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(54) **CRASH ALARM SYSTEM FOR A RAILWAY VEHICLE**

(57) A crash alarm system for a railway vehicle (6) circulating on a railway track (2) comprising a sensor module (8) placed in the front of a first railway vehicle (1) and an alarm module (10) placed inside said first railway vehicle (1), wherein the sensor module (8) is arranged to calculate a distance value (D) of the first railway vehicle (1) with respect to a detected object (4) detected on the railway track and to send this distance value (D) to a control unit (12) of the first railway vehicle (1), the control unit (12) being arranged to determine a first speed (S1) of the first railway vehicle (1) and a second speed (S2) of the detected object (4) and to send an activation signal to the alarm module (10), based on the values of said first speed (S1), second speed (S2) and distance value (D), so that the alarm module (10) activates an alarm.

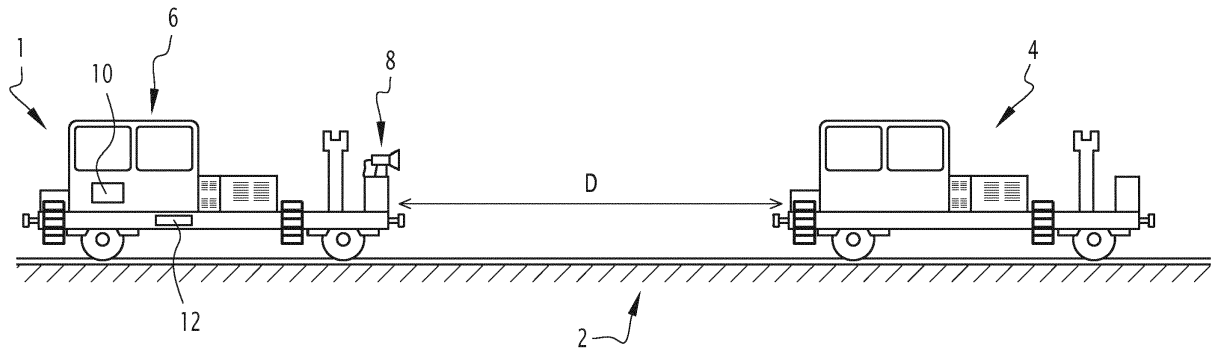

FIG.1

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Description

[0001] The present invention relates to a crash alarm system for a railway vehicle.

[0002] It is known to have systems and devices arranged to evaluate if a railway vehicle is about to collide with an obstacle (or with another vehicle) in order to send an alarm to the driver before the collision.

[0003] Document CN203766823 discloses a railway wagon anti-collision system comprising an infrared emitter, an infrared receiver, a laser distance measuring instrument and a long-distance LED (light emitting diode) projection lamp, the system being arranged on a wagon head of a railway wagon.

[0004] Document LV14384 discloses another train anti-collision device containing a movement direction detector connected with a braking program unit.

[0005] The main disadvantages of the systems of the prior art is that they are pretty complex to construct and install on the railway vehicle because they comprises many devices that need to cooperate, and they are also expensive. In addition, they often requires, in order to proper function, signals or data coming from external structures or devices such as GPS signals, Wi-Fi signals from ground emitters or from devices mounted on others railway vehicles, etc.

[0006] Other anti-collisions systems are known in the automotive field, but they are extremely complex because they need to take into considerations variables which are not relevant in the railway field, because the railway environment is pretty different from the automotive one.

[0007] In particular, in the railway field:

- the railway vehicles travel on a single and defined trajectory defined by the track;
- the vehicles have a lower average speed;
- an ESC (Electronic Stability Control) system is not present;
- an EBD (Electronic Brakeforce Distribution) system is not present;
- there are not overtaking or carriageway changes;
- the crash alarm device can be placed in any advantageous positions in order to permit an optimal evaluation of the front situation, because there are not aesthetic or aerodynamic constraints;
- the crash alarm device can be removed when not used;
- the gallery environment is particularly narrow.

In view of the above differences, it is clear that an anti-collision system for cars cannot be easily adapted to railway vehicles.

[0008] One object of the present invention is therefore to provide a crash alarm system for a railway vehicle which is simpler than similar systems usually applied to automotive vehicles, which is easy to install and cheap.

[0009] This and other objects are achieved by a crash alarm system for a railway vehicle having the characteristics defined in claim 1.

