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(54) **METHOD FOR SURFACE COATING IN AN AGRICULTURAL SPRAYER AND AGRICULTURAL SPRAYER**

(57) The disclosure refers to a method for surface coating in an agricultural sprayer, the method comprising providing an agricultural sprayer having a tank and pipe system configured for receiving and distributing a liquid material; and producing a hydrophobic coating on at least

part of an inner surface of the tank and pipe system by applying a hydrophobic material to the inner surface. Further, an agricultural sprayer is provided, the sprayer comprising a tank and pipe system configured for receiving and distributing a liquid material. (Fig. 1)

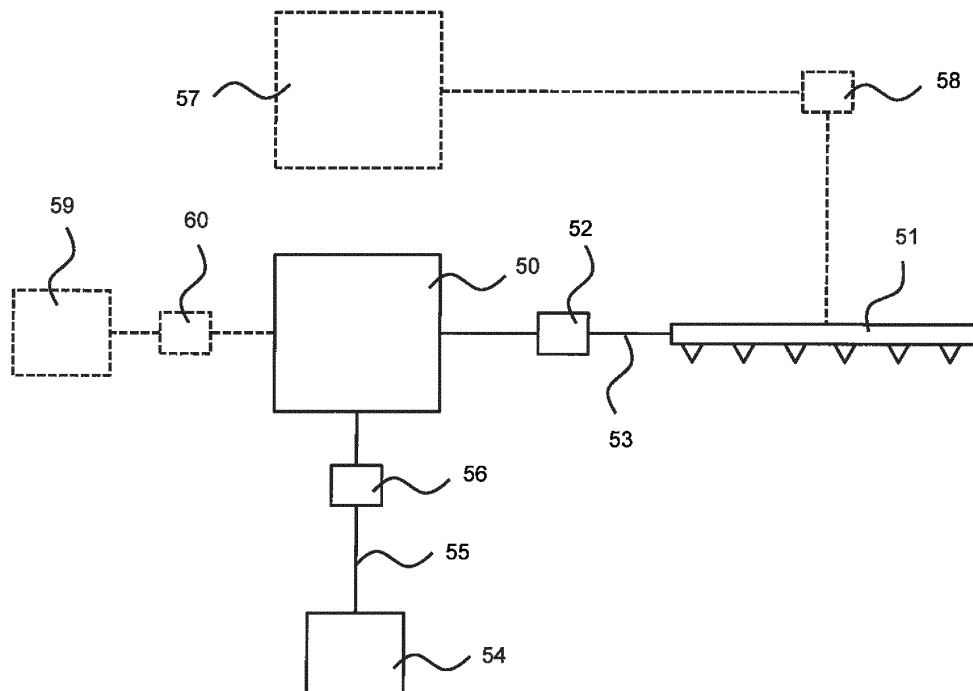


Fig. 2

Description

[0001] The present disclosure refers to a method for surface coating in an agricultural sprayer and an agricultural sprayer.

Background

[0002] An agricultural sprayer is a device used to spray a liquid. For example, the agricultural sprayer may be used for applying herbicide, pesticide, and fertilizers on agricultural crops. The agricultural sprayer may be a trailed sprayer that is connected to a tractor or a self-propelled machine.

[0003] In document EP 2 666 352 A1 for a harvesting machine it is proposed to provide a wear-resistant and hydrophobic coating on a surface on which the harvested material is conveyed in the harvesting machine. The wear-resistant and hydrophobic coating is provided by a diamondlike carbon coating.

Summary

[0004] It is an object to provide a method for surface coating in an agricultural sprayer and an agricultural sprayer allowing for improved operation of the agricultural sprayer, wherein contamination of the surface of a tank and pipe system of the agricultural sprayer is reduced or avoided.

[0005] For solving the problem, a method for surface coating in an agricultural sprayer and an agricultural sprayer according to the independent claims 1 and 10, respectively, are provided. Additional embodiments are disclosed in the dependent claims.

[0006] According to one aspect, a method for surface coating in an agricultural sprayer is provided, the method comprising: providing an agricultural sprayer having a tank and pipe system configured for receiving and distributing a liquid material, and producing a hydrophobic coating on at least part of an inner surface of the tank and pipe system by applying a hydrophobic material to the inner surface.

[0007] According to another aspect, an agricultural sprayer is provided. The agricultural sprayer comprises a tank and pipe system configured for receiving and distributing a liquid material, wherein a hydrophobic coating is provided on at least part of an inner surface of the tank and pipe system.

