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(54) **System for driving hydraulic components of a vehicle superstructure**

(57) The invention concerns a system (1) for driving hydraulic components of a superstructure (10) adapted to be arranged onto a vehicle, said system comprising: a first hydraulic device (5) capable of working as a hydraulic pump, said first hydraulic device (5) being arranged for driving of the hydraulic components of the superstructure (10); an electric device (7) capable of working as an electric motor, said electric device (7) being arranged for driving of the first hydraulic device (5); and at least one rechargeable battery (11) arranged for powering the electric device (7). The invention is **characterized in that** the electric device (7) is capable of working also as an electric generator, wherein the electric device (7) is arranged to charge the at least one battery (11) when working as an electric generator, that the first hydraulic device (5) is capable of working also as a hydraulic motor, wherein the first hydraulic device (5) is arranged to drive the electric device (7) as an electric generator when the first hydraulic device (5) works as a hydraulic motor, and that the first hydraulic device (5) is connectable to a power take-off (PTO) (2) driven by an engine of the vehicle such as to allow the first hydraulic device (5) to be driven as a hydraulic motor by the power take-off (PTO) (2). The invention also concerns a superstructure and a vehicle comprising a system of the above type. The invention also concerns a method for charging a battery in a system of the above type.

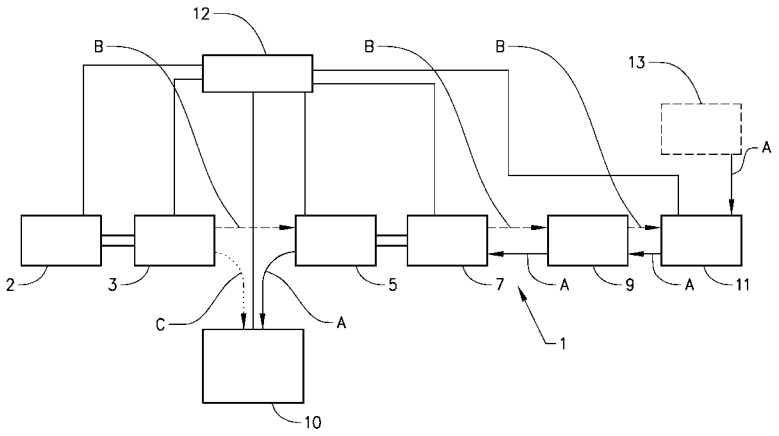

FIG. 1

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Description

TECHNICAL FIELD

[0001] This invention relates to a system for driving hydraulic components of a superstructure adapted to be arranged onto a vehicle. The invention also relates to a method for charging a battery in such a system. In particular, the invention relates to a system for driving hydraulic components of a refuse collection unit adapted to be arranged onto a truck.

BACKGROUND ART

[0002] Refuse collection vehicles generally include a refuse collection unit arranged onto a truck where the refuse collection unit normally includes a refuse container and equipment for compacting refuse dumped into the container and for lifting refuse carts. In order to drive such equipment, refuse collection units normally comprises a hydraulic system.

[0003] The hydraulic components of the refuse collection unit are conventionally driven by a hydraulic pump connected to a power take-off (PTO) driven by the engine of the vehicle. This is also the common way of driving hydraulic components of other vehicle superstructures, such as cranes and skylifts,

[0004] As exemplified in JP 2007050996 it is known to provide the refuse collection unit with batteries and an electric motor arranged to drive the hydraulic equipment via a hydraulic pump in order to reduce fuel consumption, exhaust emissions and noise during operation of a refuse collection vehicle. Using batteries for driving the collection unit, it is possible to turn off the vehicle engine when the vehicle stops. The batteries are charged when the vehicle is not in operation, usually in the night-time.

[0005] A general problem associated with the use of batteries for driving the hydraulic components is that the capacity of the battery or batteries may not be sufficient for the amount of work planned to be carried out. If the batteries run out of power the refuse collecting work must be interrupted.

[0006] One way of solving this problem is to make use of a larger battery capacity, i.e. more and/or larger batteries. A drawback of this solution is that increased battery capacity also leads to increases in weight, space and cost.

