Jan. 20, 1942. F. HYMANS 2,270,441

ELEVATOR SAFETY DEVICE

Filed Oct. 8, 1940 3 Sheets-Sheet 1

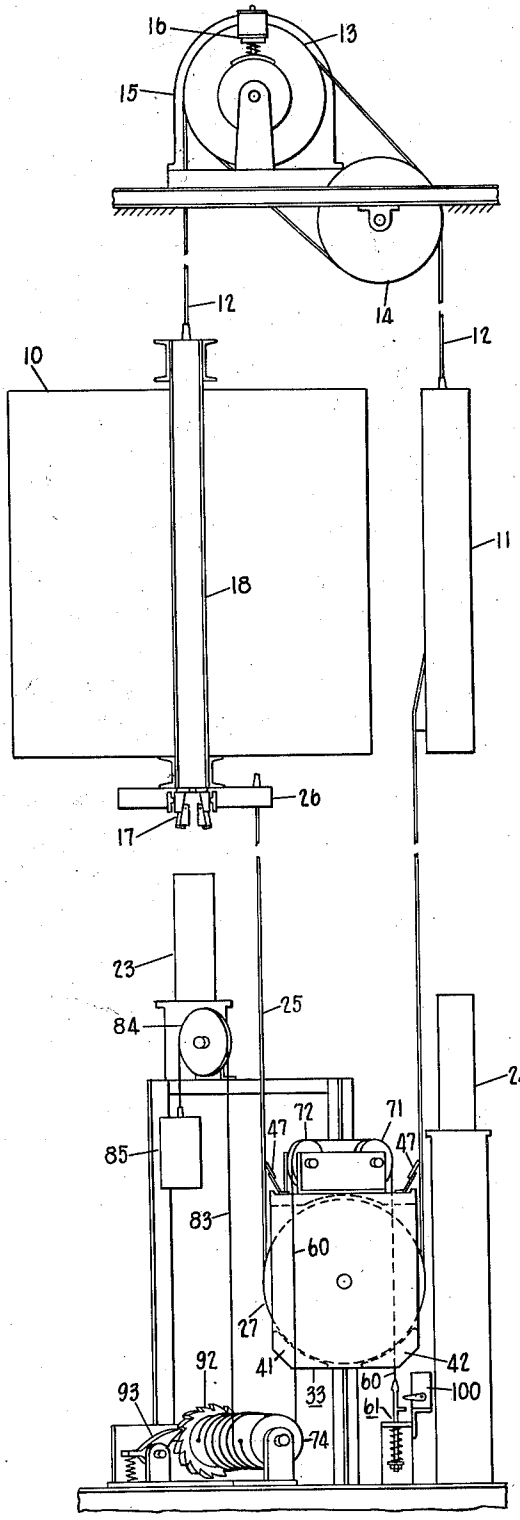

FIG. 1

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ELEVATOR SAFETY DEVICE

