

STACKING CASE STRUCTURE

The present invention relates to a stacking case structure.

5 BACKGROUND ART

For example, an endoscope apparatus disclosed in Japanese Patent Application Publication No. 2006-30902 is known as a conventional technique related to a stacking case structure. The endoscope apparatus of the Publication
10 includes an accommodation case for accommodating an endoscope having an insertion part that is flexible and thin and a device body that controls an operation of the endoscope. The endoscope apparatus has a position restriction member at an exterior of the accommodation case. When accommodation cases are placed in contact with each other, the position restriction member restricts
15 positions of the accommodation cases relative to each other. In a pair of accommodation cases facing each other, the position restriction member of the endoscope apparatus of the Publication is a protrusion formed at the exterior of one of the pair of the accommodation cases, or a recess formed in the other of the pair of accommodation cases facing the accommodation case having the
20 protrusion. The protrusion is a foldable member that has one end rotatably engaged with the exterior and can stand up relative to the exterior or be accommodated in the exterior.

According to the endoscope apparatus of the Publication, when the
25 endoscope apparatuses are stored in a stacking manner, positions of the accommodation cases relative to each other may be restricted by placing the accommodation cases in contact with each other.

However, in the endoscope apparatus of the Publication, the recess
30 formed in the exterior of the accommodation case is recessed toward the accommodation space, which may create a dead space in the accommodation space of the accommodation case. That is, the recess recessed toward the

accommodation space reduces an effective space that can be used for accommodation in the accommodation space of the accommodation case.

The present invention has been made in view of the above problems, and is directed to providing a stacking case structure that can restrict displacement between cases that are stacked vertically, and prevent reduction in an effective space in each of the cases as much as possible.

SUMMARY

In accordance with an aspect of the present disclosure, there is provided a stacking case structure including a lower case having a box shape, an upper case to be mounted on the lower case, the upper case having a box shape, a movement restriction body configured to restrict horizontal movement of the upper case relative to the lower case, and an engagement body provided in the lower case. The engagement body includes a fixing portion fixed to an upper portion of a side surface of the lower case, and an engagement portion extending outwardly from the fixing portion so as to be spaced from the side surface of the lower case. The movement restriction body is fixed to a lower portion of a side surface of the upper case and has a recess recessed in a direction from a lower portion toward an upper portion of the side surface of the upper case. The engagement portion is insertable into the recess.

Other aspects and advantages of the disclosure will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosure, together with objects and advantages thereof, may best be understood by reference to the following description of the embodiments together with the accompanying drawings in which:

FIG. 1 is a perspective view illustrating a stacking battery case structure according to a first embodiment;

FIG. 2A is a plan view of the stacking battery case structure, and FIG. 2B is a rear view of the stacking battery case structure;

FIG. 3 is a partially enlarged side view illustrating a main part of the stacking battery case structure;

FIG. 4A is a partially enlarged rear view illustrating the main part of the stacking battery case structure, and FIG. 4B is a cross-sectional view taken along line 4B-4B of FIG. 3;

FIG. 5A is a partially enlarged perspective view illustrating the main part of the stacking battery case structure before the stacking battery case structure is stacked, and FIG. 5B is a partially enlarged perspective view illustrating the main part of the stacking battery case structure after the stacking battery case structure is stacked; and

FIG. 6A is a partially enlarged perspective view according to a first modification, FIG. 6B is a partially enlarged perspective view according to a second modification, and FIG. 6C is a partially enlarged perspective view according to a third modification.

DETAILED DESCRIPTION OF THE EMBODIMENTS

First embodiment

The following will describe a stacking case structure according to a first embodiment with reference to the accompanying drawings. A stacking case structure of the present embodiment is a stacking battery case structure having two battery cases in which one battery case is stacked on top of the other. The two battery cases are mounted on a forklift truck as a battery-operated industrial vehicle.

As illustrated in FIG. 1, a stacking battery case structure 10 includes a battery case 11 and a battery case 12 that can be stacked on the battery case 11.