[0007] EP 1746049 discloses another type of solution where the refuse collection unit can be driven either by a hydraulic pump connected to an engine PTO or by another hydraulic pump connected to an electric motor powered by batteries. This way it is at least possible to complete the planned operation of the refuse collecting vehicle if the batteries run out of power. A drawback is of course that fuel consumption, noise etc. are not reduced when using the PTO as power source (which require the vehicle engine to be running).

[0008] Another solution is to allow charging of batteries during operation of the refuse collection vehicle, for instance between vehicle stops. To achieve this it has been proposed to connect one or several electric generators to the batteries and to power these generators from a vehicle engine PTO. A problem with such an arrangement is, however, that it is a rather complicated solution that is difficult to adapt to different vehicle chassis due to the limited space available. Another problem is that the generators are exposed to dirt, dust, salt etc. which jeopardize the functionality of the system.

[0009] Thus there is still a need for improvements with regard to operation of the hydraulic components of vehicle superstructures, such as refuse collection units.

DISCLOSURE OF INVENTION

[0010] The object of this invention is to provide a vehicle superstructure, such as a refuse collection unit, that exhibit an improved functionality compared to conventional superstructures with regard to operation of the hydraulic components of the superstructure. This object is achieved by the system and method defined by the technical features contained in independent claims 1 and 12. The dependent claims contain advantageous embodiments, further developments and variants of the invention.

[0011] The invention concerns a system for driving hydraulic components of a superstructure, such as a refuse collection unit, adapted to be arranged onto a vehicle, said system comprising: a first hydraulic device capable of working as a hydraulic pump, said first hydraulic device being arranged for driving of the hydraulic components of the superstructure; an electric device capable of working as an electric motor, said electric device being arranged for driving of the first hydraulic device; and at least one rechargeable battery arranged for powering the electric device.

[0012] The inventive system is characterized in: that the electric device is capable of working also as an electric generator, wherein the electric device is arranged to charge the at least one battery when working as an electric generator; that the first hydraulic device is capable of working also as a hydraulic motor, wherein the first hydraulic device is arranged to drive the electric device as an electric generator when the first hydraulic device works as a hydraulic motor; and that the first hydraulic device is connectable to a power take-off (PTO) driven by an engine of the vehicle such as to allow the first hydraulic device to be driven as a hydraulic motor by the power take-off (PTO).

[0013] Besides allowing battery powered operation of the superstructure, the inventive system has the advantageous effect that the batteries can be charged from the vehicle engine during operation of the vehicle in an effective way and with a minimum of additional components. The inventive system makes use of two-way hydraulic and electric devices that can be operated backwards, i.e. the first hydraulic device can function both as

a hydraulic pump and a hydraulic motor whereas the electric device can function both as an electric motor and an electric generator. By using such devices and making the hydraulic device connectable to the PTO it is possible to use the same devices both for driving the hydraulic components of the superstructure and for charging the batteries. This way it is not required to make use of, for instance, additional electric generators. An advantage of this is that the superstructure becomes easier to adapt to different types of vehicle chassis, in particular because of the less space required. Another advantage is that it makes the system less costly. Combined hydraulic and electric devices of the abovementioned types are known as such. Generally, such devices are reliable components which make the whole system reliable.

[0014] In an advantageous embodiment of the invention the first hydraulic device is hydraulically connectable to a second hydraulic device capable of working as a hydraulic pump, wherein the second hydraulic device is adapted to be drivingly connected to the power take-off (PTO) and to drive the first hydraulic device as a hydraulic motor. A hydraulic pump can relatively easily be connected to the PTO and be hydraulically connected to the first hydraulic device for driving the hydraulic motor. This is a simple and reliable design.

[0015] In an advantageous embodiment of the invention the superstructure is hydraulically connectable to the second hydraulic device such as to allow the second hydraulic device to drive the hydraulic components of the superstructure. Thus the system allows e.g. a refuse collection unit to be operated directly from the second hydraulic device connected to the PTO of the vehicle. This is useful if the battery level is too low to drive the hydraulic components or if there is failure in that part of the system.