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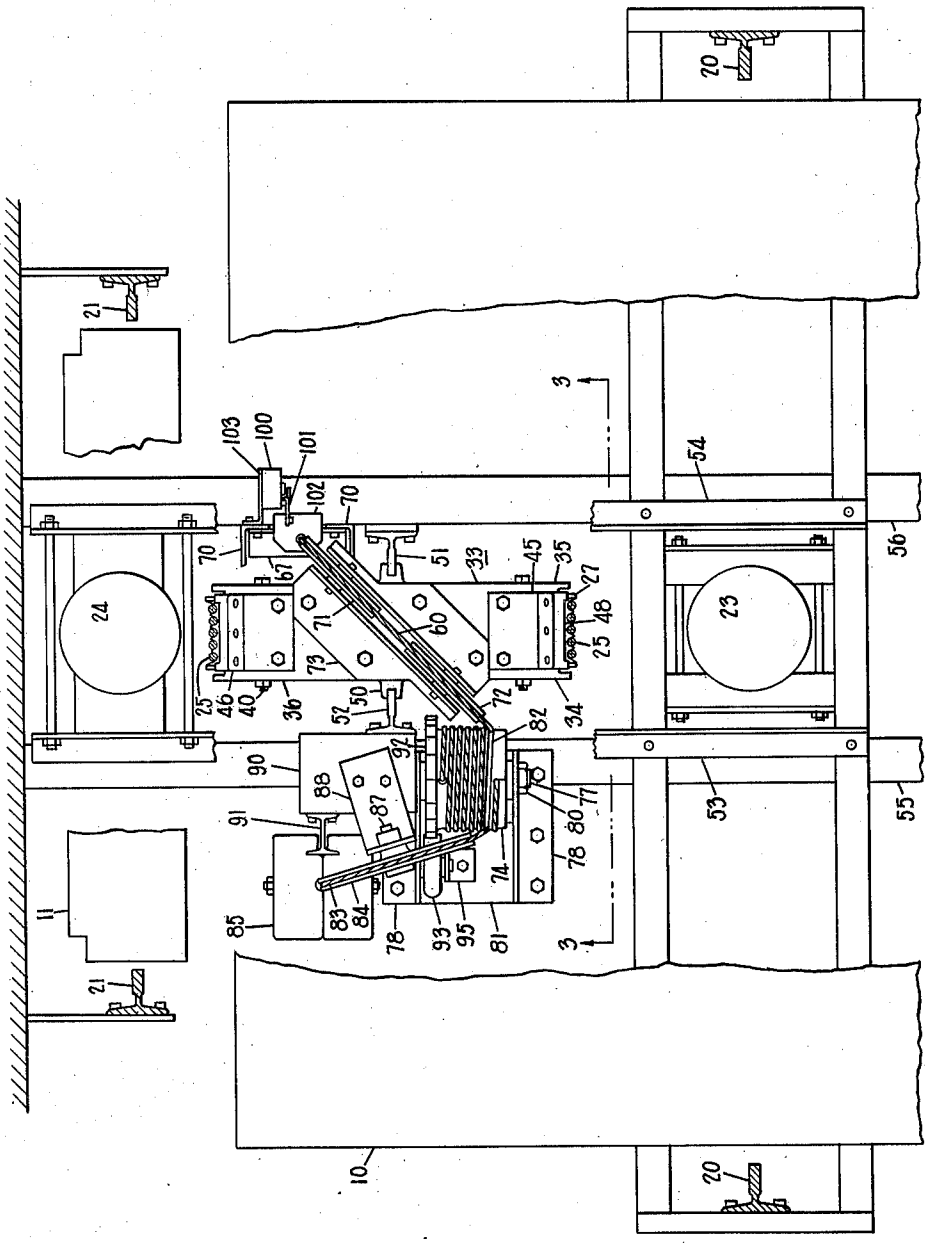

FIG. 2

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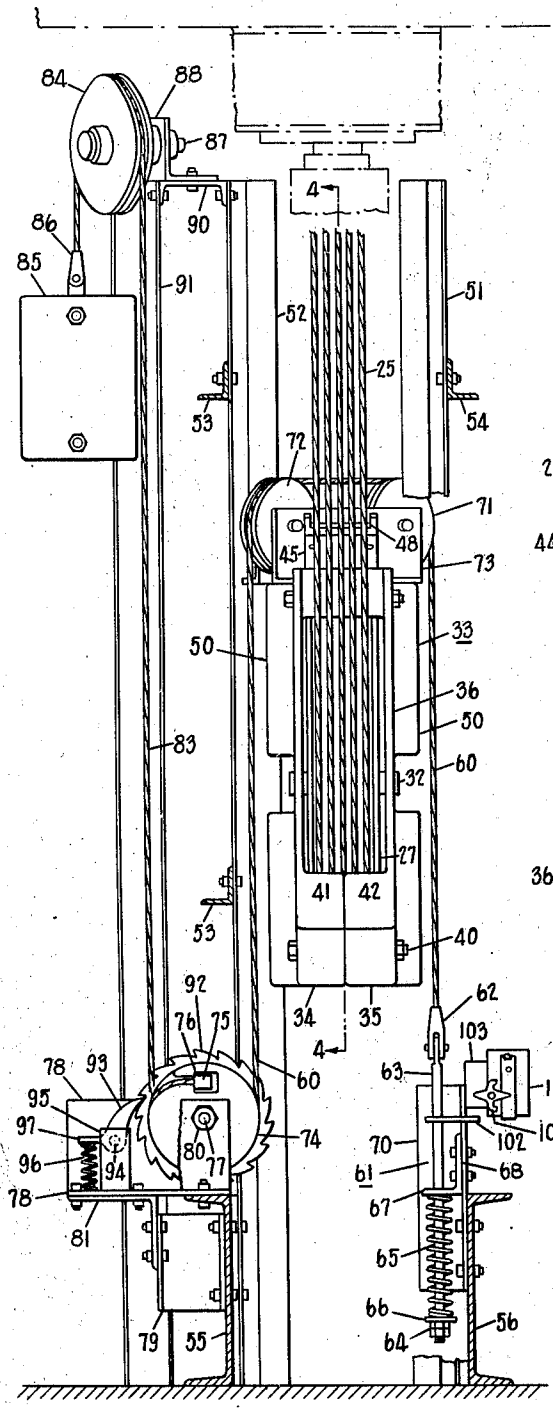

