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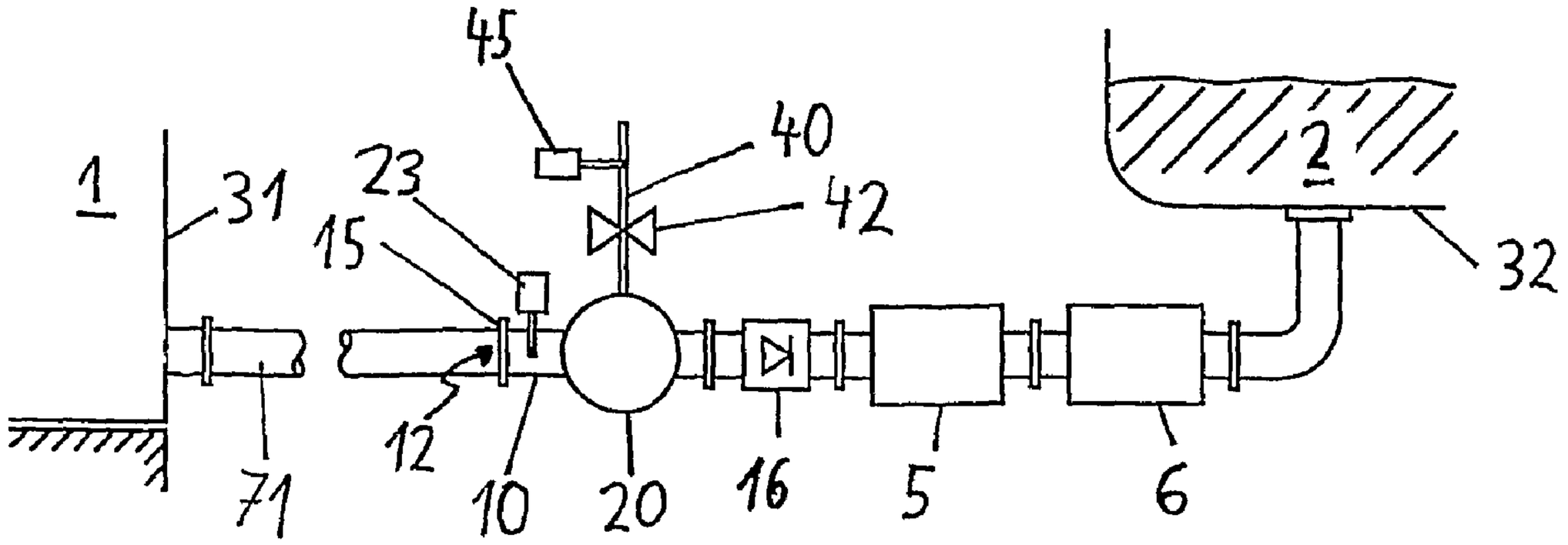
(54) Titre : PROCEDE DE REFOULEMENT ET DE DETECTION DE LA QUANTITE REFOULEE D'UN LIQUIDE ET DISPOSITIF DE DETECTION DE QUANTITE LORS DE LA RECEPTION ET / OU DU PRELEVEMENT D'UN LIQUIDE

(54) Title: METHOD FOR TRANSPORTING AND DETECTING A TRANSPORTED QUANTITY OF A LIQUID CONTAINING GAS AND CORRESPONDING DEVICE



(57) Abrégé/Abstract:
The invention relates to a method for detecting the quantity of transported gas-containing liquid consisting in transferring said gas-containing liquid through a conduit from a first pick-up position to a second pick-up position and in measuring a flow rate and a filling degree in said conduit. A device for detecting quantity during a liquid reception and/or delivering is also disclosed.

ABSTRACT

The invention relates to a method for the delivery and delivery quantity determination of a liquid having a gas component, in which the liquid together with the gas component is transferred via a pipe from a first provision location to a second provision location and both a flow measurement and a filling degree measurement is performed in the pipe. The invention also relates to an apparatus for quantity determination during the acceptance and/or discharge of a liquid.

METHOD FOR TRANSPORTING AND DETECTING A TRANSPORTED QUANTITY OF A LIQUID CONTAINING GAS AND CORRESPONDING DEVICE

The invention relates to a method for the delivery of a liquid having a gas component from a first provision location to a second provision location and for delivery quantity determination. The invention also relates to an apparatus for determining the quantity during acceptance and/or discharge of a liquid.

During the acceptance and discharge of liquid substances, particularly from a stationary tank into a mobile tank or vice versa, normally a volume measurement is necessary in the handling of goods requiring mandatory verification. The volume of the flowing product can e.g. be established from a measurement of the flow and its integration over time. However, it can be problematic in said measurement that the flowing product, e.g. milk, wine or heating oil, particularly at the start and/or finish of acceptance or discharge, but also on changing from one tank to another, can be infiltrated to a greater or lesser extent by air or optionally with some other gas. This gas content can lead to a measurement error, if the gas during the flow measurement is measured as a liquid.

The problem of the gas content can in particular occur during measurements on milk tankers and/or heating oil tankers.

In order to reduce faulty measurements as a result of the gas content, it is known to use so-called gas separators or gas measurement preventers. Such devices are e.g. known from the article "Gasabscheidende Einrichtungen" by H.-H. Oelze, published in the report of the Physikalisch-Technische Bundesanstalt "Volumen- und Massenmessungen von Flüssigkeiten", M. Zander (publisher), ISBN 3-88314-741-9, December 1987.

Gas measurement preventers and gas separators are generally complex mechanical structures. They are frequently comparatively heavy, so that the maximum service load of a mobile tank can be reduced. In addition, both their prime costs and their operating costs are comparatively high, particularly since as a rule a comparatively high cleaning expenditure is required. In addition, they can also limit the acceptance and/or discharge

speed, because the degassing of the product cannot be performed in a randomly short time.

It is known from DE 197 10 296 C1 to split up the delivery flow into a main flow and a secondary flow and free the secondary flow of air admixtures by means of a separating device. Through ultrasonic transit time measurements both in the main and secondary flows, conclusions are drawn regarding the gas component in the main flow. The method of DE 197 10 296 C1 is comparatively costly as a result of its flow guidance and the necessary double measurement. Moreover, for the secondary flow, it is still necessary to have a complicated and heavy gas separator.

WO 98/11429 discloses a method and an apparatus making it possible to optimize the acceptance capacity of a measuring installation for milk when using known air separation systems. This document teaches, e.g. through transit time measurement, the determination of the air content of the milk flow and the control of the acceptance capacity as a function of the air content found. It is assumed that a significant air content generally only arises at the start and finish of milk acceptance, whereas in the intermediate main flow there is no significant air content and therefore no reduction of the acceptance capacity is needed. In the case of small supply quantities, where the start and finish of milk acceptance directly follow one another, the aforementioned method is, however, only suitable to a limited extent, because it is then necessary to operate virtually continuously with a reduced acceptance capacity. Since, in addition, a gas content can also be present during the main flow, e.g. in the case of leaky connecting elements, particularly hose couplings, in the aforementioned method undesired time losses can arise even with large delivery quantities.

