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Catching Mechanism for Mounting Modules in an Agricultural Machine

Abstract

An agricultural machine is equipped with a cabin, a mounting volume arranged below the cabin, a hatch for providing access to the mounting volume from a top side and a catching mechanism for mounting at least one module in the mounting volume.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS
[0001] This application claims the benefit of the filing date of U. K. Provisional Patent Application

2402124.8, “Catching Mechanism for Mounting Modules in an Agricultural Machine,” filed Feb. 15, 2024, the entire disclosure of which is incorporated herein by reference.

FIELD

[0002] The present disclosure relates generally to modules of a stacking arrangement and mechanical fixation structure for mounting one or more modules in an agricultural machine.

BACKGROUND

[0003] U.S. Pat. No. 7,808,775 B2, “Modular power distribution system having sealing arrangement for use in a work machine,” granted Oct. 5, 2010, discloses a work machine with a power distribution system for supplying electrical power to four traction motors of the work machine. The power distribution system comprises several power electronic modules that are stacked in a module rack. The module rack has an opening for each module for slidably receiving the corresponding module by moving the module in a lateral direction into the rack.

BRIEF SUMMARY

[0004] Mounting volume in agricultural machines for installing any modules of the agricultural machine such as control unit modules or power electronic modules may be rather limited. Additionally, access to this mounting volume for installing or replacing such modules may be very restricted. Hence, it is an objective to provide a user-friendly arrangement for a comfortable installation of modules in a difficult accessible mounting volume of an agricultural machine.

[0005] According to an aspect of the invention there is provided an agricultural machine with a cabin, a mounting volume arranged below the cabin, a hatch for providing access to the mounting volume from a top side, and a catching mechanism for mounting at least one module in the mounting volume.

[0006] The agricultural machine may be a vehicle or a vehicle-implement combination such as a tractor towing a trailer or a plough. The cabin provides a room enclosed by a roof, windshield, rear window, a door, a side panel and a floor for an operator to control the agricultural machine. The cabin may be equipped with a seat and a user interface such as a steering wheel and pedals to control movement of the agricultural machine. The seat and the pedals may be arranged on the floor. The hatch may be integrated in the floor and may be closed by a pivotable cap to open the hatch. When the hatch is opened, the mounting volume below the floor of the cabin is accessible from the cabin for installing or removing modules in the mounting volume. The modules may be passed through the hatch and moved towards the catching mechanism. When the module gets in contact with the catching mechanism, the module is guided into a fixed position. Hence, a user-friendly installation can be achieved since only a rough manual positioning of the module in the mounting volume below the cabin is required for a precise fixation of the module due to the self-positioning effect of the catching mechanism.

[0007] The mounting volume may be accessible for mounting the at least one module from the top side only.

[0008] I. e., the hatch in the floor of the cabin may be the sole access to the mounting volume. Since the mounting volume is accessible from the cabin only, the mounting volume can be easily protected against unauthorized access. In addition, the mounting volume may be trough-shaped and can also be protected by a solid housing without any access from the outside of the agricultural machine to provide a high protection against any environmental impacts. Hence, sensitive modules such as electronics modules, e. g. power electronics module or control module, can be integrated in the mounting volume.

[0009] The agricultural machine may comprise a cover covering a top side of the mounting volume at least partly. The catching mechanism may be arranged below the cover.

[0010] The cover may be part of the floor of the cabin and/or the housing to protect the modules from any external impact, e. g. such as dust, moisture, etc. The cover may also be used to arrange or attach any components of the cabin, such as the pedals.

[0011] The catching mechanism may comprise at least one opening.

