

DESCRIPTION

ELEVATOR BUFFER

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Technical Field

The present invention relates to an elevator buffer for stopping a cage or a suspended weight while reducing shock as much as possible when the cage or the suspended weight falls for any reason. More particularly, the invention relates to
10 a buffer having plungers coupled at multiple stages.

Background Art

FIG. 1 shows a conventional elevator buffer. This elevator buffer 100A has a hydraulic buffer main body 101 provided in a bottom of a pit located at a lowermost part of
15 a hoistway. The hydraulic buffer main body 101 includes a cylinder 102 filled with oil, a plunger 103 slidably fitted to the cylinder 102 and expanded/contracted in upper and lower directions, and a compression spring 104 arranged in the plunger 103 and the cylinder 102.

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A cam attaching arm 105 is fixed to an upper end of the plunger 103. A cam rod 106 is vertically disposed in a tip of the cam attaching arm 105 extending in a horizontal direction. A lower end of the cam rod 106 is engaged with an operation arm 107a of a return checking switch 107. The

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return checking switch 107 is set to switch from ON to OFF by

a downward movement of the cam rod 106. The return checking switch 107 is fixed through a switch attaching arm 108 to the cylinder 102, and positioned so as not to interfere with the plunger 103 or the like to be contracted. Incidentally, a
5 reference numeral 109 denotes a cord for outputting switch information of the return checking switch 107.

Next, an operation of the elevator buffer 100A will be described. For example, when a cage 110 is lowered for any reason to bump into an upper surface of the plunger 103, the
10 plunger 103 is gradually contracted against hydraulic pressure or spring pressure, whereby the cage 110 is safely stopped. The contraction of the plunger 103 lowers the cam rod 106 to switch off the return checking switch 107. By switching off the return checking switch 107, power supply is
5 cut off.

After the cage 110 on the plunger 103 is raised to a normal running area by recovery work or the like, the plunger 103 is returned to an expansion position by spring pressure. By expansion of the plunger 103, the cam rod 106 is raised to
20 switch on the return checking switch 107. Power supply is turned ON for the first time by switching on the return checking switch 107, whereby normal running of the cage 110 is permitted. That is, the cage 110 can be normally run only after the plunger 103 returns to the expansion position and
25 to be in a state of stable stop against abnormal falling of

the cage 110.

FIG. 2 shows another conventional elevator buffer. As shown in FIG. 2, this elevator buffer 100B has a hydraulic buffer main body 101 provided in a bottom of a pit located at a lowermost part of a hoistway. The hydraulic buffer main body 101 includes a cylinder 102 filled with oil, a plunger 103 slidably fitted to the cylinder 102 and expanded/contracted in upper and lower directions, and a compression spring 104 arranged in the plunger 103 and the cylinder 102.

An attaching arm 111 is fixed to an upper end of the plunger 103, and one end of a flexible long member 112 such as a string is connected to a tip of the attaching arm 111 extending in a horizontal direction. The other end of the flexible long member 112 is connected to an operation arm 107a of a return checking switch 107. In an expansion position of the plunger 103, tension of the flexible long member 112 maintains the return checking switch 107 in an ON state. The return checking switch 107 is set to switch from ON to OFF by a downward movement of the plunger 103. The return checking switch 107 is fixed through a switch attaching arm 108 to the cylinder 102, and positioned so as not to interfere with the plunger 103 or the like to be contracted. Incidentally, a reference numeral 109 denotes a cord for outputting switch information of the return checking

switch 107.

Next, an operation of the elevator buffer 100B will be described. For example, when the cage 110 is lowered for any reason to bump into an upper surface of the plunger 103, the plunger 103 is gradually contracted against hydraulic pressure or spring pressure, whereby the cage 110 is safely stopped. The contraction of the plunger 103 releases tension of the flexible long member 112 to switch off the return checking switch 107. By switching off the return checking switch 107, power supply is cut off.

After the cage 110 on the plunger 103 is raised to a normal running area by recovery work or the like, the plunger 103 is returned to an expansion position by spring pressure. By expansion of the plunger 103, tension of the flexible long member 112 is restored to switch on the return checking switch 107. Power supply is turned ON by switching on the return checking switch 107, whereby normal running of the cage 110 is permitted.

