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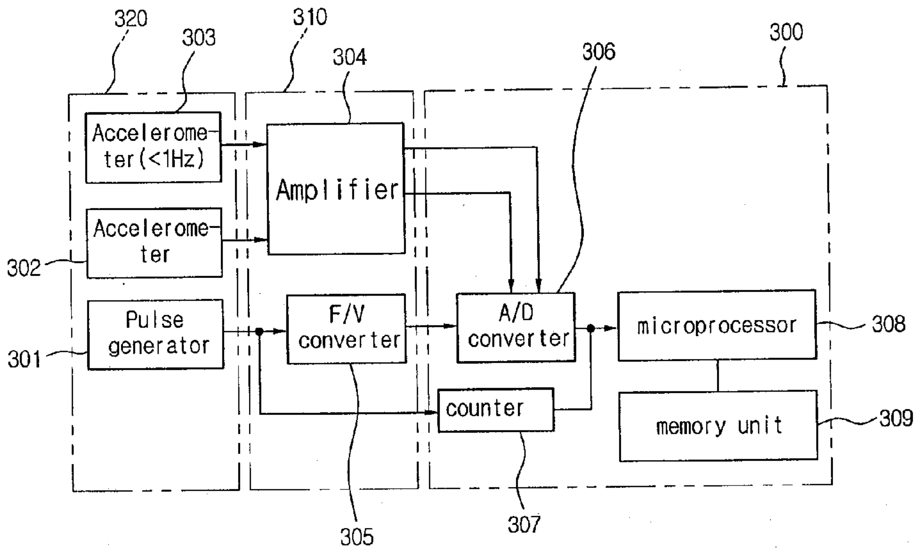
[Continued on next page]

(54) Title: APPARATUS FOR MEASURING RAILROAD TRACK PARAMETERS



(57) Abstract: The present invention relates to an apparatus for measuring railway track data, which can measure track data, such as the grade of a railway track along which a train runs, the curve radii of respective curved portions, balanced velocity and the cant of the railway track, using a longitudinal acceleration sensor and a lateral acceleration sensor, which are installed on the vehicle body of the train, and a velocity sensor, which is installed on the axle of the train, and which can be directly used to analyze the driving or braking performance of the train and the movement characteristics of the train using the measured data. The apparatus includes a sensor unit for measuring the velocity and acceleration of a railway vehicle; a signal conditioner unit for performing conversion on sensing signals generated by the sensor unit; and a data processing unit for calculating the grade of a railway track and track design parameters of each curved portion based on signals, which are processed by the signal conditioner unit, and data about weight of the railway vehicle.

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【DESCRIPTION】

【Invention Title】

APPARATUS FOR MEASURING RAILROAD TRACK PARAMETERS

【Technical Field】

The present invention relates to an apparatus for measuring railway track data and, more particularly, to an apparatus for measuring railway track data, which can measure track data, such as the grade of a railway track along which a train runs, the curve radii of respective curved portions, balanced velocity and the cant of the railway track, using a longitudinal acceleration sensor and a lateral acceleration sensor, which are installed on the vehicle body of the train, and a velocity sensor, which is installed on the axle of the train, and which can be directly used to analyze the driving or braking performance and movement characteristics of the train using the measured data.

【Background Art】

Generally, a railway track, which is constructed as shown in FIG. 1 and has graded portions and curved portions as shown in FIG. 2, includes level portions, ascending portions (uphill grades), descending portions (downhill grades), and straight portions, which are formed according to geographical features. Even a high-speed track, along which a high-speed train travels at a high speed, does not have only straight and level portions, therefore no railway tracks can avoid having uphill grades and the curved portions.

The performance of a railway vehicle is determined by the influence of the uphill grades and the curved portions. That is, the traction and braking performance of a railway vehicle is determined according to the degree of the uphill and downhill grades of the railway track, and the centrifugal force that acts on the railway vehicle at each curved portion affects passengers' driving comfort.

Accordingly, in order to manage the railway track, the conditions of the railway track are measured using a dedicated inspection and measurement vehicle. The dedicated inspection and measurement vehicle simultaneously measures three points on the track using a displacement measurement apparatus installed on the inspection and measurement vehicle, and the versine (the distance obtained by subtracting the distance from the center of a circle to the mid point of a chord from the distance from the center of a circle to the edge thereof) in the track is measured based on the three measured points. The management of the track is mostly conducted using the versine.

