

RETRACTABLE STEP FOR RAILWAY VEHICLE

Field of the Invention

The present invention relates to a retractable step for a railway vehicle, belonging to the technical field of accessories of rail vehicles.

Background of the Invention

In current design of rail vehicles, a maintenance staff or driver has to get on and off through a boarding step mounted below a bottom frame edge beam. Existing boarding steps are almost fixed, that is, a step mounting plate is designed below the bottom frame edge beam, and the step is fixedly connected to the step mounting plate, without changing the height of the step. Due to gauge requirements, such a step is generally 500 mm higher than a rail surface. When a person gets on a vehicle, a support surface of the human body moves from soles of the feet to the step, and a center of gravity gradually deviates from the support surface. If the first step is high, a person has to spend more effort and getting on the vehicle becomes more difficult. Considering that locomotives, especially railway engineering vehicles, are mostly used outdoors and lack platforms, people have to stand on the ground or sleepers, so the boarding height increases. The fixed step is inconvenient to get on and off and easily leads to injuries, which seriously affect comfort and safety.

Existing mechanical steps are rare and have some problems. A torsion spring type step disclosed in the utility model patent CN201620805680.9 has only single-layer steps with a large span and lacks protection, making it susceptible to erosion by sand and dust; the torsion spring is prone to failure; and the single-layer steps cannot be simply replaced. However, electric steps require a large space, require wiring and piping, are prone to interference with devices such as bogies, and have complex structures, low reliability, and weak seismic resistance, making them unsuitable for widespread use.

Summary of the Invention

In order to solve the problem of excessive step height and difficulty in boarding due to gauge requirements of a vehicle, the present invention provides a retractable step for a

rail vehicle. A specific technical solution is as follows.

A retractable step for a rail vehicle includes a step assembly and elastic supporting boxes located on two sides of the step assembly;

The step assembly includes two vertical and opposite vertical plates and at least two step plates arranged at intervals in a vertical direction, two ends of the step plates are fixedly connected to the vertical plates respectively, a connecting plate is arranged on an outer side of each vertical plate, and the connecting plates and the step plates are arranged horizontally; and

Each elastic supporting box includes a bottom plate, a front baffle, a rear baffle, an outer side plate, and a top plate; at least a portion of the connecting plate is located inside a cavity of the elastic supporting box, and a spring extending in the vertical direction is arranged in the elastic supporting box; one end of the spring is fixedly connected to the bottom plate or the top plate, and the other end abuts against or is connected to the connecting plate.

According to the foregoing technical solution, the entire springs are confined within cavities formed by the elastic supporting boxes and the vertical plates, which avoids erosion of the springs by dust and sand and is beneficial to improving weather resistance; the step assembly includes a plurality of step plates, and a user can choose appropriate step plates according to an actual ground height; and when the user steps on the step plates, the step plates overcome spring force and move down to limit positions, which achieves height adjustment of the step plates and is beneficial for the user to get on and off a rail vehicle. When the step plates are not in use, the step plates return to their highest positions under the action of the springs to meet gauge requirements of the vehicle without user's operation.

Further, guide rods for guiding the springs are arranged in the elastic supporting box, and the connecting plate is provided with a through hole through which the guide rod passes. When the step assembly moves up and down, the guide rod guides the step assembly to prevent its overturning. Preferably, more than two guide rods and more than two springs are arranged in one-to-one correspondence.

Further, a limit block is arranged inside the elastic supporting box, and the limit block is

fixedly connected to the bottom plate to define a limit position of downward movement of the connecting plate.

Further, a mounting plate is fixedly arranged on the outer side plate, the mounting plate is arranged horizontally and extends towards an outer side of the outer side plate, and the mounting plate is provided with connecting holes. Preferably, the connecting holes are kidney-shaped holes.

Further, the top plate is detachably connected to the mounting plate through fasteners. Advantages are as follows: After the connecting plate of the step assembly is mounted into the elastic supporting boxes, the top plates are connected to the mounting plates, which is beneficial to replacement of step assemblies with different specifications to meet requirements of different usage scenarios.

The retractable step of the present invention is simple and light in structure, can be connected to a vehicle body by means of bolts, facilitates mounting and use of welding parts and standard parts, and is easy to manufacture, stable, reliable, and long in service life. The spring mounting space is shielded by the baffles, so that substances such as sandy soil can be prevented from eroding the springs. The size of the step is convenient to replace according to actual needs. When a person gets on and off the vehicle, the boarding height is effectively reduced to improve comfort. After the person gets on and off the vehicle, the retractable step automatically returns to its initial state to meet gauge requirements of the vehicle without operations. Multi-layer steps can solve a problem of large spans, and the restoring force of the springs can help people easily board the vehicle.

