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Dumper Vehicle

Abstract

A dumper vehicle includes a chassis, a ground engaging propulsion structure mounted to the chassis; an operator seat supported by the chassis; a body supported by the chassis; a drive arrangement comprising an electric motor housed within the body, said electric motor configured to provide, at least in part, tractive power to the ground engaging propulsion structure; an electric energy storage assembly configured to provide electric power to the electric motor, wherein the electric energy storage assembly is located rearward of the ground engaging structure; and an open topped container for carrying a load therein supported by the chassis, wherein the container is moveable between a transport position for transporting a load and a discharge position for discharging of a load.

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Background/Summary

FIELD
[0001] The present teachings relate to a dumper vehicle.
BACKGROUND
[0002] Dumper vehicles, often referred to as “site dumpers” are manufactured in various different sizes to suit the needs of the application, ranging from those required for small building sites to those required for large scale construction projects. Such dumper vehicles typically include an open topped container, or skip, for transporting and dumping material.
[0003] Conventionally, dumper vehicles of the type referred to above are powered by diesel combustion engines. However, there is a general need to reduce vehicle emissions in the face of global warming leading to working machine OEMs considering alternative power and drive arrangements. Proposed alternatives include battery, hydrogen fuel cells, hydrogen internal combustion engines and various hybrid options, etc.
[0004] The present invention seeks to provide a solution to the above problem.
SUMMARY
[0005] The present teachings provide a dumper vehicle according to the appended claims.
[0006] A first aspect of the present teachings relates to a dumper vehicle.
[0007] The dumper vehicle may comprise a chassis. The dumper vehicle may comprise a ground engaging propulsion structure, for example mounted to the chassis. The dumper vehicle may comprise an operator seat, for example supported by the chassis. The dumper vehicle may comprise a body, for example supported by the chassis. The dumper vehicle may comprise a drive arrangement. The drive arrangement may comprise an electric motor, for example housed within the body, said electric motor configured to provide, at least in part, tractive power to the ground engaging propulsion structure. The dumper vehicle may comprise an open topped container for carrying a load therein supported by the chassis. The container may be moveable between a transport position for transporting a load and a discharge position for discharging of a load.
[0008] Advantageously, providing a dumper vehicle powered by a drive arrangement with an electric motor reduces vehicle emissions in the face of global warming, thereby improving the sustainability of the dumper vehicle.
[0009] The drive arrangement may comprise a cooling fan configured to cool the electric motor. The dumper vehicle may comprise a controller configured to control the cooling fan based on one or more parameters associated with the dumper vehicle.
[0010] In an electric dumper vehicle, the electric motor arrangement is considerably quieter than an internal combustion engine arrangement. As such, noise generated by the cooling fan appears considerably louder to an operator. The controller controls activation and deactivation of the cooling fan so that the cooling fan is running only when cooling of the electric motor is desirable. This helps to reduce noise generated by the cooling fan without compromising cooling of the electric motor.
[0011] The controller may be configured to control a rotational speed of the cooling fan. The controller may be configured to control the rotational speed of the cooling fan based on one or more parameters associated with the dumper vehicle.
[0012] Advantageously, controlling rotational speed of the cooling fan helps to control cooling of

the electric motor, whilst controlling the level of noise generated by rotation of the cooling fan.
[0013] The dumper vehicle may comprise a temperature sensor configured to determine an electric motor temperature at or near the electric motor. The controller may be configured to activate and deactivate the cooling fan based on the determined electric motor temperature.
[0014] Advantageously, controlling the cooling fan based on electric motor temperature helps to provide sufficient cooling of the electric motor whilst minimizing noise generated by the cooling fan when lower levels of cooling are sufficient to cool the electric motor.
[0015] The controller may be configured to activate the cooling fan at a low speed when the electric motor temperature reaches a first predetermined temperature threshold. The first predetermined temperature threshold may be in the range 53° C. to 57° C. The first predetermined temperature threshold may be in the range 54° C. to 56° C., for example approximately 55° C.
[0016] Advantageously, the control logic provides sufficient cooling to the electric motor when the electric motor reaches the predetermined temperature threshold, whilst minimizing noise from the cooling fan.
[0017] The controller may be configured to activate the cooling fan at a high speed when the electric motor temperature reaches a second predetermined temperature threshold. The second predetermined temperature may be greater than the first predetermined threshold. The second predetermined temperature threshold may be in the range 65° C. to 69° C. The second predetermined temperature threshold may be in the range 66° C. to 6° oC, for example approximately 67° C.
[0018] Advantageously, the control logic helps to provide sufficient cooling to the electric motor when the electric motor reaches a high temperature, regardless of the noise generated by the cooling fan.
[0019] The controller may be configured to deactivate the cooling fan when the electric motor temperature is at or below a third predetermined temperature threshold. The third predetermined temperature threshold may be below the first predetermined temperature threshold. The third predetermined threshold may be approximately 54° C., for example approximately 50° C.
[0020] Advantageously, deactivating the cooling fan when the electric motor temperature sensor is below the third predetermined temperature threshold helps to reduce noise generated by the cooling fan without comprising efficiency of the electric motor.
[0021] The controller may be configured to control the cooling fan based on a selected state of a forward/neutral/reverse (FNR) drive selector.
[0022] The controller may be configured to activate the cooling fan at a low speed when the drive selector is in the neutral state. The controller may be configured to activate the cooling fan at a low speed when the drive selector is in the neutral state irrespective of the electric motor temperature.
[0023] When the FNR selector is in neutral, the electric motor is typically driven at a lower rotational speed resulting in lower temperatures of the electric motor. This means that low speed cooling of the electric motor is likely sufficient to cool the electric motor, and noise of the cooling fan is minimized.
[0024] An upper surface of the body may comprise a floorplate. The electric motor may be located below, for example immediately below, the floorplate.
[0025] Advantageously, locating the electric motor below the floorplate helps to improve packaging of the dumper vehicle and improves access to the electric motor.
[0026] The cooling fan may be interposed between the floorplate and the electric motor.
[0027] Advantageously, located the cooling fan between the floorplate and the electric motor helps to utilize “dead space” of the dumper vehicle, thereby improving space efficiency of the dumper vehicle and reducing an axial length of the drive arrangement.
[0028] The floorplate may comprise one or more apertures defining a flow path therethrough.
[0029] The cooling fan may be configured and arranged to draw air through the one or more apertures and over the electric motor.