However, the versine in the track must be converted into actual track data, that is, the degree of unevenness, curve radii, uphill and downhill grades, and the cant of the track, in order to detect the influence of the railway track on the railway vehicle. In this case, due to errors that occur in this process, there are problems in that accurate track data, which approximates the shape of an actual railway track, cannot be obtained, and the influence of the railway track on the railway vehicle cannot be accurately detected either.

Furthermore, the dedicated inspection and measurement vehicle is high-priced equipment, so that it is difficult to conduct maintenance thereto. There is a problem in that a lot of time must be spent to measure versine on many running routes because the railway vehicle must run at a low speed when the versine in the railway track is measured.

【Disclosure】

【Technical Problem】

The present invention has been made keeping in mind the above problems, and an object of the present invention is to provide an apparatus for measuring railway track data, which can measure track data, such as the grade of a railway track along which a train runs, the curve radii of respective curved portions, balanced velocity and the cant of the railway track, using a longitudinal acceleration sensor and a lateral acceleration sensor, which are installed on the vehicle body of the train, and a velocity sensor, which is installed on the axle of the train, and which can be directly used to analyze the running performance or braking performance and movement characteristics of the train using the measured data.

[Technical Solution]

In order to accomplish the above object, the present invention provides an apparatus for measuring railway track data, including a sensor unit for measuring the velocity and acceleration of a railway vehicle; a signal conditioner unit for performing conversion on sensing signals generated by the sensor unit; and a data processing unit for calculating the grade of a railway track and track design parameters of each curved portion based on signals, which are processed by the signal conditioner unit, and data about weight of the railway vehicle.

The track design parameters of the curved portion are a cant, a curve radius, and a balanced velocity.

The sensor unit includes a longitudinal acceleration sensor for measuring acceleration in a longitudinal direction of the railway vehicle; a lateral acceleration sensor for measuring acceleration in a lateral direction of the railway vehicle; and a velocity sensor for measuring the velocity of the railway vehicle.

The signal conditioner unit includes an amplifier for amplifying a sensing signal, which is generated by the longitudinal acceleration sensor, and a sensing signal, which is generated by the lateral acceleration sensor, and outputting the amplified sensing signals; and a Frequency-to-Voltage (F/V) converter for converting a measurement signal, which is generated by the velocity sensor, into a voltage signal, and outputting the voltage signal.

The data processing unit includes an Analog-to-Digital (A/D) converter for converting a signal, which is output from the F/V converter, into a digital signal; a counter for converting the sensing signal, which is generated by the velocity sensor, into a train location signal, and outputting the train location signal; and a microprocessor for calculating the grade of the railway track and the track design parameters using data, which is output from the A/D converter and the counter, and the preset weight of the railway vehicle.

The lateral acceleration sensor is an accelerometer that can measure an acceleration of less than 1 Hz.

[Advantageous Effects]

The present invention can easily measure track data, such as the grade of a railway track along which a train runs, the curve radii of respective curved portions, balanced velocity and the cant of the railway track, using a longitudinal acceleration sensor and a lateral acceleration sensor, which are installed on the vehicle body of the train, and a velocity sensor, which is installed on the axle of the train.

Furthermore, the present invention can be directly used to analyze the running performance or braking performance and movement characteristics of the train using the measured data.

Furthermore, the present invention measures velocity and acceleration along each running route without using a dedicated inspection and measurement vehicle, so that it can acquire various types of track data necessary to design a railway.

[Description of Drawings]

FIG. 1 is a schematic sectional view of a typical railway;

FIG. 2 is a graph showing the grades and curved portion of a specific track;

FIG. 3 is a block diagram showing the construction of an apparatus for measuring railway track data;

FIG. 4 is a diagram showing the state of a railway vehicle traveling along an uphill grade;

FIG. 5 is a diagram showing the state of a railway vehicle traveling along a curved portion;

FIG. 6 is a graph showing lateral acceleration, from which frequency components above 0.5 Hz are removed, on the curved portion; and

FIG. 7 is a graph showing stationary lateral acceleration measured according to variation in the running velocity of a railway vehicle along arbitrary curved portions, and calculated stationary acceleration.

