Title: A DEVICE FOR AUTOMATICALLY DETECTING SEPARATION OF A TRAIN FORMATION

Abstract: A device for automatically detecting a railroad car of a train is disclosed. The device includes a railroad car detector for detecting velocity and position of the railroad car of the train in real time, a power car detector for detecting velocity and position of a power car of the train in real time, an analysis processing unit for determining whether a connection between the railroad car and the power car has been released by comparing velocity data or position data received from the railroad car detector and the power car detector, and an output unit for receiving the signal from the analysis processing unit and announcing release of the connection of the railroad car. In accordance with the present invention, there is an effect in that velocity difference between the power car and the railroad car and variation of the length of a train when in operation is detected, thereby determining whether the connection of the railroad car has been released.
Description

A DEVICE FOR AUTOMATICALLY DETECTING SEPARATION OF A TRAIN FORMATION

Technical Field

The present invention relates, in general, to a device for automatically detecting a railroad car of a train and, more particularly, to a device for automatically detecting a railroad car of a train, which automatically determines whether the connection of the railroad car has been released.

Background Art

Generally, a conventional railroad car detection device performs detection using the pressure of a brake pipe, and determines that the connection of a railroad car has been released when the pressure of the brake pipe has decreased.

However, the conventional railroad car detection device determines whether the connection of a freight car has been released through the detection of the pressure of the brake pipe, so that the conventional railroad car detection device has the problem of mistaking a decrease in pressure that occurs when braking for the decrease in pressure due to the release of a railroad car of a train, thus operating erroneously.

Furthermore, there is a problem in that the conventional railroad car detection device uses a battery having a predetermined capacity as a power supply, so that the battery must be exchanged or recharged at regular intervals (about 2.8 days). Furthermore, there is a problem in that the size and weight of the conventional railroad car detection device increase due to the weight and volume of the battery, so that the handling and management of the conventional device are inconvenient. Furthermore, the railroad car device of the conventional railroad car detection device must be re-installed on a railroad car every time a train is assembled. Accordingly, there is a problem in that, when the connection of a freight train is released, it is impossible to notify a following train of the release of the connection, which may lead to a collision with the following train.

In order to solve the problems, Korean Pat. No. 331352 entitled "Device for Detecting Railroad Car of Train and Method of Controlling the Same", which was previously filed by the present applicant, was disclosed. As shown in FIG. 1, the signal output terminal of an operation room manipulation switch unit 140 and an identification (ID) reading unit 150 are connected to the control signal input terminals of an operation room microcomputer 130. Furthermore, the display control signal output terminal of the operation room microcomputer 130 is connected to the control signal input terminal of a display unit 120. Furthermore, an alarm 110 is connected to an
alarm signal output terminal of the operation room microcomputer 130. The control signal input terminal of a wireless train protection device, that is, an alarm signal transmission means 170, is connected to another alarm transmission signal output terminal of the operation room microcomputer 130. Furthermore, an operation room transceiver 160 is connected to the transmission/reception signal input/output terminal of the operation room microcomputer 130, thereby completing an operation room device 100.

Furthermore, the signal input terminals of a railroad car microcomputer 240 are respectively connected to the signal output terminals of a pressure sensor 211, an acceleration sensor 212, an optical sensor 220 and a railroad car manipulation switch unit 250. Furthermore, a rear signal light 260 is connected to the control signal output terminal of the railroad car microcomputer 240. The railroad car microcomputer 240 is connected to the signal input/output terminal of a railroad car transceiver 230, and then power, which is generated at the power supply output terminal of a solar battery, that is, a private power station 270, is applied to the respective components of the railroad car device, thus completing the railroad car device 200. Thereafter, the operation room device 100 is installed in a locomotive and the railroad car device 200 is installed in a railroad car.

With the above-described construction, signals output from the pressure sensor 211 and the acceleration sensor 112 are compared with predetermined reference values, thereby determining whether the connection of a railroad car has been released.