[0030] Advantageously, the one or more apertures draw “clean” air through the cooling fan, as opposed to air from below the electric motor which may be contaminated with dust and debris. Such dust and debris may cause blockages of the electric motor, or be drawn through the floorplate and up towards the operator seat.
[0031] The cooling fan may define an axis of rotation. The axis of rotation of the cooling fan may extend transversely to a fore-aft axis of the dumper vehicle.
[0032] Advantageously, orientating the cooling fan transverse to the fore-aft axis helps to locate the cooling fan below the floorplate in the space between the floorplate and the electric motor. This helps to reduce an axial length of the drive arrangement.
[0033] The cooling fan may comprise a mounting arrangement configured to mount the cooling fan to the body. The mounting arrangement may be configured to mount the cooling fan to the body at a plurality of locations.
[0034] Advantageously, the mounting arrangement helps to facilitate simple and secure mounting of the cooling fan to the body.
[0035] The dumper vehicle may comprise a lighting arrangement and a floorplate on an upper surface of the body arranged in front of the operator seat. The lighting arrangement may comprise at least one light emitting member configured and arranged to illuminate at least a portion of the body, optionally a portion of the floorplate.
[0036] Advantageously, the lighting arrangement helps to improve safety of the dumper vehicle by illuminating the body, for example the floorplate.
[0037] The body may comprise an operator control console mounted thereto. The floorplate may be arranged between the operator seat and the operator control console. The at least one lighting member may be located on the operator control console. The at least one lighting member may be located on an underside of the operator control console.
[0038] Advantageously, providing the at least one lighting member on the operator control console helps to utilize the space of the operator control console to house the lighting arrangement. Additionally, as the floorplate is arranged between the operator control console and the operator seat, the lighting members are positioned to at least partially illuminate the floorplate.
[0039] The at least one lighting member may be located on an angled surface of the underside of the operator control console.
[0040] Advantageously, providing the at least one lighting member on the angled surface is a simple means of directing light towards the body.
[0041] The body may comprise a step arrangement. The step arrangement may be located adjacent to the floorplate. The at least one lighting member may be configured and arranged to at least partially illuminate at least one step of the step arrangement.
[0042] Advantageously, illuminating the step arrangement helps to improve safety of the dumper vehicle when the operator uses the access step arrangement to descend/ascend the dumper vehicle.
[0043] The dumper vehicle may comprise a controller configured to control activation and deactivation of the lighting arrangement.
[0044] The controller may be configured to activate or deactivate the lighting arrangement based on one or more of: an active or inactive state of a vehicle headlight arrangement; a position of the operator seat; an active or inactive state of the dumper vehicle; an open or closed position of a cab door of an operator cab.
[0045] Advantageously, the controller activating and deactivating the lighting arrangement may help to increase lifespan of the battery packs, as the lighting arrangement is deactivated in the event that the lighting arrangement is not needed and has been left on accidentally. This helps to prevent the battery packs from being accidentally drained, and having to be removed or replaced from the dumper vehicle which is expensive and time consuming.
[0046] The dumper vehicle may comprise a seat sensor arrangement configured to measure a position of the operator seat indicative of whether an operator is sat in the operator seat. The seat

sensor arrangement may comprise one or more of a seat position sensor, a weight sensor and/or a seatbelt sensor.
[0047] Advantageously, the seat sensor arrangement helps to detect whether an operator is sat in the operator seat, such that the controller can deactivate and/or activate the lighting arrangement so as to help reduce the lifespan of the electrical storage assembly.
[0048] The dumper vehicle may comprise an override device configured to override the controller to activate the lighting arrangement. The override device may be an actuation member, switch or button.
[0049] Advantageously, the override device enables the lighting arrangement to be deactivated and/or activated in non-standard situations which do not follow the control logic of the controller.
[0050] The controller may be configured to deactivate the lighting arrangement after the lighting arrangement has been active for a predetermined time period.
[0051] Advantageously, the controller deactivating the lighting arrangement after the predetermined period of time may help to increase lifespan of the battery packs, as the lighting arrangement is deactivated in the event that the lighting arrangement is not needed and has been left on accidentally. This helps to prevent the battery packs from being accidentally drained, and having to be removed or replaced from the dumper vehicle which is expensive and time consuming.
[0052] The dumper vehicle may comprise an electric energy storage assembly configured to provide electric power to the electric motor. The electric energy storage assembly may be located rearward of the ground engaging structure.
[0053] The ground engaging propulsion structure may comprise a front axle with a pair of front wheels mounted thereto and a rear axle with a pair of rear wheels mounted thereto. The electric energy storage assembly may be at least partially located behind the rear axle. A majority of the electric energy storage assembly may be located behind the rear axle. An entirety of the electric energy storage assembly may be located behind the rear axle.
[0054] Advantageously, providing the electric energy storage assembly rearward of the ground engaging structure, for example rearward of the rear axle, helps to improve weight distribution and packaging of the dumper vehicle.
[0055] The electric energy storage assembly may define a center of gravity. The center of gravity of the electric energy storage assembly may be located rearward of the ground engaging structure. The center of gravity of the electric energy storage device may be located rearward of the rear axle.
[0056] Advantageously, providing the center of gravity of the electric energy storage assembly rearward of the ground engaging structure, for example rearward of the rear axle, helps to improve weight distribution and packaging of the dumper vehicle.
[0057] The dumper vehicle may comprise a power arrangement configured to provide electric power to the electric motor. The ground engaging propulsion structure may comprise a front axle with a pair of front wheels mounted thereto and a rear axle with a pair of rear wheels mounted thereto. The power arrangement may be located behind the rear axle. A majority of the power arrangement may be located behind the rear axle. An entirety of the power arrangement may be located behind the rear axle.
[0058] Advantageously, this arrangement helps to improve weight distribution and packing of the dumper vehicle.
[0059] The power arrangement may comprise a first subassembly. The first subassembly may comprise an electric energy storage assembly configured to provide electric power to the electric motor.
[0060] Advantageously, providing the first subassembly helps to improve ease of assembly of the power arrangement to the dumper vehicle because the first subassembly can be pre-assembled and then lifted on to the dumper vehicle during assembly of the dumper vehicle.
[0061] The first subassembly may further comprise a power distribution unit mounted to the

electric energy storage assembly.
[0062] Advantageously, the power distribution unit helps to efficiently manage and distribute electrical power around the dumper vehicle.
[0063] The electric energy storage assembly may comprise a plurality of battery packs, for example two, three, four or more battery packs.
[0064] The power distribution unit may be mounted directly above the plurality of battery packs.
[0065] Advantageously, this arrangement helps to improve packaging and space efficiency of the dumper vehicle, and reduces an axial length of the first subassembly.
[0066] The power arrangement may comprise a second subassembly comprising an electric motor controller. The second subassembly may be mounted in front of the first subassembly.
[0067] Advantageously, providing the second subassembly helps to improve ease of assembling of the power arrangement to the dumper vehicle because the first subassembly can be pre-assembled and then lifted on to the dumper vehicle during assembly of the dumper vehicle.
[0068] The second subassembly may further comprise a cooling device mounted to the electric motor controller. The cooling device may be configured to cool the electric motor controller and/or the electric energy storage assembly.
[0069] Advantageously, the cooling device helps to provide cooling to the electric motor controller and/or electric energy storage assembly, thereby reducing the likelihood of overheating and increasing the efficiency of the power arrangement.
[0070] The power arrangement may comprise a third subassembly comprising an electrical connector for connecting the electric storage assembly to an external source of electrical power. The third subassembly may be located rearward of the first subassembly.
[0071] Advantageously, providing the second subassembly helps to improve ease of assembling of the electric motor controller to the dumper vehicle because the first subassembly can be pre-assembled and then lifted on to the dumper vehicle during assembly of the dumper vehicle.
[0072] Advantageously, locating the third subassembly rearward of the first subassembly helps to reduce a length of cabling between the third subassembly and the first subassembly.
[0073] The first subassembly may be located between the second subassembly and the third subassembly with respect to a fore-aft axis of the dumper vehicle.
[0074] Advantageously, this arrangement helps to reduce cabling between the second subassembly and the electric motor, as well as between the third subassembly and the second subassembly.
[0075] The body may define a rear wall located at a rear end of the dumper vehicle. The electrical connector may be arranged on the rear wall.
[0076] Advantageously, providing the electrical connector on the rear wall helps to provide convenient access to the electrical connector for charging.
[0077] The body may comprise a compartment accessed via an access panel located on the rear wall. The electrical connector may be housed within the compartment.
[0078] Advantageously, the compartment provides a convenient location for storing the electrical connector.
[0079] The compartment may be configured to store a charging cable arrangement.
[0080] Advantageously, this arrangement utilizes the space in the compartment to store charging cables, thereby improving the space efficiency of the dumper vehicle.
[0081] The dumper vehicle may comprise a forward/neutral/reverse (FNR) drive selector. A controller may be configured to prevent selection of the forward and/or reverse states when the access panel is in an open position.
[0082] In the event that the dumper vehicle is being charged via the electrical connector, if the dumper vehicle is accidentally driven in forward or reverse, then the charging cable may be ripped out of the electrical connector. This may result in damage to the electrical connector and/or charging cables, and insufficient battery charging Advantageously, the control logic helps to prevent the operator from driving the dumper vehicle away from the external source of electrical

