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(54) **SYSTEM AND METHOD FOR MANAGING A GUIDED VEHICLE MOVEMENT AUTHORITY**

(57) The present invention concerns a method and a system for managing a guided vehicle movement authority, the method comprising the following steps:

- sending, by means of a Trackside Centralized Movement Authority Generator (hereafter TCMAg) (4) to an on-board system (20) of a guided vehicle A, a request for checking an occupancy state of a part of the first section (10) located ahead the guided vehicle A if a distance between a position of the guided vehicle A on the track and a boundary (15) between the first section (10) and the second section (11) is smaller than a predefined distance;
- if no guided vehicle B is detected in front of the guided

vehicle A, then automatically sending a message to the TCMAg (4) informing the latter about a vacant state of the part of the first section (10) ahead the guided vehicle A;

- automatically issuing by means of the TCMAg (4) a movement authority to the on-board system (20) if and only if the occupancy state of the second section (11) is in a vacant state and if the message informing about the vacant state of the part of the first section ahead the guided vehicle is received by the TCMAg, otherwise preventing an issuance of a movement authority to the guided vehicle A.

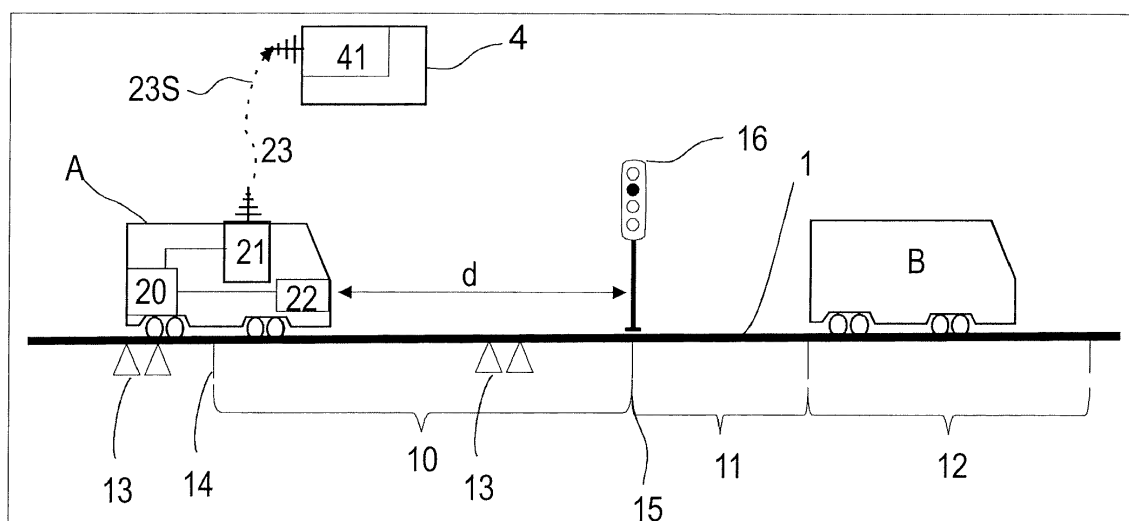


FIG 1A

Description

[0001] The present invention concerns a system and a method for safely and efficiently managing the movement of a guided vehicle on a railway network.

[0002] The present invention is essentially related to the control of the movement of guided vehicles within a railway network and the issuance of movement authority by trackside Radio Block Centre (RBC), wherein "guided vehicle" refers to public transport means such as subways, trains or train subunits, etc., as well as load transporting means such as, for example, freight trains, for which safety is a very important factor and which are guided along a route or railway by at least one rail, in particular by two rails.

[0003] Actual rail systems such as the European Rail Traffic Management System (ERTMS)/European Train Control System (ETCS) Level 2 or 3 allow to manage guided vehicle movement authority on the basis of radio signals exchanged between the guided vehicle and trackside devices of a railway network. For example, a fitted guided vehicle (i.e. comprising equipment fitting the guided vehicle for radio-based signaling) comprises devices enabling the determination of its position by reading track-mounted reference beacons and measuring a travelled distance from these reference beacons using on-board odometry. The guided vehicle then reports periodically its position to trackside devices, for example the RBC, and receives movement authority based on its position from the latter.

[0004] The RBC has to determine when, where and under which conditions a movement authority can be issued so that guided vehicle may operate safely. Typically, information from track vacancy detection systems using techniques based on track circuit occupation is analyzed by the RBC to locate guided vehicles along tracks of the railway network and determine if there is no other guided vehicle in front of an incoming guided vehicle. If the track circuit in front of the incoming guided vehicle is proved clear, then the RBC sends a movement authority (i.e. a permission to proceed with moving forward) to the incoming guided vehicle.

[0005] Problems may arise when unfitted guided vehicles are moving on the railway network, or when two guided vehicles are occupying the same track circuit at the same time, typically when a short guided vehicle is moving in front or behind another guided vehicle and the RBC cannot distinguish the two guided vehicles. In this case, the RBC should not send a movement authority and actions to prevent sending a movement authority have to be taken.

