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(71) Applicant: **Siemens Rail Automation S.A.U.**
28760 Tres Cantos (Madrid) (ES)

(72) Inventors:
- **Jurado Sanchez, Maria Jose**
  28806 Alcalà de Henares / Madrid (ES)
- **Dorado Garcia, Mario**
  28760 Tres Cantos Madrid (ES)

(74) Representative: **Deffner, Rolf**
Siemens Mobility GmbH
Postfach 22 16 34
80506 München (DE)

(54) METHOD AND SYSTEM FOR RESETTING A TRACK SECTION OCCUPANCY STATE

(57) The present invention concerns a method and system for resetting a track section occupancy state, the system (1) comprising:
- a control device (3) configured for cooperating with a physical detection system (22) in charge of a determination of the occupancy state for said track section (S2), wherein said control device (3) is configured for automatically sending a set of data to a drone system (4) at reception of a request for resetting the occupancy state of the track section (S2), wherein said set of data comprises at least one data enabling a drone system to acquire aerial images of the track section, the control device (3) being further configured for automatically resetting the occupancy state of the track section in case of reception of a drone system message whose occupancy state data indicates an absence of guided vehicle on said track section;
- the drone system (4), comprising a camera system, and configured for automatically launching (203) a process of track section aerial image acquisition, wherein aerial images of the track section (S2) are acquired and processed in real time by the drone system (4) in order to determine whether a guided vehicle is located on the track section, the drone system (4) being further configured for automatically sending (206) a message to the control device (3), wherein said message comprises an occupancy state data for the track section (S2).

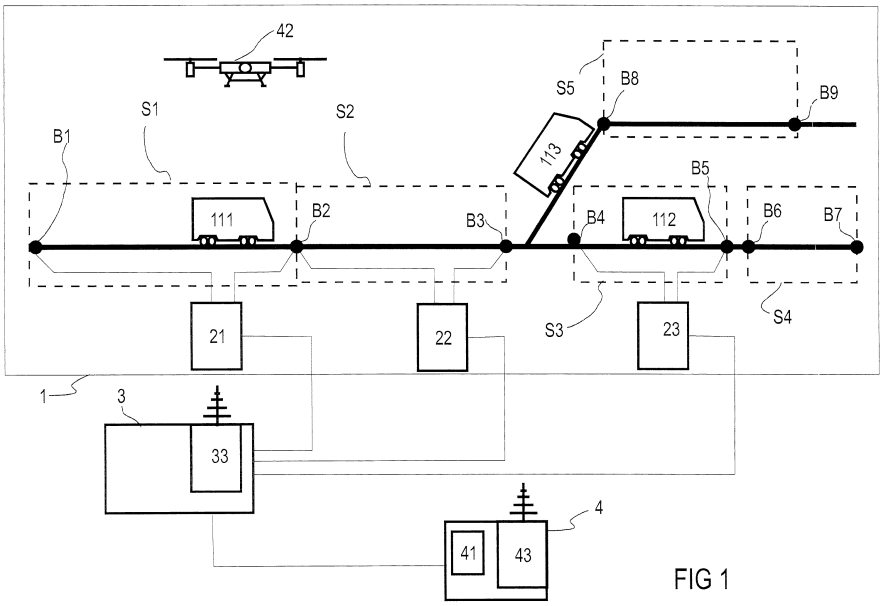

FIG 1

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Description

[0001] The present invention concerns a system and a method for track vacancy reset confirmation.

[0002] The present invention is essentially related to the field of guided vehicle, wherein the expression "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. More specifically, the present invention concerns the detection of a presence or an absence of a guided vehicle within a track section.

[0003] Usually, the detection of a presence or an absence of a guided vehicle between two points on a track, wherein the two points define respectively the two ends of a track section within a railway network, is made by means of physical detection systems that are configured for detecting whether a guided vehicle is present between said two points and for providing the result of said detection in the form of occupancy state information (or vacancy information). Such physical detection systems are for instance axle counters comprising a first counting head installed at one of the ends of the track section and a second counting head installed at the other end of the track section. When a guided vehicle enters the track section, it passes the first counting head which counts the number of wheels (or axles) that entered in the track section and when the guided vehicle leaves the track section, it passes the second counting head which also counts the number of wheels (or axles) leaving the track section. By comparing the number of wheels entering and leaving the track section, the axle counter is able to determine whether a guided vehicle is still (partially) occupying the track section and may provide a track occupancy state information accordingly, e.g. either track section occupied or track section vacant.

