

ELEVATOR ROPE TENSION ADJUSTING DEVICE AND ELEVATOR ROPE TENSION ADJUSTING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an elevator rope tension adjusting device and an elevator rope tension adjusting system. Particularly, it relates to an elevator rope tension adjusting device for adjusting rope tension of a main rope which is attached to a thimble rod belonging to a rope end portion device of an elevator so as to suspend an elevator cage and a balance weight, and an elevator rope tension adjusting system provided with such elevator rope tension devices.

2. Description of the Background Art

Generally, steel wire ropes are used as main ropes for suspending an elevator cage and a balance weight. In a high-speed and high-lifting elevator whose cage is heavy in weight and whose travel is long in distance, for example, eight to ten main ropes are often used. On the other hand, in recent years, speed and lifting height of elevators have been increased as buildings have been taller. Tension of each main rope in such an elevator is an important maintenance item in riding

quality. It is therefore desired to improve accuracy and efficiency in inspection and adjustment.

Assume that a large number of such main ropes are hoisted up by a main motor. In this case, when there is an unbalance in tension among the main ropes, there is a fear that, for example, rope strands may be worn, broken or cut. Occurrence of such an event adversely affects the lives of the ropes and also wears out sheave grooves of a hoist in an early stage. In addition, once uneven wear occurs in sheaves, there occurs a difference in length among the main ropes sent out in the case of a long travel. As a result, the unbalance in tension among the ropes is further expanded. The unbalance becomes conspicuous in proportion to the distance of the travel. It is therefore necessary particularly in a high-lifting elevator to perform periodical adjustment of rope tension to correct the unbalance in tension caused by variation with time.

Thus, easiness in adjustment is required to support the periodical adjustment of rope tension. For example, inventions disclosed in JP-A-4-164791 and JP-A-6-345356 are known as techniques supporting the easiness in adjustment. Of them, JP-A-4-164791 has disclosed an elevator main rope maintenance device in which hydraulic jacks temporarily provided on

anchoring tools of main ropes respectively are driven with the same pressure to drawing the anchoring tools, so that tensions of the main ropes can be adjusted to be equalized.

On the other hand, JP-A-6-345356 has disclosed an elevator main rope tension adjusting method intended to perform the work of adjustment easily and promptly without the necessity of adjusting the height of a spring member relative to a thimble rod provided inside a machine beam.

The technique disclosed in JP-A-4-164791 is intended to be able to easily and uniformly adjust the tensions of the main ropes provided in parallel. The technique disclosed in JP-A-6-345356 is intended to make it unnecessary to adjust the spring member relative to the thimble rod provided inside the machine beam, so that the labor of adjustment can be saved.

Each of the techniques disclosed in JP-A-4-164791 and JP-A-6-345356 asserts that adjustment can be made easier. However, a device serving to adjust the tensions of ropes is not provided with a rope turning preventing mechanism and a rope coming-off preventing mechanism. It is therefore likely that each rope may turn in the direction in which the rope may be unlaid when tension is applied to the rope. Further it is likely that the rope may come off. At any rate, this may get

in the way of the work of adjustment.

SUMMARY OF THE INVENTION

The present invention was developed in consideration of such actual circumstances of the background art. An object of the invention is to prevent each main rope to which tension is applied in adjustment of the tension of the rope, from turning and to prevent the rope from coming off, to thereby improve the safety in the work for adjusting the tension of the main rope and prolong the life of the main rope.