In the aforementioned manner, safety of the elevator is secured because the elevator buffers 100A, 100B are safely stopped against abnormal falling of the cage 110 or the like while absorbing shock, and the cage 110 or the like is stopped running until the return checking switch 107 detects returning of the plunger 103 to the expansion position after the abnormally lowered cage 110 or the like rises to the

normal running area.

For the buffer used for a very high-speed elevator, a buffer main body having a multistage-coupled plunger is used in order to realize a smaller buffer and a longer plunger stroke simultaneously. If an installation structure of the return checking switch shown in FIG. 1 is simply disposed in the buffer using the buffer main body of the multistage-coupled plunger system, a constitution is similar to that shown in FIG. 3A.

In FIG. 3A, in this buffer 100C, a hydraulic buffer main body 101 having plungers 103a to 103c coupled at multiple stages is arranged in a bottom of a pit located at a lowermost part of a hoistway. A cam attaching arm 105 is provided in the uppermost plunger 103a, and a cam rod 106 is vertically disposed in a tip of the cam attaching arm 105. Other components are similar to those described above, denoted by similar reference numerals, and description thereof will be omitted.

However, as shown in FIG. 3B, there is a problem of interference of the cam rod 106 with an installation surface 120 of a cylinder 102 because of a longer plunger stroke compared with a cylinder length.

Disclosure of Invention

An example buffer 100D shown in FIG. 4 is conceived to solve the

aforementioned problems. As shown in FIG. 4, in this buffer 100D, each of cam attaching arms 105 and cam rods 106 are disposed in each of plungers 103a to 103c, and return checking switches 107 are disposed not only in a cylinder 102 but also in the plungers 103b of the second stage and 103c of the third stage. Then, contracting movements of the plungers 103a to 103c are detected by the plurality of return checking switches 107.

The uppermost plunger 103a is not rotated because it is contracted with a cage (not shown) mounted thereon. However, the plungers 103b, 103c lower than the uppermost plunger are easily rotated as indicated by arrows in FIG. 4 because they are freely rotatable. Consequently, there may be a possibility that none of the return checking switches 107 will be operated surely.

On the other hand, application of the installation structure of the return checking switch shown in FIG. 2 to the buffer using the multistage-coupled absorber main body can be conceived. However, the flexible long member becomes very long, and there is a high probability of entanglement of the flexible long member during plunger contraction or expansion. Consequently, there is a possibility that the return checking switch will be malfunctioned. Additionally, the entanglement may break the flexible long member, thereby making it impossible to guarantee a sure and normal operation

of the return checking switch.

The embodiments of the present invention are designed to solve the aforementioned problems, and the embodiments of the invention can provide an elevator buffer which uses an absorber main body of plungers coupled at multiple stages and can be surely and accurately operated without any interference with an installation surface of the cylinder.

According to an aspect of the present invention, there is provided an elevator buffer comprising: a buffer main body in which a plurality of plungers are coupled to an upper surface of a cylinder at multiple stages, the buffer main body being arranged at a lowermost part of a hoistway; a pulley mechanism having pulley multi-winging means in which one end of a flexible long member is fixed to the uppermost plunger, the other end of the flexible long member is fixed to a fixing part, a middle part of the flexible long member has at least one or more movable pulleys, and slackening of the flexible long member is absorbed by falling of the movable pulleys; and a return checking switch operated in accordance with upper and lower positions of the movable pulleys.

In the example elevator buffer, when the plunger is contracted, the flexible long member is lowered by a dimension equal to a stroke of this plunger, and the falling dimension of the flexing long member is absorbed by the falling of the movable pulley. The falling dimension of the flexible long member can be absorbed by a sufficiently short falling distance.

Since the falling amount of the flexible long member is absorbed while it is hung between the fixed pulley and the movable pulley, no entanglement occurs. Thus, in the buffer using the buffer main body of the multistage-coupled plungers, i.e., in a case where the dimension of the cylinder is shorter than a total plunger contraction stroke, the return checking switch can be surely and normally operated without any interference with an installation surface of the cylinder.

