

Description

5 **Tensioning Device for at Least One Trailing Rope
of an Elevator Installation**

The invention relates to a tensioning device for at least
one trailing rope of an elevator installation according to
10 the preamble to Claim 1.

Within the meaning of the invention, a trailing rope can
also be a compensating rope, compensating chain, or
similar.

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In this invention the terms "vertical" and "horizontal"
relate to the direction of travel of the elevator.

"Vertical" means the direction essentially parallel to the
direction of travel of the elevator, and "horizontal"
20 means the direction essentially perpendicular to it.

The term "fluid" means some sort of gas or some sort of
liquid.

25 Tensioning devices for trailing ropes have long been
known, and are primarily used on traction elevators. The
purpose of the tensioning device is, inter alia, to guide
the trailing ropes, tension the trailing ropes, limit rope
vibrations, increase traction, and prevent the
30 counterweight or elevator car from jumping when the safety
gear of the car or counterweight is actuated, or when the

car or counterweight strikes the buffer. At speeds of 3.5 m/s and above, the tensioning device must be fitted with an anti-rebound device. Present-day anti-rebound devices consist, for example, of safety gears which trip when the tensioning device moves upward by a specified amount. Just this specified amount has disadvantageous effects. The trailing ropes are tensioned by the jumping counterweight (elastic members) and accelerate the counterweight as it falls back down. The forces which occur when the counterweight falls back onto the suspension rope are also correspondingly large. Moreover, with this known solution, when once the safety gear has tripped, the tensioning device has to be released manually. Only trained personnel are allowed to release it. The need for manual release is due to the system.

Investigations carried out using simulation have shown clearly that almost entirely undamped tensioning devices influence the characteristics of the installation negatively.

Damped tensioning devices are known, and have the advantage that when required they remove energy from the system, as a result of which the energy of the counterweight is reduced as it falls back down.

From US 4522285 an anti-rebound device is known in which the vertical motion/damping of the trailing-rope tensioning pulley is controlled by a hydraulic system. The system comprises a cylinder and a piston, which moves inside the cylinder and divides the cylinder into two

chambers. The piston rod is connected at one end to the piston, and at the other end to the tensioning pulley. Due to the one-sided arrangement of the piston rod, the displacement volume on the side of the piston with the piston rod is smaller than on the side where there is no piston rod. To balance the volume/pressure of the two chambers, outside the cylinder there is a container filled with hydraulic fluid, which works actively in conjunction with the two chambers.

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A disadvantage of this known construction is the complicated arrangement of the valves, and the inevitable necessity of an externally acting compensating container, which causes the construction of the tensioning device to be costly and complicated.

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The purpose of the invention is to create a tensioning device for at least one trailing rope which does not possess the aforementioned disadvantages, allows a simple construction, and needs no external compensation container. Damping of the tensioning device is achieved by simple means.

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A further advantage is to be seen in that the tensioning device can be manufactured inexpensively.

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This purpose is fulfilled by the characteristics of Claim 1.

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By means of the measures stated in the dependent claims, advantageous further developments and improvements of the tensioning device stated in Claim 1 are possible.

A further advantage is to be seen in that the cylinder and
5 piston rod form a guide system for the tensioning device.

All the characteristics described can be used not only in the respective combinations stated, but also in other combinations or alone without exceeding the scope of the
10 invention.

Several different exemplary embodiments of the invention are illustrated in the schematic drawings, and explained in greater detail in the description that follows. The
15 drawings show:

Fig. 1 A side view of a trailing-rope tensioning device according to a first embodiment of the invention;

20 Fig. 2 A front view of Figure 1;

Fig 3 An enlargement of a detail of Figures 1 and 2;

Fig. 4 A side view of a trailing-rope tensioning device
25 according to a second embodiment of the invention;
and

Fig. 5 A side view of a trailing-rope tensioning device according to a third embodiment of the invention.