In order to attain the foregoing object, according to a first configuration of the invention, there is provided an elevator rope tension adjusting device to be attached to a rope end portion device of an elevator, including: a thimble rod to which an end portion of a main rope of the elevator is attached; a nut which is screwed to the thimble rod; a flat washer which is attached around the thimble rod and abuts against a bottom surface of the nut; a spring which is attached around the thimble rod and which has a top surface abutting against a bottom surface of the flat washer; a fixture which is attached around the thimble rod and which has a top surface abutting against a bottom portion of the spring and a bottom surface abutting against a fixing member of the thimble rod; a split pin which is attached to

a through hole formed near a top portion of the thimble rod, so as to prevent the thimble rod from coming off; a rope coming-off preventing unit which includes a thimble rod drawing pipe lower portion and a coming-off preventing pin, the thimble rod drawing pipe lower portion being screwed and attached to the thimble rod from which the split pin has been removed, a long hole being formed in the thimble rod drawing pipe lower portion to face the through hole of the thimble rod, an external thread portion being formed in an outer circumferential portion of an upper portion of the thimble rod drawing pipe lower portion, the coming-off preventing pin being inserted into the long hole of the thimble rod drawing pipe lower portion and the through hole of the thimble rod so as to prevent the thimble rod from coming off; and a rope turning preventing unit which includes a hydraulic actuator fixing portion, a hydraulic actuator, a thimble rod drawing pipe upper portion, and a transmission tool, the hydraulic actuator fixing portion having an annular collar in a bottom portion thereof, the annular collar abutting against the flat washer and allowing a finger to be inserted thereto laterally, the hydraulic actuator having an insertion space in a central portion thereof, the insertion space allowing the thimble rod to be attached to the thimble rod drawing pipe lower

portion, the hydraulic actuator being placed on the collar of the hydraulic actuator fixing portion so as to expand/contract in an up/down direction, the thimble rod drawing pipe upper portion having a bottom surface abutting against a top surface of the hydraulic actuator, the thimble rod drawing pipe upper portion being screwed to the external thread portion of the thimble rod drawing pipe lower portion, the transmission tool transmitting torque applied to the thimble rod to the hydraulic actuator fixing portion.

In addition, according to a second configuration of the invention, there is provided a rope tension adjusting system including: rope tension adjusting devices according to the first configuration of the invention, which are attached to a plurality of main ropes suspending an elevator cage and a balance weight, respectively; a hydraulic pump which supplies pressure oil to the hydraulic actuators of the rope tension adjusting devices through pressure oil supply paths respectively; and a stop valve which is provided between a duct and the hydraulic pump so as to control circulation of the pressure oil between the duct and the hydraulic pump, the pressure oil supply paths being collectively connected to the duct.

According to the invention, it is possible to prevent

each main rope from coming off and to prevent the main rope to which tension is applied, from turning. As a result, the safety in the work for adjusting the rope tension can be improved in comparison with the background art. In addition, factors which may adversely affect the life of the main rope, such as wear, rupture or cutoff of strands of the main rope can be eliminated to prolong the life of the main rope in comparison with the background art.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view showing the structure of a typical 2:1 roping elevator;

Fig. 2 is an enlarged view of a rope end portion device shown in Fig. 1;

Fig. 3 is a front view of a thimble rod drawing pipe lower portion in an embodiment of the invention;

Fig. 4 is a front view of a thimble rod drawing pipe upper portion in the embodiment of the invention;

Fig. 5 is a front view of a coming-off preventing pin in the embodiment of the invention;

Fig. 6 is a front view of a turning preventing pin in the embodiment of the invention;

Figs. 7A-7C are views showing a hydraulic actuator in

the embodiment of the invention;

Figs. 8A-8C are views showing a hydraulic actuator fixing portion in the embodiment of the invention;

Fig. 9 is a flow chart showing a work sequence for installing a rope tension adjusting device for one main rope according to the embodiment;

Figs. 10A and 10B are views specifically showing Step S1 in the work sequence;

Figs. 11A and 11B are views specifically showing Steps S2 and S3 in the work sequence;

Figs. 12A and 12B are views specifically showing Step S4 in the work sequence;

Figs. 13A and 13B are views specifically showing Step S5 in the work sequence;

Figs. 14A and 14B are views specifically showing Step S6 in the work sequence;

Figs. 15A and 15B are explanatory views showing the principle for adjusting tension in the rope tension adjusting device according to the embodiment of the invention; and

Fig. 16 is a view showing the configuration of a system according to the embodiment of the invention, in which tensions of a plurality of main ropes can be adjusted uniformly.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the invention will be described below with reference to the drawings.