Brief Description of the Drawings

FIG. 1 is a three-dimensional diagram of a retractable step of the present invention;

FIG. 2 is a front view of FIG. 1, namely, a front view on a vehicle body;

FIG. 3 is a three-dimensional diagram of an elastic supporting box;

FIG. 4 is a front view of a step assembly;

FIG. 5 is a top view of the step assembly; and

FIG. 6 is a schematic diagram of an active state of the retractable step (some components are hidden).

In the figures: step assembly 1, connecting plate 1.1, upper step plate 1.2, vertical plate 1.3, lower step plate 1.4, elastic supporting box 2, front baffle 2.1, rear baffle 2.2, outer side plate 2.3, mounting plate 2.4, bottom plate 2.5, limit block 2.6, top plate 2.7, spring 3, guide rod 4, through hole 5, and connecting hole 6.

Detailed Description of the Embodiments

The present invention will be further described in detail below with reference to the accompanying drawings.

With reference to FIGs. 1-6, a retractable step for a rail vehicle, provided by the present invention, includes a step assembly 1 and elastic supporting boxes 2 located on two sides of the step assembly 1.

Each elastic supporting box 2 includes a front baffle 2.1, a rear baffle 2.2, an outer side plate 2.3, a mounting plate 2.4, a bottom plate 2.5, and a limit block 2.6.

For the convenience of explanation, following directions are specified: a horizontal line in FIG. 2 shows a length direction, and a size in this direction is called length; a vertical dotted line in FIG. 2 shows a perpendicular direction (vertical direction), and a size in this direction is called height; a direction perpendicular to a paper surface in FIG. 2 is a width direction (namely, a third direction in a right-handed orthogonal coordinate system), and a size in this direction is called width. The vertical dotted line in FIG. 2 is a symmetrical centerline of the retractable step, a side near the centerline in the length direction is called an inner side, and a side away from the centerline is called an outer side.

Two elastic supporting boxes 2 are symmetrically arranged on the outer side of the step assembly 1, and serve as connecting and supporting structures. Each elastic supporting box 2 includes a bottom plate 2.5, a front baffle 2.1, a rear baffle 2.2, and an outer side plate 2.3 that are fixedly connected to each other; grooves or protrusions for fixing springs 3 are designed on an upper surface of the bottom plate 2.5, the outer side plate 2.3 is connected to the outer side of the bottom plate 2.5, and a mounting plate 2.4 is connected to an upper outer side of the outer side plate 2.3; and the bottom plate 2.5, the outer side plate 2.3, and the mounting plate 2.4 form a "zigzag"-shaped structure, which serves as a force transmission component. The front baffle 2.1 and the rear baffle 2.2 are arranged in

the width direction in order to increase strength of the "zigzag"-shaped structure, shield an internal space, and constrain a movement space of the step assembly 1. The mounting plate 2.4 is arranged horizontally, and the mounting plate 2.4 is provided with connecting holes 6; and preferably, the connecting holes 6 are kidney-shaped holes. The top plate 2.7 is detachably connected to the mounting plate 2.4 through fasteners. After a connecting plate 1.1 of the step assembly is mounted into the elastic supporting box 2, the top plate 2.7 is connected to the mounting plate 2.4, which is beneficial to replacement of step assemblies 1 with different specifications to meet requirements of different usage scenarios. However, a person skilled in the art can understand that the bottom plate 2.5, the front baffle 2.1, the rear baffle 2.2, and the outer side plate 2.3 may alternatively be fixedly connected (such as welded) to form the elastic supporting box 2.

The step assembly 1 is of a frame structure, with an upper step plate 1.2 and a lower step plate 1.4 fixed together through two vertical and opposite vertical plates 1.3. Both the upper and lower step plates can undergo anti-slip treatment for stepping on. An extension portion of the upper step plate 1.2 beyond the lower step plate 1.4 is the connecting plate 1.1. Alternatively, the connecting plate 1.1 may be a plate component separately welded and fixed to the outer side of the vertical plates 1.3. The connecting plate 1.1 abuts against the springs 3, and at least a portion of the connecting plate 1.1 is located inside a cavity of each elastic supporting box 2. The step assembly 1 in this embodiment includes only two step plates. A person skilled in the art can understand that more than two step plates can be configured. The distance between the two vertical plates 1.3 is less than the distance between the two elastic supporting boxes 2, and the width of the connecting plate 1.1 is less than the distance between the front baffle 2.1 and the rear baffle 2.2, so as to ensure that the step assembly 1 can move smoothly in the vertical direction.

An upper end of each spring 3 supports the connecting plate 1.1 of the step assembly 1, and a lower end is fixed to the bottom plate 2.5 of the elastic supporting box 2. When pressure is applied to the step assembly 1, the springs 3 compress and their upper ends are lowered, thereby achieving an effect of up-and-down movement of the step assembly 1.

