(54) **Derailment detecting method and derailment detecting apparatus for rolling stock**

(57)   The invention is directed to a derailment detecting method for rolling stock (1), which is applied to rolling stock having a truck (3) which comprises wheels (5) rolling on rails (4), and spring rigging (6), and a carbody (2) to which said truck is attached, said derailment detecting method for rolling stock comprising:

a step of detecting vertical acceleration at said carbody (2) above said spring rigging (6) during running of said rolling stock on said rails (4);
a step of calculating a vertical displacement amount by double integral of said vertical acceleration every evaluating time, said evaluating time being defined as a time period from a start of descent of said carbody to arrival at half a height
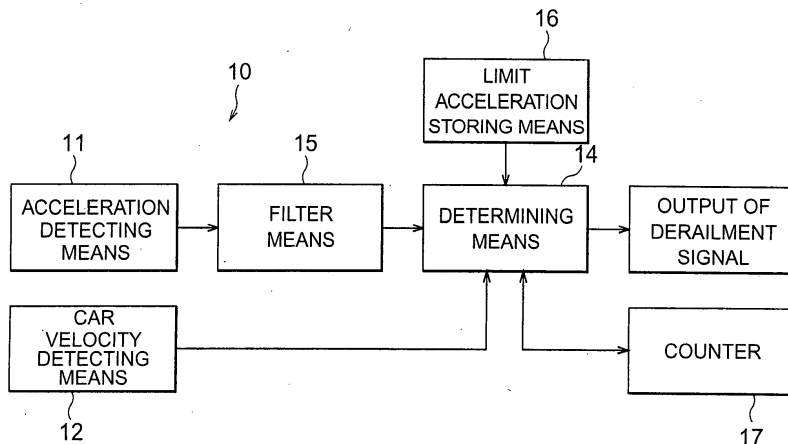
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of said rails, in a free fall of one axle of said wheels (5) by a distance equal to the height (h) of said rails; and
a step of determining that said rolling stock (1) is derailed, in the case that said vertical displacement amount is negative and an absolute value thereof is not less than a predetermined reference value.

Fig.2

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Description

Technical Field

[0001] The present invention relates to a derailment detecting method and derailment detecting apparatus for automatically detecting derailment of rolling stock.

Background Art

[0002] In general, in the event of derailment of rolling stock, the derailment must be detected by the motorman etc. of the rolling stock, by visual recognition or personal sensation of the motorman etc. However, in the case that the derailment should occur at a car coupled in the rear, even during manned operation, there would be possibilities that the motorman etc. could fail to recognize the derailment. For automatic unmanned operation of rolling stock, it is necessary to prevent the derailed rolling stock from keeping running and stop the rolling stock immediately upon occurrence of the derailment.

[0003] An object of the present invention is, therefore, to provide a derailment detecting method and derailment detecting apparatus for rolling stock capable of automatically detecting the derailment of rolling stock.

Disclosure of the Invention

[0004] A derailment detecting method for rolling stock according to the present invention is applied to the rolling stock comprises a truck having wheels rolling on rails and spring rigging, and a carbody to which the truck is attached. In this derailment detecting method, the rolling stock is preliminarily made to travel at varying running velocities on a predetermined route. On that occasion, a maximum of vertical acceleration at the carbody above the spring rigging is measured in a predetermined frequency range and at each of the varying running velocities. Then, from each maximum, a limit vertical acceleration is defined as a threshold for detecting the derailment at each running velocity. During actual traveling of the rolling stock on the route, real running velocity of the rolling stock is detected and real vertical acceleration is also detected at the carbody above the spring rigging. A component in the above-stated frequency range is extracted from the real vertical acceleration detected. In the case that an absolute value of the real vertical acceleration in the mentioned frequency range exceeds the limit vertical acceleration corresponding to the real running velocity detected, it is then determined that the rolling stock is derailed.

[0005] In this way, the derailment can be detected accurately and surely by defining the limit vertical acceleration in correspondence to the real running velocity of the rolling stock and comparing the vertical acceleration at the carbody etc. with the limit vertical acceleration corresponding to the real running velocity during the actual traveling of the rolling stock as described above.

[0006] In this case, it is preferable to set the limit vertical acceleration to a value larger than the maximum of the vertical acceleration preliminarily measured.

[0007] It is also preferable to determine that the rolling stock is derailed, in the case that there occur a predetermined number of such events that the absolute value of the real vertical acceleration exceeds the critical vertical acceleration corresponding to the real running velocity within a predetermined time period. As a result, it is possible to avoid an accident of erroneously detecting the derailment because of enormous vertical acceleration exceptionally appearing during normal traveling.

[0008] Further, it is preferable that the aforementioned frequency range be a frequency range in which an absolute value of permissible vertical acceleration for assuring riding comfort is set at a minimum. Since in this frequency range the difference becomes definite between vertical acceleration during normal traveling and vertical acceleration at derailment, the derailment can be detected accurately and surely.

[0009] Another derailment detecting method for rolling stock according to the present invention is applied to the rolling stock comprises a truck having wheels rolling on rails and spring rigging, and a carbody to which the truck is attached. In this derailment detecting method, the vertical acceleration is detected at the carbody above the spring rigging during running of the rolling stock on the rails. Then a vertical displacement amount is calculated by double integral of the vertical acceleration every predetermined evaluating time. This yields an amount of vertical displacement per evaluating time of the part above the spring rigging. In the event of the derailment of the rolling stock, the part above the spring rigging would descend over a predetermined amount. It is thus determined that the rolling stock is derailed, in the case that the vertical displacement amount is negative and an absolute value thereof is not less than a predetermined reference value. Employed as the evaluating time is a time period between a start of descent of the carbody and arrival at half the height of the rails, in a free fall of one axle of the wheels by a distance equal to the height of the rails. As a result, it is possible to surely discriminate between steady-state vertical displacement amounts of the carbody etc. during the normal traveling and vertical displacement amounts of the carbody etc. in the event of the derailment, both in flat territory and in gradient territory.

