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(54) **Support structure for an auxiliary power source**

(57) A support structure (1) for providing an auxiliary power source (8) for an electric cable driven mobile work machine comprises a support member (2) for supporting the auxiliary power source, a sliding member (3) fixed to the support member (2), attaching means (4, 5) for attaching the support structure to the mobile work machine, and a sliding frame (6) fixed to the attaching means and

arranged slidably in relation to the sliding member (3). An actuator (7) of the support structure moves the sliding frame (6) and the sliding member (3) in relation to one another between a first position of the sliding member in relation to the sliding frame and a second position of the sliding member in relation to the sliding frame to lift and lower the support member relative to attaching means.

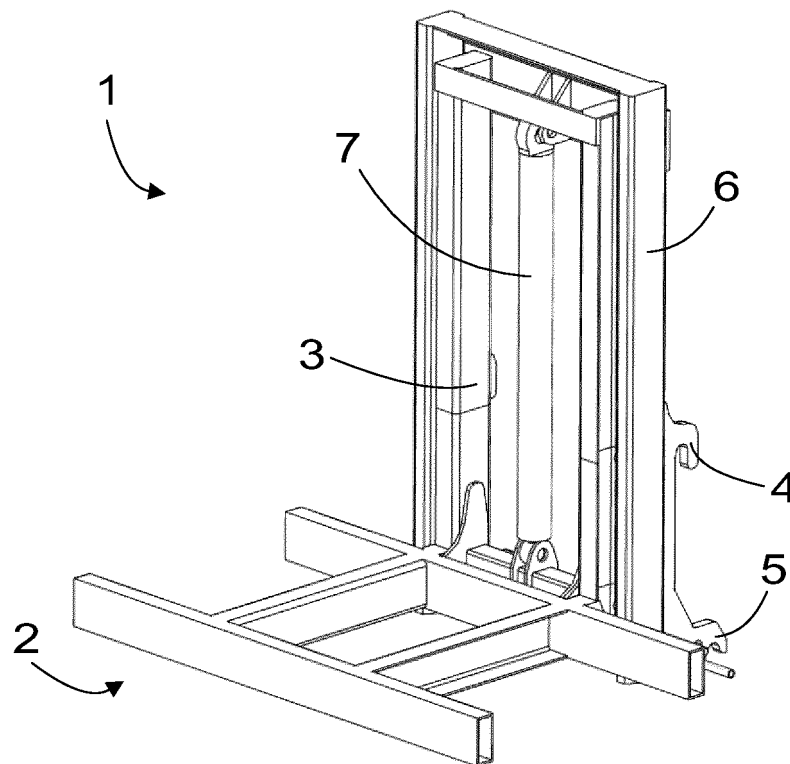


FIG. 1

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Description

BACKGROUND

[0001] The invention relates to mobile work machines, and particularly to support structures for transportable power sources in electrically operated mobile work machines.

[0002] One of the problems associated with electrically operated mobile work machines is providing a power source for the work machine. For instance for machines that are mainly supposed to be used on a restricted working area the power supply may be arranged using a power supply cable. However, there a need may occasionally occur to drive the machine outside the working area. In such cases, the cable can typically not be used due to its limited length and the power supply must be provided by an external power supply, which often requires use of a generator vehicle or a trailed generator. The handling of this kind of combinations is often difficult, requires resources and causes dangerous situations, especially when driving in reverse.

BRIEF DESCRIPTION

[0003] An object of the present solution is to provide a new method and a support structure for implementing the method. The objects of the solution are achieved by a method and a support structure, which are characterized by what is stated in the independent claims. Some embodiments of the invention are disclosed in the dependent claims.

[0004] The invention is based on the idea of providing a support structure that comprises two structural parts arranged slidably relative to one another and means for actuating this sliding movement, wherein a transportable auxiliary power source may be arranged to be supported by the support structure. Such a support structure enables transfer of a mobile work machine the power supply of which is primarily provided by an electric cable where power supply by cable is not available, such as when transferring from one work area to another or from a work area to a maintenance point.

