

DESCRIPTION

Title of Invention: DERAILMENT DETECTOR OF RAILCAR AND RAILCAR

Technical Field

[0001] The present invention relates to a derailment detector of a railcar and the railcar including the derailment detector.

Background Art

[0002] Conventionally known as a derailment detector of a railcar is a derailment detector including a derailment detection sensor having an operation piece, such as a microswitch, and configured such that when the railcar derails, the operation piece rotates to be turned on, and this activates an alarm device to cause the alarm device to emit an alarm (see PTL 1, for example).

Citation List

Patent Literature

[0003] PTL 1: Japanese Patent No. 2695976

Summary of Invention

Technical Problem

[0004] In the case of detecting the derailment by using the derailment detection sensor as in the technology described in PTL 1, the sensor easily breaks due to, for example, vibrations of a bogie. Therefore, the sensor needs to be an extremely durable, special sensor, so that the sensor becomes expensive.

[0005] An object of the present invention is to provide a derailment detector of a railcar, the derailment detector being capable of detecting derailment by simple components at low cost without using the special sensor, and the railcar including the derailment detector.

Solution to Problem

[0006] A derailment detector according to the present invention is a derailment detector provided at a front end of a bogie, the derailment detector including: a movable member moving in a predetermined direction when a load of not smaller than a predetermined value acts on the movable member; a derailment detection member receiving the load of not smaller than the predetermined value by contact with a railway track when the bogie derails and transfer the load to the movable member to cause the movable member to move in the predetermined direction; and a derailment detection wire which is used to detect the derailment of the bogie and through

which electricity or light conducts, wherein, an electricity conducting state or light conducting state of the derailment detection wire is cut off by the movement of the movable member when the bogie derails.

[0007] With this, the derailment can be detected at low cost by simple components that are the movable member, the derailment detection member, and the derailment detection wire. In addition, the derailment can be detected without using a special sensor and the like.

[0008] A railcar according to the present invention includes: the derailment detector; a derailment detection circuit connected to the derailment detection wire of the derailment detector and including a relay configured to operate when the electricity conducting state or light conducting state of the derailment detection wire is cut off; and a brake device braking in conjunction with the operation of the relay.

Advantageous Effects of Invention

[0009] The present invention can provide a derailment detector of a railcar, the derailment detector being capable of detecting derailment at low cost by simple components without using a special sensor, and the railcar including the derailment detector.

Brief Description of Drawings

[0010] Fig. 1 is a side view of a railcar bogie at which a derailment detector of a railcar is provided.

Fig. 2 is an enlarged view of a portion A of Fig. 1.

Fig. 3 is a front view of the portion A of Fig. 1.

Fig. 4 is a plan view of the portion A of Fig. 1.

Fig. 5 is a perspective view of the derailment detector.

Fig. 6 is an enlarged view showing a fixed member and a movable member at a position through which a derailment detection wire extends.

Figs. 7A and 7B are respectively a front view and a side view each showing the derailment detector in derailment.

Fig. 8 is a block diagram showing portions regarding the derailment detector in the railcar.

Figs. 9A and 9B are respectively a front view and a side view each showing a part of the railcar bogie at which the derailment detector and an obstacle detector of the railcar are provided.

Fig. 10 is a partial cross-sectional plan view showing the derailment detector and the

obstacle detector.

Fig. 11 is a block diagram showing portions regarding the derailment detector and obstacle detector in the railcar.

Description of Embodiments

[0011] Hereinafter, an embodiment will be explained in reference to the drawings.

1. Configuration of derailment detector

1-1. Outline of entire configuration

Fig. 1 is a side view of a railcar bogie at which a derailment detector of a railcar is provided. Figs. 2 to 4 are respectively an enlarged view, a front view, and a plan view each showing a portion A of Fig. 1. Fig. 5 is a perspective view of the derailment detector. In the following explanations, a concept of directions corresponds to a concept of directions when a running direction of a railcar is defined as a front direction. To be specific, a car-longitudinal direction corresponds to a front-rear direction, and a car-width direction corresponds to a left-right direction.