FIG. 3

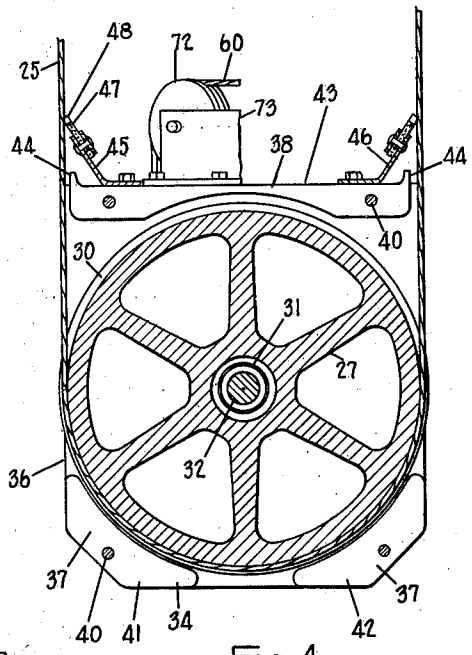

FIG. 4

Frederick Hymans INVENTOR

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Patented Jan. 20, 1942

2,270,441

UNITED STATES PATENT OFFICE

2,270,441

ELEVATOR SAFETY DEVICE

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Application October 8, 1940, Serial No. 360,221

9 Claims. (Cl. 187—22)

The invention relates to safety devices for elevators.

In elevator installations of the traction type, the elevator car and counterweight are suspended by hoisting ropes which pass over a hoisting sheave at the top of the hatchway. As a counterbalance for the hoisting ropes, compensating ropes are suspended from the car and counterweight, these ropes passing around a tensioning sheave, termed compensating sheave, at the bottom of the hatchway. In such installations, some of the emergency stops by safety brakes or buffers are made under such conditions that, if the compensating sheave were free to move upwardly, the ascending body would continue its upward movement after the descending one is brought to rest. In high speed high rise installations, the amount of continued upward movement of the ascending body might be so great that in falling back, the body would be brought to an abrupt stop as the ropes became taut, resulting in dangerous stresses and jerking the descending body upwardly. Also there would be the attendant possibility of shock or injury to occupants of the car, due to the suddenness of the stop on falling back if the car were the ascending body or the sudden jerking of the car upwardly by the counterweight if the car were the descending body. Furthermore, the stop might occur with the bodies at such positions in the hatchway that the ascending body in its continued upward movement might crash into the overhead work. By tying down the compensating sheave, that is, preventing upward movement thereof, the car, counterweight and roping are caused to function as a closed system so that when an emergency stop is made all elements of the system are retarded as a unit with the forces exerted acting on the total mass of the system. This prevents continued upward movement of the ascending body after the descending one has come to rest.

The frames for the compensating sheaves are provided with guards around the bottom of the sheave to maintain the ropes in the sheave grooves. This is desirable because unequal tension develops in the compensating ropes which may be to the extent that one or more of the ropes may become so slack that they would leave the grooves unless guards were provided. With this arrangement it is possible for one or more of the ropes to jam between the sheave and a guard. With the compensating sheave tied down, this would cause an abrupt stop with possible injury to occupants of the car and with stresses of a serious nature such that the framework of the car or counterweight might be disrupted or ropes pulled loose. Other conditions may arise to cause abnormally high forces of retardation.