[0008] The hydrophobic coating helps to avoid contamination of the inner surface of the tank and pipe system.

[0009] The tank and pipe system provides for a storage and flowing system of the agricultural machine for receiving, storing, and carrying the liquid material to be distributed by the agricultural sprayer. The tank and pipe system may be provided with one or more valves. There may be a plurality of tanks. There may be a storage container (in addition to one or more tanks for the liquid material

to be distributed) for receiving a cleaning and rinsing liquid provided for cleaning and rinsing the tank and pipe system. Tank and pipe systems as such are known for agricultural sprayers with different design.

[0010] One or more nozzles may be connected to the tank and pipe system, the nozzles configured for distributing the liquid material received by the tank and pipe system.

[0011] The agricultural sprayer may be carried by a tractor. Alternatively, the agricultural sprayer may be provided on an implement hooked to a tractor. Also, a self-propelled agricultural sprayer may be provided.

[0012] The hydrophobic coating will also minimize the (unwanted) amount of liquid remaining in the tank and pipe (rest liquid).

[0013] The applying may comprise spraying a spray material on the inner surface, the spray material containing the hydrophobic material. The spray material may be applied to the inner surface by spraying using one or more nozzles provided within the tank and pipe system, for example in the tank. The spray material may be provided from an additional tank separated from the tank receiving the liquid material for distribution. The additional tank may connect to one or more spraying nozzles by one or more pipes.

[0014] In another example, in addition or alternatively, the hydrophobic material may be applied to the inner surface by vaporization.

[0015] The applying may comprise rinsing the tank and pipe system with a rinsing material flowing through tank and pipe system, the rinsing material containing the hydrophobic material. The rinsing material or substance may be provided from an additional tank. In case both spraying and rinsing are to be conducted for producing the hydrophobic coating, a combined spraying and rinsing material containing the hydrophobic material may be applied. The combined spraying and rinsing material may be provided from the additional tank.

[0016] In this and other embodiments, the additional tank may be part of the agricultural sprayer. Alternatively, the additional tank may be provided separately from the agricultural sprayer. If the additional tank is provided as part of the agricultural sprayer, the additional tank may be fixedly or detachable connected to the tank and pipe system.

[0017] The applying may comprise applying at least one of the spraying material and the rinsing material by a cleaning system provided for cleaning the tank and pipe system. In this embodiment the cleaning system provided for cleaning the tank and pipe system in operation is additionally used for applying the spraying material and / or the rinsing material containing the hydrophobic material for producing the hydrophobic coating. Thus, the cleaning system is used as a multifunctional component of the agricultural sprayer. In a cleaning process the cleaning system will clean the tank and pipe system after it was used for distributing the liquid material. For example, clean water may be applied by the cleaning system for

cleaning and the tank and pipe system. For applying the hydrophobic coating, the cleaning system may be connected to the (additional) reservoir or tank storing the spraying or rinsing material containing the hydrophobic material or substance. Such connecting may be conducted automatically in response to some connecting signal received from a controller in case of producing the hydrophobic coating. Alternatively, the cleaning system may be connected manually to the additional tank storing the spraying or rinsing material containing the hydrophobic material or substance. For applying the spraying material, one or more nozzles of the cleaning system may be used, for example, one or more nozzles provided in the tank configured to receive the liquid material to be distributed.

[0018] The method may further comprise applying the hydrophobic material after a cleaning process conducted for the tank and pipe system. The application of the hydrophobic material after a cleaning process may be conducted as a first time application of the hydrophobic material. Alternatively, such application may be provided as a refreshing or reestablishing of the hydrophobic coating applied before. It may be provided, that the hydrophobic material is applied after each cleaning process conducted for the tank and pipe system in operation.

[0019] The method may further comprise applying the hydrophobic material prior to a first use of the agricultural sprayer. For example, the hydrophobic material may be applied at the time of production of the agricultural sprayer. For example, in a production process, besides spraying and rinsing, other methods for producing a hydrophobic coating on the inner surface of the tank and pipe system may be applied. Such methods are known as such for applying hydrophobic coating on a surface.

[0020] The method may further comprise: detecting a surface contamination for the tank and pipe system by a contamination sensor, and, in response to the detecting, applying the hydrophobic material. Alternatively, the application of the hydrophobic material may be started or initiated manually by the user. The contamination sensor may be provided with a camera configured for taking images indicating contamination of the inner surface of the tank and pipe system. For example, a biofilm provided on the inner surface of the tank and pipe system after the agricultural sprayer has been used may be detected by the contamination sensor. The step of applying the hydrophobic material may be conducted in dependence on one or more parameters of the contamination detected, for example, depending on a layer thickness and / or color of the contamination on the inner surface.