[0012] The catching mechanism may be used for fixation of a module in the mounting volume. For fixation, the module may be manually moved towards the catching mechanism. Although the accessibility to the mounting volume may be restricted, a precise manual movement or placement of the module in the mounting volume is not required for fixing the module. When the module is moved towards the catching mechanism, the module may be fetched by the opening to guide the module into a defined position for final fixation in the mounting volume. I. e., the opening is used as a guidance for supporting the self-positioning effect.
[0013] The at least one opening may comprise a slot.
[0014] The slot may provide a centering for the module for holding the module in the defined position. The module may be hold by the slot in the defined position also in case of vibrations of the mounting volume, e. g. caused by a movement of the agricultural machine over a rough terrain. The opening may guide the threading element of the module into the slot so that the threading element may be centered. When the threading element has been centered, the module may be fixed in the mounting volume with a fixation element such as a screw.
[0015] The catching mechanism may comprise at least one threading element insertable in the at least one opening.
[0016] The threading element may be formed by a (metal) sheet. The threading element may be attached to the module. When the module is moved towards the opening, the threading element may be fetched by the opening of the catching mechanism. The threading element may also be guided by the opening so that the threading element will be moved in the slot for centering.
[0017] The at least one threading element may comprise a protrusion catchable by the at least one opening.
[0018] The protrusion may support ease of use to get the threading element fetched by the catching mechanism. When the module is moved towards the catching mechanism, the protrusion may get in contact with the catching mechanism and then slide into the opening of the catching mechanism. Then, the threading element is fetched by the catching mechanism.
[0019] The protrusion may provide a profile for centering the at least one threading element in a vertical direction and a lateral direction.
[0020] I. e, when the threading element is centered in the vertical (horizontal) and the lateral direction, the module may be axially moveable in a longitudinal direction only. An axial movement in the vertical or lateral direction of the module may not be possible since the centering restricts a movement in these both degrees of freedom. So, the position for integrating the module in the mounting volume is clearly defined.
[0021] The at least one threading element comprises an abutment for abutting the threading element in a longitudinal direction.
[0022] When the threading element is inserted into the opening of the catching mechanism by an axial movement in the longitudinal direction, the movement in this third degree of freedom may also be restricted if the abutment gets in contact with another part of the catching mechanism, e. g. a catching sheet. Then, the module may be pulled back only to remove the module from the mounting volume. The movement in the longitudinal direction may correspond to the driving direction of the agricultural machine.
[0023] The at least one threading element may be L-shaped.
[0024] The horizontal portion of the L-shaped threading element may be inserted into the opening of the catching mechanism when the module is integrated in the mounting volume. The vertical portion of the L-shaped threading element may be used as abutment to limit the axial movement into the longitudinal direction when the threading element is inserted into the opening. The length of the vertical portion of the L-shaped threading element may be adapted to a specific height at which the module may be integrated in the mounting volume.
[0025] The agricultural machine may comprise at least one module. The at least one threading element may be attached to the at least one module, and the at least one opening may be integrated

in a catching sheet.
[0026] The threading element may be fixed to the module by screws, glue or anything else. For integrating the module on the mounting volume, the module may be moved so that the threading element may be moved towards the opening in the catching sheet, inserted and caught by the opening. Then, the module can be moved in the longitudinal direction until the abutment prevents a further movement in this direction. For example, the threading element may abut against the catching sheet. While the threading element is moved in the longitudinal direction, the threading element may be simultaneously centered as described above.
[0027] The agricultural machine may comprise at least one module. The at least one threading element may be attached to a catching sheet, and the at least one opening may be arranged at the at least one module.
[0028] The openings may be integrated in the housing of the module or can be integrated in another component of the module. The threading element may be fixed in the mounting volume by screws, glue or anything else. Also for this configuration, the module can be moved in the longitudinal direction until the abutment prevents a further movement in this direction. For example, the threading element may abut against the housing of the module. While the threading element is inserted in the longitudinal direction, the threading element may be simultaneously centered similarly as described above.
[0029] The catching sheet may be attached in the mounting volume of the agricultural machine.
[0030] The catching sheet may be fixed in the mounting volume by screws, glue or anything else.
[0031] The agricultural machine may comprise at least one additional module. At least one opening or at least one threading element may be attached to the at least one module, and the at least one additional module may be attached to the at least one threading element or the at least one opening of the at least one module.
[0032] I. e., if the threading element is attached to the module the additional module may comprise the opening so that the threading element of the module can be caught by the opening of the additional module. Alternatively, the module may comprise the opening and the additional module may comprise the threading element catchable by the opening. Thus, at least two modules can be stacked together to integrate more than one module in the mounting volume.
[0033] The catching mechanism may comprise a first bracket and a second bracket. The first bracket may be attached to the at least one module, and the second bracket may be attached to the at least one additional module. The first bracket of the at least one module may be fixed to the second bracket of the at least one additional module.
[0034] Hence, at least two modules being stacked together can also be fixed together to provide combined modules.
[0035] The first bracket of the at least one module may be fixed in the mounting volume.
[0036] Thus, all modules of combined modules can be fixed in the mounting volume by a fixation of the bracket of a single module in the mounting volume. The other modules of the combined modules may be fixed indirectly in the mounting volume due to the fixation to the module fixed in the mounting volume.
[0037] The agricultural machine may comprise at least two modules. The catching mechanism may comprise at least two threading elements and at least two openings. The at least two threading elements and the at least two openings may be arranged in a lateral direction, and the at least two modules may be arranged in a vertical direction.
[0038] Hence, the at least two modules can be horizontally stacked in the mounting volume about each other. When the modules are stacked together, the threading elements and the openings may be at the same horizonal height due to the lateral arrangement. This height may be very close to the bottom of the mounting volume since an integration of the modules in the mounting volume may be much easier in case of a lower height compared to a higher height close to the cover covering the top side of the mounting volume.