[0010] In this case, it is preferable on the occasion of the calculation of the vertical displacement amount to execute the double integral with the initial velocity of zero. This can cancel out the steady-state vertical displacement amounts of the carbody etc. under high-speed running in the gradient territory, whereby the derailment can be detected accurately and surely.

[0011] It is also preferable that the reference value for the comparison with the vertical displacement amount resulting from the double integral of the vertical acceleration be set to a value larger than a maximum change

amount in the vertical direction of the spring rigging. In general, the height of rails is greater than the maximum change amount in the vertical direction of the spring rigging during the normal traveling of rolling stock. Therefore, at the event of the derailment of rolling stock, the carbody etc. would descend by an amount exceeding the maximum change amount in the vertical direction of the spring rigging during the normal traveling and thus the derailment can be detected accurately and surely by setting the reference value for the comparison with the vertical displacement amount as described above.

[0012]   A derailment detecting apparatus for rolling stock according to the present invention is applied to the rolling stock comprises a truck having wheels rolling on rails and spring rigging, and a carbody to which the truck is attached. This derailment detecting apparatus comprises limit acceleration storing means, car velocity detecting means, acceleration storing means, filter means, and determining means. The limit acceleration storing means stores limit vertical acceleration as a threshold for detecting derailment. The limit vertical acceleration is defined for each running velocity, from a maximum of vertical acceleration in a predetermined frequency range, which is detected at each of varying running velocities during traveling of the rolling stock at the varying running velocities on a predetermined route and which appears at the carbody above the spring rigging. The car velocity detecting means detects the real running velocity of the rolling stock traveling on the route. The acceleration detecting means detects the real vertical acceleration at the carbody above the spring rigging during traveling of the rolling stock on the route. The filter means extracts a component in the above frequency range from the real vertical acceleration. Then the determining means determines that the rolling stock is derailed, in the case that an absolute value of the real vertical acceleration in the mentioned frequency range exceeds the limit vertical acceleration corresponding to the real running velocity.

[0013]   Another derailment detecting apparatus of rolling stock according to the present invention is applied to the rolling stock comprises a truck having wheels rolling on rails and spring rigging, and a carbody to which the truck is attached. This derailment detecting apparatus comprises acceleration detecting means, integrating means, and determining means. The acceleration detecting means detects the vertical acceleration at the carbody above the spring rigging during running of the rolling stock on the rails. The integrating means calculates a vertical displacement amount by double integral of the vertical acceleration every evaluating time, the evaluating time being a time period between a start of descent of the carbody and arrival at half the height of the rails, in a free fall of one axle of the wheels by a distance equal to the height of the rails. Then the determining means determines that the rolling stock is derailed, in the case that the vertical displacement amount is negative and an absolute value thereof is not less than

a predetermined reference value.

Brief Description of the Drawings

[0014]

Fig. 1 is a schematic and structural diagram to show the rolling stock to which the derailment detecting apparatus according to the present invention is applied.
Fig. 2 is a control block diagram of the derailment detecting apparatus for rolling stock according to the first embodiment of the present invention.
Fig. 3 is a graph to show the relationship between frequency and absolute values of vertical acceleration at the carbody of rolling stock.
Fig. 4 is a graph for illustrating a defining procedure of limit vertical acceleration.
Fig. 5 is a control block diagram of the derailment detecting apparatus for rolling stock according to the second embodiment of the present invention.
Fig. 6 is a graph for illustrating a setting procedure of evaluating time.
Fig. 7 is a graph to exemplify temporal change of vertical acceleration upon occurrence of derailment detected by the acceleration detecting means of Fig. 5.
Fig. 8 is a graph to show temporal change of vertical displacement calculated by the integration means of Fig. 5 from the vertical acceleration in Fig. 7.
Fig. 9 is a control block diagram of the derailment detecting apparatus for rolling stock according to the third embodiment of the present invention.

Best Mode for Carrying out the Invention

[0015]   The preferred embodiments of the derailment detecting method and derailment detecting apparatus for rolling stock according to the present invention will be described hereinafter in detail with reference to the drawings.

[0016]   Fig. 1 is a schematic and structural diagram to show the rolling stock to which the derailment detecting apparatus for rolling stock according to the present invention is applied. The rolling stock 1 shown in Fig. 1 is driven by manned operation or by unmanned operation and comprises a carbody 2 and two trucks 3 attached to the carbody. Each truck 3 incorporates wheels 5 rolling on rails 4, and spring rigging 6 comprised of an air spring or the like. The spring rigging 6 expands and contracts in the vertical direction during traveling of the rolling stock 1 to relieve vibration appearing at the part above the spring rigging 6 (the part including the carbody 2). The derailment detecting apparatus 10 according to the first embodiment of the present invention is mounted on the carbody 2 for accommodating passengers so as to be located substantially right above each truck 3. In this way, two derailment detecting apparatus

10 are mounted on one rolling stock 1.

[0017] Fig. 2 is a control block diagram of the derailment detecting apparatus 10. As showing in Fig. 2, the derailment detecting apparatus 10 includes an acceleration detecting means 11 and a car velocity detecting means 12. The acceleration detecting means 11 is attached to the carbody 2 and detects a vertical component (a) of acceleration appearing at the carbody 2 above the spring rigging 6 of the truck 3 during traveling of the rolling stock 1 (the vertical component will be referred to hereinafter as "vertical acceleration (a)"). The car velocity detecting means 12 detects the running velocity (v) during the traveling of the rolling stock 1. The car velocity detecting means 12 outputs a signal indicating the detected running velocity (v) of the rolling stock 1, to a determining means 14.