[0005] An advantage of the method and structure is that the support structure itself provides means for attaching the support structure to the mobile work machine, supporting the transportable auxiliary power source on the support structure and lifting the power source on the support structure to a transport and use position. This enables quick and easy mounting of a power source to an electrically driven mobile work machine and significantly improves the handling of the work machine especially when driven outside the reach of a fixed power supply cable. This considerably improves the usability of such work machines providing a usability comparable to that of diesel engine driven work machines and similar especially when work machines are transferred between work areas or outside a work area for maintenance pur-

poses or similar.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] In the following the invention will be described in greater detail by means of preferred embodiments with reference to the attached [accompanying] drawings, in which

Figure 1 illustrates a support structure; Figure 2 illustrates another support structure; and Figure 3 illustrates a method for providing an electrically operated mobile work machine with a transportable auxiliary power source.

DETAILED DESCRIPTION OF THE INVENTION

[0007] Figure 1 illustrates a support structure. Such a support structure 1 can be used for instance for providing a transportable auxiliary power source for a mobile work machine primary power supply of which is provided by an electric cable.

[0008] The support structure 1 comprises a support member 2 for supporting a transportable auxiliary power source (not shown). According to an embodiment, the support member 2 may comprise a substantially horizontal base, on top of which a transportable auxiliary power source can be mounted. In the embodiment of Figure 1 the support structure comprising the substantially horizontal base comprises a beam structure, such as a welded beam structure formed of beams known as such.

[0009] The support structure 1 also comprises a sliding member 3 fixed to the support member 2, attaching means 4, 5 for attaching the support structure 1 to the mobile work machine (not shown) and a sliding frame 6 fixed to the attaching means 4, 5 and arranged slidably in relation to the sliding member 3. According to an embodiment, the sliding member 3 and the sliding frame 6 may be arranged slidably in relation to one another by one of the sliding member 3 and the sliding frame 6 comprising a rail-like structure and the other comprising a counter-part fitting the rail-like structure. In other words, the counter-part may engage with the rail-like structure in any manner known as such enabling the counter-part sliding along the rail-like structure, thus coupling the sliding member 3 and the sliding frame 6 can to one another in a sliding manner.

[0010] The support structure 1 further comprises an actuator 7 for moving the sliding frame 6 and the sliding member 3 in relation to one another between a first position of the sliding member 3 in relation to the sliding frame 6 and a second position of the sliding member 3 in relation to the sliding frame 6 to lift and lower the support member 2 relative to attaching means 4, 5. According to an embodiment, the actuator 7 may comprise a pressure medium cylinder, such as a hydraulic cylinder or a pneumatic cylinder. According to an embodiment, the pressure medium cylinder can be driven by the transport-

able auxiliary power source, whereby the support structure 1 can be attached to the mobile work machine without an external power source. According to an embodiment, the pressure medium cylinder may be a hydraulic cylinder and the support structure 1 may comprise a hydraulic system for driving the hydraulic cylinder.

[0011] According to another embodiment, the pressure medium cylinder may be a hydraulic cylinder and the support structure 1 may comprise a connector (not shown) for connecting the hydraulic cylinder to an external hydraulic system, such as the hydraulic system of the work machine. The connector may be of quick coupling type to enable quick and easy connecting and disconnecting of the hydraulic cylinder 7 and the support structure 1 to the hydraulic system.

[0012] The attaching means 4, 5 may comprise one attaching structure or two, three, four or more structural parts that may be separate structural parts of the support structure 1 or one or several of them may form a uniform part of the structure of the support structure 1. According to an embodiment, the attaching means may comprise at least one upper attaching part 4 and at least one lower attaching part 5.

[0013] According to an embodiment, the attaching means may comprise structures for fixedly attaching the support structure 1 to the mobile work machine. In such an embodiment, the support structure 1 and, more particularly, the attaching means 4, 5 may be fixedly attached to the work machine by, for instance, welding the attaching means 4, 5 to structures of the work machine.

