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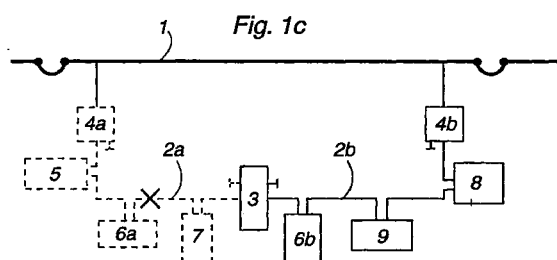
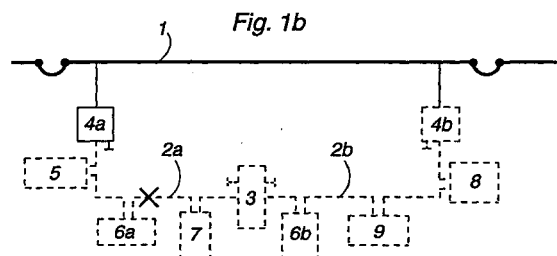
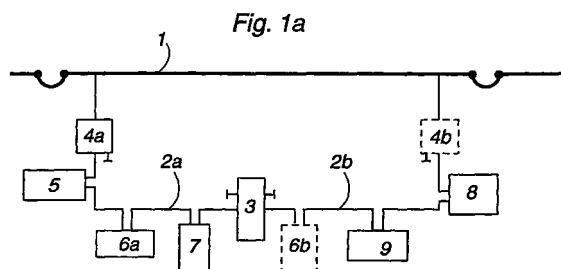
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(54) **Communication and control system for railbound vehicles**

(57) The present invention relates to a communication and control system for rail bound vehicles with one communication link called train bus (1), for transfer of information to and from the vehicles in a train, and at least one vehicle bus (2), for transfer of information within a vehicle or fixed set of vehicles. The vehicle bus works as a subsystem to the train bus and connects a number of functional units (5-9) in series. The vehicle bus comprises at least two segments (2a, 2b). In normal operation the segments work as a single communication link, but if a fault occurs the segment with the fault is disconnected, and the functional units connected to the disconnected segment take on a predetermined mode.



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Description

TECHNICAL FIELD

[0001] This invention relates to a communication system for rail vehicles comprising a communication link called train bus that transfers information in the form of data and signals through a complete train. In every vehicle or fixed set of vehicles there is a vehicle bus that works as a subsystem to the train bus. The vehicle bus connects a number of functional units and transfers data and signals within a vehicle and to and from the train bus. Functional units comprise both simpler operative units and more advanced processing units. Examples of functional units that can be placed in each vehicle or fixed set of vehicles are traction units, door manoeuvring units, air conditioning units, brakes, monitoring systems and tilt control. Functional units that can be common for a complete train are e.g. air-compressor control or high-voltage equipment.

STATE OF THE ART

[0002] Today high availability of a rail vehicle is ensured by using double circuits, cables and components: so called redundant systems. Under the development of the present invention two kinds of control systems have been used as a basis, both systems using redundancy.

[0003] A known system comprises a train bus that extends through the whole train and that transfers data and signals between the vehicles. For each vehicle or fixed set of vehicles there are two separate vehicle busses each of which are connected to the train bus via a communication unit. The vehicle busses connect a plurality of functional units in series. The vehicle busses are redundant in such a way that functional units on one vehicle bus are equivalent to units with the same functionality on the other vehicle bus. The communication units co-operate in such a way that both are active and communicate data and signals with each other and the train bus. If a fault occurs on one vehicle bus, the second bus takes control over the redundant functional units. A system like this involves great development costs, as there is complicated software needed in order to handle the communication between the doubled functions.

[0004] Another known system involves one vehicle bus that is connected to the train bus by two communication units that cooperate so that only one communication unit is active. The active communication unit receives and transfers data to and from the train bus. The vehicle bus connects a number of functional units in series, which can be doubled so that a defect unit can be by-passed and another unit can take over its function. A common vehicle bus gives a simpler system, as regards tool support, software implementation, testing and specification, but does also involve a risk that the

entire vehicle bus can be disabled by particularly serious faults e.g. damaged cable, damaged connectors or reflections caused by a lost or loose termination.

