(19) DANMARK

(10) **DK/EP 3501252 T3**

Patent- og Varemærkestyrelsen

(12) Oversættelse af europæisk patentskrift

(51) Int.Cl.: ***A 01 C 21/00 (2006.01)*** ***A 01 C 23/00 (2006.01)*** ***A 01 C 23/04 (2006.01)*** ***A 01 M 7/00 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2024-06-24**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2024-05-22**

(86) Europæisk ansøgning nr.: **18401098.1**

(86) Europæisk indleveringsdag: **2018-12-07**

(87) Den europæiske ansøgnings publiceringsdag: **2019-06-26**

(30) Prioritet: **2017-12-21 DE 102017130845**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(73) Patenthaver: **Amazonen-Werke H. Dreyer SE & Co. KG, Am Amazonenwerk 9-13, 49205 Hasbergen, Tyskland**

(72) Opfinder: **Klemann, Timo, Breitenriede 9, 49191 Belm, Tyskland**
Heer, Jochen, Blumenstraße 1a, 49074 Osnabrück, Tyskland

(74) Fuldmægtig i Danmark: **Novagraaf Brevets, Bâtiment O2, 2 rue Sarah Bernhardt CS90017, F-92665 Asnières-sur-Seine cedex, Frankrig**

(54) Benævnelse: **STYRE- OG/ELLER REGULERINGSSYSTEM, LANDBRUGSKØRETØJ OG FREMGANGSMÅDE TIL STYRING OG/ELLER REGULERING AF ET LANDBRUGSKØRETØJ**

(56) Fremdragne publikationer:
DE-A1-102017 104 805
DE-U1-202009 018 464
US-A1- 2016 175 869

CONTROL AND/OR REGULATING SYSTEM, AGRICULTURAL VEHICLE AND METHOD FOR CONTROLLING AND/OR REGULATING AN AGRICULTURAL VEHICLE

Description

The invention relates to an agricultural utility vehicle according to the preamble of patent claim 1 and to a method for open-loop and/or closed-loop control of an agricultural utility vehicle according to the preamble of patent claim 8.

Agricultural vehicles with a distributor boom are intended for dispensing materials, such as fertilizers, plant protectants, or seed, as described for example in DE 10 2017 104 805. Such distributor booms comprise a middle part and two arms connected to the middle part. The arms have at least one outer boom portion and one inner boom portion, which are connected to each other by means of joints and can be folded together. In addition, such arms may have one or more middle boom portions which are arranged between the outer and the inner boom portion and are joined in articulated fashion to these and to each other.

Distributor booms of this type have a transport position and a working position between which they can be moved. In the working position, the distributor boom extends transversely to the direction of advance and can reach a working width of up to 50 m.

With such large dimensions, in order to adapt the working width to the requirements of a current dispensing process, caused for example by the geometry of the area to be processed and/or by obstacles, it is common practice to partially fold the distributor boom in, in order to achieve a partial width working position. For this purpose, one or more boom portions are brought into a position parallel to the other boom portions.

Sensors are provided which detect the folding state of the arms and are connected to a data processing unit. The sensors detect whether a boom portion is in a partially folded-in position. The data processing unit is designed to activate or stop the deployment of the individual boom portions in a suitable manner as a function of the folding state of the arm.

The disadvantage is that the part-width working positions that can be reached in this way depend on which boom portions can be folded into a position parallel to the other boom portions. In addition, the achievable part-width working positions are a function of the dimensions of the boom portions. This means that only a few, discrete partial width working positions can be reached, which can also differ by several meters in the achievable partial working widths. In addition, it is only possible to activate or stop the deployment of a boom portion or, at best, individual nozzles.

Due to these disadvantages, the solutions known to date do not have the necessary flexibility to respond to the requirements of a dispensing process. Thus, incorrect applications resulting in yield losses due to unintentional overlaps or omissions are extremely likely.

The invention is therefore based on the object of providing an open-loop and/or closed-loop control system for an agricultural utility vehicle which overcomes the aforementioned disadvantages and allows flexible adjustment of the working width as well as optimization of the dispensing process.

US 2016 0 175 869 A1 discloses a determination of the positions of individual boom portions in relation to one another.

A further object of the invention is to provide an agricultural utility vehicle having an open-loop and/or closed-loop control system according to the invention.

Furthermore, the object of the invention is to provide a method for the open-loop and/or closed-loop control of an agricultural utility vehicle.

The object is achieved by the subject matter of claim 1.

This measure advantageously enables the output quantity to be controlled via the valves as a function of the actual working positions of the boom portions of the distributor boom, i.e., as a function of the positions and/or folding positions of the boom portions of the distributor boom.

The actual working positions of the boom portions of the distributor boom include, in addition to the standard positions in which all boom portions are aligned

substantially transversely to the direction of travel, other positions which deviate from the standard positions and do not correspond to the folded-in transport position. Depending on the requirements of a current dispensing process, the distributor boom can assume special positions in which the boom portions of the distributor boom have special positions.

A special position exists, for example, if a collision of a boom portion with an obstacle is impending and/or occurs and the arm and/or boom portion in question is pivoted to avoid damage to the distributor boom.

Another special position is present for example when arms and/or boom portions are pivoted to adjust the working width. This can be done for example using suitable adjusting means assigned to the distributor boom. By pivoting the arms and/or boom portions, the working width can be continuously varied, which advantageously allows a highly precise adjustment of the working width.

Individual boom portions, a plurality of boom portions, and/or the entire arm can be moved into a special position. According to the invention, the boom portions of an arm each have angles relative to each other, and/or the arms each have angles relative to each other. Due to the known arrangement of the nozzles on the distributor boom and the detection of the positions and/or folding positions of the boom portions of the distributor boom by detection means, the absolute positions of the nozzles with respect to the utility vehicle can be determined at any time.

The detection means are designed as sensors which can detect the positions and/or folding positions of the boom portions of the distributor boom. Preferably, the detection means are arranged in the boundary region between two adjacent boom portions and/or between a middle part of the distributor boom and an adjacent boom portion. In a particularly preferred manner, each boundary region is assigned a detection means.

The detection means are preferably designed as potentiometers, in particular as linear potentiometers or rotary potentiometers.

In an alternative embodiment, the detection means can also be designed as optical and/or imaging means.

Preferably, the detection means determine position deviations and/or angular deviations from reference values. The reference values can be defined, for example, by the positions and/or the folding positions of the boom portions of the distributor boom when the distributor boom is in the fully folded-out working position.

If material is applied through a nozzle arranged on the distributor boom, a spray fan is formed in a known manner. The geometry of the spray fan is, for example, a function of the nozzle characteristics and the pressure with which the material is fed to the nozzles. Typically, the nozzles are arranged on the distributor boom in such a way that the spray fans of adjacent nozzles overlap. This allows a particularly homogeneous dispensing of the material. If the arrangement of the nozzles on the distributor boom is known, the degree of overlap of the spray fans can be determined.

When determining the degree of overlap, not only the spatial overlap but also the temporal overlap must always be taken into account. This means that, depending on the positions and/or folding positions of the boom portions and the advance speed of the utility vehicle, the spray fans of the nozzles can also cover a position on the agricultural area in a temporally offset manner.