[0014] Figure 2 illustrates another embodiment of a support structure. The support structure 1 may be otherwise similar to the embodiment of Figure 1, but in this embodiment attaching means 4, 5 comprise structures for removably attaching the support structure 1 to the work machine. According to an embodiment, the structures for removably attaching the support structure 1 to the work machine may comprise at least one lug-like part for attaching the support structure 1 to the mobile work machine by a pin coupling. According to an embodiment, the lower attaching part 5 may comprise the lug-like part, such as in the embodiment of Figure 2.

[0015] According to an embodiment, the structures for removably attaching the support structure 1 to the mobile work machine may comprise at least one hook-like part open on at least one side. Such a hook-like part may be used to both position the support structure 1 relative to the work machine and to attach the support structure 1 to the mobile work machine. According to an embodiment, the upper attaching part 4 may comprise the hook-like part, such as in the embodiment of Figure 2.

[0016] The embodiment of Figure 2 provides a quick clamping mounting of the support structure 1 and, therefore, the transportable auxiliary power source 8 to the work machine enabling a smooth attachment and removal of the transportable auxiliary power source 8 from the work machine. It, thus, also enables easy moving of the transportable power source, for instance from one place

or work machine to another.

[0017] According to an embodiment, the attaching means 4, 5 may comprise attaching structures, such as hook structures, formed to be attachable to standardized attaching structures of forklifts, loaders or other industrial means of transport known as such, such that the support structure 1 and a transportable auxiliary power source 8 mounted on the support structure 1 can be attached to and transported with such known means of transport in a mine, a quarry and/or other type of a work area. According to an embodiment, the attaching means 4, 5 can comprise standardized quick clamping structures for quickly and easily attaching the support structure to such means of transport with standardized attaching structures and, similarly, detaching the support structure from the means of transport. According to an embodiment, these same standardized quick clamping structures can be used for attaching the support structure 1 to the means of transport and/or the mobile work machine.

[0018] Figure 2 also schematically shows a transportable auxiliary power source 8. Depending on the embodiment and the work machine, such a transportable auxiliary power source may comprise a diesel generator, a battery pack, a fuel cell unit or any unit able to independently produce electrical power. The transportable auxiliary power source may be used for direct electrical power supply or for charging batteries of a battery-operated work machine.

[0019] According to an embodiment, a transportable auxiliary power source is attached to a mobile work machine, primary power supply of which is provided by an electric cable, by a support structure described in this description such that the mobile work machine is transferable independently by the electric power provided by the auxiliary power source. In other words, the mobile work machine can be for instance transferred between two work areas or outside a work area for maintenance or other purposes by the transportable auxiliary power source supplying electric power for the mobile work machine, for instance for the driving motor of the mobile work machine.

[0020] Figure 3 illustrates a method for providing an electrically operated mobile work machine with a transportable auxiliary power source. The method may comprise mounting 31 a transportable auxiliary power source 8 on a support member 2 of a support structure 1. The support structure 1 may comprise a support structure according to an embodiment described in this description. Similarly, a support structure 1 described in this description may be configured to enable a method described in this description. The support structure 1 may, for instance, further comprise a sliding member 3 fixed to the support member 2, attaching means 4, 5 for attaching the support structure 1 to the mobile work machine, a sliding frame 6 fixed to the attaching means 4, 5 and arranged slidably in relation to the sliding member 3, and an actuator 7.

[0021] The method may also comprise moving 32 by

the actuator 7 the sliding member 3 and the sliding frame 6 to a first position in relation to one another to lift the sliding frame 6 and attaching means 4, 5 fixed to the sliding frame 6 to a position enabling attachment of the support structure to the mobile work machine. The first position may comprise an attaching position. The method may further comprise attaching 33 the support structure 1 to the mobile work machine by attaching means 4, 5 and moving 34 by the actuator 7 the sliding member 3 and the sliding frame 6 to a second position in relation to one another to lift the support member 2 relative to attaching means 4, 5 to lift the transportable auxiliary power source 8 to a transport and use position. The mobile work machine may then be transferrable independently by the electric power provided by the auxiliary power source. In other words, the mobile work machine may be for instance drivable between

[0022] According to an embodiment, the sliding member 3 and the sliding frame 6 may be in a substantially same position relative to one another in the transport and use position and the loading position, in which the transportable auxiliary power source 8 is mounted on the support member 2.

