M. E. NEENAN.

ELEVATOR.

APPLICATION FILED APR. 29, 1903. RENEWED NOV. 22, 1905.

912,256.

Patented Feb. 9, 1909.

2 SHEETS—SHEET 1.

Fig. 12

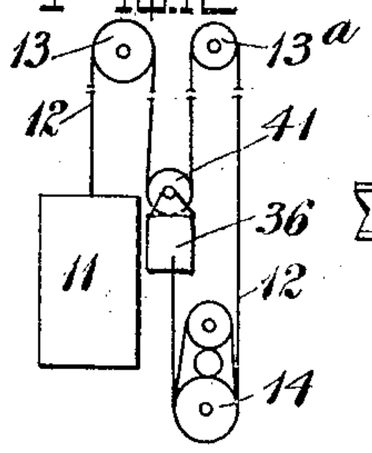


Fig. 1

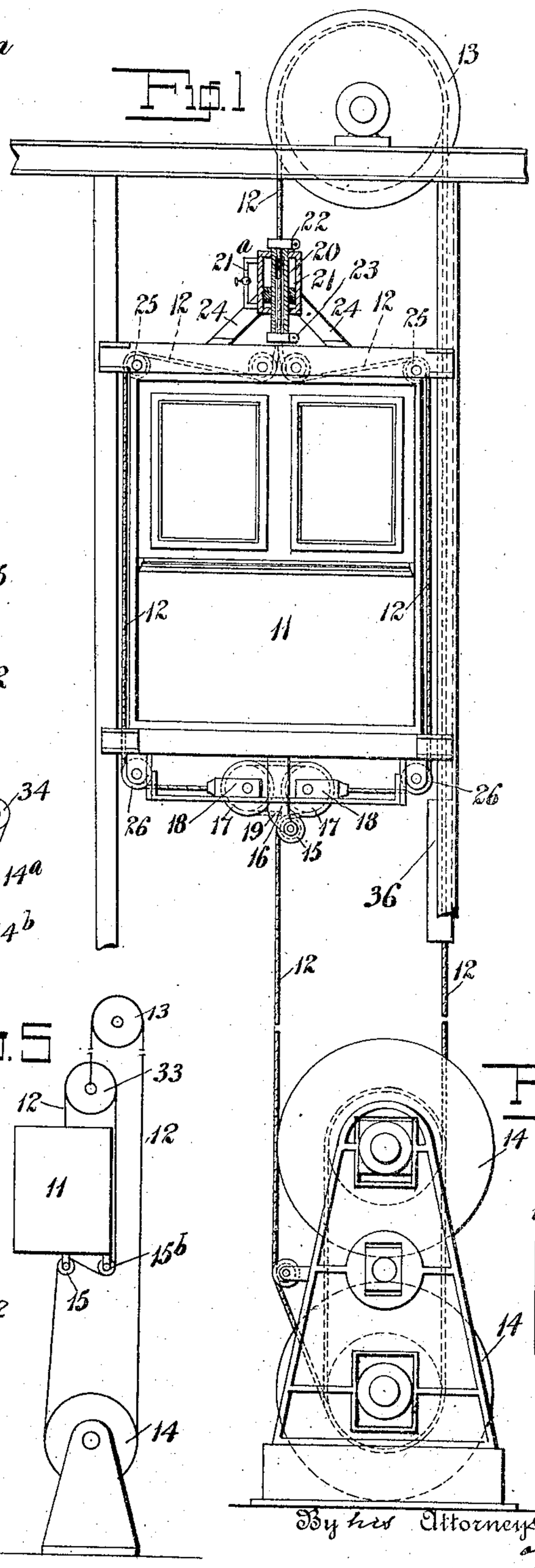


Fig. 11

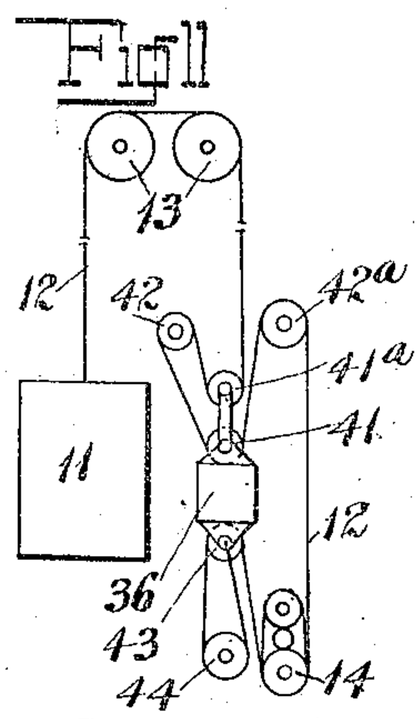


Fig. 7

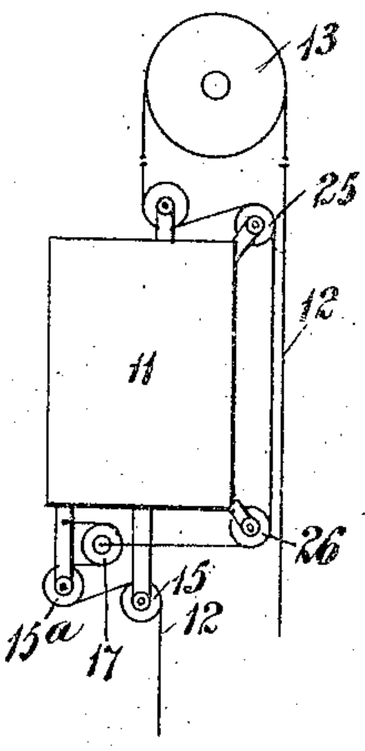


Fig. 6

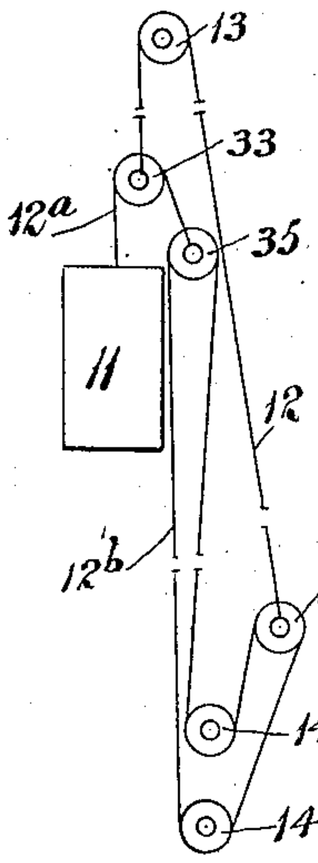


Fig. 1a

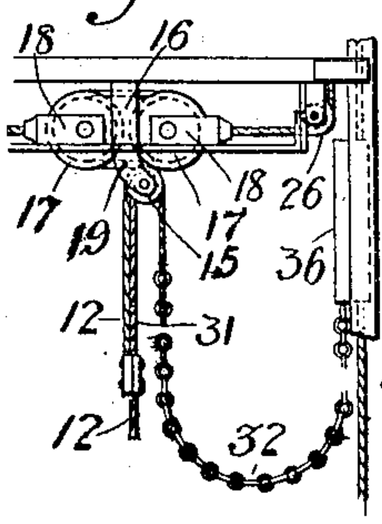
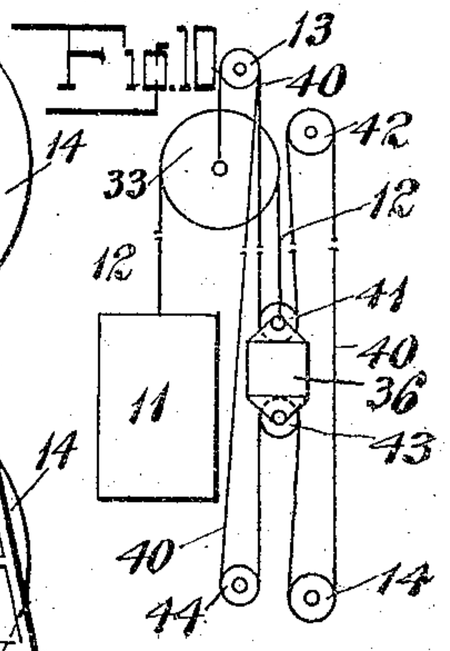


Fig. 5

Fig. 10



Witnesses
J. J. Liner
C. F. Smith

Inventor
Michael E. Neenan
By his Attorneys
Wright Bros.

M. E. NEENAN.

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2 SHEETS—SHEET 2.