[0012] In Figs. 1 to 5, a derailment detector 1 for detecting derailment of the railcar is provided at a front end (front side in a car-running direction) of a railcar bogie 4 (hereinafter may be simply referred to as a “bogie”) and is located in front of a wheel 40. The derailment detector 1 includes a fixed member 21, a movable member 11, a detection arm 12 serving as a derailment detection member, and a derailment detection wire 3.

[0013] As shown in Figs. 1 to 4, column members 42 respectively hang down from both car-width direction end portions of a front surface of a bogie frame 41 of the bogie 4. Beam members 43 extending inward in the car-width direction are respectively provided at lower portions of the column members 42. In the present embodiment, the front end of the bogie 4 is constituted by these members 42 and 43. The derailment detector 1 is attached to a support bracket 44 projecting forward from a tip end of the beam member 43.

[0014] 1-2. Configuration of fixed member 21

The fixed member 21 is fixed to the beam member 43 via the support bracket 44. Specifically, as shown in Fig. 5, the fixed member 21 has a T shape in plan view and includes: a base portion fastened to the support bracket 44 by bolts; and a plate portion projecting forward from a substantially center of the base portion and being thin in the car-width direction. A cover 21a is formed integrally with the fixed member 21. The cover 21a covers the plate portion from above and front and has a width substantially equal to a width of the base portion. A pedestal portion 21b (see Fig. 6) is provided at a region, overlapping the movable member 11,

of a car-width direction inner main surface of the plate portion of the fixed member 21.

[0015] **1-3. Configuration of movable member 11**

As shown in Figs. 2 and 3, the movable member 11 is provided at a position above a railway track R when the railcar runs on the railway track. Specifically, as shown in Fig. 5, the movable member 11 includes a main body portion 11A and an attaching portion 11B.

[0016] The main body portion 11A has a plate shape parallel to the plate portion of the fixed member 21 and extending in the car-longitudinal direction. The main body portion 11A is fastened to the plate portion of the fixed member 21 by an attachment bolt 22 extending in the car-width direction and a nut threadedly engaged with the attachment bolt 22. With this, the movable member 11 is rotatable around the attachment bolt 22. To be specific, the attachment bolt 22 serves as a rotating shaft. The movable member 11 is configured to rotate (move) in a predetermined direction B because of a below-described hollow bolt 24 when a load of not smaller than a predetermined value acts on the movable member 11.

[0017] A through hole 11Aa (see Fig. 6) is formed at a position within a region of the main body portion 11A, the region overlapping the plate portion of the fixed member 21, the position being displaced from a rotational center of the movable member 11. A through hole 21c (see Fig. 6) is formed on the plate portion and pedestal portion 21b of the fixed member 21 at a position corresponding to the through hole 11Aa. As described below, a part of the derailment detection wire 3 is inserted through the through holes 11Aa and 21c.

[0018] The attaching portion 11B has a plate shape inclined relative to the main body portion 11A such that an outer side thereof is located at a rear side. A left-right direction middle portion of the attaching portion 11B is connected to a front end portion of the main body portion 11A.

[0019] A plate-shaped obstruction guard 14 (for example, a rubber plate in which reinforced fabric is embedded) is attached to the attaching portion 11B so as to hang down from the attaching portion 11B. When the railcar runs, obstacles on the railway track R can be removed by the obstruction guard 14.

[0020] **1-4. Configuration of detection arm 12**

The detection arm 12 has, for example a rod shape and projects from a side surface of the main body portion 11A of the movable member 11 toward an inner side. It should be noted that the detection arm 12 may project toward an outer side instead of the inner side.

[0021] A base end portion of the detection arm 12 is fixed to the side surface of the main body portion 11A by welding or the like. The detection arm 12 extends in a substantially horizontal direction to a position corresponding to the vicinity of a side edge of a rail fastening

device 15. When viewed from the attachment bolt 22, the detection arm 12 is provided obliquely backward.

[0022] When the bogie 4 derails, the detection arm 12 receives the load of not smaller than the predetermined value by contact with the railway track R and then transfers the load to the movable member 11. With this, the movable member 11 fixed to the detection arm 12 rotates.