[0016] The invention also concerns a superstructure having a system of the above type.

[0017] The invention also concerns a vehicle provided with a superstructure of the above type.

[0018] The invention also concerns a method for charging a battery in a system for driving hydraulic components of a superstructure, such as a refuse collection unit, arranged onto a vehicle, said system comprising: a first hydraulic device for driving of the hydraulic components of the superstructure (10); and an electric device drivingly connected to the first hydraulic device; wherein the electric device is electronically connected to the battery for powering of the electric device. In the inventive method the step of charging the battery comprises: connecting the first hydraulic device to a power take-off (PTO) driven by an engine of the vehicle such as to operate the first hydraulic device as a hydraulic motor for driving the electric device as an electric generator that charges the battery.

[0019] In an advantageous embodiment of the inventive method the first hydraulic device is hydraulically connected to a second hydraulic device capable of working as a hydraulic pump, wherein the second hydraulic device is drivingly connected to the power take-off (PTO) such as to drive the first hydraulic device as a hydraulic motor.

BRIEF DESCRIPTION OF DRAWINGS

[0020] In the description of the invention given below reference is made to the following figure, in which:

Figure 1 shows, in a schematic view, a preferred embodiment of the invention.

EMBODIMENT(S) OF THE INVENTION

[0021] Figure 1 shows, in a schematic view, a preferred embodiment of an inventive system 1 for driving hydraulic components of a superstructure arranged onto a vehicle. In this example the superstructure is a refuse collection unit 10, the hydraulic components are means for compacting refuse dumped into the refuse collection unit, and the vehicle is a refuse collection vehicle (not shown).

[0022] The system 1 comprises a power take-off (PTO) 2 driven by a vehicle engine (not shown), a hydraulic pump 3 mounted to and driven by the PTO 2, a hydraulic device 5 in the form of a combined hydraulic pump and hydraulic motor, an electric device 7 in the form of an 80V combined electric AC generator and electric AC motor, an AC/DC converter 9, two 40V rechargeable batteries 11 and a control unit 12. The control unit 12 is electronically connected to various devices of the system 1 for controlling purposes. The electronic connections are indicated with thin solid lines in figure 1. Besides what is shown in figure 1, the control unit 12 is also connected to valves for controlling oil flow in the hydraulic part of the system 1. A further unit 13 indicates the main electrical net that is used to charge the batteries 11 via a battery charger (not shown) which is performed in the night-time when the vehicle is not in use.

[0023] The system 1 can be run in three different operation modes: a first mode A indicated by solid arrows in figure 1; a second mode B indicated by dashed arrows; and a third mode C indicated by a dotted arrow.

[0024] In the first mode A the batteries 11 supply electrical power via the AC/DC converter 9 to the electric device 7, which in mode A works as an electric motor. The electric device 7 drives the hydraulic device 5, which in mode A works as a hydraulic pump that drives the hydraulic components of the refuse collection unit 10. This mode is the normal operation mode, which include charging of the batteries 11 from the electrical net 13.

[0025] In the second mode B the PTO 2 is active, which requires that the engine of the refuse collection vehicle is running. The PTO 2 drives the hydraulic pump 3 which in mode B is set to drive the hydraulic device 5 that in this mode works as a hydraulic motor. The hydraulic device/motor 5 drives in turn the electric device 7, which in mode B works as an electric generator that, via the AC/DC converter 9, charges the batteries 11. Mode B makes it possible to charge the batteries 11 during op-

eration of the vehicle, for instance between all the stops the refuse collection vehicle makes during normal operation. Mode B is useful for allowing a continued operation of the refuse collection vehicle with continued battery-powered driving of the collection unit 10 even if the charge of the batteries 11 for some reason falls below a certain critical level.