[0006] To prevent such situations, different techniques have been developed. One technique proposes a "Track Ahead Free" process handled on-board by the driver. In this case, the driver of the guided vehicle shall confirm that the track section between the position of the head of the guided vehicle and the position of the next signal or board marking signal is free. In this process, the driver

has the responsibility to acknowledge if conditions to receive the movement authority are fulfilled. Nevertheless, human failures occur and additional safety measures are required. Another process is an automatic Track Ahead Free process called "Prove Clear Ahead" (PCA). According to this process, a movement authority is granted if the distance separating the front of the guided vehicle from the next track section for which a movement authority is requested is smaller than the smallest length of guided vehicles operating on the railway network and if the occupancy status of said next track section was in a vacant state. Nevertheless, the above-mentioned distance is sometimes very small which causes problems for high speed trains and infrastructure failures may also occur, requiring therefore complementary systems for ensuring the safety of the guided vehicle movement.

[0007] An objective of the present invention is to propose a system and a method for safely and efficiently managing the movement of a guided vehicle in a railway network, specifically for issuing the first movement authority in a manner free of any driver input, wherein the first movement authority is issued when a guided vehicle enters for the first time an operating part of a railway network.

[0008] For achieving said objective, the present invention proposes to use an on-board radar system as disclosed by the objects of independent claims 1, 7 and 11. Other advantages of the invention are presented in the dependent claims.

[0009] Indeed, the present invention proposes in particular a method for automatically managing, i.e. free of any driver intervention, a movement authority, preferentially the first movement authority, for a guided vehicle A moving on a track of a railway network, wherein said track comprises a plurality of sections, wherein each section comprises a detection device for detecting a presence or absence of a guided vehicle on the section it equips, the guided vehicle A moving on a first section of said railway network in direction of a second section consecutive to (i.e. directly following) the first section, said method comprising the steps:

- sending, by means of a Trackside Centralized Movement Authority Generator (hereafter TCMA), for instance a RBC, and to an on-board system of the guided vehicle A, a request for checking an occupancy of a part of the first section located directly ahead the guided vehicle A, preferentially said request is only sent if a distance between a position of the guided vehicle A on the track and a boundary between the first section and the second section is smaller than a predefined distance;
- at the reception of said request by the on-board system of the guided vehicle A, automatically launching (e.g. by means of the on-board system) a detection process involving a radar system preferentially equipping the head of the guided vehicle A, wherein said detection process comprises using the radar

system for detecting if a guided vehicle B is located in front of the guided vehicle A, for instance within a maximum detection length of the radar system;

- if no guided vehicle B is detected in front the guided vehicle A, for instance within said maximum detection length, then the on-board system is configured for automatically sending a message to the TCMAG informing the latter about a vacant state of a part of the first section located ahead the guided vehicle A. Preferentially, the predefined distance is calculated in function of the maximum detection length of the radar system, for instance it is the maximum detection length of the radar system independently of a track section geometry or it is the maximum detection length of the radar system for the track section geometry and configuration, so that the part of the first section located ahead the guided vehicle A might be the part of track comprised between the head of the guided vehicle A and the boundary. Preferentially, if a guided vehicle B is detected in front of the guided vehicle A, then the on-board system may send a message to the TCMAG informing the latter about an occupied state of said part of the first section located ahead the guided vehicle;
- automatically issuing by means of the TCMAG a movement authority to the on-board system if and only if the occupancy state of the second section is in a vacant state and if the message informing about the vacant state of said part of the first section is received by the TCMAG, otherwise and in particular, preventing the guided vehicle A to enter the second section, notably by preventing an issuance of a movement authority to the guided vehicle A for entering the second section. In particular, information about the occupancy state of the second section might be provided to the TCMAG by known in the art detection device configured for determining an occupancy state of track section, like a track circuit.

[0010] Preferentially, the method comprises reporting a position of the guided vehicle A to the TCMAG, for instance a RBC, by means of the on-board system. In particular, the latter might periodically report said position. In particular, the on-board system of guided vehicle A is capable of determining the position of the guided vehicle A, e.g. the position of the head and tail end of the guided vehicle A, on said railway network and reporting said position to the TCMAG, which may belong to a control system of the railway network configured for managing movement authorities over said railway network. According to a first embodiment of the invention, the on-board system periodically reports the position of the guided vehicle, and the TCMAG determines if the distance between the reported position of the guided vehicle A and the boundary between the first section and the second section is smaller than the predefined distance. According to another embodiment, the on-board system is configured for determining the position of the guided ve-

hicle A on the track and for sending to the TCMAG a request for movement authority (hereafter movement authority request) when the distance between a position of the guided vehicle A and said boundary is smaller than the predefined distance. Upon reception of the movement authority request, the TCMAG is configured for responding by sending said request for checking the occupancy of the part of the first section located directly ahead the guided vehicle A.

[0011] The predefined distance according to the invention is in particular calculated for a section of track, preferentially for each section, from railway network track geometry and/or a maximum detection length of the radar system, so that said predefined distance is a function of the maximum detection length and/or the track section geometry. The TCMAG comprises for instance a database comprising for the section on which the guided vehicle is moving, preferentially for each section of the railway network, at least one predefined distance, preferentially different predefined distances in function of guided vehicle features. In particular, at least one predefined distance is stored in said database for each guided vehicle of the railway network and/or for each section. Preferentially, the TCMAG comprises a processing unit configured for determining for each section said predefined distance, for instance in function of specificities of the guided vehicle A (e.g. specificities of its radar system, like its detection length) and/or track section (e.g. its geometry). Preferentially, the TCMAG is configured for selecting in the database one predefined distance for the guided vehicle A whose on-board system reports the position, said selection being in particular based on the specificities of the radar system of the guided vehicle A.