Preferably, a tensioner weight is attached to the movable pulleys, and the return checking switch is attached to the tensioner weight or the cylinder.

In example elevator buffer, since tension of the flexible long member is increased, malfunction or entanglement of the flexible long member due to slackening can be prevented. Since the return checking switch is not installed in a fixed place, it is not necessary to secure its installation space. The operating position of the return checking switch can be easily adjusted because a length of the flexible long member needs not be adjusted.

Additionally, since it is not necessary to separately install a fixing part for fixing the return checking switch, a structure can be simplified.

A guide rail may be disposed to guide an up-and-down movement of the tensioner weight.

According to this configuration, swinging of the movable pulley or the flexible long member may be suppressed by

the tensioner weight. Thus, the movable pulley or the like can be smoothly moved.

Elastic urging means may be disposed to urge the movable pulleys downward.

In the example elevator buffer, since the movable pulleys are easily moved by a pressing force of the elastic means when plunger is contracted, slackening of the flexible long member can be prevented as much as possible. Thus, it is possible to prevent malfunction and entanglement of the flexible long member due to slackening.

An amplification link may be disposed in which one end thereof is connected to the movable pulleys, the return checking switch is engaged with the other end thereof, and an up-and-down displacement of each of the pulleys is transmitted as amplified displacement to the other end thereof.

In the example elevator buffer, since a falling stroke of the movable pulley is converted into a large displacement by the amplification link, and the return checking switch is operated by this large displacement. Thus, the return checking switch can be operated more surely and accurately.

Brief Description of Drawings

FIG. 1 is a schematic front view showing an elevator buffer of a conventional example.

FIG. 2 is a schematic front view showing an elevator buffer of another conventional example.

FIGS. 3A and 3B show a case of using an absorber main body of a multistage-coupled plunger system and simply
5 disposing an installation structure of a return checking switch shown in FIG. 1: FIG. 3A a schematic front view of the elevator buffer in expansion of the plungers, and FIG. 3B a schematic front view of the elevator buffer in contraction of the plungers.

10 FIG. 4 is a schematic front view of the buffer where the installation structure of the return checking switch of FIG. 1 is disposed for each plunger, in the case of using the absorber main body of the multistage-coupled plunger system.

FIG. 5 is a schematic front view showing an elevator
15 buffer of a first embodiment of the present invention.

FIG. 6 is a perspective view showing pulley multi-winging means of a pulley mechanism of the first embodiment of the present invention.

FIG. 7 is a view explaining a falling distance of a
20 movable pulley with respect to a falling dimension of a flexible long member in the pulley mechanism of the first embodiment of the present invention.

FIG. 8 is a schematic front view showing an elevator buffer of a second embodiment of the present invention.

25 FIG. 9 is a schematic front view of an elevator buffer

of a third embodiment of the present invention.

FIG. 10 is a schematic front view showing an elevator buffer of a fourth embodiment of the present invention.

FIG. 11 is a schematic front view showing an elevator
5 buffer of a fifth embodiment of the present invention.

FIG. 12 is a schematic front view showing an elevator buffer of a sixth embodiment of the present invention.

FIG. 13 is a schematic front view showing an elevator buffer of a seventh embodiment of the present invention.

10 FIG. 14 is a schematic front view showing an elevator buffer of an eighth embodiment of the present invention.

Best Mode for Carrying Out the Invention

Next, the preferred embodiments of the present
15 invention will be described below with reference to the accompanying drawings.

(First Embodiment)

FIGS. 5 to 7 show a first embodiment of the present invention. FIG. 5 is a schematic front view of an elevator
20 buffer 1A, FIG. 6 is a perspective view of pulley multi-winging means 10 of a pulley mechanism 3, and FIG. 7 is a view explaining falling distances of movable pulleys 12a, 12b with respect to a falling dimension of a flexible long member 9 in the pulley mechanism 3.