[0026] In the third mode C the PTO 2 is active, which requires that the engine of the refuse collection vehicle is running. Similar to mode B the PTO 2 drives the hydraulic pump 3. However, in mode C the hydraulic pump 3 is set to directly drive the hydraulic components of the refuse collection unit 10. Mode C is a sort of emergency mode allowing operation of the refuse collecting unit 10 even if the battery level is too low to drive the hydraulic components.

[0027] Which mode to use, and which system settings to be used, is determined by the control unit 12. If the charging level of the batteries 11 is or falls below a first predetermined level during normal operation in mode A, the control unit 12 notifies the operator/driver of the vehicle and checks whether the PTO 2 is possible to activate, i.e. whether the vehicle engine is running. If so, and provided that the operator does not interrupt the process, the control unit 12 activates the PTO 2 so that the hydraulic pump 3 starts up. The control unit 12 also sets the oil valves (not shown) such that hydraulic oil flows from the hydraulic pump 3 to the hydraulic device 5 such as to drive the hydraulic device 5 as a hydraulic motor. The system is now operating according to mode B (see above) as long as the vehicle engine is running or until operation of the refuse collection unit 10 is requested by the operator/driver. In such cases the control unit 12 automatically sets the system in mode A.

[0028] The system 1 can be set so to run according to mode B anytime the vehicle engine is running for a sufficient total time until the charging level of the batteries 11 has reached a second predetermined level.

[0029] If the battery level is or falls below a third predetermined level where driving of the refuse collection unit 10 by the batteries 11 is difficult or impossible, the control unit 12 notifies the operator/driver of the vehicle. In such a case the operator can set the system in mode C when operation of the collection unit 10 is desired. Mode B is then applied when the collecting unit 10 is not in use (but when the vehicle engine is running). Mode C may also be used when mode A can not be used, e.g. because of failure of the hydraulic or electric devices 5, 7.

[0030] Typically, mode A is used most of the time. Switching between modes A and B is used for continued operation of the refuse collecting vehicle and intermittent charging of batteries 11 with a fairly low charge level. Switching between modes B and C is used for continued operation of the refuse collecting vehicle and intermittent charging of batteries 11 with a very low charge level. Switching between modes A and B is normally carried automatically by the control unit 12. Mode C is normally manually chosen by the operator.

[0031] Combined hydraulic and electric devices that can be run in a forward and a backward direction such as to function both as a motor and pump/generator are known as such. The main purpose of using the hydraulic device 5 and the electric device 7 is to make it possible to charge the batteries 11 during operation of the vehicle engine. An advantage of using such devices in the inventive application is that the number of components is reduced compared to the use of additional electric generators. Another advantage is that such devices are more reliable.

[0032] The system 1 shown in figure 1 is typically intended to be used by municipal refuse collection vehicles. However, the invention is applicable also to other types of vehicle superstructures using hydraulic components, such as cranes and skylifts. Also in such applications it is advantageous to use a system that allows battery-powered operation of the hydraulic components so that the vehicle engine can be turned off. Consequently, charging of batteries is important also in such applications.

[0033] With the term "superstructure" is meant a vehicle accessory unit that typically is a separate part that is mounted to the chassis of a truck.

[0034] The invention is not limited by the embodiments described above but can be modified in various ways within the scope of the claims. For instance, it is possible to dispense with the second hydraulic device 3 and connect the first hydraulic device 5 directly to the PTO 2. This would necessitate a gearbox or similar for disengaging the first hydraulic device 5 from the PTO 2 when the system is to be operated in the first mode A. It may also be required to be able to disengage the first hydraulic device 5 from the electric device 7 when the system is to be operated in the third mode C. In the embodiment shown in figure 1 disengagement of the first hydraulic device 3 from the PTO 2 is simply carried out by controlling the oil valves of the hydraulic circuit.

[0035] Moreover, the superstructure does not necessarily have to be a refuse collection unit but can be another type of superstructure that is intended to be arranged onto vehicle and that makes use of hydraulic components during operation, such as a crane or a skylift arranged onto a truck.