The battery case 11 corresponds to a lower case, and the battery case 12 corresponds to an upper case. The battery case 11 and the battery case 12 each are a box-shaped iron case for accommodating a battery (not illustrated) as an object to be accommodated. The battery (battery cell) is, for example, a lithium ion secondary battery.

The battery case 11 has a bottom plate 14 having a rectangular shape, a pair of side plates 15 extending vertically from the bottom plate 14, a pair of side plates 16 each having a surface perpendicular to the side plates 15, and a top plate 17 facing the bottom plate 14. The bottom plate 14, the pair of side plates 15, the pair of side plates 16, and the top plate 17 form a rectangular parallelepiped accommodation space inside the battery case 11. In a state in which the battery case 11 is mounted on a vehicle body of the forklift truck (not illustrated), one of the side plates 15 and the other of side plates 15 face the front side and the rear side, respectively, of the vehicle body. In the state in which the battery case 11 is mounted on the vehicle body, one of the side plates 16 and the other of the side plates 16 face the right side and the left side, respectively, of the vehicle body.

The bottom plate 14 forms a bottom surface of the battery case 11, the pair of side plates 15 forms side surfaces of the battery case 11 in a front-rear direction, the pair of side plates 16 form side surfaces of the battery case 11 in a lateral direction, and the top plate 17 forms an upper surface of the battery case 11, as illustrated in FIG. 2B.

A cutout 18 is formed near an upper end of the other of the side plates 15. The cutout 18 is for a drawn wire 19 from the battery cell to pass through the battery case 11. A guide stopper 20 is formed in the other of the side plates 16. The guide stopper 20 is a member for easy positioning of the battery case 11 relative to the vehicle body. The guide stopper 20 has a recess 21 recessed upward from a lower surface in a mountain shape. A protrusion formed in the vehicle body (not illustrated) is inserted and fitted into the recess 21.

The top plate 17 is attached to the upper ends of the pair of side plates 15 and the upper ends of the pair of side plates 16 with bolts (not illustrated). Therefore, the top plate 17 can be removed from the side plates 15, 16 by removing the bolts.

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Next, the battery case 12 will be described. The battery case 12 is substantially identical to the battery case 11. The battery case 12 has a bottom plate 24 having a rectangular shape, a pair of side plates 25 extending vertically from the bottom plate 24, a pair of side plates 26 each having a surface perpendicular to the side plates 25, and a top plate 27 facing the bottom plate 24. The bottom plate 24, the pair of side plates 25, the pair of side plates 26 and the top plate 27 form a rectangular housing space inside the battery case 12. In a state where the battery case 12 is mounted on a vehicle body of the forklift truck (not illustrated), one of the side plates 25 and the other of side plates 25 face the front side and the rear side, respectively, of the vehicle body. In the state in which the battery case 12 is mounted on the vehicle body, one of the side plates 26 and the other of the side plates 26 face the right side and the left side, respectively, of the vehicle body.

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As illustrated in FIG. 2B, the bottom plate 24 forms a bottom surface of the battery case 12, the pair of side plates 25 forms side surfaces of the battery case 12 in the front-rear direction, the pair of side plates 26 form side surfaces of the battery case 12 in the lateral direction, and the top plate 27 forms an upper surface of the battery case 12.

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A cutout 28 is formed near an upper end of the other of the side plates 25. The cutout 28 is for a drawn wire 29 from the battery cell to pass through the battery case 12. When the battery case 12 is stacked on the battery case 11, the bottom plate 24 of the battery case 12 is in contact with the top plate 17 of the battery case 11.

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The stacking battery case structure 10 has an engagement body formed

in the battery case 11 as the lower case, and a wire or a hook with which the battery case 11 is suspended is to be engaged with the engagement member. In addition, the stacking battery case structure 10 has a movement restriction body that restricts movement of the battery case 12 as the upper case relative to the battery case 11 as the lower case.