25 As shown in FIG. 5, the elevator buffer 1A comprises a

hydraulic buffer main body 2 provided in a bottom of a pit located at a lowermost part of a hoistway, a pulley mechanism 3 for lowering movable pulleys 12a, 12b by contraction of plungers 6a to 6c of the hydraulic buffer main body 2, and a return checking switch 4 operated in accordance with upper and lower positions of the movable pulleys 12a, 12b of the pulley mechanism 3.

The hydraulic buffer main body 2 includes a cylinder 5 filled with oil, the multistage-coupled plungers 6a to 6c slidably fitted to the cylinder 5 and expanded/contracted in upper and lower directions, and a compression spring (not shown) arranged in the multistage-coupled plungers 6a to 6c and the cylinder 5.

The pulley mechanism 3 includes a flexible long member 9 having one end connected through an attaching arm 7 to an upper end of the uppermost plunger 6a and the other end connected to a first fixing part 8 installed at a height approximately equal to an upper surface of the cylinder 5, and pulley multi-winging means 10 arranged in a height range of the cylinder 5 (between upper and lower surfaces of the cylinder 5) to wind the flexible long member 9. As specifically shown in FIG. 6, the pulley multi-winging means 10 has two movable pulleys 12a, 12b mutually coupled by rotatably supporting the flexible long member 9 on an axis 11, and one fixed pulley 13 supported by the first fixing part 8.

The flexible long member 9 drooped from the uppermost plunger 6a side is wound about one upper movable pulley 11a, the upper fixed pulley 13, and the other movable pulley, sequentially. The other end side of the flexible long member wound in this order is connected to the first fixing part 8. The first fixing part 8 is installed by being fixed through an attaching member 18 to the cylinder 5 or through an attaching member (not shown) to a hoistway (not shown). The same applies to the following second fixing part 14.

As shown in FIG. 5, the return checking switch 4 includes a switch main body 4a and an operation arm 4b protruding from the switch main body 4a. The switch main body 4a is fixed to the second fixing part 14 arranged in the height range of the cylinder 5. The operation arm 4b is arranged in a position to be interfered with by the movable pulleys 12a, 12b. The return checking switch 4 is set to switch from ON to OFF by downward movements of the movable pulleys 12a, 12b made by falling of the plungers 6a to 6c. Incidentally, a reference numeral 15 denotes a cord for outputting switch information of the return checking switch 4.

Next, an operation of the elevator buffer 1A will be described. For example, when a cage 16 is lowered for any reason to bump into an upper surface of the uppermost plunger 6a, each of the plungers 6A to 6c is gradually contracted against hydraulic pressure or spring pressure, whereby the

cage 16 is safely stopped. When the contraction of each of the plungers 6a to 6c lowers the flexible long member 9 by a dimension equal to a plunger stroke, the movable pulleys 12a, 12b fall to absorb the falling dimension of the flexible long member 9. Upon the falling of the movable pulleys 12a, 12b, the return checking switch 4 is switched OFF. By switching off the return checking switch 4, power supply is cut off.

When the cage 16 on the plungers 6a to 6c is raised to a normal running area by recovery work or the like, the plungers 6a to 6c are returned to expansion positions by spring pressure. When the plungers 6a to 6c are expanded, the movable pulleys 12a, 12b are raised to switch on the return checking switch 4 by an operation reverse to the above. By switching on the return checking switch 4, power supply is turned ON for the first time to permit normal running of the cage 16.

Now, description will be made of a relation between the falling dimension of the flexible long member 9 and the falling distances of the movable pulleys 12a, 12b in the aforementioned operation process. If the falling dimension of the flexible long member 9 is L_1 and the winding number of the flexible long member 9 about each of the movable pulleys 12a, 12b is N , a falling distance L_2 of the movable pulleys 12a, 12b becomes $L_2 = L_1 / (2 \times N)$. According to the first embodiment, since N is 2 because the flexible long member 9

is wound about the two movable pulleys 12a, 12b, the falling distance L2 of the movable pulleys 12a, 12b becomes 1/4 of the falling distance L1, i.e., a plunger stroke, of the flexible long member 9. Thus, since the falling dimension L1 of the flexible long member 9 can be absorbed by short falling distances of the movable pulleys 12a, 12b, interference of the movable pulleys 12a, 12b with an installation surface 17 of the cylinder 5 never occurs. Moreover, the flexible long member 9 is not entangled because the falling distance thereof is absorbed while it is hung between the fixed pulley 13 and the movable pulleys 12a, 12b. Accordingly, in the buffer using the buffer main body 2 of the multistage-coupled plungers 6a to 6c, i.e., in a case where the cylinder 5 is shorter than a total contraction stroke of the plungers, the return checking switch 4 can be surely and normally operated without any interference with the installation surface 17 of the cylinder 5. Therefore, it is possible to obtain the highly reliable buffer 1A.