DE 198 39 112 A1, DE 100 17 379 A1 and DE 100 46 921 C1 disclose dip or gauge stick methods with which the problem of faulty measurements in the case of a gas content can be avoided. However, since every tank to be filled or emptied must generally have at least one individual gauge stick measuring device and since as a rule each tank must be calibrated with respect to its volume by an official gauging litre content measurement, the aforementioned gauge stick measuring methods can prove comparatively costly.

WO 93/12413, US 5,503,026, DE 93 16 008 U1 and DE 101 56 450 A1 disclose methods and apparatuses for determining a liquid volume flow.

US 4,456,149 discloses a system for delivering a liquid using a pump. A pressure sensor is provided for establishing whether air is present on the high pressure side of the pump, in which case the pump is stopped.

The **object** of the invention is to provide a method for the delivery and delivery quantity determination of a liquid having a gas component from a first provision location to a second provision location, as well as an apparatus for quantity determination during the acceptance and/or discharge of a liquid, which in the case of high measurement accuracy permit a particularly simple, rapid and economic liquid transfer.

According to the invention the object is achieved by a method having the features of claim 1 and an apparatus having the features of claim 11. Preferred embodiments are given in the in each case dependent claims.

A first aspect of the invention is based on a method for the delivery and delivery quantity determination of a liquid having a gas component, particularly milk or fuel, from a first provision location to a second provision location, in which the liquid with the gas component is transferred from the first provision location into a pipe, the liquid with the gas component is passed through the pipe, in the pipe a filling degree measurement is performed, in the pipe a flow measurement is performed, the liquid together with the gas component contained therein is transferred from the pipe into the second provision location and the results of the flow measurement are entered into a calculation with those results of the filling degree measurement for determining the delivery quantity.

It might be regarded as a fundamental idea of the invention that gas bubbles which are located in the medium to be conveyed and measured, are not separated or discharged, but instead determined by measurement and are calculated in during delivery quantity determination. For this purpose a filling degree measurement is provided with which the gas content, particularly the gas bubble content of the liquid in the pipe can be established.

Thus, advantageously, there is no gas separation on liquid transfer between the two provision locations. Correspondingly there is no need for the hitherto standard air separator or gas measurement preventer. This reduces costs, particularly as a result of reduced maintenance costs, whilst there is also a reduction in the weight of the apparatus used for performing the method. Particularly in the case of mobile apparatuses this weight reduction can lead to an increase in the service load. Moreover, in the case of the method according to the invention, when compared with the known methods using

gas separators, there is a reduction of the flow resistance in the pipe, which leads to an increase in the suction/pumping rate or a reduction of the pumping costs. In addition, the invention makes it possible to simplify the tubing and leads to a particularly easy cleaning of the apparatus, particularly using a cleaning-in-place (CIP) method. The apparatus used for the method can, according to the invention, be designed in a particularly manipulation-proof manner. Finally the inventive method also leads to a comparatively high measurement accuracy. In tests it was possible to achieve a relative error, i.e. a gauging accuracy, of approximately 0.3% or better when determining the delivery quantity. The method and apparatus according to the invention are fundamentally suitable for random delivery quantities, but more particularly also for large delivery quantities.

The term filling degree can e.g. be understood to mean the liquid content and/or liquid level in the pipe, but also the gas content, particularly the undissolved gas content, in the liquid. For filling degree measurement a filling degree measuring device can be provided on the pipe and which can in particular be constructed as a bubble detector. The filling degree measuring device can preferably be constructed as a conductivity sensor, capacitive sensor and/or optical sensor. The filling degree measurement can consequently more particularly be a conductivity measurement, a capacitive measurement and/or an optical measurement of the filling degree. A conductivity measurement is particularly suitable in the case of conductive liquids, such as e.g. milk, whereas a capacitive or optical measurement is particularly preferred for non-conductive liquids, such as e.g. heating oil.

During the flow measurement it is particularly possible to measure a volume flow and/or a mass flow through the pipe. Appropriately a flow measuring device is used for the flow measurement. This flow measuring device can e.g. be a volume meter, particularly a volumetric meter, i.e. can be constructed as a directly measuring volume meter, and/or a flowmeter, i.e. can be constructed as an indirectly measuring volume meter. In particular, it is possible to provide a displacement meter, a discharge meter, hydrometric vanes, a head meter and/or a Coriolus meter. A particularly reliable and precise flow measurement can be obtained with a magnetic-inductive meter.

As flow measurements, particularly when using a Coriolus measuring method, can be generally impaired by the influence of gas contents, the invention provides a filling degree measurement by means of which these impairments can be compensated when determining the delivery quantity. According to the invention the filling degree measurement and/or flow measurement can be used for determining any measurement quantity correlated with the filling degree or flow, respectively, i.e. also for indirect measurement.

In particularly preferred manner the filling degree measuring device for the filling degree measurement and/or the flow measuring device for the flow measurement is constructed in the manner described in EP 0 617 789 B1, EP 0 626 567 A1 and/or German utility model application 20 2004 019 442.2. Thus, the filling degree measuring device can in particular be constructed with a measuring chamber wall surrounding a measuring chamber in which there is at least one opening for introducing and/or discharging the liquid, and at least two flat electrodes facing one another in the vicinity of the measuring chamber wall in the measuring chamber, the measuring chamber wall having an electrically insulating construction in insulation areas connected to the two electrodes and surrounding the latter in flat manner.

The inventive method can in particular be used during the acceptance and/or discharge of liquid substances, preferably from stationary tanks into mobile tanks and/or vice versa, e.g. in the handling of goods requiring mandantory verification. The invention can prove suitable for any liquid, but preferably for milk, dairy products, wine or fuel, particularly heating oil. At least one of the provision locations can be on a tanker, particularly a milk tanker or on a heating oil tanker. Preferably the inventive method is used in the quantity determination during liquid acceptance, particularly milk acceptance, with a mobile or stationary acceptance system.

For entering into calculation, e.g. offsetting, the measurement results and for determining the delivery quantity appropriately an evaluating device is provided with which the filling degree measuring device and flow measuring device are in signal connection. This preferably has an electronic computer.

Any measuring method can be used for the filling degree and/or flow measurement. However, in particularly preferred manner for the filling degree measurement a conductivity measurement and/or capacity measurement is performed and/or for the flow measurement a volumetric flow measurement, particularly a magnetic-inductive measurement is performed. Thus, a high measurement accuracy can be achieved accompanied by high reliability.

It is also preferred that the liquid is passed continuously through the pipe. The filling degree measurement and/or flow measurement can also be performed continuously, but at least repeatedly. It is more particularly possible to time-vary the delivery rate of the liquid and this can e.g. take place as a function of the characteristics of the medium in the pipe, preferably in filling degree-dependent manner.