One object of the invention is to tie down the compensating sheave by mechanism which will perform under varied conditions of elevator operation in a safe and efficient manner.

Another object of the invention is to tie down the compensating sheave in such way as to yield when the compensating ropes jam.

Another object of the invention is to provide a tied down compensating sheave which is released when the force tending to lift the compensating sheave exceeds a certain amount.

In carrying out the invention according to the arrangement which will be described, the compensating sheave is tied down by roping. Freedom of movement of the compensating sheave in the down direction is permitted to take up any stretch in the hoisting and compensating roping, any slack tending to develop in the tying down roping due to this downward movement being taken up with provision, however, for a limited upward movement of the sheave to accommodate any contraction of roping due to temperature and humidity changes. The tensile strength of the tying down roping is such that it holds the sheave against upward movement upon emergency stops being made but that it will break upon occurrence of abnormal conditions such as the compensating ropes becoming jammed between the sheave and the frame.

Features and advantages of the invention will be apparent from the following description and appended claims.

In the drawings:

Figure 1 is a schematic representation of an elevator installation with tied down compensating sheave embodying the invention;

Figure 2 is a plan view of the tied down compensating sheave arrangement of Figure 1;

Figure 3 is a side view of the compensating sheave arrangement of Figure 2 taken along the line 3—3 of Figure 2; and

Figure 4 is a section through the compensating sheave taken along the line 4—4 of Figure 3.

Referring to Figure 1, the elevator car 10 and counterweight 11 are suspended by hoisting ropes 12. These ropes extend upwardly from the car around a hoisting sheave 13, then around an idler sheave 14 and back around traction sheave 13 to provide double wrap and thence down to the counterweight. The traction sheave is driven by

a hoisting motor 15. 16 is an electromechanical brake for holding the car and counterweight at rest. 17 is a safety brake carried by the framework 18 of the elevator car, this brake and a similar brake on the other side of the car cooperating with the guide rails to bring the car to a stop under emergency conditions. The counterweight may be provided with similar safety brakes not shown. The guides 20 for the elevator car and guides 21 for the counterweight are shown in Figure 2. 23 is a buffer for the elevator car and 24 is a buffer for the counterweight for bringing these members to a stop should they continue into the elevator pit during downward movement.

The compensating ropes are designated 25. These ropes are secured to a hitch frame 26 carried by the framework of the elevator car from which they extend downwardly around the compensating sheave 27 and then upwardly to the counterweight 11 to which they are secured. Referring also to Figures 2, 3 and 4, grooves 30 are provided around the periphery of the compensating sheave for the compensating ropes. The compensating sheave is mounted on ball bearings 31 on a shaft 32 supported by the side plates 36 of the compensating sheave frame 33. This frame is made in two similar halves 34 and 35. Each half comprises the side plate 36 on which are formed two arcuate bosses 37, one at each lower corner, and an elongated boss 38 across the top. The plates are held together by bolts 40 passing through aligned apertures extending through bosses 37 and 38. The lower arcuate bosses 37 form guards 41 and 42 for maintaining the compensating ropes on the compensating sheave, the inner surfaces of these guards being concentric with the compensating sheave. The upper boss 38 forms a cover 43 for the compensating sheave, lips 44 being provided on these bosses adjacent the compensating ropes as a protection against things getting between the ropes and the compensating sheave. Supplementing this protection are a pair of angle plates 45 and 46, one on each side of the frame and secured to the cover 43 to form a trough. The ends of these plates adjacent the ropes are flexible, having pieces 47 of sheet leather secured thereto, each of which is cut away at 48 to extend around the ropes, these flexible ends being provided to take care of the possibility of the ends coming in contact with the ropes.

Guides 50 are formed on the outside of side plates 36. These guides cooperate with vertical guide rails 51 and 52 to guide the frame and therefore the sheave 27 during any movement thereof that may occur. The guide rails are secured to structural angle bars 53 and 54 and channel members 55 and 56 extending crosswise of the pit.