[0021] The method may further comprise: detecting a threshold number for use cycles by a counting device, and, in response to the detecting, applying the hydrophobic material. After the agricultural sprayer has been used several times for distributing the liquid material such as herbicide, pesticide, or fertilizer, the hydrophobic material is applied automatically. Alternatively, the application of the hydrophobic material may be initiated by the user

manually after a certain number of use cycles. A use cycle may be characterized by a predefined number of fillings of the tank. Such tank filling may be detected by a level indicator or sensor.

[0022] Alternatively or in addition, other controlling parameters may be detected and assessed or evaluated for controlling the application of the hydrophobic material. For example, a time period parameter may be detected, the time period parameter indicating at least one of a time period after last application of the hydrophobic material and a time period of use of the agricultural sprayer.

[0023] The hydrophobic material may comprises at least one of the following substances: perfluorinated compound, paraffine, lipid, and silicon.

[0024] A superhydrophobic or ultrahydrophobic coating may be applied to at least part of the inner surface of the tank and pipe system.

[0025] The embodiments disclosed above with respect to the method for surface coating may be applied to the agricultural sprayer *mutatis mutandis*.

Description of further embodiments

[0026] Following, further embodiments are disclosed by referring two figures. In the figures, show:

Fig. 1 a schematic block diagram for a method for surface coating in an agricultural sprayer; and

Fig. 2 a schematic representation of a tank and pipe system of an agricultural sprayer.

[0027] Fig. 1 refers to a block diagram for a method for surface coating in an agricultural sprayer. In step 10 an agricultural sprayer is provided. The agricultural sprayer is having a tank and pipe system configured for receiving and distributing a liquid material which is to be distributed by the agricultural sprayer. For example, distribution of the liquid material is conducted by a nozzle system connected to the tank and pipe system. The tank and pipe system may comprise one or more tanks connected to or separated from each other. Following, in step 20 a hydrophobic coating is produced on at least part of an inner surface of the tank and pipe system by applying a hydrophobic material to the inner surface. In step 30 the agricultural sprayer is receiving a liquid material to be distributed in the tank and pipe system. The liquid material is distributed by the agricultural sprayer in step 40.

[0028] Fig. 2 shows a schematic representation of a tank and pipe system for an agricultural sprayer. The tank and pipe system is configured to receive in a tank 50 a liquid material to be distributed, the liquid material comprising, for example, herbicide, pesticide, or fertilizer. The liquid material is distributed by an arrangement of nozzles 51. A pump 52 is used for providing the liquid material from the tank 50 to the arrangement of nozzles 51 through a pipe or pipe arrangement 53.

[0029] A separate tank 54 is connected to the tank 50 by a pipe or pipe arrangement 55. A cleaning material

may be pumped from the separated tank 54 by a further pump 56. The separate tank 54 is provided for a cleaning and rinsing system configured to clean and rinse elements or components of the tank and pipe system after use. For example, the tank 50 and the pipe 53 may be cleaned after a liquid material has been distributed by the arrangement of nozzles 51. By cleaning the tank and pipe system is prepared for use with another liquid material to be distributed, for example, a fertilizer. Also, cleaning and rinsing may be applied for avoiding surface contamination in the tank and pipe system.

[0030] In addition, the separate tank 54 may receive a hydrophobic or substance which is applied to the tank and pipe system through the pipe 55 for producing a hydrophobic surface coating on an inner surface of the tank and pipe system, for example, in the tank 50, and the pipe 53.

[0031] Optional elements of the tank and pipe system are depicted by dotted lines in Fig. 2. In addition to the tank 50 and the separated tank 54, an additional tank 57 for receiving additional liquid material to be distributed may be provided in combination with an additional pump 58.

[0032] An additional separate tank 59 may be provided for receiving a substance containing the hydrophobic material in combination with still a further pump 60. In such embodiment a substance for cleaning and rinsing may be provided from the separated tank 54, but the hydrophobic material or substance will be provided from the additional separate tank 59 to, for example, the tank 50 and the pipe 53 for producing the hydrophobic surface coating.