[0012] The present invention also concerns in particular an on-board system configured for being installed on-board a guided vehicle A, said on-board system comprising:

- a position determination unit configured for determining the position of the guided vehicle A, for example by using beacons installed along a track followed by the guided vehicle A, or GPS techniques, or odometry systems using railway network track cartography, etc. The position determination unit is preferentially able to determine a distance between a position of the guided vehicle and a boundary between a track section on which the guided vehicle is moving and the consecutive next track section;
- a communication system for communicating with the TCMAG of a control system of the railway network on which said guided vehicle A is configured to operate, said communication system being preferentially configured for periodically reporting the position of the guided vehicle A to the TCMAG;
- a radar system comprising at least one radar, preferentially a first radar and a second radar, each configured for detecting a presence of a guided vehicle B in front of the guided vehicle A, wherein the first

radar provides a first detection signal to a processing unit of the radar system and the second radar provides a second detection signal to said processing unit;

wherein the on-board system is configured for automatically launching the radar system when receiving a request from the TCMAG for checking an occupancy state of a part of the track ahead the guided vehicle, for instance of the part of a first section ahead the guided vehicle A, and for automatically sending a message to the TCMAG informing the latter about a vacant state of the part of the track ahead the guided vehicle A, for instance of the part of the first section located between the head of the guided vehicle A and the boundary between the first section and the second section, if no guided vehicle B is detected in front of the guided vehicle A by its radar system, otherwise and in particular, for sending a message to the TCMAG informing the latter about an occupancy state of said part of the first section. In particular, said message informing about a vacant state is sent by the on-board system if and only if the first detection signal coincides with the second detection signal.

[0013] The present invention concerns also a preferred embodiment of a TCMAG for managing a movement authority for a guided vehicle A, wherein said TCMAG is for instance a trackside device or a device located at a central command station of the railway network. The TCMAG according to the invention comprises:

- a communication device for communicating with an on-board system of a guided vehicle A. The communication device is in particular configured for receiving a position report from the guided vehicle A, wherein said position report is designed for indicating a position of the guided vehicle A on the track;
- optionally, a processing unit configured for determining a distance between said reported position and a boundary between a section of the track on which the guided vehicle A is moving and a consecutive next track section, for instance the boundary between the first section and the second section, the processing unit being further preferentially configured for determining a predefined distance for said position of the guided vehicle A, for

comparing said distance with the predefined distance; the TCMAG according to the invention being characterized in that it is further configured for automatically sending to the on-board system of the guided vehicle A a request for checking an occupancy of a part of the track ahead the guided vehicle A, for instance of a part of the first section ahead the guided vehicle, wherein said request is preferentially sent only if said distance is smaller than the predefined distance, said request being configured for automatically launching a radar system by means of the on-board system. The TCMAG is preferentially further configured for releasing a movement au-

thority for guided vehicle A if and only if the occupancy state of the consecutive next track section, for instance the second section, is in a vacant state and if it received, in return of its request, a message from said on-board system reporting the vacant state of said part, wherein for each track section, at least one predefined distance is preferentially stored in a database of the TCMAG in function of the guided vehicle A specificities (like the type of radar system equipping said guided vehicle A, and for instance its maximal detection length) and/or track geometry.

[0014] Finally, the present invention concerns also a control system designed for controlling and managing a movement authority for a guided vehicle A operating on a railway network, said control system comprising:

- optionally beacons designed for being installed at points along tracks of the railway network, configured for communicating with an on-board system designed for equipping said guided vehicle A, said beacons providing for instance localization information to the on-board system suitable for the determination, by the on-board system, of the position of the guided vehicle A on a track of said railway network;
- said on-board system as previously described and configured for being installed on-board the guided vehicle A;
- said TCMAG, as previously described.

[0015] Further aspects of the present invention will be better understood through the following drawings, wherein like numerals are used for like and corresponding parts:

Figures 1A-1D schematic representation of a method for managing a movement authority according to the invention in the particular case of a track free ahead.

Figures 2A-2D schematic representation of a method for managing a movement authority according to the invention in the particular case of an occupied track ahead.

[0016] Figures 1A-1D and figures 2A-2D illustrate preferred embodiments of the method for automatically managing movement authority, in particular the first movement authority, according to the invention. Figures 1A to 1D as well as figures 2A to 2D show chronologically the steps according to the claimed method in the case of a vacant state of a section in front of a guided vehicle (Fig. 1A-1D) and in the case of an occupied section in front of the guided vehicle (Fig. 2A-2D). A section of track according to the present invention is a part or an area of a track that comprises a detection device for detecting if the section, i.e. if said part or area of track it equips, is occupied or vacant, i.e. if a guided vehicle is respectively present or not on said track section, said detection device

being usually a track circuit.