[0004] Sometimes, it arrives that the number of wheels entering and leaving the track section does not coincide because of an error or failure of the axle counter. In such a case, the track section might be set for instance as occupied, while it is in fact vacant. When such a situation occurs, then an interlocking device usually allows an operator to initialize a reset procedure in the axle counter in order to clear the wrong occupation. At the end of the reset procedure, the track section is indicated as clear. Due to safety requirements, a visual checking of the vacancy of the track section is mandatory before performing the reset procedure.

[0005] This is usually realized by the driver of an approaching guided vehicle who has to determine, using visual inspection, whether the track section that has to be cleared is free of any guided vehicle, the driver informing then an operator of a control center about the vacancy of the track section, and said operator taking then the decision of authorizing or not to start the reset procedure, notably in function of received and/or known additional information about the track section and/or railway network.

[0006] An objective of the present invention is to propose a new method and system for efficiently and automatically determining whether a reset procedure can be authorized or not for a track section whose occupancy state has to be verified before starting a reset procedure.

[0007] For achieving said objective, the present invention proposes notably a system and method for resetting a track section occupancy state as disclosed by the objects of the independent claims. Other advantages of the invention are presented in the dependent claims.

[0008] The present invention concerns in particular a method for automatically resetting an occupancy state of a track section, wherein said occupancy state might be stored within a physical detection system in charge of determining the occupancy state of the track section by detecting or determining a presence or an absence of a guided vehicle on the track section or within a control system involved in the management of guided vehicle movements within the railway network comprising said track section, the method comprising the following steps:

- receiving a request for resetting the occupancy state of the track section. Said request might be sent manually by an operator or automatically by the control system of the railway network, wherein said control system is configured for instance for determining a failure of the physical detection system and/or a potential error of within the occupancy state reported/stored for the track section whose occupancy state is determined by said physical detection system. The request is received by a control device configured for controlling the physical detection system and capable of communicating with the latter for exchanging for instance track section occupancy state information. The control device may comprise a processing unit and a memory, as well as an interface for communicating with other devices, e.g. said physical detection system. Said control device is for instance an interlocking device and the physical detection system is for instance an axle counter or any other device capable of detecting/determining whether a guided vehicle is located on the track section;
- the reception of said request triggering a sending, preferentially automatically triggering said sending, by the control device to a drone system, e.g. to a control module of said drone system, of a set of data comprising at least one data configured for enabling the drone system to acquire aerial images of the track section. For instance, said at least one data is data enabling the drone system to locate the track section, and/or to determine a flight trajectory enabling an acquisition of the aerial images of the track section whose vacancy state has to be reset. Preferentially, said data is a position data that indicates the position of the track section whose track vacancy state has

to be reset, for e.g. the position of at least one of the ends of the track section. Alternatively or additionally, said set of data may comprise an identification data that enables the drone system to identify the concerned track section. Preferentially, the position data and/or the identification data are configured for enabling the drone system, e.g. its control module, to determine a position of the track section with respect to a position of a drone of the drone system. In particular, said position data comprises for instance the position of each end of the track section. In particular, the identification data comprises a code which is associated with the track section whose occupancy state has to be checked, said code enabling for instance the control module to determine which track section has to be checked or to directly select a trajectory for the drone, each code being associated for instance with a trajectory and/or with the position of at least one, preferentially each, end of the track section to be checked. For instance, according to a preferred embodiment, the control module comprises a database wherein each code is associated with a specific track section of the railway network, wherein for each code, a trajectory for the drone is stored in the database, i.e. predefined in the database for instance in function of track section known environment. Indeed, according to the present invention, the known track section environment enables to define for each track section the most efficient flight trajectory, i.e. an optimized flight trajectory, for imaging said track section, making therefore the process of checking the occupancy state of the track section more efficient;

- the reception of said set of data by the drone system, e.g. by its control module, automatically triggering the launching of a process for track section image acquisition, wherein aerial images of the track section, preferentially real time aerial images, are acquired by the drone system, for instance by flying over the track section. Preferentially, the reception of the set of data may trigger a determination or a selection by the drone system of a trajectory enabling an acquisition, e.g. by the drone system itself or by a drone of the drone system, of aerial images of the track section whose track occupancy state has to be reset. For this purpose, the drone system may operate the drone according to said trajectory;
- the drone system acquiring, e.g. by means of its drone, aerial images of the track section notably by following a flight trajectory which has been predefined or determined by the drone system from the received set of data;
- automatically processing, by the drone system, the track section aerial images, and determining the occupancy state of the track section. Preferentially, the drone system uses a pattern recognition technique/algorithm for determining whether a guided vehicle is present on the track section or absent from the latter;
- the drone system automatically communicating a message to the control device, wherein said message comprises an occupancy state data indicating at least either a presence or an absence of a guided vehicle on the track section;
- automatically resetting, by means of the control device, the vacancy state of the track section if the occupancy state data indicates an absence of a guided vehicle. For instance, the control device might perform a reinitialization of the physical detection device, said reinitialization automatically resetting the track vacancy state.