[0033] The embodiments described above refer to producing and / or refreshing hydrophobic surface coating in the tank and pipe system after such tank and pipe system has been produced and has optionally already been in use. In an alternative example, the hydrophobic surface coating on at least part of the inner surface of the tank and pipe system may be produced at the time of production already.

[0034] In another example, a superhydrophobic or ultrahydrophobic coating may be applied to at least part of the inner surface of the tank and pipe system. A superhydrophobic surface coating provides a non-wettable surface with high water contact angles and facilitates sliding of drops. Such surface coating provides a surface layer that (even better) repels water. Droplets hitting this kind of coating can fully rebound in the shape of a column or pancake. Superhydrophobic coatings can be made from different materials, for example, materials selected from the following group: manganese oxide polystyrene (MnO₂ / PS) nano-composite, zinc oxide polystyrene (ZnO / PS) nano-composite, precipitated calcium carbonate, carbon nano-tube structures, silica nano-coating, fluorinated silanes, and fluoropolymer coatings. Silica-based coatings can be gel-based and can be applied either by dipping the object to be coating into the gale or via aerosol spray.

[0035] The features disclosed in this specification, the figures and / or the claims may be material for the realization of various embodiments, taken in isolation or in various combinations thereof.

Claims

1. A method for surface coating in an agricultural sprayer, comprising
 - providing an agricultural sprayer having a tank and pipe system configured for receiving and distributing a liquid material; and
 - producing a hydrophobic coating on at least part of an inner surface of the tank and pipe system by applying a hydrophobic material to the inner surface.
2. The method according to claim 1, wherein the applying comprises spraying a spray material on the inner surface, the spray material containing the hydrophobic material.
3. The method according to claim 1 or 2, wherein the applying comprises rinsing the tank and pipe system with a rinsing material flowing through tank and pipe system, the rinsing material containing the hydrophobic material.
4. The method according to claim 2 or 3, wherein the applying comprises applying at least one of the spraying material and the rinsing material by a cleaning system provided for cleaning the tank and pipe system.
5. The method according to at least one of the preceding claims, further comprising applying the hydrophobic material after a cleaning process conducted for the tank and pipe system.
6. The method according to at least one of the preceding claims, further comprising applying the hydrophobic material prior to a first use of the agricultural sprayer.
7. The method according to at least one of the preceding claims, further comprising
 - detecting a surface contamination for the tank and pipe system by a contamination sensor; and
 - in response to the detecting, applying the hydrophobic material.
8. The method according to at least one of the preceding claims, further comprising
 - detecting a threshold number for use cycles by

a counting device; and
- in response to the detecting, applying the hydrophobic material.

9. The method according to at least one of the preceding claims, wherein the hydrophobic material comprises at least one of the following substances: perfluorinated compound, paraffine, lipid, and silicon. 5
10. An agricultural sprayer, comprising a tank and pipe system configured for receiving and distributing a liquid material, wherein a hydrophobic coating is provided on at least part of an inner surface of the tank and pipe system. 10