【Best Mode】

An apparatus for measuring railway track data according to the present invention is described in detail below.

FIG. 3 is a block diagram showing the construction of an apparatus for measuring railway track data, FIG. 4 is a diagram showing the state of a railway vehicle traveling along an uphill grade, FIG. 5 is a diagram showing the state of a railway vehicle traveling along curved portions, FIG. 6 is a graph showing lateral acceleration, from which frequency components above 0.5 Hz are removed, on the curved portion, and FIG. 7 is a graph showing measured stationary lateral acceleration, which depends on variation in the running velocity of a railway vehicle along an arbitrary curved portion, and calculated stationary acceleration.

The apparatus for measuring railway track data according to the present invention is configured to easily measure track data, such as the grade of a railway track along which a railway vehicle runs, the curve radii of respective curved portions, balanced velocity and the cant of the railway track, using a longitudinal acceleration sensor and a lateral acceleration sensor, which are installed on the vehicle body 201 of the railway vehicle, and a velocity sensor, which is installed on the axle of the railway vehicle.

FIG. 1 is a schematic sectional view of a typically constructed railway 100. The railway 100 includes a pair of left and right rails 101 and 102, ties 103 installed at regular intervals, a ballast 104 constructed from gravel or concrete, and a roadbed 105 constructed by filling or cutting, or constructed in a bridge or tunnel form.

The pair of rails 101 and 102 is installed on the ties supported by the roadbed and the ballast, and the weight transferred from a train to the rails 101 and 102 is transferred to the roadbed 105 via the ties 103 and the ballast 104. The pair of rails 101 and 102, along which the train actually runs, has level portions, uphill grades, downhill grades, curved portions, and straight portions, which are formed according to the roadbed 105.

FIG. 2 is a graph showing the grades and curved portions of a specific track that is actually constructed. As shown in FIG. 2, it can be seen that the railway 100 has uphill grades and downhill grades, which are repeated thereon, and that discrete curved portions exist at arbitrary locations along the track.

FIG. 3 is a block diagram showing the hardware construction of the apparatus for measuring railway track data according to the present invention. The apparatus includes a sensor unit 320 including a velocity sensor 301, which is installed at the axle 203 of the railway vehicle, acceleration sensors 302 and 303 installed on a vehicle body 201, a signal conditioner unit 310 including an amplifier 304 and Frequency-to-Voltage (F/V) converter 305, and a data processing unit 300 including an Analog-to-Digital (A/D) converter 306, a counter 307, a microprocessor 308 and a memory unit 309.

The acceleration sensors 302 and 303, which are devices that are installed on the vehicle body 201, are a longitudinal acceleration sensor and a lateral acceleration sensor, respectively. It is preferred that the longitudinal acceleration sensor 302 be implemented using a measurement range of a typical accelerometer (a measurement range of 1 Hz ~ 100 Hz), and that the lateral acceleration sensor 303 be implemented using an accelerometer having a measurement range of less than 1 Hz. The reason for this is because lateral acceleration having a very low frequency cannot be measured in each curved portion if the lateral acceleration sensor 303 cannot measure an acceleration of 1 Hz.

The velocity sensor 301 is a device that is installed in the axle 203. The velocity that is measured by the velocity sensor 301 from the axle 203 installed under any of trucks 202 is indicated by the number of pulses per revolution. In order to use the number of pulses to measure velocity, the number of pulses is converted into a voltage signal by the F/V converter 305, and the voltage signal is transferred. The same number of pulses is transferred via the counter 307 to measure the moving distance of the train. This is used to accurately detect the location of the train and is also used to minimize accumulated error that may occur through the integration of a velocity signal obtained by the F/V converter 305.

The microprocessor 308 of the data processing unit 300 calculates track data, such as the grade of the railway track and the curve radii of the curved portions, balanced velocity and the cant of the railway track, based on data input through the sensor unit 320 and the signal conditioner unit 310, which are constructed as described above.

FIG. 4 is a diagram showing the state of a railway vehicle traveling along an uphill grade. Rolling friction exists between the wheels and rails 102 of the railway vehicle, and the railway vehicle is greatly affected by air resistance, in proportion to the velocity thereof, and thus the railway vehicle is affected by running resistance as indicated in the following Equation 1.

$$R = a + bV + cV^2[daN] \tag{1}$$

where V is the running velocity of a train [km/h], constants a, b and c are coefficients which are determined through a coasting test, the square term of the velocity is the effect of aerodynamic resistance, and the remaining part is the effect of rolling friction.