[0009] The present invention proposes also a system for automatically resetting a track section occupancy state, the system according to the invention comprising:

- a control device configured for cooperating with or controlling the physical detection system and capable of communicating with the latter for exchanging for instance track section occupancy state information, said control device being for instance an interlocking device. The control device is in particular configured for receiving a request for resetting the occupancy state of the track section, wherein the reception of said request triggers a sending, by the control device and to a control module of a drone system, of a set of data comprising at least one data enabling the drone system to acquire aerial images of the track section. Said at least one data is for instance a position data and/or an identification data, wherein the position data is configured for enabling the drone system to determine the position of the track section with respect to a drone's position, said position data providing for instance the position of each end of the track section, and said identification data may comprise a code which is associated with the track section whose occupancy state has to be checked. For instance, said code is configured for enabling an identification by the control module of the track section that has to be checked, each code being associated for instance to a (predefined optimized) trajectory and/or to the position of at least one, preferentially each, end of the track section to be checked. The control device according to the invention is further configured for automatically resetting the track occupancy state of the physical detection system at the reception of a message sent by the drone system if the message indicates an absence of guided vehicle on the track section. In particular, said message comprises a track occupancy state data configured for indicating at least either a presence or an absence of a guided vehicle on the track section. According to the present invention, the control device is preferentially a wayside device, so that the whole process for automatically resetting the occupancy state of a track section is performed lo-

cally, free of an involvement of a central system configured for managing the railway network. Of course, the central system might be informed about the result of the process for automatically resetting the occupancy state of the track section;

- optionally, the physical detection system configured for determining the occupancy state of the track section, i.e. an absence or presence of a guided vehicle on said track section defined as a segment of track comprised between a first end and a second end, said first end and second end defining therefore the boundaries of the track section;
- a drone system configured for automatically launching a process of track section aerial image acquisition at reception of said set of data, wherein aerial images of the track section are acquired and processed in real time by the drone system 4 by flying over the track section according for instance to a flight trajectory determined in function of the received set of data. The drone system may comprise at least a drone and said control module, the latter being installed on-board or off-board the drone and configured for determining a flight trajectory for the drone, wherein the determination of said flight trajectory is preferentially triggered by the reception by the control module of said set of data sent by the control device. The drone system, e.g. its drone, comprises a camera system comprising at least one camera for acquiring aerial images of the track, the drone system being an autonomous system capable of operating free of any human operator intervention, notably to fly its drone. In particular, the drone system is further configured for identifying objects on the tracks using a pattern recognition technique/algorithm, e.g. based on artificial intelligence (machine learning, artificial neural networks, etc.). For this purpose, the drone system, e.g. its module, comprises image processing means configured for performing pattern recognition on the aerial acquired images. In particular, the flight trajectory is configured for enabling the drone system to acquire aerial images of the track section from one end of said track section to the other end, wherein the drone system is configured for detecting, notably in real time and during its motion or the motion of its drone according to said flight trajectory, a presence or absence of a guided vehicle located within the track section from the acquired aerial images and by using the pattern recognition technique/algorithm. The drone system, e.g. its control module, is further configured for directly and automatically communicating a message to the control device, e.g. the interlocking, wherein said message comprises a track occupancy state data indicating at least either a presence or an absence of a guided vehicle on the checked track section.

[0010] Further aspects of the present invention will be better understood through the following drawings, wherein like numerals are used for like and corresponding parts:

Figure 1 schematic representation of a system according to the invention.

Figure 2 flowchart of a preferred method according to the invention.