30 Figure 1 shows a side view of a trailing-rope tensioning device 1 in which a tensioning pulley 2.1 can be seen

between a first double-acting cylinder 3 and a second double-acting cylinder 4. Cylinders 3 and 4 are constructed as damping means, and therefore act as hydraulic or pneumatic dampers. Wrapped around the tensioning pulley 2.1 are trailing ropes S, which connect an elevator car to a counterweight in the normal way. The first double-acting cylinder 3 has an upper chamber 3.1 and a lower chamber 3.2, which are separated by a first piston 5. The second double-acting cylinder 4 has an upper chamber 4.1 and a lower chamber 4.2, which are separated by a second piston 6. The chambers 3.1, 3.2, 4.1, 4.2 contain inside them as working substance a fluid F, for example oil. On a first end EE of the first cylinder 3 above the upper chamber 3.1 is an upper seal 7.1, and on the other, second end EA of the first cylinder 3 below the lower chamber 3.2 is a lower seal 7.2. In the same manner, the second cylinder 4 has an upper seal 8.1 and a lower seal 8.2.

A first, preferably column-shaped piston rod 9 extends vertically, and therefore axially, over at least the entire length of the first cylinder 3, and over at least a length corresponding to the length of the cylinder 3 plus the length of the stroke. The first piston rod 9 runs concentrically within the first cylinder 3, and is joined to the first piston 5 by means of, for example, a thread. Above the first piston 5 the piston rod 9 passes through the upper chamber 3.1 and through the upper seal 7.1 of the first cylinder 3. In the same way, below the first piston 5 the piston rod 9 passes through the lower chamber

3.2 and through the lower seal 7.2 of the first cylinder 3.

In a manner similar to the first cylinder 3, a second,
5 preferably column-shaped piston rod 10 extends vertically
over at least the entire length of the second cylinder 4,
and specifically over at least a length which corresponds
to the length of the cylinder 4 plus the length of stroke.
The second piston rod 10 runs concentrically within the
10 second cylinder 4 and is connected to the second piston 6.
Above the second piston 6, the piston rod 10 passes
through the upper chamber 4.1 and the upper seal 8.1 of
the second cylinder 4. In the same manner, below the
second piston 6, the piston rod 10 passes through the
15 lower chamber 4.2 and through the lower seal 8.2 of the
second cylinder 4. The seals 7.1, 7.2, 8.1, 8.2 are
arranged movably on the respective piston rods 9, 10.

In this manner the first piston rod 9 is arranged so as to
20 be on both sides of the first piston 5. This has the
effect that the volume of displacement in the upper
chamber 3.1 of the first cylinder 3 is the same as the
volume of displacement in the lower chamber 3.2 of the
first cylinder 3. The same obviously applies for the
25 second piston rod 10 in the second cylinder 4.

This makes it unnecessary to have an external compensating
vessel acting to compensate the volume.

30 The first piston rod 9 and the second piston rod 10 are
permanently connected at both ends to an immovable

structure 11.1, 11.2. The structure preferably has an upper support 11.1 and a lower support 11.2, which are arranged above or below the two cylinders 3, 4, and on which the first piston rod 9 and the second piston rod 10 are fastened. For this reason, the piston rod 9, 10 together with the pistons 5, 6 are immovable in relation to the structure 11.1, 11.2. The lower support 11.2 is preferably fastened to the hoistway floor by fastening means B.

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The tensioning pulley 2.1 is mounted in a frame 12. The frame 12 is connected laterally to the cylinders 3, 4 by means of, for example, screws. The first piston rod 9 and the second piston rod 10 take the form of a guide for the first cylinder 3 and the second cylinder 4 respectively. In this way, the system formed by the piston rod and cylinder forms a guide system for the moving part of the trailing-rope tensioning device 1, which means that when the tensioning pulley moves, the two cylinders 3, 4 together with the respective seals 7.1, 7.2, 8.1, 8.2 are moved along the two piston rods 9, 10 and guided by them. Because the two pistons 5, 6 are connected to the respective piston rods 9, 10, they also remain fixed while the tensioning device moves.

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The upper chamber 3.1 of the first cylinder 3 is connected to the lower chamber 3.2 of the first cylinder 3 by a connecting line 13 which has a throttle 14. In this embodiment, the connecting line 13, hereinafter also referred to as the throttled connecting line 13, ends in the vicinity of the upper seal 7.1 and lower seal 7.2 of

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the first cylinder 3. The throttled line 13 is also connected by a first line 15 to the upper chamber 4.1 of the second cylinder 4. The first line 15 could also directly connect the upper chamber 3.1 of the first
5 cylinder 3 to the upper chamber 4.1 of the second cylinder 4. In the same manner, the throttled line 13 is connected by a second line 16 to the lower chamber 4.2 of the second cylinder 4. The second line 16 could also directly connect the lower chamber 3.2 of the first cylinder 3 to the lower
10 chamber 4.2 of the second cylinder 4. The purpose of the first line 15 and the second line 16 is to feed the fluid stream of the two cylinders 3, 4 through a common throttle 14.