[0039] Within the scope of this application it should be understood that the various aspects, embodiments, examples and alternatives set out herein, and individual features thereof may be taken independently or in any possible and compatible combination. Where features are described with reference to a single aspect or embodiment, it should be understood that such features are applicable to all aspects and embodiments unless otherwise stated or where such features are incompatible.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] Several aspects of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

[0041] FIG. **1** illustrates an agricultural machine with a stacking arrangement in a mounting volume.

[0042] FIG. **2** illustrates the mounting volume with an integrated module.

[0043] FIG. **3** illustrates a module.

[0044] FIG. **4** illustrates the mounting volume with an integrated module.

[0045] FIG. **5** illustrates a threading element of a catching mechanism.

[0046] FIG. **6** illustrates an opening of a catching mechanism.

[0047] FIG. **7** illustrates two modules of the stacking arrangement.

[0048] FIG. **8** illustrates three modules of the stacking arrangement.

[0049] FIG. **9** illustrates the mounting volume with three integrated modules.

DETAILED DESCRIPTION

[0050] FIG. **1** shows exemplarily an agricultural machine **100**. The agricultural machine **100** may be a vehicle or a vehicle-implement combination. The vehicle may generate a tractive force to tow the implement through the agricultural field. The vehicle may be an agricultural vehicle such as a tractor, a harvester, a combine, a sprayer or of any other type such as a truck. The implement may be used for an operation in the agricultural field and may be of the type of a plough, a rake, a planter, a sprayer, a mower, a trailer, etc. The agricultural machine **100** may be controlled by an operator sitting in a cabin **102** of the agricultural machine. Below the cabin **102**, there is a mounting volume **104** in the agricultural machine **100** for integrating any components such as a stacking arrangement **106**. The mounting volume **104** is an enclosed volume and may be trough-shaped. The mounting volume **104** is accessible via a hatch **108** for integrating or removing components integrated in the mounting volume **104**. The hatch **108** is arranged at a top side of the mounting volume **104** that forms part of a floor of the cabin **102**. I. e., the mounting volume **104** is accessible from the cabin **102** and from a top side of the mounting volume **104**. A cap **110** arranged at the hatch **108** can be manually moved in an opened or closed position to control accessibility of the hatch **108**.

[0051] FIG. **2** shows the mounting volume **104** with the integrated stacking arrangement **106** from a top side. The hatch **108** is opened so that the stacking arrangement **106** and the mounting volume **104** are accessible. The stacking arrangement **106** comprises three modules **208**, **214** and **220** (see FIG. **8** and FIG. **9**), a catching mechanism **204** and brackets **212**, **218** and **224** (see FIG. **8** and FIG. **9**). The top side of the mounting volume **104** and parts of the stacking arrangement **106** below the top side, e. g. the catching mechanism **204**, are at least partly covered by a cover **202**. The cover **202** may be part of the floor of the cabin **102**.