For further increasing the measurement accuracy it is possible for a pressure measurement to be performed in the pipe, particularly in the vicinity of a filling degree measurement point. To this end appropriately at least one pressure measuring device is provided on the pipe. The pressure measurement is based on the fact that gas or gas bubbles, as opposed to liquid, are highly compressible. Consequently the measured filling degree can be dependent on the instantaneous pressure. The results of the pressure measurement, for determining the delivery quantity, can be entered into the calculation with the results of the flow measurement and the results of the filling degree measurement. For this the at least one pressure measuring device is appropriately in signal connection with the evaluating device. A pressure measurement can e.g. also be performed in the vicinity of a flow measurement point. Fundamentally the pressure measurement can be performed in random areas of the pipe and a pressure measurement can also take place at several locations.

It is possible according to the invention to pass the liquid, e.g. by gravity action, through the pipe. However, it is particularly preferred that the liquid is pumped through the pipe by means of a feed pump located thereon. The feed pump can e.g. be constructed as a centrifugal pump.

It is also possible for a pressure measurement to be performed in the pipe both upstream and downstream of the feed pump, so that the measurement accuracy can be further increased.

The filling degree measurement and flow measurement can be performed at any measurement points within the pipe system. A particularly easy performance of the method with a high measurement accuracy can result from the filling degree and conductivity measurements being performed at the same measurement point. For this purpose the filling degree measuring device and flow measuring device can be combined and in particular have a common pair of electrodes, which can e.g. be used both for conductivity measurement and for magnetic-inductive flow measurement. With respect to the feed pump the filling degree measuring device and flow measuring device can be fundamentally arranged at random. Thus, with respect to the feed pump, they can e.g. be located on the same pipe side, but can also be on different pipe sides. If the filling degree and flow measuring devices are positioned on the same pipe side relative to the feed pump, either the filling degree measuring device or the flow measuring device can be located closer to the feed pump on the pipe.

It is particularly advantageous for the filling degree measurement to be performed upstream of the feed pump and for the pumping capacity of the feed pump to be set in filling degree-dependent manner. Thus, in this case the filling degree measuring device is used for controlling the pump. To this end appropriately a control device is provided, which is in signal connection both with the feed pump and with the filling degree measuring device. The filling degree-dependent setting more particularly makes it possible to reduce the pumping capacity of the feed pump with increasing gas proportion, e.g. on exceeding a limit value. Alternatively or additionally to the filling degree measuring device, at least one further filling degree measuring device, which can be combined with a temperature sensor, can be provided for setting the pumping capacity.

Another advantageous embodiment of the invention involves at least one of the provision locations being in a container, which is preferably mobile. Preferably each provision location is in a separate container. The at least one container can be in the form of a tank.

A self-priming delivery can inventively result from the fact that at least temporarily a vacuum is produced in the pipe for sucking the liquid into it. For this purpose e.g. an ejector or vacuum pump can be provided. A vacuum can more particularly be produced if the delivery capacity of the pumping mechanism decreases or breaks down as a result of excessively high gas proportions, which can in particular be the case at the start or end of delivery.

The measurement accuracy can be further increased in that for the equidistribution of the gas component the liquid is passed upstream of the filling degree measurement point through a screen or sieve positioned in the pipe cross-section. This can lead to a particularly uniform distribution of gas bubbles over the pipe flow cross-section, which allows a particularly accurate filling degree measurement. Alternatively or additionally to the screen can be provided a filter, a grating and/or a flow straightener.

For increasing the delivery rate or capacity, a gas column present in the pipe prior to the start of liquid delivery can be discharged therefrom via a vent pipe. For this purpose on the vent pipe can be provided a vent valve, which is operated as a function of a fill level in the vent pipe. Appropriately the vent pipe is located on a feed pump casing.

For further increasing the measurement accuracy, preferably at the start of delivery, the filling degree measuring device can be flooded and temporarily a flow stagnation or stoppage is produced in the filling degree measuring device. For this purpose the feed pump can e.g. be put out of operation and/or the pipe can be blocked for a liquid passage downstream of the filling degree measuring device using valves. This makes it possible to calibrate the filling degree measuring device, particularly at the start of delivery, with the liquid flow stationary. In particular, the liquid in the case of a stationary flow can be left in the filling degree measuring device until the gas component has been separated and/or has passed out of the filling degree measuring device into remaining pipe areas.

Another aspect of the invention is an apparatus for quantity determination during the acceptance and/or discharge of a liquid, preferably milk or fuel, with at least one container for receiving the liquid, a pipe which at its one end is in connection and which at its other end has a liquid flow opening, preferably a feed pump located on the pipe for pumping the liquid through the pipe, a

filling degree measuring device located on the pipe, a flow measuring device located on the pipe, and an evaluating device for determining the delivered liquid quantity, which is in signal connection with the filling degree measuring device and flow measuring device.

The inventive apparatus is particularly suitable for performing the inventive method, so that the advantages explained in this connection can be obtained. The inventive apparatus can in particular be constructed as described in conjunction with the method. Quantity determination is, according to the invention, understood to mean a volume determination. Advantageously the flow opening is located on a pipe acceptance coupling.

A particularly low flow resistance and therefore a particularly high delivery rate can, according to the invention, be achieved in that the pipe, at least outside the feed pump, the filling degree measuring device and/or the flow measuring device, has an at least approximately constant pipe cross-section. At least outside the feed pump, filling degree measuring device and/or flow measuring device, the pipe is advantageously constructed for an approximately linear flow, i.e. in particular for a flow direction along the pipe wall and on acceptance an ideal laminar flow. The pipe is preferably constructed without gas separator and without gas measurement preventer.

The apparatus according to the invention can also be referred to as a measuring installation for milk and other liquids containing air.

The invention is described in greater detail hereinafter relative to preferred embodiments and which are diagrammatically illustrated in the drawings, in which show:

Figs. 1 to 6 Different embodiments of inventive apparatuses when performing the inventive method.

Elements acting in the same way are given the same reference numerals throughout the drawings.

A first embodiment of an apparatus according to the invention is shown in fig. 1. The apparatus shown is used for delivering a liquid from a first provision location 1 to a second provision location 2. The first provision location 1 is located in a first container 31 in the form of a tank and the second provision location 2 is in a second container 32 also in the form of a tank. Container 32 can be looked upon as a component of the apparatus according to the invention. It can in particular, as can the entire inventive apparatus, be provided in mobile manner on a tanker and/or collection vehicle.

The apparatus has a pipe 10, which is arranged in fixed manner on the container 32 constructed as a collecting container. The pipe 10 contains a feed pump 20 constructed as a centrifugal pump. Between feed pump 20 and container 32 the pipe 10 contains a filling degree measuring device 5 and a flow measuring device 6. In the embodiment shown the filling degree measuring device 5 is positioned closer to the feed pump 20 than the flow measuring device 6. However, a reverse arrangement is also possible, where the flow measuring device 6 is closer to the feed pump. The flow measuring device 6 and filling degree measuring device 5 can also be combined in a common device.

