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Description

[0001] The present invention relates to an agricultural field sprayer according to the preamble of Claim 1.

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[0002] A field sprayer of this kind is known by way of example from the EP 2 789 232 A2. A field sprayer is furthermore known from DE 102 43 024 A1.

[0003] A float element is provided there in the liquid tank and is connected to an electronic angular position encoder and an electronic display device in order to calculate and display the filling level of a liquid in the liquid tank.

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[0004] Alternatively, as provided in WO 2006/0323, a capacitive filling level sensor can be used in order to determine the amount of liquid in the liquid tank.

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[0005] One drawback with measuring the filling level in this way is however that the measurements are subject to severe variations owing to the fluctuations in the liquid tank which are caused by way of example by the movement of the field sprayer. Furthermore, statistical fluctuations in the measurements via the rotary potentiometer and the float lead to further inaccuracies when determining the filling level of the liquid in the liquid tank.

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[0006] It is therefore the object of the present invention to provide an agricultural field sprayer in which the filling level of a liquid in the liquid tank can be determined more accurately.

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[0007] This is achieved by an agricultural field sprayer according to Patent Claim 1.

[0008] This is achieved according to the invention in particular in that a measurement of a liquid sensor assigned to the liquid tank is combined with a further measurement of a flow rate sensor, and the filling level of the liquid in the liquid tank is determined based on this combination. By way of example the actual

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amount dispensed by the field sprayer can be taken into consideration by the flow rate sensor when determining the filling level. A more accurate determination of the filling level is thereby possible. If by way of example no liquid is dispensed then the filling level can be determined as constant although the filling level sensor
5 of the liquid tank suggests where applicable fluctuations of the filling level as a result of movement of the field sprayer.

[0009] The agricultural field sprayer can be in particular a plant protection sprayer.

10 **[0010]** The liquid tank can be a broth tank for the spraying liquid broth. It is however also possible that the liquid tank can be a clear water tank. It is also conceivable that both a clear water tank and also a broth tank are provided, and each of the tanks is assigned a filling level sensor. To determine the filling level of a liquid in the respective liquid tank the evaluation device can then combine
15 measurements of the respective filling level sensors with a measurement of an associated flow rate sensor in order to determine the filling level of a liquid in the respective liquid tank.

[0011] The filling level sensor assigned to the liquid tank can comprise in particular
20 a float which is connected to a rotary potentiometer. A measurement of the filling level sensor which corresponds to the filling level determined by the filling level sensor can be determined via the output voltage of the rotary potentiometer. This value can be used by the evaluation device as a measurement of the filling level sensor. Alternatively, or additionally, the evaluation device can also use the
25 measurement signal of the filling level sensor, in particular of the rotary potentiometer, directly to calculate the filling level of the liquid in the liquid tank through combination with the measurement of the flow rate sensor or measurement signal of the flow rate sensor.

30 **[0012]** The evaluation device can be in particular an electronic control and/or regulating device. This control and/or regulating device can also be used to control or regulate the dispensing of the liquid from the liquid tank by means of the agricultural field sprayer. The evaluation device corresponds in particular to the

on-board computer of the field sprayer, or can comprise same.

[0013] The flow rate sensor can be an electronic or electromechanical element which supplies a measurement signal proportional to the amount of liquid which flows through a liquid line per unit of time. The flow rate sensor can be by way of example a flywheel counter. With this measuring method the flow speed is determined by means of rotating mechanical elements (flywheels) arranged in the liquid line. Picking up the rotational speed is carried out contactlessly via magnetic sensors whose pulses through the blades are evaluated via an electronics system. The rotational speed of the flywheels is proportional to the through flow and volume flow.

[0014] The measurement of the flow rate sensor which is used by the evaluation device to determine the filling level can be in particular a quantity of liquid which has flowed through the corresponding liquid line in a previously determined time span. The measurement of the flow rate sensor can correspond by way of example to the total amount of liquid dispensed by the field sprayer since the last time the liquid tank was filled.

[0015] The flow rate sensor can be connected in particular to the liquid tank, in particular via a liquid line. The flow rate sensor can be configured in particular so that it enables the amount of liquid dispensed by the agricultural field sprayer to be determined.

[0016] The filling level determined by the evaluation device can be displayed via a display device of the agricultural field sprayer. The display device can be by way of example the display device of the on-board computer.

[0017] The evaluation device can be configured in particular so that it combines the measurements of the sensors via an algorithm. The algorithm can comprise in particular a Kalman filter. A particularly reliable determination of the filling level is thereby possible.

[0018] For the algorithm the accuracy or exactness of the respective measurements, thus of the filling level sensor and flow rate sensor, can be given as parameters. These parameters form to some extent weighting factors with which the measurement of the filling level sensor or measurement of the flow rate sensor is taken into account. By changing these parameters or weighting factors it is thus possible to influence which of the measurements is given a higher statistical weight. The sensor values are each taken into account by the algorithm with regard to their physical connections, in particular the filling level and/or the change in the filling level.