Fig. 1 is a view showing the structure of a typical 2:1 roping elevator. As shown in Fig. 1, a machine room 2 is provided in a top portion of a hoistway 1 which is, for example, formed in a building, and a hoist 3 is placed in the machine room 2. The hoist 3 has an electric motor and a sheave which is driven by the electric motor. The electric motor is placed on a floor of the machine room 2. One end side of a main rope 4 is wound around the sheave. On one side of the main rope 4, an elevator cage 5 is suspended through a thimble rod 6 and a spring 7 which belong to a rope end portion device as will be described later.

On the other hand, a deflector sheave 8 is provided on a beam of the machine room 2 in the top portion of the hoistway 1. A portion of the main rope 4 reaching the other side is wound around the deflector sheave 8. The main rope 4 wound around the deflector sheave 8 is suspended in the hoistway 1. A balance weight 9 is suspended at a lower end of the main rope 4. When the electric motor of the hoist 3 is driven in the elevator configured thus, the sheave fixed to the electric motor is rotated. With the rotation of the sheave, the main rope

4 moves so that the elevator cage 5 and the balance weight 9 can move up/down in opposite directions to each other in the hoistway 1.

Fig. 2 is an enlarged view of the rope end portion device shown in Fig. 1. As shown in Fig. 2, the rope end portion device includes the thimble rod 6, a lock nut 11, a flat washer 10, the spring 7, a fixture 62 and a split pin 12. An end portion of the main rope 4 is connected to a lower end of the thimble rod 6. The lock nut 11 is attached to the thimble rod 6. The thimble rod 6 abuts against a fixing member 61 through the fixture 62 on the lower portion side thereof. The flat washer 10 is disposed above the fixture 62. The spring 7 is disposed between the fixture 62 and the flat washer 10 so as to give an elastic force to separate the fixture 62 and the flat washer 10 from each other.

The lock nut 11 is disposed on the flat washer 10. The lock nut 11 is constituted by two nuts 11a and 11b. The lock nut 11 is screwed to an external thread portion formed in an upper portion of the thimble rod 6 so as to press the spring 7 through the flat washer 10 in the longitudinal direction of the spring 7. Thus, the spring length of the spring 7 is regulated so that an elastic force can be generated in accordance

with the regulated spring length. A through hole 6a is provided (see Fig. 3) in an illustrated highest portion of the external thread portion of the thimble rod 6. The split pin 12 is inserted into the through hole 6a so as to prevent the thimble rod 6 from coming off.

The thimble rod 6 is fixed to the fixing member 61. The main rope 4 is attached to the lower end of the thimble rod 6 projecting downward from the fixing member 61. The rope tension adjusting device is attached to an upper side of the flat washer 10 of the thimble rod 6.

The rope tension adjusting device is mainly constituted by the thimble rod 6, the fixture 62, the spring 7, the flat washer 10, the nut 11a, a hydraulic actuator 17 which is attached to an upper portion side of the thimble rod 6, a thimble rod drawing pipe upper portion 14, a safety pin 16 and a thimble rod drawing pipe lower portion 13, as shown in Figs. 14A-14B and Figs. 15A-15B.

A thimble rod drawing pipe is attached to the external thread portion of the upper portion of the thimble rod 6. The thimble rod drawing pipe is constituted by two parts, that is, the thimble rod drawing pipe lower portion 13 and the thimble rod drawing pipe upper portion 14. Fig. 3 is a front view of

the thimble rod drawing pipe lower portion 13 shown in Figs. 14A-14B and Figs. 15A-15B. Fig. 4 is a front view of the thimble rod drawing pipe upper portion 14.