[0011] Figure 1 illustrates a preferred embodiment of a system for automatically resetting a track section occupancy state according to the invention. A railway network 1 comprises different track sections S1 - S5, i.e. segment of tracks, wherein each track section is delimited by two boundaries: a first boundary located at one of the ends of the track section and a second boundary located at the other end of the track section. For instance, the track section S1 is delimited by the boundaries B1 and B2, the track section extended therefore from the boundary B1 until the boundary B2, a first end of the track section S1 corresponding (i.e. being located) at the boundary B1 and a second end corresponding to the boundary B2. A boundary can be common to two or more track sections. For instance, boundary B2 is also a boundary for track section S2, which extends from boundary B2, corresponding to a first end of track section S2, until boundary B3, which corresponds to the other end of the track section. Also, two consecutive track sections may not share a boundary: for instance, track section S3 extends from boundary B4 until boundary B5, and is followed by track section S4 which extends from boundary B6, different from B5, until boundary B7. Each track section might be occupied by a guided vehicle, wherein several guided vehicles are not allowed to occupy a same track section at the same time. For instance, track section S1 is occupied by guided vehicle 111, which, when leaving track section S1 will enter the directly next track section, i.e. track section S2, when passing the boundary B2, track section S2 being currently vacant. Another guided vehicle 113 previously left track section S2 and is going to enter track section S5 as soon as it will pass the boundary B8 at a first end of the track section S5. The boundary B9 marks the other end of the track section S5. During the time period needed for the guided vehicle 113 to move from boundary B8 to B9, the track section S5 has to be marked as occupied until the guided vehicle 113 integrally passes the boundary B9 and leaves the track section S5. Similarly, the track section S3 is shown as occupied by a guided vehicle 112, while the consecutive next track section S4 is currently free of any guided vehicle.

[0012] In order to manage the movement of the guided vehicles over the railway network 1 and provide movement authorization to guided vehicles, it is important to determine which track section is occupied or not. For this purpose, each track section has its occupancy state controlled/determined by a physical detection system 21, 22, 23, which is in charge of determining whether a guided

vehicle is present or not on the track section it is responsible for. For instance, the physical detection system 21 in charge of controlling the occupancy state of track section S1 is an axle counter comprising a processing unit connected to a first counting head located at the boundary B1 and a second counting head located at the boundary B2. The counting heads of the axle counter are able to detect wheels (or axle) passing the boundary as well as the direction of displacement of these wheels, and consequently it is able to detect for each boundary the number of wheels entering or leaving the track section, and from this number to deduct whether a guided vehicle is still present on the track section. Therefore, by detecting a number of wheels passing each boundary of a track section and their direction of displacement, the processing unit of the axle counter is able to determine and report to a control device 3 whether the track section is occupied or not. For this purpose, an information regarding the occupancy state of the track section is sent by the physical detection system 21, 22, 23 to the control device 3 and/or to a remote control center. The control device 3 according to the invention comprises for instance a processing unit and optionally a memory for storing data related to the railway network or track sections it manages. The control device 3 may comprise communication means 33 for communicating with other devices, e.g. wayside devices located remotely from the control device 3. In case of an initialization or reinitialization of the physical detection system 21, 22, 23, the current occupancy state of its track section (i.e. the track section for which it is responsible for determining the occupancy state) has to be checked or determined in order to ensure that the occupancy state reported by the physical detection system at the end of its (re)initialization at time T corresponds (i.e. is the same) as the occupancy state of the track section at said time T. Such an initialization or reinitialization may occur for instance in case of a failure of a physical detection system 21, 22, 23, which makes it necessary to check/determine the current occupancy state of the track section it is responsible for. For instance, in case of a detection of a failure or of a potential failure by the control device 3 or by the remote control center, e.g. by an operator of the remote control center, the occupancy state of the track section has to be cleared before reinitializing the physical detection system.

[0013] In such a context, the present invention proposes a new method and system for automatically resetting a track section occupancy state, which involves a drone system 4 comprising at least a control module 41 and a drone 42. Indeed, according to the present invention, the communication means 33 of the control device 3 are further configured for communicating with communications means 43 of the drone system 4. The drone system might be a single object that is an unmanned aerial vehicle capable of autonomous operation (the whole drone system is the object capable of flying in this case) or may comprise at least two objects, a terrestrial object like a terrestrial base and a flying object, i.e. a drone capable of flying, for instance from the terrestrial base to specific predefined and/or in real time determined locations, according for instance to a predefined trajectory. In particular, the control module 41 is a processing unit comprising for instance one or several processors and optionally a memory, and that is configured for determining a flight trajectory for the drone 42 and for communicating with the control device 3 via the communication means 43. The control module 41 might be installed on-board the drone 42, or in a part of the drone system remotely located with respect to the drone 42, e.g. in said terrestrial basis. The drone 42 comprises at least a camera system configured for acquiring aerial images of a track section. The camera system is preferentially configured for sending to the control module 41 the acquired aerial images, wherein the latter is further configured for processing the acquired images in order to determine whether a guided vehicle is located within a track section currently controlled. The aerial images according ot the present invention are images acquired during a flight over the track section, operated by the drone system 4 free of any human/operator input. In particular, the control module 41 is configured for identifying, in the acquired images, each boundary of the track section, and to determine whether a guided vehicle is located on the track delimited by said boundaries. According to the present invention, the drone system 4 is an autonomous and unmanned system: the drone system or more specifically its flying object like the drone 42 is configured for autonomously taking off, e.g. from a predefined site like the terrestrial base, flying according to a trajectory configured for enabling the camera system acquiring images of a track section whose vacancy state has to be checked, and flying back to the predefined site, and landing. In particular, the predefined site may comprise any relevant means for providing energy to the drone system, e.g. charging a battery of the drone 42, and/or storing aerial images of the track section.

