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DESCRIPTION

[0001] The present invention refers to a method for operating an agricultural machine and an agricultural machine.

Background

[0002] Different types of agricultural machines are known. For example, so-called agricultural application machines are provided for applying or dispensing a granular material, a liquid material or a powder-form material. For dispensing a granular material or a powder-form material, for example, a spreader may be used. A liquid material may be applied by a sprayer. Also, a seeder is an agricultural machine for applying a granular material, namely seeds.

[0003] Another type of an agricultural machine, for example, is a mower configured to cut grass or other plants that grow on soil.

[0004] Document US 2006/0123764 A1 refers to windrow shields that pivot adjacent the forward ends thereof into and out of the path of crop material to control the width of the windrow. An electric motor and linkage to the shields allows the relationship between the shields to be adjusted on-the-go from the operator's location.

[0005] Document US 3,906,710 discloses an automatic height-of-cut control for a crop harvesting implement such as a swather comprising a sensor disposed behind the cutting bar for indicating the cut crop material length. In one embodiment the sensor is positioned by a cable and pulley mechanism in relation to the cutting bar height such that for positions of the cutting bar there is a corresponding sensor position providing a preselected stubble to crop height ratio. A controller filters the sensor output which positions an electrohydraulic valve to either raise, lower or maintain the swather table by means of a hydraulic actuator.

[0006] Document EP 3 042 555 A1 refers to the field of seeders. In a seeder unit a movable member can be relocated with respect to a seeder disc, thereby, providing different lines of movement for seeds ejected by the seeder disc through the movable member.

[0007] Document CN 10 7390620 refers to an agricultural work machine, comprising an automatic work control unit. The automatic work control unit has a system management module, a memory module, a human-machine interaction module, an interpolation module, a PLC function module, a position control module, a system bus, a work work program automatic generation module, a work tool device control module, and a communication module. An electrical logic control unit has a CPU, a RAM, a ROM, and an input and output interface circuit. The electrical logic control unit internally adopts a bus structure. The bus is used for transmitting data information, address information, and control information. A driving unit includes: a position control unit, a speed control unit, a detection and feedback unit, and a

driving unit. An agricultural work machine mechanical structure main body has front and rear (Y-axis) motion driving devices, upper and lower (Z-axis) lifting driving devices, left and right (X-axis) motion driving devices, rotary driving devices, and working tool device clamping and placing devices. The working tool device has a grip handle, a workman equipment racks and work tool.

[0008] Document WO 98 / 04112 A2 discloses a mowing machine, comprising a cutter bar, a crushing device including a rotor provided with crushing elements, and adjusting means by means of which the distance between the crushing elements and the cutter bar can be adjusted. The mowing machine further comprises measuring means with the aid of which it is possible to determine the number of revolutions and / or the force by which the crushing device is driven. The mowing machine further comprises a control mechanism for activating the adjusting means on the basis of the signals supplied by the measuring means.

Summary

[0009] It is an object to provide a method for operating an agricultural machine and an agricultural machine for which improved operating conditions are provided.

[0010] For solving the problem a method for operating an agricultural machine according to claim 1 and an agricultural machine according to claim 12 are provided. Embodiments are provided in dependent claims.

[0011] The working space may be referred to as an area of activity of a working tool of the working device. For example, with regard to a spreader or sprayer, the working space may be the space to which the material to be applied is dispensed. The working tool can be operated by driving the working device.

[0012] The determining may refers to measuring or detecting, by the control unit, the first and second electric load supplied to the electric drive. Electric energy may be provided to the electric drive by a power supply provided on a tractor or an implement trailed or carried by the tractor. The agricultural machine, alternatively, may be provided as a self-propelling machine.

[0013] The information gathered by determining the first and second electric load may be used in a process of observing operation of the agricultural machine. Alternatively, the information about the first and second electric load may be used for controlling any function of the agricultural machine in response to determining at least one of the first and second electric loads. For example, a mode of operation for the tractor and / or the implement trailed or carried by the tractor may be controlled in response to determining at least one of the first and second electric load supplied to the electric drive.

[0014] The electric power provided to the electric drive may comprise at least one of AC voltage and DC voltage.