When the distributor boom is fully folded out, the lateral distance between the individual nozzles is at its maximum and thus the degree of overlap of the spray fans is minimal. If the positions and/or folding positions of the boom portions of the distributor boom are changed, for example to set a smaller working width, the lateral distance between the relevant nozzles changes, thereby increasing the overlap of the relevant spray fans. In order to avoid any misapplication caused as a result of this, the output quantity of the nozzles must be suitably reduced based on the positions and/or folding positions of the boom portions of the distributor boom and/or based on the actual degree of overlap of the spray fans determined from the positions and/or folding positions of the boom portions of the distributor boom.

The calculation of the appropriate output quantity of the nozzles as a function of the actual positions and/or folding positions of the boom portions of the distributor boom is based on geometric considerations which take into account the shape

and/or size of the spray fans. The shape of the spray fans is generally elliptical, but spray fans with rectangular or linear profiles are also possible.

The output quantity of the nozzles can be reduced in many ways. For example, the output quantity can be adjusted via the pressure with which the material is fed to the nozzle. In this case, the valves are designed, for example, as proportional valves or pressure relief valves, and the pressure with which the material is fed to the nozzles can be adjusted via the control signals for the valves generated by a data processing unit.

In another embodiment, valves operable with pulse-width modulation and/or frequency modulation can be provided. Pulse-width-modulated and/or frequency-modulated valves open and close periodically. The output quantity is substantially determined by the ratio of opening time to closing time. The output quantity can be easily adjusted via the control signals for the valves generated by the data processing unit by changing the ratio of opening time to closing time and/or varying the period duration.

The data processing unit can, for example, be part of a known terminal for operating and/or controlling agricultural utility vehicles. Alternatively, the data processing unit can be part of a control module assigned to the utility vehicle for controlling vehicle functions, for example a job computer. Typically, such a terminal and such a control module are connected in terms of signals and set up for interaction.

In an advantageous embodiment, the adjustment of the output quantity according to the invention can be combined with measures known from the prior art for controlling the output quantity. For example, it is known to adjust the output quantity as a function of the advance speed of the agricultural utility vehicle. Since, as a rule, a location- and/or demand-specific target quantity is to be dispensed per area, which quantity is known to the data processing unit, this measure ensures that this can be maintained at different and/or varying advance speeds. This is particularly important when traveling through curves since, due to the lateral extension of the distributor boom in the working position, individual boom portions and/or nozzles have different path speeds, which must be compensated for for a

homogeneous dispensing of the material. It is therefore common practice to detect traveling in a curve and/or the movement of individual boom portions and/or nozzles in order to adjust the output quantity on this basis. The adjustment of the output quantity according to the invention can then be available to an agricultural utility vehicle as an alternative, or additionally.

Analogously, it is provided for it to be possible to combine it with measures known from the prior art for the location- and/or demand-specific adjusting of the output quantity. When the output quantity is adjusted based on location and/or demand, the data processing unit has a location and/or demand-specific target rate.

In all of the cases described, the invention therefore provides for the output quantity to be adapted in a suitable manner to the local requirements on the basis of the positions and/or folding positions of the boom portions of the distributor boom and/or on the basis of the actual degree of overlap of the spray fans determined from the positions and/or folding positions of the boom portions of the distributor boom.

It is advantageous that the distributor boom is divided into partial working widths and all nozzles of a partial working width are connected to a valve. Preferably, a partial working width corresponds to the width of a boom portion. Thus, a simple and cost-effective variant of the system according to the invention is provided. By at least partially folding and/or pivoting an entire arm and/or an individual boom portion, this portion is aligned substantially diagonally to the direction of advance. As a result, the degree of overlap of the spray fans changes uniformly for the nozzles of a particular boom portion. The control of a valve which regulates the supply of material for all nozzles of the relevant boom portion is therefore sufficient for adjusting the output quantity to the degree of overlap, wherein the regulation effort is low.

In particular, the dispensing via the nozzles of a corresponding boom portion can thus be stopped in a simple manner, for example if adjacent, partially folded-in boom portions are in a parallel position. In this case, a complete overlap would be achieved.

It is advantageous that each nozzle is connected to one corresponding valve in each case. Preferably, a partial working width here corresponds to a single nozzle.

This measure allows a highly precise adjustment of the output quantity. In an advantageous manner, it can thus also be taken into account that, in particular when traveling on a curve, the path speed of the individual nozzles in the lateral extension of the distributor boom, in particular within a boom portion, is different.

This measure advantageously takes into account the fact that the nozzles have different positions with respect to the direction of advance due to the partial folding. This means that the nozzles can be controlled individually as required, in particular in a time-offset manner. In particular, this relates to activating and/or stopping the dispensing of material through the relevant nozzle when an application limit is reached. This significantly optimizes the dispensing and reduces incorrect applications such as overlaps and/or omissions.

Application boundaries can for example be boundaries of the agricultural area beyond which dispensing is not permitted and/or boundaries within the agricultural area which separate areas which have already been processed and areas which have not been processed.

An advantage is that the nozzles are connected to valves which are operable in a pulse-width-modulated and/or frequency-modulated manner. The previously described functionality of pulse-width-modulated and/or frequency-modulated valves enables a highly precise and very fast adjustment of the output quantity. Pulse-width-modulated and/or frequency-modulated valves can be operated over a wide frequency range. A typical operating frequency is in the range of 50 Hz. Higher operating frequencies in the order of 100 Hz are achievable. This means that such valves have very short switching times, which allow them to respond quickly to the requirements of the work process.

A particular advantage is achieved by using valves that can be operated with pulse width modulation and/or frequency modulation, because a change in the ratio of opening time to closing time and/or a variation in the period of the valve does not change the droplet spectrum dispensed by the nozzle in question. The droplet spectrum has a major influence on the dispensing quality. A droplet spectrum that is constant at different output quantities ensures a correspondingly consistent dispensing quality.

It is advantageous that the shape and/or size of the spray fans of the nozzles arranged on the distributor boom can be stored and control signals for the valves can be generated on the basis of the shape and/or size of the spray fans. This measure advantageously enables the previously described exact determination of the actual degree of overlap as a function of the geometry of the spray fan.

This measure is particularly advantageous when the nozzles are part of so-called multiple nozzle bodies. Multiple nozzle bodies each carry a plurality of individual nozzles, wherein the nozzles can be selected as a function of the requirements of the dispensing process. The spray fans of the nozzles of a multiple nozzle body can have different geometries, so that for a selected nozzle the data processing unit must always know the geometry of the relevant spray fan in order to perform the adjustment according to the invention of the output quantity in an exact manner.

It is also advantageous that the system has detection devices which are designed to detect changes in position and/or folding position and on the basis of which the control signals for the valves can be generated. This measure makes it possible to detect relative movements between the arms and/or individual boom portions. The data processing unit can react in real time to these relative movements and/or to the speed differences of the individual arms, boom portions, and/or nozzles caused by the relative movements and generate the control signals for the valves on this basis. This significantly optimizes the adjustment of the output quantity and significantly reduces incorrect applications.

Basically, for the present invention, it must be taken into account that a change in the position and/or folding position of an arm and/or boom portion can be brought about in various ways. A maneuver in order to avoid a collision as described above results in a change in the position and/or folding position of an arm and/or boom portion. This avoidance can be done passively by allowing an arm and/or boom portion to be pivoted by the advance of the utility vehicle in the event of a collision.

Alternatively or additionally, evasive action can also be taken in advance and actively when a collision is expected. For this purpose, it is conceivable to detect the environment, which detection is then evaluated for example by the data processing unit. The data processing unit can then generate suitable control

signals which are fed to actuating devices which are designed to change the positions and/or folding positions of the boom portions of the distributor boom.

