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ELEVATOR COMPENSATING ROPE SHEAVE

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Fig. 1.

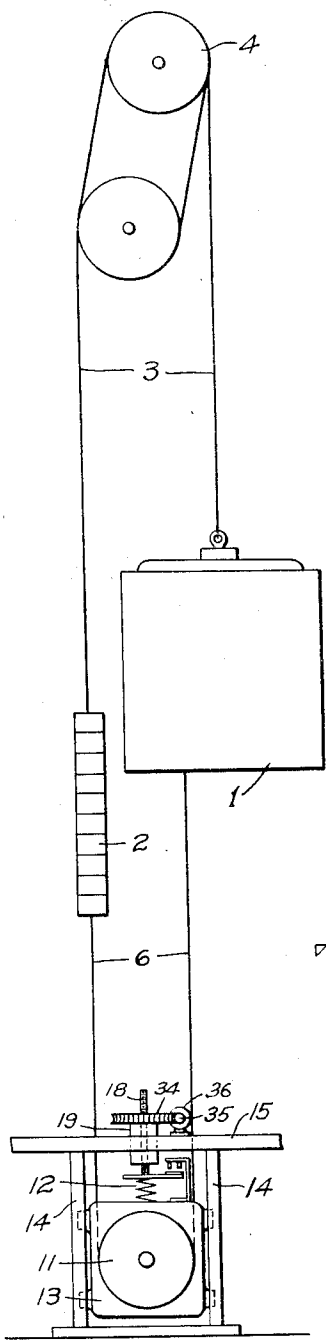
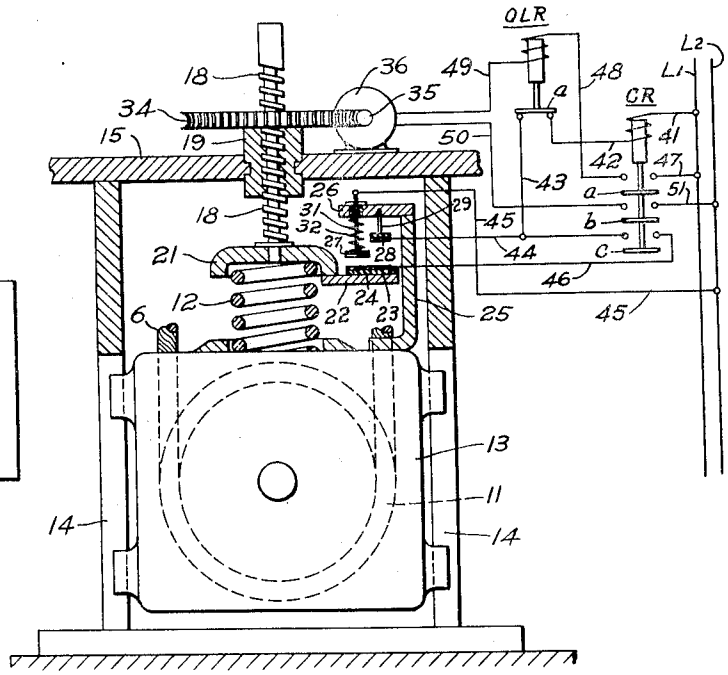


Fig. 2.



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ELEVATOR COMPENSATING ROPE SHEAVE

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My invention relates to elevator systems and more particularly to a compensating rope sheave for use therewith.

When an elevator car moves up or down, some of the hoist cable is transferred from one side of the hoist sheave to the other thereby unbalancing the system since the cable has considerable weight. To compensate for this condition it has been customary to provide a loop of compensating cable interconnected between the car and the counterweight extending to the bottom of the hatchway. As a portion of the hoist cable passes from one side of the hoist sheave to the other, an equal length of compensating cable passes in the opposite direction and, if its weight per unit length is equal to that of the hoist cable, it will preserve the equilibrium of the system. It has been common practice to hang a heavy sheave in the loop of the compensating cables to keep them taut.

In such a system, if the car while moving downward, be quickly stopped, by its overtravel or overspeed protective devices, or otherwise, it sometimes happens that the counterweight does not come to rest as quickly as the car, because of its momentum. The hoist cable then becomes slack and the compensation sheave is raised in its guides. A serious shock occurs when the counterweight falls back again.

It is accordingly an object of my invention to prevent slack cable in elevator systems during sudden stops.

It is also an object of my invention to increase the tractive effort of the hoist cables on the hoist sheave and prevent slippage.

A further object of my invention is to provide a compensating sheave which will maintain a substantially constant downward pressure of the compensating sheave upon the compensating cables without adding mass.

