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(54) **Electrical rail transportation system**

(57) Electrical rail transportation system comprising:
(i) a rail system for one or more electrically powered vehicles, said rail system comprising rail means for suspending one or more electrically-powered vehicles and

electrical conductors for providing the vehicles with electrical power;
(ii) one or more transport vehicle(s), each transport vehicle comprising an electronically commutated (EC) motor for driving the vehicle along the rail system.

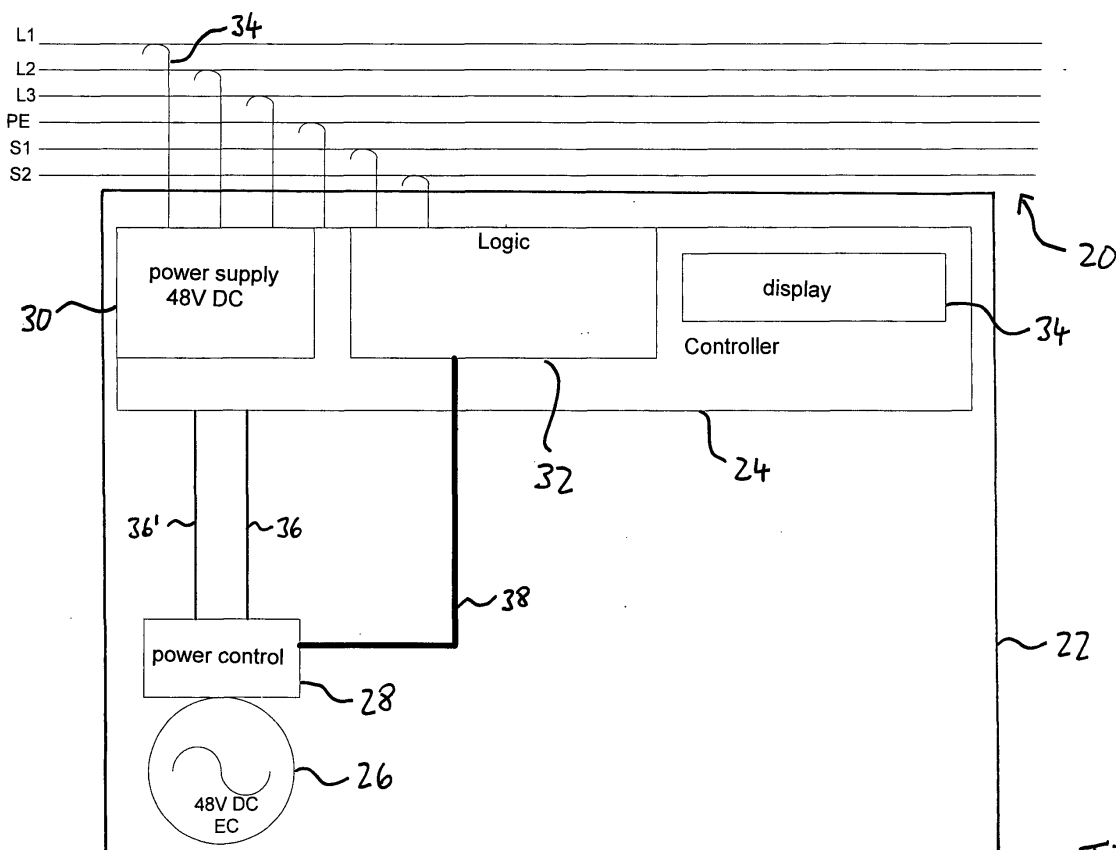


Fig. 2

Description

FIELD OF THE INVENTION

[0001] The present invention relates to an electrical rail transportation system, notably an electrical rail transportation system for suspended transport vehicles.

BACKGROUND OF THE INVENTION

[0002] Electrical rail transportation systems for suspended vehicles are known e.g. from EP 0 567 122 A1. They typically comprise a rail system and transport vehicles engaging a rail of the rail system. The vehicles are driven along the rails by electric motors that are powered via conductors or inductive power wires in the rail system. The vehicles of conventional electrical rail transportation systems are driven by standard 400 V rotary current asynchronous motors on each transport vehicle. Force transmission means transmit the force from the motor shaft to a drive wheel engaging the rail means of the rails system. The vehicle drive systems of conventional electrical rail transportation systems are complex and the motors have a high construction volume. Further, a brake is included in the drive system in order to hold the vehicles at a given position along the rails, e.g. for loading or unloading the transport vehicles. The brake is activated when no voltage is applied to the motor. However, an activated brake does not allow to move the vehicle by hand as is frequently required during maintenance of the transportation system. Therefore, a clutch is included in the force transmission means between the gear box and the drive wheel for decoupling the drive wheel from the activated brake so that the vehicle can be moved by hand. The brake and the clutch provide substantial complexity, weight, and bulkiness to the drive system.