[0017] Both figure 1 and figure 2 show a track 1 of a railway network, wherein different guided vehicles may move, for instance a guided vehicle A and another guided vehicle, e.g. a guided vehicle B. Preferentially, guided vehicle A is a fitted guided vehicle and guided vehicle B is a non-fitted guided vehicle. The track 1 is divided into a plurality of sections, for instance a first section 10, a second section 11 and a third section 12. In figures 1A-1D, guided vehicle B is moving on the third section 12, and therefore, the second section 11 and the part of the first section 10 located ahead the guided vehicle A are free. In figures 2A-2D, the guided vehicle A and the guided vehicle B are both located on the first section 10, the guided vehicle B being located in front of guided vehicle A. Each section comprises preferentially said detection device for determining its occupancy state, i.e. either vacant or occupied. Said detection device is preferentially configured for communicating with a TCMAG 4 which is in charge of managing issuance of movement authority to the guided vehicles on said railway network, and so in particular, for issuing or not a movement authority to the guided vehicle A moving from the first section 10 to the second section 11. Due to the presence of two guided vehicles on the same track section, there is a risk that the detection device does not distinguish the guided vehicle A from the guided vehicle B and considers that there is only one guided vehicle on the first track section 10. Each track section might comprise also a device enabling a guided vehicle to determine its position, like for example a beacon 13 that is able to communicate with the guided vehicle in order to exchange information, like position on the track or track section. Each track section is separated from the next track section by a boundary, like the boundary 15 separating the first track section 10 from the second track section 11, a guided vehicle being authorized to pass said boundary 15 for entering the next track section only if the next track section has been proved clear, i.e. has a vacant state. In particular, an entry signal 16 might be positioned at the boundary 15 between two track sections for signaling if the next track section is vacant or not and providing a visual authorization to entry the next track section.

[0018] The guided vehicle A comprises an on-board system 20 configured for managing a movement of the guided vehicle A on the track 1, said on-board system 20 comprising a position determination unit for determining the position of the guided vehicle A on the track 1. Preferentially, said position determination unit is able to communicate with beacons 13 for determining the position of the guided vehicle A according to techniques known in the art. Preferentially, said position determination unit may also comprise, additionally or alternately, a GPS system and/or an odometry system for determining said position of the guided vehicle A. The on-board system 20 further comprises a communication device 21 for communicating with a communication device 41 of the TCMAG 4 in order to exchange, via a communication

canal 23, messages or information, notably about the position of the guided vehicle A and occupancy state of the track sections. The on-board system 20 according to the invention further comprises a radar system 22 preferentially installed at the front end of the guided vehicle A, wherein said radar system comprises at least one radar, preferentially a first radar and a second radar redundant with the first radar. Each radar of the radar system 22 is configured for detecting if another guided vehicle, like guided vehicle B, is located in front of the guided vehicle A. In particular, said radar system is used for detecting if a guided vehicle B is located on a part of the first track section comprised between the head of the guided vehicle A and the end of said first track section, i.e. the boundary 15 when the distance between said head and said boundary matches a maximum detection length of the radar. In particular, the first radar and the second radar provide to a processing unit of the radar system 22 respectively a first detection signal and a second detection signal, wherein said first and second detection signal are used by the processing unit for safely determining if a guided vehicle B is present in front of the guided vehicle A, notably by checking a coincidence of the first signal with the second signal: if they coincide and indicate an absence, respectively a presence, of a guided vehicle B in front of the guided vehicle A, then the processing unit is configured for informing the on-board system 20 about said absence, respectively presence, otherwise, if they do not coincide, the processing unit is configured for informing the on-board system 20 about a presence of a guided vehicle until checking said coincidence gives rise to a matching result.

[0019] According to the present invention, the TCMAG 4 and the on-board system 20 cooperate together for the determination of a possible issuance of a movement authority to the guided vehicle A as it will be explained in more details by reference to the figures 1A-1D in the case of a free section in front of the guided vehicle A and by reference to the figures 2A-2D in the case of an occupied section in front of the guided vehicle.

[0020] As illustrated in Fig. 1A and 2A, the on-board system 20 is configured for reporting to the TCMAG 4, notably in real time and preferentially periodically, the position of the guided vehicle A by sending 23S, to the TCMAG 4 and via the communication device 21, messages comprising position information.

[0021] Upon a reception of a position information sent by the on-board system 20 of the guided vehicle A, the TCMAG is configured for determining if a distance d between the reported position of the guided vehicle A and a boundary 15 between the first section 10 and the second section 11 is smaller than a predefined distance. Then, if said distance is smaller than the predefined distance and as illustrated in Fig. 1B and 2B, the TCMAG is configured for sending to the on-board system 20 of the guided vehicle A a request for checking an occupancy state of a part of the first section 10, wherein said part is ahead the guided vehicle A. Preferentially, if the distance

is not smaller than said predefined distance, then the TC-MAG is configured for waiting until receiving a position information for which the distance between the reported position and the boundary is smaller than the predefined distance. According to another preferred embodiment, the on-board system 20 is configured for determining the distance between the head of the guided vehicle A and the boundary 15 and for automatically checking the occupancy state of a part of the first section directly ahead the guided vehicle A by means of the radar system 22 if and only if said distance is smaller than the predefined distance. The result of this check of the occupancy state might be automatically sent by the on-board system to the TC-MAG for triggering or not the issuance of a movement authority.

[0022] According to the present invention, the predefined distance might be stored in a database of the TC-MAG 4, wherein for each section, at least one predefined distance is stored. Preferentially the predefined distance is the maximum detection length of the radar system 22 equipping the on-board system 20 of the guided vehicle A, in particular, the maximum detection length for the section on which the guided vehicle is moving, for example, for the first section 10 in the present case. In other words, said maximum detection length is in particular not simply the maximum detection length that might be achieved by the radar of the radar system 22, but is preferentially defined for each section in function of a track geometry and a detection capacity of the radar for said track geometry, taking thus into account the track geometry in the detection achievable by the radar. Preferentially, the TC-MAG is also configured for determining for each section said predefined distance, for instance in function of specificities of the guided vehicle A (e.g. specificities of its radar system, like its detection length) and/or track section (e.g. its geometry that might be stored in its database), and then, optionally, saving the predefined distance in its database.