The flexible long member 9 specifically includes a rope, a belt, a chain or the like. The flexible long member 9 can be prepared inexpensively if it is constituted of a rope. If it is constituted of a belt, the return checking switch 4 can be operated more accurately because of its smaller expansion compared with the rope. If it is constituted of a chain, the return checking switch 4 can be operated much more accurately

because of smaller expansion compared with the rope and the belt, and additionally, a folding diameter (sheave diameter) can be set small. A specific example of the flexible long member 9 will be similar in the following second embodiment and thereafter.

In the first embodiment, the number of movable pulleys is two, i.e., 12a and 12b, and the winding number of the flexible long member 9 about the movable pulleys 12a, 12b is also two. Needless to say, however, the number of movable pulleys may be one and the winding number of the flexible long member 9 about the movable pulleys may also be one (in this case, fixed pulleys are basically not necessary), or the number of movable pulleys may be equal to or more than three, and the winding number of the flexible long member 9 about the movable pulleys may also be equal to or more than three. A value of the winding number of the flexible long member 9 about the movable pulleys is properly determined in accordance with a total plunger contraction stroke and a height dimension of the cylinder 5. The same applies to the following second embodiment.

(Second Embodiment)

FIG. 8 is a schematic front view showing an elevator buffer 1B of a second embodiment of the present invention.

As shown in FIG. 8, the elevator buffer 1B of the second embodiment is different from the first embodiment in

that a tensioner weight 20 is attached to movable pulleys 12a, 12b. Other components are similar to those of the first embodiment, denoted by similar reference numerals and thus description thereof will be omitted.

5 An operation of the elevator buffer 1B of the second embodiment is similar to that of the first embodiment. By this operation, in the buffer using a buffer main body 2 of multistage-coupled plungers 6a to 6c, a return checking switch 4 can be surely and normally operated without any
10 interference with an installation surface 17 of the cylinder 5. Thus, it is possible to obtain the highly reliable buffer 1B.

Moreover, according to the second embodiment, since tension of a flexible long member 9 can be increased by the
15 tensioner weight 20, malfunction and entanglement of the flexible long member 9 due to slackening can be prevented.

(Third Embodiment)

FIG. 9 is a schematic front view showing an elevator buffer 1C of a third embodiment of the present invention.

20 In the second embodiment, the return checking switch 4 is attached to a second fixing part 14, but as shown in FIG. 9, in the elevator buffer 1C of the third embodiment, a return checking switch 4 is attached below a tensioner weight 20, and an operation arm 4b of the return checking switch 4
25 is arranged in a position for interfere with a cam 21 fixed

to a cylinder 5. Other components are similar to those of the second embodiment, denoted by similar reference numerals and description thereof will be omitted.

An operation of the elevator buffer 1C of the third embodiment is similar to that of the second embodiment. By this operation, in the buffer using a buffer main body 2 of multistage-coupled plungers 6a to 6c, the return checking switch 4 can be surely and normally operated without any interference with an installation surface 17 of the cylinder 5. Thus, it is possible to obtain the highly reliable buffer 1C.

Moreover, according to the third embodiment, since the return checking switch 4 is not installed in a fixed place, it is not necessary to secure its installation space. An operation position of the return checking switch 4 can be adjusted by varying a position of the cam 21 without adjusting a length of the flexible long member 9. Thus, the adjustment is easy.

According to the third embodiment, since the return checking switch 4 is arranged in the position directly below the tensioner weight 20, exposure of the return checking switch 4 to refuse and dust can be prevented as much as possible. Therefore, malfunction of the return checking switch 4 can be prevented.

