CLAIMS

1. A collision energy absorbing device of a railcar, the collision energy absorbing device comprising:

a plurality of outside plates forming an outer tube having an axis extending in a car longitudinal direction; and

at least one partition plate extending in the car longitudinal direction in an internal space surrounded by the plurality of outside plates, the at least one partition plate being fixed to the plurality of outside plates and dividing the internal space, wherein:

an outer shape of the outer tube is symmetrical with respect to a virtual horizontal surface including the axis, and

the at least one partition plate includes a cutout portion located in the internal space, the cutout portion extending on each side of the axis of the outer tube and having a shape that changes as the cutout portion extends along a perpendicular direction of the at least one partition plate, which is perpendicular to the axis of the outer tube.

2. The collision energy absorbing device according to claim 1, wherein the shape of the cutout portion has an area of a cross section of the partition plate that increases and decreases as the cross section of the partition plate extends from a front side to a rear side.

3. The collision energy absorbing device according to claim 1, wherein the shape of the cutout portion is symmetrical with respect to the virtual horizontal surface including the axis or a virtual vertical surface including the axis.

4. The collision energy absorbing device according to claim 1, further comprising:

a front plate facing a front end of the outer tube; and

a rear plate facing a rear end of the outer tube, wherein

the front plate closes an opening of the front end of the outer tube, and

the rear plate closes an opening of the rear end of the outer tube.

5. The collision energy absorbing device according to claim 1, further comprising a front plate facing a front end of the outer tube, wherein

the front plate has a shape in a car width direction middle portion of the front plate that projects forward beyond both car width direction end portions of the front plate.

6. The collision energy absorbing device according to claim 1, wherein:

the at least one partition plate includes a vertical partition plate and a horizontal partition plate intersecting with the vertical partition plate;

the cutout portion of at least one of the vertical partition plate and the horizontal partition plate is formed at a car longitudinal direction end portion of the at least one partition plate;

the car longitudinal direction end portion includes a concave portion depressed in the car longitudinal direction and a convex portion projecting in the car longitudinal direction; and

the convex portion is arranged at a position where the vertical partition plate and the horizontal partition plate intersect with each other.

7. The collision energy absorbing device according to claim 1, wherein a vertical length of a rear end of the outer tube is longer than a horizontal length of the rear end of the outer tube, and a vertical length of a front end of the outer tube is shorter than a horizontal length of the front end of the outer tube.

8. The collision energy absorbing device according to claim 2, wherein the shape of the cutout portion is symmetrical with respect to the virtual horizontal surface including the axis or a virtual vertical surface including the axis.

9. The collision energy absorbing device according to claim 2, further comprising:

a front plate facing a front end of the outer tube; and

a rear plate facing a rear end of the outer tube, wherein

the front plate closes an opening of the front end of the outer tube, and the rear plate closes an opening of the rear end of the outer tube.

10. The collision energy absorbing device according to claim 3, further comprising:

a front plate facing a front end of the outer tube; and

a rear plate facing a rear end of the outer tube, wherein

the front plate closes an opening of the front end of the outer tube, and the rear plate closes an opening of the rear end of the outer tube.

11. The collision energy absorbing device according to claim 2, further comprising a front plate facing a front end of the outer tube, wherein

the front plate has a shape such that a car width direction middle portion of the front plate projects forward beyond both car width direction end portions of the front plate.

12. The collision energy absorbing device according to claim 3, further comprising a front plate facing a front end of the outer tube, wherein

the front plate has a shape such that a car width direction middle portion of the front plate projects forward beyond both car width direction end portions of the front plate.

13. The collision energy absorbing device according to claim 2, wherein:

the at least one partition plate includes a vertical partition plate and a horizontal partition plate intersecting with the vertical partition plate;

the cutout portion of at least one of the vertical partition plate and the horizontal partition plate is formed at a car longitudinal direction end portion of the at least one partition plate;

the car longitudinal direction end portion includes a concave portion depressed in the car longitudinal direction and a convex portion projecting in the car longitudinal direction; and

the convex portion is arranged at a position where the vertical partition plate and the horizontal partition plate intersect with each other.

14. The collision energy absorbing device according to claim 3, wherein:

the at least one partition plate includes a vertical partition plate and a horizontal partition plate intersecting with the vertical partition plate;

the cutout portion of at least one of the vertical partition plate and the horizontal partition plate is formed at a car longitudinal direction end portion of the at least one partition plate;

the car longitudinal direction end portion includes a concave portion depressed in the car longitudinal direction and a convex portion projecting in the car longitudinal direction; and

the convex portion is arranged at a position where the vertical partition plate and the horizontal partition plate intersect with each other.

15. The collision energy absorbing device according to claim 4, wherein:

the at least one partition plate includes a vertical partition plate and a horizontal partition plate intersecting with the vertical partition plate;

the cutout portion of at least one of the vertical partition plate and the horizontal partition plate is formed at a car longitudinal direction end portion of the at least one partition plate;

the car longitudinal direction end portion includes a concave portion depressed in the car longitudinal direction and a convex portion projecting in the car longitudinal direction; and

the convex portion is arranged at a position where the vertical partition plate and the horizontal partition plate intersect with each other.

16. The collision energy absorbing device according to claim 2, wherein a vertical length of a rear end of the outer tube is longer than a horizontal length of the rear end of the outer tube, and a vertical length of a front end of the outer tube is shorter than a horizontal length of the front end of the outer tube.

17. The collision energy absorbing device according to claim 3, wherein a vertical length of a rear end of the outer tube is longer than a horizontal length of the rear end of the outer tube, and a vertical length of a front end of the outer tube is shorter than a horizontal length of the front end of the outer tube.

18. The collision energy absorbing device according to claim 4, wherein a vertical length of a rear end of the outer tube is longer than a horizontal length of the rear end of the outer tube, and a vertical length of a front end of the outer tube is shorter than a horizontal length of the front end of the outer tube.

19. The collision energy absorbing device according to claim 5, wherein a vertical length of a rear end of the outer tube is longer than a horizontal length of the rear end of the outer tube, and a vertical length of a front end of the outer tube is shorter than a horizontal length of the front end of the outer tube.

20. The collision energy absorbing device according to claim 6, wherein a vertical length of a rear end of the outer tube is longer than a horizontal length of the rear end of the outer tube, and a vertical length of a front end of the outer tube is shorter than a horizontal length of the front end of the outer tube.