Such adjusting devices are provided for distributor booms of this type in order to move the distributor boom between the transport position and the working position. In addition, it is possible to use the adjusting devices to move the distributor boom into a previously described partial width working position and/or to change the positions and/or folding positions of the boom portions of the distributor boom in the manner described above in order to adapt the working width to the requirements of the dispensing process.

Advantageously, the current working width of the utility vehicle is always known and can be taken into account when operating and/or controlling the utility vehicle.

Furthermore, in the manner described, the current resulting path speed of the individual boom portions and/or nozzles is always known, even when the boom portions are moving relative to one another, which enables a further optimized adjustment of the output quantity.

The data processing unit can be assigned a storage unit, wherein information about areas of an agricultural area that have already been processed and/or are still to be processed is stored in the storage unit. It is advantageous that the control signals for the valves can be generated based on the information about areas that have already been processed and/or are still to be processed. This measure makes it easy to adjust the output quantity to the amount already dispensed at a field position.

By knowing the exact positions and/or folding positions of the boom portions of the distributor boom and/or the nozzles, in particular in the direction of advance, in conjunction with the information stored in the storage unit about areas already processed and/or still to be processed, a highly precise adjustment of the output quantity is made possible in a particularly advantageous manner. In particular, the dispensing by an individual boom portion and/or an individual nozzle can be activated and/or stopped at appropriate times.

It is advantageous that the output quantity of the nozzles can be controlled by means of the control signals that can be generated for the valves. The fluid connection between the valves and the nozzles regulates the amount of material fed to the nozzles via the valves. This makes it particularly easy to carry out the measures described above. In particular, it should be remembered that the output quantity of a nozzle can also be zero. In this respect, the functionality of a known partial width circuit is also included in a simple manner.

In order to achieve the above-mentioned advantages, it is provided to equip an agricultural utility vehicle for dispensing material, such as fertilizers, plant protectants, or seed, with a described open-loop and/or closed-loop control system. With regard to the advantages and modifications of the agricultural utility vehicle according to the invention, reference is made to the advantages and modifications of the open-loop and/or closed-loop control system according to the invention.

According to the invention, a method of the type mentioned at the outset is additionally provided, wherein the output quantity of the nozzles is changed via the control signals generated for the valves. With regard to the advantages and modifications of the method according to the invention, reference is first made to the advantages and modifications of the open-loop and/or closed-loop control system according to the invention.

In a particularly preferred embodiment of the method according to the invention, the output rate of the nozzles is changed by means of the generated control signals for the valves by means of a pulse width modulation and/or a frequency modulation. Pulse width modulation and/or frequency modulation achieves periodic opening and closing of the valves. The output quantity is substantially determined by the ratio of opening time to closing time. Changing the output quantity of the nozzles preferably comprises changing the ratio of opening time to closing time and/or varying the period duration.

In addition, a method according to the invention is advantageous in which control signals for the valves are generated on the basis of the shape and/or size of the spray fans of the nozzles arranged on the distributor boom. Typically, the nozzles are arranged on the distributor boom in such a way that the spray fans of adjacent

nozzles overlap. This allows a particularly homogeneous dispensing of the material. If there is a change in the position of one or more boom portions of the distributor boom, the output quantity at one or more nozzles must be adjusted in order to maintain the homogeneous dispensing of the material.

Furthermore, a method according to the invention is advantageous in which position changes and/or folding position changes of the boom portions of the lateral arms are detected. Control signals for the valves are generated on the basis of the detected position changes and/or folding position changes of the boom portions of the lateral arms. The detection of the position changes and/or folding position changes of the boom portions of the lateral arms is preferably carried out via detection means, in particular sensors. Preferably, the detection means are arranged in the boundary region between two adjacent boom portions and/or between a middle part of the distributor boom and an adjacent boom portion. In a particularly preferred manner, each boundary region is assigned a detection means. Preferably, the detection of the position changes and/or folding position changes of the boom portions of the lateral arms comprises the detection of position deviations and/or angular deviations from reference values. The reference values can be defined, for example, by the positions and/or the folding positions of the boom portions of the distributor boom when the distributor boom is in the fully folded-out working position.

In a development of the method according to the invention, control signals for the valves are generated on the basis of information about regions of an agricultural area that have already been processed and/or are still to be processed. The information on areas of the agricultural area that have already been processed and/or are still to be processed can be stored on a storage unit of the agricultural utility vehicle. By knowing the exact positions and/or folding positions of the boom portions of the distributor boom and/or the nozzles, in particular in the direction of advance, the information on areas already processed and/or still to be processed can be used in a particularly advantageous manner to enable highly precise adjustment of the output quantity. In particular, the dispensing by an individual boom portion and/or an individual nozzle can be activated and/or stopped at appropriate times.

Further details of the invention can be found in the description of examples and in the drawings. In the figures:

Fig. 1 shows an agricultural utility vehicle in the form of a towed field sprayer with the distributor boom in the transport position in an oblique perspective view from the rear above,

Fig. 2 shows a field sprayer with the distributor boom in working position in an oblique perspective view from the rear above,

Fig. 3 shows a field sprayer with an angled outer boom portion in a view from above,

Fig. 4 shows a field sprayer with an angled arm in a view from above,

Fig. 5 shows a field sprayer with a folded-in outer boom portion in a view from the rear,

Fig. 6 shows a field sprayer with a distributor boom in a partial width working position in an oblique perspective view from the rear above,

Fig. 7.1 shows a folding state of the distributor boom of a field sprayer in a view from above,

Fig. 7.2 shows another folding state of the distributor boom of a field sprayer in a view from above,

Fig. 7.3 shows another folding state of the distributor boom of a field sprayer in a view from above,

Fig. 7.4 shows another folding state of the distributor boom of a field sprayer in a view from above, and

Fig. 7.5 shows another folding state of the distributor boom of a field sprayer in a view from above.

Agricultural utility vehicles in the form of agricultural field sprayers 1, as shown in Fig. 1 to 7, are used for dispensing material, such as fertilizers, plant protectants, and/or seed on agricultural land.

Agricultural field sprayers 1 can be designed as variants that are self-propelled, mounted on a towing vehicle 2 or, as in the selected embodiment, towed by a towing vehicle 2.

To store the material to be dispensed, a field sprayer 1 comprises a storage container 3. The storage container 3 is supported on a frame which is connected to the towing vehicle 2 and is supported on the ground via wheels 4.

To dispense the stored material, the field sprayer 1 comprises a distributor boom 5 which is connected to the frame via a suspension device 6. The distributor boom 5 comprises a middle part 7 and two arms 8a, 8b arranged laterally on the middle part 7. The arms 8a, 8b each comprise at least one outer boom portion 9a and one inner boom portion 9i which is connected to the middle part 7. In addition, the arms 8a, 8b, as in the chosen example, can comprise one or more middle boom portions 9 m which are each arranged between the inner boom portion 9i and the outer boom portion 9a.

The adjacent boom portions 9a, 9i, 9 m are connected to each other by means of joints. The inner boom portions 9i are connected to the middle part 7 by means of joints.

Nozzles are arranged at a distance from one another on the boom portions 9a, 9i, 9m, which nozzles are connected to the storage container 3 in a fluid-conducting manner via a line system, and through which nozzles the material to be dispensed is output. In the preferred embodiment, each nozzle is assigned a controllable valve via which the output quantity supplied to the nozzle is controlled and/or regulated.