power and damaging the charging cable and/or electrical connector.
[0083] The ground engaging propulsion structure may comprise a front axle with a pair of front wheels mounted thereto and a rear axle with a pair of rear wheels mounted thereto. The electric motor may be located in front of the rear axle. A majority of the electric motor may be located in front of the rear axle. An entirety of the electric motor may be located in front of the rear axle.
[0084] Advantageously, the arrangement of the electric motor helps to improve weight distribution of the electric motor.
[0085] The chassis may comprise a main chassis having the operator seat mounted thereto. The chassis may comprise an articulating front chassis having the container mounted thereto. A lower extent of the front chassis may be arranged to be lower than a lower extent of the main chassis.
[0086] Advantageously, mounting the container on a front chassis that is lower than the chassis on which the operator is situated has been found to increase the visibility over the container of an operator sat in an operator seat. Furthermore, such an arrangement lowers the center of gravity of the dumper vehicle, which improves the overall stability of the vehicle both when the container is loaded and empty.
[0087] The dumper vehicle may comprise an electric energy storage assembly configured to provide electric power to the electric motor. A first distance may be defined between a rear of the dumper vehicle and a rear axle. A second distance may be defined between the rear of the dumper vehicle and a center of gravity of the electric energy storage assembly. A ratio of the first distance to the second distance may be in the range 1:1.25 to 1:4, for example in the range 1:1.75 to 1:3, optionally in the range 1:2 to 1:2.5.
[0088] A second aspect of the present teachings relates to a working vehicle.
[0089] The working vehicle may comprise a chassis. The working vehicle may comprise a ground engaging propulsion structure, for example mounted to the chassis. The working vehicle may comprise an operator seat, for example supported by the chassis. The working vehicle may comprise a body, for example supported by the chassis. The working vehicle may comprise a drive arrangement. The drive arrangement may comprise an electric motor, for example housed within the chassis, said electric motor configured to provide, at least in part, tractive power to the ground engaging propulsion structure.
[0090] Advantageously, providing a working vehicle powered by a drive arrangement with an electric motor reduces vehicle emissions in the face of global warming, thereby improving the sustainability of the working vehicle.
[0091] The drive arrangement may comprise a cooling fan configured to cool the electric motor. The working vehicle may comprise a controller configured to control the cooling fan based on one or more parameters associated with the working vehicle.
[0092] In an electric working vehicle, the electric motor arrangement is considerably quieter than an internal combustion engine arrangement. As such, noise generated by the cooling fan appears considerably louder to an operator. The controller controls activation and deactivation of the cooling fan so that the cooling fan is running only when cooling of the electric motor is desirable. This helps to reduce noise generated by the cooling fan without compromising cooling of the electric motor.
[0093] The controller may be configured to control a rotational speed of the cooling fan based on one or more parameters associated with the working vehicle.
[0094] Advantageously, controlling rotational speed of the cooling fan helps to control cooling of the electric motor, whilst controlling the level of noise generated by rotation of the cooling fan.
[0095] The working vehicle may comprise a temperature sensor configured to determine an electric motor temperature at or near the electric motor. The controller may be configured to activate and deactivate the cooling fan based on the determined electric motor temperature.
[0096] Advantageously, controlling the cooling fan based on electric motor temperature helps to provide sufficient cooling of the electric motor whilst minimizing noise generated by the cooling

fan when lower levels of cooling are sufficient to cool the electric motor.
[0097] The controller may be configured to activate the cooling fan at a low speed when the electric motor temperature reaches a first predetermined temperature threshold. The first predetermined temperature threshold may be in the range 53° C. to 57° C. The first predetermined temperature threshold may be in the range 54° C. to 56° C., for example approximately 55° C.
[0098] Advantageously, the control logic provides sufficient cooling to the electric motor when the electric motor reaches the predetermined temperature threshold, whilst minimizing noise from the cooling fan.
[0099] The controller may be configured to activate the cooling fan at a high speed when the electric motor temperature reaches a second predetermined temperature threshold. The second predetermined temperature may be greater than the first predetermined threshold. The second predetermined temperature threshold may be in the range 65° C. to 69° C. The second predetermined temperature threshold may be in the range 66° C. to 68° C., for example approximately 67° C.
[0100] Advantageously, the control logic helps to provide sufficient cooling to the electric motor when the electric motor reaches a high temperature, regardless of the noise generated by the cooling fan.
[0101] The controller may be configured to deactivate the cooling fan when the electric motor temperature is at or below a third predetermined temperature threshold. The third predetermined temperature threshold may be below the first predetermined temperature threshold. The third predetermined threshold may be approximately 54° C., for example approximately 50° C.
[0102] Advantageously, deactivating the cooling fan when the electric motor temperature sensor is below the third predetermined temperature threshold helps to reduce noise generated by the cooling fan without comprising efficiency of the electric motor.
[0103] The controller may be configured to control the cooling fan based on a selected state of a forward/neutral/reverse (FNR) drive selector.
[0104] The controller may be configured to activate the cooling fan at a low speed when the drive selector is in the neutral state. The controller may be configured to activate the cooling fan at a low speed when the drive selector is in the neutral state irrespective of the electric motor temperature.
[0105] When the FNR selector is in neutral, the electric motor is typically driven at a lower rotational speed resulting in lower temperatures of the electric motor. This means that low speed cooling of the electric motor is likely sufficient to cool the electric motor, and noise of the cooling fan is minimized.
[0106] The working vehicle may comprise a lighting arrangement and the lighting arrangement may comprise at least one light emitting member configured and arranged to illuminate at least a portion of the working vehicle.
[0107] Advantageously, the lighting arrangement helps to improve safety of the working vehicle by illuminating the working vehicle.
[0108] The working vehicle may comprise an operator control console mounted thereto. The at least one lighting member may be located on the operator control console. The at least one lighting member may be located on an underside of the operator control console.
[0109] Advantageously, providing the at least one lighting member on the operator control console helps to utilize the space of the operator control console to house the lighting arrangement.
[0110] The at least one lighting member may be located on an angled surface of the underside of the operator control console.
[0111] Advantageously, providing the at least one lighting member on the angled surface is a simple means of directing light towards the working vehicle.
[0112] The working vehicle may comprise a step arrangement. The at least one lighting member may be configured and arranged to at least partially illuminate at least one step of the step arrangement.