Fig. 3

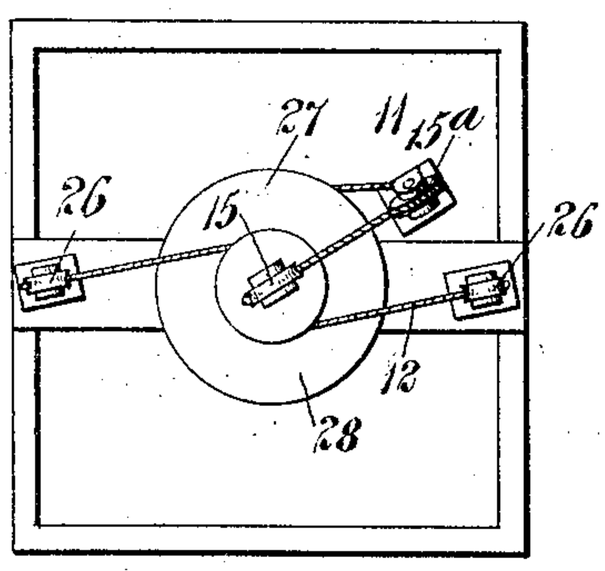


Fig. 2

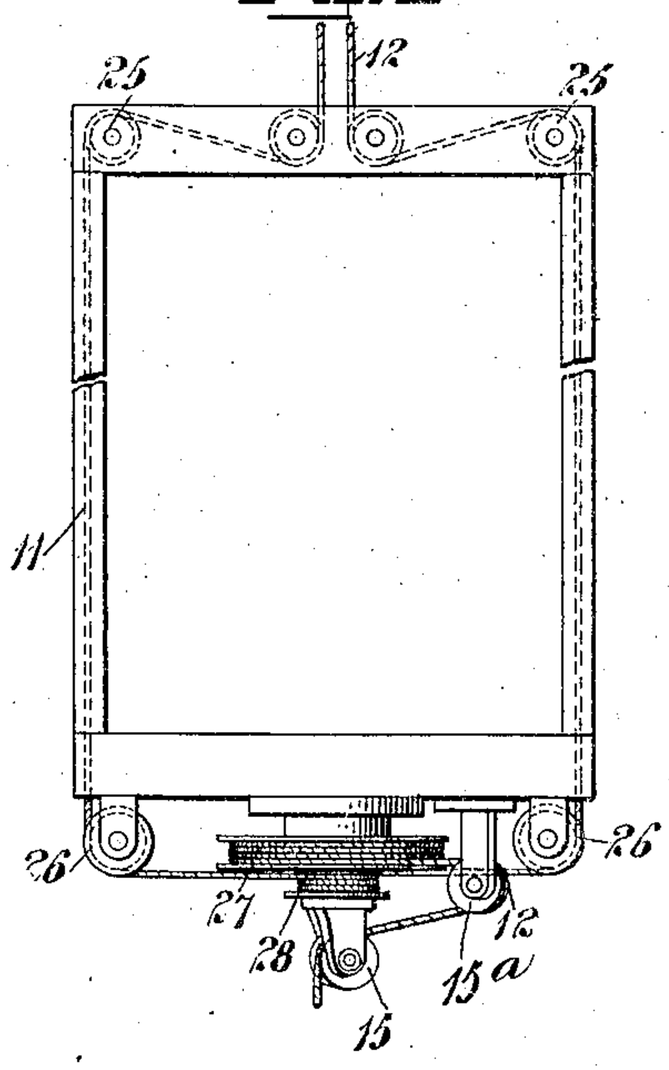


Fig. 8

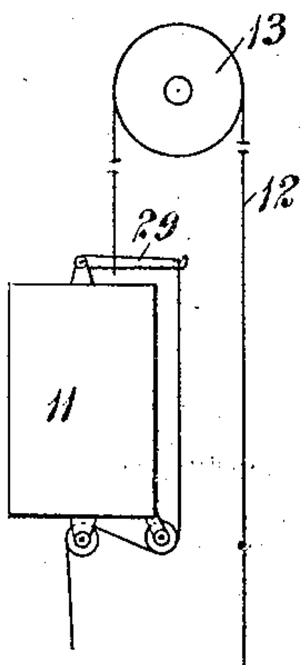


Fig. 4

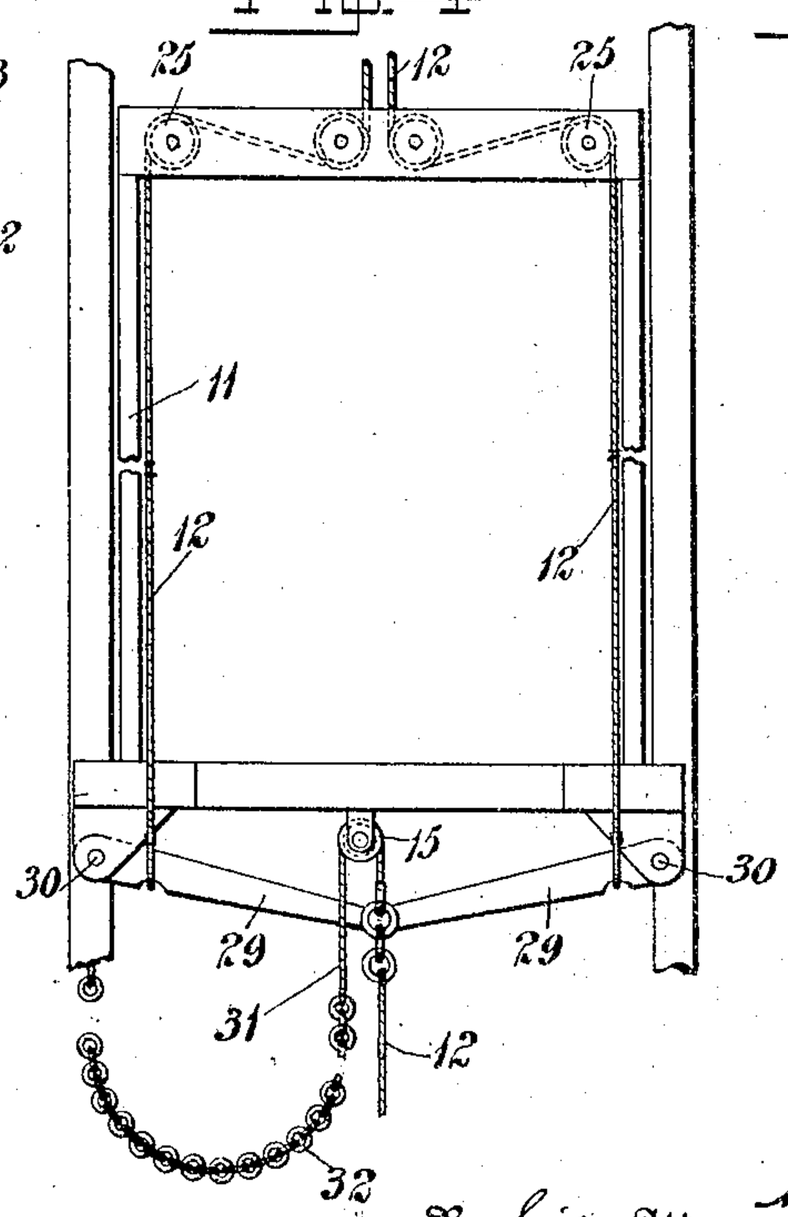
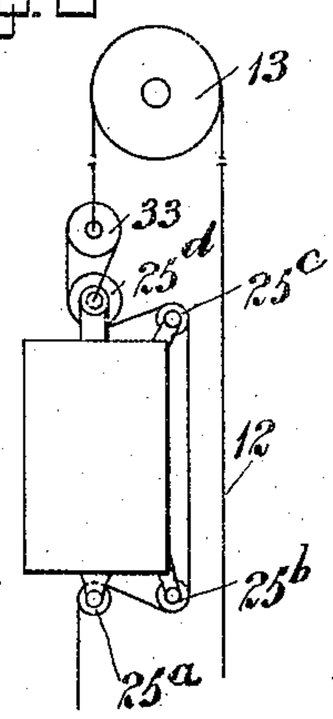


Fig. 9



Witnesses
J. I. Liner
C. F. Smith.

Inventor
Michael E. Neenan
By his Attorneys Knight Bros.

UNITED STATES PATENT OFFICE.

MICHAEL E. NEENAN, OF NEW YORK, N. Y.

ELEVATOR.

No. 912,256. Specification of Letters Patent. Patented Feb. 9, 1909.

