift af en indretning ifølge et af kravene 1 til 15 eller et dermed udstyret anlæg, hvor en eller flere pumper (14) til- eller frakobles afhængig af højden af væskestanden i en væskebeholder (16), og et eller flere væskeniveauer, navnlig pumpernes (14) tilkoblings- og frakoblingsniveauer, registreres af en eller flere sensorer (21, 22, 23, 24, 25) forbundet med en styreindretning (18), k e n d e t e g n e t v e d , at under drift tilpasses mindst en af pumpernes (14) frakoblingsniveau afhængig af tilløbsmængden af væsken, der skal rummes af beholderen (16).

17. Fremgangsmåde ifølge krav 16, k e n d e t e g n e t v e d , at ved større tilløbsmængder hæves pumpernes (14) frakoblingsniveau, og/eller ved mindre tilløbsmængder sænkes pumpernes (14) frakoblingsniveau.

18. Fremgangsmåde ifølge krav 16 eller 17, k e n d e t e g n e t v e d , at gennemstrømningen af den tilløbende væske fastslås.

19. Fremgangsmåde ifølge krav 18, k e n d e t e g n e t v e d , at tilløbsmængden fastslås ved måling af væskeniveauets stigningstid mellem i det mindste to måleniveauer.

20. Fremgangsmåde ifølge krav 19, k e n d e t e g n e t v e d , at der som første måleniveau vælges en pumpes (22) tilkoblingspunkt, og et andet måleniveau arrangeres derunder.

21. Fremgangsmåde ifølge et af kravene 18 til 20, k e n d e t e g n e t v e d , at fastslåelsen af tilløbsmængden sker ved stilstand af pumperne (14) og før hver tilkobling af en pumpe (14).

22. Fremgangsmåde ifølge et af kravene 16 til 21, k e n d e t e g n e t v e d , at afhængig af tilløbsmængden udvælges pumpernes (14) frakoblingsniveauer blandt flere forskellige koblingsniveauer.

23. Fremgangsmåde ifølge et af kravene 16 til 22, k e n d e t e g n e t v e d , at koblings- og/eller måleniveauerne ved hjælp af sensorer (21, 22, 23, 24) er givet ved en eller flere individuelle koblingspositioner.

24. Fremgangsmåde ifølge et af kravene 16 til 23, k e n d e t e g n e t v e d , at flere væskeniveauer registreres med en sensor (25) forbundet med en styreindretning (18).

25. Fremgangsmåde ifølge krav 24, k e n d e t e g n e t v e d , at der anvendes en sensor (25) med kontinuerligt udgangssignal.

26. Fremgangsmåde ifølge krav 24 eller 25, k e n d e t e g n e t v e d , at der med styreindretningen (18) dannes et eller flere koblings- og/eller måleniveauer.

27. Fremgangsmåde ifølge et af kravene 16 til 26, k e n d e t e g n e t v e d , at målingen af tilløbsmængden sker med et måleapparat arrangeret på tilløbsrøret (17).

28. Fremgangsmåde ifølge et af kravene 16 til 27, k e n d e t e g n e t v e d , at målingen af væskeniveauet sker med en eller flere sensorer (21, 22, 23, 24) arrangeret

uden på beholderen (16).

29. Fremgangsmåde ifølge et af kravene 16 til 28, k e n d e t e g n e t v e d , at målingen af væskeniveauet sker med en svømmer (26) arrangeret i beholderen (16), hvilken svømmers løftebevægelse omdannes til et udgangssignal, der svarer til væskeniveauet.

30. Fremgangsmåde ifølge et af kravene 16 til 29, k e n d e t e g n e t v e d , at utilladeligt store tilløbsmængder identificeres og/eller alarmer frembringes.