The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment, when read in conjunction with the accompanying drawing, in which:

Figure 1 is a diagrammatic view representing an elevator system arranged in accordance with my invention; and

Fig. 2 is a side elevational view, partly in section, showing my automatic compensation sheave, with the control circuits diagrammatically represented.

Referring more specifically to the drawing, the apparatus shown in Fig. 1 comprises an elevator car 1 and its counterbalancing counterweight 2 suspended by a hoist cable 3 which passes over a hoist sheave 4 driven in any conventional manner. A compensating cable 6 is provided having one end secured to the bottom of the car and the other end secured to the bottom of the counterweight, the intermediate portion thereof hanging as a loop in the lower end of the hatchway. A compensating sheave 11 is hung in the loop of compensating cable 6 and is depressed by a spring 12 to keep the cable taut.

The compensating sheave 11 is journalled in a frame 13 which moves freely between vertical guides 14, as shown in Fig. 2. A head plate 15 extends between the upper ends of the vertical guides 14, and the biasing means for depressing the sheave comprises the compression spring 12 which reacts upon the upper side of the movable frame 13.

In order that the tension on the compression spring 12 may be adjusted to apply a suitable biasing force on the sheave a threaded shaft 18 extends vertically through a threaded nut 19 which, as shown in Fig. 2, is journalled in the head plate 15. To the lower end of the shaft is secured a spring cap 21 which receives the upper end of the spring 12. A contact plate 22 may be secured at one side of the spring cap 21, as by welding, and extends laterally therefrom. A contact member 23 is supported on the upper side of the contact plate in insulated relation thereby suitable insulating material 24. The outer edge of the contact plate 22 extends adjacent a bracket 25 rising from the frame 13 which prevents rotation of the threaded shaft 18.

The upper end of the bracket 25 rising from the frame is provided with a horizontal portion 26 for supporting a pair of depending contact members 27 and 28 adjacent the first contact member 23 which is supported from the spring cap. One contact member 28 of said pair of depending contact members is supported rigidly in an elevated position from the bracket on the end of a bolt 29. The other contact member 27 of said pair is mounted on the end of a pin 31 which slides freely through the horizontal portion 26 of the bracket 25 and it is depressed by a light spring 32 concentrically disposed thereon. The pair of contact members on the bracket are so disposed that as the sheave frame descends, by slackening of the cables, the contact 23 on the spring cap 21 will first engage the flexible contact 27 and then the rigid contact 28.

A worm wheel 34 is rigidly secured to the

threaded nut 19 which is journalled in the head plate 15, and it operatively engages a worm 35 on the shaft of an electric motor 36. When the motor 36 is energized, it rotates the worm wheel 34 and the threaded nut 19, but the threaded shaft 18 cannot rotate because the end of the contact plate 22 engages the bracket 25, as above set forth. Hence, the rotation of the threaded nut 19 by the motor causes the threaded shaft 18 to be moved vertically with a movement of translation carrying with it the spring cap 21 which depresses the spring 12.

The motor may be energized from the main conductors L1 and L2 through suitable conductors and the contact members *a* and *b* of a control relay CR. The control relay CR is preferably energized from the main line conductors L1 and L2 by way of a circuit which extends from line L1 through a suitable conductor 41 to the winding of relay CR, thence by way of a conductor 42 through the normally closed back contacts *a* of an overload relay OLR and other conductors 43 and 44 to the rigid contact 28 on the bracket. A conductor 45 connects the resilient contact 27 directly to the other main line conductor L2. After the control relay CR is energized, the elevated contact 28 is connected to the contact 23 on the spring cap by way of a conductor 46, the normally open front contacts *c* of the control relay CR, and a conductor extending therefrom. The motor energizing circuit is completed from line L1 through a conductor 47, the contacts *a* of the control relay CR, thence by way of a conductor 48 through the winding of an overload relay OLR, through a conductor 49 to the motor, thence by way of a conductor 50 to the contact members *b* of the control relay CR returning through a conductor 51 to the other line conductor L2.

The winding of the overload relay OLR being inserted in the motor energizing circuit and its back contacts being connected into the energizing circuit of the control relay serve to protect the system if the motor becomes stalled.

Assuming that, in operation, the compensating sheave 11 is lowered by slackening of the cables, the resilient contact 27 will first engage the relatively stationary contact 23 supported on the spring cap 21. This will not have any effect, however, since the contact supported on the spring cap is open circuited at the contacts *c* of the control relay CR.