However, in the above conventional technology, the acceleration of the railroad car is detected using the acceleration sensor 112 and the pressure of the brake pipe, so that the problem still exists in that the size and weight of the conventional railroad car detection device increases due to the weight and volume of the battery, so that the conventional device is inconvenient to handle and manage.

**Disclosure of Invention**

**Technical Problem**

Accordingly, the present invention has been made keeping in mind the above problems that the conventional railroad car detection device has, and an object of the present invention is to provide a device for automatically detecting a railroad car of a train, which detects a velocity difference between the railroad car and a power car, and variation in the length of a train when in operation, thus determining whether the connection between the railroad car and the power car has been released.

**Technical Solution**

In order to accomplish the above objects, a device for automatically detecting a railroad car of a train in accordance with the present invention includes a railroad car
detector for detecting the velocity of the railroad car of the train in real time; a power car detector for detecting the velocity of a power car of the train in real time; an analysis processing unit for determining whether a connection between the railroad car and the power car has been released by comparing velocity data received from the railroad car detector with velocity data received from the power car detector; and an output unit for receiving a signal from the analysis processing unit and announcing the release of the connection of the railroad car.

Furthermore, a device for automatically detecting a railroad car of a train in accordance with the present invention includes a railroad car detector for detecting the position of the railroad car of the train in real time; a power car detector for detecting the position of the power car of the train in real time; an analysis processing unit for determining whether a connection between the power car and the railroad car has been released by determining variation in the length of a train based on position data received from the railroad car detector and the power car detector; and an output unit for receiving a signal from the analysis processing unit and announcing release of the connection of the railroad car.

Preferably, the analysis processing unit determines variation in length of the train by comparing the length of the train in a stopped state with the length of the train when in operation.

Preferably, the analysis processing unit determines the length of the train in a stopped state to be the length of the train immediately before departure of the train.

Preferably, the analysis processing unit allows a user to initialize information about the length of the train in a stopped state.

At least one of the railroad car detector and the power car detector may include a Global Positioning System (GPS) receiver.

The analysis processing unit may apply an operation signal to an emergency brake means in case of release of the connection.

When it is determined that the connection of the railroad car has been released, the analysis processing unit may transmit a release signal to an operation room of the power car, a station building or a nearby train in operation through a communication means.

**Advantageous Effects**

As described above, in accordance with the present invention, the velocity of a railroad car is compared with the velocity of a power car in real time, so that there is an effect in that it is possible to rapidly and accurately determine whether the connection of the railroad car has been released.

Furthermore, in accordance with the present invention, there is an effect in that
variation of the length of a train when in operation is detected, thereby determining whether the connection of the railroad car has been released.

**Brief Description of the Drawings**

[20] FIG. 1 is a diagram showing an example of a conventional railroad car detection device;

[21] FIG. 2 is a diagram showing a device for automatically detecting a railroad car in accordance with one embodiment of the present invention; and

[22] FIG. 3 is a diagram showing a device for automatically detecting a railroad car in accordance with another embodiment of the present invention.

**Best Mode for Carrying Out the Invention**

[23] A device for automatically detecting a railroad car of a train in accordance with preferred embodiments of the present invention is described in detail below with reference to the accompanying drawings.

[24] The device for automatically detecting a railroad car of a train in accordance with one embodiment of the present invention includes a railroad car detector 10 for detecting the velocity of a railroad car of a train in real time, a power car detector 20 for detecting the velocity of the power car of the train in real time, an analysis processing unit 30 for determining whether the connection between the railroad car and the power car has been released by comparing velocity data received from the railroad car detector with velocity data received from the power car detector, and an output unit 40 for receiving signals from the analysis processing unit 30 and announcing the release of the connection of the railroad car.

[25] The railroad car detector 10 includes a railroad car velocity detection unit 11, a wireless railroad car transceiver unit 12 and a railroad car control unit 13.

[26] The railroad car velocity detection unit 11 detects the velocity of the railroad car in real time, and may use a Global Positioning System (GPS) receiver and a velocity meter simultaneously or selectively.