Based on Newton's Second Law, an equilibrium equation for force that acts on the vehicle in FIG. 4 is expressed as the following Equation 2:

$$F = ma = R \pm W \sin\theta \qquad (2)$$

where F denotes the inertial force of a train, m denotes the mass of the train, R denotes running resistance, θ denotes the grade of a railway track, the plus sign (+) denotes the uphill grade of the railway track, and the minus sign (-) denotes a downhill grade of the railway track.

From Equation 2, the grade can be obtained as indicated by the following Equation 3:

$$\theta = \sin^{-1}\frac{(ma - R)}{\pm W} \qquad (3)$$

In this case, it should be noted that acceleration must be measured under a coasting condition, in which a train moves using only the inertial force thereof. In the case where the train is towed or braked, the grade of a railway track cannot be determined because the longitudinal acceleration thereof varies. Furthermore, since the running resistance and mass of the train are already known, the uphill and downhill grade of the track can be obtained in a coasting state.

FIG. 5 is a diagram showing the state of a railway vehicle traveling along a curved portion. In the curved portion, centrifugal force indicated by the following Equation 4 is generated according to the running velocity of the railway vehicle. Since such centrifugal force causes passengers in the railway vehicle discomfort, cant C is assigned to the left and right rails to cancel the centrifugal force, and thus the railway vehicle is biased inward by centripetal force, as indicated by the following Equation 5. When centripetal force, which is caused by the assigned cant, and centrifugal force, which depends on a certain train running velocity, are the same, the cant and the train running velocity are referred to as balanced cant and balanced velocity, respectively. This balanced velocity has the same effect as if a train were running on a flat track.

$$F_c = \frac{W \times V^2}{3.6^2 \times R \times g} \qquad (4)$$

where F_c denotes centrifugal force [kN], W denotes the weight of a train [ton], R denotes a curve radius [m], and V denotes the running velocity of the train [km/h].

$$F_w = \frac{W \times C}{G} = \frac{W \times V_c^2}{3.6^2 \times R \times g} \qquad (5)$$

where F_w denotes centripetal force [kN], C denotes the cant [mm] of a railway track, G denotes the distance between rails [mm], and V_c denotes the balanced velocity of a train [km/h].

FIG. 6 is a graph showing lateral acceleration, which occurs a train travels along a curved portion and from which frequency components above 0.5 Hz have been removed. The lateral acceleration decreases as the running velocity of the train increases. This refers to excess cant, in which the running velocity of the train is smaller than the balance velocity (the train running velocity when the centrifugal force and the centripetal force are the same, that is, the stationary lateral acceleration becomes '0').

FIG. 7 is a graph showing stationary lateral acceleration, which is measured according to variation in the running velocity of a railway vehicle on arbitrary curved portions, and stationary lateral acceleration, which is calculated using cant C and curve radius R that are obtained based on the following Equations 6 and 7.

$$R = \pm \frac{W(V_c^2 - V^2)}{3.6^2 \times a_{sta} \times g} \qquad (6)$$

where a_{sta} denotes measured stationary lateral acceleration, the plus sign (+) denotes excess cant, and the minus sign (-) denotes insufficient cant.

$$C = \frac{W \times V_c^2 \times G}{3.6^2 \times R \times g} \qquad (7)$$

The point at which the measured stationary lateral acceleration is changed from a positive (+) number to a negative (-) number is balanced velocity in an arbitrary curved portion. The curve radius of the arbitrary curved portion can be calculated using the stationary lateral acceleration and the obtained balanced velocity, as indicated by the above Equation 6, and the cant of the constructed track can be obtained using the above Equation 7.

As described above, the apparatus for measuring railway track data according to the present invention can accurately measure the grade of a railway track and the track design parameters of each curved portion, and can be directly used to analyze the running performance and braking performance and movement characteristics of the train using the measured data.

The above-described embodiment is the most preferred embodiment of the present invention. The present invention is not limited to this embodiment, however, and may be implemented in various ways within a range that does not depart from the technical spirit of the present invention.