If material is dispensed through a nozzle arranged on the distributor boom 5, a spray fan is formed. The geometry of the spray fan is, for example, a function of the nozzle characteristics and the pressure with which the material is fed to the nozzles. Typically, the nozzles are arranged on the distributor boom 5 in such a way that the spray fans of adjacent nozzles overlap. The arrangement of the nozzles on the distributor boom 5 as well as the geometry of the spray fan are known and stored in a storage unit assigned to the data processing unit. Based on this data, the degree of overlap of the spray fans is determined.

Each boom portion 9a, 9i, 9 m is assigned an adjusting device (not shown) by means of which the articulated boom portions 9a, 9i, 9 m can be folded relative to one another, and in this way the distributor boom 5 can be folded. The adjusting devices can be operated hydraulically, pneumatically, or in other equivalent ways.

For road transport trips, the distributor boom 5 can be moved into a transport position by the adjusting devices, as shown in Fig. 1. For dispensing material, the distributor boom 5 can be brought into a working position, as shown in Fig. 2. In this working position, the distributor boom 5 extends substantially transversely to the direction of advance V. The working width of a fully folded-out distributor boom 5 can be up to 50 m.

The field sprayer 1 has several detection means, not shown, designed as sensors. The detection means are designed as potentiometers, for example as linear potentiometers or as rotary potentiometers, and are arranged in the boundary region between two adjacent boom portions 9a, 9i, 9 m and/or between the middle part 7 and an adjacent boom portion 9i. Thus, the detection means are assigned to the joints between two adjacent boom portions 9a, 9i, 9 m and/or between the middle part 7 and an adjacent boom portion 9i.

The detection means are designed to detect the angular position between two adjacent boom portions 9a, 9i, 9 m and/or between the middle part 7 and an adjacent boom portion 9i and to feed the measurement data to a data processing unit assigned to the field sprayer. The positions and/or folding positions of the arms 8a, 8b and/or the boom portions 9a, 9i, 9 m can be determined via the angular position between two adjacent boom portions 9a, 9i, 9 m and/or between the middle part 7 and an adjacent boom portion 9i.

Alternatively, the detection means can also be assigned to the adjusting devices between two adjacent boom portions 9a, 9i, 9 m and/or between the middle part 7 and an adjacent boom portion 9i. By detecting the working position of the actuating device, it is possible in an analogous manner to determine the positions and/or folding positions of the arms 8a, 8b and/or the boom portions 9a, 9i, 9m.

When carrying out a dispensing operation, it is often necessary to adapt the working width of the distributor boom 5 to the requirements of the dispensing

process. In particular, for this purpose the actual working width must be reduced compared to the maximum possible working width with the distributor boom 5 fully folded out if, for example, it is not spatially possible and/or not legally permitted to continue the dispensing process with the distributor boom 5 fully folded out.

A typical example is an obstacle H located on the surface to be processed, as shown for example in Fig. 3 to 5. In order to avoid damage to the distributor boom 5, boom portions 9a, 9i, 9 m can perform an avoidance maneuver in the direction opposite the advance direction V, in the event of a collision that has occurred and/or is expected (Fig. 3).

In an analogous manner, an arm 8b can also move completely opposite the direction of advance V in the event of a collision that has occurred or is expected with an obstacle H, as shown in Fig. 4, where the second arm is omitted.

The avoidance can be done passively. Due to the continuous advance of the field sprayer 1, a boom portion 9a, 9i, 9 m and/or an arm 8a, 8b then pivots against the advance direction V.

Alternatively, avoidance can be done actively. For this purpose, it is conceivable to detect the environment, which detection is then evaluated for example by the data processing unit. The data processing unit then generates suitable control signals which are fed to actuating devices designed to change the positions and/or folding positions of the boom portions of the distributor boom.

By means of an open-loop and/or closed-loop control system 10 of the field sprayer 1, control signals are generated for the valves, which cause an adjustment of the output quantity at one, a plurality of, or all nozzles. The output quantity is adjusted as a function of the change in the positions and/or folding positions of the boom portions 9a, 9m, 9i.

After the boom portions 9a, 9i, 9 m and/or arms 8a, 8b have carried out the avoidance, it is provided that the boom portion 9a, 9i, 9 m automatically returns to its initial position.

Fig. 5 shows a complete folding in of the relevant outer boom portion 9a in order to bypass the obstacle H, in order to achieve an adjusted partial width working position of the distributor boom 5.

Another, symmetrical partial width working position for adjusting the working width is shown in Fig. 6. Here the middle boom portions 9 m are folded in and brought into a position parallel to one another.

Fig. 7.1 to 7.5 provide, as an example, a schematic overview of achievable positions and/or folding positions of the arms 8a, 8b and/or boom portions 9a, 9i, 9m. To simplify the illustration, in each case the distributor boom 5 is shown on one side only.

Fig. 7.1 shows the transport position again, Fig. 7.2 the fully folded-out working position with maximum working width. Fig. 7.3 shows a partially folded partial width working position. Fig. 7.4 shows an angled arm 8b. Fig. 7.5 shows the distributor boom with angled boom portions 9a, 9i, 9m.

Such positions and/or folding positions of the arms 8a, 8b and/or the boom portions 9a, 9i, 9 m can be brought about by means of the adjusting devices and serve to continuously adjust the working width to the requirements of the dispensing process.

Regardless of its cause, be it passive or active pivoting, a change in the position and/or folding position of an arm 8a, 8b and/or boom portion 9a, 9i, 9 m always leads to a change in the degree of overlap of the spray fans on the relevant arm 8a, 8b and/or boom portion 9a, 9i, 9m. The degree of overlap of the spray fans influences the quantity of material to be dispensed that is output per unit area.

In order to achieve the most homogeneous dispensing possible, a fixed degree of overlap of the spray fans of adjacent nozzles is provided, even at maximum working width. A change in the position and/or folding position of an arm 8a, 8b and/or boom portion 9a, 9i, 9 m leads to a reduced lateral distance between the respective nozzles and thus to an increased degree of overlap.

In order to adjust the output quantity to the location- and/or demand-specific target quantity, it is necessary to adjust the output quantity of the relevant nozzles to the changed degree of overlap of the spray fans.

For this purpose, the data processing unit processes the measurement data of the detection means for detecting the positions and/or the folding positions of the boom portions 9a, 9i, 9 m of the distributor boom 5, and generates control signals for the controllable valves from these data.

The valves can then be designed, for example, as proportional valves or pressure relief valves. The pressure at which the material is fed to the nozzles is then adjusted via the control signals for the valves generated by the data processing unit.

In a preferred embodiment, valves that can be operated with pulse width modulation and/or frequency modulation are provided. The output quantity can be easily adjusted via the control signals for the valves generated by the data processing unit by changing the ratio of opening time to closing time and/or varying the period duration.

By additionally detecting position changes and/or folding position changes of the individual boom portions 9a, 9i, 9m, relative speeds between the individual boom portions 9a, 9i, 9 m or nozzles are detected and supplied to the data processing unit. This allows the described adjustments of the output quantity to be carried out in real time even during a relative movement of the boom portions 9a, 9i, 9 m or nozzles, for example caused by pivoting.

The intended data processing unit can, for example, be part of a known terminal for operating and/or controlling agricultural utility vehicles. Alternatively, the data processing unit can be part of a control module assigned to the utility vehicle for controlling vehicle functions, for example a job computer. Typically, such a terminal and such a control module are connected in terms of signals and set up for interaction.