[27] The GPS receiver, which is used as the railroad car velocity detection unit, detects the velocity of the railroad car through a plurality of satellites in real time. Furthermore, the railroad car control unit 13 transmits detected velocity data to the analysis processing unit 30 through the wireless railroad car transceiver unit 12.

[28] When mounted on the power car, the analysis processing unit 30 receives velocity data from the railroad car velocity detection unit through the wireless power car transceiver unit 22. Alternatively, when mounted outside the power car, the analysis processing unit 30 must be equipped with its own wireless transceiver equipment. The railroad car velocity detection unit 11 can then receive the velocity data through the wireless transceiver equipment that is installed in the analysis processing unit 30.
Data transmission and reception through the wireless railroad car transceiver unit 12 may be replaced with Power Line Communication (PLC) technology. It is preferred that the data transmission and reception through the PLC technology be implemented using a power supply line that supplies power to the train.

The velocity meter is a tachometer-like device, and measures the real-time velocity of the railroad car using only equipment mounted in the railroad car, not external equipment. The railroad car control unit 13 detects velocity data from the velocity meter and transmits the velocity data to the power car detector 20.

The power car detector 20 includes a power car velocity detection unit 21, a wireless power car transceiver unit 22 and a power car control unit 23.

The power car velocity detection unit 21 detects the velocity of the power car in real time, and may use a GPS receiver and a velocity meter simultaneously or selectively, like the railroad car detection unit 11.

The GPS receiver and the velocity meter used as the power car velocity detection unit 21, are operated in the same way as the GPS receiver and the velocity meter used as the railroad car velocity detection unit 11.

The wireless power car transceiver unit 22 receives velocity data from the wireless railroad car transceiver unit 12 and transfers them to the analysis processing unit 30. At this time, the power car control unit 23 transfers the velocity data received from the power car transceiver unit 22 and the velocity data detected by the power car velocity detection unit 21 to the analysis processing unit 30. When the analysis processing unit 30 is mounted outside the power car, the wireless power car transceiver unit 22 plays the role of transmitting the velocity data, which are detected by the power car velocity detection unit 21, to the analysis processing unit 30 which is at a distance, like the wireless railroad car transceiver unit 12.

Data transmission and reception by the wireless power car transceiver unit 22 may be replaced with PLC technology, like the wireless railroad car transceiver unit 12.

The analysis processing unit 30 analyzes the power car velocity data and the velocity data received from the railroad car detector 10 by comparing them.

If, as a result of the comparison and the analysis, the power car's velocity is not identical to the railroad car's velocity, it signifies the release of the connection between the railroad car and the power car. Thus, notification of the release of the connection is provided through an output unit 40.

The output unit 40 may be implemented in the form of a display that visually represents the release of the connection, or may be implemented in the form of an alarm.

The power car detector 20 and the analysis processing unit 30 may be components of the operation room control unit of the power car. The analysis processing unit 30
can be installed in a control room on the ground. In this case, the analysis processing unit 30 receives velocity data from the operation room control unit of the power car and the railroad car detector 10 of the railroad car via wireless communication, and performs the comparison of velocities in the control room on the ground.

Meanwhile, the output unit 40 may be installed in the operation room of the power car and inform an engineer of the release state of the connection. At the same time, the output unit 40 may be installed in another train or a station building and announce the release state of the connection of the railroad car to the outside via wireless communication.

When it is determined that the connection of the railroad car has been released, the analysis processing unit 30 transmits a release signal to the operation room of the power car, the station building or a nearby train in operation through a communication means 70. As a result, an accident can be prevented in advance.

In that case, the communication means 70 can be implemented in a wireless manner or a wired manner. In the case of the wired manner, the communication means 70 may be implemented using PLC technology.

Data transmission and reception using the wireless communication are implemented using a wireless train protection device disclosed in Korean Pat. No. 175108. A detailed description thereof is omitted.