[0018] On the other hand, the acceleration detecting means 11 is connected to a filter means 15 consisting of a band-pass filter or the like. This filter means 15 extracts a component in a predetermined frequency range (which is, for example, the frequency range of 6 to 20 Hz in this case, but which may also be set as the range of 4 to 8 Hz) from the output of the acceleration detecting means 11. The following is the reason why the component in the predetermined frequency range (6 to 20 Hz) is extracted herein from the vertical acceleration (a) detected by the acceleration detecting means 11.

[0019] Namely, the rolling stock is designed and manufactured so that the relation between frequency f and absolute values of the vertical acceleration (a) at the carbody satisfies, for example, the characteristics illustrated in Fig. 3, in order to keep the riding comfort thereof good. Fig. 3 is a graph to show the relation between frequency f and absolute values of the vertical acceleration (a) at the carbody, in which characteristic lines are illustrated at respective grades G1, G1.5, G2, G3 of riding comfort. In this case, the acceleration below the characteristic line corresponding to each grade G1 to G3 is judged as being within a permissible range, whereas the acceleration above it as being off the permissible range.

[0020] Since at each grade the vertical acceleration in the frequency range of 6 to 20 Hz can be the cause of deteriorating the riding comfort, the absolute value of tolerance of vertical acceleration (permissible vertical acceleration) is set to be flat and smaller in this frequency range than in the other frequency ranges. That is, the difference becomes definite between the vertical acceleration during normal traveling and the vertical acceleration at derailment in the frequency range of 6 to 20 Hz, whereby the derailment can be detected accurately and surely.

[0021] The signal indicating the vertical acceleration (a) in the frequency range of 6 to 20 Hz extracted by the filter means 15 is sent to the determining means 14. A limit acceleration storing means 16 is connected to the determining means 14 and the limit acceleration storing means 16 stores data indicating limit vertical acceleration (al) defined at each predetermined velocity as a

threshold for detection of derailment. The determining means 14 determines whether the absolute value of the vertical acceleration (a) in the frequency range of 6 to 20 Hz is over the limit vertical acceleration (al) corresponding to the running velocity (v) detected by the car velocity detecting means 12, in accordance with the signal indicating the vertical acceleration (a), which is received through the filter means 15 from the acceleration detecting means 11, and the signal indicating the running velocity (v), which is received from the car velocity detecting means 12.

[0022] The determining means 14 is connected to an operation unit of the rolling stock 1 or an automatic train stop device or the like, which is not illustrated. The determining means 14 outputs a derailment signal indicating the derailment of rolling stock 1, to the operation unit or the like when the absolute value of the vertical acceleration (a) becomes over the limit vertical acceleration (al). With output of the derailment signal, for example, power running of the rolling stock 1 is terminated and emergency brakes are actuated to stop the rolling stock 1 immediately. It is also possible to provide the operation unit with a derailment alarm lamp and to make the derailment alarm lamp blink when the derailment signal is outputted.

[0023] Moreover, a preferred configuration is such that a counter 17 is connected to the determining means 14, as shown in Fig 2, and the rolling stock 1 is judged as being derailed when there occur a predetermined number of such events that the absolute value of the vertical acceleration (a) exceeds the limit vertical acceleration (al) corresponding to the running velocity (v), within a predetermined time period. As a result, it is possible to avoid the accident of erroneous detection of derailment due to the enormous vertical acceleration (a) exceptionally appearing during the normal traveling.

[0024] In application of the derailment detecting method according to the first embodiment of the present invention, the rolling stock 1 is preliminarily made to travel at varying running velocities (v) on a predetermined route (use line). At each of the varying running velocities (v) the vertical acceleration (a) appearing at the carbody 2 above the spring rigging 6 is measured in the frequency range of 6 to 20 Hz. Then the limit vertical acceleration (al) is determined from the vertical acceleration (a) in the frequency range of 6 to 20 Hz. The limit vertical acceleration (al) can be determined by plotting maximums of the vertical acceleration (a) corresponding to the respective running velocities (v), preliminarily measured, defining straight lines passing through values greater than the maximums, and setting values on each straight line as the limit vertical acceleration (al), as shown in Fig. 4. Then the limit vertical acceleration (al) thus obtained is stored in the limit acceleration storing means 16.

[0025] During actual traveling of the rolling stock 1 on the route (i.e., during business operation), the running velocity (v) (real running velocity) of the rolling stock 1

is detected and the vertical acceleration (a) (real vertical acceleration) is detected at the carbody 2 above the spring rigging 6. The filter means 15 extracts the component in the frequency range of 6 to 20 Hz from the vertical acceleration (a) detected. When the absolute value of the vertical acceleration (a) in the above frequency range exceeds the limit vertical acceleration (al) corresponding to the running velocity (v) detected, the determining means 14 determines that the rolling stock 1 is derailed.

[0026] In this way the derailment can be detected accurately and surely by defining the limit vertical acceleration (al) corresponding to the running velocity (v) of the rolling stock 1 and comparing the vertical acceleration (a) appearing at the carbody 2 etc. with the limit vertical acceleration (al) corresponding to the running velocity (v) during the actual traveling of the rolling stock 1.

[0027] The embodiment was described in the structure in which the limit vertical acceleration (al) was set so as to vary corresponding to the running velocity, but the invention is not limited to this. Namely, the limit vertical acceleration (al) may also be set to be constant. In this case, the determining means 14 can be configured so as to output the derailment signal when the absolute value of the vertical acceleration (a) received from the filter means 15 becomes, for example, over 0.2 G.