Application filed April 29, 1903, Serial No. 154,835. Renewed November 22, 1905. Serial No. 288,560½.

To all whom it may concern:

Be it known that I, MICHAEL E. NEENAN, a citizen of the United States, residing in the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in Elevators, of which the following is a specification.

My invention relates to frictional driving apparatus for elevators and consists of a device combining the opposite sections or leads of the ropes passing on and off the driving apparatus whereby the tension throughout said ropes is regulated by the load suspended therefrom. By my invention weights as used heretofore to apply tension to the ropes are dispensed with, and it is rendered impossible for any increased load on the car or sudden stoppage of the same to cause the frictional driving mechanism to slip. To this end the ropes and sheaves are so disposed, and the car so suspended therefrom, that while the weight of the car holds in tension its direct suspension and hoisting ropes, it also holds in tension the opposite leads of the ropes and takes up the slack thereof, and applies greater tension to the said opposite leads of the ropes when the load on the car causes increased tension on its direct suspension or hoisting ropes, or inertia is to be overcome.

In the accompanying drawings, Figure 1 is an elevation of an elevator mechanism illustrating my invention; Fig. 1ª is a diagrammatic elevation illustrating the application of a rope-counter-balance to the embodiment of the invention shown in Fig. 1. Fig. 2 is an elevation of the car and its appurtenances showing a modification; Fig. 3 is a bottom view of the car and its accessories shown in Fig. 2; Fig. 4 is an elevation of another modification; and Figs. 5 to 12, inclusive, are diagrammatic elevations of still further modifications, which illustrate modes of carrying into effect the principles of my invention.

Referring to Fig. 1, 11 represents the elevator car suspended by ropes 12 carried over a suspension sheave 13, from whence they pass down to and around a frictional driving drum or drums 14 of suitable construction, and thence up to the bottom of the car; being carried over a fixed guide sheave 15 in a hanger 16 and around a pair of movable sheaves 17 mounted in horizontal slides 18, the ends of the ropes being fixed to the hanger 16 at 19. The upper parts of the ropes 12 from which the car is suspended pass through the hollow piston rod 20 of a dash-pot 21, being secured by clamp collars 22, 23, above and below so as to fix the ropes in vertical adjustment in said hollow piston rod and permit their adjustment therein from time to time when necessary to compensate for stretching of the ropes. Thus when stretching of the ropes causes the dash-pot piston to reach the end of its stroke in its cylinder, the clamps are loosened and the piston readjusted to its primary position. The dash-pot cylinder 21 has a suitable by-pass 21ª and is firmly fixed to the top of the car by means of a bracing frame 24, or it may be arranged similarly on the bottom of the car, or in any other desired position, so as to perform its office. The office of the dash-pot is to control the action of the tension-slack-rope take-up device so as to prevent thereby a too sudden or jumping movement of the car. From the lower clamping collar 23 beneath the dash-pot piston rod, the ropes 12 separate and are carried around guide sheaves, 25, 25 down the sides of the car and around guide sheaves 26, 26 at the bottom, and are attached at their ends to the horizontal slides 18, so that the weight of the car and its load tends to draw apart the said slides in which the movable sheaves 17 are mounted. In opposition to this the tension of the lower part of the ropes, carried up from the frictional driving drums 14 to the bottom of the car and carried around the movable sheaves 17, tends to draw said sheaves together so that a constant balance is maintained and tension applied to the said lower part of the ropes and consequent friction on the driving drum automatically regulated by the weight of the car and its load. Suitable counterweights 36 may be applied to the ropes 12 to counter-balance the normal weight of the car.

It should be noted that in Fig. 1 the car is suspended in a loop, the maximum strain being thrust upon the take-up device. This take-up device obviously comprises two portions, each having a limited to-and-fro movement. It should be observed that the take-up device acts in the manner of a give-and-take connection, and that upon changes of load it relieves the strain on one lead extending from the driving apparatus and increases the strain on the other lead. For instance, if the driving apparatus is stopped and the inertia of the car tends to continue

movement of the same downwardly, the strain on the right-hand lead is relieved or made less than it would be if it were connected directly to the top of the car, whereas the left-hand lead is tightened or has the tension therein increased to prevent its becoming slack, and therefore to prevent slipping of the power transmitting rope on the driving sheave or drum.

In the modification shown in Figs. 2 and 3, the lower ends of the suspension ropes 12, after passing as before around the guide sheave 15 on the bottom of the car, are carried around a second fixed guide sheave 15[a] and coiled on a take-up sheave 27 to which their ends are secured. Integral with or fixed to the sheave 27 so as to turn therewith, is a smaller sheave 28, on which the upper parts of the ropes 12 are coiled so that a strain applied to the said ropes by the load on the car tends to rotate the combined sheaves 27, 28 and thereby wind up the lower part of the ropes 12 on the larger sheave 27; thus, as before, taking up the slack and applying tension to the lower or opposite lead of the ropes regulated by the load on the car.

In the modification shown in Fig. 4, the car ropes 12 are carried around guide sheaves 25, as before, and are connected at their ends to levers 29 fulcrumed at 30 on the bottom of the car. The connections of the car suspension ropes with the levers 29 are near the fulcrums thereof, and the meeting ends of said levers are connected to the lower parts of the ropes, coming up from the driving drums 14. The meeting ends of the levers 29 are also connected to the depending end of a rope 31 running over the fixed sheave 15 on the bottom of the car and attached to the end of the rope-counterbalance chain 32 which is suspended therefrom. This chain serves the double purpose of counterbalancing the weight of the lower part of the ropes 12 exerted on the tension device from which they are suspended at the bottom of the car, as this lower part of the ropes is elongated by the rising of the car; and also, in conjunction with said ropes, counterbalancing the weight of the suspension ropes above the car as this is elongated when the car descends. In practice the weights of the ropes and chain are properly proportioned to effect a substantially perfect rope-counterbalance. In this illustration (Fig. 4) the weight of the car tending to raise the levers 29 will apply tension to the lower or opposite lead of the ropes 12, graduated according to the lever proportions, so that—as in the other illustrations—the tension on all the ropes extending on both sides of the driving drums is regulated by the load on the car; increased load producing greater tension.