As the sheave 11 sags further, the rigid elevated contact 28 on the bracket will eventually engage the spring cap contact 23, and when this occurs, the latter contact acts as a bridging contact and completes a circuit between the pair of contacts 27 and 28 on the bracket thereby energizing the winding of the control relay CR. The latter then pulls up, closing the previously traced motor energizing circuit through its contact members *a* and *b*.

The motor 36 starts to drive the threaded nut 19 in the proper direction to force the threaded shaft 18 downwardly and compress the spring 12. As soon as the motor starts to drive the spring cap 21 downwardly, the contact 23 supported thereon is moved away from the elevated contact 28 on the bracket. This does not deenergize the control relay CR, however, since the lower contacts "*c*" thereof have prepared a holding circuit through conductor 46 and the spring cap contact 23, and the motor will now continue to run as long as the latter is in engagement with the lower or resilient contact 27 depending from the bracket.

When the spring cap 21 has been driven down sufficiently to separate its contact 23 from the lower contact 27 on the bracket, the control relay CR is deenergized which causes its contacts to open and deenergizes the motor 36. The spring 12 has then been sufficiently compressed to provide the proper tension on the compensating sheave 11. The spring compression and corresponding downward force on the sheave, will thus automatically be maintained between the limits corresponding to the positions of contacts 27 and 28.

If the motor 36 stalls from any cause, the overload relay OLR will become sufficiently energized to open its back contacts "*a*" and since the contacts of the overload relay are inserted in the energizing circuit of the control relay CR, as previously set forth, the latter is deenergized and the continuous energization of the motor with subsequent damage thereto is prevented. The elevated contact member 28 may also be mounted resiliently on the bracket 26 in a manner similar to the lowermost contact 27 to prevent injury thereto if the motor overruns.

It will be seen that I have provided a compensation sheave which automatically maintains a predetermined tension on the compensating cables to improve traction and to prevent slack cable without adding excessive mass.

Although I have shown and described a specific embodiment of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except as necessitated by the prior art and the scope of the appended claims.

I claim as my invention:

1. The combination with a car and a counterweight interconnected by hoist cables passing over a hoist sheave at the top of the hatchway, of a compensating sheave at the lower end of the hatchway, compensating cables interconnected between the car and the counterweight and passing under the compensating sheave, vertical guides between which the compensating sheave is free to move, resilient biasing means for continuously biasing said compensating sheave downwardly, and means responsive to the slackening of the compensating cables for maintaining the biasing means above predetermined pressure.

2. The combination with a car and a counterweight interconnected by a hoist cable passing over a hoist sheave at the top of the hatchway, of a compensating sheave at the lower end of the hatchway, a compensating cable interconnected between the car and the counterweight and passing under the compensating sheave, vertical guides between which the compensating sheave is free to move, resilient biasing means for continuously biasing said compensating sheave downwardly, means for adjusting the biasing force applied by said biasing means, an electric motor for actuating said adjusting means, and contacting means for automatically controlling said motor comprising a contact member movable with the compensating sheave and a second contact member movable with said adjusting means.

3. In a compensating sheave for tensioning the compensating cables of an elevator system, a sheave, a frame for pivotally supporting said sheave, vertical guides between which the sheave frame is free to move, a compression spring engaging the upper side of said frame for biasing the latter downwardly, and means for automatically adjusting the tension on the spring comprising an electric motor and contact members associated with said sheave and adjusting means.

4. In a compensating sheave for tensioning the compensating cables of an elevator system, a sheave, vertical guides, a frame mounted for free movement between said guides, means for journalling said sheave in said frame, a head plate extending between the upper ends of said guides, a compression spring disposed between said head plate and said frame to continuously bias the latter downwardly, adjustable means on said head plate for compressing said spring, a motor for driving said adjustable means, a contact member movable with said frame, and a second contact member cooperable therewith to control the motor for compressing said spring in accordance with the position of said frame.

5. The combination with a compensating sheave for tensioning the compensating cables of an elevator system comprising a sheave, biasing means for continuously depressing said sheave, means for adjusting said biasing means, and a motor for actuating said adjusting means, of a contact movable with said sheave, a resilient contact and a rigid contact mounted in the path of movement of said first contact whereby they will be engaged as the cables slacken, said resilient contact being disposed for engagement prior to said rigid contact, electromagnetic switching means energized by the engagement of said rigid contact, and contactor means controlled thereby for starting said motor and for completing a stick circuit for said electromagnetic switch through said resilient contact.

6. In a mechanism for tensioning the compensating cable of an elevator system, a compensating sheave for applying tension to the cable, biasing means continuously applying a biasing force to the sheave to maintain the tension on the cable, and means responsive to the tension of the cable for causing the biasing means to maintain the biasing force above a predetermined pressure.

KENNETH M. WHITE.