[0014] The method according to the invention will be described now in more details with reference to Figure 2, which illustrates a preferred embodiment of the method according to the invention in the form of a flowchart.

[0015] At step 201, the control device 3, e.g. its communication means 33, receives a request for resetting the occupancy state of one of the track sections it is responsible for. The received request is configured for enabling the control device 3 to identify the track section whose occupancy state has to be reset. The received request comprises for instance a track section identification data identifying the track section whose occupancy state has to be reset. For instance, from the track section identification data of the received request, the control device 3 is able to determine that the occupancy state of track section S2 has to be reset. In particular, the control device 3 is able to determine which physical detection device has to be initialized or reinitialized in order to reset a track section vacancy state. For this purpose, the control device 3 may comprise a database storing data which

enable the control device 3 to identify for each track section, the physical detection device that is responsible for determining the occupancy state of the considered track section. Optionally, said database may comprise, for each track section, data indicating the position (geographic position) of at least one, preferentially each, of the ends of the track section. For instance, for each track section like the track section S2, the database may comprise the geographic position of the first boundary B2 and of the second boundary B3. Optionally, or alternately, data enabling an identification of the geographic position of the boundaries of each track section that are notably managed by the control device 3 might be stored in a database or memory of the drone system 4.

[0016] At step 202, at the reception of the request by the control device 3, the latter is configured for sending a set of data to the control module 41 of the drone system, which is for instance located at a predefined position. Said set of data comprises at least one data configured for enabling the drone system 4 to acquire images of the track section. For instance, said data is defined in function of a position of the track section. For instance, said data enables the drone system to determine or know or identify at least one position (e.g. a position defined with respect to the predefined position of the drone system, or a geographic position provided by geographic coordinates, or GPS data) of the track section whose vacancy state has to be reset, and/or preferentially a trajectory enabling an acquisition of images of the track section. Alternatively, or additionally, said data comprises a trajectory determined by or predefined within the control device 3. According to a preferred embodiment, the control device 3 might be configured for providing a set of data comprising a position data indicating for instance the position of each ends of the track section, wherein the control module 41 is then able, from said position of each ends, to determine a flight trajectory enabling to acquire images of the track section. According to another embodiment, the control device 3 provides a set of data comprising an identification data enabling the drone system to identify the track section whose vacancy state has to be reset. In this case, the control module is then able to determine, from this identification data, the position of the track section, notably the position of each of its ends. In particular, the drone system may comprise a database storing:

- for each track section, the position of each of its ends; and/or
- for each track section, a predefined trajectory; and/or
- an identification code for each track section, each identification code being associated to one or several geographic positions of the track section and a flying direction.

The position of the track section or of its end(s) according to the present invention is configured for enabling the drone system to determine or select a flight trajectory that enables an acquisition of aerial images of the track section. Indeed, optionally and if needed, the drone system 4 may determine or identify from the received set of data at least one position of the track section whose vacancy state has to be reset, and then a flight trajectory that enables an acquisition of aerial images of the considered track section.