[0023] Preferentially, the TC-MAG is configured for determining, from the position information reported by the on-board system 20, on which section the guided vehicle A is moving, and for determining, from the previously determined section, the predefined distance, e.g. by calculating it or by selecting it in its database in function of the section, wherein the predefined distance may depend on the maximum detection length of the radar, and optionally the track geometry of the determined section.

[0024] At reception 23R of said request, the on-board system 20 of the guided vehicle A is configured for automatically launching a detection process, wherein the radar system 22 is configured for detecting by means of its radar if a guided vehicle B is located in front of the guided vehicle A within the predefined distance, i.e. in particular within the maximum detection length that has been determined for the specific geometry of the track located in front of the guided vehicle A until the boundary 15 for the first section 10. If an object is located in front of the guided vehicle A, then the radar system is config-

ured for providing a signal to the on-board system indicating the presence of a guided vehicle in front of the guided vehicle A, otherwise, if no object is detected, the radar system provides a signal indicating a free track ahead.

[0025] If no guided vehicle B is detected in front the guided vehicle A, then the on-board system 20 is configured for automatically sending a message 23M to the TC-MAG informing the latter about a vacant state of the part of the first section 10 located in front of the guided vehicle A. If a guided vehicle B is detected in front of the guided vehicle A, then no message is sent to the TC-MAG as illustrated in Fig. 2C, or a message comprising information reporting an occupied state of the track section in front of guided vehicle A is sent to the TC-MAG.

[0026] Upon reception of the message 23M reporting the vacant state of the part of the first section 10 in front of the guided vehicle, the TC-MAG is configured for automatically issuing a movement authority for each next section that has been proved clear, in the present case as illustrated in Fig. 1D, for the second section 11. Otherwise and in particular if the TC-MAG 4 receives the message reporting the occupied state or if the next track section, e.g. said second section 11 is occupied, then the TC-MAG is configured for preventing the guided vehicle A to enter the next section, e.g. said second section 11, notably by preventing an issuance of a movement authority to the guided vehicle A.

Claims

1. Method for automatically managing a movement authority for a guided vehicle A moving on a track (1) of a railway network, said track (1) comprising a first section (10) and a second section (11) consecutive to the first section (10), the guided vehicle A moving on the first section (10) in direction of the second section (11), said method comprising chronologically the following steps:

- sending, by means of a Trackside Centralized Movement Authority Generator (hereafter TC-MAG) (4) to an on-board system (20) of the guided vehicle A, a request for checking an occupancy state of a part of the first section (10) located ahead the guided vehicle A;
- at the reception of said request by the on-board system (20), automatically launching a detection process involving a radar system (22) of the guided vehicle A, wherein said detection process comprises using the radar system (22) for detecting if a guided vehicle B is located in front of the guided vehicle A;
- if no guided vehicle B is detected in front of the guided vehicle A, then automatically sending a message to the TC-MAG (4) informing the latter about a vacant state of the part of the first section

- (10) located ahead the guided vehicle A;
 - automatically issuing by means of the TCMAG (4) a movement authority to the on-board system (20) if and only if the occupancy state of the second section (11) is vacant and if the message informing about the vacant state of the part of the first section ahead the guided vehicle is received by the TCMAG.
2. Method according to claim 1, wherein said request is sent only if a distance between a position of the guided vehicle A on the track and a boundary (15) between the first section (10) and the second section (11) is smaller than a predefined distance.
3. Method according to claim 2, wherein the on-board system (20) reports the position of the guided vehicle A to the TCMAG (4) and the latter determines if the distance between said position that has been reported and the boundary (15) between the first section (10) and the second section (11) is smaller than the predefined distance.
4. Method according to claim 2, wherein the on-board system (20) determines the position of the guided vehicle A on the track and sends to the TCMAG (4) a request for movement authority if and only if the distance between the position of the guided vehicle A and said boundary is smaller than the predefined distance.
5. Method according to one of the claims 2 to 4, wherein the predefined distance is determined by the TCMAG and/or the on-board system (20) for the first section (10) in function of a maximum detection length of the radar system (22) and optionally a track geometry of the part of said first section (10) in front of the guided vehicle A.
6. Method according to claims 2-5, wherein the TCMAG (4) comprises a database and is configured for selecting the predefined distance stored in said database.
7. Method according to one of the claims 1 to 6, wherein a message is automatically sent by the on-board system (20) to the TCMAG (4) for informing the latter about an occupied state of the part of the first section (10) ahead the guided vehicle A if a guided vehicle B is detected in front of the guided vehicle A.
8. On-board system (20) configured for being installed on-board a guided vehicle A, said on-board system (20) comprising :
- a position determination unit configured for determining a position of the guided vehicle A on a track (1);
 - a communication system (21) for communicating with a TCMAG (4);
 - a radar system (22) comprising at least one radar configured for detecting a presence of a guided vehicle B in front of the guided vehicle A;
- the on-board system (20) being configured for automatically launching the radar system (22) upon reception (23R) of a request from the TCMAG (4) for checking an occupancy state of a part of the track (1) ahead the guided vehicle A and for automatically sending (23M) a message to the TCMAG (4) informing the latter about a vacant state of the part of the track (1) ahead the guided vehicle A if no guided vehicle B is detected in front of the guided vehicle A by its radar system (22).
9. On-board system (20) according to claim 8, wherein said communication system (21) is configured for reporting (23S), preferentially periodically, the position of the guided vehicle A to the TCMAG (4).
10. On-board system (20) according to claim 8 or 9, configured for sending to the TCMAG (4) a request for movement authority if and only if the distance between the position of the guided vehicle A and a boundary between a first section (10) and a second section (11) is smaller than a predefined distance that is a function of a maximal length detection of the radar system (22).
11. On-board system (20) according to claim 9, configured for sending said message if and only if a first detection signal provided by a first radar coincides with a second detection signal provided by a second radar of the radar system (22).
12. TCMAG (4) configured for managing a movement authority of a guided vehicle A moving on a track (1) of a railway network wherein the track (1) comprises a plurality of sections, the TCMAG (4) comprising a communication device (41) for communicating with an on-board system (20) of a guided vehicle A and being configured for sending to the on-board system (20) a request for checking an occupancy of a part of the track (1) ahead the guided vehicle A that is configured for automatically launching a radar system (22) of the on-board system (20) designed for checking an occupancy state of said part ahead the guided vehicle A, the TCMAG (4) being further configured for issuing a movement authority to the guided vehicle A only upon reception of a message from the on-board system (20) reporting a vacant state of said part and if said consecutive next track section is also vacant.
13. TCMAG (4) according to claim 11, comprising a processing unit configured for determining a dis-