[0113] Advantageously, illuminating the step arrangement helps to improve safety of the working vehicle when the operator uses the access step arrangement to descend/ascend the working vehicle.
[0114] The working vehicle may comprise a controller configured to control activation and deactivation of the lighting arrangement.
[0115] The controller may be configured to activate or deactivate the lighting arrangement based on one or more of: an active or inactive state of a vehicle headlight arrangement; a position of an operator seat; an active or inactive state of the working vehicle; an open or closed position of a cab door of an operator cab.
[0116] Advantageously, the controller activating and deactivating the lighting arrangement may help to increase lifespan of the battery packs, as the lighting arrangement is deactivated in the event that the lighting arrangement is not needed and has been left on accidentally. This helps to prevent the battery packs from being accidentally drained, and having to be removed or replaced from the working vehicle which is expensive and time consuming.
[0117] The working vehicle may comprise a seat sensor arrangement configured to measure a position of the operator seat indicative of whether an operator is sat in the operator seat. The seat sensor arrangement may comprise one or more of a seat position sensor, a weight sensor and/or a seatbelt sensor.
[0118] Advantageously, the seat sensor arrangement helps to detect whether an operator is sat in the operator seat, such that the controller can deactivate and/or activate the lighting arrangement so as to help reduce the lifespan of the electrical storage assembly.
[0119] The working vehicle may comprise an override device configured to override the controller to activate the lighting arrangement. The override device may be an actuation member, switch or button.
[0120] Advantageously, the override device enables the lighting arrangement to be deactivated and/or activated in non-standard situations which do not follow the control logic of the controller.
[0121] The controller may be configured to deactivate the lighting arrangement after the lighting arrangement has been active for a predetermined time period.
[0122] Advantageously, the controller deactivating the lighting arrangement after the predetermined period of time may help to increase lifespan of the battery packs, as the lighting arrangement is deactivated in the event that the lighting arrangement is not needed and has been left on accidentally. This helps to prevent the battery packs from being accidentally drained, and having to be removed or replaced from the working vehicle which is expensive and time consuming.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0123] Embodiments will now be described by way of example only with reference to the accompanying figures, in which:
[0124] FIGS. **1** and **2** are perspective views of a dumper vehicle according to the present teachings;
[0125] FIGS. **3** and **4** are perspective views of a drive arrangement of the dumper vehicle of FIGS. **1** and **2**;
[0126] FIG. **5** is a plan view of the drive arrangement of FIGS. **3** and **4**;
[0127] FIG. **6** is a schematic of a controller for controlling a cooling fan of the drive arrangement of FIGS. **3** and **4**;
[0128] FIG. **7** is a perspective view of a power arrangement of the dumper vehicle of FIGS. **1** and **2**;
[0129] FIGS. **8** and **9** are plan views of the power arrangement of FIG. **7**;
[0130] FIG. **10** is a rear view of a portion of a body of the dumper vehicle of FIGS. **1** and **2**;

[0131] FIG. **11** is a rear view of the dumper vehicle of FIGS. **1** and **2**;
[0132] FIG. **12** is a perspective view of a compartment of the body of FIG. **10**;
[0133] FIGS. **13** and **14** are perspective views of a lighting arrangement of the dumper vehicle of FIGS. **1** and **2**; and
[0134] FIG. **15** is a schematic of a controller for controlling the lighting arrangement of FIGS. **13** and **14**.

DETAILED DESCRIPTION

[0135] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of various embodiments and the teachings. However, those skilled in the art will understand that: the present teachings may be practiced without these specific details or with known equivalents of these specific details; that the present teachings are not limited to the described embodiments; and, that the present teachings may be practiced in a variety of alternative embodiments. It will also be appreciated that well-known methods, procedures, components, and systems may not have been described in detail.
[0136] With reference to FIGS. **1** and **2**, there is illustrated a dumper vehicle **10** according to an embodiment of the present teachings. The dumper vehicle **10** includes a chassis **12** having a front end **14** and a rear end **16** and a body **18** supported by the chassis **12**. The dumper vehicle **10** includes a ground engaging propulsion structure **20**, **22** mounted to the chassis **12**. The ground engaging propulsion structure **20**, **22** includes a front axle with a pair of front wheels **20** mounted thereto and a rear axle **22** with a pair of rear wheels mounted thereto. It shall be appreciated that in alternative embodiments, the ground engaging propulsion structure **20**, **22** may include a pair of tracks.
[0137] The chassis **12** includes an operator seat **24** supported by the chassis **12**. In the illustrated embodiment, the operator seat **24** is located proximate to the rear wheels **22** along a longitudinal length of the chassis **12**. The operator seat **24** is provided within an open canopy **26**. As illustrated in FIGS. **1** and **2**, the open canopy **26** may include one or more handles **31**, for example two handles **31** located on opposing side of the open canopy **26**. The handles **31** are configured to assist the operator when ascending and descending the operator seat **24**. However, it shall be appreciated that in alternative embodiments, an operator cab or an alternative roll cage or frame may be used instead. The operator seat **24** is mounted to the body **18**. In particular, the operator seat **24** is mounted to a housing **19** defined by the body **18**, as will be described in more detail below.
[0138] The body **18** defines an upper surface **18***a* including a floorplate **40**. The upper surface **18***a* defines a cut-out section, and the floorplate **40** forms a cover over the cut-out section so as to define the upper surface **18***a*. The body **18** also includes an operator control console **27** mounted to the body **18**. The floorplate **40** is arranged between the operator seat **24** and the operator control console **27**. The floorplate **40** provides a substantially planar surface to support feet of the operator, and provides a surface on which the operator may walk, for example to mount and dismount the operator seat **24**. The floorplate **40** may include recessed sections for receiving components of the dumper vehicle **10**, for example a foot pedal arrangement accessible from the operator seat **24**.
[0139] The operator control console **27** is located frontward of the operator seat **24**. The operator control console **27** is configured to control one or more operations of the dumper vehicle **10**, for example steering of the dumper vehicle **10**. As illustrated in FIGS. **1** and **2**, the operator control console **27** extends at an angle towards the operator seat **24** such that the operator can reach one or more control devices. The one or more control devices may be actuation devices such as a steering wheel, for controlling operations of the dumper vehicle **10**. The operator console control **27** includes one or more handles **29** for assisting the operator when ascending and descending the floorplate **40** of the dumper vehicle **10**. It shall be appreciated that the handle **29** may be omitted, and an alternative arrangement of operator control console **27** may be used.
[0140] The dumper vehicle **10** includes an access step arrangement **25***a*, **25***b* configured to provide access to the operator seat **24**. The floorplate **40** is located adjacent the access step arrangement

25*a*, **25***b*. In the embodiment of the Figures, the dumper vehicle **10** includes an upper access step **25***a* and a lower access step **25***b* mounted to the body **18** on both sides of the dumper vehicle **10**. This helps to provide access from both sides of the dumper vehicle **10**. The floorplate **40** may be positioned between the upper access steps **25***a* on the opposing side of the dumper vehicle **10**. The upper access step **25***a* on each side protrudes in a rearward direction beyond the rear axle. The open canopy **26** is mounted to the rearward protrusion of the upper access step **25***a*. In particular, the open canopy **26** is mounted either side of the housing **19**. It shall be appreciated that in alternative embodiments, any suitable access arrangement, for example including any suitable number of access steps may be used. The access arrangement may be located only on one side of the dumper vehicle **10**.

[0141] The dumper vehicle **10** includes a drive arrangement **34**, illustrated in FIGS. **3** to **5**, including an electric motor **36** housed within the body **18**, said electric motor **36** configured to provide, at least in part, tractive power to the ground engaging propulsion structure **20**, **22**. An entirety of the electric motor **36** is located in front of the rear axle so as to improve weight distribution of the dumper vehicle **10**. The dumper vehicle **10** further includes a power arrangement **35** configured to provide electric power to the electric motor **36**.

[0142] An open topped container **28** for carrying a load therein, commonly referred to as a skip, is also mounted to the chassis **12**. The container **28** is positioned above the front wheels **20**, and a portion of the container **28** is located between the front wheels **20** and the rear wheels **22**. The container **28** is pivotally mounted to the chassis **12**, for example via a pivotable mount. This enables the container **28** to be moveable or pivotable between a transport position for transporting a load and a discharge position for discharging a load. In FIGS. **1** and **2**, the container **28** is illustrated in the transport position. Actuation or movement of the container **28** between the transport positions and discharge position may be controlled via a control (not shown) on the control console **27**.