In the modification shown in the diagram, Fig. 5, a loose sheave 33 is suspended from the upper ends of the suspension ropes 12, and the lower ends of the suspension ropes passing around guide-sheaves 15, 15[b] mounted on the bottom of the car are carried up and over the loose sheave 33 and attached at their extremities to the top of the car. In this illustration of the invention the downward strain of the car applied to the terminal ends of the suspension ropes 12, will, through the medium of the loose sheave 33, apply double tension to the upper section of said ropes and single tension to the lower sections so as to increase or decrease the said tensions on the ropes correspondingly with the load on the car, as in the other illustrations.

The diagram Fig. 6 shows the same device applied to the well known differential speed drum elevator mechanism. As in Fig. 5, 12 represents the main hoisting rope carried over the suspension sheave 13; 33 the loose sheave suspended by the upper section of said rope. 12[a] is a separate rope section from which the car 11 is suspended. 14[a], 14[b] are the differentially rotated driving drums, and 12[b] the endless rope driven thereby and carried over loose sheaves 34, 35, respectively, hung from the extremities of the ropes 12 and 12[a]. In this illustration likewise the strain applied to the rope 12 by weight of the car and its load, through the medium of the sheave 33, will take up the slack and automatically graduate the tension on the opposite leads of the ropes to correspond with the load, as before explained.

Instead of the ropes 12 being carried around guide sheaves 25, 26 on both sides of the car, as in Fig. 1, they may pass on one side only, as shown in Fig. 7, and be connected to one movable sheave 17, the other movable sheave being dispensed with.

Instead of the two levers 29 shown in Fig. 4, a single lever may be employed, the ropes being carried down on one side of the car, as in Fig. 7, and this lever may be mounted on top of the car, as shown in Fig. 8.

The same effect described with reference to Fig. 5 may be produced with the arrangement of ropes shown in Fig. 9, in which the bottom sections of the ropes are carried around guide sheaves 25[a], 25[b], 25[c], 25[d], thence over the loose sheave 33 and attached to the top of the car. This produces a double take-up effect by associating the ropes with the sheaves 25[d] and 33.

In the diagram Fig. 10, the car 11 is suspended at one end of the car-ropes 12 which pass over a sheave 33 and are attached at their other ends to the counterweight 36. The sheave 33 is hung to the secondary driving rope 40 passing over the fixed sheave 13, thence downward under a sheave 41 mounted on the top of the counterweight 36, thence up

and over a fixed sheave 42, thence down and around the motor-drum 14, thence up and around a sheave 43 mounted on the bottom of the counterweight 36, thence down and around a fixed sheave 44, and thence up to and around the fixed sheave 13, as already stated. Under this arrangement the car is moved up or down by the movement imparted to the counterweight 36 by the secondary rope 40 which is driven in either direction by the motor-drum 14. The weight of the car applied to the secondary driving rope 40 maintains tension on said driving rope, automatically takes up any slack therein, and regulates the friction on the motor-drum 14 according to the load on the car.

It should be noted that in Fig. 10 the parts may be so designed that the fixed sheave 13 may have a limited degree of rotation so that said sheave in reality acts in the manner of a pivoted tension lever. Obviously the sheave 13 may be made of any desired diameter. The advantage of this arrangement is that the action of the take-up device is direct and, furthermore, that the cables suspended from said sheave 13 are maintained substantially vertical. The latter advantage, however, is not of so great importance as it is found in practice that the movement of the sheave 13 would be small in acting as a tensioning device to vary the tension in the leads winding on and off the drum to prevent slipping.

In the diagram Fig. 11 the secondary driving rope 40 is dispensed with by carrying the car-ropes 12 over one or more fixed sheaves 13, thence down beneath a sheave 41^a from which the counterweight 36 is suspended, thence up over fixed sheave 42, thence down around the sheave 41 mounted on the top of the counterweight, thence up and over a fixed sheave 42^a, thence down and around the motor-drums 14, thence up and over the sheave 43 mounted on the bottom of the counterweight, thence down and under the fixed sheave 44 and thence up to the bottom of the counterweight to which said car-ropes 12 are attached at their lower end.

Figs. 10 and 11 show a motion-reducing gear of two to one and three to one respectively, referring to the reduction of motion between the rope on the face of the driving drum and the car. With a structure on the principle illustrated in Fig. 11, this can be carried out to any extent desired where the reduction is represented by an odd number, such as three to one, five to one, and so on; or with a reduction represented by even numbers, two to one, four to one, and so on, with a structure such as represented in Fig. 10 where a sheave 33 is suspended from the supplemental hoisting rope 40.

The diagram Fig. 12 shows a more simple arrangement in which the car suspension ropes 12 are carried from the car 11 over a fixed sheave 13, thence down under sheave 41 mounted on the top of the counterweight 36, thence up and over a fixed sheave 13^a, thence down to and around the motor-drums 14 and thence up to the bottom of the counterweight 36 to which the lower end of said car-ropes is fixed. Under this arrangement it will be apparent that the travel in either direction of the ropes 12 between the drum 14 and the bottom of the counterweight 36 is compensated by that between the sheave 13^a and the top of the counterweight so that movement of the counterweight down or up imparted by rotation of the motor-drum is communicated with equal motion in raising or lowering the car. It will also be seen that the weight of the car, acting through the medium of the sheave 41, necessarily exerts a two-to-one upward draft on the hoisting rope attached to the bottom of the counterweight, and a one-to-one draft on the opposite lead of the rope from the drum, so as to take up slack and apply tension to both leads of the rope and consequent friction on the driving drum regulated by the load on the car.