[0028] Fig. 5 is a control block diagram of the derailment detecting apparatus according to the second embodiment of the present invention. The derailment detecting apparatus 20 shown in Fig. 5 is also provided two units per rolling stock 1, as in the case of the aforementioned derailment detecting apparatus 10. The derailment detecting apparatus 20 incorporates an acceleration detecting means 21 for detecting the vertical acceleration (a) at the carbody 2 above the spring rigging 6 of the truck 3 during traveling of the rolling stock 1. The acceleration detecting means 21 is attached to the carbody 2, which is the part above the spring rigging 6. The acceleration detecting means 21 is connected to an integrating means 22 and the integrating means 22 executes the double integral of output from the acceleration detecting means 21 to calculate a vertical displacement amount (d) at the mount position of the acceleration detecting means 21.

[0029] The integrating means 22 executes the double integral of the vertical acceleration (a) every evaluating time (T), the evaluating time (T) (see Fig. 6) being defined as a time period from a start of descent of the carbody 2 to arrival at half the height of the rails 4, i.e., at h/2 (see Fig. 1) in a free fall of one axle of wheels 5 by a distance equal to the height h of the rails 4, to obtain the vertical displacement amount (d). This evaluating time (T) is preliminarily calculated as a value inherent to the rolling stock 1 equipped with the derailment detecting apparatus 20, by computer simulations or the like. The integrating means 22 executes the double integral with the initial velocity of zero, for calculating the vertical displacement amount (d). That is, the double integral by the integrating means 22 is carried out in a state in which all integration constants are zero. As a result, it is possible to cancel out the steady-state vertical displacement amounts of the carbody 2 etc. appearing while the rolling stock 1 is under normal traveling at high speed in the gradient territory, whereby the derailment can be detected accurately and surely.

[0030] The arithmetic result calculated by the integrating means 22 is sent to the determining means 23. The determining means 23 determines that the rolling stock 1 is derailed, in the case that the vertical displacement amount (d) is negative and an absolute value thereof is not less than a predetermined reference value (dc) (which is, for example, 40 mm in this case). It is preferable here that the reference value (dc) for the comparison with the vertical displacement amount (d) obtained by the double integral of the vertical acceleration (a) be set to a value greater than a maximum change amount in the vertical direction of the spring rigging 6 during the normal traveling of the rolling stock 1. As a result, it is possible to surely discriminate the vertical displacement of the carbody 2 etc. in the event of derailment and the steady-state vertical displacement of the carbody 2 etc. during the normal traveling, both in the flat territory and in the gradient territory.

[0031] Fig. 7 is a graph to illustrate temporal change in the vertical acceleration (a) upon derailment, detected by the acceleration detecting means 21, and Fig. 8 is a graph to show temporal change in the vertical displacement (d) calculated by the integrating means 22 from the vertical acceleration (a) in Fig. 7. Since the wheels 5 of the rolling stock 1 drop from the rails 4 to the ground on the occasion of occurrence of derailment, the vertical displacement (d) increases largely within the evaluating time (T). On the other hand, during the normal traveling of the rolling stock 1, the carbody 2 vibrates in the vertical direction within the range of expansion and contraction in the vertical direction of the spring rigging 6 while the vertical vibration is relieved by the spring rigging 6. In general, the height of the rails 4 is greater than the maximum change amount of the spring rigging 6 in the vertical direction during the normal traveling. Therefore, once the rolling stock 1 is derailed, the carbody etc. will descend by an amount exceeding the maximum change amount of the spring rigging 6 in the vertical direction during the normal traveling.

[0032] In general, the expansion and contraction amounts of the spring rigging 6 are, for example, ±30 mm and in that case, the maximum change amount of the spring rigging 6 is 60 mm. The evaluating time (T) is normally about 0.2 sec in the case of the ordinary rolling stock, and changing amount of the spring rigging 6 within the evaluating time (T) (about 0.2 sec) is not more than 20 mm. On the other hand, the height h of the rails 4 is normally 150 mm. In the case of the truck of two-axle structure, when one axle of wheels should be derailed, the vertical change (d) of the carbody would be about 75 mm at the center pivot of the truck 3. Therefore,

the apparatus can be so structured that the reference value (dc) = -40 mm and that the determining means 23 determines whether the vertical displacement (d) calculated by the integrating means 22 satisfies the condition of the vertical displacement (d) < -40 mm, as shown in Fig. 8. In this case, the determining means 23 outputs the derailment signal when the condition of the vertical displacement (d) < -40 mm is met.

[0033] In the derailment detecting method according to the second embodiment of the present invention, the vertical acceleration (a) appearing at the carbody 2 above the spring rigging 6 is detected by the acceleration detecting means 21 during the running of the rolling stock 1 on the rails 4. Then the vertical acceleration (a) detected is subjected to the double integral every evaluating time (T) by the integrating means 22, thereby obtaining the vertically displacing amount per evaluating time (T) of the part above the spring rigging 6, i.e., the vertical displacement amount (d). Then the determining means 23 determines that the rolling stock 1 is derailed, in the case that the vertical displacement amount (d) is negative and the absolute value thereof is not less than the predetermined reference value (dc). The derailment can also be detected accurately and surely by the derailment detecting method according to the second embodiment of the present invention.

[0034] Fig. 9 is a control block diagram of the derailment detecting apparatus according to the third embodiment of the present invention. The derailment detecting apparatus 30 shown in Fig. 9 is equivalent to a combination of the derailment detecting apparatus 10 of the first embodiment with the derailment detecting apparatus 2 of the second embodiment, which were already described above. This derailment detecting apparatus 30 is also provided two units per rolling stock 1, as in the case of the aforementioned derailment detecting apparatus 10. In the derailment detection apparatus 30, the vertical acceleration (a) detected by the acceleration detecting means 31 is sent via the integrating means 33 to a displacement determining means 34 and is also sent via the filter means 35 to an acceleration determining means 36. In the case that the displacement determining means 34 determines that the vertical displacement amount (d) is negative and that the absolute value thereof is not less than the predetermined reference value dc, or in the case that the acceleration determining means 36 determines that the absolute value of the vertical acceleration (a) in the predetermined frequency range is over the limit vertical acceleration (al) corresponding to the running velocity (v) detected by the car velocity detecting means 32, an OR gate 38 outputs the derailment signal. The derailment can also be detected accurately and surely by use of the derailment detection apparatus 30 as described.