[0023] **1-5. Configuration of derailment detection wire 3**

The derailment detection wire 3 is a wire through which electricity or light conducts. When the bogie 4 derails, an electricity conducting state or light conducting state of the derailment detection wire 3 is cut off by the rotation of the movable member 11. Thus, the derailment can be detected. Specifically, as shown in Fig. 8, the derailment detection wire 3 is connected to a derailment detection circuit 51 provided at a carbody. When the derailment detection circuit 51 detects the derailment, information of this derailment is displayed on a monitoring device 52. For example, the derailment detection circuit 51 includes a relay configured to operate when the electricity conducting state or light conducting state of the derailment detection wire 3 is cut off. When the relay operates, a brake device 53 operates as an emergency brake in conjunction with the operation of the relay.

[0024] In the present embodiment, used as the derailment detection wire 3 is an electric wire through which electricity conducts. It should be noted that the derailment detection wire 3 may be an optical fiber through which light conducts. In this case, both ends of the derailment detection wire 3 are connected to the derailment detection circuit 51 through a light emitting unit configured to convert electricity into light and a light receiving unit configured to convert light into electricity. In a case where the electric wire is used as the derailment detection wire 3, noises may be applied to a signal device or an electrical device. However, by using the optical fiber, the generation of those noises can be prevented.

[0025] Most of an outgoing line and returning line of the derailment detection wire 3 are bundled as a single cable 30 such that the derailment detection wire 3 has a string shape including a loop at its tip end. The cable 30 is provided along the column member 42, and a loop portion formed by a middle portion of the derailment detection wire 3 intersects with the plate portion of the fixed member 21 twice. More specifically, the derailment detection wire 3 is inserted through a through hole provided at an upper position of the plate portion of the fixed member 21 and a continuous hole constituted by the through hole 11Aa of the movable member 11 and the through hole 21c of the fixed member 21.

[0026] As shown in Fig. 6, a shaft portion of the hollow bolt 24 is inserted into the through hole 11Aa of the movable member 11 and the through hole 21c of the fixed member 21. In

other words, the hollow bolt 24 penetrates the main body portion 11A of the movable member 11 and the pedestal portion 21b and plate portion of the fixed member 21. A nut 25 is threadedly engaged with the shaft portion of the hollow bolt 24. With this, the movable member 11 and the plate portion of the fixed member 21 are fastened to each other. Then, the derailment detection wire 3 is inserted through the hollow bolt 24. The derailment detection wire 3 exposed from the hollow bolt 24 is covered with a rubber hose 26. At exits of the through holes 11Aa and 21c, the derailment detection wire 3 is covered with a heat shrinkable tube 27.

[0027] With this, when the bogie 4 derails, and the load of not smaller than the predetermined value acts on the movable member 11 through the detection arm 12 that contacts the railway track R, the movable member 11 rotates, so that the through hole 11Aa of the movable member 11 is displaced relative to the through hole 21c of the fixed member 21. Thus, the hollow bolt 24 breaks. To be specific, the strength of the hollow bolt 24 is set such that the hollow bolt 24 breaks when the load of not smaller than the predetermined value acts on the hollow bolt 24. In other words, the predetermined value is breaking strength of the hollow bolt 24.

[0028] **1-6. Detection of derailment and obstacle**

When the car derails, as shown in Figs. 7A and 7B, the wheel 40 of the bogie 4 is separated from the rail R, and the bogie 4 including the wheel 40 falls downward. With this, the detection arm 12 projecting toward one car side contacts an upper surface of the railway track R, and the load of not smaller than the predetermined value acts on the movable member 11 through the detection arm 12. Since the movable member 11 rotates in a predetermined direction relative to the fixed member 21, it serves as an edged tool and cuts the hollow bolt 24 and the derailment detection wire 3 inserted through the hollow bolt 24. When the derailment detection wire 3 is cut, the electricity conducting state is cut off. Thus, the derailment is detected.

[0029] For example, the load that causes the movable member 11 to move is a static load of about 1 ton but may be variously changed depending on the diameter of the hollow bolt 24, the distance from the rotational center to the hollow bolt 24, and the like and may be any load as long as the derailment can be detected.