DESCRIPTION OF THE INVENTION

[0005] The purpose of the invention is to increase availability of rail bound vehicles by reducing the risk for vehicle standstill as the result of a fault in the communication and control system. The system should also be simple in respect of tool support, implementation of software, testing and specification.

[0006] A new system design makes it possible to disconnect the part of the communication network where a fault has occurred, and to drive the train with reduced functionality. It is a way to handle faults that otherwise could lead to a train standstill, with great consequences for railway traffic.

[0007] This new system design is also simple. The system can be run with less sophisticated software than a system as described above. A simpler procedure for locating faults and testing is also expected. For certain applications is redundancy of the vehicle bus no longer needed, as the new system design ensures availability of more than half of the system. This is an advantage as a non-redundant vehicle bus can be used, e.g. if a customer specification is that at least one of two traction units must be working. A non-redundant vehicle bus means lower hardware cost simpler installation and also requires simpler software than a system that handles redundant communication links.

[0008] A coupling device divides the vehicle bus in at least a first and a second segment that each are connected to the train bus via a communication unit. The communication units interact in such a way that the first one is active and the second is passive. Under normal operation conditions the two segments work as one single vehicle bus, in case of a fault on one of the segments, this segment will be disconnected, while the other segment is intact. The communication units co-operate in such a way that only the unit that connects the undamaged segment to the train bus is active. By disconnecting the segments the system is set into fallback mode. The functional unit that is connected to the fault-carrying segment is set into a predetermined status, which could mean, e.g. in traction units, change to manual manoeuvring of doors or a functional unit is set into passive status.

[0009] Each of the segments must comprise enough functions for the train to be moveable, but not all functions need to be on both segments. It might be desirable to have doubled units for handling functions that concern passenger safety, but only single units for functions that concern passenger comfort. It could be acceptable that the air-conditioning is not working or that one out of two traction units does not work, but it would but unacceptable if doors could not be opened.

FIGURES

[0010]

Figure 1 a shows the system under normal operation condition.

Figure 1b shows the same system when a fault occurs.

Figure 1c shows the system in fallback mode.

DESCRIPTION PREFERRED OF EMBODIMENTS.

[0011] Figures 1 a-c show how a communication system according to the invention can work in practice. A vehicle bus 2 is connected to a train bus 1 via the connection units 4 a. and b. The vehicle bus 2 is divided into two segments 2a, 2b by a coupling device 3. Each of the segments 2a, 2b is connected to a plurality of functional units 5-9. Some units are placed on both segments and have the same function, thus doubling this function. If a fault occurs, for instance a damaged cable (marked X in figure 1b), the whole vehicle bus fails. The fault does not propagate to the train bus, but is stopped by the active communication unit. The fault is handled by activation of the fallback mode. Breaking the connection between the first and second segment (figure 1c) activates the fallback mode. The communication unit at the intact segment is activated, thus maintaining the communication between vehicle bus and train bus. The damaged segment and the functional units connected to it are set into a predetermined status.

[0012] There are a number of possibilities to implement the invention. In a first preferred embodiment a bus repeater, provided with a power switch, is used to connect the segments. By cutting off the power to the repeater the connection is interrupted in a controlled way. In the bus repeater are terminations of the segments. The power switch can be controlled from functional units of the respective segments. The switch may also be controlled by the train-operator who then manually activates the fallback mode if the communication network fails. Another option is to control the switch from a functional unit that is built in to the coupling device itself.

[0013] In a second advantageous embodiment a simple switch is used to connect the segments. The segments are provided with a termination each, so that the connection can be broken in a controlled way. The switch is manually controlled by the driver or controlled by a monitoring unit on each of the segments, on the train bus or in connection to the switch.

[0014] A third advantageous embodiment includes a more sophisticated coupling device that in addition to the above-mentioned functions also comprises filter, fault detection means and fault localisation means.

[0015] In a forth advantageous embodiment a coupling device is included in a functional unit on each of the segments e.g. as an extra function in a processing

unit.