Above the feed pump 20 is provided a vent pipe 40, which is in fluid connection with pipe 10. On said vent pipe 40 are provided a vent valve 42 and above the latter a fill level measuring device 45. A check valve 16 is located in pipe 10 between the second container 32 and the feed pump 20. In the embodiment shown the check valve 16 is positioned between the feed pump 20 and the filling degree measuring device 5 as well as the flow measuring device 6.

At its end remote from the container 32 the pipe 10 has a flow opening 12, at which the pipe 10 is detachably flanged by an acceptance coupling 15 to the first container 31. Flow opening 12 can also be referred to as a supply and/or discharge opening. On pipe 10, in the represented embodiment between flow opening 12 and feed pump 20, is provided a temperature sensor 23. By means of said temperature sensor 23 temperature measurements can be performed on the delivered liquid, which can be used for quality control and/or compensation calculations, e.g. for converting to a standard volume.

Temperature sensor 23 can also be constructed as a combined temperature-filling degree sensor, more particularly as a combined temperature-conductivity sensor. In this case the temperature-filling degree sensor can be used for control functions for feed pump 20. Thus, in the case of significant air introductions this makes it possible to reduce the pumping capacity. A fine setting of the pump can take place on the basis of measured values of the filling degree device 5, which can also be referred to as an air bubble sensor.

A connection of pipe 10 to tank 31 can, as shown in fig. 1, be provided by a rigid pipe piece 71 and/or, as shown in fig. 2, by a flexible hose 72. In the manner shown in fig. 2, an acceptance valve 14 can be provided on pipe 10 on the side of acceptance coupling 15.

The apparatus according to the invention can be used for the measured discharge of liquid, particularly milk, from the first container 31, which can also be called a delivery tank, to the second container 32, which can be called a target tank. The apparatus can be positioned in such a way that the acceptance coupling 15 and particularly also the feed pump 20, as shown in fig. 2, are positioned lower than the first container 31, so that liquid can flow by gravity action to feed pump 20.

At the start of delivery vent valve 42 and acceptance valve 14 are opened. Consequently the product can flow from the first container 31 to feed pump 20 and a gas column contained in the pipe 10 before the product can be drained off via the vent pipe 40. As a result a system ventilation can be implemented and this is particularly advantageous if the feed pump 20 is constructed as a non-self priming pump, e.g. as a centrifugal pump. Venting permits reliable operation with high efficiency of feed pump 20.

Successful system ventilation can be proved by means of the fill level measuring device 45 and the vent valve 42 can be closed as soon as the fill level measuring device 45 indicates wetting.

The feed pump 20 can now be put into operation, so that a pressure builds up which opens check valve 16. The liquid passes from feed pump 20 into the filling degree measuring device 5, which measures the gas proportion in the product to be measured

and which can also be called an air quantity meter. From here the complete liquid flow together with the gas component passes into the flow measuring device 6, which can be constructed as a volumetric meter. From the flow measuring device 6 the liquid finally passes, together with the gas component therein, into the second container 32.

If the pipe 10 in the filling degree measuring device 5 and the flow measuring device 6 is constructed with the same cross-section, the speed in the liquid column on devices 5 and 6 is at least approximately identical. This can in particular be achieved if the filling degree measuring device 5 is constructed as a conductivity measuring device and the flow measuring device 6 as a magnetic-inductive measuring device.

By means of the filling degree measuring device 5, alternatively or additionally by means of the temperature sensor 23 constructed as a combined temperature-filling degree sensor, the gas component, particularly the bubble component, in the liquid can be monitored and monitoring is preferably repeated. If the gas proportion exceeds a certain value, this indicates the end of acceptance and/or suction or eddy formation in the first container 31. The pumping capacity of feed pump 20 can then be reduced in order to reduce suction or eddy formation. Particularly in the case of a higher positioned first container 31, this makes it possible to perform the entire acceptance with a controlled and measured gas introduction.

As can e.g. be gathered from the embodiment of fig. 3, between feed pump 20 and filling degree measuring device 5, i.e. upstream of the latter, a filter and/or screen 18 can be provided. By means of said filter and/or screen 18 existing air bubbles can be reduced in size and uniformly distributed before filling degree measurement, which increases the filling degree measurement accuracy.

As is also shown in the embodiment of fig. 3, a pressure sensor 51 can be provided on pipe 10. By means of said pressure sensor the pressure of the fluid in pipe 10 can be measured and taken into account during delivery quantity determination. Appropriately the pressure sensor 51 is located in the immediate vicinity of the filling degree measuring device 5. As shown in fig. 3, it can also be positioned downstream of the measuring section comprising filling degree measuring device 5 and flow measuring device 6.

Preferably the pressure sensor 51 is located on the same pipe side with respect to feed pump 20 as the filling degree measuring device 5.

The embodiment of fig. 3 moreover differs from the embodiments of figs. 1 and 2 in that at the bottom of the second container 32 a bottom valve 36 is provided in pipe 10. Such a bottom valve 36 can in particular be provided if the second container 32 is located on a tanker. In particular, e.g. on the same tanker, there can be several second containers 32, which are all linked with pipe 10 by means of a respective bottom valve 36. In this case and according to the invention via the measuring section air-permeated milk can be introduced into different second containers 32, as was only possible to a limited extent in the case of a gauge stick tanker. The second container 32 can e.g. also be located on a trailer.

Another embodiment of an apparatus according to the invention is shown in fig. 4. The apparatus of fig. 4 can be used both for the acceptance and discharge of gas-containing liquids, accompanied by simultaneous quantity determination. In place of the check valve 16 of the apparatuses of figs. 1 to 3, the apparatus of fig. 4 has a switchable valve 61 in pipe 10. Such a switchable valve 61 can optionally be provided as a bypass valve with respect to check valve 16.

The embodiment of fig. 4 also differs from the preceding embodiments in that between the second container 32 and the filling degree measuring device 5 in pipe 10 is provided a filter and/or screen 18'. There is also a pressure sensor 51' between the measuring section and the feed pump 20 on pipe 10. The filter and/or screen 18' or pressure sensor 51' can be provided alternatively or additionally to the screen 18 or pressure sensor 51, respectively, of the embodiment of fig. 3.

At the start of the discharge process using the apparatus of fig. 4 the bottom valve 36 is opened with the valve 14 closed. If there are several second containers 32, by opening the corresponding bottom valve 36 the desired container 32 to be emptied can be selected. If pipe 10 was empty at the start of the discharge process, the vent valve 42 can now be opened and the feed pump 20 flooded. Vent valve 42 is closed as soon as the detector 45 detects liquid. The liquid then stands at least up to valve 14. The filled filling degree measuring device 5 can now be calibrated to the liquid present. Feed pump

20 is then put into operation and valve 14 is opened. The volume flow of the flowing product is measured using the flow measuring device 6 and the gas bubble proportion is determined by the filling degree measuring device 5 and entered into a calculation together with the volume flow for delivery quantity determination.