Claims

1. System (1) for driving hydraulic components of a superstructure (10) adapted to be arranged onto a vehicle, said system comprising:

   - a first hydraulic device (5) capable of working as a hydraulic pump, said first hydraulic device (5) being arranged for driving of the hydraulic components of the superstructure (10);
   - an electric device (7) capable of working as an electric motor, said electric device (7) being arranged for driving of the first hydraulic device

(5); and
- at least one rechargeable battery (11) arranged for powering the electric device (7),

characterized in

- **that** the electric device (7) is capable of working also as an electric generator, wherein the electric device (7) is arranged to charge the at least one battery (11) when working as an electric generator,
- **that** the first hydraulic device (5) is capable of working also as a hydraulic motor, wherein the first hydraulic device (5) is arranged to drive the electric device (7) as an electric generator when the first hydraulic device (5) works as a hydraulic motor, and
- **that** the first hydraulic device (5) is connectable to a power take-off (PTO) (2) driven by an engine of the vehicle such as to allow the first hydraulic device (5) to be driven as a hydraulic motor by the power take-off (PTO) (2).

2. System (1) according to claim 1,
characterized in
that the first hydraulic device (5) is hydraulically connectable to a second hydraulic device (3) capable of working as a hydraulic pump, wherein the second hydraulic device (3) is adapted to be drivingly connected to the power take-off (PTO) (2) and to drive the first hydraulic device (5) as a hydraulic motor.

3. System (1) according to claim 2,
characterized in
that the superstructure (10) is hydraulically connectable to the second hydraulic device (3) such as to allow the second hydraulic device (3) to drive the hydraulic components of the superstructure (10).

4. System (1) according to anyone of the above claims,
characterized in
that the electric device (7) is a combined electric motor and electric generator.

5. System (1) according to claim 4,
characterized in
that the electric device (7) is an AC motor/generator and that the system comprises an AC/DC converter (9) connecting the electric device (7) and the at least one battery (11).

6. System (1) according to anyone of the above claims,
characterized in
that the first hydraulic device (5) is a combined hydraulic pump and hydraulic motor.

7. System (1) according to anyone of the above claims,
characterized in
that the superstructure (10) is a refuse collection unit.

8. Superstructure (10) for arrangement onto a vehicle, said superstructure (10) comprising hydraulic components and a system (1) for driving the hydraulic components,
characterized in
that the system (1) for driving the hydraulic components is arranged according to anyone of the above claims.

9. Superstructure (10) according to claim 8,
characterized in
that the superstructure (10) is a refuse collection unit.

10. Superstructure (10) according to claim 9,
characterized in
that the hydraulic components are arranged for compacting refuse dumped into the refuse collection unit.

11. Vehicle,
characterized in
that it comprises a superstructure (10) according to anyone of claims 8-10.

12. Method for charging a battery (11) in a system (1) for driving hydraulic components of a superstructure (10), such as a refuse collection unit, arranged onto a vehicle, said system comprising:

- a first hydraulic device (5) for driving of the hydraulic components of the superstructure (10); and
- an electric device (7) drivingly connected to the first hydraulic device (5);

wherein the electric device (7) is electronically connected to the battery (11) for powering of the electric device (7),
characterized in
that the step of charging the battery (11) comprises:

- connecting the first hydraulic device (5) to a power take-off (PTO) (2) driven by an engine of the vehicle such as to operate the first hydraulic device (5) as a hydraulic motor for driving the electric device (7) as an electric generator that charges the battery (11)

13. Method according to claim 12,
characterized in
that the first hydraulic device (5) is hydraulically connected to a second hydraulic device (3) capable of working as a hydraulic pump, wherein the second hydraulic device (3) is drivingly connected to the power take-off (PTO) (2) such as to drive the first

hydraulic device (5) as a hydraulic motor.