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[0019] The evaluation device can be configured correspondingly so that it adapts or alters or updates weighting factors or parameters used by the algorithm dependent on the operation of the agricultural field sprayer. It is thereby possible to take into account changed accuracies of the measurements of the individual sensors corresponding to the operation of the field sprayer.

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[0020] “Dependent on the operation of the field sprayer” can mean in particular dependent on one or more operating parameters and/or dependent on a mode of operation of the agricultural field sprayer. Operating parameters of the field sprayer can be by way of example the speed, gradient and/or position of the field sprayer. With the operating modes of the field sprayer, it is possible by way of example to differentiate between a dispensing mode, where liquid is dispensed from the liquid tank onto an agricultural surface, and a filling mode where the liquid tank is filled with a liquid.

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[0021] The evaluation device can thus be configured so that it adapts weighting factors used by the algorithm or parameters dependent on the speed and/or the acceleration of the field sprayer and/or the incline of the field sprayer and/or the radius when negotiating curves and/or the filling level and/or dependent on whether the field sprayer is operated in a filling mode or a dispensing mode.

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[0022] If by way of example the field sprayer is filled in particular via a dome then no fluid is dispensed. The field sprayer is thus located in a filling mode.

Furthermore, the speed of the field sprayer equals zero (0) if the filling is carried out when stationary. The flow rate sensor correspondingly measures no through flow. In this case greater weight is given to the filling level sensor so that the increase in the filling level is correctly reproduced.

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[0023] In order to determine the operating parameter or operating mode the field sprayer can comprise further sensors, by way of example a speed sensor and/or a gradient sensor and/or an acceleration sensor and/or steering angle sensor.

10 **[0024]** The field sprayer can furthermore comprise a distributor boom comprising spray nozzles, and a liquid line connecting the liquid tank to the distributor boom wherein the flow rate sensor is arranged in the liquid line. The amount dispensed by the field sprayer can thereby be advantageously determined via the flow rate sensor.

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[0025] The field sprayer can furthermore comprise a pump connected to the liquid tank and via which the liquid can be conveyed from the tank into the liquid line.

20 **[0026]** The field sprayer, in particular the distributor boom, can comprise several partial widths which can be controlled in particular separately and thus which each have its own spray line.

25 **[0027]** In this case, the at least one liquid line can be divided in a region between the liquid tank and the distributor boom into several spray lines wherein the spray lines are assigned in particular shut-off valves. The flow rate sensor can in this case be arranged between the pump and the branching of the liquid line.

30 **[0028]** In the region in which the liquid line is divided into several spray lines a further branch can be provided into a branch line returning to the liquid tank, in particular wherein the branch line is likewise assigned a shut-off valve.

[0029] In this case, a further flow rate sensor can be arranged in the branch line, in particular between the shut-off valve of the branch line and the liquid tank, with

this sensor being connected to the evaluation device. The actual amount dispensed by the field sprayer can be accurately determined via a further flow rate sensor of this kind, in particular when small amounts are dispensed.

5 [0030] The evaluation device can in this case be configured so that it combines a measurement of the further flow rate sensor with the measurement of the filling level sensor and the measurement of the flow rate sensor to determine the filling level. In other words, measurements of the two flow rate sensors and a measurement of the filling level sensor can be taken into consideration for
10 determining the filling level. It is thereby possible to further increase the reliability of the filling level calculation.

[0031] It is also possible that even more flow rate sensors are provided via which liquid flows can be determined which affect the filling level of the liquid in the
15 tank. Measurements of these additional flow rate sensors can be used or taken into consideration by the evaluation device for determining the filling level.

[0032] The evaluation device can be configured such that it uses at least two filling levels and/or flow rates determined by combination of the measurements, in order
20 to carry out an automatic calibration of the flow rate sensor or of the flow rate sensors on the basis of a difference between the at least two filling levels and/or flow rates. Through this measure it is possible to provide a simple calibration of the flow rate sensor which increases the accuracy of the measurements of the flow rate sensors.

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[0033] Flow rate sensors must normally be calibrated regularly, by way of example annually, since the measurement can become more inaccurate during the course of time.

30 [0034] The automatic calibration can comprise in particular the adaption or correction of a calibration value or calibration factor. The calibration value can indicate in particular the number of pulses of the flow rate sensor per litre. The calibration value can be calculated directly via the evaluation device. Alternatively,

the evaluation device can comprise a regulator with which the calibration value is determined. The regulator can comprise by way of example a PT₁ member.

5 [0035] The automatic calibration can be carried out multiple times during operation of the field sprayer with tank filling of the liquid tank.

10 [0036] The automatic calibration can be carried out in particular when the difference between at least two filling levels deviates in a predetermined way from the flow rate determined at the same time by the flow rate sensor. By way of example the change in the filling level in the liquid tank can be determined continuously and compared with the accumulated flow through the flow rate sensor. If the difference between these values exceeds a predetermined threshold value then the calibration can be carried out.