[0017] At step 203, the drone system 4 launches a process of track section image acquisition, wherein aerial images of the track section are acquired by flying over the track section according to a flight trajectory. In particular, the flight trajectory is determined either by the control device 3 or by the drone system 4 from a track section position. The position of the track section (e.g. of one of its ends) is notably used by the drone system for determining the position of the drone 42 and/or drone system 4 with respect to the track section. In particular, according to a first embodiment, the drone system 4 is itself an unmanned autonomous aircraft, wherein the whole drone system is configured for automatically taking off from a terrestrial base, located for instance remotely with respect to the considered track section, and then flying according to a flight trajectory that enables acquiring images of the considered track section. According to a second embodiment, the drone system 4 comprises a terrestrial base and a drone 42, wherein the control module 41 might be located either within the terrestrial base, as shown in Fig. 2, or on-board the drone 42. Preferentially, the control module 41 is configured for providing track section information to the drone 42, said track section information comprising for instance a predefined flight trajectory, and/or a position of at least one end of the track section and optionally a flying direction, and/or the position of each of the ends of the track section, and/or at least one geographic position of the track section. The drone 42 is then able, from the received information, to autonomously take off and choose a flight trajectory that will enable an acquisition of images that enable to determine the occupancy state of the track section.

[0018] According to the present invention, the acquired aerial images provide notably a continuous view of the track section from one of its ends to its other end. "Continuous" means here that the whole track section is imaged, no part being skipped or remaining invisible in the acquired images. During its flight, the drone system is configured for automatically and autonomously acquiring images of the track section, while taking account of the surrounding environment, for instance by avoiding any obstacle.

[0019] At step 204, the drone system 4, for instance its drone 42, automatically processes the acquired aerial images in order to determine the occupancy state of the track section, i.e. whether a guided vehicle is present or not on the track section. For this purpose, it comprises at least one processing unit capable of performing image processing tasks in real time. For instance, it is configured for tracking the track section from processing the images acquired by a camera system of the drone system, and determining whether the whole track section has been

imaged. If not, the drone system is configured for automatically performing a reacquisition of aerial images of the track section. Said camera system is installed for instance on-board the drone 42. In particular, the drone system is further configured for identifying the track section in the acquired images, and continuously adapting the flight trajectory, notably in front of the environment surrounding the track section and the flying drone, in order to continuously acquire images of the track section from one of its ends to the other end. The drone system is further configured for automatically determining whether a guided vehicle is located on the track section, or whether the track section is free of any guided vehicle from processing the acquired images. In particular, the drone system 4, for instance its drone 42, is configured for determining in real time, e.g. by means of a pattern recognition technique/algorithm, whether a guided vehicle is present on the track section or absent from the latter. According to the present invention, the drone system 4 is configured for identifying each of the ends of the track section in the acquired aerial images of the track. For this purpose, different known techniques might be used, like a training on a training dataset comprising images of each track section wherein each end of each track section has been previously identified, or using the geographic coordinate of each end of the track section, or using special marker in the neighborhood of the track, wherein each marker is associated to a track section end, etc.

[0020] At step 205, as soon as the whole track section has been imaged from one of its end until the other of its ends, the drone system 4 automatically sends a message to the control device 3, wherein said message comprises at least an occupancy state data indicating the occupancy state of the track section, i.e. either an absence of guided vehicle or a presence of a guided vehicle. Said data can be a binary data.

[0021] At step 206, the control device 3 receives the message and automatically resets the occupancy state of the track section if said message indicates an absence of a guided vehicle. In order to reset the vacancy state, the control device 3 is configured for automatically (re)initializing (207) the physical detection system in charge of determining the vacancy state of the track section if the message indicates an absence of guided vehicle on the latter. Otherwise, in case of a presence of a guided vehicle, the control device 3, or the drone system 4, may directly inform a remote centralized control center about said presence of a guided vehicle on said track section. At the end of its initialization, the physical detection system 22 indicates an absence of guided vehicle on the track section, e.g. the number of axles counted by both counting heads of an axle counter being for instance zero after the initialization. Optionally, in case of a presence of a guided vehicle, the drone system is able to identify the type of guided vehicle and/or one or several features of the guided vehicle, e.g. the number of its axles, and this information is provided to the control device 3 which is configured for performing a reinitialization of the physical detection system 22, wherein at the end of said initialization, the physical detection system 22 indicates a presence of a guided vehicle. In particular, in case of a physical detection system being an axle counter, the reinitialization process performed by the control device 3 is characterized in that it stores within the axle counter a virtual number of axles counted by the counting head located upstream the guided vehicle as equal to the number of axles of the guided vehicle that is currently occupying the track section, and a virtual number of axles counted by the counting head located downstream (i.e. in front of the guided vehicle with respect to its motion) as equal to zero. From these virtual numbers of both counting head received at the end of its initialization, the axle counter may safely start a new tracking of the occupancy state of the track section.

[0022] To summarize, the present invention proposes a new way of resetting the vacancy state of a track section, which is completely automatic and based on the use of a drone system for checking the vacancy state of the track section and authorizing an automatic reset of the occupancy state of the track section.