The compensating sheave is tied down by means of a rope 60. This rope is secured to a spring hitch 61 comprising a thimble 62 to which the end of the rope is secured, the thimble in turn being pivotally connected to a rod 63. The lower end of rod 63 is threaded to receive nuts 64. A spring 65 is arranged on the lower end of the rod between a washer 66 above the nuts and the leg 67 of a cross angle member 68, the leg having an aperture through which the rod extends. The cross angle is fastened to two upright angles 70 in turn secured to channel member 56. Rope 60 extends upwardly from the hitch to the top of the compensating sheave frame where it extends over two idler pulleys 71 and 72. These pulleys are mounted on shafts supported by angle members 73 secured to the cover 43 of the frame. These angle members are arranged diagonally to position the two leads of rope 60 equidistant from the center of the compensating sheave, while maintaining structural clearances. From the top of the frame the rope extends downwardly to a tensioning drum 74 to which it is secured by a thimble 75 on the end of the rope extending into a socket 76 in the end of the drum.

The drum 74 is rotatably mounted on a shaft 77 supported by the side plates of angle members 78 and held in place by nuts 80 threaded on the end of the shaft. These angle members are secured at one end to the top of channel member 55. At the other end, members 78 are tied together underneath by a cross angle 81 supported through an I beam member 79 by channel member 55. The drum has a spiral groove 82 for winding thereon the rope 60, the socket 76 leading into the end of the groove. Another rope 83 is oppositely wound on the drum, the end of this rope being secured to the drum at the other end thereof so as to lead into the end of the spiral groove. This latter rope extends upwardly from the drum to and over an idler pulley 84 and thence down to a tensioning weight 85 to which it is pivotally secured by a thimble 86. The pivot shaft 87 for the pulley 84 is supported by an angle bracket 88 mounted on a cross member 90 extending between guide rail 52 and an upright member 91 in the form of an I beam. This member also serves as a guide for tensioning weight 85. The tensioning weight acts through rope 83 and drum 74 to maintain rope 60 taut and thus spring 65 in a state of compression.

A ratchet wheel 92 is formed on the end of the drum 74 and cooperates with a pawl 93 to lock the drum against unwinding of rope 60. The pawl is mounted on a shaft 94 extending between one of the angle members 78 and a bracket 95 secured to cross angle 81. A spring 96 is arranged beneath a lug 97 on the pawl and cross angle 81 for biasing the pawl into cooperative relation with the teeth of the ratchet. This ties down the compensating sheave frame while permitting free downward movement thereof to take up slack in the hoisting and compensating ropes. Spring 65 permits a limited upward movement of the compensating sheave frame to allow for any contraction of roping due to temperature and humidity changes.

In order that the action may be clearly understood, assume that the car or counterweight is brought to an emergency stop during its descent by its safety brake or buffer at a rate in excess of gravity. Under such conditions the ascending body tending to retard more slowly than the descending one, a force is exerted tending to lift the compensating sheave. Initially the sheave and its frame move upwardly on guides 51 and 52 a short distance until spring 65 is compressed, whereupon they are brought to a stop, pawl 93 and ratchet wheel 92 preventing the unwinding of rope 60 from drum 74. Thus, the car and counterweight are slowed down as a unit and come to a stop simultaneously, preventing excessive retardation and continued upward movement of the ascending body and thus falling back after the descending body has come to rest, other than the small amount allowed by spring 65 for contraction of the roping and due to the clearance between pawl 93 and the locking tooth on the ratchet wheel 92. When stretching of the ropes

occurs, the compensating sheave and frame move downwardly on guides 51 and 52. As this occurs, drum 74 is rotated by weight 85 to take up on rope 60, the pawl 93 and ratchet wheel 92 acting to lock the drum and prevent reverse rotative movement thereof other than a small amount due to the pitch of the ratchet wheel teeth.

A switch 100 is provided to be operated upon any upward movement of the compensating sheave sufficient to fully compress spring 65. This switch has a trip lever 101 which is operated by a trip plate 102 secured as by welding to rod 63. The switch is mounted on an angle 103 secured to one of the upright angles 70 with its trip lever in the path of movement of the trip plate. This switch is connected to cause upon operation the discontinuance of the supply of power to the hoisting motor 15 and the application of the brake 16 to stop rotation of the hoisting sheave 13.