15 [0037] It is furthermore possible to convert two filling level values into one throughflow and compare this with the measurement of the flow rate sensor. If the difference exceeds a predetermined threshold value then the calibration can be carried out.

20 [0038] If several flow rate sensors are used then the calibration of the individual flow rate sensors can be carried out in different operating modes. Through the correspondingly selected operating mode it can be ensured that a through flow takes place through the flow rate sensor which is to be calibrated.

25 [0039] If by way of example a flow rate sensor is provided between the pump and the branching of the liquid line into several spray lines and into a branch line leading back to the liquid tank, then the calibration of this flow rate sensor can be carried out if a shut-off valve assigned to the branch line is closed. A flow rate sensor provided in the branch line can be correspondingly calibrated if all the
30 partial widths, thus all the spray lines which lead to the partial widths of the distributor boom, are closed. In the latter case the throughflow quantities in the branch line and in the liquid line up to the branch point are the same.

[0040] The invention further provides a method for determining a filling level of a liquid tank of an agricultural field sprayer according to Claim 9. This method enables a reliable determination of the filling level of a liquid in a liquid tank of an agricultural field sprayer.

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[0041] The agricultural field sprayer and the corresponding elements of the field sprayer can have one or more of the aforementioned features. According to the method, the evaluation device can carry out one or more of the steps for which it was designed to carry out as described previously.

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[0042] In particular the evaluation device can combine the measurements via an algorithm wherein the algorithm can comprise in particular a Kalman filter. The weighting factors used by the Kalman filter or parameters can be adapted as described above in dependence on the operation of the agricultural field sprayer.

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[0043] The method can furthermore comprise an automatic calibration of the flow rate sensor based on a difference between at least two determined filling levels. The automatic calibration can be carried out as described above.

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[0044] In other words the method can be a method for determining a filling level of a liquid tank by means of an agricultural field sprayer previously described.

[0045] Further features and advantages of the invention will be explained below with reference to the figures given by way of example and in which

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Fig. 1 shows a diagrammatic illustration of an exemplary agricultural field sprayer;

Fig. 2 shows a diagrammatic illustration of a further exemplary field sprayer; and

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Fig. 3 shows a time graph of the filling level of the liquid in the liquid tank as well as of the total amount dispensed by the field sprayer.

[0046] Fig. 1 shows diagrammatically an example of an agricultural field sprayer,

in particular a plant protection sprayer. The field sprayer comprises a liquid tank 1 which is in particular a broth tank of the broth sprayer.

5 [0047] This liquid tank 1 is assigned a filling level sensor 2 which in this example comprises a float element 4 and a rotary potentiometer 5. The rotary potentiometer 5 is connected to an evaluation device 3. It is therefore possible to deliver a measurement signal of the rotary potentiometer to the evaluation device.

10 [0048] The liquid tank 1 is connected via a liquid line 6 to a distributor boom 7 which comprises several spray nozzles 8. A flow rate sensor 9 is provided in the liquid line 6 and is likewise connected to the evaluation device 3 so that a measurement signal of the flow rate sensor 9 can be sent to the evaluation device 3.

15 [0049] The evaluation device 3 can be by way of example the on-board computer of the field sprayer. The evaluation device 3 receives measurement signals of the filling level sensor 2 and of the flow rate sensor 9. The evaluation device 3 then determines the filling level of a liquid in the liquid tank 1 based on a measurement of the filling level sensor 2 and a measurement of the flow rate sensor 9.

20 [0050] The said measurements can either correspond directly to the measurement signals of the sensors or can be based on these measurement signals. By way of example the evaluation device can first change or convert the measurement signals into suitable measurements and carry out the determination of the filling level based on the measurements thus determined. By way of example the signal of the rotary
25 potentiometer 5 can first be converted into a provisional filling level. The measurement signal of the flow rate sensor 9 can be converted via a calibration value into a throughflow amount which was conveyed through the liquid line 6 since the last filling of the liquid tank 1 or during a predetermined time span.

30 [0051] The determination of the filling level can be carried out based on these values.

[0052] In particular the evaluation device 3 combines the measurements of the sensors 2, 9 through its own algorithm which is filed by way of example in a storage element (not shown).

5 [0053] Through such combination it is possible to compensate or correct fluctuations and measuring inaccuracies of the filling level determination via the filling level sensor 2 alone. If by way of example no spray broth is dispensed then the determined filling level remains constant and does not fluctuate although the filling level measurement via the filling level sensor 2 is subject to fluctuations, by
10 way of example through the movements of the field sprayer.

[0054] The algorithm can comprise in particular a Kalman filter or can be a Kalman filter. A Kalman filter is a filter or algorithm for estimating the state of linear and non-linear systems. The basis of this filter can form a physical model of the liquid
15 tank wherein the filling level as well as the change in the filling level (the throughflow) can be taken into consideration in the model. The change in the filling level corresponds to the derivation of the filling level according to time. The change in the filling level can be determined via the flow rate sensor 9 which is connected to the liquid tank 1 and the distributor boom 7.