Claims

1. Method (1) for automatically resetting an occupancy state of a track section (S2), the method comprising the steps:

   - a control device (3) receiving (201) a request for resetting the occupancy state of the track section;
   - the control device (3) sending (202) to a drone system (4) a set of data comprising at least one data configured for enabling the drone system (4) to acquire aerial images of the track section;
   - the reception of said set of data by the drone system automatically launching (203) a process of track section image acquisition, wherein aerial images of the track section (S2) are acquired by the drone system (4);
   - automatically processing (204), by the drone system (4), the track section aerial images that are acquired and determining the occupancy state of the track section;
   - the drone system (4) automatically sending (205) a message to the control device (3), wherein said message comprises an occupancy state data for the track section (S2);
   - the control device (3) receiving (206) the message and automatically resetting the occupancy state of the track section if the occupancy state data indicates an absence of guided vehicle on the track section.

2. Method (1) according to claim 1, wherein automati-

cally resetting the occupancy state comprises automatically initializing or reinitializing (207) a physical detection system configured for determining in real time the occupancy state of the track section.

3. Method (1) according to claim 2, automatically determining or identifying at least one position of the track section (S2) from said set of data.

4. Method (1) according to one of the claims 1 to 3, comprising automatically determining or selecting a flight trajectory from the received set of data.

5. Method (1) according to one of the claims 1 to 4, wherein automatically processing the acquired images comprises the drone system (4) automatically identifying objects on tracks using a pattern recognition technique or algorithm configured for determining whether a guided vehicle is located or not on said track section (S2).

6. Method (1) according to one of the claims 1 to 5, wherein, in case of a presence of a guided vehicle on the track section, the drone system (4) automatically informs a remote centralized control center about said presence.

7. Method (1) according to one of the claims 1 to 6, wherein the drone system (4) is configured for identifying the type of guided vehicle and/or the number of axels or wheels of the guided vehicle.

8. System for automatically resetting an occupancy state of a track section (S2), the system comprising:

- a control device (3) configured for cooperating with a physical detection system (22) in charge of a determination of the occupancy state for said track section (S2), wherein said control device (3) is configured for automatically sending a set of data to a drone system (4) at reception of a request for resetting the occupancy state of the track section (S2), wherein said set of data comprises at least one data enabling a drone system to acquire aerial images of the track section, the control device (3) being further configured for automatically resetting the occupancy state of the track section in case of reception of a drone system message whose occupancy state data indicates an absence of guided vehicle on said track section;
- the drone system (4), comprising a camera system, and configured for automatically launching (203) a process of track section aerial image acquisition, wherein aerial images of the track section (S2) are acquired and processed in real time by the drone system (4) in order to determine whether a guided vehicle is located on the track section, the drone system (4) being further configured for automatically sending (206) a message to the control device (3), wherein said message comprises an occupancy state data for the track section (S2).

9. System according to claim 8, wherein the drone system (4) is configured for identifying objects on the tracks using a pattern recognition technique or algorithm in order to determine whether a guided vehicle is located or not on said track section (S2).

10. System according to claim 8 or 9, wherein the drone system (4) comprises a control module (41) and a drone (42), wherein the control module (41) is configured for automatically determining or selecting a trajectory for the drone (42) from the set of data received from the control device (3).

11. System according to one of the claims 8 to 10, wherein the control device (3) is an interlocking.

12. System according to one of the claims 8 to 11, wherein the control device (3) comprises communication means (33) configured for communicating with communication means (43) of the drone system (4).

13. System according to one of the claims 8 to 12, wherein the drone system (4) is a single autonomous unmanned aerial vehicle or comprises a terrestrial base and a drone (42).

14. System according to one of the claims 8 to 13, wherein the drone system (4) comprises a database storing

- for each track section, the position of at least one of its ends; and/or
- for each track section, a predefined trajectory; and/or
- an identification code for each track section, each identification code being associated to one or several geographic positions of the track section and a flying direction.