【Industrial Applicability】

The present invention relates to an apparatus for measuring railway track data and, more particularly, to an apparatus for measuring railway track data, which can measure track data, such as the grade of a railway track along which a train runs, the curve radii of respective curved portions, balanced velocity and the cant of the railway track, using a longitudinal acceleration sensor and a lateral acceleration sensor, which are installed on a vehicle body, and a velocity sensor, which is installed on the axle of the train, and can be directly used to analyze the driving or braking performance and movement characteristics of the train using the measured data.

【CLAIMS】

【Claim 1】

An apparatus for measuring railway track data, comprising:

a sensor unit for measuring velocity and acceleration of a railway vehicle;

a signal conditioner unit for performing conversion on sensing signals generated by the sensor unit; and

a data processing unit for calculating grade of a railway track and track design parameters of each curved portion based on signals, which are processed by the signal conditioner unit, and data about weight of the railway vehicle.

【Claim 2】

The apparatus according to claim 1, wherein the track design parameters of the curved portion are a cant, a curve radius, and a balanced velocity.

【Claim 3】

The apparatus according to claim 1 or 2, wherein the sensor unit comprises:

a longitudinal acceleration sensor for measuring acceleration in a longitudinal direction of the railway vehicle;

a lateral acceleration sensor for measuring acceleration in a lateral direction of the railway vehicle; and

a velocity sensor for measuring velocity of the railway vehicle.

【Claim 4】

The apparatus according to claim 3, wherein the signal conditioner unit comprises:

an amplifier for amplifying a sensing signal, which is generated by the longitudinal acceleration sensor, and a sensing signal, which is generated by the lateral acceleration sensor, and outputting the amplified sensing signals; and

a Frequency-to-Voltage (F/V) converter for converting a measurement signal, which is generated by the velocity sensor, into a voltage signal, and outputting the voltage signal.

【Claim 5】

The apparatus according to claim 4, wherein the data processing unit comprises:

an Analog-to-Digital (A/D) converter for converting a signal, which is output from the F/V converter, into a digital signal;

a counter for converting the sensing signal, which is generated by the velocity sensor, into a train location signal, and outputting the train location signal; and

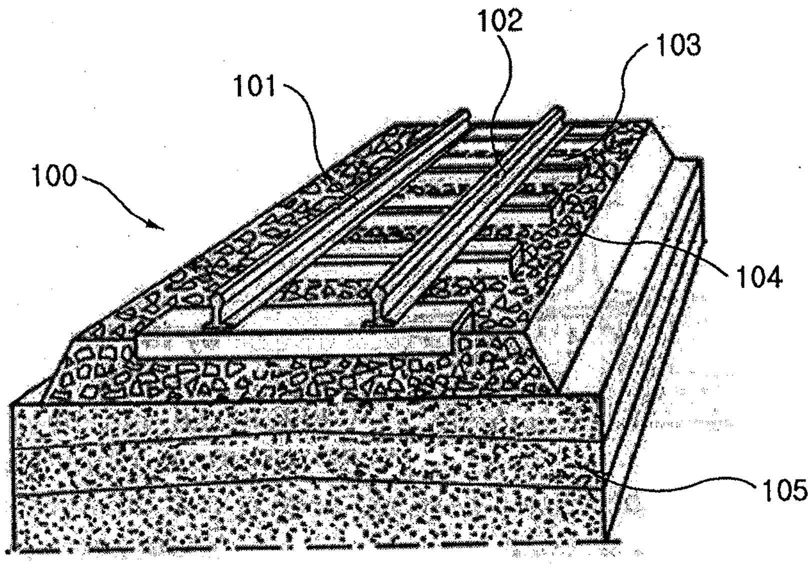
a microprocessor for calculating the grade of the railway track and the track design parameters using data, which is output from the A/D converter and the counter, and the preset weight of the railway vehicle.