15 The first piston 5 and the second piston 6 each have a channel 17, 18 which connects the upper chambers 3.1 and 4.1 of the first cylinder 3 and second cylinder 4 respectively to the corresponding lower chambers 3.1 and 4.2 of the first cylinder 3 and second cylinder 4
20 respectively. These channels 17 and 18 each have a nonreturn valve, 19 and 20 respectively, which in this embodiment allows fluid to flow from the upper chambers 3.1 and 4.1 into the lower chambers, 3.2 and 4.2 respectively, and prevent it from flowing in the opposite
25 direction.

For the sake of simplicity, in Figures 2 to 5 the same elements are shown with the same reference numbers as in Figure 1.

Figure 2 shows a front view of Figure 1, in which two tension pulleys 2.1, 2.2 in the frame 12, and a cylinder 3 connected to the frame 12, can be seen. It can be seen more clearly in this figure how in this embodiment the
5 respective elements of the tensioning device are arranged in relation to each other. To increase the stability of the structure 11.1, 11.2, there are also braces 21 connecting the upper support 11.1 to the lower support 11.2.

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Figure 3 shows an enlarged exemplary view of the nonreturn valve 19 of the first cylinder 3 in the first piston 5. This is preferably a normal nonreturn valve 19, through which the fluid can only flow downward. The same applies
15 to the nonreturn valve 20 of the second cylinder 4.

Figure 4 shows a further preferred embodiment of the invention, which corresponds in essence to the embodiment shown in Figures 1 and 2. Connected to the throttled
20 connecting line 13 via a third line 22 is a reservoir 23. The function of the reservoir 23 is to compensate for the leakage which can occur through the seals 7.1, 7.2, 8.1, 8.2 of the two cylinders 3, 4. The third line 22 has a further nonreturn valve 24, so that the fluid can only
25 flow in one direction. In another embodiment, the reservoir 23 could be formed as a pressure reservoir in which the fullness of the reservoir 23 can be monitored by, for example, a pressure switch not shown here.

30 There now follows a more detailed explanation of the functional principle by reference to Figure 4:

By way of example, the case will be considered in which the elevator car safety gear is actuated. The working fluid used is oil. The trailing ropes S connect the
5 underside of the elevator car to the underside of the counterweight via a tensioning pulley arranged on the floor of the hoistway.

If the safety gear on the car is actuated, the car and
10 counterweight are decelerated at different rates. Due to the sudden stopping of the car, the counterweight will jump upward, which causes a tension in the trailing ropes. The rope force is generated when the counterweight continues to move upward when the car is stationary. This
15 leads to a sudden upward movement of the tensioning pulleys. When this occurs, oil flows from the lower oil chambers 3.2, 4.2 of the two cylinders 3, 4, via the connecting line 13, the throttle 14, and the lines 15, 16, into the upper oil chambers 3.1, 4.1 of the two cylinders
20 3, 4. The upwardly directed, jerking movement is damped by the tensioning device according to the invention. The adjustable throttle 14 determines the damping effect.

When the rope tension decreases, the tensioning device 1
25 tends toward its lowest position, and the oil from the upper chambers 3.1, 4.1 of the cylinders 3, 4 flows mainly through the nonreturn valves 19, 20 into the lower chambers 3.2, 4.2 of the cylinders 3, 4. The nonreturn valve allows rapid lowering of the tensioning pulleys, and
30 rapid retensioning.

A small reservoir 23 with a nonreturn valve compensates possible leakage. Its fullness can be monitored, for example, electrically.