It is preferred that the data transmission and reception using the PLC technology be implemented using a power supply line that supplies power to the train. In this case, a modem or a system that distributes power or communication data in the PLC technology is mounted in the railroad car or the power car.

Furthermore, the analysis processing unit 30 provides an operation signal to an emergency brake means 80 in case of the release of the connection. Preferably, the emergency brake means 80 automatically stops the train when the train has not stopped after the release signal is applied and then a predetermined time has elapsed.

Another embodiment of the device for automatically detecting a railroad car of a train in accordance with the present invention is described in detail below with reference to FIG. 3.

The device for automatically detecting a railroad car of a train in accordance with another embodiment of the present invention includes a railroad car detector 10' for detecting the position of the railroad car of the train in real time, a power car detector 20' for detecting the position of the power car of the train in real time, an analysis processing unit 30' for determining variation of the length of a train based on the positional data received from the railroad car detector 10' and the power car detector 20' and determining whether the connection between the power car and the railroad car has been released, and an output unit 40 for receiving the signal from the analysis
processing unit 30' and announcing the release of the connection of the railroad car.

The railroad car detector 10' and the power car detector 20' respectively detect the positions of the railroad car and the power car using GPS receivers and transmit them to the analysis processing unit 30'.

The railroad car detector 10' includes a railroad car position detection unit 11', a wireless railroad car transceiver unit 12 and a railroad car control unit 13. The power car detection unit 20' includes a power car position detection unit 21', a wireless power car transceiver unit 22 and a power car control unit 23.

The analysis processing unit 30' calculates the length of a train using the railroad car's position data received from the railroad car detector 10' and the power car's position data received from the power car detector. That is, the difference between the railroad car's position and the power car's position is taken as the length of the train.

As described above, the analysis processing unit 30' calculates the length of a train in real time, compares the previously determined length of the train with the currently determined length of the train, and determines that the connection of the railroad car has been released if the length of the train varies. That is, if the difference between the railroad car's position and the power car's position has increased, the connection of the railroad car is determined to have been released.

In this case, the analysis processing unit 30' may set a reference value for the length of a train when the train is stopped, and determine variation in length by comparing the reference value with the length of the train when in operation. That is, the length of the train before the departure of the train is taken as the reference value and then the reference value is compared with the length of the train when in operation.

Since the length of a train may vary when the train is stopped, the analysis processing unit 30' preferably determines the length of a train in a stopped state immediately before the departure of the train.

The analysis processing unit 30' may allow a user (an engineer) to initialize information about the length of a train in a stopped state. That is, the engineer can set the reference value for the comparison by inputting the information about the length of a train. Also, the engineer directs the analysis processing unit 30' to automatically detect the varied length of a train through the GPS receivers and then set the reference value to the detected data.

The reference numerals of the present embodiment, which are not described, designate components that perform functions similar to those of the components of the former embodiment having the same reference numerals.

In order to obtain the velocity and position information of the train, Korean Pat. No. 330424 entitled "Method and Device for Identifying and Tracking Objects in Motion Using GPS", which was previously filed by the present applicant, may be used. A
detailed description thereof is omitted.

[57] Although the present invention has been described only in conjunction with the above embodiments, the present invention is not limited to those embodiments. Furthermore, various modifications are possible without departing from the scope and spirit of the invention.

**Industrial Applicability**

[58] The present invention can be used as a device for detecting a railroad car of a train, which can determine whether the connection between the railroad car and the power car has been released.
Claims

[1] A device for automatically detecting a railroad car of a train, comprising:
   a railroad car detector for detecting velocity of the railroad car of the train in real
time;
   a power car detector for detecting velocity of a power car of the train in real
time;
   an analysis processing unit for determining whether a connection between the
   railroad car and the power car has been released by comparing velocity data
   received from the railroad car detector with velocity data received from the
   power car detector; and
   an output unit for receiving a signal from the analysis processing unit and
   announcing release of the connection of the railroad car.