[0143] The container **28** defines an upper edge thereof including a front edge **30**. A pair of opposing sidewalls **32** are provided at opposing sides of the front edge **30**. The combination of the front edge **30** and the opposing sidewalls **32** forms a chute at the front of the container **28**. Providing such a chute enables a flow of material to be directed forwards away from the front wheels **20** when material is discharged from the container **28**.

[0144] The chassis **12** is provided in two parts that are able to articulate with respect to each other. That is, the chassis **12** includes a main chassis **12***a* and a front chassis **12***b*. The rear wheels are provided on the main chassis **12***a* and the front wheels are provided on the front chassis **12***b*. The operator seat **24**, the power arrangement **35** and the drive arrangement **34** are supported by the main chassis **12***a* in the embodiment shown in the Figures. The container **28** is mounted to the front chassis **12***b*. The main chassis **12***a* and the front chassis **12***b* are pivotally connected together via a linkage. The linkage is such that the front chassis **12***b* is able to pivot or articulate up to an angle of 350 with respect to the main chassis **12***a*.

[0145] The container **28** defines an internal volume for receiving a load therein. A majority of the internal volume of the container **28** is positioned behind the front axle and in front of the rear axle. This arrangement provides a more even weight distribution between the front axle and the rear axle when the container **28** is loaded with material. Providing a more even weight distribution between the front **14** and rear **16** of the dumper vehicle **10** improves the stability and traction of the dumper vehicle **10**.

[0146] The drive arrangement includes a cooling fan **38**, illustrated in FIGS. **3** to **6**, configured to cool the electric motor **36**. In the embodiment of the Figures, the electric motor **36** is located below the floorplate **40**. The cooling fan **38** is interposed between the floorplate **40** and the electric motor **36**. The cooling fan **38** may be positioned immediately below the floorplate **40** so that there are no components positioned between the cooling fan **38** and the floorplate **40**. Put another way, a vacant space is defined between the cooling fan **38** and the floorplate **40**. In addition, there are no

components position between the cooling fan **38** and the electric motor **36**. Put another way, a vacant space is defined between the cooling fan **38** and the electric motor **36**. This helps to enhance air flow and improves access to the electric motor **36**, for example for maintenance.

[0147] The floorplate **40** includes one or more apertures **40***a*, for example a plurality of apertures **40***a* as illustrated in FIG. **2**, defining a flow path therethrough. The cooling fan **38** is configured and arranged to draw air through the one or more apertures **40***a* and over the electric motor **36**. The apertures **40***a* may be arranged in any suitable array. The apertures **40***a* may extend over a majority, for example an entirety, of the floorplate **40**. The aperture arrangement facilitates "clean" air to be drawn through the fan, as opposed to air from below the electric motor **36** which may be contaminated with dust and debris. Such dust and debris may cause blockages of the electric motor **36**, or may be drawn through the floorplate **40** and up towards the operator seat **24**.

[0148] The cooling fan **38** defines an axis of rotation, and the cooling fan **38** is mounted such that an axis of rotation of the cooling fan **38** extends transversely to a fore-aft axis a-a of the dumper vehicle **10**. Put another way, the axis of rotation of the cooling fan **38** extends substantially vertically, or transversely to the floorplate **40**. The cooling fan **38** includes a mounting arrangement **42** configured to mount the cooling fan **38** to the body **18**. As illustrated in FIGS. **4** and **5**, the mounting arrangement **42** is an annular bracket **42** extending around the cooling fan **38**.

[0149] The mounting arrangement **42** is mounted to the upper surface **18***a* of the body **18** by a tab **44***a*. The tab **44***a* and the upper surface **18***a* include corresponding bores for receiving a fastener. The tab **44***a* extends substantially parallel to the upper surface **18***a*. The tab **44***a* may include a power supply connection **45** mounted thereto for supplying power to the cooling fan **38**. The mounting arrangement **42** is mounted to the body **18** by one or more mounting plates **44***b-d* illustrated in FIG. **4** where three mounting plates **44***b-d* are provided. The mounting plate **44***b* extends between a side portion of the body **18** and the mounting arrangement **42**. The mounting plate **44***c* extends between the mounting arrangement **42** and a portion of the body **18** located rearward of the electric motor **36**. The mounting plate **44***d* extending between the mounting arrangement **42** and the foot pedal arrangement, or a portion of the body **18** adjacent the foot pedal arrangement. As such, the cooling fan **38** is mounted to the body **18** at a plurality of locations, thereby providing secure mounting and reducing vibration of the cooling fan **38**, in use. It shall be appreciated that the cooling fan **38** may be mounted at any suitable located to the chassis **12** and/or the body **12**. It shall be appreciated that in alternative embodiments, any suitable mounting arrangement may be used to mount the cooling fan **38** to the dumper vehicle **10**.

[0150] The dumper vehicle **10** includes and a controller **100** configured to control the cooling fan **38** based on one or more parameters associated with the dumper vehicle **10**, illustrated in FIG. **6**. In the embodiment of FIG. **6**, the controller **100** is a nano intelligent control and command system (ICCS) controller, however any alternative controller may be used, for example any suitable microcontroller. The controller **100** may comprise: control circuitry; and/or processor circuitry; and/or at least one application specific integrated circuit (ASIC); and/or at least one field programmable gate array (FPGA); and/or single or multi-processor architectures; and/or sequential/parallel architectures; and/or at least one programmable logic controllers (PLCs); and/or at least one microprocessor; and/or at least one microcontroller; and/or a central processing unit (CPU), to perform the described methods. The controller **100** may include an associated memory or the memory may be located locally to the controller or remotely. The memory may be a non-volatile flash memory.

[0151] The controller **100** is configured to control a rotational speed of the cooling fan **38** based on one or more parameters associated with the dumper vehicle **10**. The drive arrangement **34** includes a temperature sensor **46** configured to sense an electric motor temperature or to sense a temperature near the electric motor **36** indicative of the temperature of the electric motor **36**. As such, in both embodiments the temperature sensed by the electric motor temperature sensor **46** will be referred to as the electric motor temperature even if the electric motor temperature sensor **46** does not directly