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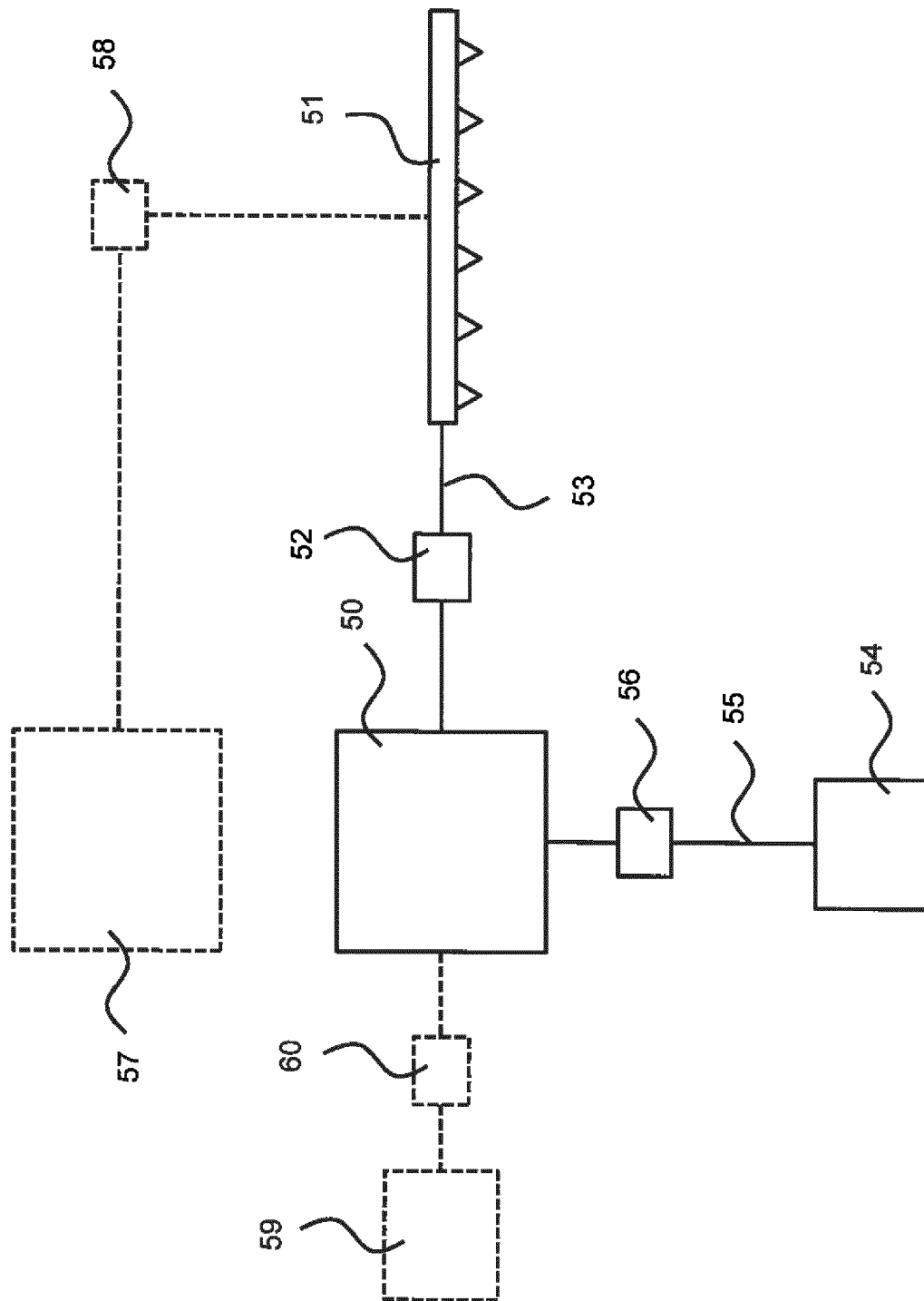


Fig. 2

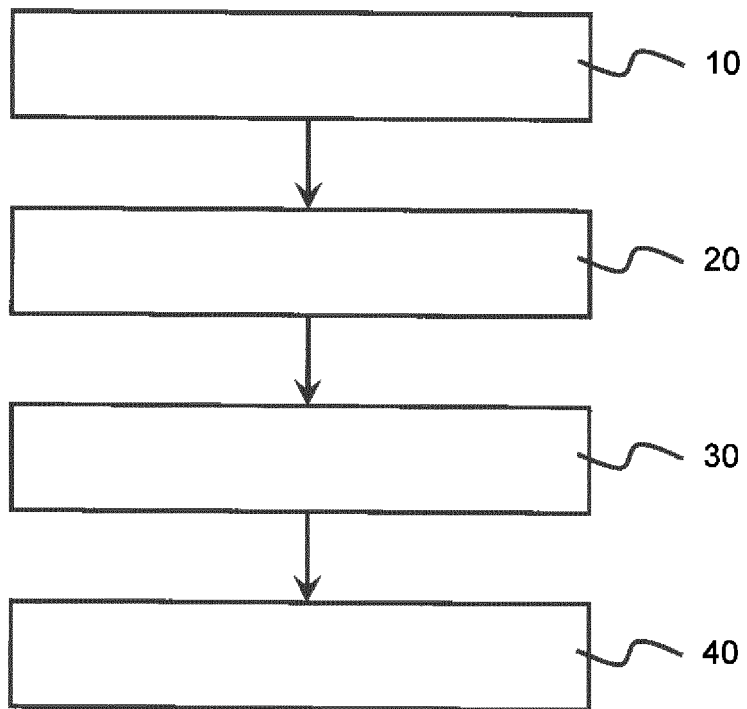


Fig. 1



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Application Number
EP 18 21 5507

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A	* paragraph [0029] - paragraph [0055]; figures 1-3 *	3,4,7,8	ADD. B05B13/00 B08B9/08 B08B9/46 B08B17/02
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 June 2019	Examiner Lohse-Busch, Heike
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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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