Firstly, the engagement body will be described. As illustrated in FIG. 3, a plate member 31, which is made of iron and corresponds to the engagement body, is attached to each of the pair of side plates 16 of the battery case 11 by welding. It is noted that, although the plate member 31 is attached to each of the pair of side plates 16, for the sake of description, the plate member 31 attached to the other of the pair of side plates 16 will be described. The plate member 31 has a fixing portion 32 and an engagement portion 33. The fixing portion 32 is a substantially rectangular portion that is fixed to an upper portion of each of the side plates 16 of the battery case 11. The fixing portion 32 has a fixing portion front surface 34, a fixing portion rear surface 35, a fixing portion bottom surface 36, and a pair of fixing portion side surfaces 37. The fixing portion front surface 34 is a surface facing the left side. The fixing portion rear surface 35 is a surface extending substantially parallel to the fixing portion front surface 34, and is a connecting surface to be connected to its associated one of the side plates 16. The fixing portion bottom surface 36 is a surface extending substantially parallel to a plate surface of the top plate 17, and the pair of the fixing portion side surfaces 37 is a surface extending in a vertical direction and substantially perpendicular to the fixing portion bottom surface 36.

The engagement portion 33 is a portion having a substantially trapezoidal shape and extending outwardly from the fixing portion 32 so as to be spaced from its associated one of the side plates 16. The fixing portion 32 and the engagement portion 33 are integrally formed. As illustrated in FIGS. 4A and 4B, the engagement portion 33 is mostly disposed above the top plate 17, and a direction in which the engagement portion 33 extends is a direction that is inclined with respect to its associated one of the side plates 16. An inclination angle of the

engagement portion 33 relative to its associated one of the side plates 16 is about 20 degrees.

The engagement portion 33 has an engagement portion front surface 41,
5 an engagement portion rear surface 42, a pair of engagement portion side surfaces 43, and an engagement portion upper surface 44. The engagement portion front surface 41 is a surface continuous with the fixing portion front surface 34. The engagement portion rear surface 42 is a surface continuous with the fixing portion rear surface 35 and extending substantially parallel to the
10 engagement portion front surface 41. The engagement portion front surface 41 and the engagement portion rear surface 42 are inclined at about 20 degrees with respect to its associated one of the side plates 16. The pair of engagement portion side surfaces 43 is formed so that the width of the engagement portion 33 decreases toward a distal end thereof from the fixing portion 32. One of the
15 engagement portion side surfaces 43 is a side surface that extends continuously from one of the fixing portion side surfaces 37 and is inclined with respect to the one of the fixing portion side surfaces 37. The other of the engagement portion side surfaces 43 is a side surface that extends continuously from the other of the fixing portion side surfaces 37 and is inclined with respect to the other of the fixing
20 portion side surfaces 37.

The engagement portion upper surface 44 is a surface connecting the upper ends of the engagement portion side surfaces 43 and forms the distal end of the engagement portion 33. Since the pair of engagement portion side surfaces 43 is formed so that the width of the engagement portion 33 decreases
25 from the fixing portion 32 toward the distal end, a length of the engagement portion upper surface 44 is smaller than that of the fixing portion bottom surface 36. The engagement portion 33 has a through hole 45 extending from the engagement portion front surface 41 to the engagement portion rear surface 42 at the center of
30 the engagement portion 33. The through hole 45 is a hole that allows the wire or the hook for suspending the battery case 11 to be inserted to engage with the engagement portion 33.

The following will describe the movement restriction body. As illustrated in FIGS. 4A and 4B, a plate member 51 is fixed to each of the side plates 26 of the battery case 12 by welding. The plate member 51 corresponds to the movement
5 restriction body that restricts the movement of the battery case 12 relative to the battery case 11. The plate member 51 is disposed at a lower portion of each of the side plates 26 and near the bottom plate 24. The plate member 51 has a plate member front surface 52, a plate member rear surface 53, a plate member upper surface 54, and a pair of plate member side surfaces 55. In addition, the
10 plate member 51 has a pair of plate member lower bottom surfaces 56, a pair of plate member inner side surfaces 57, and a plate member upper bottom surface 58.