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[0055] The accuracies of the respective measurements with the respective sensors, thus flow rate sensor 9 and filling level sensor 2, can be indicated as parameters in the algorithm. If these parameters are changed then the weighting of, the measurements is also changed correspondingly. This has the result that the
25 determined or calculated filling level is determined more by the measurement of the filling level sensor or more by the measurement of the flow rate sensor depending on the weighting.

[0056] This weighting can be adapted or modified dependent on the operation of
30 the field sprayer. For this, one or more operating parameters and/or an operating mode of the field sprayer can be taken into consideration. The operating parameters comprise by way of example the gradient or speed of the field sprayer. Different weightings can be expedient according to the gradient. With a steeply inclined

field sprayer by way of example the filling level which is determined via the filling level sensor 2 can fluctuate severely and be unreliable. In this case a higher weight can be placed on the flow rate measurement via the flow rate sensor 9. Also, at a higher speed greater fluctuation of the values of the filling level sensor 2 can be expected so that an adaptation of the weighting factors can be indicated.

[0057] Alternatively, during filling of the field sprayer, by way of example via a dome, the weighting factor can be reduced for the measurement of the flow rate sensor. During filling a change in the filling level (increase in the filling level) namely occurs without the flow rate sensor 9 measuring a throughflow. Where applicable, the weighting factor of the flow rate sensor 9 can in this case also be set to 0. The combination of the measurements by the evaluation device in this case substantially reproduces the filling level which is supplied by the filling level sensor 2.

[0058] Fig. 2 shows a further example of an agricultural field sprayer in a slightly more detailed illustration. An important difference from the example of Fig. 1 lies in the fact that two flow rate sensors are provided in this embodiment.

[0059] The example of the field sprayer in Fig. 2 likewise comprises a liquid tank 1, a filling level sensor 2 assigned to the liquid tank 1 and comprising a float 4, and a rotary potentiometer 5 which is connected to an evaluation device 3. The connection between the rotary potentiometer 5 and the evaluation device 3 is through a corresponding line 15.

[0060] The field sprayer also comprises a distributor boom 7 which in this example however is divided into several partial widths 7'. Each of these partial widths 7' comprises corresponding spray nozzles 8.

[0061] The distributor boom 7 is connected to the liquid tank 1 via a liquid line 6 into which liquid can be conveyed via a pump 10. The line section of the liquid line 6 downstream of the pump 10 can also be called a pressure line since the pump can supply the liquid with an excess pressure.

[0062] Fig. 2 also shows a metering fitting 12 which is connected to the pump 10. The metering fitting 12 is adjustable by a servomotor 13. A return line 11 is branched off from the liquid line 6 at the metering fitting 12.

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[0063] Between the metering fitting 12 and the distributor boom 7 the liquid line 6 is branched off into several spray lines 10 and into a branch line 20 which leads back to the liquid tank 1.

10 [0064] The spray lines 10 are assigned shut-off valves 25 which can be actuated by motorized setting members 26. The setting members 26 are likewise connected to the evaluation device 3 which in this example also forms the control and/or regulating unit for the spraying operation.

15 [0065] The first flow rate meter 9 which supplies measurement signals to the evaluation device 3 via the line 16 is provided in the liquid line 6 before the branch point into the individual spray lines 10. A second flow rate sensor 21 which is connected to the evaluation device 3 via the line 22 is likewise arranged in the branch line 20 after an associated shut-off valve 17. The shut-off valve 17
20 comprises the motorized setting element 18 which is connected to the evaluation device 3 via the line 19.

[0066] The evaluation device 3 has in this region individual switches 23 for actuating the actuating elements 26 which are assigned to the shut-off valves 25
25 and by means of which the respective partial width 7' can be released or shut off. Furthermore, a central switch 24 is provided by means of which all the shut-off valves 25 can be actuated simultaneously via the actuating elements 26.

[0067] In order to determine the filling level of a liquid in the liquid tank 1 the
30 evaluation device 3 is configured such that it combines a measurement of the filling level sensor 2 with a measurement of the first flow rate sensor 9 and a measurement of the second flow rate sensor 21 via an algorithm. The algorithm can as detailed above comprise a Kalman filter or can correspond to one such filter. Further

features can be formed corresponding to the exemplary embodiment of Fig. 1.

[0068] Since the actual amount dispensed by the field sprayer can be determined more accurately by the two flow rate sensors 9, 21, the determination of the filling level can be further improved by combining the two flow rate sensors.

[0069] The calculated filling level can then be displayed on a display device (not shown) of the field sprayer, and/or form the basis for further calculations.

[0070] The filling levels thus determined can be used according to a further exemplary embodiment to automatically calibrate the or each flow rate sensor.