Generally the gas bubble proportion rises towards the end of discharge if a suction or eddy is formed in the discharge container. If the gas bubble proportion exceeds a certain value, which can be determined using the filling degree measuring device 5, the delivery capacity of the feed pump 20 can be reduced. This can optionally lead to a stop and go operation both during acceptance and discharge.

If pipe 10 is filled with liquid prior to discharge, the liquid volume contained therein can also be taken into account in the delivery quantity determination. For this purpose the inner volume of pipe 10 can e.g. undergo litre content measurement beforehand.

Another embodiment of a quantity determination apparatus is shown in fig. 5. The embodiment of fig. 5 differs from the embodiments of figs. 1 to 3 essentially in that the filling degree measuring device 5' is provided between acceptance coupling 15 and feed pump 20, i.e. on the suction side or upstream of feed pump 20. This arrangement makes it possible to measure the gas proportion on the suction side of feed pump 20 and the measured results can be used for controlling said feed pump 20. This is advantageous in that generally a particularly high measuring accuracy is possible with the filling degree measuring device 5'. With such an arrangement of the filling degree measuring device 5' it is particularly advantageous, as shown in fig. 5, if a pressure sensor 51, 51' is provided both on the suction and discharge side of feed pump 20, i.e. on either side thereof. This makes it possible to take account of different bubble sizes for different pressure ratios on the suction and discharge sides of feed pump 20 and determine same by measurement for correcting the calculated delivery quantity.

Another embodiment of an inventive apparatus is shown in fig. 6. The embodiment of fig. 6 differs from the previously described embodiments in that it is constructed as a self-priming system with a vacuum generating device. The vacuum generating device has an ejector 57 which is positioned terminally on vent pipe 40. The vacuum generating device also has a compressed air generator 59 by means of which the ejector 57

can be supplied with compressed air via a controllable valve 58. Alternatively or additionally the vacuum generating device can also have a vacuum pump, which can also be positioned terminally on the vent pipe 40.

By means of the vacuum generating device it is possible to produce in the suction system (area A) a vacuum on opening vent valve 42. If acceptance valve 14 is now opened, liquid is sucked from the first provision location 1 and first container 31. The air volume present in hose 72 is blown out through ejector 57 and the suction system is evacuated in area B. As soon as the liquid from the first container 31 has reached the fill level measuring device 45 the system is filled and the vent valve 42 and in particular also the control valve 58 can be closed.

The now filled feed pump 20 can be put into operation, where upon a pressure builds up and the second container 32 is filled. A possibly present air bubble component is measured in the filling degree measuring device 5 and is entered into a calculation with the volume flow measured in flow measuring device 6.

If the air proportion is excessive, the pumping capacity of feed pump 20 is reduced. In assisting manner the vacuum generating device can be activated with increasing gas proportion to prevent the delivery of feed pump 20 breaking down and/or the built up pressure no longer being sufficient to open the check valve 16 as a result of excessive air introductions, e.g. at the end of acceptance.

The embodiment of fig. 6 represents a self-priming pumping system with which precise volume quantity determinations are possible without an air separator or gas measurement preventer.

In all the embodiments of the inventive method the gas bubble proportion of the volume flow is measured and used metrologically for determining the total volume.

NEW CLAIMS

1. Method for the delivery and delivery volume determination of a liquid having a gas component, particularly milk or fuel, from a first provision location to a second provision location, in which

- the liquid with the gas component is transferred from the first provision location (1) into a pipe (10),
- the liquid with the gas component is passed through pipe (10),
- a filling degree measurement is performed in pipe (10),
- a flow measurement is performed in pipe (10),
- the liquid together with the gas component contained therein is transferred from pipe (10) into the second provision location (2) and
- the results of the flow measurement are entered into a calculation with those of the filling degree measurement for determining the delivery volume.

2. Method according to claim 1, characterized in that for filling degree measurement a conductivity measurement and/or a capacity measurement is performed and/or for flow measurement a volume flow measurement, particularly a magnetic-inductive measurement, is performed.

3. Method according to one of the claims 1 to 2, characterized in that a pressure measurement is performed in the pipe (10), particularly in the vicinity of a measurement point for the filling degree.

4. Method according to one of the claims 1 to 3, characterized in that the liquid is pumped through the pipe (10) by means of a feed pump (20) located on the pipe (10).

5. Method according to claim 4, characterized in that a pressure measurement is performed in the pipe (10) both upstream and downstream of the feed pump (20).

6. Method according to one of the claims 4 or 5, characterized in that the filling degree measurement is in particular performed upstream of the feed pump (20) and that the pumping capacity of the feed pump (20) is set in filling degree-dependent manner.

7. Method according to one of the claims 1 to 6, characterized in that at least one of the provision locations (1, 2) is located in a container (31, 32), which is preferably mobile.

8. Method according to one of the claims 1 to 7, characterized in that at least temporarily a vacuum is produced in the pipe (10) for sucking liquid into said pipe (10).

9. Method according to one of the claims 1 to 8, characterized in that for the equidistribution of the gas component upstream of the filling degree measurement point the liquid is passed through a screen (18) arranged in the cross-section of the pipe (10) or through a filter arranged in the cross-section of the pipe (10).

10. Method according to one of the claims 1 to 9, characterized in that a gas column contained in pipe (10) prior to the start of liquid delivery is drained out of pipe (10) via a vent pipe (40).

11. Apparatus for volume determination during acceptance and/or discharge of a liquid, preferably milk or fuel, particularly for performing the method according to one of the claims 1 to 10, having

- at least one container (32) for receiving the liquid,
- a pipe (10) which at its one end is in flow connection with the container (32), and which at its other end has a flow opening (12) for the liquid,
- a filling degree measuring device (5), which is placed on the pipe (10),
- a flow measuring device (6), which is placed on the pipe (10), and
- an evaluating device for determining the delivered liquid volume and which is in signal connection with the filling degree measuring device (5) and flow measuring device (6).

12. Apparatus according to claim 11, characterized in that a feed pump (20) is located on the pipe (10) for pumping the liquid through the pipe (10).

13. Apparatus according to one of the claims 11 or 12, characterized in that the pipe (10) has an at least approximately constant pipe cross-section, at least outside the feed pump (20), the filling degree measuring device (5) and/or the flow measuring device (6).