measure electric motor temperature.
[0152] The controller **100** is configured to activate and deactivate the cooling fan **38** based on the determined electric motor temperature. In an electric dumper vehicle, the electric motor arrangement is considerably quieter than an internal combustion engine arrangement. As such, noise generated by the cooling fan **38** appears considerably louder. However, the cooling fan **38** is important for preventing overheating of the electric motor **36**. The controller **100** controls activation and deactivation of the cooling fan **38** so that the cooling fan **38** is running only when cooling of the electric motor **36** is desirable. This helps to reduce noise generated by the cooling fan **38** without compromising electric motor cooling.
[0153] The controller **100** is configured to activate the cooling fan **38** at a low speed when the electric motor temperature reaches a first predetermined temperature threshold. The low-speed setting of the cooling fan **38** may be in the range 500 rpm to 3000 rpm, for example in the range 1000 rpm to 2300 rpm, for example in the range 1500 rpm to 1800 rpm. The first predetermined temperature threshold may be in the range 53° C. to 57° C., optionally in the range 54° C. to 56° C., for example approximately 55° C. This helps to provide sufficient cooling to the electric motor **36** when the electric motor **36** reaches a predetermined temperature threshold, whilst minimizing noise from the cooling fan **38**.
[0154] The controller **100** is configured to activate the cooling fan **38** at a high speed when the electric motor temperature reaches a second predetermined temperature threshold, wherein the second predetermined temperature threshold greater than the first predetermined temperature threshold. The high-speed setting of the cooling fan **38** may be in the range 2500 rpm to 4500 rpm, for example in the range 3000 rpm to 3700 rpm, for example 3200 rpm to 3500 rpm. The second predetermined temperature threshold may be in the range 65° C. to 69° C., optionally in the range 66° C. to 68° C., for example approximately 67° C. This helps to provide sufficient cooling to the electric motor **36** when the electric motor **36** reaches a high temperature, regardless of the noise generated by the cooling fan **38**.
[0155] The controller **100** is configured to deactivate the cooling fan **38** when the electric motor temperature is at or below a third predetermined temperature threshold, below the first predetermined temperature threshold. The third temperature threshold is below 54° C., for example below 50° C. Deactivating the cooling fan **38** when the electric motor temperature sensor **46** is below the third threshold helps to reduce noise generated by the cooling fan **38** without comprising efficiency of the electric motor **36**.
[0156] It shall be appreciated that the first, second and third temperature thresholds as well as the high and low speed settings of the cooling fan **38** may vary depending on the type of electric motor and the type of cooling fan used. As such, the above ranges are exemplary. Furthermore, additional speed settings of the cooling fan **38** may be used in alternative embodiments. For example, in embodiments where the drive arrangement is driven using pulse-width modulation (PWM) control, the cooling fan **38** may be driven at any speed within a particular range. The high and low speeds may, therefore, vary throughout operation of the dumper vehicle **10**. The high speed may refer to a high-speed threshold and the low speed may refer to a low speed threshold (i.e. the cooling fan **38** may be driven above the high speed, or below the low speed).
[0157] In some embodiments, the controller **100** may be configured to control the cooling fan **38** based on a selected state of forward/neutral/reverse (FNR) drive selector. When the selector is in neutral, the electric motor **36** is driven at a lower rotational speed and the temperature of the electric motor **36** is likely to be low. Dumper vehicles typically spend a large proportion of operations with the FNR drive selector in the neutral state. In the neutral state, low speed cooling of the electric motor **36** is sufficient to cool the electric motor **36**. In this embodiment, the dumper vehicle **10** may include an FNR drive selector state sensor **47** configured to detect the state of the FNR drive selector, and whether the FNR drive selector is in a forward/neutral/reverse state. In particular, the controller **100** is configured to activate the cooling fan **38** at a low speed when the

drive selector is in the neutral state. For example, the controller **100** may be configured to activate the cooling fan **38** at a low speed when the drive selector is in the neutral state irrespective of the electric motor temperature. This helps to reduce noise generated by the cooling fan **38** when the FNR drive selector is in the neutral state, i.e. for a majority of operations of the dumper vehicle.
[0158] The power arrangement **35**, illustrated in FIGS. **7** to **9**, is housed within the body **18**. The body **18** includes the housing **19** located at the rear **16** of the dumper vehicle **10** in which the power arrangement **35** is housed. As such, the housing **19** forms a protective cover over the power arrangement **35**. As the operator seat **24** is mounted to an uppermost surface of the housing **19**, the power arrangement **35** is at least partially located below the operator seat **24**. The power arrangement **35** is located behind the rear axle. A majority or an entirety of the power arrangement **35** may be located behind the rear axle. This helps to improve weight distribution and packaging of the dumper vehicle **10**. The power arrangement **35** includes first, second and third subassemblies **48**, **50**, **52**. It shall be appreciated that in alternative embodiments, components of the first second and/or third subassemblies **48**, **50**, **52** may be omitted and/or alternative components may be included.
[0159] The first subassembly **48** includes an electric energy storage assembly **54***a-d* configured to provide electric power to the electric motor **36** and a power distribution unit **56** mounted to the electric energy storage assembly **54***a-d*. It shall be appreciated that the electric energy storage assembly **54***a-d* may be included in embodiments wherein the first subassembly **48** and/or additional components of the power arrangement **35** are omitted. It shall be appreciated that in embodiments where the dumper vehicle **10** is a hybrid electric vehicle (HEV), the power arrangement, for example the first subassembly **48**, may also include an internal combustion engine (ICE). The ICE may be used to charge the electric energy storage assembly **54***a-d*, or to directly power the electric motor **36**. It shall therefore be appreciated that the term "power arrangement" therefore refers to both electric and hybrid power arrangements. In such an embodiment, the ICE may be located adjacent the first subassembly **48**, or at an alternative location rearward of the rear axle.
[0160] The electric energy storage assembly **54***a-d* and the power distribution unit **56** are located behind the rear axle. A majority or an entirety of the electric energy storage assembly **54***a-d* and/or the power distribution unit **56** may be located behind the rear axle. The electric energy storage assembly **54***a-d* comprises a plurality of battery packs **54***a-d*. In the embodiment illustrated in the Figures, the electric energy storage assembly includes four battery packs **54***a-d*, however in alternative embodiments, any suitable number of battery packs **54***a-d* may be used, for example two, three or more battery packs. Each of the battery packs is a 48V battery pack, such that the electric energy storage assembly is a 48V system.
[0161] Each of the battery packs **54***a-d* includes a terminal portion located at a front end of each of the battery packs **54***a-d*, as illustrated in FIG. **9**. The terminals of each of the battery packs **54***a-d* are located on the terminal portion. The four battery packs **54***a-d* are stacked in pairs such that two of the battery packs **54***a*, **54***b* are upper battery packs **54***a*, **54***b* and two of the battery packs **54***c*, **54***d* are lower battery packs **54***c*, **54***d*. The upper battery packs **54***a*, **54***b* are vertically offset from the lower battery packs **54***a*, **54***d*. Put another way, the terminal portions of the lower battery packs **54***c*, **54***d* are located closed to the front **14** of the dumper vehicle **10** than the terminal portions of the upper battery packs **54***a*, **54***b*. As such, the terminal portions of the lower battery packs **54***c*, **54***d* are accessible despite being stacked below the upper battery packs **54***a*, **54***b*.
[0162] It shall be appreciated that in alternative embodiments, any suitable arrangement of battery packs may be used. For example, the battery packs **54***a-d* may be vertically aligned, or stacked in a single stack one on top of the other. Furthermore, any suitable alternatives to batteries may be used, for example supercapacitors.
[0163] The power distribution unit **56**, illustrated in FIGS. **7** and **8**, is configured to manage and distribute electrical power around the dumper vehicle **10**. The power distribution unit **56** receives