[0015] The forming of the second working space may comprise reducing the first working space to the second working space reduced compared to the first working space. Alternatively, the forming of the second working space may comprise expanding the first working space to the second working space expanded or being wider compared to the first working space. The second working space may cover a spatial room bigger than the first working space. Alternatively, the second working space may cover an area in a working plane different from the first working space.

[0016] The method further comprises: determining a first working space condition from the first electric load indicative of the first working space condition; and determining a second working space condition from the second electric load indicative of the second working space condition. For example, the first work space condition may be an overload condition. If, by the working device, a granular or a liquid material is dispensed, the overload condition may indicate too much material dispensed into the working space at a given point of time. For example, there may be too much of the liquid or granular material in the working space causing a higher electric load to the working device. The second working space condition may indicate a non-overload condition. In such case the second electric load may be below a threshold electric load, thereby, indicating that there is not too much material dispensed to the working space.

[0017] The method may further comprise positioning the shaping member in a third position relative to the working device in response to determining the first working space condition or the second working space condition, the third position being different from the first and second positions. If it is determined that the first or the second working space condition is present, the shaping member is moved to a different position, for example, for reducing or eliminating an overload condition with regard to the working space. In case the agricultural machine is provided with a mower, the first or the second electric load supplied to the electric drive may indicate a condition of congestion in the working space. Moving the shaping member to the third position may provide for reducing or eliminating the congestion. Such mode of congestion may be indicated by the electric load supplied to the electric drive being above a threshold value.

[0018] The method may further comprise operating the electric device with a third electric load different from the first and second electric load. In addition to moving the shaping device to the third position the electric load provided to the electric drive may be increased or decreased, thereby, providing the third electric load.

[0019] The method may further comprise determining at least one of determining a first position value for the first position of the shaping device from the first electric load indicative of the first position; and determining a second position value for the second position of the shaping device from the second electric load indicative of the second position. The first or second position values may indicate a distance between the shaping member and some reference point, for example, a reference point on the working device. Alternatively or in addition, the first and second position values may be indicative of a positional height of the

shaping member. Also, a spatial position of the shaping member may be indicated by the first and second position values. It may be further provided to position the shaping member in a third position relative to the working position in response to determining the first position value or the second position value.

[0020] The method may further comprise comparing at least one of the first electric load and the second electric load to reference electric load data, the reference electric load data being assigned to least one of the following: the first work space condition, the second work space condition, the first position value, and the second position value. The electric load measured or detected while the working device is driven by the electric drive is compared to reference electric load data which in turn are assigned to different conditions or values. Thereby, a present electric load detected or measured can be assigned to some condition and / or position value. For example, a present position of the shaping member is determined from the information about the first and / or the second electric load supplied to the electric drive.

[0021] The method may further comprise providing the working device with a spreader device configured to dispense a granular material; and driving the spreader device by the electric drive. The spreader may be a disc spreader. In such and other embodiments the shaping member may be provided with a plate member, for example a border plate. The plate member, for example, is movable relative to the spreader device for shaping or conditioning the area or the space provided for the working space. For example, the plate member may be used to limit the working space if the spreader or sprayer comprising the spreader device and the sprayer device, respectively, is moving along a border of a field to which the granular / liquid material is dispensed. By moving the plate member in different positions relative to the spreader or sprayer device, the area or the space (working space) to which the granular or liquid material is dispensed is shaped or conditioned. Depending on the position of the plate member relative to the spreader or sprayer device the electric load of the electric drive will vary because of providing different conditions for the dispensing process. In conclusion, the electric load measured for the electric drive may be indicative of the positioning of the plate member relative to the spreader device or the sprayer device.

[0022] The method may further comprise providing the working device with a sprayer device configured to dispense a liquid material; and driving the sprayer device by the electric drive. The sprayer device may be provided with a nozzle for dispensing the liquid material. The observations or embodiments disclosed above with regard to the spreader device may apply to the sprayer device *mutatis mutandis*.

[0023] The method may further comprise: providing the working device with a cutting device configured to cut grass or other plant; and driving the cutting device by the electric drive. The cutting device may be provided on a mower. A shaping device may be provided with a plate such a movable cover plate positioned for shaping the working space, such working space allowing free movement of a cutting tool of a cutting device, for example free rotation in the process of cutting grass or other plants. The embodiments outlined above with regard to at least one of the spreader device and the sprayer device may apply to the cutting device

mutatis mutandis.