Industrial Utilization

[0035] As described above, because the derailment of the rolling stock under traveling is detected automatically, the present invention is effectively applicable to the cases of preventing the derailed rolling stock from keeping running and stopping the rolling stock immediately upon occurrence of derailment and is also effectively applicable to both the rolling stock under manned operation and the rolling stock under unmanned operation.

Claims

1. A derailment detecting method for rolling stock, which is applied to rolling stock having a truck which comprises wheels rolling on rails, and spring rigging, and a carbody to which said truck is attached, said derailment detecting method for rolling stock comprising:

   a step of detecting vertical acceleration at said carbody above said spring rigging during running of said rolling stock on said rails;
   a step of calculating a vertical displacement amount by double integral of said vertical acceleration every evaluating time, said evaluating time being defined as a time period from a start of descent of said carbody to arrival at half a height of said rails, in a free fall of one axle of said wheels by a distance equal to the height of said rails; and
   a step of determining that said rolling stock is derailed, in the case that said vertical displacement amount is negative and an absolute value thereof is not less than a predetermined reference value.

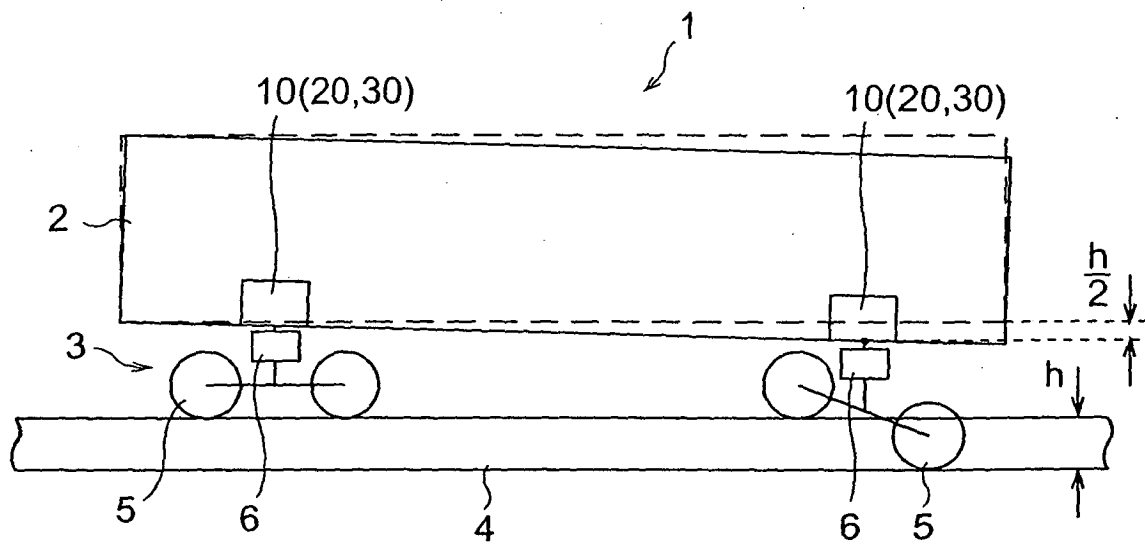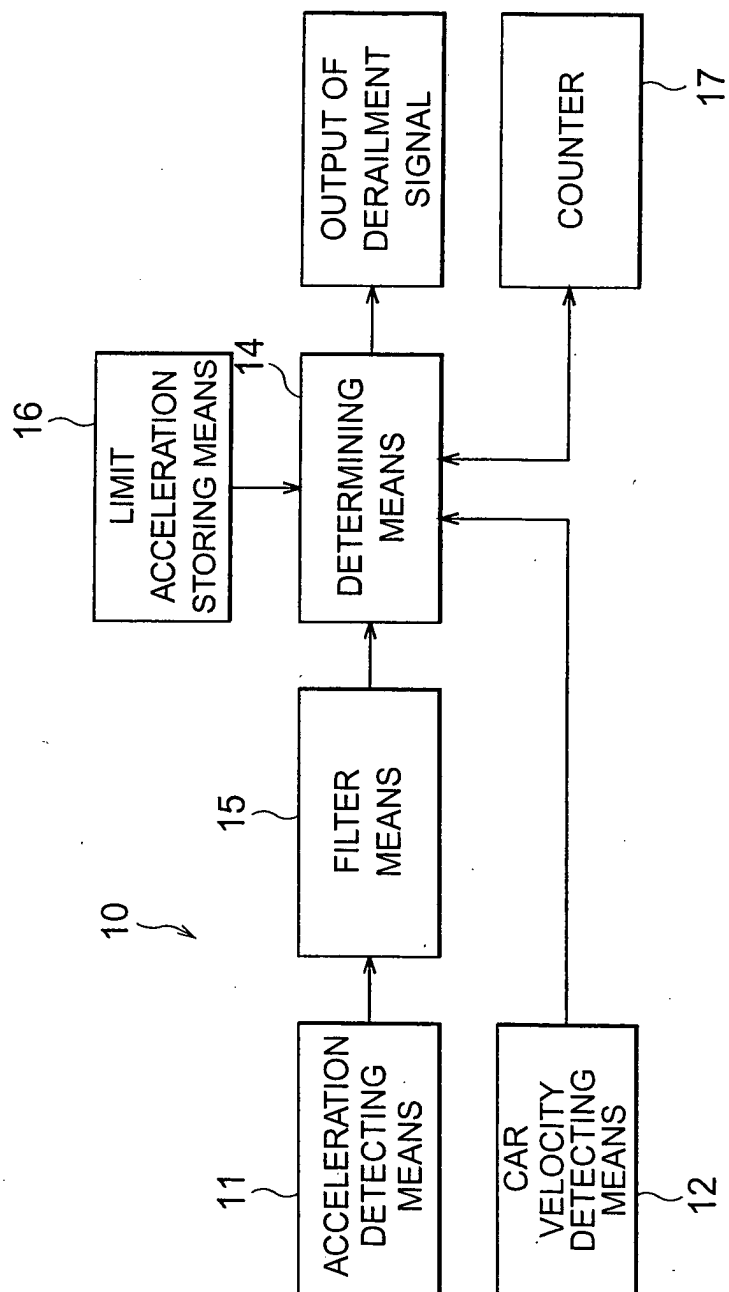2. The derailment detecting method for rolling stock according to Claim 1, wherein in calculating said vertical displacement amount, the double integral is carried out with initial velocity of zero.