tance between a position of the guided vehicle A and a boundary (15) between a first section (10) of the track (1) on which the guided vehicle A is moving and a consecutive second section (11) where the guided vehicle is going to enter, for determining a predefined distance for said first section (10), and for sending said request if and only if said distance is smaller than the predefined distance.

14. TCMAG (4) according to claim 12 or 13, wherein the processing unit is configured for determining the predefined distance from a maximum length detection of the radar system of the guided vehicle A and/or a track section geometry of said first section (10).

15. Control system designed for controlling and managing a movement authority of a guided vehicle A operating on a track (1) of a railway network, said control system comprising:

- an on-board system (20) according to one of the claims 8-11;
- a TCMAG (4) according to one of the claims 12-14.

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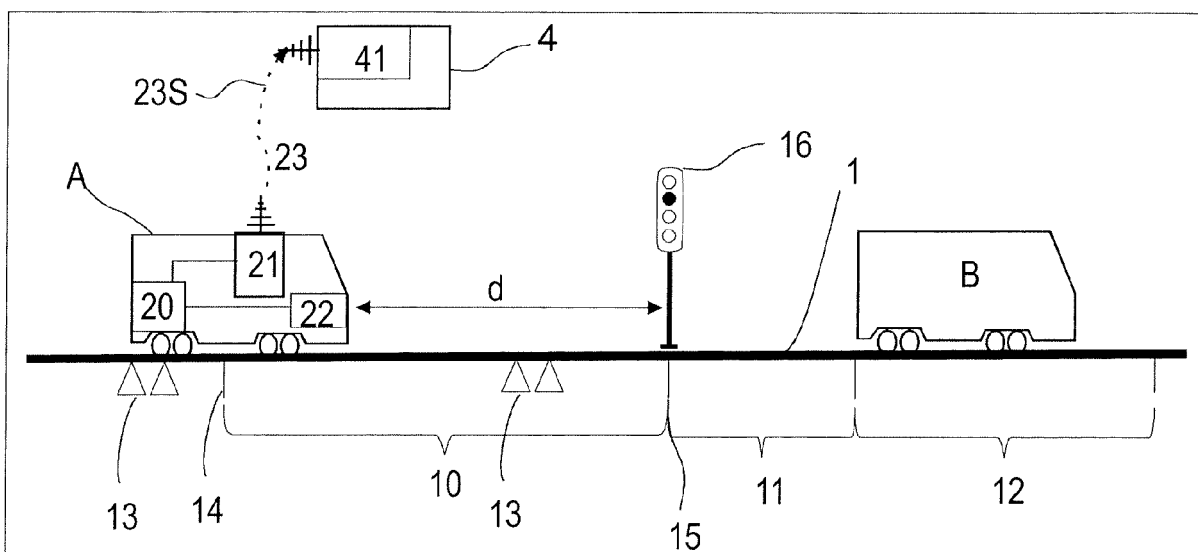