The plate member front surface 52 is a surface facing the left side. The
15 plate member rear surface 53 is a surface extending substantially parallel to its associated one of the side plates 26 and is a connecting surface to be connected to its associated one of the side plates 26. The plate member upper surface 54 is an upper surface of the plate member 51, extending substantially parallel to a plate surface of the bottom plate 24. The pair of plate member side surfaces 55
20 extends in the vertical direction and substantially perpendicularly to the plate member upper surface 54. As illustrated in FIG. 3, the pair of plate member lower bottom surfaces 56 is surfaces extending from the bottom ends of the plate member side surfaces 55 in a direction that is perpendicular to plate member side surfaces 55, and is disposed near the top plate 17 at the lower portion of its
25 associated one of the side plates 26.

As illustrated in FIGS. 3, 5A and 5B, the pair of plate member inner side surfaces 57 and the plate member upper bottom surface 58 are surfaces forming a recess 59 in the plate member 51. The pair of plate member inner side surfaces
30 57 is formed so that a width of the recess 59 decreases upward from the plate member lower bottom surfaces 56. The plate member inner side surfaces 57 are inclined with respect to the vertical direction. The plate member upper bottom

surface 58 is a surface connecting the upper ends of the plate member inner side surfaces 57 and extending substantially parallel to the plate member lower bottom surfaces 56. A length of the plate member upper bottom surface 58 is greater than that of the engagement portion upper surface 44.

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In a state in which the battery case 12 is stacked on the battery case 11, a portion of the engagement portion 33 is inserted into the recess 59. Inclination angles of the engagement portion side surfaces 43 and the plate member inner side surfaces 57 with respect to the vertical direction are the same or substantially the same. Therefore, when the battery case 12 is stacked on the battery case 11, the engagement portion side surfaces 43 of the engagement portion 33 are in contact with their associated plate member inner side surfaces 57 of the plate member 51, which function as a guide for positioning the battery case 12 relative to the battery case 11 in the front-rear direction. The engagement portion rear surface 42 is placed in contact with a corner of one of the side surfaces and the bottom surface of the battery case 12 to function as the guide for positioning the battery case 12 relative to the battery case 11 in the lateral direction.

Although the inclination angle of the engagement portion 33 is set to 20 degrees, the angle of the engagement portion 33 may be set according to conditions such as a space for mounting the battery cases 11, 12 on the vehicle body. A distance from the distal end of the engagement portion 33 to its associated one of the side plates 16 increases as the inclination angle of the engagement portion 33 increases. Since the battery cases 11, 12, which are heavy objects, are suspended, the inclination angle is preferably in a range of 15 to 30 degrees considering the strength as the engagement body.

Next, the operation of the stacking battery case structure 10 of the present embodiment will be described. In stacking the battery case 12 on the battery case 11 which have been placed in advance, an operator moves the suspended battery case 12 above the battery case 11, aligns the orientation of the battery case 12 with the orientation of the battery case 11, and then lowers the battery

case 12. When the battery case 12 is lowered, the position of the battery case 12 in the lateral direction may be slightly different from that of the battery case 11. In such a case, when the bottom plate 24 and the side plates 26 of the battery case 12 are placed in contact with the rear surface of the engagement portion 33 of the plate member 31, the battery case 12 is guided by the engagement portion rear surface 42. As a result, the battery case 12 is positioned in the lateral direction while the battery case 12 is lowered.

When the battery case 12 is lowered, the position of the battery case 12 in the front-rear direction may be slightly different from that of the battery case 11. In such a case, when the engagement portion 33 of the plate member 31 is inserted in the recess 59 of the plate member 51 of the battery case 12, the plate member 51 is guided by the engagement portion 33. More specifically, when the plate member inner side surfaces 57 are in contact with the engagement portion side surfaces 43 with the battery case 12 lowered, the plate member inner side surfaces 57 are guided by the engagement portion side surfaces 43. As a result, the battery case 12 is positioned in the front-rear direction while the battery case 12 is lowered.

In the state in which the battery case 12 is stacked on the battery case 11, the plate member inner side surfaces 57 of the plate member 51 are placed in contact with the engagement portion side surfaces 43 of the plate member 31 even if the battery case 12 moves to be displaced in the front-rear direction. This prevents the battery case 12 from being displaced relative to the battery case 11 in the front-rear direction. Even if the battery case 12 moves to be displaced in the lateral direction, the plate member 51 is placed in contact with the engagement portion 33 of the plate member 31, which prevents the battery case 12 from being displaced relative to the battery case 11 in the lateral direction. Accordingly, in the present embodiment, horizontal movement of the battery case 12 relative to the battery case 11 is restricted by the engagement portion 33 of the plate member 31 and the plate member 51.