[0016] It is possible to divide the vehicle bus in more than two segments. Either each of the segments are connected to the train bus through a communication unit or every second segment is independent and connected to the train bus and the intermediate segments are dependent of one or the other of the adjacent segments.

10 Claims

1. A communication system for rail bound vehicles comprising a train bus, for transfer of information to and from vehicles in a train, and at least one vehicle bus, for transfer of information within a vehicle or fixed set of vehicles, which vehicle bus works as a subsystem to the train bus and connects a plurality of functional units in series **characterised in** that the vehicle bus comprises at least a first and a second segment, whereby a segment with a fault is disconnectable, and the functional units connected to the segment with the fault are arranged to take on a predetermined mode.
2. A communication system for rail bound vehicles according to claim 1 **characterised in** that at least one of the functional units arranged at the disconnected segment is replaceable by a functional unit arranged at the other second segment.
3. A communication system for rail bound vehicles according to claim 1 or 2 **characterised in** that each of the segments are connected to the train bus via a communication unit each, and that only one of the communication units is active at a time.
4. A communication system for rail bound vehicles according to any of the preceding claims **characterised in** that a coupling device connects two adjacent segments in a first mode and disconnects the two segments in a second mode.
5. A communication system for rail bound vehicles according to claim 4 **characterised in** that the coupling device comprises a bus termination of each of the segments.
6. A communication system for rail bound vehicles according to claim 4 or 5 **characterised in** that the coupling device is a bus repeater.
7. A communication system for rail bound vehicles according to claim 4, 5 or 6 **characterised in** that the coupling device is controllable from a processing unit arranged at adjacent segments.
8. A communication system for rail bound vehicles according to claim 4, 5 or 6 **characterised in** that

the coupling device is controllable by the train-operator.

9. A method for handling faults in a vehicle bus for transfer of information within a vehicle or fixed set of vehicles, which vehicle bus connects a plurality of functional units in series and works as a subsystem to a train bus **characterised in that**;
- a.) the vehicle bus is divided in at least two segments,
 - b.) in case of a fault the segment with the fault is disconnected and that
 - c.) the functional units connected to the segment with the fault take on a predetermined mode.