While each of the arrangements described possesses structural and operative advantages of its own, and some of the parts thereof are interchargeable, it will be evident that the different arrangements of the sheaves or levers of the tension device afford simple means for causing the weight of the car or momentum of the same to graduate the tension to be applied to the ropes on both sides of the driving drum, and consequent friction of the same. The two movable sheaves under the car, as in Fig. 1, cause a tension effect equivalent to four-to-one of the weight of the load between the respective leads, while a single movable sheave, as in Fig. 7, produces a tension of two-to-one. The arrangement shown in Fig. 11 causes a tension effect of one and one third to one. The levers (Fig. 4) and the two sheaves under the car (Fig. 2) which act virtually as continuous levers, admit of a finer graduation and can be used to obtain this effect if found desirable in the other structures.

Heretofore, in frictional driving elevator mechanism, the weight of the tension devices was fixed according to the maximum load the elevator was built to carry. Hence it will be clearly apparent that the weight of the tension device above that required by the various loads is detrimental, causing a loss of power and increased wear on the mechanism, and consequent reduction in the life of the same; whereas my invention achieves the ideal result in frictional driving elevator machinery of causing the tension on the ropes on both sides of the driving drums to increase or decrease automatically according to the load which may include inertia when the car is started from rest and momen-

tum of the moving masses when the car is being stopped, as well as the actual weight to be lifted or lowered.

In the foregoing description, I have referred to "ropes 12" in the plural number, because in passenger elevators the hoisting ropes are commonly used in gangs for additional security; but for simplicity of representation, I have shown in the drawing a single rope as viewed from one side of the gang, except where the ropes are bifurcated or separated to pass around opposite sides of the car. The invention may, of course, be used with one or with any desirable number of ropes.

Figs. 1, 2, 3 and 4 are intended to indicate a gang of hoisting ropes (usually two or four) as commonly employed in passenger elevators. Such ropes being separated at the top of the car, as shown in Fig. 1, may be carried down on each side of the car and connected to the respective sliding-pulley boxes 18, as shown in Fig. 1, or coiled from opposite sides on the sheaves 28, as shown in Figs. 2 and 3 or connected to the respective levers 29, as shown in Fig. 4. The tail end of the ropes carried up from the driving drum to the bottom of the car may be united in one by means of a clamp, such as shown in Fig. 1ª so that a single rope extends to and around the pulley 15, as shown in Figs. 2 and 3. Or the plurality of ropes may be carried up in one plane, which, when viewed edgewise, will appear as a single rope, as shown in Fig. 1. As the strain on this tail-end of the rope is one-fourth or even less, than that on the head end from which the car is suspended, the use of a single rope at bottom as shown in Figs. 2, 3 and 4 is entirely feasible.

The illustrative structures shown may be modified in various ways in carrying into effect the principles of my invention.

Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent.

1. The combination of a frictional driving system comprising power-transmitting means, and appliances operated by the load for varying the tension in said transmitting means upon changes of load and in direct proportion thereto.

2. The combination of a load-carrying device, and a rope drive connected thereto and comprising means to apply tension in the ropes and to automatically regulate such tension.

3. The combination of a car or carrier, and a rope drive therefor comprising means operated by the load to effect the application of variable tension in all the ropes and to regulate such tension.

4. In a rope drive elevator, the combination with a car, of a system of ropes connected thereto, and apparatus for driving said ropes, the said system of ropes comprising means actuated directly by the load to apply tension to the ropes.

5. In a frictional driving elevator, the combination with driving apparatus, of a car, connections between the driving apparatus and car, including means for regulating the tension in said connections in accordance with the load.

6. In a frictional driving elevator, the combination with driving apparatus, of a car, a rope system connecting the driving apparatus and car, and means operated by the load for maintaining said rope system taut when at rest or in motion.

7. In a frictional driving elevator, the combination with driving apparatus, of a car, ropes connecting said driving apparatus and car, and means permitting the load to apply tension to the rope leads extending from the driving apparatus.

8. In a frictional driving elevator system, the combination of a car and driving drum, and suspension ropes suitably connected therewith, and a tension slack rope take-up device operated to apply variable tension and pressure to the ropes and frictional driving mechanism governed by the load on the car.

9. In a frictional driving elevator mechanism, the combination of a car, a hoisting rope or ropes therefor, a driving device on which the ropes are coiled, and a rope take-up device actuated by the weight of the car and its load, said car and take-up device being connected to all the leads of the ropes winding on and off the driving apparatus and applying to all said ropes tension changing with the load.

10. In a frictional driving elevator mechanism, the combination of a car, a frictional driving drum, suspension ropes passing down on the side of the car, and a rope take-up device connected with the car and with said ropes, so that the weight of the car and its load can apply tension, changing with the load, to all leads of the ropes winding respectively on and off the driving drum.

11. The combination with frictional driving apparatus, of a car, connecting means between the frictional driving apparatus and said car, and means associated with said connecting-means for varying the tension in the leads of said connecting means when the load varies.

12. In a frictional driving elevator, the combination with driving apparatus, of an elevator car, ropes connecting the driving apparatus and car, and means for effecting the application of tension in proportion to the load, to the leads of all the ropes winding respectively on and off the driving apparatus in the operation of the elevator.

13. The combination with a frictional driving apparatus, of a load-carrying device,

flexible means for connecting the load-carrying device to the driving apparatus, and means for effecting a variation in the tension of all the leads of said connecting means in direct proportion to variations of load.