[0003] Departing from the prior art, it is a problem of the invention to reduce the complexity of the drive system of conventional electrical rail transportation systems.

[0004] This problem has been solved according to claim 1 by the use of an electronically commutated motor (herein referred to as "EC motor") on the vehicles of the rail transportation system.

[0005] It has surprisingly been found by the inventors that neither a clutch nor a brake is required on the drive system if an EC motor is used for driving the vehicles of an electrical rail transportation system. The EC motor allows to hold the vehicle at a defined position without employing a brake, since when the EC motor is set to zero speed, the motor exerts torque preventing movement of the vehicle along the rail. Movement of the vehicles by hand as frequently required for maintenance purposes is possible when the motor is currentless or switched off. Thus, the invention provides a drive system for vehicles of an electrical rail transportation system that is simpler, less heavy as well as smaller without compromising flexibility and functionality. As a consequence, it is also more economical.

[0006] In the electrical rail transportation system of the invention, the transport vehicle typically comprises one or more drive wheels engaging the rail means, and force transmission means, such as a gear box, for transmitting force from said EC motor to the one or more drive wheels. The drive wheel(s) may engage the rail by frictional connection. Thus, each vehicle has its own EC motor for driving the vehicle along the rail. In addition to the drive wheels, the vehicles may have one or more guide wheels or guide rolls for improving the stability of the vehicles and/or for preventing undesired swinging thereof. In one embodiment, the force transmission means does not have a clutch that allows to decouple force transmission from the EC motor to the drive wheel(s). It is possible not to provide the force transmission means with a brake.

[0007] Rail means (also referred to as "rail" herein) usable in the rail transportation system of the invention are known such as from US 4,641,582. Preferred rail means are described in EP 1 785 311 A1. Another rail is described in US 2005/098059. The rail means comprise means for receiving or suspending the transport vehicles. Typically, the drive wheel(s) and optionally further guide wheels may run in channel provided by the rail means. The rail means further comprise electrical conductors or conductor bars for providing the vehicles with electrical power and/or with control signals. The conductors or conductor bars extend along the rail means so that current collectors of the vehicles can contact the conductors as the vehicle moves along the rail. Several conductors may be arranged in a conductor bar assembly attached to the rail such as in a channel formed by the rail means as described in EP 1 785 311 A1. Said electrical conductors may be inductive power wires for contactless power transmission to the vehicles, similarly as described in DE10013767 A1, DE20002984 U1 or DE19955042 A1 for electrical floor transport systems.

[0008] The term "EC motor" refers to an electronically commutated (EC) motor that is also referred to in the art as brushless direct current (BLDC) motor. EC motors are known and are commercially available, e.g. from ebm-papst Mulfingen GmbH & Co. KG, Germany. An EC motor is, for example, described in EP1560319 A1. A control system for an EC motor is described in EP1499008 A2. A preferred EC motor may be operated with 48 V DC power. It is preferred to use EC motors having low rotational speed for avoiding excessive gearing in the force transmission from the EC motor to the drive wheel(s). Commercial EC motors typically have an in-built power control for electronically commutating and controlling the EC motor.

[0009] Each transport vehicle typically has a controller that comprises a power supply providing the EC motor with the required power. In one embodiment, the conductor bars on the rail provide the power supply on the vehicle with electrical power of 35 V, 3ph AC. In another embodiment, inductive power supply providing 48V DC is used. Such or other low voltage electrical power has the advantage that little safety measures are required.

The power supply may then transform the power to that required by the EC motor e.g. via a three-phase bridge. In another embodiments, the conductor bars on the rail provide the power supply on the vehicle with 400 V 2ph AC or with 240V 1 ph AC. The skilled person can make use of other solutions as the case requires. In this embodiment, a switching power supply may be used for providing the EC motor with suitable power. It is, however, preferred that the electrical conductors or inductive wire system of the rail system provide safety extra-low voltage, i.e. less than 60V, alternating current to the vehicles.