[0010] Preferred embodiments of the invention are the subject matter of the dependent claims, whose content is to be understood as forming an integral part of the present description.

[0011] Further characteristics and advantages of the present invention will become apparent from the following description, provided merely by way of non-limiting example, with reference to the enclosed drawings, in which:

- Figure 1 shows a schematic lateral view of a railway vehicle equipped with a crash alarm system according to the present invention.

[0012] Briefly, the crash alarm system for a railway vehicle according to the present invention is an electronic system that is able to intervene through an optic-acoustic signal in order to warn the driver about the possibility of a collision between the vehicle on which it is installed and a potentially colliding vehicle or obstacle, particularly in the event the driver has not activated the speed regulation system of the railway vehicle (accelerator and brakes).

[0013] Figure 1 shows a schematic lateral view of a first railway vehicle 1 moving along a railway track 2 on which a second railway vehicle 4 is also present, at a distance D.

[0014] In the following of the description reference will be made to the second railway vehicle 4 as possible colliding obstacle, but the principle of the invention applies also in case of objects present on the railway track 2.

[0015] The first railway vehicle 1 moves at a first speed S1 while the second railway vehicle moves at a second speed S2, in the same or in the opposite direction with respect to the direction of movement of the first railway vehicle 1. If the second railway vehicle 4 moves in an opposite direction with respect to the direction of movement of the first railway vehicle 1, the second speed S2 is negative.

[0016] The railway vehicle 1 is equipped with a crash alarm system 6 which comprises a sensor module 8 and an alarm module 10.

[0017] The sensor module 8 comprises several devices such as a laser sensor, a radar sensor and/or a video-camera arranged to calculate in a manner per se known the distance D between the first railway vehicle 1 and the second railway vehicle 4.

[0018] The devices present in the sensor module 8 are per se known and they are robust in terms of weather condition, in particular, they allow the sensor module 8 to calculate the distance D both when the sun is in front of the first railway vehicle 1, and when there is sunlight from a lateral side, with shadow generation on sensor module 8 itself, and at night, i.e. considering lighting system installed on the first railway vehicle 1 not enough strong to make any obstacle present on the railway track

2 visible and under the hypothesis that no other light sources are available.

[0019] The sensor module 8 is placed in front of the first railway 1 and is therefore arranged to analyze the portion of the railway track 2 placed between the first railway vehicle 1 itself and the second railway vehicle 4, and to transmit a distance value representative of the distance D to a control unit 12 of the first railway vehicle 1. The transmission of the distance value D is preferably done in a wireless mode, for example through a wi-fi communication.

[0020] The sensor module 8 is removable to prevent thefts and the distance between the sensor module 8 and the control unit 12 can be up to 20m, depending from the composition of the railway vehicle 1, therefore, the wi-fi technology for communication with the control unit 12 is the preferred solution to have elasticity in the design of the overall system.

[0021] The control unit 12 is arranged to acquire, in a manner per se known, the first speed S1 from the first railway vehicle 1 and the second speed S2 from the second railway vehicle 4, and to elaborate these speed signals together with the distance value D as herein below disclosed, to decide whether to send to the driver of the first railway vehicle 1 an alarm using the alarm module 10.

[0022] For example, the control unit 12 is arranged to receive the first speed S1 from a speed sensor installed on the first railway vehicle 1 itself, and to calculate the second speed S2 of the second railway vehicle 4 through an elaboration per se known of a plurality of data acquired by the sensor module 8 and relative to the second railway vehicle 4. This plurality of data is acquired by the various devices of the sensor module 8, in a manner known per se.

[0023] After having acquired the speeds S1 and S2, the control unit 12 is arranged to determine if the distance D starts decreasing. For example, consecutive measurements of the distance D are calculated at predetermined time intervals by the sensor module 8, and iterative comparisons are done by the control unit 12 between each new distance value and the previous ones, in order to evaluate if there is a decreasing trend of the distance values.

[0024] If the distance D starts decreasing, the control unit 12 calculates in a manner per se known the relative speed of the first railway vehicle 1 with respect to the second railway vehicle 4, and if the first speed S1 is greater than the second speed S2, the control unit 12 send an activation signal to the alarm module 10 which in turns activates an alarm.