power from the battery packs **54***a-d* and distributes it to components of the dumper vehicle **10**, for example the electric motor **36**. The power distribution unit **56** is mounted directly above the battery packs **54***a-d*. This helps to improve packaging and space efficiency of the dumper vehicle **10**, and reduces an elongate length of the first subassembly **48**. The first subassembly **48** includes a mounting arrangement **58** configured to mount the power distribution unit **56** to the battery packs **54***a-d*. The mounting arrangement **58** enables the first subassembly **48** to be assembled together prior to being lifted onto the chassis **12**, thereby simplifying assembly of the dumper vehicle **10**.
[0164] The second subassembly **50** includes an electric motor controller **60** and a cooling device **62**. As illustrated in the plan views of FIGS. **8** and **9**, the second subassembly **50** is mounted in front of the first subassembly **48**. The electric motor controller **60** manages rotational speed, torque and direction of the electric motor **36** by controlling the supply of electric energy to the electric motor **36**. The cooling device **62** is configured to cool the electric motor controller **60** and/or the electric energy storage assembly **54***a-d*. The cooling device **62** includes a cooling fan located in a housing. The fan defines a rotational axis, and the rotational axis is arranged substantially transversely to the fore-aft axis a-a of the dumper vehicle **10**.
[0165] The cooling device **62** is mounted to the electric motor controller **60**. In particular, the cooling device **62** is mounted adjacent the electric motor controller **60**. The second subassembly **50** includes a frame **64** configured to mount the electric motor controller **60** to the cooling device **62**. It shall be appreciated that the frame **64** may also be used to mount additional electric components, for example inverters. The frame **64** includes a front wall **64***a* configured to mount the electric motor controller **60** to the cooling device **62** as well as to provide protection to the power arrangement **35**. As such, the cooling device **62** and the electric motor controller **60** can be assembled together prior to being lifted onto the chassis **12**, thereby simplifying assembly of the dumper vehicle **10**. The frame **64** extends partially between opposing sides of the dumper vehicle **10** in a lateral direction with respect to the fore-aft axis a-a. As such, the frame **64** may provide protection to the power arrangement **35**, in particular the battery packs **54***a-d*, in the event of a collision or impact to the dumper vehicle **10**.
[0166] The third subassembly **52** is located rearward of the first subassembly **48**. In the embodiment illustrated in FIGS. **7** to **12**, the first subassembly **48** is located between the second subassembly **50** and the third subassembly. The third subassembly **52** includes an electrical connector **66** for connecting the battery packs **54***a-d* to an external source of electrical power. The electrical connector **66** includes a charging port **66***a*, illustrated in FIGS. **11** and **12**. As such, the battery packs **54***a-d* can be plugged in and charged from the external source of electrical power.
[0167] The body defines a rear wall **16***a* located at the rear end **16** of the dumper vehicle **10**, and the electrical connector **66** is arranged on the rear wall **16***a*. This arrangement is advantageous over arranging the electric connector **66** on a sidewall because the operator can access the operator seat **24** from either side of the dumper vehicle **10**. The body **18** includes a compartment **68** accessed via an access panel **70** located on the rear wall **16***a*, and the electrical connector **66**, including the charging port **66***a*, is housed within the compartment **68**. The access panel **70** is moveable between an open position in which the electrical connector **66** is accessible, and a closed position. The compartment **68** further defines a space for housing a charging cable arrangement for connecting the battery pack **54***a-d* to the external source of electrical power.
[0168] In the event that the dumper vehicle **10** is being charged via the electrical connector **68** and the dumper vehicle **10** was accidentally driven in forward or reverse, then the charging cable may be ripped out of the electrical connector **68**. This could result in damage to the charging cable and/or electrical connector **68**, and may result in insufficient charging of the battery packs **54***a-d*. The electric motor controller **60** is configured to prevent selection of the forward and/or reverse states of the FNR drive selector when the access panel **70** is in the open position. This helps to prevent the operator from driving the dumper vehicle **10** away from the external source of electrical power and damaging the charging cable and/or electrical connector **66**. The access panel **70** may

include any suitable sensor, for example a position sensor, for sensing whether the access panel **70** is in the open position.

[0169] The dumper vehicle **10** includes a lighting arrangement **72***a-d*, illustrated in FIGS. **13** and **14**, including at least one lighting member **72***a-d* configured and arranged to illuminate at least a portion of the body **18**, for example at least a portion of the floorplate **40** and/or at least a portion of the access step arrangement **25***a*, **25***b*. The at least one light emitting members may be LED lights, or any suitable type of lighting member may be used. In the embodiment shown in FIGS. **14** and **15**, four discrete light emitting members **72***a-d* are provided, however in alternative embodiments any suitable number of light emitting members **72***a-d* may be used. Alternatively, a lighting strip may be used, for example an LED lighting strip.

[0170] The at least one lighting member **72***a-d* is located on the operator control console **27**. The light emitting members **72***a-d* are arranged spaced apart on the operator console **27**. In particular, as illustrated in FIG. **13**, the at least one lighting member **72***a-d* may be located on an underside of the operator control console **27**. The underside of the operator control console **27** includes an angled surface **27***a*. The angled surface **27***a* extends in a generally downward and rearward direction towards the floorplate **40**. The angled surface **27***a* is substantially planar. The angled surface **27***a* is located above a lowermost edge of the operator console **27** such that operator console helps to direct light towards the floorplate **40** and/or access steps **25***a*, **25***b*.

[0171] The dumper vehicle **10** includes a controller **200**, illustrated in FIG. **15**, configured to control activation and deactivation of the lighting arrangement **72***a-d*. The controller **200** may be the same as the controller **100**, or a separate controller **200** may be used to control activation and deactivation of the lighting arrangement **72***a-d*. The controller may be a nano ICCS controller, however any alternative controller may be used. The controller **200** may include any of the features of the controller **100**.

[0172] The controller **200** is configured to activate or deactivate the lighting arrangement **72***a-d* based on one or more of: an active or inactive state of a vehicle headlight arrangement (not shown); a position of the operator seat **24**; an active or inactive state of the dumper vehicle **10**; an open or closed position of a cab door, in embodiments where the dumper vehicle **10** includes an operator cab.

[0173] The controller **200** activating and deactivating the lighting arrangement **72***a-d* may help to increase lifespan of the battery packs **54***a-d*, as the lighting arrangement **72***a-d* is deactivated in the event that the lighting arrangement **72***a-d* is not needed and has been left on accidentally. This helps to prevent the battery packs **54***a-d* from being inadvertently drained, and having to be removed or replaced from the dumper vehicle **10** which is expensive and time consuming.

[0174] The operator seat **24** includes a seat sensor arrangement **202** configured to measure a position of the operator seat **24** indicative of whether the operator is sat in the operator seat **24**. The seat sensor arrangement **202** may include one or more of a seat position sensor, a weight sensor and/or a seatbelt sensor. The dumper vehicle **10** may also include sensors to sense the active or inactive state of the vehicle headlight arrangement, the active or inactive state of the dumper vehicle **10** and/or the open or closed position of the cab door. As illustrated in FIG. **16**, the dumper vehicle **10** may include a dumper state sensor **204**, a headlight sensor **206** and/or a cab door position sensor **208**. The dumper state sensor **204** may be a sensor for sensing a position of a vehicle ignition, i.e. whether the vehicle ignition is on (and the dumper vehicle **10** is in the active state) or the vehicle ignition is off (and the dumper vehicle **10** is in the inactive state).

[0175] In a first example, the controller **200** may be configured to activate the lighting arrangement **72***a-d* when the vehicle headlight arrangement has been active within a predetermined time period and the dumper vehicle **10** goes from inactive to active, e.g. when the vehicle ignition is switched from off to on. The predetermined time may be in the range 5 minutes to 25 minutes, for example in the range 10 minutes to 20 minutes, e.g. 15 minutes. In a second example, the controller **200** may be configured to activate the lighting arrangement **72***a-d* when all of the following occur: the