[0024] The method may further comprise positioning a swath forming member in an operation position in response to determining at least one of the first working space condition, the second working space condition, the first position value, and the second position value. The swath forming member may be pivotably or movably mounted on a mower, the swath forming member being configured to form a swath from crop cut by the cutting device. Depending on the load received by the electric drive the swath forming process may be controlled by controlling positioning of the swath forming member, the swath forming member being moved to different operation positions.

[0025] The method may further comprise providing the working device with a seeder device configured to dispense seeds; and driving the seeder device by the electric drive. The shaping member may be provided with a plate configured to additional guide seeds dispensed from an opening of the seeder device.

[0026] With regard to the agricultural machine, the embodiments disclosed with regard to the method of operating the agricultural machine above may apply *mutatis mutandis*. The agricultural machine may be an agricultural application machine such as spreader, sprayer, mower or seeder.

Description of embodiments

[0027] Following, further embodiments, by way of example, are described with reference to figures. In the figures show:

Fig. 1

a schematic representation of an arrangement comprising a spreader device;

Fig. 2

a schematic representation of the arrangement in Fig. 1, wherein a shaping device is moved to a different position;

Fig. 3

a schematic representation of an arrangement comprising a sprayer device;

Fig. 4

a schematic representation of an arrangement comprising a cutting device; and

Fig. 5

a schematic representation of another arrangement comprising a cutting device for a mower.

[0028] Fig. 1 shows a schematic representation of an arrangement for an agricultural machine provided with a working device 1 which is a spreader device in the embodiment shown. The

working device 1 is assigned an electric drive 2 such as an electric motor configured to drive the working device 1. Specifically, a working tool 3 of the working device 1 is driven by the electric drive 2. In the embodiment shown, the working device 3 may be provided with a disc spreader driven by the electric drive 2 for applying or dispensing some material.

[0029] Electric energy is supplied to the electric drive 2 by a power supply 4 provided, for example, on a tractor or an implement trailed or carried by the tractor, the implement comprising the working device 1. AC or DC voltage may be provided to the working device 1.

[0030] Referring to Fig. 1, the working device 1 is dispensing a granular material 5 into a working space 6 assigned to the working device 1. A shaping member 7 is provided, for example a plate member, for conditioning or shaping the working space 6 on at least one side. Depending on the position of the shaping member 7 relative to the working device 1 there are differently shaped or conditioned forms of the working space 6 (see Figs. 1 and 2). In an alternative embodiment more than one shaping member may be provided.

[0031] In case the working device 1 is driven for operation (applying material), depending on the actual shape or form of the working space 6, the electric load supplied to or needed by the electric drive 2 will be different. Such different electric loads are detected by a control unit 8. The electric loads measured by the control unit 8 are compared to reference electric load data provided, for example, in a memory of the control unit 8, for assigning a measured electric load to a reference electric load. The reference electric load is assigned to a working space condition. In addition, the reference electric load may be assigned to a position value indicative of the position of the shaping member 7. Such analysis of the operation conditions present can be done without additional sensor devices for measuring the relative position between the working device 1 and the shaping member 7, exclusively based on the information about the electric load.

[0032] Fig. 3 shows a schematic representation of an arrangement for an agricultural machine in which the working device 1 is provided with a sprayer device 10 configured to dispense some liquid material. The arrangement from Fig. 3 may be provided in an agricultural sprayer. The embodiments described above with regard to the arrangement in Fig. 1 and 2 apply to the arrangement in Fig. 3 *mutatis mutandis*.

[0033] Fig. 4 shows a schematic representation of an arrangement in which the working device 1 is provided with a cutting device 20 configured to cut grass or other grown plants. The arrangement may be provided in a mower. Again, the shaping member 7 is positioned in the vicinity of the cutting device 20, thereby, shaping the working space 6. The electric load to the cutting device 20 may depend, for example, on some congestion condition or non-congestion condition with regard to the working space 6 indicating the working space 6 covered or congested by crop more or less. For example, in case of congestion condition the electric load will increase indicating a position of the shaping member 7 limiting the working space 6 too much. In response to such detection of electric load, the shaping member 7 may be moved in a position (e.g. moving up) providing a wider working space 6 for the cutting device 20.