Fig. 4

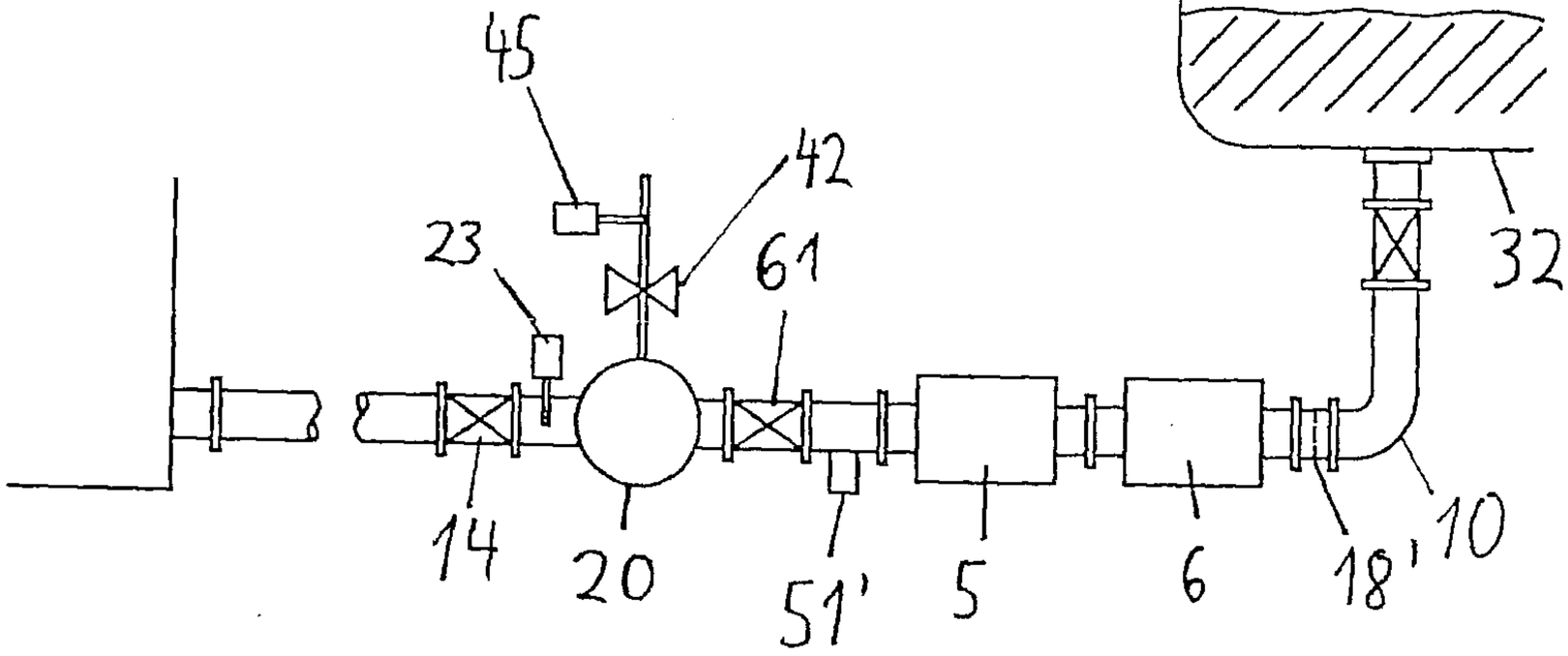


Fig. 3

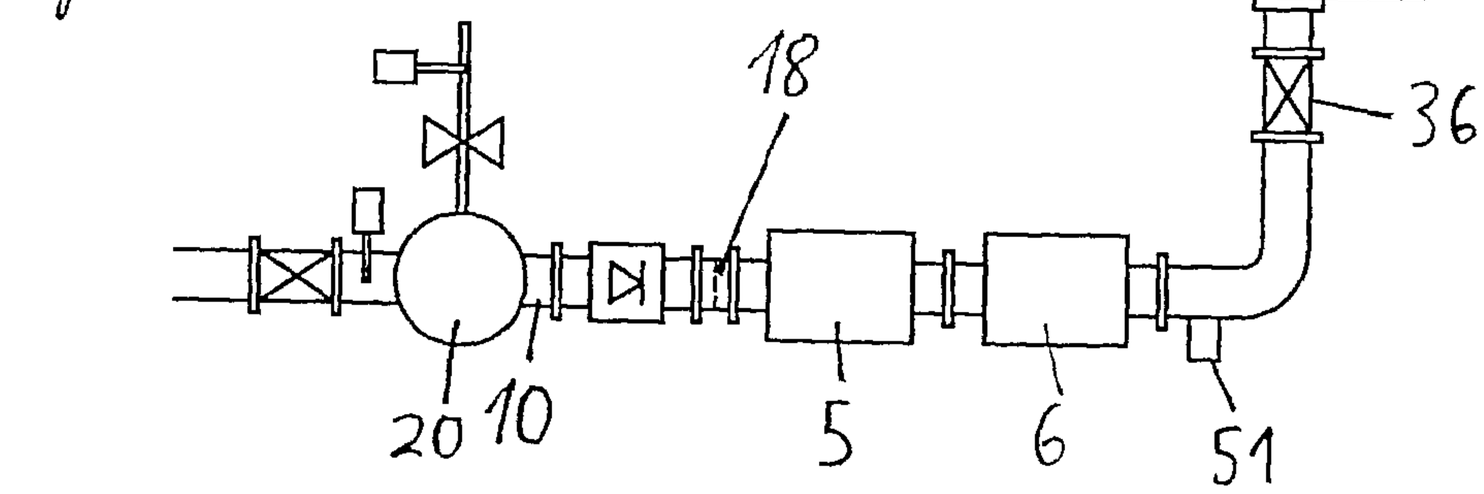


Fig. 2

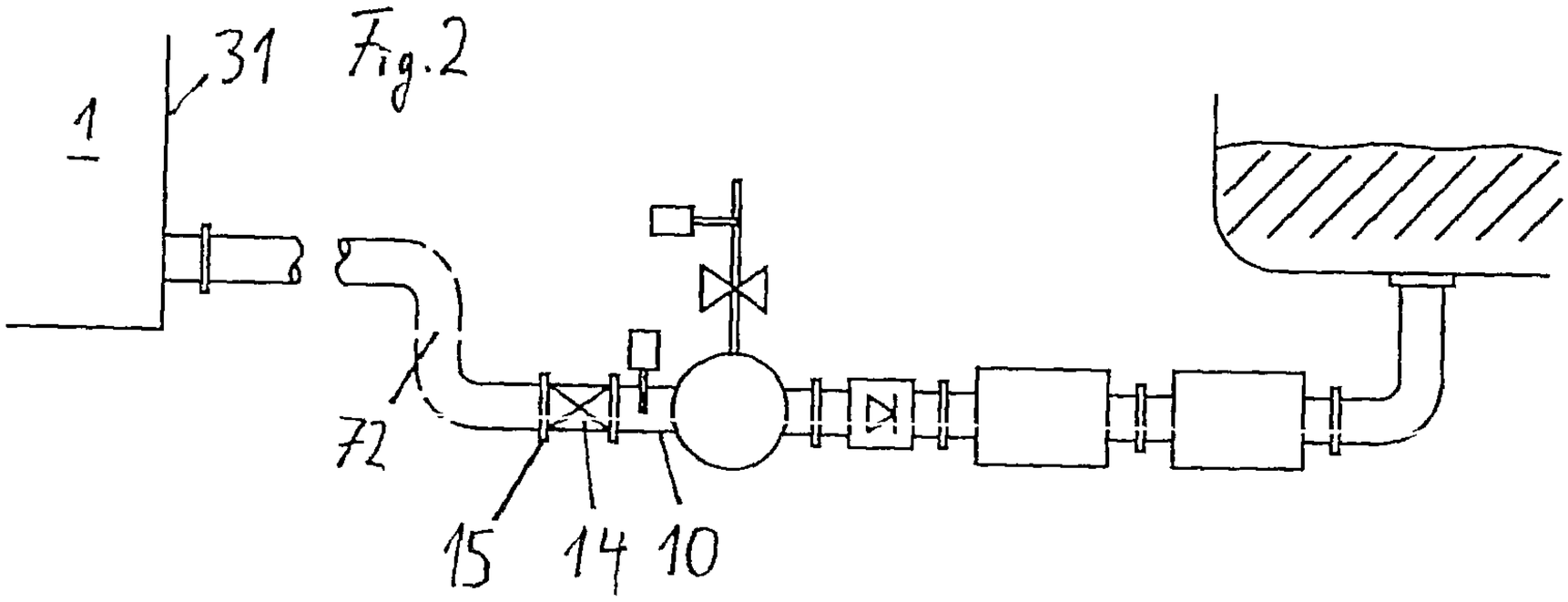