[0052] The stacking arrangement **106** is fixed in the mounting volume **104**. At least one of the brackets is attached to a ground of the mounting volume **104** and may be fixed by screws. A catching sheet **206** of the catching mechanism **204** is also fixed in the mounting volume **104** and may be glued or welded. Threading elements **210**, **216** of the catching mechanism **204** are attached

to the modules **208**, **214** of the stacking arrangement **106**. The threading elements **210**, **216** are inserted in the catching sheet **206** for fixing the modules to the catching sheet **206** (as explained in more detail below).

[0053] The modules **208**, **214**, **220** may be any component of the agricultural machine **100** such as electric components, as for example a control unit, power electronics, communication electronics, electronic interfaces, etc. Each module is encapsulated in a separate housing. The threading elements and the brackets may be attached to a housing of a module.

[0054] FIG. **3** and FIG. **4** illustrate the mounting of a first module **208** of the stacking arrangement **106** in the mounting volume **104** by attaching the module **208** to the catching mechanism **204**. The module **208** may be carried from the cabin **102** through the hatch **108** into the mounting volume **104** and moved towards the catching sheet **206** of the catching mechanism **204** as illustrated.

[0055] The catching sheet **206** comprises two openings **302***a* and **302***b*. Each of these openings **302***a* and **302***b* has a hole **604** and a slot **602** as shown in FIG. **6**. The two openings **302***a* and **302***b* are arranged in a lateral direction (i. e. at the same horizontal height) next to each other.

[0056] The threading element **210** is L-shaped. A proximal part of the L-shaped threading element **210** is fixed to the housing of the module **208**. A protrusion **304** forms a distal part of the L-shaped threading element **210**. The protrusion **304** is profiled for inserting the threading element **210** into the opening **302***a* of the catching sheet **206** as can be seen in FIG. **5**. The protrusion **304** of the L-shaped threading element **210** comprises an abutment **506**. From the abutment **506**, the profile **504** of the protrusion **304** tapers to a nose **502**. The dimensions of the nose **502** are smaller than the dimensions of the hole **604**. Due to the different dimensions, the threading element **210** can be easily fetched by the opening **302***a* of the catching sheet **206** when the module **208** is moved towards the catching mechanism **204** for integrating the module **208** in the mounting volume **104**. The nose **502** can be inserted into the hole **604** even when the nose **502** is not exactly centered in respect of the hole **604**. Hence, a rough positioning of the nose **502** in respect of the opening **302***a* is sufficient to get the protrusion **304** of the threading element **210** fetched by the catching mechanism **204**. As indicated by the two arrows at the opening **302***a* in FIG. **3**, the threading element **210** including the module **208** can still be moved in a lateral or vertical direction when the nose **502** is inserted in the opening **302***a*.

[0057] When the nose **502** was fetched by the catching mechanism **204**, the module **208** may be moved further in a longitudinal direction towards the catching mechanism **204**. Then, the threading element **210** gets into alignment with the opening **302***a*. The tapered protrusion **304** of the threading element **210** moves into the slot **602** of the opening **302***a* so that the threading element **210** is centered in respect of the opening **302***a* in a vertical and lateral direction. I. e., a movement of the module **208** in these two directions will be restricted and only a movement of the module **208** in the longitudinal direction will be possible until the abutment **506** of the threading element **210** gets in contact with the catching sheet **206**. When the threading element **210** abuts against the catching sheet **206**, a predefined position for mounting the module **208** in the mounting volume **104** has been reached. Then, the module **208** can be fixed to the ground of the mounting volume **104** by fixing the bracket **212** attached to the module **208** with a screw. Thus, the first module **208** of the stacking arrangement **106** has been integrated and fixed in the mounting volume **104**.

[0058] As shown in FIG. **7**, a second module **214** of the stacking arrangement **106** can be integrated and fixed in the mounting volume **104** similarly to the first module **208**. The second module **214** may also be carried from the cabin **102** through the hatch **108** into the mounting volume **104** and moved towards the catching sheet **206** of the catching mechanism **204**.