[0071] Flow rate sensors of field sprayers have to be calibrated regularly since the measurement becomes more inaccurate during the course of time owing to wear and sediments. In the prior art a corresponding calibration was carried out at specific time intervals, by way of example annually. Calibration was generally not possible however for the operator himself of the field sprayer.

[0072] The present embodiment of the invention proposes that a difference between at least two filling levels is determined and used as the defined liquid quantity in order to carry out an automatic calibration of the flow rate sensors.

[0073] By way of example the differences between filling levels of one work process can be compared permanently or continuously with the total flow quantity through the flow rate sensor. A time graph of these values is shown by way of example in Fig. 3. The line 30 reproduces the time change of the filling level of the liquid tank which as shown above was determined based on a combination of the measurements. The line 31 on the other hand reproduces the total flow through a flow rate sensor, by way of example the flow rate sensor 9 of the above exemplary embodiments. A calibration is carried out in the event of a deviation of the two values by more than one predetermined threshold value, by way of example 100 litre (l). In the example of Fig. 3 the difference 32 between the values corresponds to about 180 l. In this example an automatic calibration is carried out

correspondingly as follows.

[0074] First the amount dispensed during the work process is determined from the filling level difference. A dispensed amount of 5400 l can be provided here by way of example. It is assumed that this difference in the filling levels corresponds to the actual amount dispensed since the filling levels were reliably determined with the method described above.

[0075] The throughflow amount measured by the flow rate sensor is then determined and converted by multiplication with the actual calibration value into pulses of the work process. By way of example the total flow amount through the flow rate sensor can correspond to 5580 l. Multiplied with an actual calibration value example of 700 pulses per litre, a total number of 3.906.000 pulses is produced therefrom. The new or updated calibration value can then be determined by dividing these pulses by the actual amount dispensed. Thus, in this case the number of pulses 3.906.000 is divided by 5400 l. In this concrete example this produces a new calibration value of 723 pulses per litre.

[0076] This new calibration value can as in this calculation example be calculated directly via the evaluation device 3 or can be determined by means of a regulator which comprises by way of example a PT₁ member or is one such member.

[0077] A corresponding automatic calibration can be carried out several times during one work process. The calibration can also be carried out several times over several work processes, in particular if no further filling of the liquid tank is carried out in the meantime.

[0078] If two flow rate sensors are used, as shown in the example of Fig. 2, the calibration can be carried out in different situations or operating modes. For calibrating the first flow rate sensor 9 of Fig. 2 the branch line 20 can be closed by way of example via the shut-off valve 17. To calibrate the second flow rate sensor 21 however all the partial widths 7' can be closed, by way of example by shutting off all the shut-off valves 25 by the corresponding actuating elements 26 via the

central switch 24. If all the partial widths are closed then the throughflow amounts in the liquid line 6 and the branch line 20 are identical.

5 [0079] It is understood that features mentioned in the previously described exemplary embodiments are not restricted to these special combinations and are possible also in any other combinations. Furthermore, the filling level sensor by way of example is not restricted to a combination of float and rotary potentiometer. Other sensors can also be provided, by way of example optical sensors. The flow rate sensors are not restricted to a specific embodiment.

PATENTKRAV

1. Landbrugs-marksprøjte, omfattende:

5 En væsketank (1);
en fyldstandsdetektor (2), som er tilordnet til væsketanken (1); og
en evalueringsindretning (3), som er forbundet med fyldstandsdetektor
10 ren (2); hvorved evalueringsindretningen (3) desuden er forbundet med
en flowsensor (9; 21);
kendetegnet ved, at
evalueringensindretningen (3) er udformet således, at den kombinerer en
måleværdi fra fyldstandsdetektoren (2) med en måleværdi fra flowsen-
soren (9, 21) med henblik på bestemmelse af fyldstanden for en væske
i væsketanken (1).

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2. Landbrugs-marksprøjte ifølge krav 1,
hvorved evalueringensindretningen (3) er udformet således, at den via en algo-
ritme kombinerer måleværdierne, hvorved algoritmen tager i betragtning de fy-
siske sammenhænge for sensorværdierne, navnlig mellem fyldstandshøjde og
20 fyldstandsændring, samt tager vægtningsfaktorer, henholdsvis nøjagtigheden
af måleværdierne i betragtning.

3. Landbrugs-marksprøjte ifølge krav 2,
hvorved evalueringensindretningen (3) er udformet således, at den tilpasser de af
25 algoritmen anvendte vægtningsfaktorer i afhængighed af driften af landbrugs-
marksprøjten.

4. Landbrugs-marksprøjte ifølge krav 3, hvorved evalueringensindretningen (3) er
udformet således, at de af algoritmen anvendte vægtningsfaktorer tilpasses i
30 afhængighed af marksprøjtes hastighed og/eller marksprøjtes hældning
og/eller fyldstanden i marksprøjten og/eller om marksprøjten drives i en påfyld-
ningsmodus eller i en udbringningsmodus.