The open-loop and/or closed-loop control system 10 according to the invention and the method according to the invention can be combined with systems and/or methods known per se for the location- and/or demand-specific dispensing of

material. Information about regions of the agricultural area that have already been processed and those that still need to be processed is stored in the storage unit assigned to the data processing unit. The output quantity can thus be additionally adjusted in the manner described based on this information.

Since the position of each nozzle, in particular in the direction of advance (cf. Fig. 7.5), is known from the positions and/or folding positions of the boom portions 9a, 9i, 9 m of the distributor boom 5, times can be determined for each nozzle, in particular as a function of the advance speed at which the dispensing of material must be activated or stopped so that the location- and/or demand-specific target quantity is dispensed without interruption.

The location- and/or demand-specific target quantity is determined in a known manner on the basis of the current dispensing process and is supplied to the data processing unit.

The present invention thus provides a powerful system and method for flexible adjustment of the working width and for optimization of the dispensing process in a simple manner.

Reference symbols

1	Agricultural utility vehicle
2	Towing vehicle
3	Storage container
4	Wheels
5	Distributor boom
6	Suspension device
7	Middle part
8a, 8b	Arm
9a, 9i, 9m	Boom portions
10	Open-loop and/or closed-loop control system
V	Advance direction
H	Obstacle

PATENTKRAV

1. Landbrugsnyttekøretøj (1) til udbringning af materiale, såsom gødningsstoffer, plantebeskyttelsesmidler eller såsæd, med et styre- og/eller regelsystem (10), med en fordelerbom (5) til udbringning af materiale, hvilken bom omfatter to sidearme (9a, 9b), som hver især har mindst én bevægelig bomdel (9a, 9i, 9m), hvor bomdelene (9a, 9i, 9m) har mindst to arbejdspositioner, dvs. positioner og/eller sammenfoldningspositioner, hvor en arms bomdele hver især har vinkler i forhold til hinanden, og/eller armene hver især har vinkler i forhold til hinanden, og der er anbragt dyser på bomdelene (9a, 9i, 9m), hvilke dyser er forbundet med regulerbare ventiler, og hvor systemet (10) har en flerhed af detekteringsmidler og en databehandlingsenhed, hvor detekteringsmidlerne er udformet til at detektere arbejdspositionen af fordelerbommens (5) bomdele (9a, 9i, 9m), **kendetegnet ved, at** databehandlingsenheden er konfigureret således, at signalerne fra detekteringsmidlerne kan behandles, og der på basis deraf kan genereres styresignaler for ventilerne, hvor dysernes udbringningsmængde kan ændres ved hjælp af styresignalerne for ventilerne.

2. Køretøj (10) ifølge krav 1,

kendetegnet ved, at fordelerbommen (5) er opdelt i delarbejdsbredder, og alle dyser i en delarbejdsbredde er forbundet med en ventil.

3. Køretøj (10) ifølge krav 1 eller 2,

kendetegnet ved, at hver dyse i hvert tilfælde er forbundet med én ventil.

4. Køretøj (10) ifølge et hvilket som helst af de foregående krav,

kendetegnet ved, at dyserne er forbundet med ventiler, der kan fungere på en pulsbreddemoduleret og/eller frekvensmoduleret måde.

5. Køretøj (10) ifølge et hvilket som helst af de foregående krav,

kendetegnet ved, at formen på og/eller størrelsen af sprøjtevifterne på dyserne, der er anbragt på fordelerbommen (5), kan lagres, og der kan genereres styresignaler for ventilerne på basis af sprøjtevifternes form og/eller størrelse.

6. Køretøj (10) ifølge et hvilket som helst af de foregående krav,

kendetegnet ved, at systemet (10) har detekteringsindretninger, der er udformet til at detektere positionsændringer og/eller sammenfoldningspositionsændringer af sidearmenes (9a, 9b) bomdele (9a, 9i, 9m), på basis af hvilke styresignalerne for ventilerne kan genereres.

7. Køretøj (10) ifølge et hvilket som helst af de foregående krav,

hvor informationer vedrørende allerede behandlede og/eller endnu ikke behandlede områder af et landbrugsareal kan lagres i en hukommelsesenhed,

kendetegnet ved, at styresignalerne for ventiler kan genereres på basis deraf.

8. Fremgangsmåde til styring og/eller regulering af et landbrugsnyttekøretøj (1) ifølge et hvilket som helst af kravene 1 til 7, hvor landbrugsnyttekøretøjet (1) har en fordelerbom (5) til udbringning af materiale, hvilken fordelerbom omfatter to sidearme (9a, 9b), der hver især har mindst én bevægelig bomdel (9a, 9i, 9m), hvor bomdelene (9a, 9i, 9m) har mindst to arbejdspositioner, dvs. positioner og/eller sammenfoldningspositioner, hvor en arms bomdele hver især har vinkler i forhold til hinanden, og/eller armene hver især har vinkler i forhold til hinanden, og hvor der er anbragt dyser på bomdelene (9a, 9i, 9m), hvilke dyser er forbundet med regulerbare ventiler, hvilken fremgangsmåde omfatter følgende trin:

- detektering af arbejdspositionen af fordelerbommens (5) bomdele (9a, 9i, 9m);

kendetegnet ved følgende trin:

- generering af styresignaler for ventilerne på basis af bomdelenes (9a, 9i, 9m) detekterede arbejdsposition;

- ændring af dysernes udbringningsmængde ved hjælp af de genererede styresignaler for ventilerne.

9. Fremgangsmåde ifølge krav 8,

kendetegnet ved, at dysernes udbringningsmængde ændres ved hjælp af de genererede styresignaler for ventilerne ved hjælp af en pulsbreddemodulation og/eller en frekvensmodulation.

10. Fremgangsmåde ifølge krav 8 eller 9,

kendetegnet ved, at der genereres styresignaler for ventilerne på basis af formen på og/eller størrelsen af sprøjtevifterne på dyserne, der er anbragt på fordelerbommen (5).

11. Fremgangsmåde ifølge et hvilket som helst af kravene 8 til 10,

kendetegnet ved følgende trin:

- detektering af positionsændringer og/eller

sammenfoldningspositionsændringer af sidearmenes (9a, 9b) bomdele (9a, 9i, 9m),

hvor der genereres styresignaler for ventilerne på basis af de detekterede positionsændringer og/eller sammenfoldningspositionsændringer af sidearmenes (9a, 9b) bomdele (9a, 9i, 9m).

12. Fremgangsmåde ifølge et hvilket som helst af kravene 8 til 11,

kendetegnet ved, at der genereres styresignaler for ventilerne på basis af informationer vedrørende allerede behandlede og/eller endnu ikke behandlede områder af et landbrugsareal.