[0030] The derailment detection circuit 51 detects the derailment. However, the derailment detection circuit 51 may detect the obstacle by utilizing the obstruction guard 14. To be specific, the obstruction guard 14 is attached to the movable member 11 (attaching portion 11B), so that even in a case where the obstruction guard 14 collides with the obstacle on the railway track R to receive the load of not smaller than the predetermined value from the obstacle,

the movable member 11 receives the load of not smaller than the predetermined value through the obstruction guard 14 to rotate in the predetermined direction, thereby breaking the hollow bolt 24. In this case, by the break of the hollow bolt 24, the derailment detection wire 3 is cut, and therefore, the electricity conducting state is cut off. If the obstacle with which the obstruction guard 14 collides is ballast or the like on the railway track R, the obstacle is just removed from the railway track R, and the movable member 11 does not rotate.

[0031] **1-7. Effects by respective configurations**

As above, the derailment detector 1 can detect the derailment by a simple configuration in which when the bogie 4 derails, the detection arm 12 contacts the railway track R to cause the movable member 11 to rotate, and the derailment detection circuit 51 electrically detects the rotation of the movable member 11.

[0032] For example, in a case where a derailment detection sensor (microswitch) is attached to the bogie 4 to detect the derailment as in conventional technologies, a special sensor needs to be used as the derailment detection sensor in order to surely avoid the break of the derailment detection sensor due to, for example, vibrations of the bogie 4. However, this can be avoided by the above components, and those components are also advantageous in cost.

[0033] By a simple configuration in which the detection arm 12 (derailment detection member) projecting toward the inner side (or the outer side) from the side surface of the movable member 11 is provided in order to detect the derailment, the derailment can be detected, and the emergency brake can be activated.

[0034] In addition, the obstacle on the railway track R can be detected, and the emergency brake can be activated in the same manner as above. Especially, since the movable member 11 and the derailment detection wire 3 can be used in both the detection of the derailment and the detection of the obstacle, the structure can be simplified.

[0035] Further, since the derailment is detected by cutting the derailment detection wire 3 (hollow bolt 24) by a simple operation that is the rotation of the movable member 11, the detection can be performed at low cost without using the special sensor.

[0036] The movable member 11 does not rotate without receiving the load of not smaller than the predetermined value. Therefore, when the railcar runs normally, the movable member 11 does not rotate, so that the electricity conducting state of the derailment detection wire 3 is not carelessly cut off.

[0037] **2. Others**

In addition to the above, the above embodiment may be modified as below.

[0038] (1) Not only the detection arm 12 (derailment detection member) but also the

obstruction guard 14 is attached to the movable member 11. However, only the detection arm 12 (derailment detection member) may be attached to the movable member 11. In this case, an obstacle detector including an obstruction guard having the same configuration as above may be additionally provided at the bogie 4, and a dedicated obstacle detection circuit configured to detect the obstacle on the railway track R may be further included in the railcar. The following will explain this example in detail in reference to Figs. 9A to 11.

[0039] Figs. 9A and 9B are respectively a front view and a side view each showing a part of the railcar bogie 4 at which the derailment detector 1 and an obstacle detector 6 are provided.

Fig. 10 is a partial cross-sectional plan view showing the derailment detector 1 and the obstacle detector 6. In the present modification example, the support bracket 44 for the derailment detector 1 projects backward from a tip end of the beam member 43, and a support bracket 45 for the obstacle detector 6 projects forward from the tip end of the beam member 43.

[0040] The derailment detector 1 has the same configuration as in the above embodiment except that the movable member 11 is constituted only by a plate-shaped portion parallel to the plate portion of the fixed member 21. To be specific, only the detection arm 12 is attached to the movable member 11.

[0041] The obstacle detector 6 has the same configuration as the derailment detector 1 of the above embodiment except that the detection arm 12 is not provided. To be specific, the obstacle detector 6 includes: a fixed member 71 fixed to the beam member 43 via the support bracket 45; a cover 72 formed integrally with the fixed member 71; a movable member (secondary movable member) 61 coupled to the fixed member 71; and an obstacle detection wire 8.