In suspending the battery cases 11, 12 with the battery case 12 stacked on the battery case 11, a wire (not illustrated) is inserted through the through hole 45, engaged with the engagement portion 33, and pulled up, thereby suspending the battery cases 11, 12 with the battery case 12 stacked on the battery case 11.
5 Alternatively, a hook (not illustrated), instead of the wire, inserted through the through hole 45 and engaged with the engagement portion 33, thereby suspending the battery cases 11, 12.

The plate member 31 is provided in each of the side plates 16 of the
10 battery case 11, and the plate member 51 is provided in each of the side plates 26 of the battery case 12. Therefore, a rectangular accommodation space without irregularities is formed inside each of the battery cases 11, 12, and a dead space is less likely to be formed.

15 The stacking battery case structure 10 of the present embodiment offers the following advantageous effects.

(1) The plate member 31 as the engagement body has the fixing portion 32 fixed to the upper portion of its associated one of the side plates 16 of the
20 battery case 11, and the engagement portion 33 extending outwardly from the fixing portion 32 so as to be spaced from its associated one of the side plates 16. In addition, the plate member 51 as the movement restriction body is fixed to the lower portion of its associated one of the side plates 26 of the battery case 12 and has the recess 59 recessed from the lower portion toward the upper portion of the
25 associated one of the side plates 26. In a state in which the battery case 12 is stacked on the battery case 11, the engagement portion 33 of the plate member 31 is inserted into the recess 59 of the plate member 51. Therefore, even if the battery case 12 moves horizontally relative to the battery case 11, the plate member 51 is placed in contact with the engagement portion 33, which prevents
30 movement of the battery case 12 relative to the battery case 11. In addition, the plate member 31 is fixed to its associated one of the side plates 16 of the battery case 11, and the plate member 51 is fixed to its associated one of the side plates

26 of the battery case 12, so that an effective space for accommodating in each of the battery cases 11, 12 is not reduced. As a result, it is possible to restrict the displacement between the battery cases 11, 12 which are stacked vertically, as well as to prevent the reduction of the effective space in each of the battery cases 11, 12 as much as possible.

(2) Since the plate member 31 as the engagement body is a plate member in which the fixing portion 32 and the engagement portion 33 are integrally formed, an increase in the number of parts can be suppressed, and the engagement body may be easily manufactured.

(3) The plate member 31 has the through hole 45. Thus, the engagement body that allows the wire or the hook for suspending the battery case 11 to be engaged with the engagement portion 33 may be provided by only forming the through hole 45 in the engagement portion 33. As a result, an additional member for the wire or the hook to be engaged is not necessary, thereby reducing the production cost.

(4) The engagement portion 33 has the pair of engagement portion side surfaces 43 that is inclined to reduce the width of the engagement portion 33 from the fixing portion 32 toward the distal end of the engagement portion 33. The plate member 51 has the pair of plate member inner side surfaces 57 as a pair of recess side surfaces that is inclined to reduce the width of the recess 59 toward the upper portion of its associated one of the side plates 26 of the battery case 12. Thus, the engagement portion side surfaces 43 of the engagement portion 33 serve as the guide that guides the plate member 51 in stacking the battery case 12 on the battery case 11.

(5) The lower case and the upper case correspond to the battery case 11 and the battery case 12, respectively, to be mounted on the battery-operated industrial vehicle. The battery case 12 as the upper case does not move relative to the battery case 11 as the lower case during travelling of the battery-operated

industrial vehicle.

Modifications

The following will describe a first modification of the present invention.