[0023] The solution thus enables a mobile work machine being transferrable independently by the electric power provided by an auxiliary power source for instance between locations between which no electric cable is available. In other words, the mobile work machine may be for instance drivable between two work areas or outside a work area for maintenance or other purposes by the electric power provided by the transportable auxiliary power source, whereas within a work area it can be operated by the electric power provided by an electric cable. Thereby, the use of the auxiliary power source can be limited to transfers and use outside the reach of available electric cables suitable for supplying power for the work machine. In such a way the same transportable auxiliary power source may be utilised for transfer several mobile work machine, one at a time. The support structure may be configured to be quick and easy to attach and detach, whereby it can be quickly detached from one mobile work machine and attached to another or only attached to the mobile work machine when needed.

[0024] It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. A support structure for providing a transportable auxiliary power source for a mobile work machine primary power supply of which is provided by an electric cable, **characterized in that** the support structure comprises:

a support member for supporting a transportable auxiliary power source;
a sliding member fixed to the support member;
attaching means for attaching the support structure to the mobile work machine;
a sliding frame fixed to the attaching means and arranged slidably in relation to the sliding member; and
an actuator for moving the sliding frame and the sliding member in relation to one another between a first position of the sliding member in relation to the sliding frame and a second position of the sliding member in relation to the sliding frame to lift and lower the support member relative to attaching means.

2. A support structure according to claim 1, wherein the support member comprises a substantially horizontal base, on top of which a transportable auxiliary power source can be mounted.
3. A support structure according to claim 1 or 2, wherein one of the sliding member and the sliding frame comprises a rail-like structure and the other comprises a counter-part fitting the rail-like structure such that the sliding member and the sliding frame are coupled to one another in a sliding manner.
4. A support structure according to any one of the claims 1 to 3, wherein the attaching means comprise structures for fixedly attaching the support structure to the mobile work machine.
5. A support structure according to any one of the claim 1 to 3, wherein the attaching means comprise structures for removably attaching the support structure to the mobile work machine.
6. A support structure according to claim 5, wherein the structures for removably attaching the support structure to the mobile work machine comprise at least one lug-like part for attaching the support structure to the mobile work machine by a pin coupling.
7. A support structure according to claim 5 or 6, wherein the structures for removably attaching the support structure to the mobile work machine comprise at least one hook-like part open on at least one side to position the support structure relative to the mobile work machine and to attach the support structure to the mobile work machine.
8. A support structure according to any one of claims 1 to 7, wherein the actuator comprises a pressure medium cylinder.
9. A support structure according to claim 8, wherein the pressure medium cylinder can be driven by the trans-

portable auxiliary power source.

10. A support structure according to claim 8 or 9, wherein the pressure medium cylinder is a hydraulic cylinder and the support structure comprises a hydraulic system for driving the hydraulic cylinder. 5

11. A support structure according to claim 8, wherein the pressure medium cylinder is a hydraulic cylinder and the support structure comprises a connector for connecting the hydraulic cylinder to an external hydraulic system. 10

12. A mobile work machine primary power supply of which is provided by an electric cable, **characterized in that** a transportable auxiliary power source is attached to the mobile work machine by a support structure according to any one of claims 1 to 10 such that the mobile work machine is transferrable independently by the electric power provided by the auxiliary power source. 15
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13. A mobile work machine according to claim 12, wherein the transportable auxiliary power source comprises at least one of the following: a diesel generator, a battery pack and a fuel cell unit. 25