Fig. 1

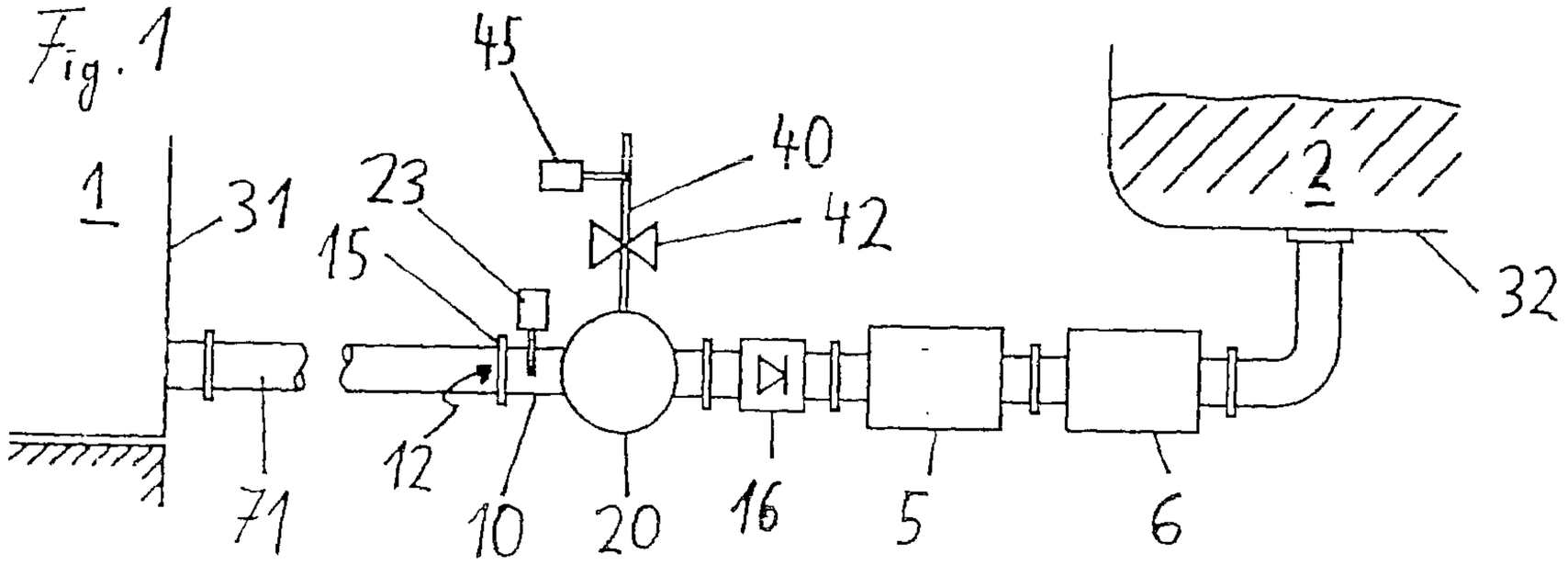


Fig. 5

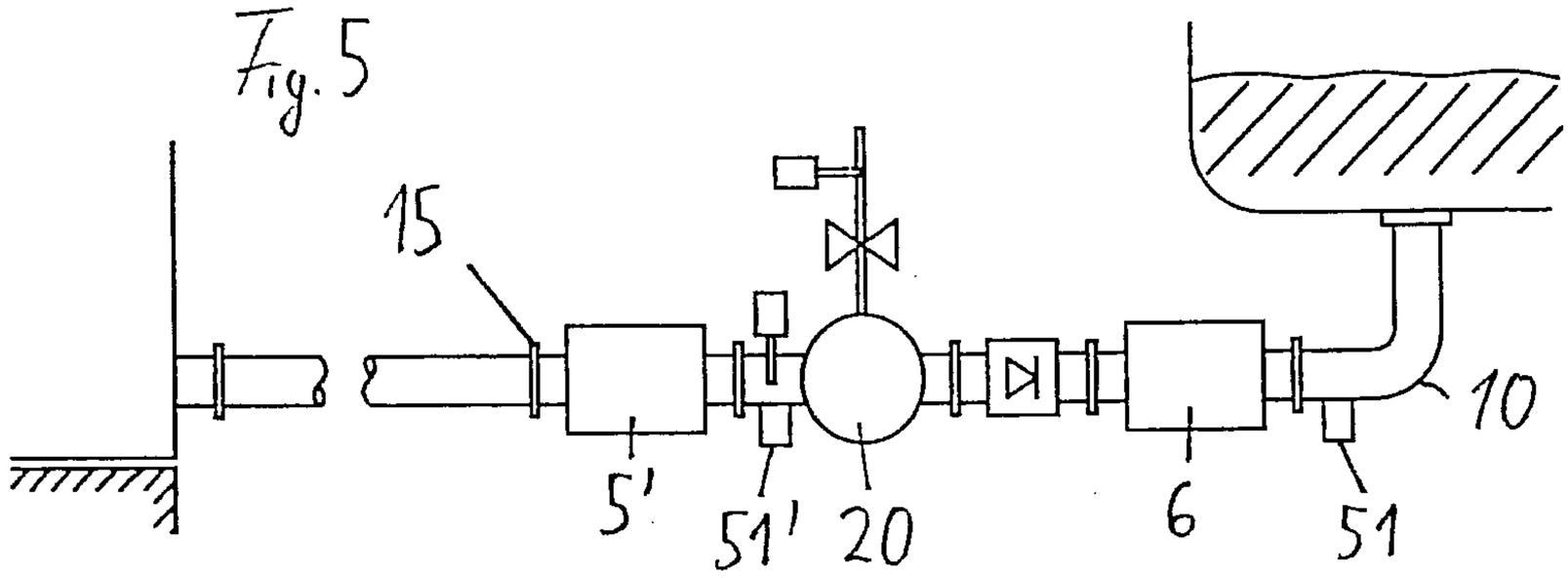