3. The derailment detecting method for rolling stock according to Claim 1, wherein said reference value is set to a value greater than a maximum change amount of said spring rigging in the vertical direction.

4. A derailment detecting apparatus for rolling stock, which is applied to rolling stock having a truck which comprises wheels rolling on rails, and spring rigging, and a carbody to which said truck is attached, said derailment detecting apparatus for rolling stock comprising:

   acceleration detecting means for detecting vertical acceleration at said carbody above said spring rigging during running of said rolling stock on said rails;

integration means for executing double integral of said vertical acceleration every evaluating time to calculate a vertical displacement amount, said evaluating time being defined as a time period from a start of descent of said carbody to arrival at half a height of said rail, in a free fall of one axle of said wheels by a distance equal to the height of said rails; and

determining means for determining that said rolling stock is derailed, in the case that said vertical displacement amount is negative and an absolute value thereof is not less than a predetermined reference value.

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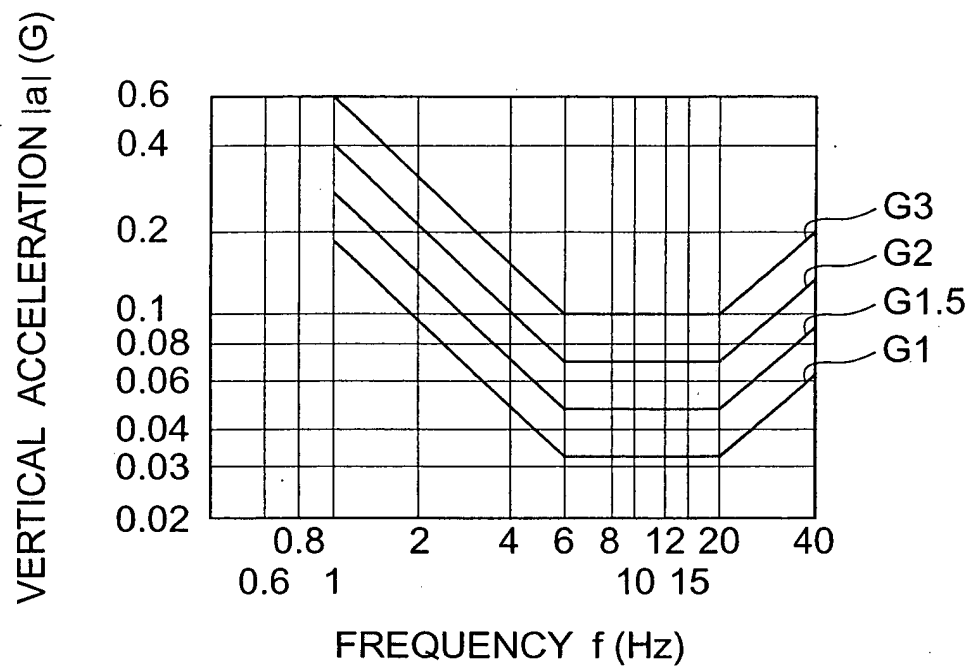
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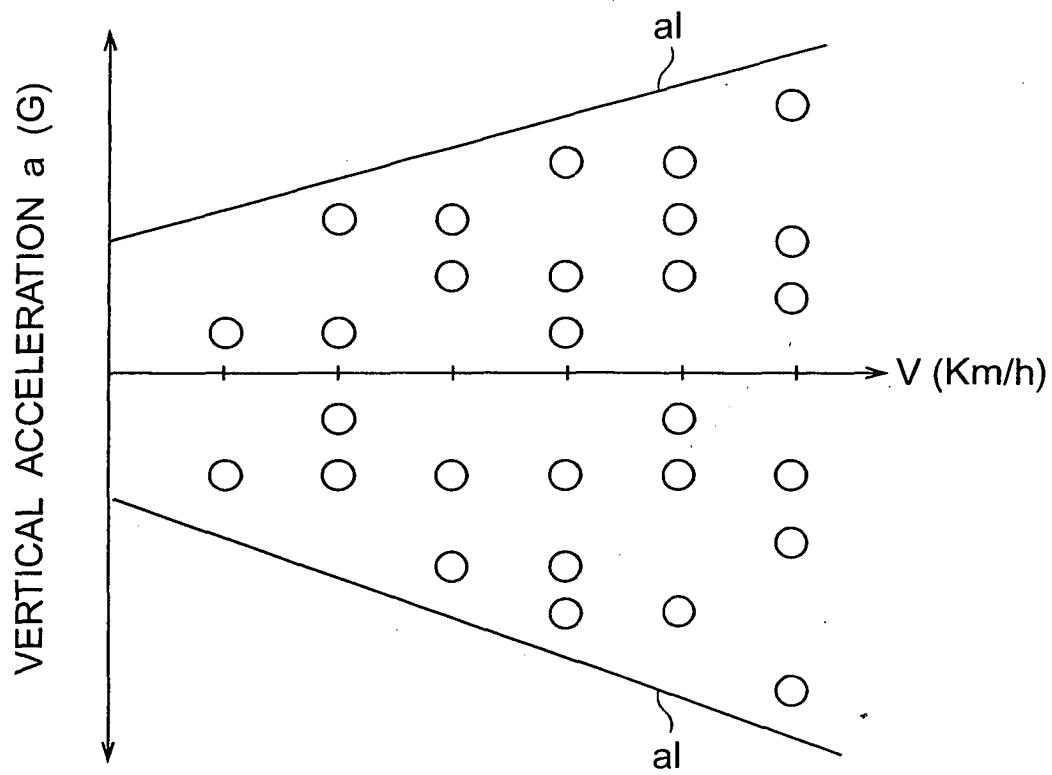
Fig.2