While an elevator installation with tied down compensating sheave may continue in operation throughout its life without the compensating ropes ever jamming between the sheave and its guards 41 and 42, nevertheless it is possible for such jamming to occur. For example, notwithstanding the cover 43 and its supplementary protecting plates 45 and 46, it is possible, especially where one or more ropes are slack or in installations in which the sheave is diagonally arranged in the hatchway, for things to get between the ropes and the sheave below the cover on the side on which the ropes lead onto the sheave, causing the ropes to jam between the guard and the sheave. This might also be caused by one of the ridges between compensating grooves breaking off, getting between the ropes and the sheave or causing one or more ropes to climb onto the ridges. Also, one or more of the ropes might become so slack as to get under taut ropes and force them to jam between the sheave and the guard. Such jamming would lock the compensating sheave to the compensating ropes, resulting in a force being exerted to jerk the sheave upwardly. With the sheave tied down in such manner as to be able to resist this force, the car and counterweight would be brought to an abrupt stop, with possible injury to occupants of the car and with stresses of such high order as to damage the framework of the car or counterweight, or pull the ropes loose or even pull the hitch plate loose from the car framework with the attendant additional damage due to the parts falling in the hatchway.

With the compensating sheave yieldably tied down in accordance with the invention, such undesirable possibilities are avoided. With the sheave tied down by a rope, as by rope 60 in the construction illustrated, the strength of this rope is chosen so as to be able to withstand the force tending to lift the compensating sheave under emergency stop conditions but so as to break when the force is above a certain amount in excess of such lifting force, as when jamming of the compensating ropes occurs. Also, the rope 60 may be attached so as to pull loose at one or the other of its ends when jamming occurs. Thus an abrupt stop of the car and counterweight and dangerous stresses in the apparatus under such conditions are avoided. When the cause of such excessive force has been removed, all that need be done to restore the tying down of the compensating sheave is to replace or reattach rope 60. It is to be noted that when such conditions arise, switch 100 is operated to stop rotation of the hoisting sheave and thus avoid any prolongation of the forces lifting the compensating sheave.

While the invention has been particularly described in connection with a condition where jamming of the compensating ropes occurs, it is to be understood that the invention is equally effective under other conditions when a force of a certain amount is exerted upwardly on the compensating sheave. Also, other constructions of mechanism for tying down the compensating sheave may be used, as, for example, chains may be used instead of ropes in tying down the sheave, and other arrangements which will permit upward movement of the compensating sheave in the event that the tension in the compensating ropes exceeds a predetermined amount, may be employed. Therefore, as many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An elevator system comprising, an elevator car, a counterweight, hoisting mechanism for said car and counterweight including hoisting roping, compensating roping, a tensioning sheave for said compensating roping, and means for tying down said tensioning sheave against more than a limited amount of upward movement, said last named means including means enabling more than said limited amount of upward movement of said tensioning sheave only when the force tending to lift said sheave exceeds a predetermined amount.

2. An elevator system comprising, an elevator car, a counterweight, a hoisting sheave, hoisting roping connected to said car and counterweight and extending over said hoisting sheave, compensating roping for said hoisting roping connected to said car and counterweight, a tensioning sheave for said compensating roping, safety means for bringing the car to a stop under emergency conditions, and means for tying down said tensioning sheave against more than a limited upward movement upon operation of said safety means to bring said car to a stop, said last named means including means for permitting more than said limited amount of upward movement of said tensioning sheave when the force tending to lift said sheave exceeds a predetermined amount which is greater than the maximum force that may be exerted to lift said tensioning sheave due to operation of said safety means.

3. An elevator system comprising, an elevator car, a counterweight, a hoisting sheave, hoisting roping connected to said car and counterweight and extending over said hoisting sheave, compensating roping for said hoisting roping connected to said car and counterweight, a tensioning sheave for said compensating roping, and means for tying down said tensioning sheave against more than a limited upward movement provided the force exerted to lift said tensioning sheave does not exceed a predetermined amount, said last named means including flexible means the tensile strength of which is such that the flexible means will break if such force is exceeded.