FIG 1A

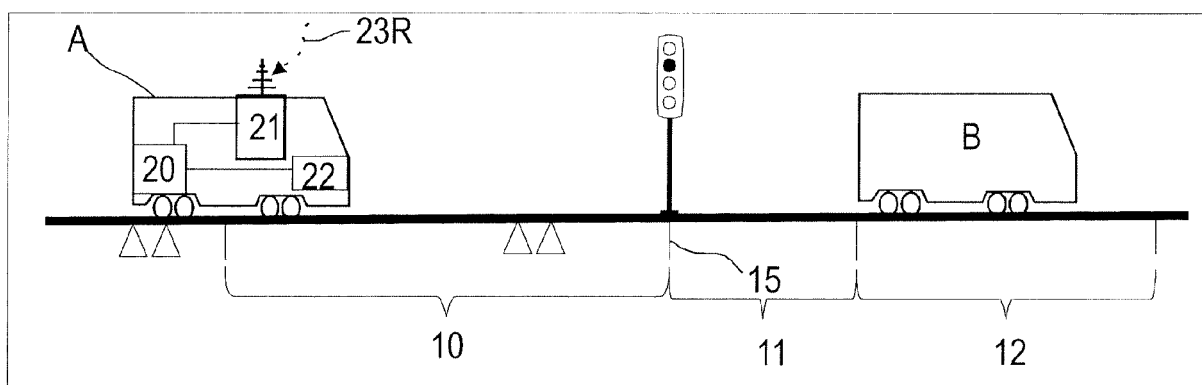


FIG 1B

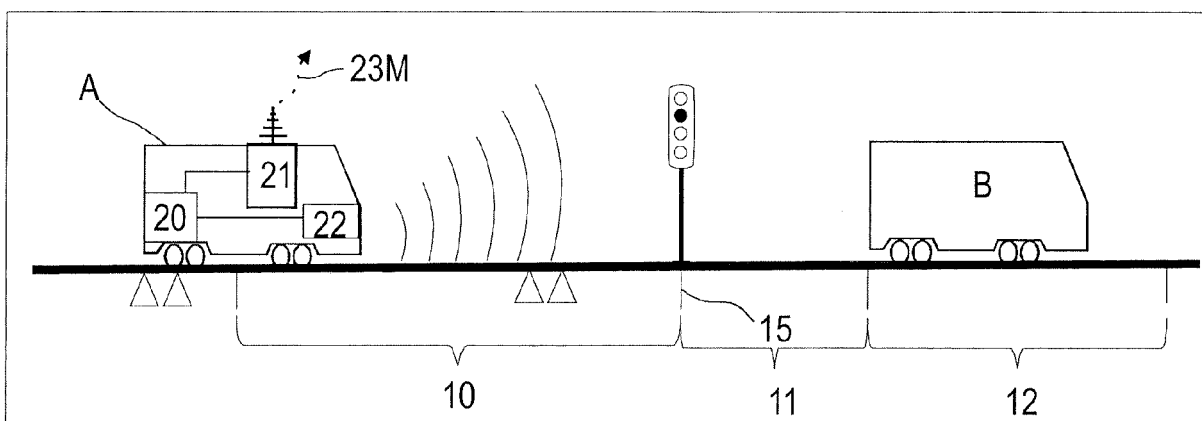


FIG 1C

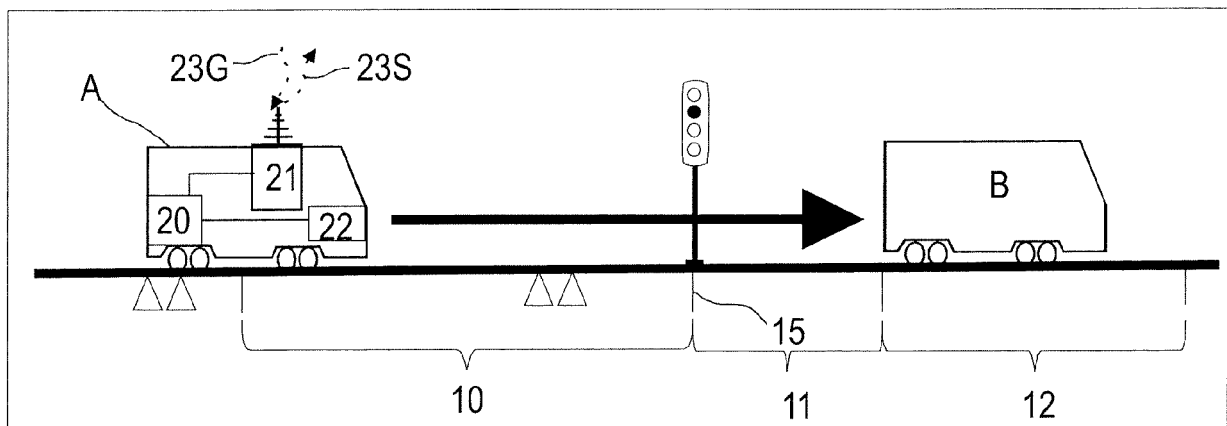


FIG 1D

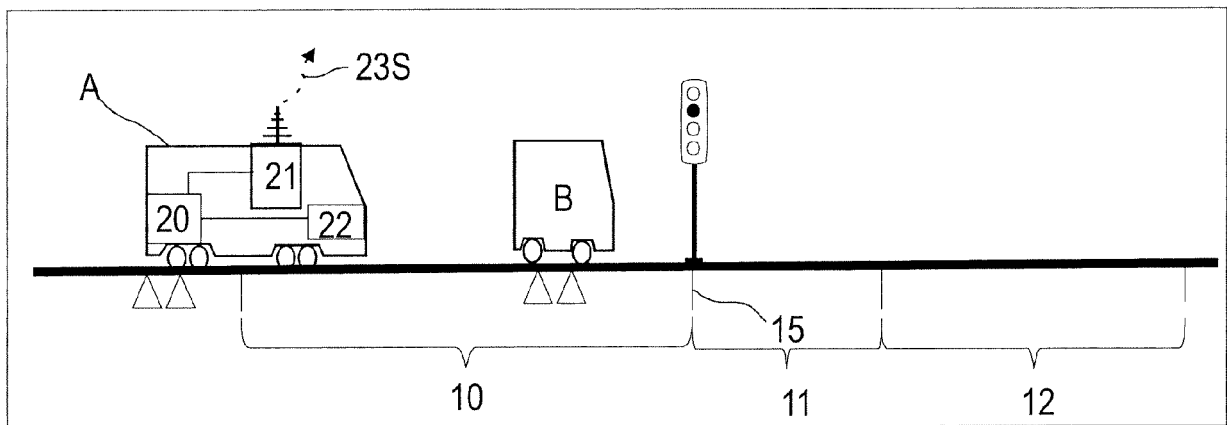


FIG 2A

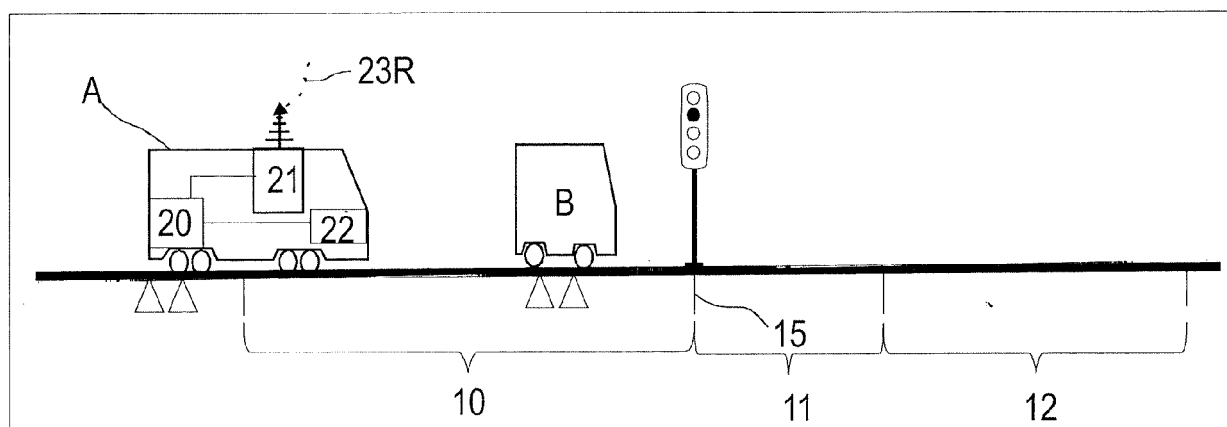


FIG 2B

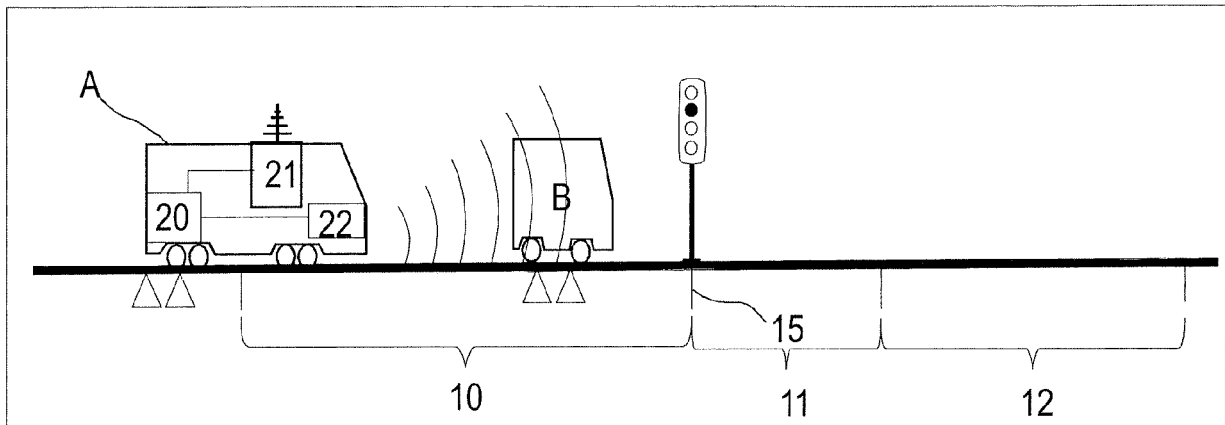