[0025] The detection capability of the decreasing of the distance is the result of the braking capacity of the first railway vehicle 1 related to its travel speed, without any difference in case of straight railway track 2 or in case of presence of curves.

[0026] In particular, tests have been performed wherein two main situations have been considered:

- straight railway track: at least 26m available before collision for braking simulation at 20km/h;
- curved railway track: bending radius of 300m available for detecting a possible collision.

[0027] The decrease of the distance D can happen in the following situations:

a) The first railway vehicle 1 and the second railway vehicle 4 are moving in the same direction so that both the first speed S1 and the second speed S2 are positive, with the first speed S1 greater than the second speed S2;

b) The first railway vehicle 1 and the second railway vehicle 4 are moving in opposite directions so that the first speed S1 is positive and the second speed S2 is negative, and the condition that the first speed S1 is greater than the second speed S2 is still respected;

c) The second speed S2 is equal to zero, i.e. the second railway vehicle 4 is motionless (for example, in case of a stationary obstacle), while the first speed S1 is positive.

[0028] The alarm module 10, which is placed inside the first railway vehicle 1, activates an alarm according to the following rules, based on the value of the distance D, in particular based on the value of the last measurement of the consecutive measurements or on any value of the distance D which satisfies the following conditions:

a) A visual alarm is provided to the driver of the first railway vehicle 1, for example through a display placed in the first railway vehicle 1, if there is low probability of impact between the first railway vehicle 1 and the second railway vehicle 4, i.e. if the distance value D is between a first threshold value, for example 250m, and a second threshold value, for example 180m.

b) A visual and sound alarm is provided to the driver of the first railway vehicle 1, for example through the display and a horn, if the situation is getting worse than that in point a), i.e. if the distance value D is between the second threshold value, 180m, and a third threshold value, for example 120m.

c) A visual and sound alarm is provided to the driver of the railway vehicle 1, as above disclosed, and a sound alarm is provided to an external device placed outside the railway vehicle 1 in order to be hear by the driver of the second railway vehicle 4, if the situation is getting worse than that in point b), i.e. if the distance is under the third threshold value of 120m.

[0029] In a preferred embodiment of the present invention, in order to ensure the correct detection of dangerous situations, the sensor module 8 has to be able to identify and eliminate from the analysis any obstacle which is not actually on the railway track 2.

[0030] In this regard, the main objects which have not to be identified as possible obstacles are poles, station sidewalks and signaling components (in particular, elements below a predetermined threshold from the iron plane, for example 40cm, must not be detected).

[0031] The crash alarm system of the present invention is a protection system "stand-alone" in the sense that if a railway vehicle is equipped with the system itself, it can deal with all the dangerous situations independently of equipment installed on other railway vehicles moving on the same railway track 2.

[0032] Moreover, the crash alarm system of the present invention is suitable also for people protection, because, for example, it can advise the driver of the first railway vehicle 1 in case of presence of people on the railway track 2. In fact, a person is pretty like a convoy with second speed S2 equal to zero.

[0033] The system works everywhere because it doesn't need external signals such as GPS signals, Wi-Fi signals from ground emitters, devices mounted on others railway vehicles, etc., so that tunnels or old lines without particular predispositions are not a problem for the correct functioning of the crash alarm system of the present invention, and the equipped railway vehicle is able of detecting any "obstacle" present on the railway track 2, such as persons, other railway vehicles, cars, etc.

[0034] Clearly, the principle of the invention remaining the same, the embodiments and the details of production can be varied considerably from what has been described and illustrated purely by way of non-limiting example, without departing from the scope of protection of the present invention as defined by the attached claims.

Claims

1. A crash alarm system for a railway vehicle (6) circulating on a railway track (2) comprising a sensor module (8) placed in the front of a first railway vehicle (1) and an alarm module (10) placed inside said first railway vehicle (1), wherein the sensor module (8) is arranged to calculate a distance value (D) of the first railway vehicle (1) with respect to a detected object (4) detected on the railway track and to send this distance value (D) to a control unit (12) of the first railway vehicle (1), the control unit (12) being arranged to determine a first speed (S1) of the first railway vehicle (1) and a second speed (S2) of the detected object (4) and to send an activation signal to the alarm module (10), based on the values of said first speed (S1), second speed (S2) and distance value (D), so that the alarm module (10) activates an alarm.