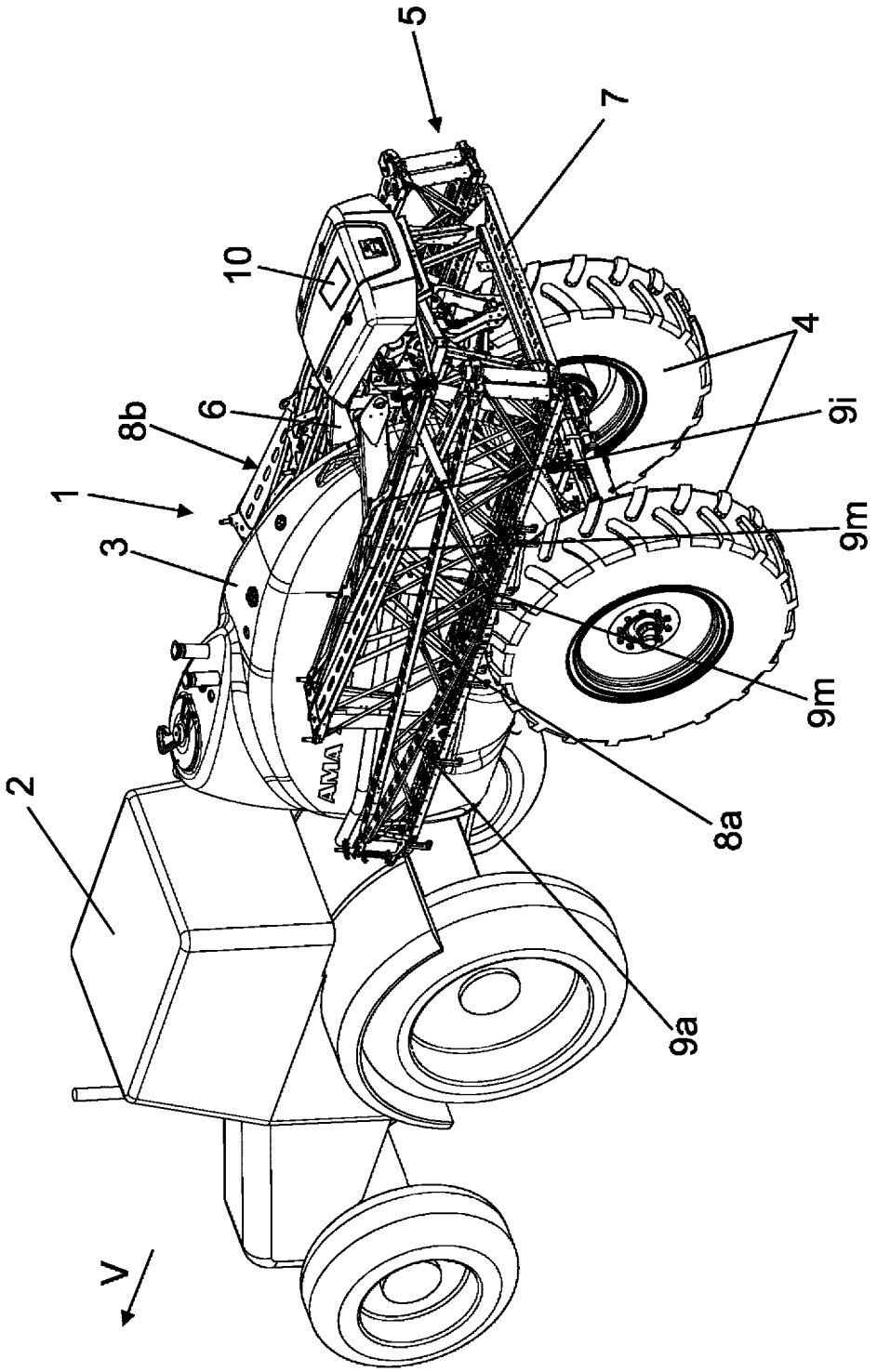

Fig.1

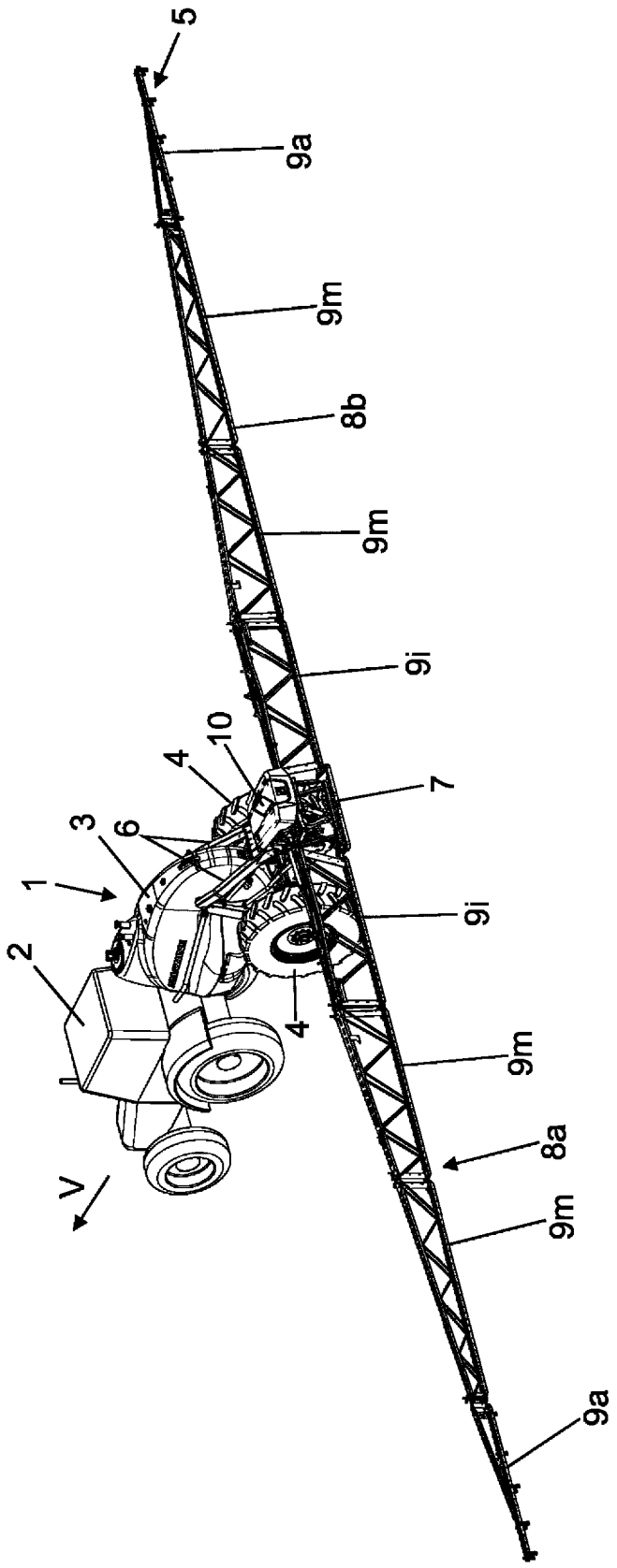

Fig.2

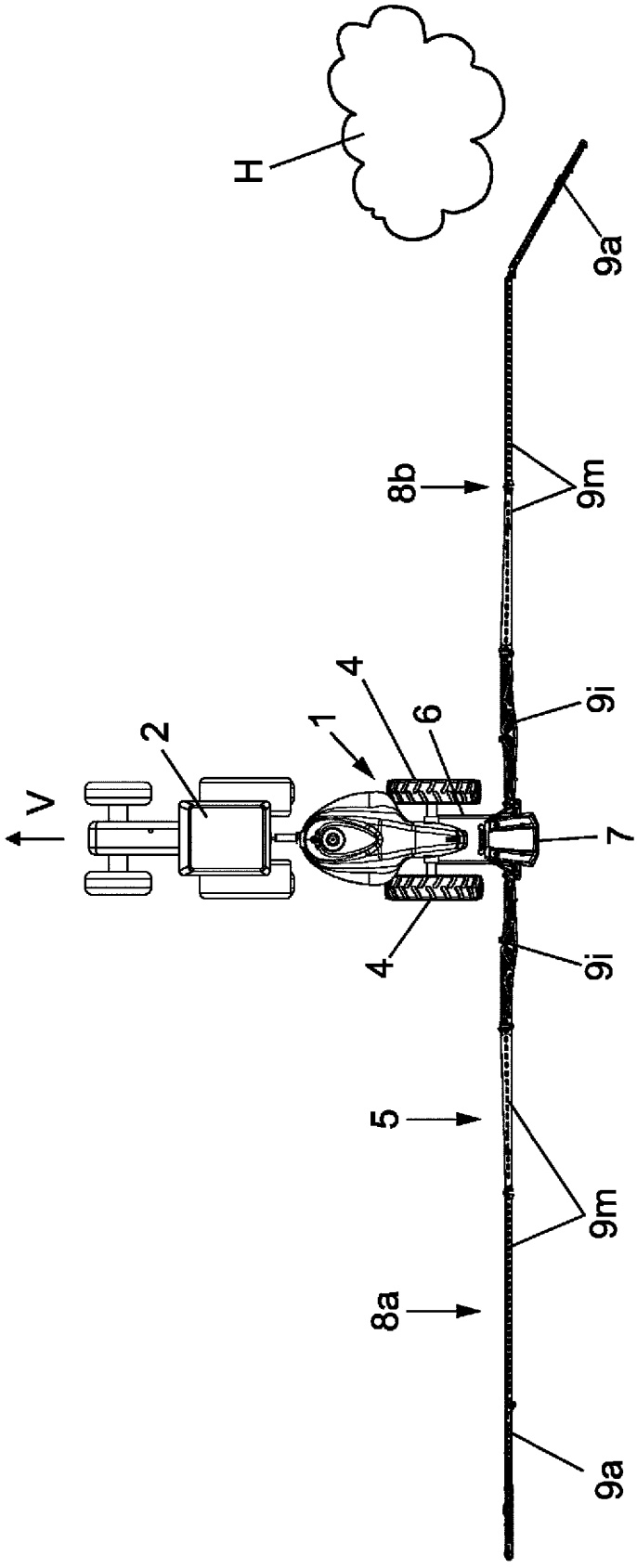