31. Anvendelse af en indretning ifølge et af kravene 1 til 15 til et løfteanlæg.

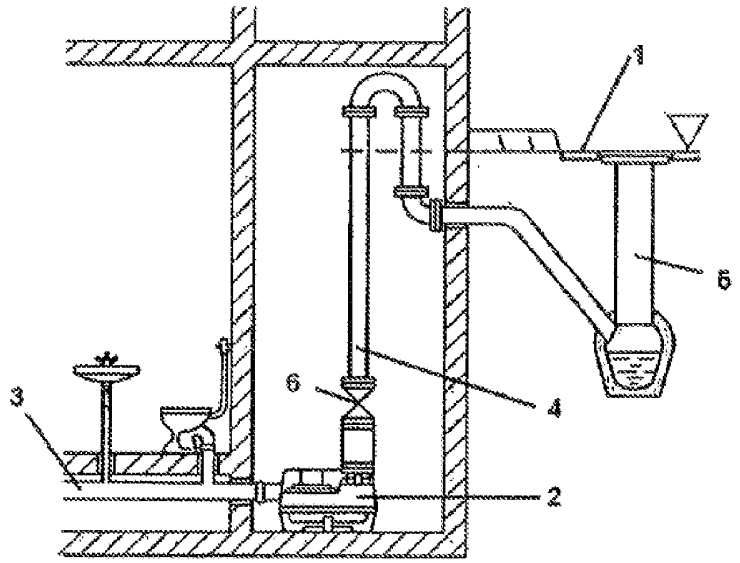
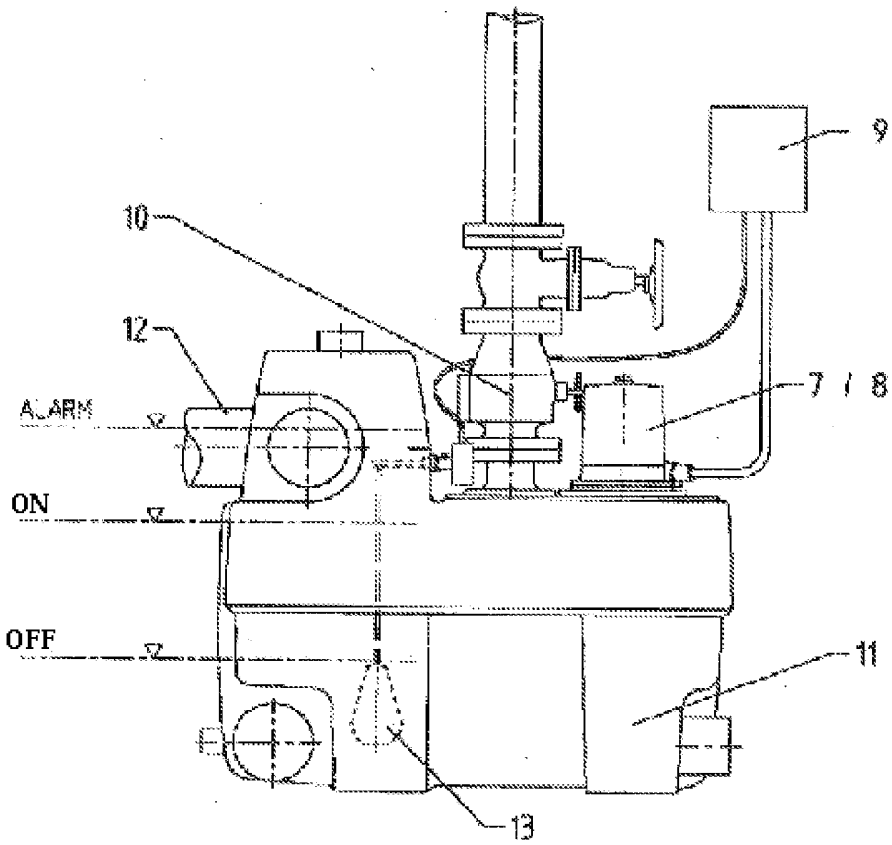