5 As illustrated in FIG. 6A, a plate member 61 as the engagement body has a fixing portion 32 and an engagement portion 63. The engagement portion 63 has a pair of engagement portion side surfaces 66 and an engagement portion upper surface 67. The pair of engagement portion side surfaces 66 is parallel. A plate member 71 as the movement restriction body has a recess 72. A pair of plate member inner side surfaces 73 forming the recess 72 extends substantially in parallel, and a length between the plate member inner side surfaces 73 in the recess 72 is slightly greater than a length between the pair of engagement portion side surfaces 66 of the engagement portion 63. When the battery case 12 is lowered to be stacked on the battery case 11 with the position of the battery case 12 in the front-rear direction relative to the battery case 11 precisely set, the battery case 12 may be stacked on the battery case 11 suitably.

The following will describe a second modification of the present invention.

20 As illustrated in FIG. 6B, an engagement portion 83 of a plate member 81 has a pair of engagement portion side surfaces 86 and an engagement portion upper surface 87. The engagement portion 83 does not have the through hole 45, but has a cutout 88 extending into the engagement portion 83 from one of the pair of engagement portion side surfaces 86. The cutout 88 is a cutout through which the wire or the hook for suspending the battery cases 11, 12 passes.

25 The following will describe a third modification of the present invention.

As illustrated in FIG. 6C, an engagement portion 93 of a plate member 91 has a pair of overhanging portions 98 that increases a width of the engagement portion 93 near an engagement portion upper surface 97. The overhanging portions 98 are portions where a width of the engagement portion 93 increases, which extend from the upper ends of the pair of engagement portion side surfaces 96, and a wire or a hook may pass below the overhanging portions 98. According to the

first to third modifications, it is possible to restrict the displacement between the battery cases 11, 12 which are stacked, as well as to prevent the reduction of the effective space in each of the battery cases 11, 12 as much as possible.

5 The present invention is not limited to the above-described embodiment, but may be modified in various manners within the scope of the invention, as exemplified below.

10 In the above embodiment, the lower case and the upper case as the battery cases mounted on the battery-operated industrial vehicle have been described as an example of the stacking case structure. However, the configuration of the present invention is not limited thereto. The lower case and the upper case of the stacking case structure may be cases for storing goods and the like.

15 Although the engagement body is provided only in the lower case in the above embodiment, the configuration of the present invention is not limited thereto. The engagement body may be provided in the upper case. By providing the engagement body in the upper case, another case can be stacked on top of the upper case. In addition, the engagement body may be provided in the upper case, and the movement restriction body may be provided in the lower case. In this case, the upper case may function as the lower case and the lower case may be stacked as the upper case.

25 In the above embodiment, the fixing portion and the engagement portion are integrally formed. However, the configuration of the engagement body is not limited thereto. The fixing portion and the engagement portion may be separate parts and connected by a connecting member.

What is claimed is:

1. A stacking case structure comprising:

a lower case having a box shape;

5 an upper case having a box shape and to be mounted on the lower case;

a movement restriction body configured to restrict horizontal movement of the upper case relative to the lower case; and

an engagement body provided in the lower case, characterized in that the engagement body includes:

10 a fixing portion fixed to an upper portion of a side surface of the lower case; and

an engagement portion extending outwardly from the fixing portion so as to be spaced from the side surface of the lower case,

15 the movement restriction body is fixed to a lower portion of a side surface of the upper case, and has a recess recessed in a direction from a lower portion of the side surface of the upper case toward an upper portion of the side surface of the upper case, and

the engagement portion is insertable into the recess.

20 2. The stacking case structure according to claim 1, characterized in that

the engagement body is a plate member in which the fixing portion and the engagement portion are integrally formed.

3. The stacking case structure according to claim 1 or 2, characterized in that

25 the engagement portion has a through hole that allows a wire or a hook for suspending the lower case to engage with the engagement portion.

4. The stacking case structure according to claim 1 or 2, characterized in that the engagement portion has a pair of engagement portion side surfaces

30 that is inclined to reduce a width of the engagement portion from the fixing portion toward a distal end of the engagement portion, and

the movement restriction body has a pair of recess side surfaces that is

inclined to reduce a width of the recess toward the upper portion of the side surface of the upper case.

5. The stacking case structure according to claim 1 or 2, characterized in that
- 5 the lower case and the upper case are battery cases to be mounted on a battery-operated industrial vehicle.