14. The combination with a frictional driving apparatus, of a load-carrying device, flexible ropes or cables connecting said load-carrying device to the driving apparatus, and means for effecting a variation in the tension of all the leads of said ropes in a predetermined ratio to the weight of the load.

15. In an elevator, the combination with frictional driving apparatus, of a load-carrying device, flexible ropes or cables connecting said load-carrying device to the driving apparatus, and means connected to the leads of the cables winding respectively on and off the driving apparatus, for automatically effecting a variation in the tension on all the leads of said ropes in a predetermined ratio to the variation of load.

16. In a frictional driving elevator mechanism, the combination of a load-carrying device, a frictional driving apparatus, flexible means looped around the driving apparatus and driven thereby, and a connection between the leads of the driven flexible means whereby the weight of the car and its load holds tight all the said leads winding respectively on and off the driving apparatus, and the tension on said leads changes with the load.

17. The combination with frictional driving apparatus, of a load-carrying device, connecting means between the frictional driving apparatus and said load-carrying device, and means for regulating the tension of said connecting means to effect a variation of tension throughout the latter in proportion to variations of load.

18. In a frictional driving elevator, the combination with frictional driving apparatus, of a load-carrying device, flexible means for connecting the driving apparatus and said load-carryng device, and means for regulating the tension of said flexible means to effect a variation of tension throughout the latter in proportion to variations of load.

19. The combination with a frictional driving apparatus, of a car, flexible connection between the driving apparatus and said car, and means associated with said connection for effecting a variation in the tension in said connection in direct proportion to variations of load.

20. In a frictional driving elevator, the combination with an elevator car, of driving apparatus, ropes connecting the driving apparatus and the car, and means permitting the weight of the car to apply variable tension to the leads of all the ropes winding respectively on and off the driving apparatus in the operation of the elevator and to regulate such tension in accordance with the load.

21. The combination with a frictional driving apparatus, of flexible means driven thereby, a load-carrying device connected to said means, and a connection between the opposite leads of the same winding respectively on and off the driving apparatus, whereby tension on all the said leads changes with the load.

22. The combination with a frictional driving apparatus, of flexible means driven thereby, a load-carrying device, and a connection between the load-carryin device and all the leads of the flexible means winding respectively on and off the driving apparatus, whereby tension on all the said leads changes with the load.

23. The combination of a frictional driving apparatus, flexible means driven thereby, a load-carrying device connected to said flexible means, and a connection between the load-carrying device and the opposite leads of the said flexible means, whereby tension changing with the load and in a predetermined ratio to the weight of the load, is applied to all the said leads winding respectively on and off the driving apparatus.

24. In an elevator, the combination with a car, of frictional driving means, power-transmitting means, and means connected between the car and the opposite leads of said power-transmitting means to vary the tension in the said leads when the load varies.

25. In an elevator, the combination with driving apparatus, of power-transmitting means, a load-carrying device, and a variable connection between the load-carrying device and the power-transmitting means to effect tension in the latter in proportion to the load.

26. In a frictional drive, the combination with a frictional driving drum or sheave, of a car, power-transmitting means connecting the drum and car, and a device having a limited degree of movement to cause the load to place said power-transmitting means under tension and to vary such tension upon variation of load.

27. In an elevator, the combination with frictional rope driving apparatus, of a load-carrying device, power-transmission means comprising flexible ropes or cables, and a tensioning device having oscillating parts for tightening the leads on said rope driving apparatus upon changes of load.

28. The combination of a frictional rope driving apparatus, flexible means driven thereby, a load-carrying device, and a take-up device connected to all the leads of the flexible means winding respectively on and off the driving apparatus and applying tension to all said leads varying with the load.

29. In a frictional driving elevator mechanism, the combination with a car, of suspension ropes, a frictional driving drum, and a take-up device; said ropes being suitably

connected to the car and to the take-up device, and said take-up device automatically applying variable tension between limits of travel of the car to the section of the ropes between the driving mechanism and said take-up device.

30. In a frictional driving elevator mechanism, the combination with a car, of a frictional driving drum, car suspension means, a rope take-up device, and a hoisting rope looped around the drum, and connected by on-winding and off-winding leads to car-suspension means and to the rope take-up device, whereby tension changing with the load, and in a predetermined ratio thereto, is applied to all the leads of the ropes winding on and off the frictional driving drum in the operation of the elevator.

31. A frictional driving elevator mechanism comprising a car, a driving drum, a rope coiled thereon and having a suitable suspensory connection with the car, and a rope take-up device connected to the car and applying tension therefrom to the lead of the rope opposite to that by which the car is suspended, whereby tension, changing with the load, is applied by the weight of the car and its load to all the leads of the ropes winding on and off the drum.

32. The combination with a car, of a frictional driving drum, suspension ropes associated with said drum and connected to the car, and a tension-take-up device applying variable tension to the leads of the ropes on the driving drum opposite to those from which the car is suspended.

33. In an elevator, the combination of a car, a driving sheave or drum and power-transmitting means, and a take-up device applying variable tension to the section of the power-transmitting means extending from the driving drum or sheave.

34. In a frictional driving elevator mechism, the combination with a car, of a driving drum and ropes connecting the same, and a tension slack-rope take-up device operating to apply variable tension to the ropes and pressure between the latter and the drum, such tension and pressure being governed by the load on the car.

35. The combination of frictional driving apparatus, a load-carrying device, power-transmitting means associated with the driving apparatus and connected to the load-carrying device, and a take-up device for varying the frictional connection between the driving apparatus and said power-transmitting means in accordance with variations of load.

36. In a frictional driving elevator mechanism, the combination of a car, a frictional driving drum, suspension ropes passing down on the sides of the car, and a take-up device connected with said ropes and applying variable tension to the lower section thereof.