[2] A device for automatically detecting a railroad car of a train, comprising:
   a railroad car detector for detecting a position of the railroad car of the train in
real
time;
   a power car detector for detecting a position of a power car of the train in real
time;
   an analysis processing unit for determining whether a connection between the
   power car and the railroad car has been released by determining variation in the
   length of a train based on position data received from the railroad car detector
   and the power car detector; and
   an output unit for receiving a signal from the analysis processing unit and
   announcing release of the connection of the railroad car.

[3] The device according to claim 2, wherein the analysis processing unit determines
variation in length of the train by comparing a length of the train in a stopped
state with a length of the train when in operation.

[4] The device according to claim 3, wherein the analysis processing unit determines
the length of the train in a stopped state to be the length of the train immediately
before departure of the train.

[5] The device according to claim 3, wherein the analysis processing unit allows a
user to initialize information about the length of the train in a stopped state.

[6] The device according to any one of claims 1 to 5, wherein at least one of the
railroad car detector and the power car detector comprises a Global Positioning
System (GPS) receiver.

[7] The device according to any one of claims 1 to 5, wherein the analysis
processing unit applies an operation signal to emergency brake means in case of
release of the connection.
[8] The device according to any one of claims 1 to 5, wherein, when it is determined that the connection of the railroad car has been released, the analysis processing unit transmits a release signal to an operation room of the power car, a station building or a nearby train in operation through communication means.

[9] The device according to claims 8, wherein the communication means is Power Line Communication (PLC) means.
[Fig. 2]

11 - GPS receiver
13 - railroad car control unit
12 - wireless railroad car transceiver unit

20 - train station building
21 - GPS receiver
23 - power car control unit
22 - wireless power car transceiver unit

20 - communication means
30 - analysis processing unit
80 - emergency brake means
40 - output unit

[Fig. 3]

11' - GPS receiver
13' - railroad car control unit
12' - wireless railroad car transceiver unit

20' - train station building
21' - GPS receiver
23 - power car control unit
22 - wireless power car transceiver unit

20' - communication means
30 - analysis processing unit
80 - emergency brake means
40 - output unit
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 B61K 13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 B61L 1/00-25/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KR, JP : IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

KIPO eKIPASS System : "(speed or location)" and "(train or locomotive) and "(GPS or sense)"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>JP 2004-168216 A (RAILWAY TECHNICAL RES. INST.) 17 June 2004</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>(See the whole document)</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>JP 2001-56234 A (RAILWAY TECHNICAL RES. INST.) 27 February 2001</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>(See the whole document)</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>US 6,421,584 B2 (GE Harris Railway Electronics, LLC) 16 July 2002</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>(See the whole document)</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>US 6,704,626 B1 (Herzog Contracting Corp.) 9 March 2004</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>(See the whole document)</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>KR 20-0139545 B1 (Segen Systems) 1 September 2000</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>(See the whole document)</td>
<td></td>
</tr>
</tbody>
</table>

☐ Further documents are listed in the continuation of Box C.
☒ See patent family annex.

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "N" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents such combination being obvious to a person skilled in the art
  "&" document member of the same patent family

Date of the actual completion of the international search: 12 DECEMBER 2005 (12.12.2005)


Name and mailing address of the ISA/KR

Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

LEE, Jin Hyung

Telephone No. 82-42-481-5462

Form PCT/ISA/210 (second sheet) (April 2005)
### INTERNATIONAL SEARCH REPORT

Information on patent family members

<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP 2004-188216 A</td>
<td>17.06.2004</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>JP 2001-56234 A</td>
<td>27.02.2001</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 6,704,626 B1</td>
<td>09.03.2004</td>
<td>AU 765122 B2</td>
<td>11.09.2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2398857 A1</td>
<td>12.10.2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 1175550 A4</td>
<td>24.03.2004</td>
</tr>
<tr>
<td>KR 20-0195456 Y1</td>
<td>01.09.2000</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>

Form PCT/ISA/210 (patent family annex) (April 2005)