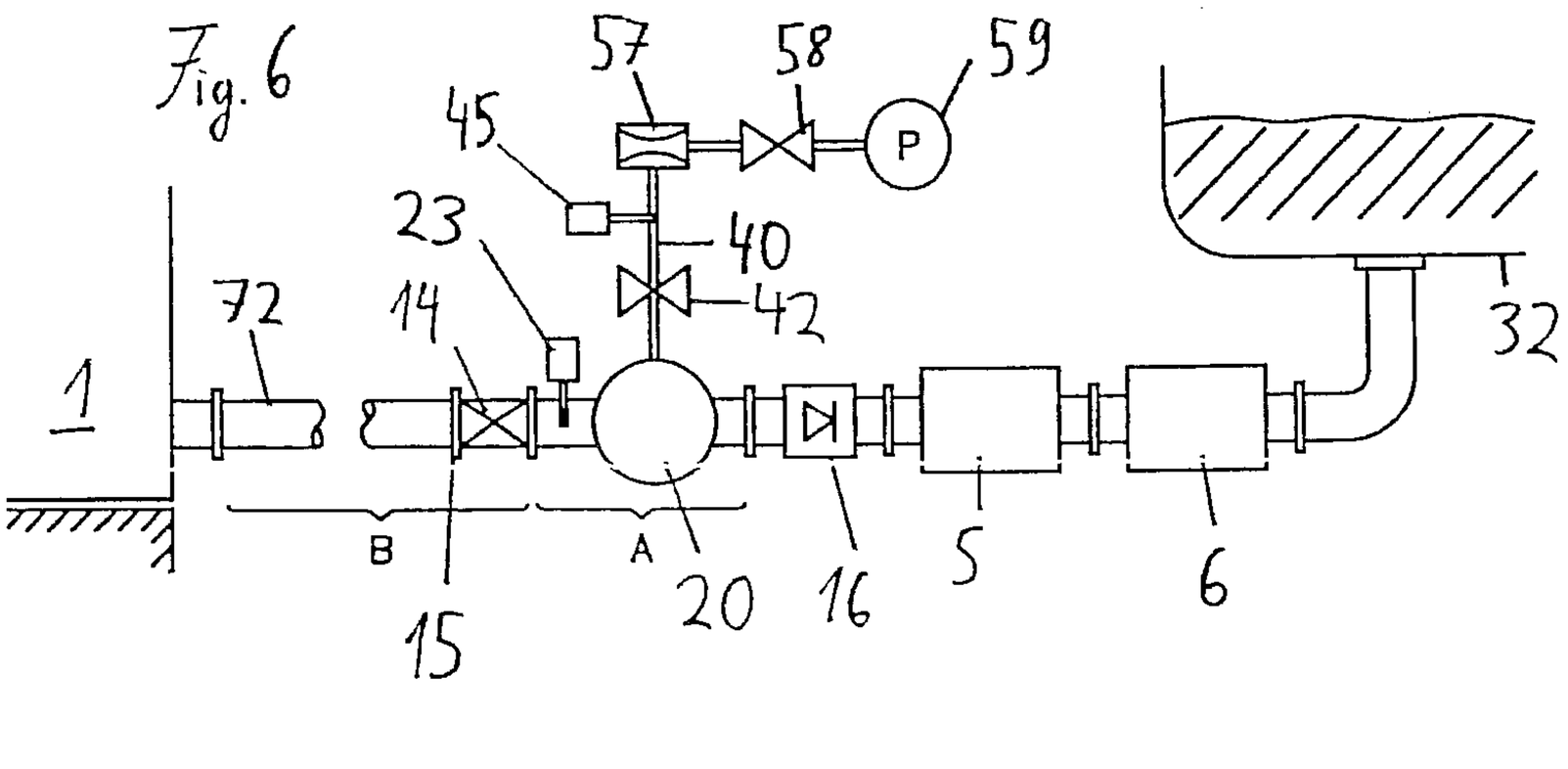
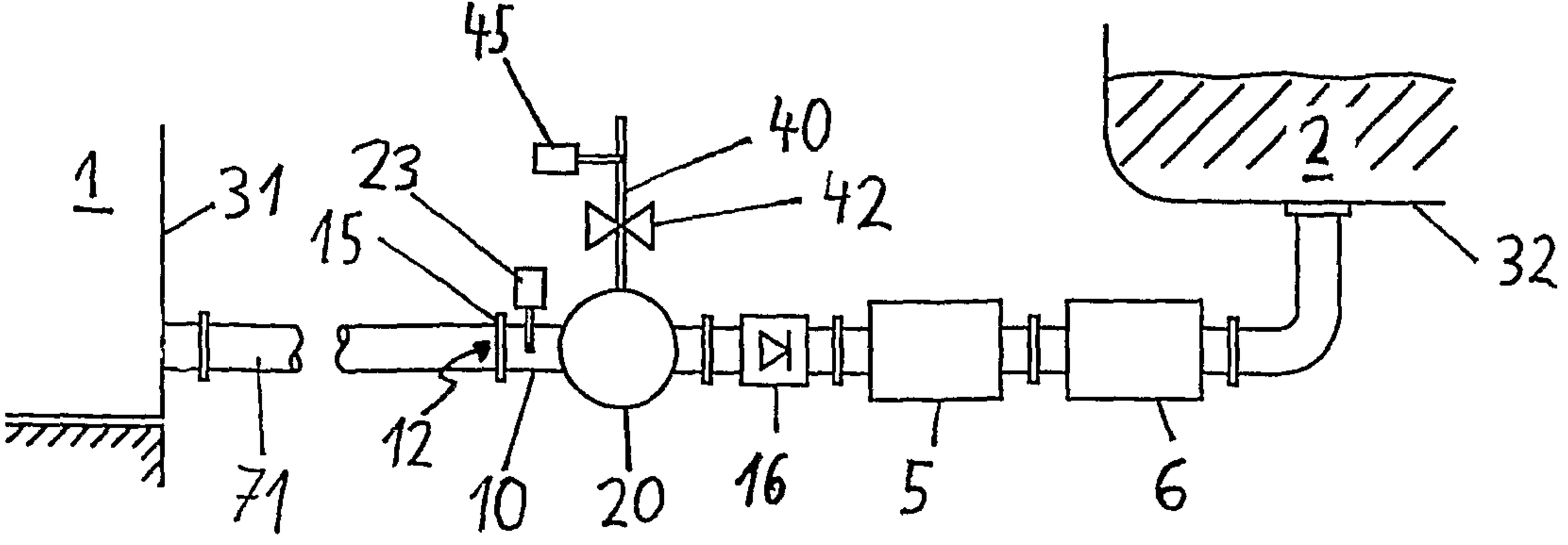


Fig. 6

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