The thimble rod drawing pipe lower portion 13 is screwed and attached to the external thread portion of the thimble rod 6 from which the split pin 12 shown in Fig. 2 has been removed. A coming-off preventing long hole 13a is formed in the thimble rod drawing pipe lower portion 13 so as to face the through hole 6a of the thimble rod 6. An external thread portion 13c is formed above the coming-off preventing long hole 13a and in an outer circumferential portion of the thimble rod drawing pipe lower portion 13. Further, a turning preventing pin hole 13b is formed as a through hole in the external thread portion 13c.

The thimble rod drawing pipe upper portion 14 has an internal thread portion which can be screwed and attached to the external thread portion 13c of the thimble rod drawing pipe lower portion 13. A bottom surface of the thimble rod drawing pipe upper portion 14 abuts against a top surface of the hydraulic actuator 17.

Fig. 5 is a front view of the coming-off preventing pin 15. The coming-off preventing pin 15 is inserted into the

coming-off preventing long hole 13a of the thimble rod drawing pipe lower portion 13 and the through hole 6a of the thimble rod 6 so as to prevent the thimble rod 6 from coming off from the thimble rod drawing pipe lower portion 13.

Fig. 6 is a front view of the turning preventing pin 16. The turning preventing pin 16 serves as a transmission tool by which torque given to the thimble rod 6 can be transmitted to a hydraulic actuator fixing portion 18 (see Figs. 8A to 8C).

Figs. 7A-7C are views showing the hydraulic actuator. Fig. 7A is a front view, Fig. 7B is a side view, and Fig. 7C is a view showing an example of an internal structure. The hydraulic actuator 17 is attached to an outer circumference of a cylindrical portion of the thimble rod drawing pipe lower portion 13 where the long hole 13a is formed. Therefore, the hydraulic actuator 17 has a columnar insertion space 17c on its central side. The insertion space 17c is inserted into the thimble rod drawing pipe lower portion 13 and placed on a collar 18a of the hydraulic actuator fixing portion 18. In this state, a piston rod 17d of the hydraulic actuator 17 expands/contracts vertically.

In the hydraulic actuator 17, an annular cylinder 17e is provided in an annular portion of an outer circumference

of the insertion space 17c. The cylinder 17e is smaller than the radial width of the annular portion of the outer circumference of the insertion space 17c. An annular piston 17f is inserted into the cylinder 17e. The piston rod 17d having a driving surface 17a in its top portion is provided to extend from the piston 17f toward a top portion of the hydraulic actuator 17. A hydraulic valve 17b is connected to the cylinder 17e through a hydraulic path 17g so as to control supply of pressure oil from a pressure oil source which will be described later.

A body portion of the hydraulic actuator 17 is, for example, formed integrally so that the strength thereof is increased to prevent the pressure oil from leaking from the body portion. In addition, the height-direction size of the hydraulic actuator 17 may be reduced to cope with the case where an installation space is small. Further, the diameter size of the insertion space 17c may be set in consideration of the inclination of the main rope 4 and the installation space. This can deal with the inclination of the main rope 4 which may inevitably occur when the main rope 4 is hoisted. The integral formation of the body portion or the setting of the diameter of the insertion space 17c can deal with the case where a lateral force is applied to the main rope 4 when the thimble rod drawing pipe lower portion

13 tilts and abuts against the main rope 4.

In addition, in this embodiment, a seal member for securing seal between an internal surface of the cylinder 17e and an external surface of the piston 17f in Fig. 7C is formed as a slipper seal 17h1 to secure the seal. In this embodiment, a seal member on an internal surface side is formed as an O-ring 17h2.

Figs. 8A-8C are views showing the hydraulic actuator fixing portion 18. Fig. 8A is a front view, Fig. 8B is a side view, and Fig. 8C is a sectional view taken on line I-I in Fig. 8A. The hydraulic actuator fixing portion 18 has an annular collar 18a and plate-like turning preventing pin guides 18b which are attached to face an outer circumferential portion of the collar 18a. The collar 18a is located in a lower portion of the hydraulic actuator fixing portion 18. The turning preventing pin guides 18b are paired and attached to be opposed to each other and to extend upward from the collar 18a.