5. Landbrugs-marksprøjte ifølge et af de foregående krav, ydermere omfattende:

5 En fordelerbom (7), omfattende sprøjtedyser (8); og
en væskeledning (6), der forbinder væsketanken (1) med fordelerbommen (7);
hvorved flowsensoren (9) er anbragt i væskeledningen (6).

10 6. Landbrugs-marksprøjte ifølge et af de foregående krav,
hvorved evalueringsindretningen (3) er udformet således, at den mindst anvender to fyldstande og/eller flowhastigheder, bestemt ved kombination af måleværdierne, med henblik på at udføre automatisk kalibrering af flowhastighedssensoren (9; 21) på basis af en differens mellem de mindst to fyldstande og/eller flowhastigheder.

15 7. Landbrugs-marksprøjte ifølge krav 6,
hvorved den automatiske kalibrering udføres en flerhed af gange under driften af marksprøjten med en tankpåfyldning af væsketanken (1).

20 8. Landbrugs-marksprøjte ifølge krav 6 eller 7,
hvorved den automatiske kalibrering udføres, når differensen mellem de mindst to fyldstande og/eller flowhastigheder på forudbestemt måde afviger fra flowmængden, der samtidig er bestemt ved hjælp af flowhastighedssensoren.

25 9. Landbrugs-marksprøjte ifølge et af de foregående krav,
kendetegnet ved, at algoritmen til kombination af målingerne omfatter et Kalman-filter.

30 10. Fremgangsmåde til bestemmelse af en fyldstand for en væsketank (1) i en landbrugs-marksprøjte, der omfatter en væsketank (1), en fyldstandsdetektor (2), som er tilordnet til væsketanken (1), en flowhastighedssensor (9; 21) samt en evalueringsindretning (3), der er forbundet til fyldstandsdetektoren (2) og flowhastighedssensoren (9; 21); hvilken fremgangsmåde omfatter trinnene:

Bestemmelse af en måleværdi fra fyldstandsdetektoren (2);
bestemmelse af en måleværdi fra flowhastighedssensoren (9; 21); og
bestemmelse af fyldstanden for væsketanken (1) ved hjælp af evalueringssindretningen (3) på basis af en kombination af måleværdien fra
5 fyldstandsdetektoren (2) og måleværdien fra flowhastighedssensoren
(9; 21).

11. Fremgangsmåde ifølge krav 9, hvorved evalueringssindretningen (3) kombi-
nerer målingerne via en algoritme, og vægtningsfaktorerne, som anvendes af
10 algoritmen, tilpasses i afhængighed af driften af landbrugs-marksprøjten.

12. Fremgangsmåde ifølge krav 9 eller 10, ligeledes omfattende automatisk ka-
librering af flowhastighedssensoren på basis af en differens mellem mindst to
bestemte fyldstande.

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13. Fremgangsmåde ifølge et af kravene 10-13, **kendetegnet ved, at** algoritmen til kombination af måleværdierne omfatter et Kalmann-filter.