【Claim 6】

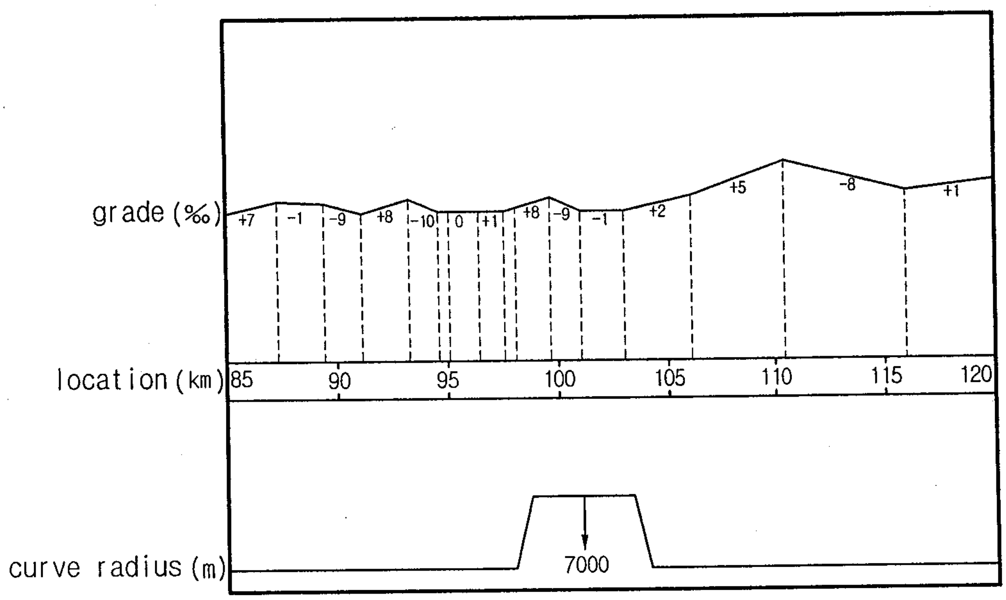
The apparatus according to claim 3, wherein the lateral acceleration sensor is an accelerometer that can measure an acceleration of less than 1 Hz.