FIG 2C

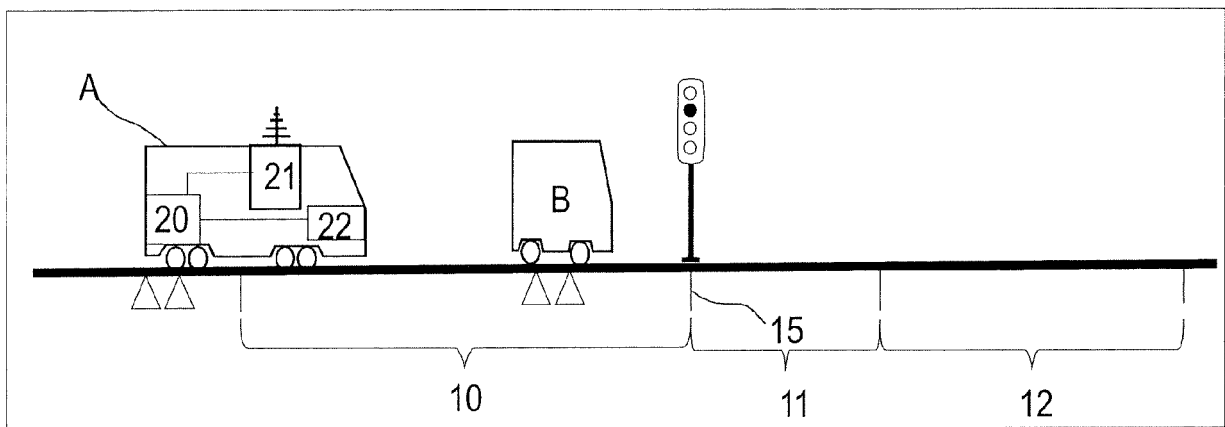


FIG 2D



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Place of search Munich		Date of completion of the search 4 October 2016	Examiner Mäki-Mantila, M
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