20

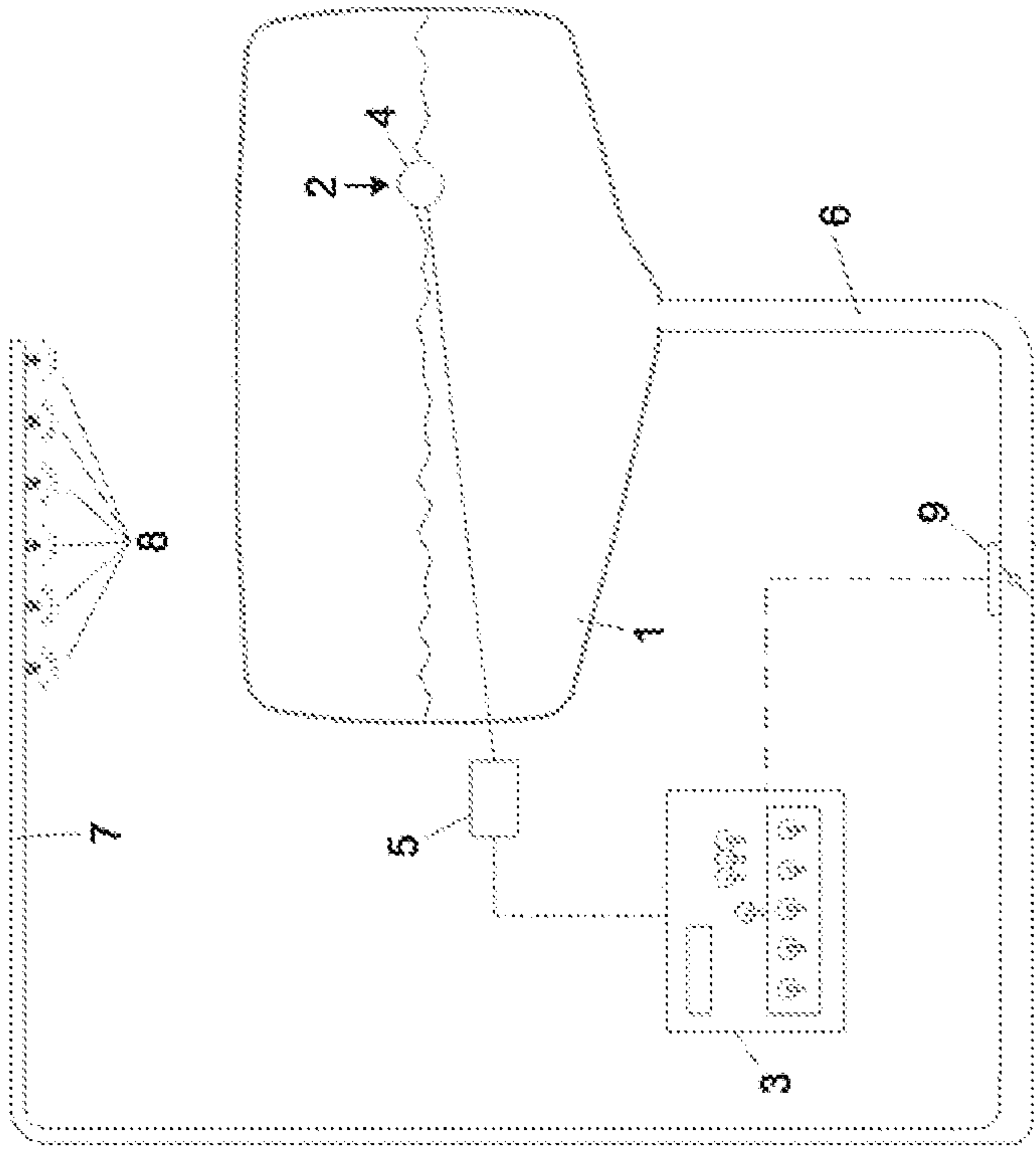


FIG. 1

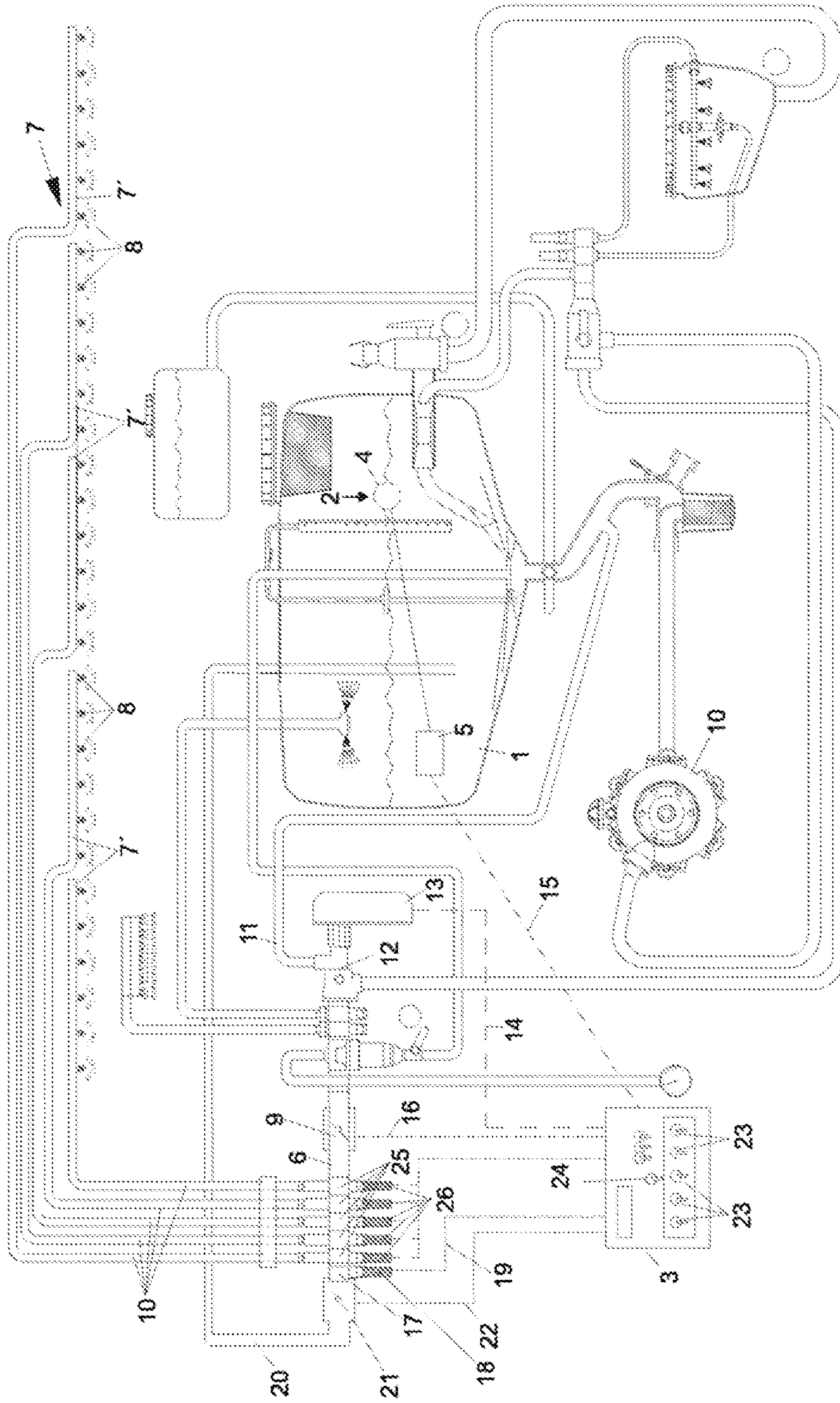