[0010] The controller may further have a logic device that receives control signals and transmits control signals to the power control of the EC motor. Control signals may be provided from an operator of the rail transportation system to the controller via conductor bars of the rail system. Other communication means between the controller and an operator such as wireless communication means are known to the skilled person and can be used in the transport system of the invention. The logic device receives control signals from an operator and analyzes them. Processed control signals may be transmitted to the power control of the EC motor. Thus, the logic device controls the power control of the EC motor. The logic device may further provide feedback signals to an operator via the communications means mentioned above, e.g. via conductors of the rail system. The logic device may further have a data input device and/or a data output device such as a display. Further, the controller may have a sensor unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 shows schematically a conventional drive system of a conventional transport vehicle (Fig. 1 A) and a drive system according to the invention (Fig. 1B). Fig. 2 shows schematically electric components of the rail transport system and electrical connections therebetween.

DETAILED DESCRIPTION OF THE INVENTION

[0012] Fig. 1 compares the drive systems of the prior art with one used according to the invention. The drive system of the prior art (Fig. 1A) contains a motor, typically an asynchronous motor (1), a downstream gear box (2), a drive wheel (4) that engages a rail means (not shown), and a clutch (3) for decoupling force transmission between the motor and drive wheel (4). Further, a brake (5) is present, typically upstream of the motor for securing a vehicle at a desired location along the rail. (6) indicates a part of the force transmission means, such as a belt, transmitting force from the gear box (2) to the drive wheel (4).

[0013] The drive system employed in the invention allows a much simpler structure. It comprises EC motor

(11) and a gear box (12). Depending on the EC motor used, a gear box may not be needed. From the gear box (12), drive force is transmitted to the drive wheel (14), optionally via force transmission component (16) which may be a V-belt. The brake of the prior art system can be dispensed with, since the EC motor can exert torque against a rotation of the drive wheel when the EC motor is set at zero speed. A clutch is also not necessary, since a vehicle comprising the drive system can be moved by hand during maintenance work when the EC motor is not active and since there is no brake keeping the motor shaft at a fixed position when the vehicle is set to standstill.

[0014] Fig. 2 shows schematically a conductor assembly (20) and a transport vehicle (22). The conductor assembly is attached to a rail (not shown). The conductor assembly may comprise six conductors. The conductor assembly may comprise three conductors (L1, L2, L3) providing the transport vehicles with electrical power and a grounding conductor (PE). The conductor assembly further comprises control signal conductors (S1, S2) providing control signals to the vehicle. The transport vehicle (22) comprises a controller (24) and an EC motor (26). The EC motor comprises power control (28). The EC motor may be a 48 V DC motor. The controller (24) comprises a power supply (30) and a logic device (32). The power supply may transform a 35V, 3ph, 50 Hz AC power to 48V DC required by the EC-motor. The logic device (32) may comprise a display (34) for displaying control states. The transport vehicle (22) further has current collectors (34) that contact conductors L1, L2, L3, PE, S1 and S2 and slide along these conductors as the vehicle moves along the rail. Conductors (L1, L2, L3) provide electrical power to the controller (24). The power supply (30) of the controller transforms the electrical power received from conductors (L1, L2, L3) to the power required by the EC motor. Conductors (36, 36') provide the EC motor with electrical power from the power supply (30). Conductor (S1) provides control signals to the logic device (32) of the controller (24). Conductor (S2) may provide feedback signals from the logic device to an operator. Conductors (38) provide control signals from the logic device (32) to the power control (28) of the EC motor (26).

Claims

1. Electrical rail transportation system comprising:

- (i) a rail system for one or more electrically powered vehicles, said rail system comprising rail means for suspending one or more electrically-powered transport vehicles and electrical conductors for providing the vehicles with electrical power;
- (ii) one or more transport vehicle(s), each transport vehicle comprising an electronically commutated (EC) motor for driving the vehicle along the rail system.