A bottom portion of the collar 18a always touches a top surface of the flat washer 10 so as to abut against the top surface of the flat washer 10 as shown in Figs. 14A-14B and Figs. 15A-15B. A round hole 18d into which a finger can be inserted laterally is formed in a side surface of the collar

18a. In addition, a turning preventing pin guide long hole 18c is formed in each turning preventing pin guide 18b so as to face the turning preventing pin hole 13b. The aforementioned turning preventing pin 16 is inserted into the turning preventing pin guide long holes 18c of the turning preventing pin guides 18b and the turning preventing pin hole 13b of the thimble rod drawing pipe lower portion 13.

Fig. 9 is a flow chart showing a work sequence for installing the rope tension adjusting device for one main rope 4 according to the embodiment.

In this work sequence in Fig. 9, processings from Step S1 to Step S6 are carried out sequentially. In the work sequence, first in Step S1, as shown in Figs. 10A-10B, the split pin 12 (see Fig. 2) attached to the thimble rod 6 is removed, and the lock nut 11 is then unlocked. That is, of the two nuts 11a and 11b, the upper nut 11b is removed and only the lower nut 11a is left behind. Fig. 10A is a front view showing a main portion of the thimble rod 6, and Fig. 10B is a side view thereof.

Next, in Step S2, as shown in Figs. 11A-11B, the thimble rod drawing pipe lower portion 13 is attached to the thimble rod 6. An internal thread portion is formed in the thimble rod drawing pipe lower portion 13 in advance so that the thimble

rod drawing pipe lower portion 13 can be screwed to the thimble rod 6. The thimble rod drawing pipe lower portion 13 is sufficiently screwed to the thimble rod 6 so that the through hole 6a for the split pin 12 removed in Step S1 can be located to face the coming-off preventing pin long hole 13a provided in the thimble rod drawing pipe lower portion 13.

Further, in Step S3, as shown in Fig. 11A, the coming-off preventing pin 15 is inserted and attached into the through hole 6a for the split pin 12 through the coming-off preventing long hole 13a provided in the thimble rod drawing pipe lower portion 13. The length of the coming-off preventing pin 15 is set to be short enough for its opposite end portions to stay in the coming-off preventing pin long hole 13a when the coming-off preventing pin 15 is inserted into the through hole 6a and placed in a predetermined position. Thus, even if the thimble rod 6 falls down, the coming-off preventing pin 15 can abut against a lower end of the coming-off preventing pin long hole 13a so that the coming-off preventing pin 15 can function as a stopper. As a result, the main rope 4 is prevented from coming off. That is, even if the thimble rod 6 seeks to fall down from the thimble rod drawing pipe lower portion 13 for some reason, the coming-off preventing pin 15 can abut against

a lower portion of the coming-off preventing long hole 13a so as to prevent the thimble rod 6 from falling down. Fig. 11A is a front view showing a state where the thimble rod drawing pipe lower portion 13 has been attached to the thimble rod 6, and Fig. 11B is a side view thereof.

In Step S4, as shown in Figs. 12A-12B, the collar 18a of the hydraulic actuator fixing portion 18 is inserted to an outer circumferential portion of the thimble rod drawing pipe lower portion 13 so that the collar 18a is disposed on the flat washer 10 so as to surround the nut 11a. Further, the hydraulic actuator 17 is disposed on the collar 18a. At that time, the insertion space 17c of the hydraulic actuator 17 is inserted to the thimble rod drawing pipe lower portion 13 so that the hydraulic actuator 17 is disposed to surround the thimble rod drawing pipe lower portion 13.