Fig. 2

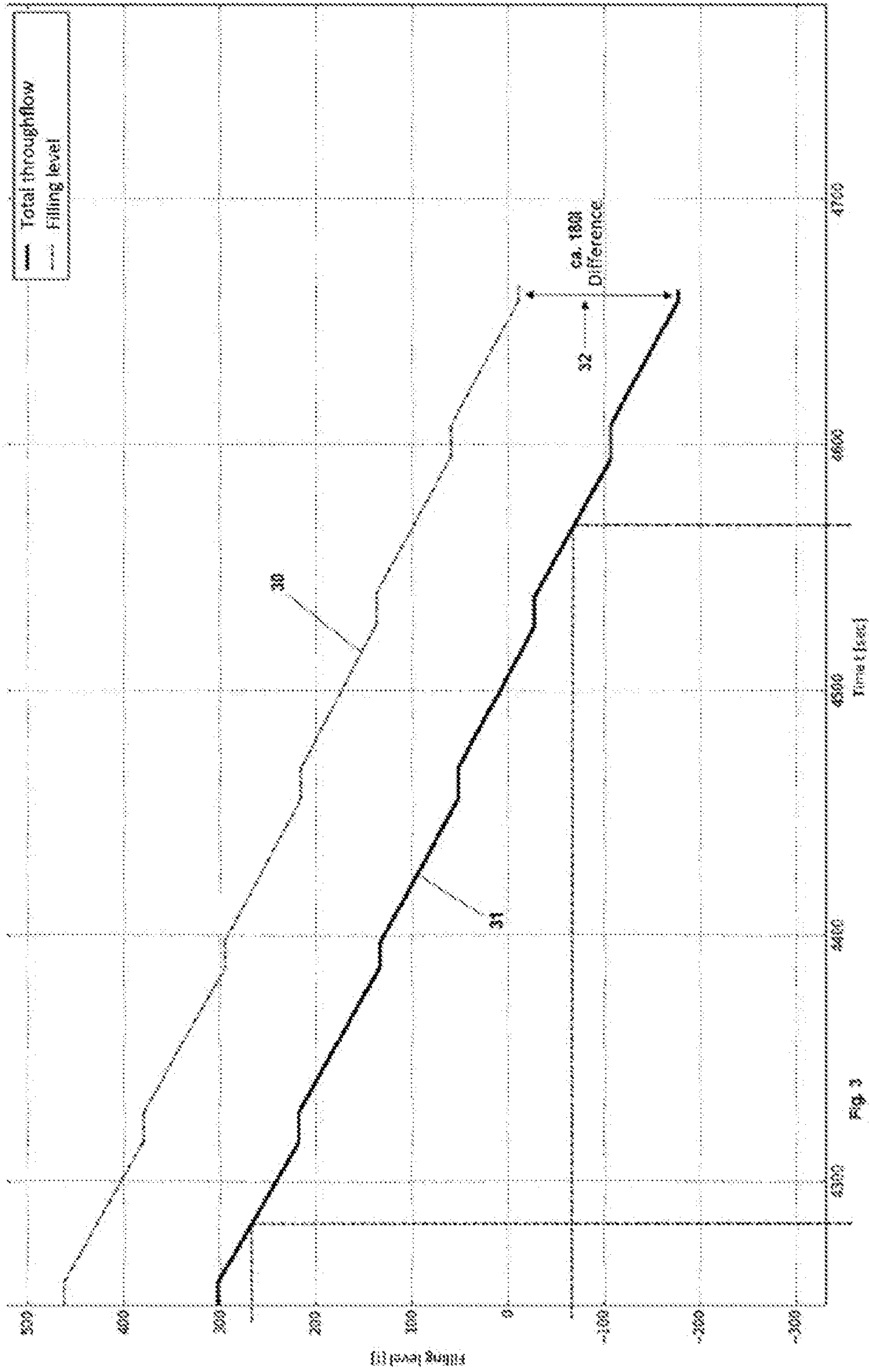


Fig. 3