[0034] Fig. 5 shows a schematic representation of another arrangement comprising a cutting device 20 for a mower. Crop cut will be conditioned by a conditioner 30. The working space 6 assigned to the conditioner 30 can be adjusted by the shaping member 7 provided with a conditioner plate 40 pivotable.

REFERENCES CITED IN THE DESCRIPTION

Cited references

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- [US3906710A](#) [0005]
- [EP3042555A1](#) [0006]
- [CN107390620](#) [0007]
- [WO9804112A2](#) [0008]

Fremgangsmåde til at betjene en landbrugsmaskine og landbrugsmaskine**Patentkrav**

1. Fremgangsmåde til at betjene en landbrugsmaskine, der har
 - et arbejdsredskab (1);
 - en elektrisk motor (2), der er konfigureret til at drive arbejdsredskabet (1);
 - en styreenhed (8); og
 - et formgivningselement (7), der er konfigureret til at formgive et arbejdsrum (6), der er tildelt arbejdsredskabet (1), ved en relativ bevægelse mellem arbejdsredskabet (1) og formgivningselement (7);idet fremgangsmåden omfatter
 - drivning af arbejdsredskabet (1) ved hjælp af den elektriske motor (2);
 - dannelse af et første arbejdsrum, der omfatter placering af formgivningselementet (7) i en første position i forhold til arbejdsredskabet (1); og
 - dannelse af et andet arbejdsrum, der omfatter placering af formgivningselementet (7) i en anden position i forhold til arbejdsredskabet (1);kendetegnet ved, at fremgangsmåden yderligere omfatter bestemmelse, ved hjælp af styreenheden (8), af
 - en første strømbelastning, der er tilført til den elektriske motor (2), når det første arbejdsrum er dannet;
 - en første arbejdsrumstilstand fra den første strømbelastning, der angiver tilstanden i det første arbejdsrum;
 - en anden strømbelastning, der er tilført til den elektriske motor (2), når det andet arbejdsrum er dannet, hvor den anden strømbelastning er forskellig fra den første strømbelastning; og
 - en anden arbejdsrumstilstand fra den anden strømbelastning, der angiver tilstanden i det andet arbejdsrum.
2. Fremgangsmåden ifølge krav 1, hvor dannelsen af det andet arbejdsrum omfatter reduktion af det første arbejdsrum (6) til det andet arbejdsrum, der er reduceret sammenlignet med det første arbejdsrum.
3. Fremgangsmåden ifølge krav 1 eller 2, der yderligere omfatter placering af

formgivningselementet (7) i en tredje position i forhold til arbejdsredskabet (1) som reaktion på bestemmelsen af den første arbejdsrumstilstand eller den anden arbejdsrumstilstand, idet den tredje position er forskellig fra første og anden position.

4. Fremgangsmåden ifølge mindst et af de foregående krav, der yderligere omfatter betjening af den elektriske anordning (2) med en tredje strømbelastning, der er forskellig fra den første og anden strømbelastning.
5. Fremgangsmåden ifølge mindst et af de foregående krav, der yderligere omfatter bestemmelse af mindst et af
 - bestemmelse af en første positionsværdi for den første position af formgivningselementet (7) ud fra den første strømbelastning, der angiver den første position; og
 - bestemmelse af en anden positionsværdi for den anden position af formgivningselementet (7) ud fra den anden strømbelastning, der angiver den anden position.
6. Fremgangsmåden ifølge mindst et af de foregående krav, der yderligere omfatter sammenligning af mindst en af den første strømbelastning og den anden strømbelastning med referencedata om strømbelastning, idet referencedataene for strømbelastning er tildelt til mindst en af følgende: den første arbejdsrumstilstand, den anden arbejdsrumstilstand, den første positionsværdi og den anden positionsværdi.
7. Fremgangsmåden ifølge et af de foregående krav, der yderligere omfatter
 - forsyning af arbejdsredskabet (1) med en sprederanordning, der er konfigureret til at sprede et granuleret materiale; og
 - drivning af af sprederanordningen med den elektriske motor (2).
8. Fremgangsmåden ifølge et af de foregående krav, der yderligere omfatter
 - forsyning af arbejdsredskabet (1) med en sprøjteanordning, der er konfigureret til at sprede et flydende materiale; og
 - drivning af sprøjteanordningen med den elektriske motor (2).