Fig. 1




Prior art

Fig. 2

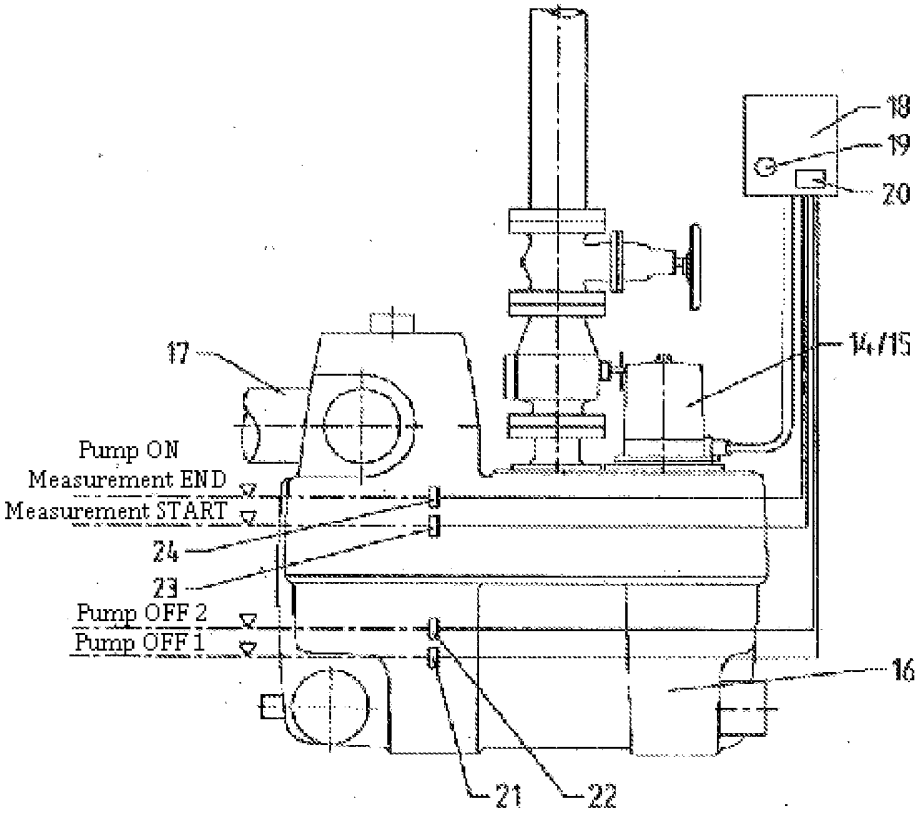

18
19
20
17
14/15
Pump ON
Measurement END
Measurement START
24
23
Pump OFF 2
Pump OFF 1
16
21
22

Fig. 3

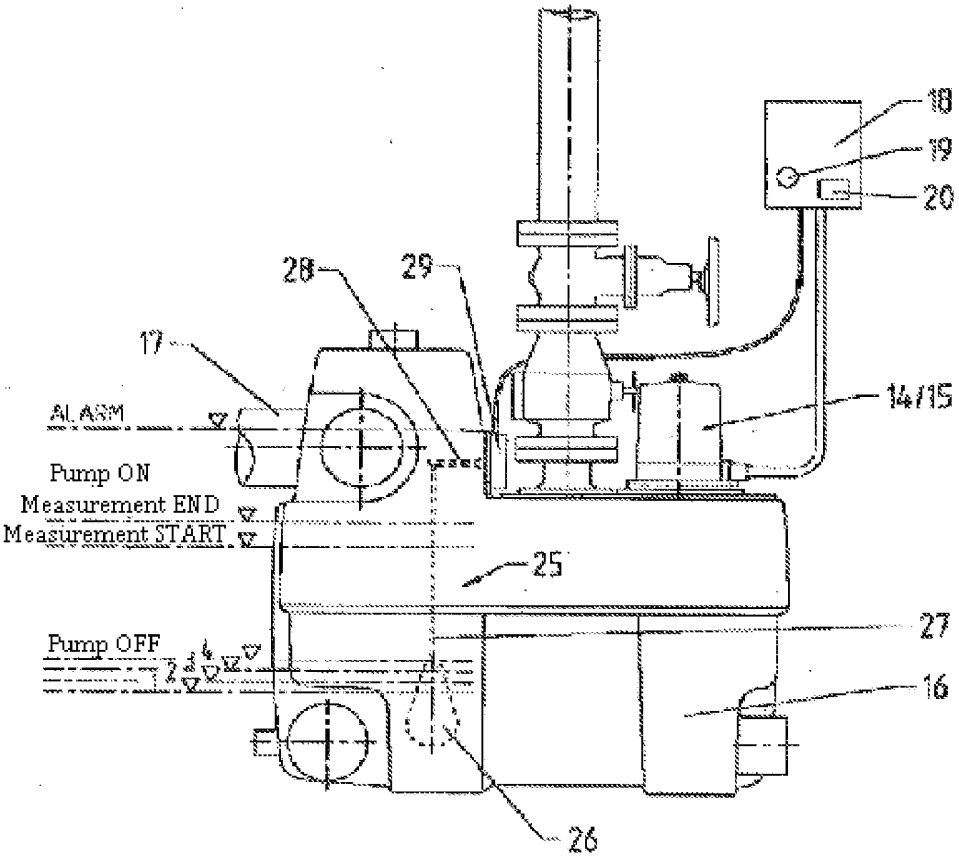

18
19
20
28
29
17
14/15
ALARM
Pump ON
Measurement END
Measurement START
25
27
Pump OFF
16
26

Fig. 4