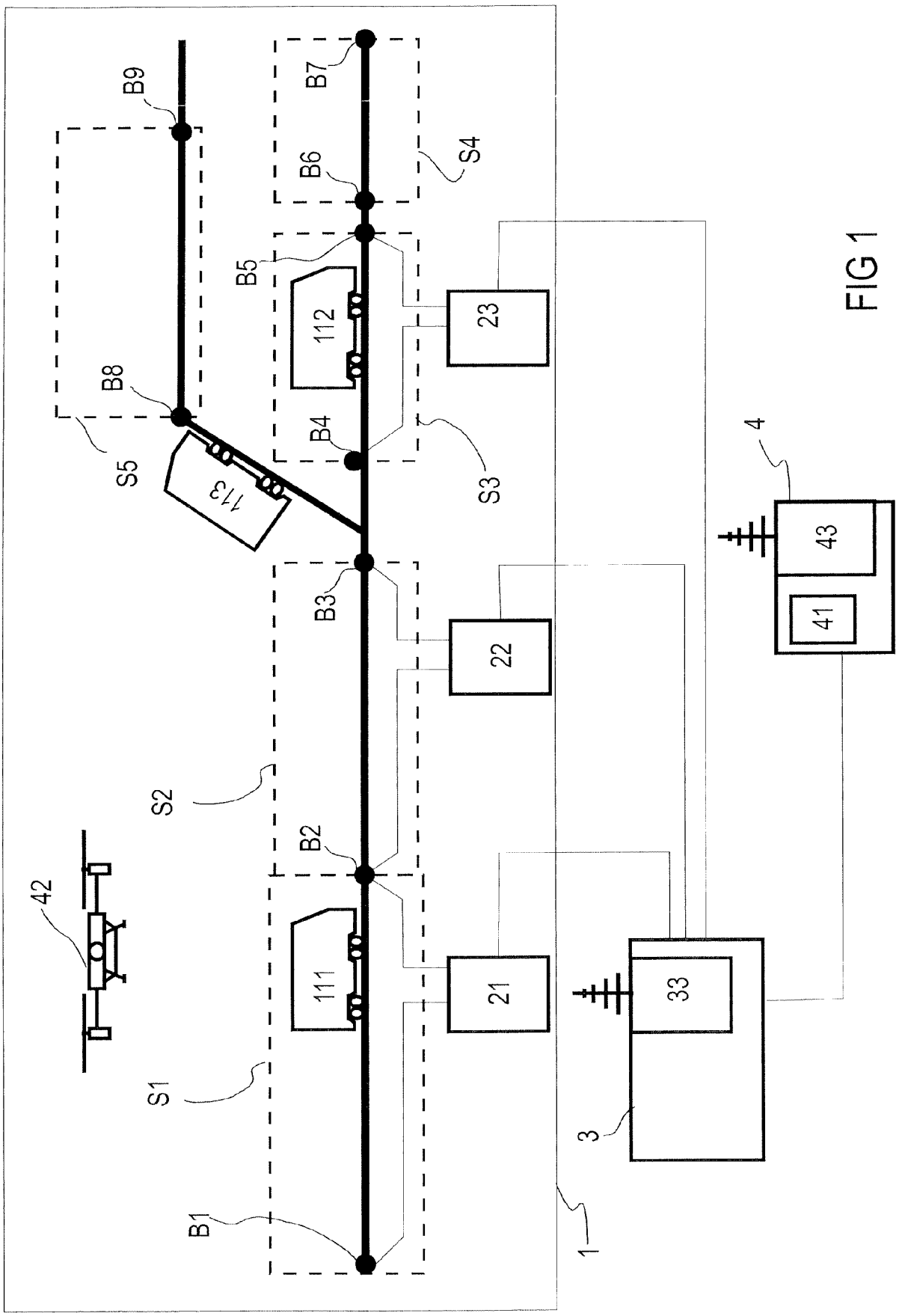
B9
B7
B6
S4
B5
112
23
B8
B4
S5
113
S3
4
43
41
B3
22
S2
B2
42
111
21
33
S1
3
B1
1

FIG 1

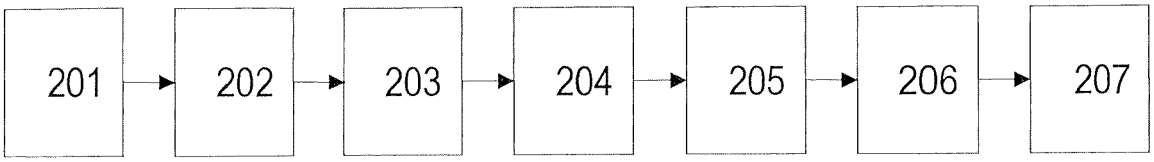

FIG 2

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EUROPEAN SEARCH REPORT

Application Number
EP 20 38 0002

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B61L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 July 2020	Kassner, Holger

CATEGORY OF CITED DOCUMENTS

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20-07-2020

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82