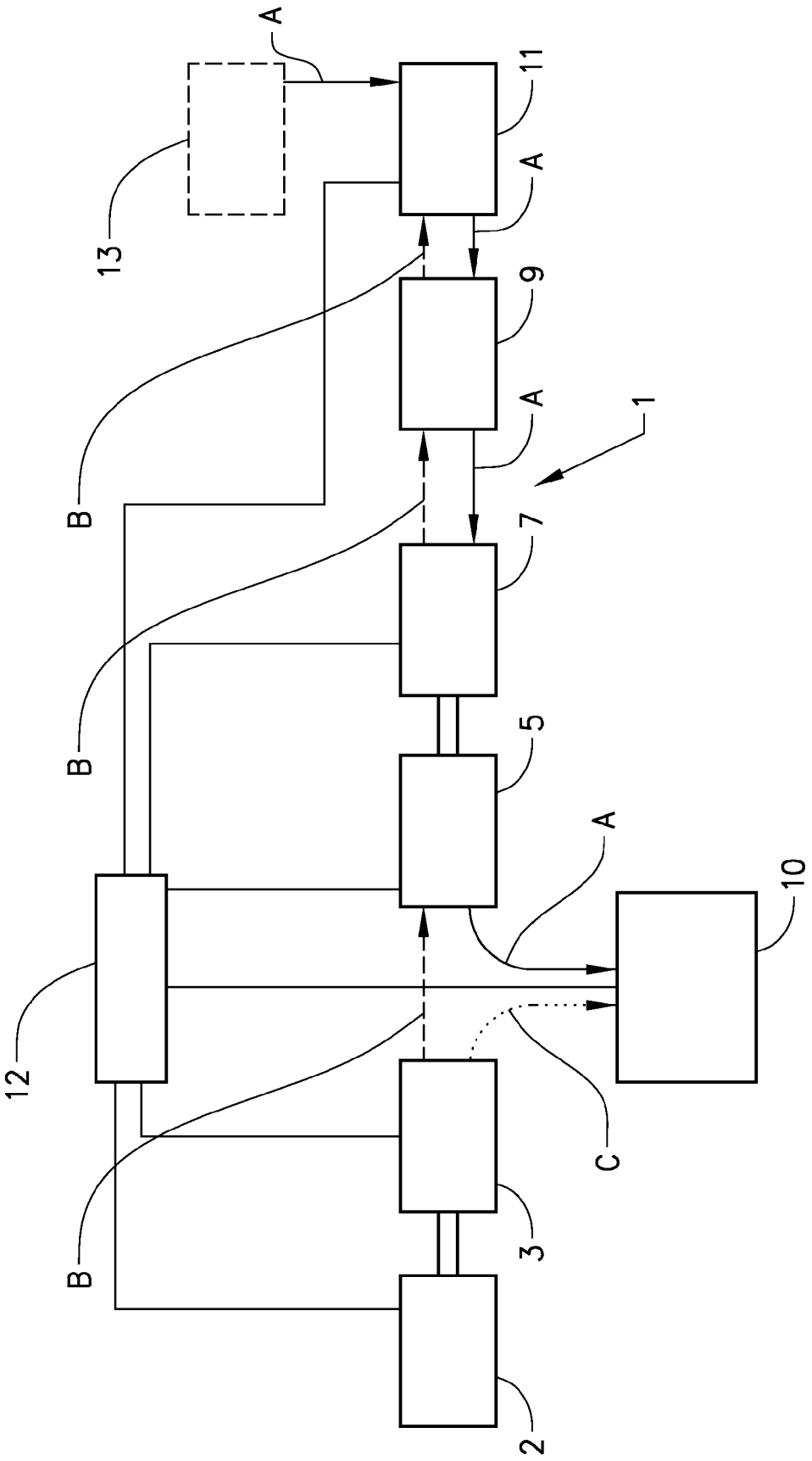

FIG. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 07 15 0097

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
D,A	EP 1 746 049 A (H. ARTMANN) 24 January 2007 (2007-01-24) * the whole document *	1-13	INV. B65F3/00
A	DE 30 41 630 A (SCHÖRLING GMBH & CO WAGGONBAU) 13 May 1982 (1982-05-13) * the whole document *	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

B65F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 May 2008	Smolders, Rob

CATEGORY OF CITED DOCUMENTS

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22-05-2008

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EP 1746049 A	24-01-2007	AT 502217 A1	15-02-2007
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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