[0042] The movable member 61 includes: a plate-shaped main body portion 61A fastened to the plate portion of the fixed member 71 by the attachment bolt 22 and the nut and extending in the car-longitudinal direction; and an attaching portion 61B which is inclined relative to the main body portion 61A and to which the obstruction guard 14 is attached. To be specific, the movable member 61 is rotatable around the attachment bolt 22. As with the configuration shown in Fig. 6, the movable member 61 is fastened to the plate portion of the fixed member 71 by the hollow bolt 24 and the nut 25. With this, the movable member 61 rotates (moves) in a predetermined direction when the load of not smaller than the predetermined value acts on the movable member 61. The obstacle detection wire 8 is inserted through the hollow bolt 24.

[0043] The obstacle detection wire 8 is a wire through which electricity or light conducts. When the railcar runs, the movable member 61 receives the load of not smaller than the predetermined value from the obstacle on the railway track R and therefore rotates. With this,

the electricity conducting state or light conducting state of the obstacle detection wire 8 is cut off. Thus, the obstacle can be detected. Specifically, as shown in Fig. 11, the obstacle detection wire 8 is connected to an obstacle detection circuit 54 provided at the carbody. When the obstacle detection circuit 54 detects the obstacle, information of this detection is displayed on the monitoring device 52. For example, the obstacle detection circuit 54 includes a relay configured to operate when the electricity conducting state or light conducting state of the obstacle detection wire 8 is cut off. When the relay operates, the brake device 53 operates as the emergency brake in conjunction with the operation of the relay.

[0044] An electric wire through which electricity conducts or an optical fiber through which light conducts may be used as the obstacle detection wire 8. In the latter case, both ends of the derailment detection wire 8 are connected to the obstacle detection circuit 54 through a light projecting unit configured to convert electricity into light and a light receiving unit configured to convert light into electricity. As with the derailment detection wire 3, most of an outgoing line and returning line of the obstacle detection wire 8 are bundled as a single cable 80 such that the obstacle detection wire 8 has a string shape including a loop at its tip end. The cable 80 is provided along the column member 42, and a loop portion formed by a middle portion of the obstacle detection wire 8 intersects with the plate portion of the fixed member 61 twice. As with the configuration shown in Fig. 6, the through hole 11Aa is formed on the movable member 61, and the through hole 21c is formed on the plate portion and pedestal portion 21b of the fixed member 21. Then, the shaft portion of the hollow bolt 24 is inserted into the through hole 11Aa of the movable member 61 and the through hole 21c of the fixed member 21.

[0045] Or, the detection of the derailment and the detection of the obstacle can be separately performed by utilizing the movable member 11 of the derailment detector 1. In this case, the addition of the obstacle detection wire 8 to the derailment detector 1 shown in Figs. 1 to 5 and the addition of the obstacle detection circuit 54 to the carbody are only required. The addition of the obstacle detection wire 8 to the derailment detector 1 denotes that two hollow bolts 24 are provided at one movable member 11.

[0046] (2) The movable member 11 of the derailment detector 1 and/or the movable member 61 of the obstacle detector 6 are not necessarily required to rotate and may move (linear movement, bent movement, or the like) to cut the derailment detection wire 3 and/or the obstacle detection wire 8.

[0047] (3) The derailment detection wire 3 and/or the obstacle detection wire 8 are not required to penetrate both the through holes 11Aa and 21a and may penetrate only one of the through holes. The derailment detection wire 3 and/or the obstacle detection wire 8 can be

provided so as to be cut by the movement of the movable member 11 without penetrating the through holes at all. For example, in a case where the derailment detection wire 3 and/or the obstacle detection wire 8 are disposed transversely to a movement track (rotation track) of the movable member 11, the derailment detection wire 3 and/or the obstacle detection wire 8 can be naturally cut by the movement of the movable member 11.

[0048] (4) In the above embodiment, the brake device 53 operates as the emergency brake. However, instead of this, for example, a warning lamp of a driver's seat may light, or an alarm device may sound.

[0049] (5) Instead of the columnar shape, the detection arm 12 as the derailment detection member may have a prismatic shape, a plate shape, a box shape, or the like and may be any shape as long as it can detect the derailment.

[0050] (6) The fixed member 21 is not necessarily required to be formed separately from the bogie 4 and may be formed integrally with a part of the bogie 4.