Fig.3

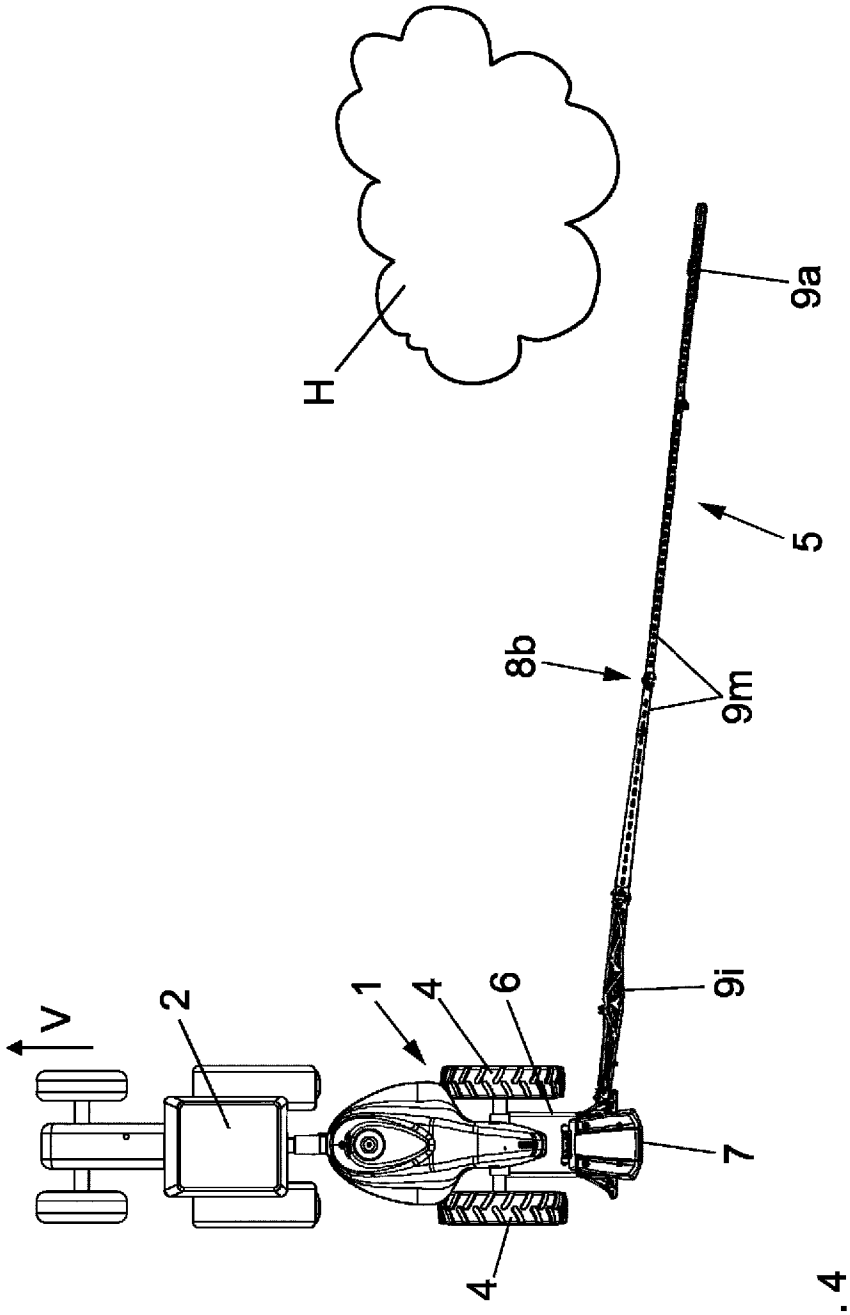

Fig. 4

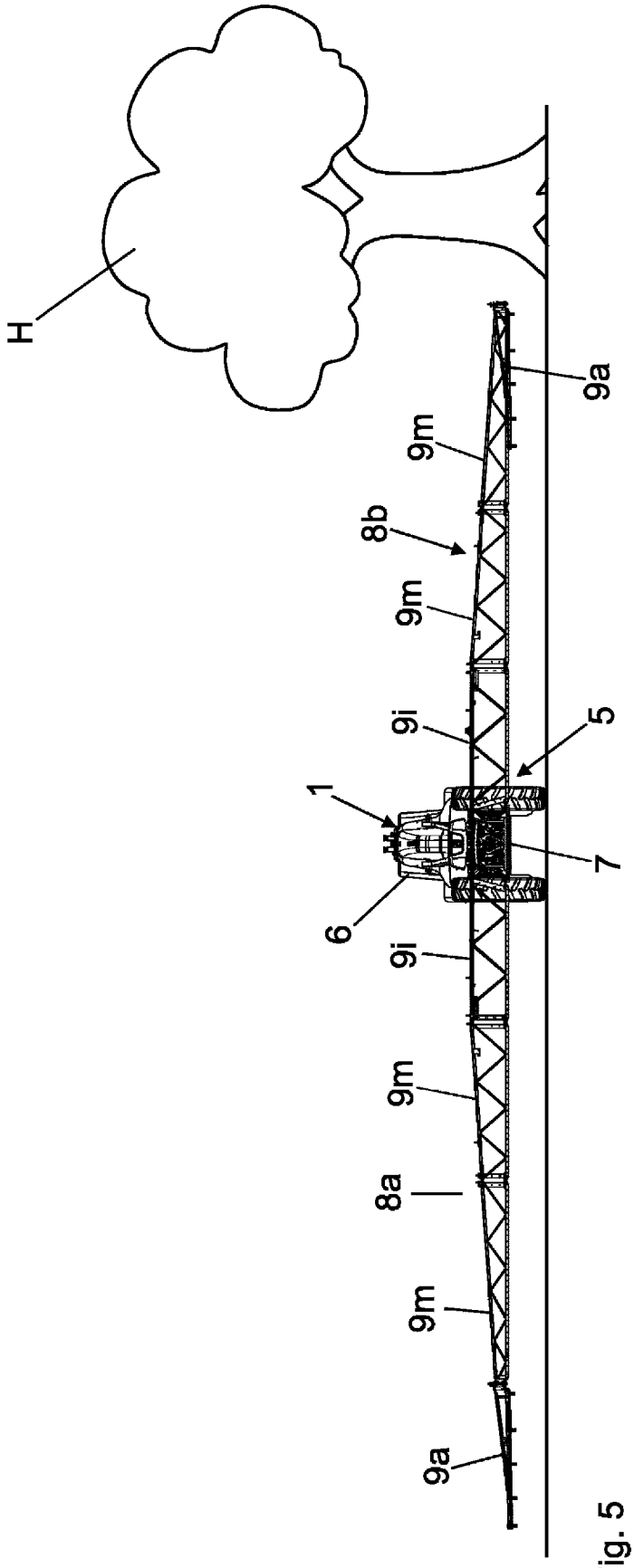

Fig. 5