2. Electrical rail transportation system according to claim 1, said transport vehicle comprising one or more drive wheel(s) engaging the rail means and force transmission means that may include a gear box for transmitting force from said EC motor to the drive wheel(s). 5
3. Electrical rail transportation system according to claim 2, said force transmission means not having a clutch that allows to decouple force transmission from the EC motor to the drive wheel(s). 10
4. Electrical rail transportation system according to any one of claims 1 to 3, said transport vehicle having a controller comprising a power supply providing said EC motor with power, and a logic device receiving control signals and transmitting control signals to the EC motor. 15
5. Electrical rail transportation system according to claim 4, said EC motor comprising a power control that is controlled by said logic device. 20
6. Electrical rail transportation system according to any one of claims 1 to 5, wherein the electrical conductors provided in the rail system provide safety extra-low voltage alternating current to the vehicles. 25
7. Electrical rail transportation system according to any one of claims 1 to 6, wherein said electrical conductors further provide control signals to the one or more transport vehicles. 30
8. Electrical rail transportation system according to any one of claims 1 to 7, wherein said electrical conductors transmit electrical power from said conductors to said vehicles inductively or via power collectors on the transport vehicles. 35

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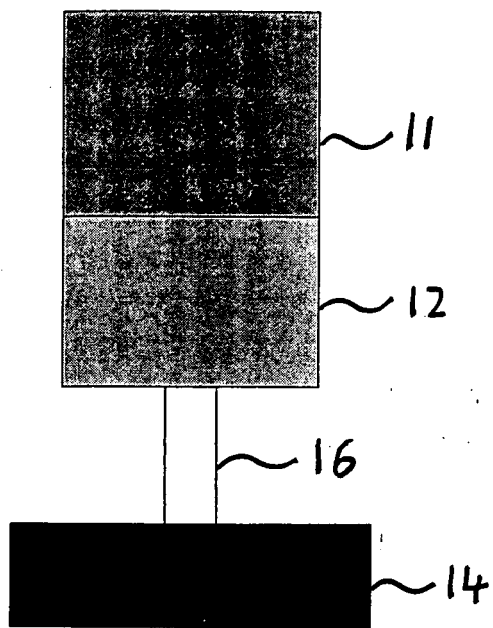