4. An elevator system comprising, an elevator car, a counterweight, a hoisting sheave, hoisting roping connected to said car and counterweight and extending over said hoisting sheave, compensating roping for said hoisting roping connected to said car and counterweight, a tensioning sheave for said compensating roping, said tensioning sheave having a frame, rotatable means carried by said frame, and a rope extending over said rotatable means and secured at its ends to prevent more than a limited upward movement of said tensioning sheave, said rope having a tensile strength such that the rope will break to permit unlimited upward movement of said compensating sheave only in the event that a force is exerted to lift said tensioning sheave which exceeds a predetermined amount.

5. An elevator system comprising, an elevator car, a counterweight, a hoisting sheave, hoisting roping connected to said car and counterweight and extending over said hoisting sheave, compensating roping for said hoisting roping connected to said car and counterweight, a tensioning sheave for said compensating roping, said tensioning sheave having a frame, rotatable means carried by said frame, a rope extending over said rotatable means, and means securing the ends of said rope to restrict the upward movement of said tensioning sheave, said rope yielding to permit unlimited upward movement of said compensating sheave in the event of said compensating ropes jamming between said tensioning sheave and said frame.

6. An elevator system comprising, an elevator car, a counterweight, a hoisting sheave, hoisting roping connected to said car and counterweight and extending over said hoisting sheave, compensating roping for said hoisting roping connected to said car and counterweight, a tensioning sheave for said compensating roping, said tensioning sheave having a frame, rotatable means carried on top of said frame, a rope extending over said rotatable means, and means for securing the ends of said rope to tie down the compensating sheave.

7. An elevator system comprising, an elevator car, a counterweight, a hoisting sheave, hoisting roping connected to said car and counterweight and extending over said hoisting sheave, compensating roping for said hoisting roping connected to said car and counterweight, a tensioning sheave for said compensating roping, said tensioning sheave having a frame, rotatable means carried on top of said frame, a coil spring, a drum, a rope secured at one end to said drum, extending over said rotatable means and fastened down at its other end through said spring, means for effecting rotative movement of said drum in a direction to wind up said rope thereon to take up any slack in said hoisting ropes and compensating ropes, and means for preventing reverse rotative movement of said drum.

8. An elevator system comprising, an elevator car, a counterweight, a hoisting sheave, hoisting roping connected to said car and counterweight and extending over said hoisting sheave, compensating roping for said hoisting roping connected to said car and counterweight, a tensioning sheave for said compensating roping, said tensioning sheave having a frame, rotatable means carried on top of said frame, a drum below said frame on one side thereof, a stationary member below said frame on the other side thereof and having an aperture therein, a rope extending at one end upwardly through said aperture to said compensating sheave frame, over said rotatable means and downwardly therefrom to said drum to which the other end of said rope is connected, said drum having a spiral groove thereon for winding said rope on said drum, a coil spring arranged on said rope between said one end thereof and said stationary member, means for effecting rotative movement of said drum in a direction to wind up said rope thereon in the event of downward movement of said tensioning sheave, and a pawl and ratchet device for preventing reverse rotative movement of said drum.

9. An elevator system comprising, an elevator car, a counterweight, a hoisting sheave, hoisting roping connected to said car and counterweight and extending over said hoisting sheave, compensating roping for said hoisting roping connected to said car and counterweight, a tensioning sheave for said compensating roping, said tensioning sheave having a frame, vertical guides for said frame, rotatable means carried on top of said frame, a drum below said frame on one side thereof, a stationary member below said frame on the other side thereof and having an aperture therein, a first rope extending at one end upwardly through said aperture to said compensating sheave frame, over said rotatable means and downwardly therefrom to said drum to which the other end of said first rope is connected, said drum having a spiral groove thereon for winding said first rope on said drum, a coil spring arranged on said first rope between said one end thereof and said stationary member, a second rope secured to said drum and oppositely wound thereon in said groove in space not occupied by said first rope, a pulley above said drum over which said second rope extends, a weight secured to the other end of said second rope for effecting rotative movement of said drum in a direction to wind up said first rope thereon in the event of downward movement of said tensioning sheave, a ratchet wheel formed on said drum, and a pawl for cooperating with said ratchet wheel to prevent reverse rotative movement of said drum to thereby tie down said compensating sheave against more than the limited upward movement thereof permitted by said spring and said pawl and ratchet wheel unless the force exerted to lift said sheave creates a stress in said first rope in excess of the tensile strength thereof.

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