2. The crash alarm system (6) of claim 1, wherein the sensor module (8) is arranged to calculate a plurality of distance values (D) so that control unit (12) determines if said distance values (D) decrease over time and, in positive case, sends the activation signal if the first speed (S1) is greater than the second speed (S2).

3. The crash alarm system (6) of claim 2, wherein determining if the distance values (D) decrease over time comprises calculating consecutive measurements of the distance value (D) at predetermined time intervals and performing iterative comparisons between each new distance value (D) and the previous ones, in order to evaluate if there is a decreasing trend of the distance values (D).

4. The crash alarm system of claim 2 or 3, wherein the control unit (12) sends the activation signal in the following situations:

   a) the first railway vehicle (1) and the detected object (4) are moving in the same direction and both the first speed (S1) and the second speed (S2) are positive, with the first speed (S1) greater than the second speed (S2);
   b) the first railway vehicle (1) and the detected object (4) are moving in opposite directions so that the first speed (S1) is positive and the second speed (S2) is negative;
   c) the second speed (S2) is equal to zero while the first speed (S1) is positive.

5. The crash alarm system (6) of any of the preceding claims, wherein the transmission of the distance value (D) to the control unit (12) is done in a wireless mode.

6. The crash alarm system (6) of claim 2, wherein the alarm module (10) provides a driver of the first railway vehicle (1):

   a) a visual alarm if any distance value (D) is between a first threshold value and a second threshold value;
   b) a visual and sound alarm if any distance value (D) is between the second threshold value and a third threshold value;
   c) a visual and sound alarm, together with a sound alarm provided to an external device placed outside the railway vehicle (1), if any distance value (D) is under the third threshold value.

7. The crash alarm system (6) of any of the preceding claims, wherein the sensor module (8) is removable.

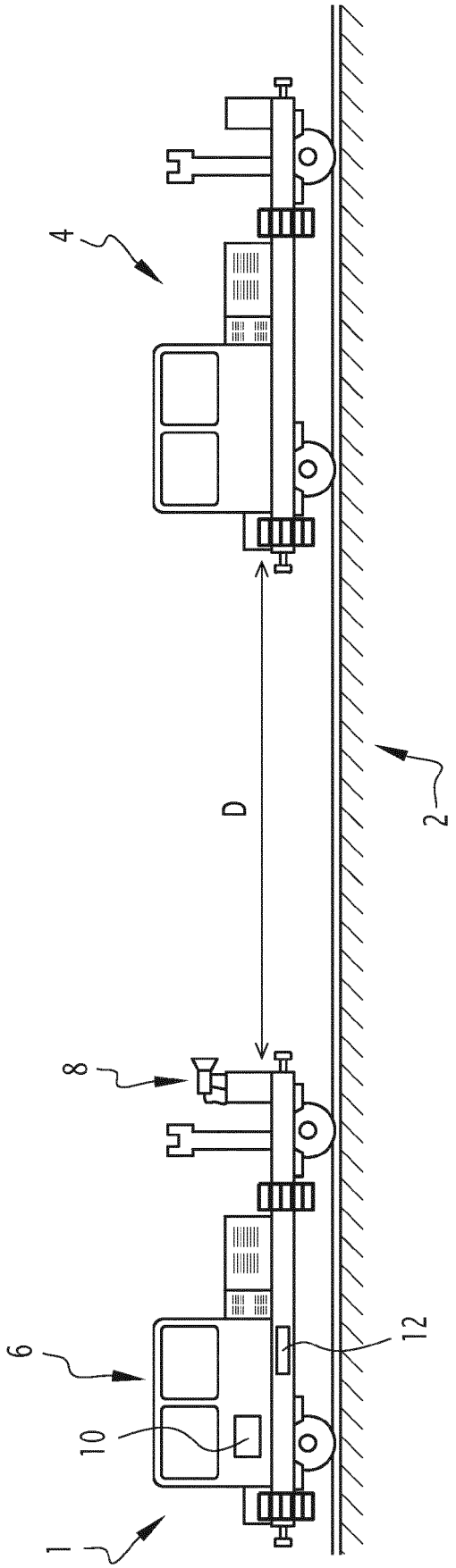

FIG.1

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EUROPEAN SEARCH REPORT

Application Number
EP 17 30 6088

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	1 February 2018	Mäki-Mantila, M

CATEGORY OF CITED DOCUMENTS

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