[0059] The threading element **216** is attached to the module **214**. The threading element **216** has the same protrusion **304** as the threading element **210** as shown in FIG. **5**. The second opening **302***b* of the catching sheet **206** has the same hole **604** and slot **602** as the first opening **302***a* as shown in FIG. **6**. Consequently, the threading element **216** of the second module **214** can be fetched in the same way by the opening **302***b* as the threading element **210** of the first module **208** by the opening

302*a* (as described above). Due to the different dimensions, the threading element **216** can be easily fetched by the opening **302***b* of the catching sheet **206** when the module **214** is moved towards the catching mechanism **204** for integrating the module **214** in the mounting volume **104**.
[0060] When the nose **502** of the threading element **216** was fetched by the catching mechanism **204**, the module **214** may be moved further in a longitudinal direction towards the catching mechanism **204**. Then, the threading element **216** gets into alignment with the opening **302***b*. The tapered protrusion **304** of the threading element **216** moves into the slot **602** of the opening **302***b* so that the threading element **216** is centered in respect of the opening **302***b* in a vertical and lateral direction. I. e., a movement of the module **214** in these two directions will be restricted and only a movement of the module **214** in the longitudinal direction will be possible until the abutment **506** of the threading element **216** gets in contact with the catching sheet **206**. When the threading element **216** abuts against the catching sheet **206**, a predefined position for mounting the module **214** in the mounting volume **104** has been reached. Then, the module **214** can be fixed to the ground of the mounting volume **104** by fixing the bracket **218** attached to the module **214** with a screw. Thus, first and second modules **208** and **214** of the stacking arrangement **106** have been integrated and fixed in the mounting volume **104**.
[0061] Due to the arrangement of the two openings **302***a* and **302***b* in the lateral direction, the two threading elements **210** and **216** of the modules **208** and **214** are also arranged in the lateral direction (i. e. at the same horizontal height) next to each other, as can be seen in FIG. **7**. Instead, the two modules **208**, and **214** are arranged in a vertical direction and take place at different horizontal heights for forming a stack.
[0062] In addition to the threading element **216**, groove sheets **702** and **704** are attached to the module **214**. A proximal part of the groove sheet **702** and a proximal part of the groove sheet **704** are fixed to the housing of the module **214**. Each groove sheet **702** and **704** comprises a distal part extending away from the module **214**. Each groove sheet **702**, **704** comprises an opening **706***a*, **706***b* integrated in the distal part of each groove sheet **702**, **704**. The openings **706***a* and **706***b* are similar to the openings **302***a* and **302***b* of the catching sheet **206** and may comprise a hole **604** and a slot **602** as shown in FIG. **6**.
[0063] As shown in FIG. **8** and FIG. **9**, a third module **220** of the stacking arrangement **106** can be integrated and fixed in the mounting volume **104**. The third module **220** may also be carried from the cabin **102** through the hatch **108** into the mounting volume **104** and moved towards the groove sheets **702**, **704** of the second module **214**.
[0064] A threading element **222** is attached to the module **220**. The threading element **222** has a protrusion being similar to the protrusion **304** as shown in FIG. **5** so that the protrusion can be inserted into the opening **706***a* of the groove sheet **702** or opening **706***b* of the groove sheet **704**. An abutment of the protrusion of the threading element **222** can be used to abut the threading element **222** against the groove sheet **702** or **704**.
[0065] Similarly to the first and second module **208**, **214**, the threading element **222** of the third module **220** can be fetched by the opening **706***a* of the groove sheet **702** or opening **706***b* of the groove sheet **704**. Due to the different dimensions, the threading element **222** can be easily fetched by the opening **706***a* or **706***b* when the module **220** is moved towards the groove sheet **702** or **704** for integrating the module **220** in the mounting volume **104**.
[0066] When the nose **502** of the threading element **222** was fetched, the module **220** may be moved further in a longitudinal direction towards the groove sheet **702** or **704**. Then, the threading element **222** gets into alignment with the opening **706***a* or **706***b*. The tapered protrusion of the threading element **222** moves into the slot **602** of the opening **706***a* or **706***b* so that the threading element **222** is centered in respect of the opening **706***a* or **706***b* in a vertical and lateral direction. I. e., a movement of the module **220** in these two directions will be restricted and only a movement of the module **220** in the longitudinal direction will be possible until the abutment **506** of the threading element **222** gets in contact with the groove sheet **702** or **704**. When the threading