9. Fremgangsmåden ifølge et af de foregående krav, der yderligere omfatter
 - forsyning af arbejdsredskabet (1) med en klippeanordning, der er konfigureret til at klippe græs eller andre planter; og
 - drivning af klippeanordningen med den elektriske motor (2).
10. Fremgangsmåden ifølge krav 10, der yderligere omfatter placering af et skårdannende element i en arbejdsposition som reaktion på bestemmelse af mindst én af den første arbejdsrumstilstand, den anden arbejdsrumstilstand, den første positionsværdi og den anden positionsværdi.
11. Fremgangsmåden ifølge et af de foregående krav, der yderligere omfatter
 - forsyning af arbejdsredskabet (1) med en såanordning, der er konfigureret til at sprede frø; og
 - drivning af såanordningen med den elektriske motor (2).
12. Landbrugsmaskine, der har
 - et arbejdsredskab (1);
 - en elektrisk motor (2), der er konfigureret til at drive arbejdsredskabet (1);
 - en styreenhed (8); og
 - et formgivningselement (7), der er konfigureret til at formgive et arbejdsrum (6), der er tildelt arbejdsredskabet (1), ved en relativ bevægelse mellem arbejdsredskabet (1) og formgivningselement (7);kendetegnet ved, at styreenheden (8) er konfigureret til at bestemme
 - en første strømbelastning, der er tilført til den elektriske motor (2), når der dannes et første arbejdsrum, det formgivningen omfatter placering af formgivningselementet (7) i en første position i forhold til arbejdsredskabet (1);
 - en første arbejdsrumstilstand fra den første strømbelastning, der angiver tilstanden i det første arbejdsrum;
 - en anden strømbelastning, der er tilført til den elektriske motor (2), når der dannes et andet arbejdsrum, idet formgivningen omfatter placering af formgivningselementet (7) i en anden position i forhold til arbejdsredskabet (1); og
 - en anden arbejdsrumstilstand fra den anden strømbelastning, der angiver tilstanden i det andet arbejdsrum.

13. Landbrugsmaskine ifølge krav 12, der er udvalgt fra følgende gruppe:
landbrugsmaskine som for eksempel spreder eller sprøjte, plæneklipper og såmaskine.