37. In a frictional driving elevator, the combination with an elevator car, of a frictional driving drum, ropes passing down on the sides of the car, and a rope take-up device for maintaining said ropes taut under varying conditions of the elevator.

38. In frictional driving elevator apparatus, the combination with a car, of suspension ropes, driving mechanism, and a plurality of movable sheaves, said suspension ropes being in suitable connection with the car, separating at the top of the car and passing down on opposite sides of the same and connected respectively to said sheaves.

39. In a friction driving elevator mechanism, the combination of a car, a frictional driving drum, ropes driven by said drum in suitable suspensory connection with the car, separating at the top of the car and passing down on opposite sides thereof, and movable sheaves connected respectively to the ends of said descending ropes so as to be drawn apart thereby and having the section of the ropes opposite to that from which the car is suspended looped around them so as to receive tension by the drawing apart of said sheaves.

40. In a friction driving elevator mechanism, the combination of a car, suspension ropes, a frictional driving drum, guide sheaves at the sides of the car, a take-up device comprising movable take-up sheaves to the boxes of which the extremities of the upper sections of the ropes are connected so as to draw said take-up sheaves apart by the weight of the load, the said take-up device carrying the lower parts of the ropes around the take-up sheaves so as to draw said sheaves together in opposition to the weight of the car and apply tension, changing with the load, to all the leads of the rope winding on and off the driving drum.

41. The combination of a frictional driving apparatus, ropes driven thereby, a load-carrying device connected to said ropes, and a give-and-take connection between the load-carrying device and all the leads of the rope winding respectively on and off the driving apparatus, whereby tension on all the leads of the ropes changes with the load.

42. In an elevator, the combination with driving apparatus, of power-transmitting means, a load-carrying device, and means for relieving the strain of the lead of said power-transmitting means winding off the driving apparatus, and substantially at the same time tightening the lead winding on the driving apparatus.

43. In an elevator, the combination with frictional driving apparatus, of power-transmitting means comprising ropes or cables, a

car suspended in a loop of said power-transmitting means, one end of said loop being connected directly to one of the leads extending from the driving apparatus, and a take-up device between the other end of the loop and the other lead.

44. The combination with a car, of rope drive apparatus connected thereto and comprising means for regulating the tension in the ropes of said apparatus, and a counterbalance chain connected to said regulating means.

45. The combination with a car, of rope drive apparatus therefor comprising a take-up device for maintaining the ropes of said elevator in suitable tension, and a counterbalancing chain connected to said device.

46. The combination of a car, a driving drum or sheave, power-transmission means in suitable connection therewith, a tensioning device applying tension to the lead of the power-transmission means extending from the driving drum opposite to that from which the car is suspended, and a chain connected to said tensioning device to counteract the weight of the leads thereon as the car ascends and descends.

47. In a frictional driving elevator mechanism, the combination of a car, a driving drum, suspension ropes driven by said drum and in suitable suspensory connection with the car, a rope take-up device actuated by the weight of the car and its load and applying tension changing with the load to the lead of the ropes winding on the driving drum opposite that from which the car is suspended, and a chain so connected thereto as to counteract the weight of the ropes on said take-up device.

48. The combination with a rope drive elevator comprising a car or carrier, of a slack rope taking-up device, and dash pot mechanism for controlling said take-up device to prevent sudden movement of the load in either direction.

49. The combination with a car, of rope drive apparatus therefor comprising a slack rope take-up device, and dash-pot mechanism for controlling said take-up device to prevent sudden movement of the load in either direction.

50. The combination with frictional driving apparatus, an elevator car and power-transmitting ropes, of a slack rope take-up device, and an adjustable dash-pot device carried by the car for controlling said take-up device to prevent sudden movements of the car.

51. The combination with driving apparatus, of an elevator car, ropes or cables connecting the driving apparatus and said car, and means connected between said ropes and the car for preventing teetering of the latter.

52. In an elevator, the combination with an elevator car, of driving apparatus, connecting ropes or cables, a tensioning device operated by the load, and a cushioning device to prevent teetering of the car.

53. In a friction driving elevator mechanism, the combination with a car and a frictional driving drum, of suspension ropes suitably connected to the car and drum, a take-up device applying tension to the lower section of the suspension ropes, and a dash-pot device connected to the suspension ropes and car so as to prevent sudden movement of the car.

54. In a friction driving elevator mechanism, the combination of a car, a frictional driving drum, suspension ropes, a dash-pot device through which the suspension ropes are connected to the car, and means for fixing the suspension ropes adjustably with relation to the dash-pot device.

55. In a frictional driving elevator mechanism, the combination of a car, suspension ropes, a dash-pot cylinder fixed to the car, a hollow dash-pot piston rod through which the ropes are passed, and clamps above and below the dash-pot piston, by means of which the ropes are secured adjustably therein.

56. The combination with driving apparatus, of an elevator car, power-transmitting ropes or cables, a slack rope take-up device comprising sliding sheaves connected to said ropes and carried by the car, and means for limiting the movements of said sheaves.

57. The combination with driving apparatus, of an elevator car, a counterweight, power-transmitting ropes or cables, a take-up device, and a dash-pot device, said power-transmitting ropes connecting the driving apparatus, the counterweight, the car, the dash-pot and take-up device and being divided into a double set of ropes between the dash-pot device and the take-up device.

58. In an elevator, the combination with frictional driving apparatus, of a load carrying device, flexible ropes or cables connecting said load carrying device with the driving apparatus, and a tensioning appliance comprising a part having a narrow range of relative movement, said appliance being associated with said ropes to tighten the leads on the driving apparatus proportionately to the load.

MICHAEL E. NEENAN

Witnesses:
J. GREEN,
OCTAVIUS KNIGHT.