[0051] (7) A factor of cutting off the electricity conducting state or light conducting state of the derailment detection wire 3 is not necessarily limited to the cut of the derailment detection wire 3. One example may be such that: the derailment detection wire 3 is divided into a wire portion at the fixed member 21 side and a wire portion at the movable member 11 side; these wire portions are connected to each other through a connector; and the connector is divided into two parts when the movable member 11 moves. The same is true for the obstacle detection wire 8.

[0052] (8) The predetermined value based on which the movable member 11 of the derailment detector 1 and/or the obstacle detector 6 of the movable member 61 move in the predetermined direction is not necessarily required to be the breaking strength of the hollow bolt 24 and may be suitably selected. For example, a buckling strength of a tubular member extending in the car-longitudinal direction may be adopted.

Reference Signs List

[0053]	1	derailment detector
	11	movable member
	11A	main body portion
	11Aa	through hole
	11B	attaching portion
	12	detection arm
	14	obstruction guard

- 21 fixed member
- 21a through hole
- 24 hollow bolt
- 3 derailment detection wire
- 4 railcar bogie
- 40 wheel
- 51 derailment detection circuit
- 53 brake device
- 54 obstacle detection circuit
- 6 obstacle detector
- 61 movable member (secondary movable member)
- 8 obstacle detection wire

CLAIMS

1. A derailment detector of a railcar, the derailment detector being provided at a front end of a bogie,

the derailment detector comprising:

a movable member moving in a predetermined direction when a load of not smaller than a predetermined value acts on the movable member;

a derailment detection member

receiving the load of not smaller than the predetermined value by contact with a railway track when the bogie derails and

transferring the load to the movable member to cause the movable member to move in the predetermined direction; and

a derailment detection wire which is used to detect the derailment of the bogie and through which electricity or light conducts, wherein an electricity conducting state or light conducting state of the derailment detection wire is cut off by the movement of the movable member when the bogie derails.

2. The derailment detector according to claim 1, wherein the derailment detection wire is cut by the movement of the movable member.

3. The derailment detector according to claim 2, wherein:

the movable member receives the load of not smaller than the predetermined value to rotate around a rotating shaft extending in a car-width direction; and

the derailment detection wire is disposed transversely to a rotation track of the movable member.

4. The derailment detector according to claim 2 or 3, further comprising:

a fixed member fixed to the front end of the bogie; and

a hollow bolt penetrating the movable member and the fixed member, wherein:

the derailment detection wire is inserted through the hollow bolt; and

the predetermined value is breaking strength of the hollow bolt.

5. The derailment detector according to any one of claims 1 to 4, wherein:

the movable member is provided at a position above the railway track when the

railcar runs on the railway track; and

the derailment detection member is an arm projecting from a side surface of the movable member toward an outer side or an inner side.

6. A railcar comprising:

the derailment detector according to any one of claims 1 to 5;

a derailment detection circuit connected to the derailment detection wire of the derailment detector and including a relay configured to operate when the electricity conducting state or light conducting state of the derailment detection wire is cut off; and

a brake device braking in conjunction with the operation of the relay.

7. The railcar according to claim 6, wherein:

an obstruction guard removing an obstacle on the railway track is attached to the movable member of the derailment detector; and

when the railcar runs, the movable member receives the load of not smaller than the predetermined value from the obstacle on the railway track to move in the predetermined direction,

the railcar further comprising:

an obstacle detection wire which is used to detect the obstacle on the railway track and through which electricity or light conducts, wherein an electricity conducting state or light conducting state of the obstacle detection wire is cut off by the movement of the movable member; and

an obstacle detection circuit connected to the obstacle detection wire.

8. The railcar according to claim 6, further comprising:

an obstruction guard removing the obstacle on the railway track from the railway track;

a secondary movable member to which the obstruction guard is attached and which moves in a predetermined direction when a load of not smaller than a predetermined value acts on the secondary movable member;

an obstacle detection wire which is used to detect the obstacle on the railway track and through which electricity or light conducts, wherein an electricity conducting state or light conducting state of the obstacle detection wire is cut off by the movement of the secondary movable member; and

an obstacle detection circuit connected to the obstacle detection wire.