DRAWINGS

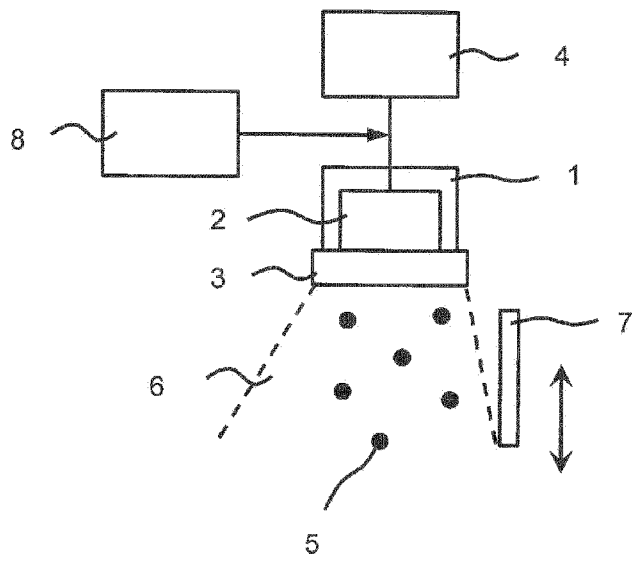


Fig. 1

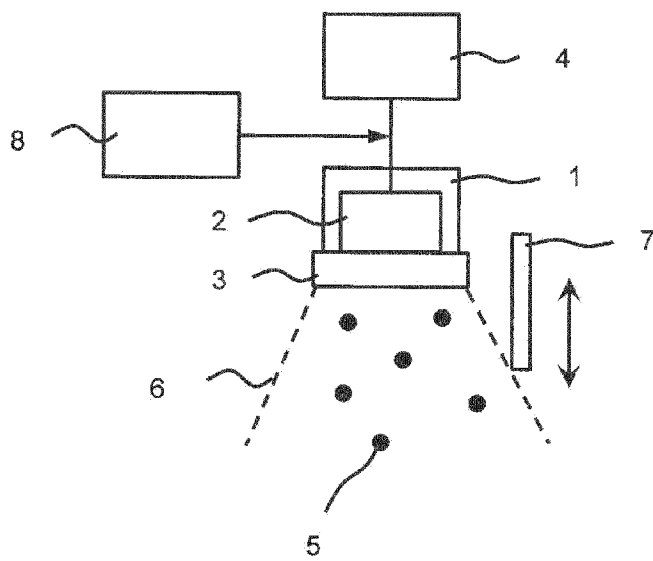


Fig. 2

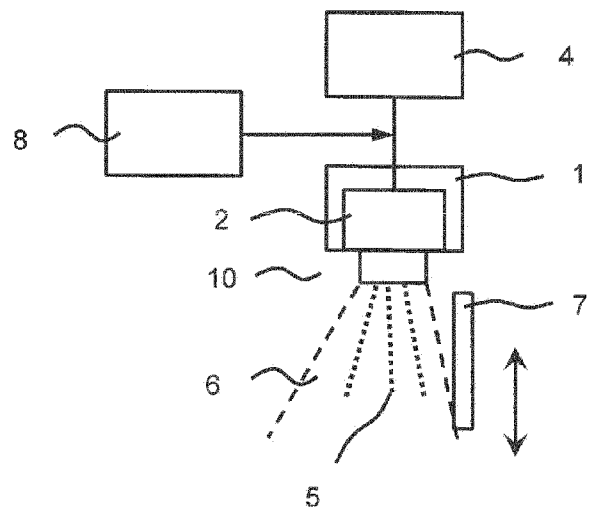


Fig. 3

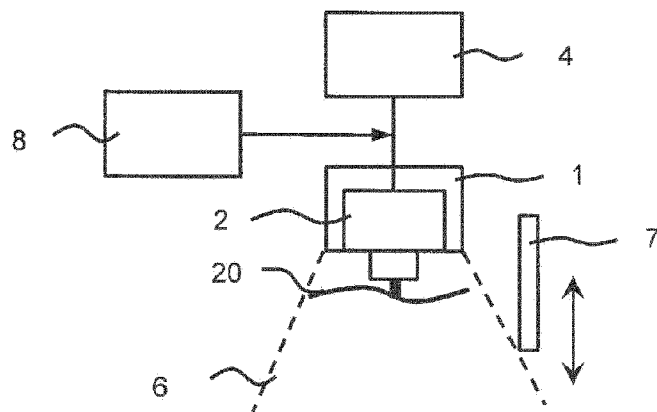


Fig. 4

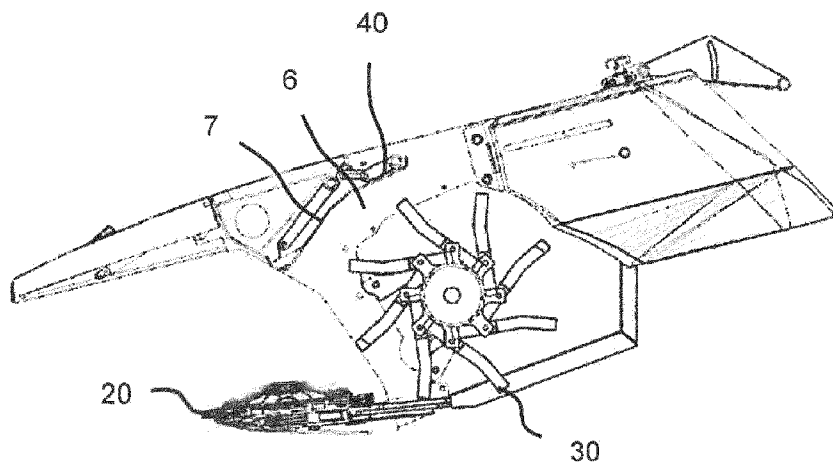


Fig. 5