In the hydraulic actuator 17, pressure oil flows into the internal cylinder 17e through the hydraulic valve 17b shown in Figs. 14A-14B etc., or flows out from the inside, due to driving of a hydraulic pump 170 as a drive source shown in Fig. 16. Thus, the piston rod 17d expands/contracts. In addition, as described previously, the turning preventing pin guide long holes 18c are provided in the turning preventing pin guides

18b so that the turning preventing pin 16 can be guided even when the thimble rod 6 is drawn up to contract the spring 7 in adjustment of the rope tension.

Fig. 12A is a front view showing a state where the hydraulic actuator fixing portion 18 has been attached to the outer circumferential portion of the thimble rod drawing pipe lower portion 13, and Fig. 12B is a side view thereof.

In addition, the thimble rod drawing pipe upper portion 14 is screwed and attached to the external thread portion 13c of the thimble rod drawing pipe lower portion 13 in Step S5 as shown in Figs. 13A-13B. An adjustment start line 14a and an adjustment end line 14b which are used when the rope tension is adjusted are provided in the surface of the thimble rod drawing pipe upper portion 14 as shown in Figs. 15A-15B which will be described later.

Fig. 13A is a front view showing a state where the thimble rod drawing pipe upper portion 14 has been attached to the thimble rod drawing pipe lower portion 13, and Fig. 13B is a side view thereof.

Finally, in Step S6, as shown in Figs. 14A and 14B, the turning preventing pin 16 is inserted into the turning preventing pin guide long holes 18c of the hydraulic actuator fixing portion

18 and the turning preventing pin hole 13a of the thimble rod drawing pipe lower portion 13 so that the hydraulic actuator fixing portion 18 and the thimble rod drawing pipe lower portion 13 are coupled with each other by the turning preventing pin 16. Each portion is assembled thus so that the weight of the hydraulic actuator 17 is applied to the collar 18a of the hydraulic actuator fixing portion 18. As a result, a frictional resistance force against the torque given to the collar 18a acts between the collar 18a and the flat washer 10. Thus, when a force to turn the thimble rod 6 is transmitted to the turning preventing pin 16 so as to turn the turning preventing pin 16 together with the thimble rod 6, the motion of the turning preventing pin 16 is blocked by the collar portion 18a of the hydraulic actuator fixing portion 18. In this manner, the thimble rod 6 can be prevented from turning. That is, the main rope 4 which is connected to the thimble rod 6 and whose tension is adjusted can be prevented from turning.

Fig. 14A is a front view showing a state where the turning preventing pin 16 has been attached to the hydraulic actuator fixing portion 18, and Fig. 14B is a side view thereof.

The rope tension adjusting device according to the embodiment, which has been attached thus, can draw up the thimble

rod 6 and contract the spring 7 to thereby adjust the rope tension in accordance with the principle of operation shown in Figs. 15A-15B.

That is, in the state where the rope tension adjusting device according to the embodiment has been attached to the thimble rod 6 as shown in Fig. 15A, the hydraulic pump 170 shown in Fig. 16 as will be described later is operated so that pressure oil is made to flow into the cylinder 17g of the hydraulic actuator 17. As a result, the piston rod 17d of the hydraulic actuator 17 expands. Thus, the thimble rod drawing pipe lower portion 13 and the thimble rod drawing pipe upper portion 14 seek to be drawn up as the driving surface 17a of the piston rod 17d moves up. On this occasion, the thimble rod 6 coupled with the thimble rod drawing pipe lower portion 13 and the thimble rod drawing pipe upper portion 14 also seeks to be drawn up. When the thimble rod 6 seeks to be drawn up in this manner, the flat washer 10 is pushed down relatively, and the spring 7 following the flat washer 10 pushed down is also contracted and bent as shown in Fig. 15B.

Here, the hydraulic actuator 17 has a limit in its expanding stroke. Accordingly, adjustment work has to be performed while making sure that the top portion of the hydraulic

actuator 17 is located between the adjustment start line 14a and the adjustment end line 14b provided in the thimble rod drawing pipe upper portion 14.