Fig.3

Fig.4

Fig.5

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ACCELERATION DETECTING MEANS	→	INTEGRATING MEANS	→	DETERMINING MEANS	→	OUTPUT OF DERAILMENT SIGNAL

21   22   23

Fig.6

VERTICAL DISPLACEMENT

T

—— DISPLACEMENT OF WHEEL

---- DISPLACEMENT OF BODY

$h/2$

h

t
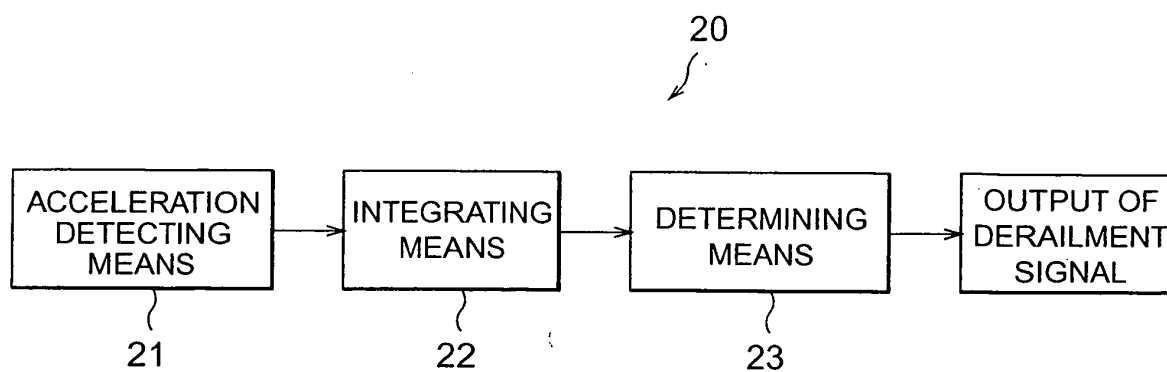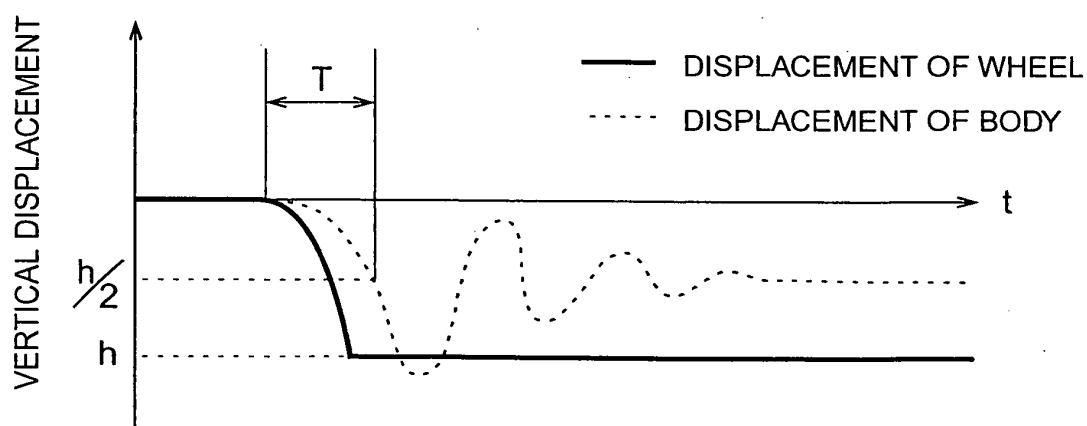
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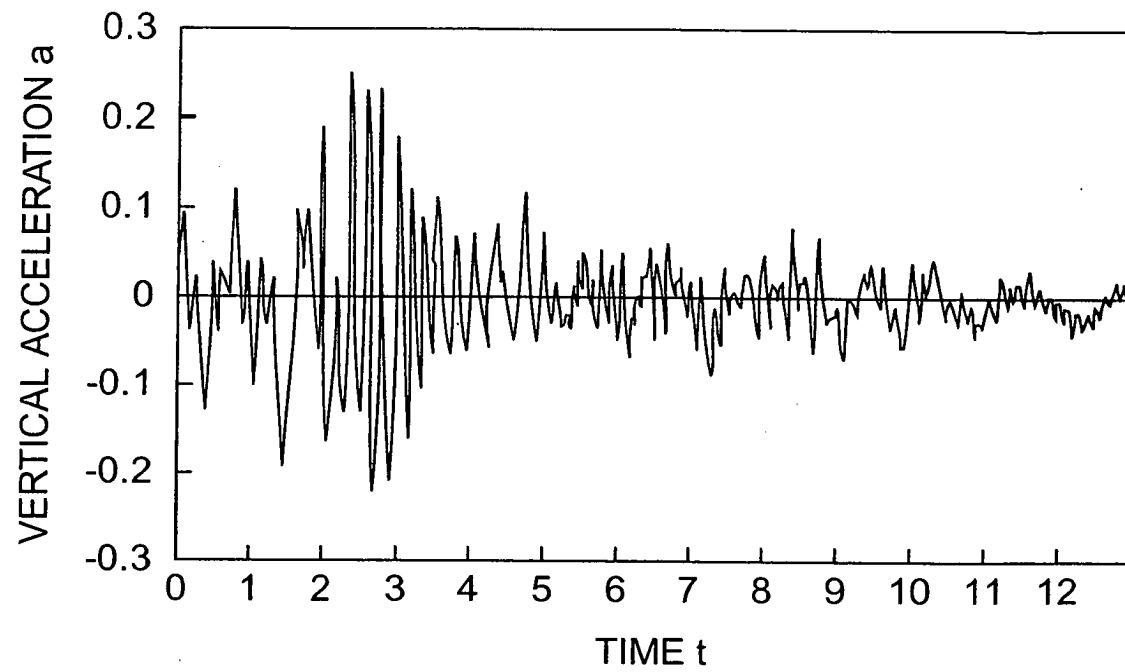
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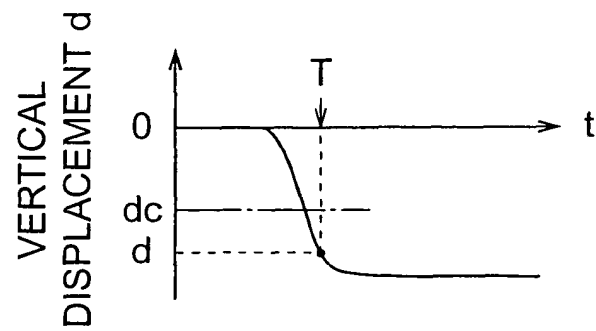
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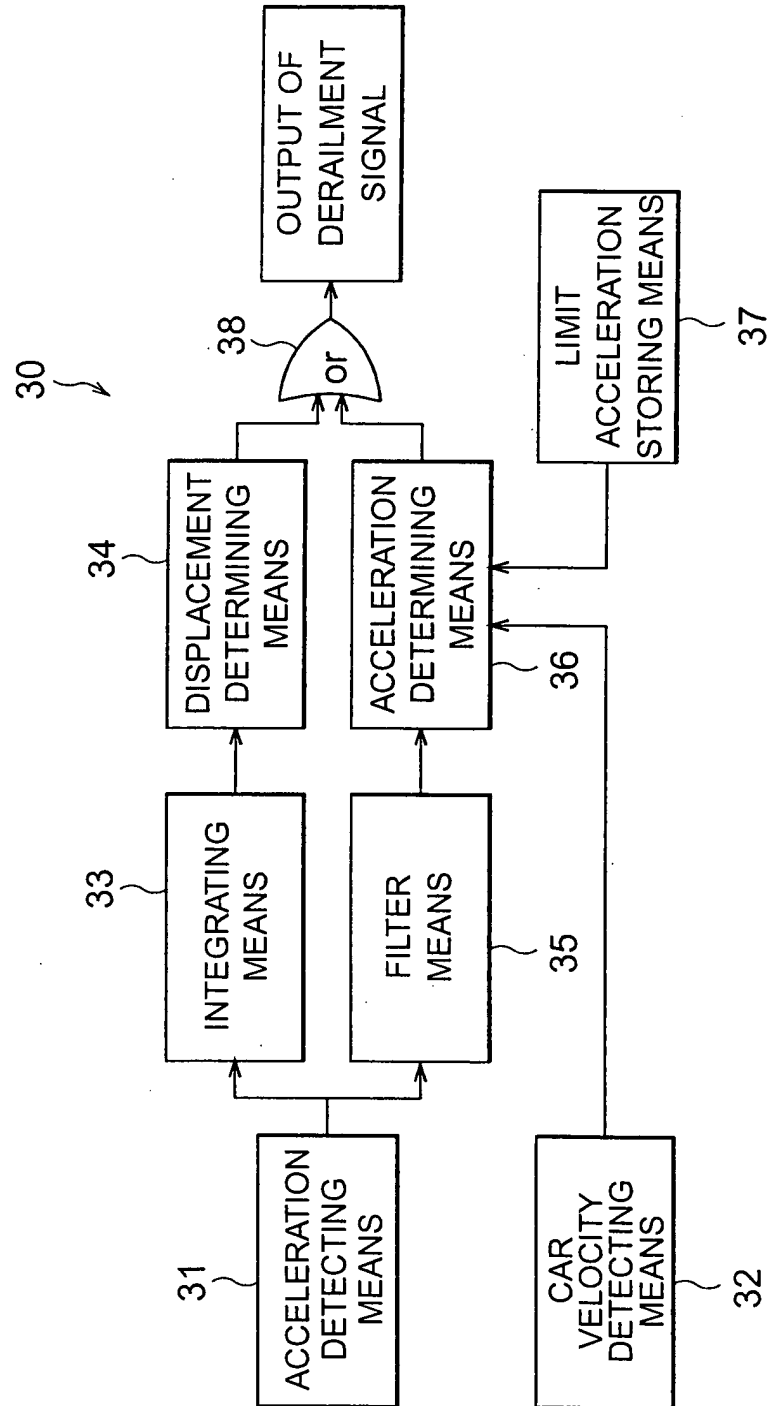
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EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 06, 30 June 1997 (1997-06-30) & JP 09 039790 A (TOKYU CAR CORP), 10 February 1997 (1997-02-10) * abstract * -----	1,4	B61F9/00 B61K13/00
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B61F B61K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	12 December 2003	Ferranti, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 03 02 6141

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12-12-2003

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
JP 09039790	A	10-02-1997	JP	3458872 B2	20-10-2003

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