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Fig. 1a

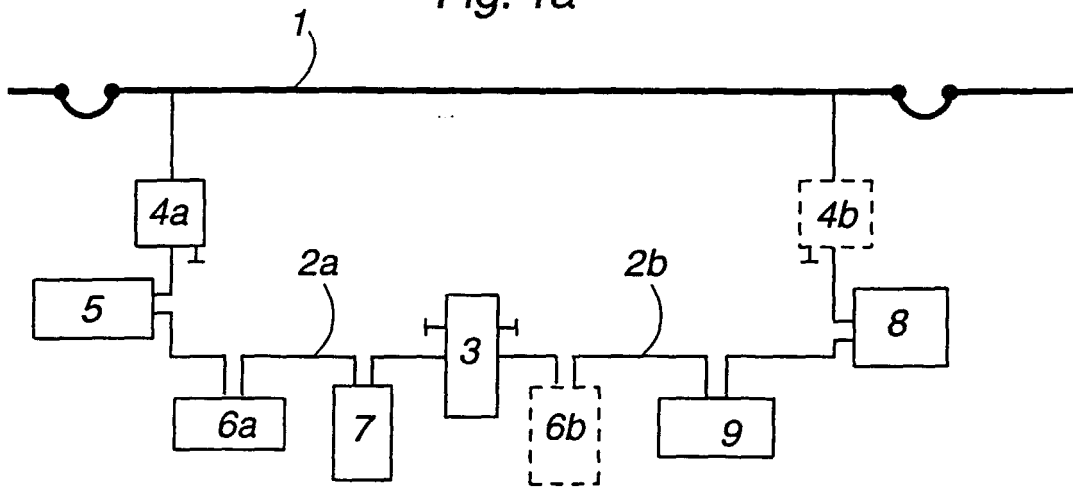


Fig. 1b

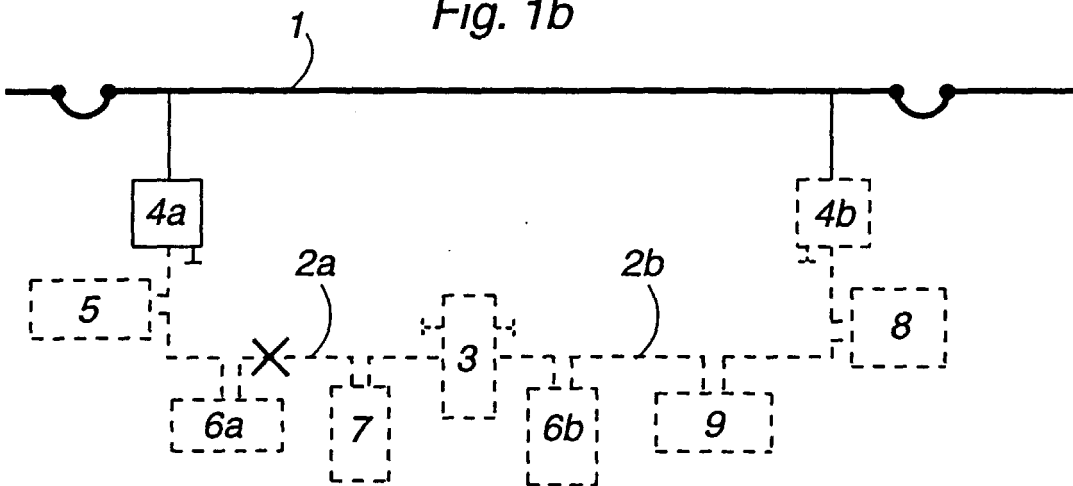
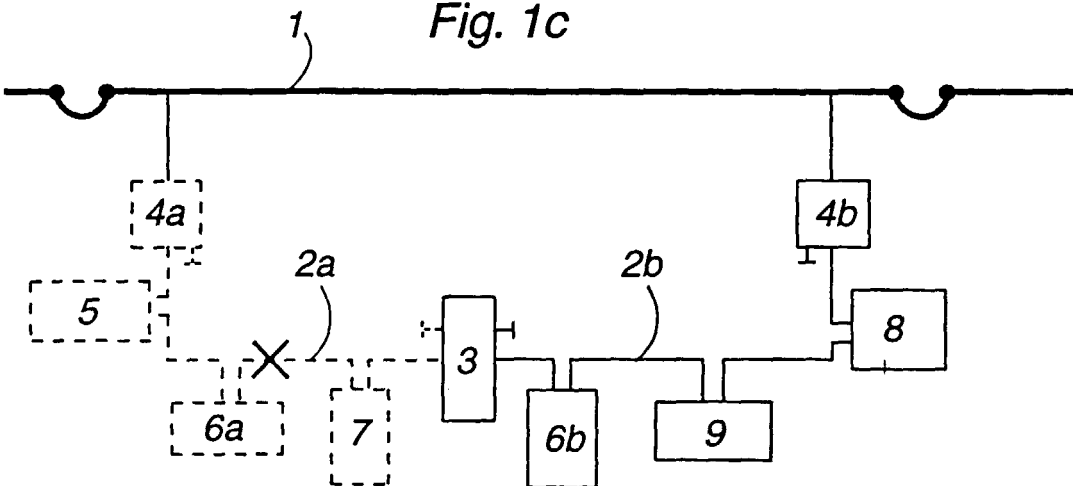


Fig. 1c





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EUROPEAN SEARCH REPORT

Application Number
EP 00 25 0224

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	US 5 404 465 A (NOVAKOVICH MICHAEL R ET AL) 4 April 1995 (1995-04-04) * column 2, line 14 - column 3, line 15 *	1-9	B61L15/00 G06F11/20
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A	PATENT ABSTRACTS OF JAPAN vol. 016, no. 067 (E-1168), 19 February 1992 (1992-02-19) & JP 03 261244 A (NEC CORP), 21 November 1991 (1991-11-21) * abstract *	1	
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 18 October 2000	Examiner Reekmans, M
CATEGORY OF CITED DOCUMENTS		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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EP 00 25 0224

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18-10-2000

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