vehicle headlight arrangement has been active within the predetermined time period, the seat sensor arrangement **202** indicates that the operator is not sat in the operator seat **24**, and the dumper vehicle **10** is in an active state, e.g. the vehicle ignition has been left on.
[0176] This helps to prevent the lighting arrangement **72***a-d* from being deactivated or off when the operator needs illumination, whilst saving energy.
[0177] There may be a delay between the controller **200** determining that any of the above condition are met and the controller **200** activating the lighting arrangement **72***a-d*. The delay may be in the range 1 second to 10 seconds, for example 5 seconds. The controller **200** may be configured to activate the lighting arrangement **72***a-d* for a predetermined period of activation. The predetermined period of activation may be in the range 10 seconds to 120 seconds, for example 45 seconds to 90 seconds, for example 60 seconds.
[0178] The controller **200** may be configured to deactivate the lighting arrangement **72***a-d* after the predetermined period of activation, or based on any of the conditions discussed above.
[0179] The dumper vehicle **10** includes an override device (not shown) configured to override the controller **200** when the controller **200** activates and deactivates the lighting arrangement **72***a-d*. The override device may be an actuation member, for example a switch or a button. The override device may be located on the operator control console **27**. The override device enables the operator to activate and deactivate the lighting arrangement **72***a-d* in non-standard situations which do not follow the control logic of the controller **200**.
[0180] Although the invention has been described above in terms of the frame being provided in two parts, it will be appreciated that the frame could be provided as a single component. The region of the frame on which the container is mounted could be substantially lower than the region of the frame on which the operator's seat is mounted.
[0181] Although the controllers **100**, **200** or any of the control logic described above (for example the access panel control logic) have been described in relation to an electric dumper vehicle **10**, it shall be appreciated that the teachings are applicable to any type of working vehicle. For example, the controllers **100**, **200** may be applicable to any of a skid-steer loader, a compact track loader, a wheel loader, a telescopic wheel loader, a slew excavator, a backhoe loader or a tractor, by way of example. These vehicles may include ICEs, or may be hybrid electric vehicles or electric vehicles. As such, components described in relation to the dumper vehicle, for example the chassis, body, operator seat, drive arrangement etc. may be altered or omitted when the teachings are applied to alternative working vehicles.
[0182] The one or more embodiments are described above by way of example only and it will be appreciated that the variations are possible without departing from the scope of protection afforded by the appended claims.

Claims

1. A dumper vehicle comprising: a chassis; a ground engaging propulsion structure mounted to the chassis, said ground engaging propulsion structure comprises a front axle with a pair of front wheels mounted thereto and a rear axle with a pair of rear wheels mounted thereto; an operator seat supported by the chassis; a body supported by the chassis; a drive arrangement comprising an electric motor housed within the body, said electric motor configured to provide, at least in part, tractive power to the ground engaging propulsion structure; an electric energy storage assembly configured to provide electric power to the electric motor, wherein the electric energy storage assembly is located at least partially rearward of the rear axle; and an open topped container for carrying a load therein supported by the chassis, wherein the container is moveable between a transport position for transporting a load and a discharge position for discharging of a load.
2. The dumper vehicle according to claim 1, comprising a power arrangement configured to provide electric power to the electric motor, wherein the power arrangement comprises the electric

energy storage assembly, and wherein the power arrangement is located behind the rear axle.
3. The dumper vehicle according to claim 2, wherein the power arrangement comprises a first subassembly comprising the electric energy storage assembly and a power distribution unit mounted to the electric energy storage assembly.
4. The dumper vehicle according to claim 3, wherein the power arrangement comprises a second subassembly comprising an electric motor controller.
5. The dumper vehicle according to claim 4, wherein the second subassembly further comprises a cooling device mounted to the electric motor controller, and wherein the cooling device is configured to cool the electric motor controller and/or the electric energy storage assembly.
6. The dumper vehicle according to claim 3, wherein the power arrangement comprises a third subassembly comprising an electrical connector for connecting the battery packs to an external source of electrical power.
7. The dumper vehicle according to claim 6, wherein the body defines a rear wall located at a rear end of the dumper vehicle, and wherein the electrical connector is arranged on the rear wall.
8. The dumper vehicle according to claim 7, wherein the body comprises a compartment accessed via an access panel located on the rear wall, wherein the access panel is moveable between an open position and a closed position, and wherein the electrical connector is housed within the compartment.
9. The dumper vehicle according to claim 8, comprising a forward/neutral/reverse (FNR) drive selector, wherein a controller is configured to prevent selection of the forward and/or reverse states when the access panel is in the open position.
10. The dumper vehicle according to claim 1, wherein the drive arrangement comprises a cooling fan configured to cool the electric motor, and wherein the dumper vehicle comprises a controller configured to control the cooling fan, based on one or more parameters associated with the dumper vehicle.
11. The dumper vehicle according to claim 10, comprising a temperature sensor configured to determine an electric motor temperature at or near the electric motor, and wherein the controller is configured to activate and deactivate the cooling fan based on the determined electric motor temperature.
12. The dumper vehicle according to claim 11, wherein the controller is configured to activate the cooling fan at a low speed when the electric motor temperature reaches a first predetermined temperature threshold and/or wherein the controller is configured to activate the cooling fan at a high speed when the electric motor temperature reaches a second predetermined temperature threshold, wherein the second predetermined temperature is greater than the first predetermined threshold.
13. The dumper vehicle according to claim 12, wherein the controller is configured to deactivate the cooling fan when the electric motor temperature is at or below a third predetermined temperature threshold, wherein the third predetermined temperature threshold is below the first predetermined temperature threshold.
14. The dumper vehicle according to claim 10, wherein the controller is configured to control the cooling fan based on a selected state of a forward/neutral/reverse (FNR) drive selector.
15. The dumper vehicle according to claim 1, wherein an upper surface of the body comprises a floorplate, and wherein the electric motor is located below the floorplate.
16. The dumper vehicle according to claim 1, comprising a lighting arrangement, wherein an upper surface of the body defines a floorplate arranged in front of the operator seat, and wherein the lighting arrangement comprises at least one light emitting member configured and arranged to illuminate at least a portion of the body.
17. The dumper vehicle according to claim 16, wherein the body comprises an operator control console mounted thereto, wherein the floorplate is arranged between the operator seat and the operator control console, and wherein the at least one lighting member is located on the operator

control console.

18. The dumper vehicle according to claim 16, comprising a controller configured to control activation and deactivation of the lighting arrangement, wherein the controller is configured to activate or deactivate the lighting arrangement based on one or more of: an active or inactive state of a vehicle headlight arrangement; a position of the operator seat; an active or inactive state of the dumper vehicle; an open or closed position of a cab door of an operator cab.

19. A dumper vehicle comprising: a chassis; a ground engaging propulsion structure mounted to the chassis, said ground engaging propulsion structure comprises a front axle with a pair of front wheels mounted thereto and a rear axle with a pair of rear wheels mounted thereto; an operator seat supported by the chassis; a body supported by the chassis; a drive arrangement comprising an electric motor housed within the body, said electric motor configured to provide, at least in part, tractive power to the ground engaging propulsion structure; an electric energy storage assembly configured to provide electric power to the electric motor; and an open topped container for carrying a load therein supported by the chassis, said container moveable between a transport position for transporting a load and a discharge position for discharging of a load, wherein the drive arrangement comprises a cooling fan configured to cool the electric motor, and wherein the dumper vehicle comprises a controller configured to control the cooling fan based on one or more parameters associated with the dumper vehicle.

20. A dumper vehicle comprising: a chassis; a ground engaging propulsion structure mounted to the chassis, said ground engaging propulsion structure comprises a front axle with a pair of front wheels mounted thereto and a rear axle with a pair of rear wheels mounted thereto; an operator seat supported by the chassis; a body supported by the chassis, wherein an upper surface of the body comprises a floorplate; a drive arrangement comprising an electric motor housed within the body and located below the floorplate, said electric motor configured to provide, at least in part, tractive power to the ground engaging propulsion structure; an electric energy storage assembly configured to provide electric power to the electric motor; and an open topped container for carrying a load therein supported by the chassis, said container moveable between a transport position for transporting a load and a discharge position for discharging of a load, wherein a cooling fan is interposed between the floorplate and the electric motor.