(Fourth Embodiment)

FIG. 10 is a schematic front view showing an elevator buffer 1D of a fourth embodiment of the present invention.

In the second embodiment, the return checking switch 4 is attached to the second fixing part 14, but as shown in FIG.

5 10, in the elevator buffer 1D of the fourth embodiment, a return checking switch is attached to a cylinder 5. Other components are similar to those of the second embodiment, denoted by similar reference numerals and description thereof will be omitted.

10 An operation of the elevator buffer 1D of the fourth embodiment is similar to that of the second embodiment. By this operation, in the buffer using a buffer main body 2 of multistage-coupled plungers 6a to 6c, the return checking switch 4 can be surely and normally operated without any
15 interference with an installation surface 17 of the cylinder 5. Thus, it is possible to obtain the highly reliable buffer 1D.

Moreover, according to the fourth embodiment, since it is not necessary to separately install a fixing part (similar
20 to the second fixing part 14 of FIG. 8) for fixing the return checking switch 4, a structure can be simplified.

(Fifth Embodiment)

FIG. 11 is a schematic front view showing an elevator buffer 1E of a fifth embodiment of the present invention.

25 As shown in FIG. 11, the elevator buffer 1E of the

fifth embodiment is different from the fourth embodiment in that a cover 22 is attached to cover an outer periphery of each of movable pulleys 12a, 12b. Other components are similar to those of the fourth embodiment, denoted by similar reference numerals and description thereof will be omitted.

An operation of the elevator buffer 1E of the fifth embodiment is similar to that of the fourth embodiment. By this operation, in the buffer using a buffer main body 2 of multistage-coupled plungers 6a to 6c, a return checking switch 4 can be surely and normally operated without any interference with an installation surface 17 of a cylinder 5. Thus, it is possible to obtain the highly reliable buffer 1E.

Moreover, according to the fifth embodiment, since a possibility of dust or the like adhering to the movable pulleys 12a, 12b is prevented as much as possible by the cover 22, it is possible to prevent operation failures of a flexible long member 9 or the movable pulleys 12a, 12b due to dust or the like as much as possible.

(Sixth Embodiment)

FIG. 12 is a schematic front view showing an elevator buffer 1F of a sixth embodiment of the present invention.

As shown in FIG. 12, the elevator buffer 1F of the sixth embodiment is different from the fourth embodiment in that a guide rail 23 is disposed to guide an up-and-down movement of a tensioner weight 20. Other components are

similar to those of the fourth embodiment, denoted by similar reference numerals and description thereof will be omitted.

An operation of the elevator buffer 1F of the sixth embodiment is similar to that of the fourth embodiment. By this operation, in the buffer using a buffer main body 2 of multistage-coupled plungers 6a to 6c, a return checking switch 4 can be surely and normally operated without any interference with an installation surface 17 of a cylinder 5. Thus, it is possible to obtain the highly reliable buffer 1F.

Moreover, according to the sixth embodiment, swinging of movable pulleys 12a, 12b or a flexible long member 9 is suppressed by the tensioner weight 20, whereby the movable pulleys 12a, 12b or the like are smoothly moved.

(Seventh Embodiment)

FIG. 13 is a schematic front view showing an elevator buffer 1G of a seventh embodiment of the present invention.

As shown in FIG. 13, the elevator buffer 1G of the seventh embodiment is different from the fifth embodiment in that a compression spring 24 is disposed as elastic urging means for urging movable pulleys 12a, 12b downward. Other components are similar to those of the fifth embodiment, denoted by similar reference numerals and description thereof will be omitted.

An operation of the elevator buffer 1G of the seventh embodiment is similar to that of the fifth embodiment. By

this operation, in the buffer using a buffer main body 2 of multistage-coupled plungers 6a to 6c, a return checking switch 4 can be surely and normally operated without any interference with an installation surface 17 of a cylinder 5.

5 Thus, it is possible to obtain the highly reliable buffer 1G.

Moreover, according to the seventh embodiment, since the movable pulleys 12a, 12b are easily moved by an urging force of the compression spring 24 when the plungers 6a to 6c are expanded/contracted, slackening of a flexible long member
10 9 can be prevented as much as possible. Thus, it is possible to prevent malfunction or entanglement of the flexible long member 9 due to slackening.