14. A method for providing an electrically operated mobile work machine primary power supply of which is provided by an electric cable with a transportable auxiliary power source, **characterized by** mounting a transportable auxiliary power source on a support member of a support structure, the support structure further comprising: a sliding member fixed to the support member, attaching means for attaching the support structure to the mobile work machine, a sliding frame fixed to the attaching means and arranged slidably in relation to the sliding member, and an actuator; 30
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moving by the actuator the sliding member and the sliding frame to a first position in relation to one another to lift the sliding frame and attaching means fixed to the sliding frame to a position enabling attachment of the support structure to the mobile work machine;
attaching the support structure to the mobile work machine by attaching means; and
moving by the actuator the sliding member and the sliding frame to a second position in relation to one another to lift the support member relative to attaching means to lift the transportable auxiliary power source to a transport and use position, wherein the mobile work machine is transferrable independently by the electric power provided by the auxiliary power source.

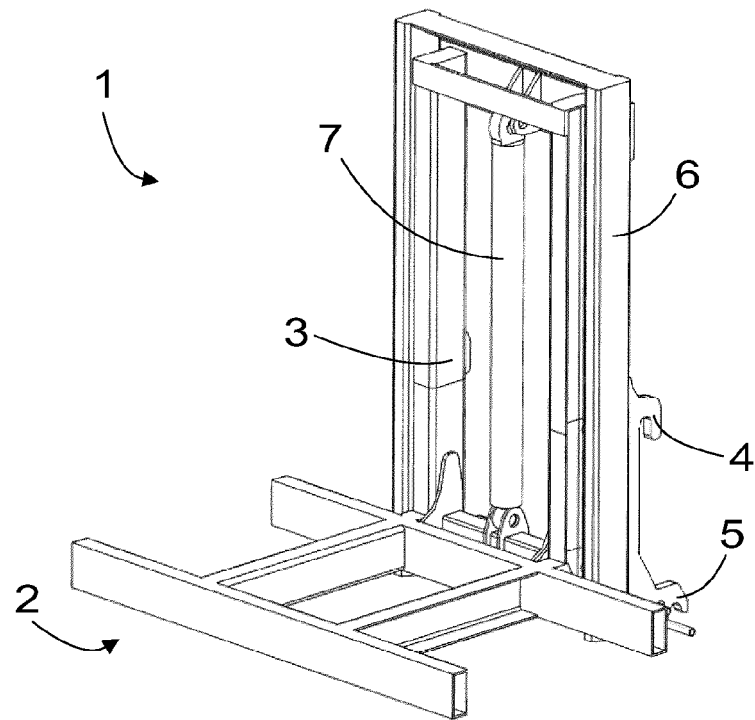


FIG. 1

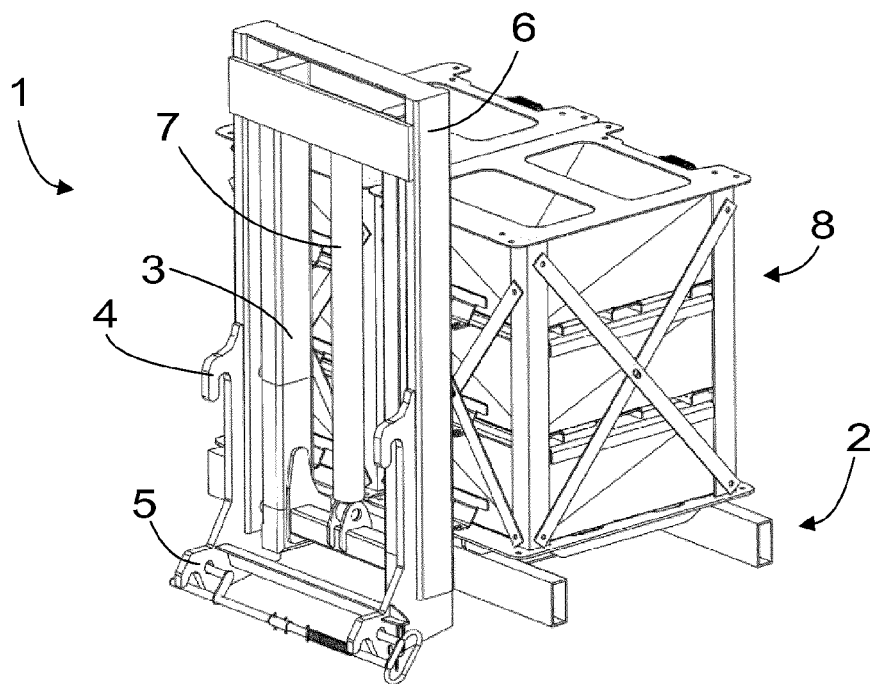


FIG. 2

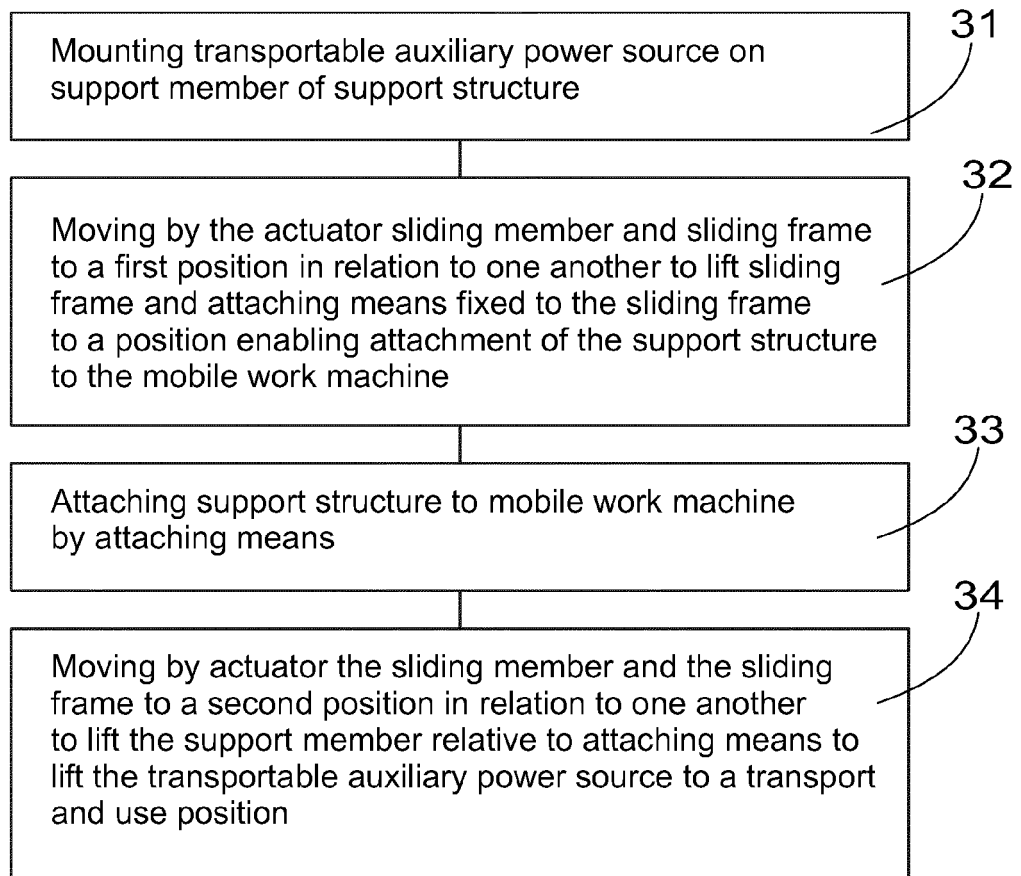


FIG. 3



EUROPEAN SEARCH REPORT

Application Number
EP 14 19 5055

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Place of search The Hague		Date of completion of the search 23 April 2015	Examiner Guthmuller, Jacques
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EPO FORM 1503 03/82 (P04C01)

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