5 Figure 5 shows a further embodiment of the invention. Here, by comparison with the embodiments according to Figures 1 to 4, a further throttled line 25 is added in addition to the throttled line 13 already mentioned, to connect the upper chamber 4.1 of the second cylinder 4 to
10 the lower chamber 4.2 of the second cylinder 4. The further throttled line 25 has a further throttle 26. As a result, the flow of the fluid F could be adjusted in the two cylinders 3, 4 independent of each other. In this embodiment the first line 15 and the second line 16 could
15 possibly be dispensed with if, for example, the throttle 14 and the further throttle 26 are set identically, and the throttled connecting lines 13 and 25 are of equal size. The two lines 15 and 16 can particularly be of assistance if the two throttles 14 and 26 are set
20 differently.

Although the description relates mainly to a trailing-rope tensioning device fitted with hydraulic dampers, it is self-evidently also possible in the same manner and with
25 the same function/effect to equip the trailing-rope tensioning device according to the invention with pneumatic dampers. In this case a gaseous medium is used as the working fluid.

List of Reference Numbers

	1	Trailing-rope tensioning device
	2.1	Tensioning pulley
5	2.2	Tensioning pulley
	3	First cylinder
	3.1	Upper chamber
	3.2	Lower chamber
	4	Second cylinder
10	4.1	Upper chamber
	4.2	Lower chamber
	5	First piston
	6	Second piston
	7.1	Upper seal
15	7.2	Lower seal
	8.1	Upper seal
	8.2	Lower seal
	9	First piston rod
	10	Second piston rod
20	11.1	Upper support
	11.2	Lower support
	12	Frame/housing
	13	Throttled connecting line
	14	Throttle
25	15	First line
	16	Second line
	17	Channel
	18	Channel
	19	Nonreturn valve
30	20	Nonreturn valve
	21	Brace

	22	Third line
	23	Reservoir
	24	Further nonreturn valve
	25	Further throttled connecting line
5	26	Further throttle
	B	Fastening means
	D1,D2	Damping means / damper
	EE	First end of cylinder
	EA	Second end of cylinder
10	F	Fluid
	S	Trailing rope

Patent Claims

1. Tensioning device for at least one trailing rope of an elevator installation,
5 the tensioning device (1) comprising at least one tensioning pulley (2.1,2.2) and at least one damping means (D1,D2) having a piston (5,6) and a cylinder (3,4), the piston (5,6) dividing the cylinder (3,4) into two chambers (3.1,3.2,4.1,4.2) containing a
10 working substance (F), which are connected by means of a throttled connecting line (13) and a channel (17,18) fitted with a nonreturn valve (19,20),
characterized in that
there is at least one piston rod (9,10) entering into
15 a first end (EE) and emerging from a second end (EA) of the cylinder (3,4) and which is connected to the piston (5,6).
2. Tensioning device according to Claim 1,
20 characterized in that
the piston rod (9,10) is formed as a guide for the cylinder (3,4).
3. Tensioning device according to one of the foregoing
25 claims,
characterized in that
the damping means (D) is of pneumatic or hydraulic type and the working substance (F) is a fluid.
- 30 4. Tensioning device according to one of the foregoing claims,



characterized in that
the piston rod (9,10) is arranged concentrically in
the cylinder (3,4).

- 5 5. Tensioning device according to one of the foregoing
claims,
characterized in that
the tensioning pulley (2.1,2.2) is connected directly
or indirectly to the cylinder (3,4).

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6. Tensioning device according to one of the foregoing
claims
characterized in that
the channel (17,18) fitted with the nonreturn valve
15 (19,20) is arranged inside the piston (5,6).

7. Tensioning device according to one of the foregoing
claims,
characterized in that
20 in the vicinity of its first end (EE) and in the
vicinity of its second end (EA) the cylinder (3,4) has
seals (7.1, 7.2, 8.1, 8.2).

8. Tensioning device according to one of the foregoing
25 claims,
characterized in that
the tensioning device (1) has a reservoir (23) for the
purpose of compensating a possible leakage of the
damping medium (D).

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9. Tensioning device according to one of the foregoing claims,
characterized in that
a further damping means (D2) is provided, the two
5 damping means (D1, D2) being connected to each other
through lines (15,16).
10. Tensioning device according to one of the foregoing claims,
10 characterized in that
two tensioning pulleys (2.1, 2.2) are provided.
11. Use of a tensioning device according to one of Claims
1 to 10 for an elevator installation.