In addition, when the nut 11a floats above the flat washer 10 as shown in Fig. 15B, a finger is inserted into the round hole 18d formed in the collar 18a as shown in Fig. 8A so as to rotate and move the nut 11a to the lower side of the thimble rod 6 till the nut 11a abuts against the flat washer 10. The moving direction and the moving distance of the nut 11a are defined in accordance with the rotating direction of the nut 11a relative to the external thread and the pitch of the external thread.

When the pressure applied to the cylinder 17e of the hydraulic actuator 17 is removed in the state where the nut 11a has been moved to abut against the flat washer 10, the piston rod 17a is contracted, and the spring 7 is restored to the same expanding form as the state shown in Fig. 15A, due to its own elastic force. In this state, the length of the thimble rod 6 projecting upward from the flat washer 10 is longer than that in the case of Fig. 8A. Thus, the tension (i.e. rope tension) of the main rope 4 connected to the thimble rod 6 is higher than that till then.

Fig. 15A is a view showing an initial state before pressure oil is made to flow into the hydraulic actuator 17. Fig. 15B is a view showing a state where the pressure oil has been made to flow into the hydraulic actuator 17 to contract the spring 7.

Fig. 16 is a view showing the configuration of a system in which rope tensions of a plurality of main ropes 4 can be adjusted uniformly using the aforementioned principle of operation. In the system shown in Fig. 16, rope tension adjusting devices according to the embodiment, including hydraulic actuators 17, are disposed in the end portions of the main ropes 4 respectively, and pressure oil is supplied to the hydraulic actuators 17 of the rope tension adjusting devices in the end portions of the main ropes 4 by the hydraulic pump 170. Thus, the rope tensions of the main ropes 4 can be adjusted uniformly.

On that occasion, a stop valve 19 is provided between a hydraulic adjustment duct 21 and the hydraulic pump 170. Pressure oil supply paths 20 of the hydraulic actuators 17 are collectively connected to the hydraulic adjustment duct 21. The stop valve 19 is closed in the state where the main ropes 4 have been drawn up. Thus, the pressure oil can be confined

between the stop valve 19 and the cylinder 17e of each hydraulic actuator 17. When the pressure oil is confined thus, the pressures in the cylinders 17e attached to the main ropes 4 are equalized to each other so that distribution of the pressure oil to the hydraulic actuators 17 can be equalized simultaneously.

The stop valve 19 is closed at the timing when the hydraulic actuators 17 are actuated for all the thimble rods 6 to draw up all the main ropes 4 as shown in Fig. 15B. In this state, the stop valve 19 is closed, and all the nuts 11a are rotated as described previously, so as to restore the state to a state shown in Fig. 8A. Generally, three to eight main ropes 4 are provided. Thus, tensions of the main ropes 4 can be also trued up easily when adjustment is performed thus.

In this manner, according to the embodiment, the coming-off preventing pins 15 are attached so that the main ropes 4 can be prevented from coming off. It is therefore possible to improve the safety in the work for adjusting the rope tensions. In addition, the turning preventing pins 16 are attached so that the main ropes 4 to which the tensions are applied can be prevented from turning. As a result, factors which may adversely affect the lives of the main ropes 4, such

as wear, rupture or cutoff of strands of the main ropes 4, can be eliminated to prolong the lives of the main ropes 4.

The rope tension adjusting device according to the embodiment can be placed permanently. When the rope tension adjusting device is placed permanently in this manner, it is not necessary to attach and remove the rope tension adjusting device whenever the rope tension is adjusted. Thus, the working time for the work of adjusting the rope tension can be saved to improve the work efficiency.

In addition, when rope tension adjusting devices according to the embodiment are installed for the main ropes 4 respectively, each of the main ropes 4 can be prevented from turning and coming off without giving any influence to the other main ropes 4.