element **222** abuts against the groove sheet **702** or **704**, a predefined position for mounting the module **220** in the mounting volume **104** has been reached. Then, the module **220** can be fixed in the mounting volume **104** by fixing the bracket **224** attached to the module **220** with a screw to the bracket **218** of the second module **214**. Thus, first, second and third modules **208**, **214** and **220** of the stacking arrangement **106** have been integrated and fixed in the mounting volume **104**.

[0067] All references cited herein are incorporated herein in their entireties. If there is a conflict between definitions herein and in an incorporated reference, the definition herein shall control.

TABLE-US-00001 LISTING OF DRAWING ELEMENTS 100 agricultural machine 102 cabin 104 mounting volume 106 stacking arrangement 108 hatch 110 cap 202 cover 204 catching mechanism 206 catching sheet 208 module 210 threading element 212 bracket 214 module 216 threading element 218 bracket 220 module 222 threading element 224 bracket 302a opening 302b opening 304 protrusion 502 nose 504 profile 506 abutment 602 slot 604 hole 702 groove sheet 704 groove sheet 706a opening 706b opening

Claims

1. An agricultural machine, comprising: a cabin; a mounting volume arranged below the cabin; a hatch for providing access to the mounting volume from a top side; and a catching mechanism for mounting at least one module in the mounting volume.

2. The agricultural machine of claim 1, wherein the mounting volume is accessible for mounting the at least one module from the top side only.

3. The agricultural machine of claim 1, comprising a cover covering a top side of the mounting volume at least partly; wherein the catching mechanism is arranged below the cover.

4. The agricultural machine of claim 1, wherein the catching mechanism comprises at least one opening.

5. The agricultural machine of claim 4, wherein the at least one opening comprises a slot.

6. The agricultural machine of claim 4, wherein the catching mechanism comprises at least one threading element insertable in the at least one opening.

7. The agricultural machine of claim 6, wherein the at least one threading element comprises a protrusion catchable by the at least one opening.

8. The agricultural machine of claim 7, wherein the protrusion provides a profile for centering the at least one threading element in a vertical direction and a lateral direction.

9. The agricultural machine of claim 6, wherein the at least one threading element comprises an abutment for abutting the threading element in a longitudinal direction.

10. The agricultural machine of claim 6, wherein the at least one threading element is L-shaped.

11. The agricultural machine of claim 6, comprising at least one module; wherein the at least one threading element is attached to the at least one module; and the at least one opening is integrated in a catching sheet.

12. The agricultural machine of claim 6, comprising at least one module; wherein the at least one threading element is attached to a catching sheet; and the at least one opening is arranged at the at least one module.

13. The agricultural machine of claim 11, wherein the catching sheet is attached in the mounting volume of the agricultural machine.

14. The agricultural machine of claim 11, comprising at least one additional module; wherein at least one opening or at least one threading element is attached to the at least one module; and the at least one additional module is attached to the at least one threading element or the at least one opening of the at least one module.

15. The agricultural machine of claim 14, wherein the catching mechanism comprises a first bracket and a second bracket; wherein the first bracket is attached to the at least one module; and the second bracket is attached to the at least one additional module; wherein the first bracket of the

at least one module is fixed to the second bracket of the at least one additional module.

16. The agricultural machine of claim 15, wherein the first bracket of the at least one module is fixed in the mounting volume.

17. The agricultural machine of claim 11, comprising at least two modules; and the catching mechanism comprising at least two threading elements; and at least two openings; wherein the at least two threading elements and the at least two openings are arranged in a lateral direction; and the at least two modules are arranged in a vertical direction.