To protect the springs 3 and control a maximum travel, a limit block 2.6 is arranged inside

each elastic supporting box 2, and a size of the limit block avoids the spring. When the step assembly 1 moves down, the limit blocks 2.6 are in contact with the connecting plate 1.1 to limit the movement of the step assembly 1 to a maximum downward travel.

To prevent instability of the springs 3, guide rods 4 may be arranged on the bottom plate 2.5, the springs 3 are sheathed on the guide rods 4, and a sliding sleeve or bearing (not shown) is arranged between an upper part of each spring 3 and the connecting plate 1.1. A person skilled in the art can understand that the sliding sleeves or bearings may alternatively be cancelled. The connecting plate 1.1 is provided with through holes 5 through which the guide rods 4 pass.

To reduce vertical vibration of the springs 3 during vehicle operation, the initial state of the springs 3 is a compressed state, and the connecting plate 1.1 abuts against the top plate 2.7. It is suggested that initial compression force is 1 to 3 times the weight of the step assembly.

A mounting method is as follows: The elastic supporting boxes 2 are mounted on a vehicle body (through the mounting plates 2.4), where the mounting plates 2.4 are provided with kidney-shaped holes for appropriately adjusting positions of the elastic supporting boxes 2. The springs 3 are mounted on the guide rods 4 of the elastic supporting boxes 2, and sliding sleeves are placed on upper ends of the springs 3. The connecting plate 1.1 of the step assembly 1 is mounted into spaces of the elastic supporting boxes 2, the guide rods 4 pass through the connecting plate 1.1, and the distance between the two elastic supporting boxes 2 is adjusted. The top plates 2.7 are mounted after initial stress is applied to the step assembly 1. When it is necessary to replace the step assembly 1, only the top plates 2.7 are removed to mount a new step assembly 1.

It should be noted that the compression springs used in the foregoing embodiment may alternatively be tension springs, for example, an upper end of each tension spring is fixed to the top plate 2.7, and a lower end is connected to the connecting plate 1.1, which can also achieve the same technical effect.

The limit blocks 2.6 can be cancelled, and springs with higher stiffness can be used, or the bottom plates 2.5 can be used to form limits.

The embodiments of the present invention are described above with reference to the

accompanying drawings, and the embodiments of the present invention and the features of the embodiments may be combined with each other without conflicts. The present invention is not limited to the foregoing specific implementations, and the foregoing specific implementations are merely illustrative but not restrictive. Many forms may also be made by those of ordinary skill in the art under the enlightenment of the present invention without departing from the purpose of the present invention and the scope of the claims, and these forms fall into the scope of the present invention.

Claims

1. A retractable step for a rail vehicle, wherein comprising: a step assembly (1) and elastic supporting boxes (2) located on two sides of the step assembly (1),
the step assembly (1) comprises two vertical and opposite vertical plates (1.3) and at least two step plates (1.2, 1.4) arranged at intervals in a vertical direction, two ends of the step plates (1.2, 1.4) are fixedly connected to the vertical plates (1.3) respectively, a connecting plate (1.1) is arranged on an outer side of each vertical plate (1.3), and the connecting plates (1.1) and the step plates (1.2, 1.4) are arranged horizontally; and
each elastic supporting box (2) comprises a bottom plate (2.5), a front baffle (2.1), a rear baffle (2.2), an outer side plate (2.3), and a top plate (2.7); at least a portion of the connecting plate (1.1) is located inside a cavity of the elastic supporting box (2), and a spring (3) extending in the vertical direction is arranged in the elastic supporting box (2); one end of the spring (3) is fixedly connected to the bottom plate (2.5) or the top plate (2.7), and the other end abuts against or is connected to the connecting plate (1.1).
2. The retractable step for a rail vehicle according to claim 1, wherein guide rods (4) for guiding the springs (3) are further arranged in the elastic supporting box (2), and the connecting plate (1.1) is provided with a through hole (5) through which the guide rod (4) passes.
3. The retractable step for a rail vehicle according to claim 2, wherein more than two guide rods (4) and more than two springs (3) are arranged in one-to-one correspondence.
4. The retractable step for a rail vehicle according to claim 1, wherein a limit block (2.6) is further arranged inside the elastic supporting box (2), and the limit block (2.6) is fixedly connected to the bottom plate (2.5) to define a limit position of downward movement of the connecting plate (1.1).
5. The retractable step for a rail vehicle according to claim 1, wherein a mounting plate is fixedly arranged on the outer side plate (2.3), the mounting plate is arranged horizontally and extends towards an outer side of the outer side plate, and the mounting plate is provided with connecting holes (6).
6. The retractable step for a rail vehicle according to claim 5, wherein the connecting holes (6) are kidney-shaped holes.

7. The retractable step for a rail vehicle according to claim 5, wherein the top plate (2.7) is detachably connected to the mounting plate through fasteners.