The invention is not limited to the aforementioned embodiment, but various modifications can be made without departing from the gist of the invention. All the technical items included in the technical ideas stated in the claims are covered by the invention. The embodiment simply shows a preferred example. It will be understood by those in the art that various alternatives, revisions, modifications or improvements can be obtained from the disclosed contents of

the specification, and are included in the technical scope stated in the attached claims.

What is claimed is:

1. An elevator rope tension adjusting device to be attached to a rope end portion device of an elevator, comprising:

a thimble rod to which an end portion of a main rope of the elevator is attached;

a nut which is screwed to the thimble rod;

a flat washer which is attached around the thimble rod and abuts against a bottom surface of the nut;

a spring which is attached around the thimble rod and which has a top surface abutting against a bottom surface of the flat washer;

a fixture which is attached around the thimble rod and which has a top surface abutting against a bottom portion of the spring and a bottom surface abutting against a fixing member of the thimble rod;

a split pin which is attached to a through hole formed near a top portion of the thimble rod, so as to prevent the thimble rod from coming off;

a rope coming-off preventing unit which includes a thimble rod drawing pipe lower portion and a coming-off preventing pin, the thimble rod drawing pipe lower portion being screwed and attached to the thimble rod from which the split pin has been

removed, a long hole being formed in the thimble rod drawing pipe lower portion to face the through hole of the thimble rod, an external thread portion being formed in an outer circumferential portion of an upper portion of the thimble rod drawing pipe lower portion, the coming-off preventing pin being inserted into the long hole of the thimble rod drawing pipe lower portion and the through hole of the thimble rod so as to prevent the thimble rod from coming off; and

a rope turning preventing unit which includes a hydraulic actuator fixing portion, a hydraulic actuator, a thimble rod drawing pipe upper portion, and a transmission tool, the hydraulic actuator fixing portion having an annular collar in a bottom portion thereof, the annular collar abutting against the flat washer and allowing a finger to be inserted thereto laterally, the hydraulic actuator having an insertion space in a central portion thereof, the insertion space allowing the thimble rod to be attached to the thimble rod drawing pipe lower portion, the hydraulic actuator being placed on the collar of the hydraulic actuator fixing portion so as to expand/contract in an up/down direction, the thimble rod drawing pipe upper portion having a bottom surface abutting against a top surface of the hydraulic actuator, the thimble rod drawing pipe upper

portion being screwed to the external thread portion of the thimble rod drawing pipe lower portion, the transmission tool transmitting torque applied to the thimble rod to the hydraulic actuator fixing portion.

2. An elevator rope tension adjusting device according to Claim 1, further comprising:

a turning preventing pin hole which is formed as a through hole in the thimble rod drawing pipe lower portion; and

turning preventing pin guides which are included in the hydraulic actuator fixing portion, which are fixed to the collar of the hydraulic actuator fixing portion so as to be provided erectly from the collar, and which have turning preventing pin guide long holes formed therein so as to face the turning preventing pin hole; wherein:

the transmission tool includes a turning preventing pin which is inserted into the turning preventing pin guide long holes of the turning preventing pin guides and the turning preventing pin hole of the thimble rod drawing pipe lower portion.

3. A rope tension adjusting system comprising:

rope tension adjusting devices according to Claim 1 or 2, which are attached to a plurality of main ropes suspending

an elevator cage and a balance weight, respectively;

a hydraulic pump which supplies pressure oil to the hydraulic actuators of the rope tension adjusting devices through pressure oil supply paths respectively; and

a stop valve which is provided between a duct and the hydraulic pump so as to control circulation of the pressure oil between the duct and the hydraulic pump, the pressure oil supply paths being collectively connected to the duct.

4. A rope tension adjusting system according to Claim 3, wherein:

the stop valve closes the circulation of the pressure oil between the duct and the hydraulic pump in a state where the pressure oil has been supplied to the rope tension adjusting devices to draw up the main ropes respectively.