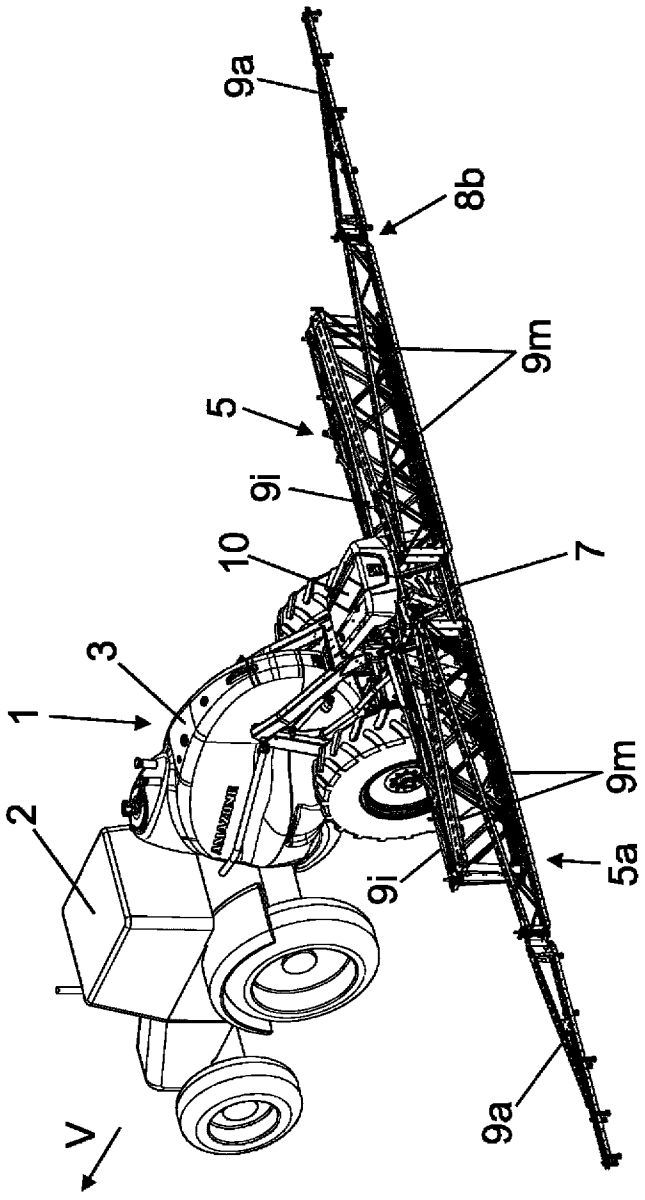

Fig.6

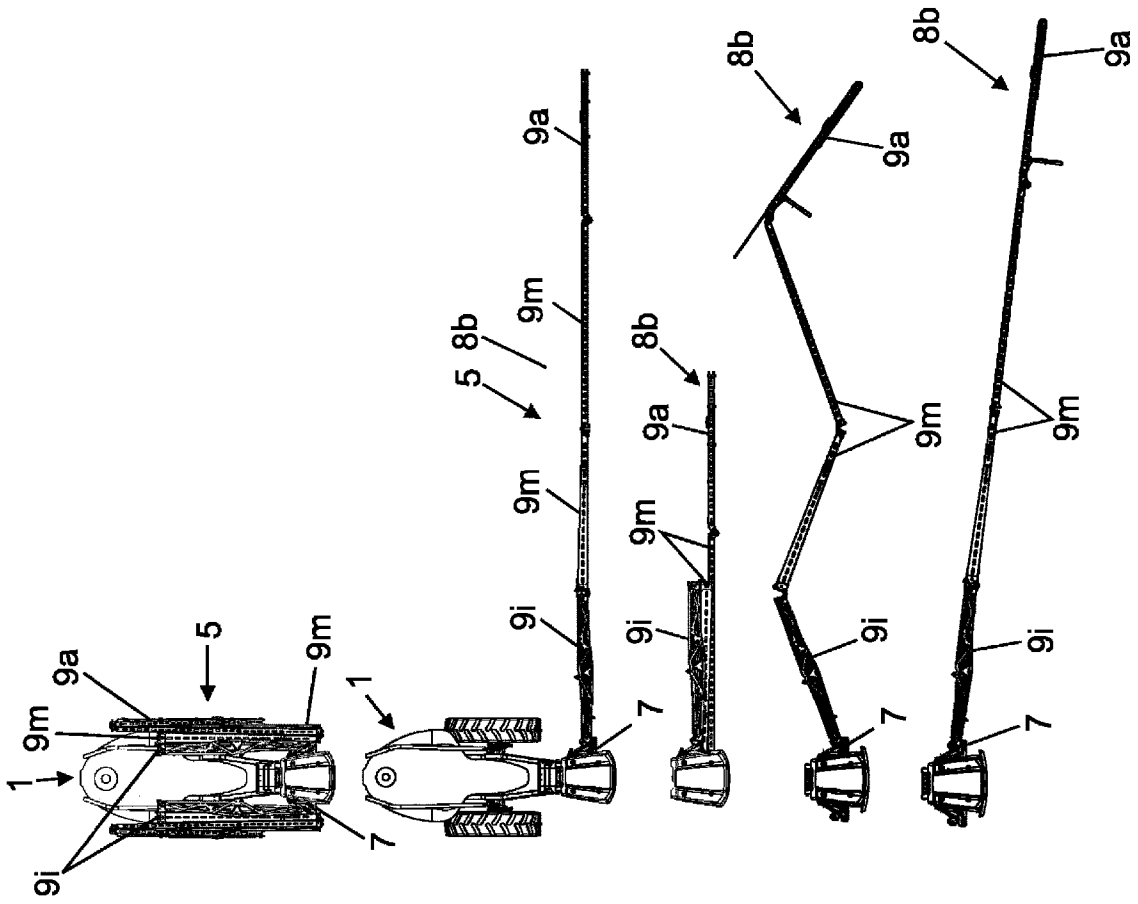

Fig.7.1 Fig.7.2 Fig.7.3 Fig.7.4 Fig.7.5