【DRAWINGS】

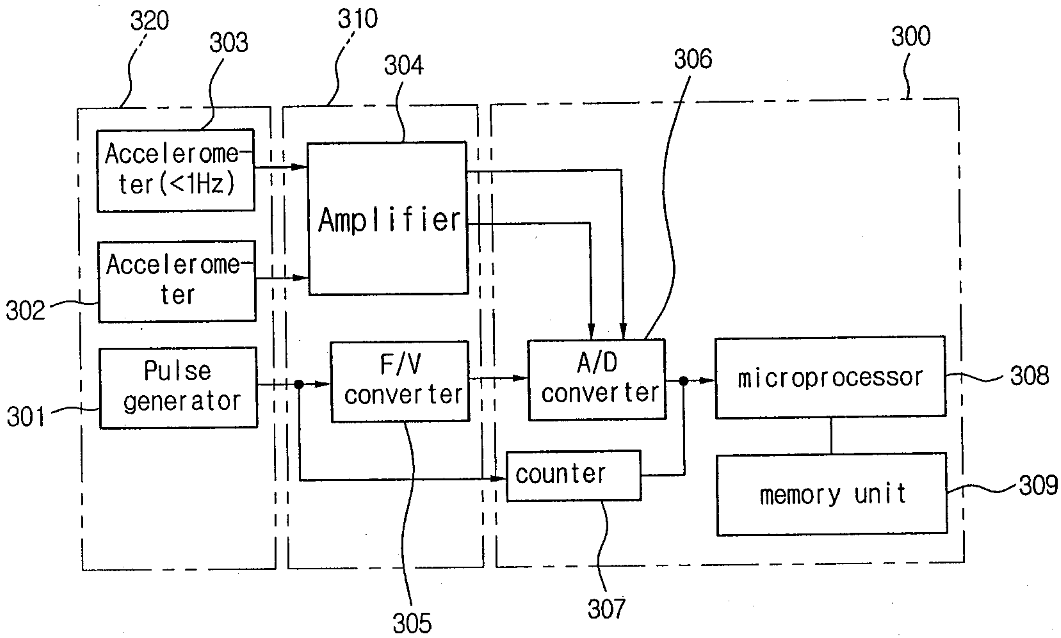
【Figure 1】



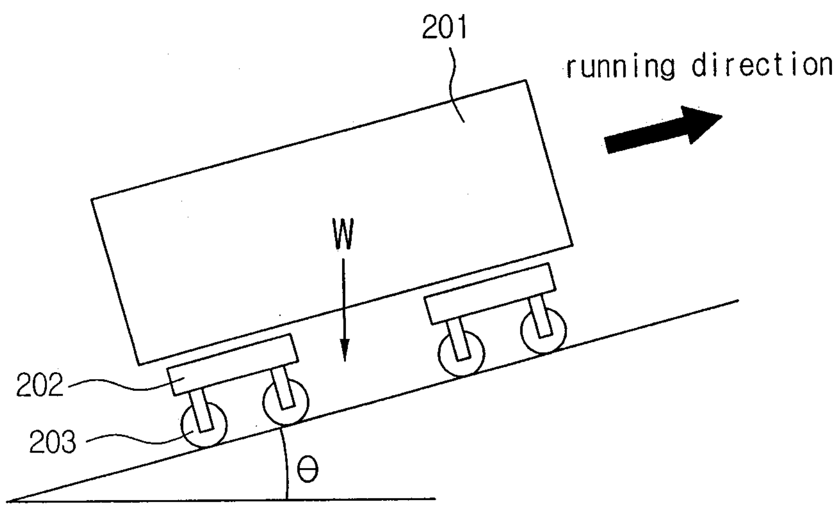
【Figure 2】



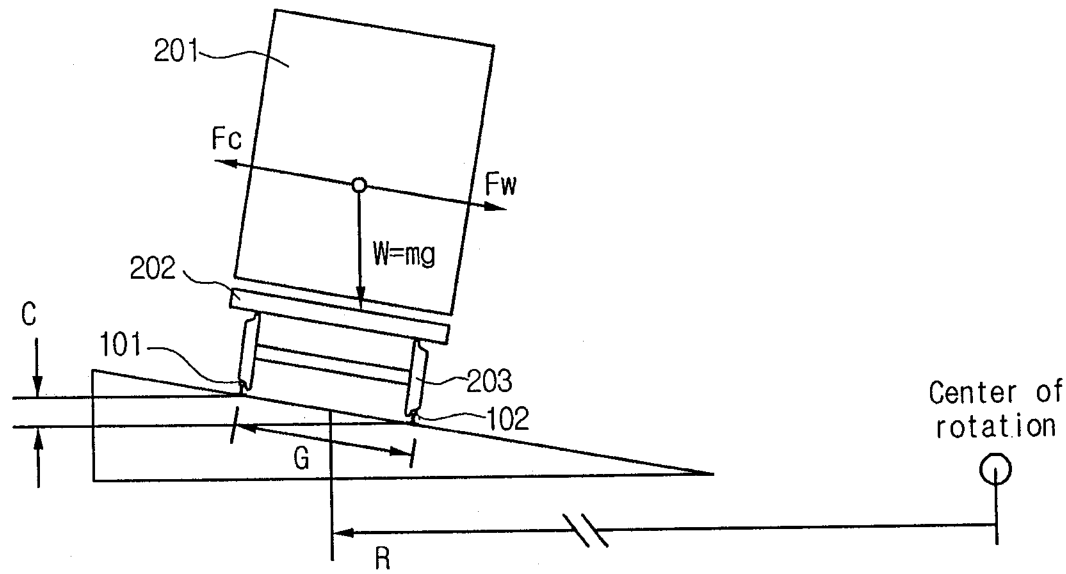
【Figure 3】



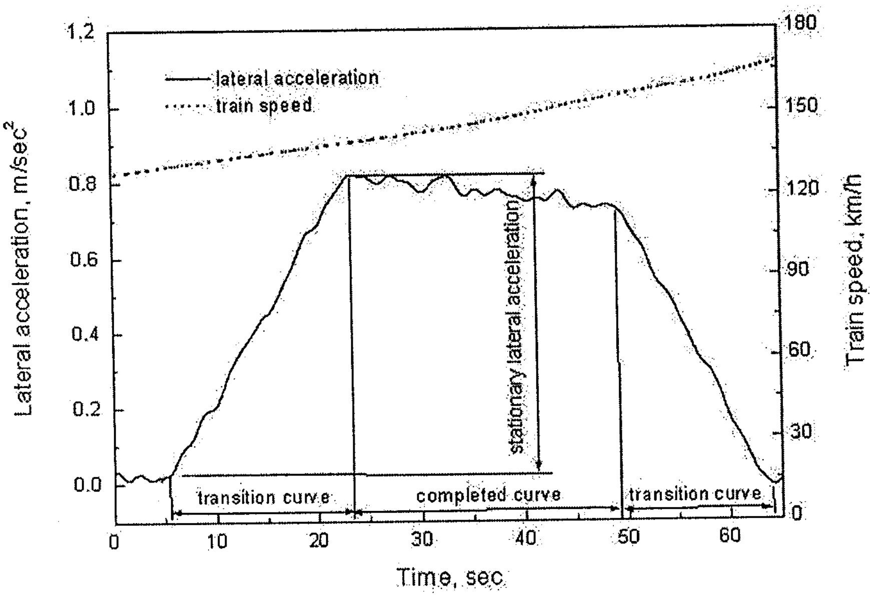
【Figure 4】



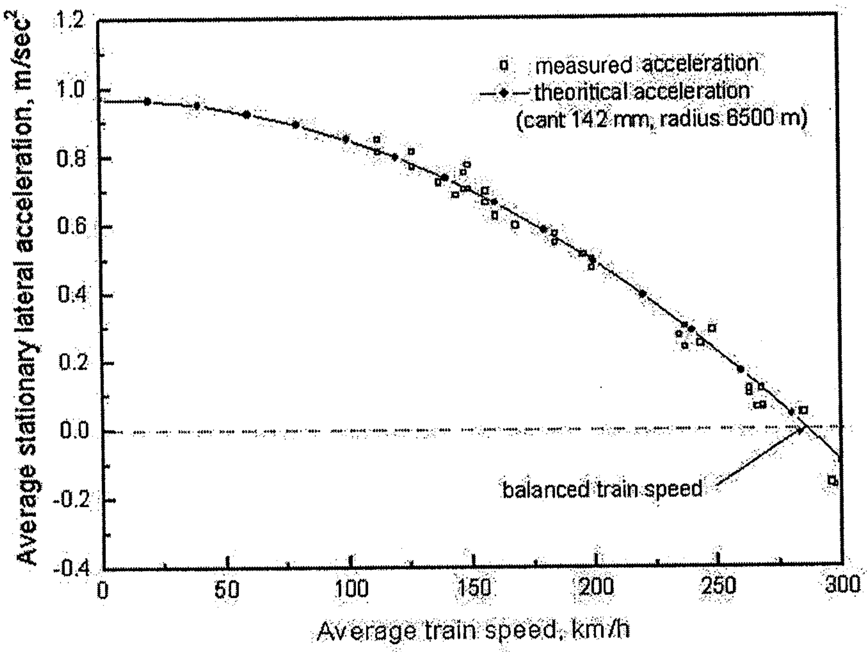
【Figure 5】



【Figure 6】



【Figure 7】


measured acceleration
theoritical acceleration
(cant 142 mm, radius 6500 m)
balanced train speed
Average stationary lateral acceleration, m/sec^2
Average train speed, km/h
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
0
50
100
150
200
250
300

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/005369

A. CLASSIFICATION OF SUBJECT MATTER

B61L 3/12(2006.01)i

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)
IPC 8 H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KR.JP : classes as above

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)
eKIPASS (KIPO internal)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 06804621 BA, (Tata Consultancy Services), 12 October 2004 (12.10.2004) see the abstract, figure 1, column 6:34~6:52, claims.	1 - 6
A	US 05605099 A, (Pandrol Jackson, Inc.), 25 February 1997 (25.02.1997) see the abstract, figure 4, column 2:34~2:39, claims.	1 - 6
A	US 06064428 A, (National Railroad Passenger Corporation), 16 May 2000 (16.05.2000) see the abstract and claims.	1 - 6

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

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 MARCH 2007 (19.03.2007)	**20 MARCH 2007 (20.03.2007)**

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Republic of Korea
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Authorized officer
JOUNG, Meyoung Ju
Telephone No. 82-42-481-8493

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2006/005369

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 06804621 BA	12.10.2004	US20040204882A1	14.10.2004
		US2004204882AA	14.10.2004
		US2005080569A1	14.04.2005
		US2005080569AA	14.04.2005
		US6804621BA	12.10.2004
		US7130753BB	31.10.2006
US 05605099 A	25.02.1997	US5605099A	25.02.1997
US 06064428 A	16.05.2000	US6064428A	16.05.2000
		US6356299B1	12.03.2002
		US6356299BA	12.03.2002