Fig. 1B

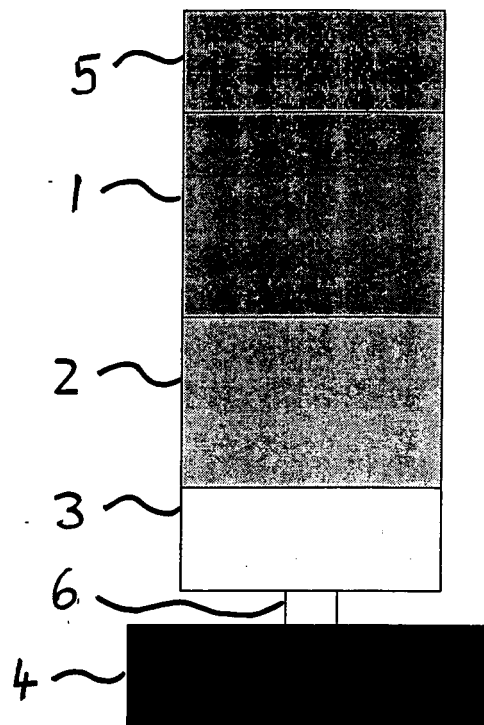


Fig. 1A

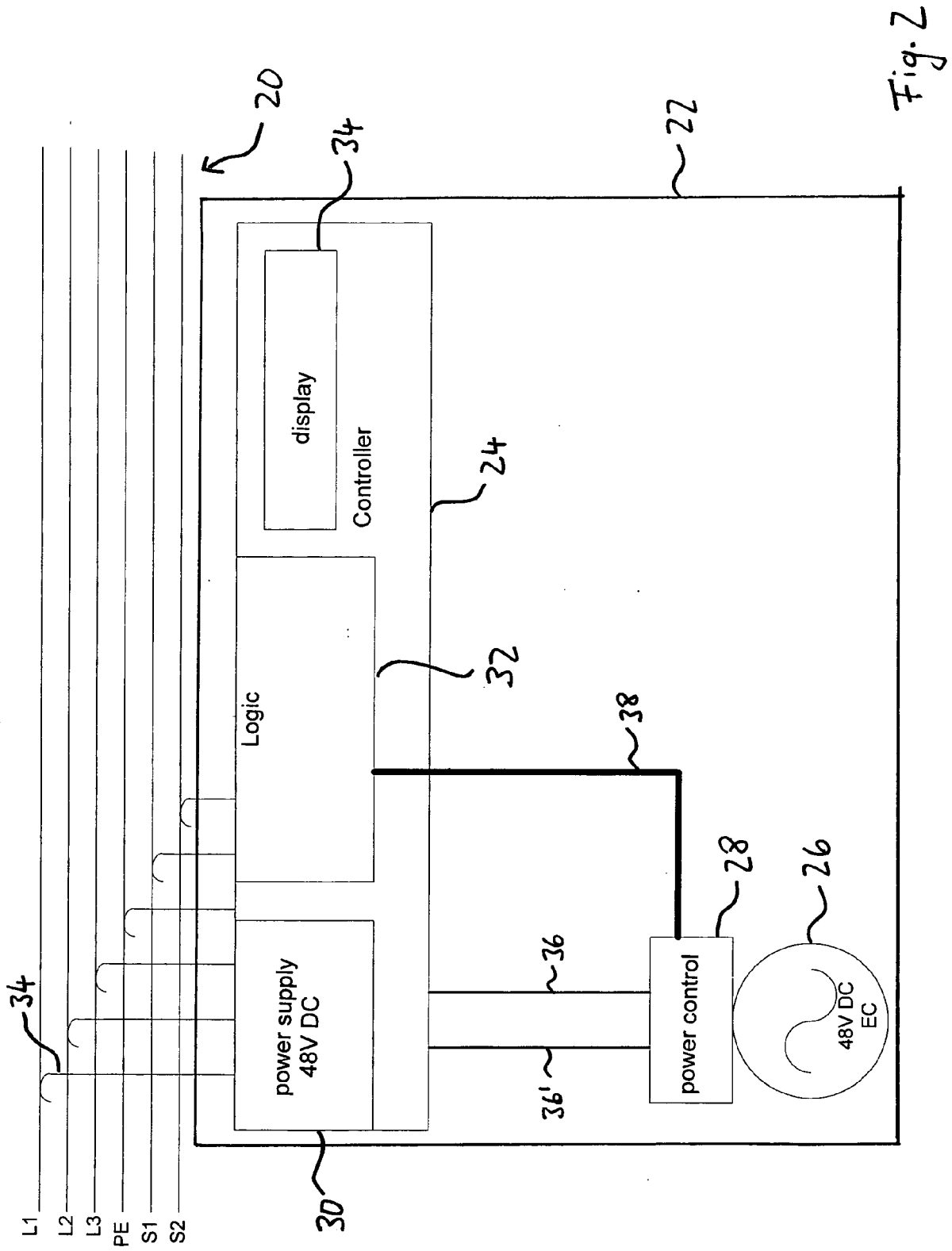


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 09 01 0954

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2006 049588 A1 (SEW EURODRIVE GMBH & CO [DE]) 16 August 2007 (2007-08-16) * figures 2-4 *	1-5,7	INV. B61B3/02
A,D	EP 0 567 122 A (ROSENHEIMER FOERDERANLAGE [DE] UTTSCHIED GEORG [DE]) 27 October 1993 (1993-10-27) * the whole document *	1	
A	DE 101 55 996 A1 (WEYAND KLAUS [DE]; BERWALD WERNER [DE]; BERWALD DITHMAR [DE]) 12 June 2003 (2003-06-12) * paragraph [0053] *	1	
A	GB 2 305 645 A (HALSALL VINCENT REGINALD [GB]) 16 April 1997 (1997-04-16) * page 2, paragraph 6 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B61B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 February 2010	Examiner Lorandi, Lorenzo
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 01 0954

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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10-02-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102006049588 A1	16-08-2007	EP 1984203 A2	29-10-2008
		WO 2007090500 A2	16-08-2007
		US 2009013899 A1	15-01-2009

EP 0567122 A	27-10-1993	AT 139960 T	15-07-1996
		DE 4213392 A1	28-10-1993
		DK 567122 T3	05-08-1996
		ES 2058044 T1	01-11-1994

DE 10155996 A1	12-06-2003	NONE	

GB 2305645 A	16-04-1997	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 0567122 A1 [0002]
- US 4641582 A [0007]
- EP 1785311 A1 [0007]
- US 2005098059 A [0007]
- DE 10013767 A1 [0007]
- DE 20002984 U1 [0007]
- DE 19955042 A1 [0007]
- EP 1560319 A1 [0008]
- EP 1499008 A2 [0008]