According to the seventh embodiment, the elastic urging means is constituted of the compression spring 24. However,
15 any means can be employed as long as it imparts an initial downward urging force to the movable pulleys 12a, 12b.

(Eighth Embodiment)

FIG. 14 is a schematic front view showing an elevator buffer 1H of an eighth embodiment of the present invention.

20 As shown in FIG. 14, the elevator buffer 1H of the eighth embodiment is different from the fifth embodiment in that an attaching arm 7 is set longer, and one end side of an amplification link 25 is engaged with movable pulleys 12a, 12b side (specifically, below a tensioner weight 20), while
25 the other end thereof is coupled to an operation arm 4b of a

return checking switch 4. In the amplification link 25, a fulcrum 26 is set so as to transmit a falling displacement of each of the movable pulleys 12a, 12b as an amplified displacement to the other end thereof.

5 Other components are similar to those of the fifth embodiment, denoted by similar reference numerals and description thereof will be omitted. Incidentally, the attaching arm 7 can be set to a length equal to those of the other embodiments.

10 An operation of the elevator buffer 1H of the eighth embodiment is similar to that of the fifth embodiment. By this operation, in the buffer using a buffer main body 2 of multistage-coupled plungers 6a to 6c, a return checking switch 4 can be surely and normally operated without any
15 interference with an installation surface 17 of a cylinder 5. Thus, it is possible to obtain the highly reliable buffer 1H.

Moreover, according to the eighth embodiment, a falling stroke of each of the movable pulleys 12a, 12b is converted into a large displacement by the amplification link 25, and
20 the return checking switch 4 can be operated by this large displacement. Thus, the return checking switch 4 can be surely and accurately operated. That is, since the falling stroke of each of the movable pulleys 12a, 12b is set short (set at least shorter than a height dimension of the cylinder
25 5), malfunction may occur if the return checking switch 4 is

directly operated by the short falling stroke. Such a possibility can be surely eliminated by use of the eighth embodiment.

According to the embodiment, the multistage-coupled plungers 6a to 6c are constituted at three stages. Needless to say, however, the present invention can be applied to two stages, four stages or more.

Industrial Applicability

As described above, according to the present invention, the falling dimension of the flexible long member can be absorbed by the falling of the movable pulleys, and the falling dimension of the flexible long member can be absorbed by a sufficiently short falling distance of the movable pulleys. Moreover, there is an advantage that since the flexible long member of a falling portion is absorbed while it is hung between the fixed pulley and the movable pulleys, no entanglement occurs. According to the present invention, it is possible to surely and normally operate the return checking switch without any interference with the installation surface of the cylinder.

CLAIMS

1. An elevator buffer comprising:

a buffer main body in which a plurality of plungers are
5 coupled to an upper surface of a cylinder at multiple stages,
the buffer main body being arranged at a lowermost part of a
hoistway;

a pulley mechanism having pulley multi-winging means in
which one end of a flexible long member is fixed to the
10 uppermost plunger, the other end of the flexible long member
is fixed to a fixing part, a middle part of the flexible long
member has at least one or more movable pulleys, and
slackening of the flexible long member is absorbed by falling
of the movable pulleys; and

15 a return checking switch operated in accordance with
upper and lower positions of the movable pulleys.

2. The elevator buffer according to claim 1, wherein a
tensioner weight is attached to the movable pulleys, and the
20 return checking switch is attached to the tensioner weight or
the cylinder.

3. The elevator buffer according to claim 2, further
comprising a guide rail to guide an up-and-down movement of
25 the tensioner weight.

4. The elevator buffer according to one of claims 1 to 3, further comprising elastic urging means for urging the movable pulleys downward.

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5. The elevator buffer according to one of claims 1 to 3, further comprising an amplification link in which one end thereof is coupled to the movable pulleys, the other end side thereof is engaged with the return checking switch, and an
10 up-and-down displacement of each of the pulleys is transmitted as amplified displacement to the other end thereof.