

L. ATWOOD.
COMPENSATING COUNTERWEIGHT.
APPLICATION FILED AUG. 10, 1908.

1,047,143.

Patented Dec. 17, 1912.

2 SHEETS—SHEET 1.

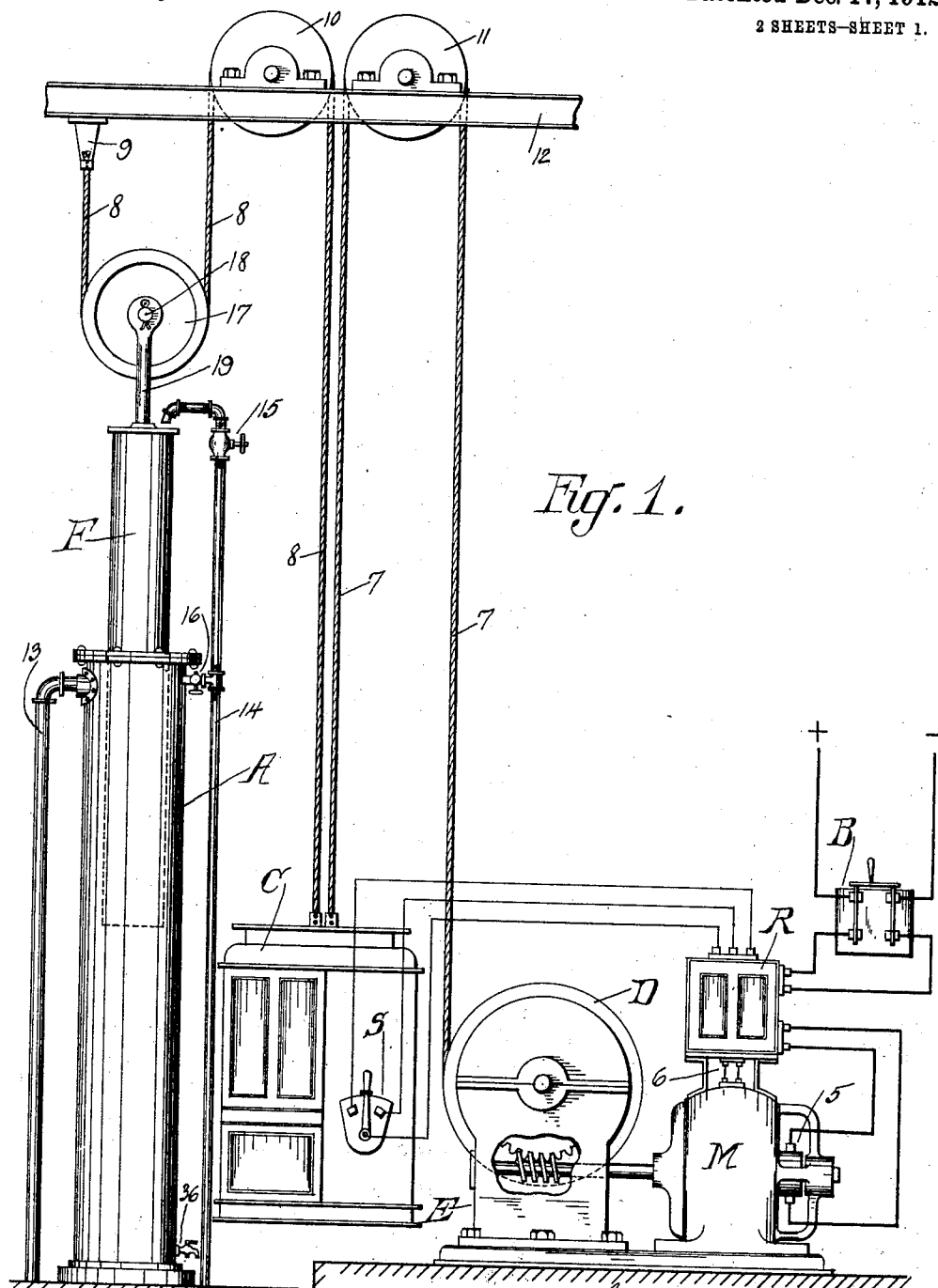


Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

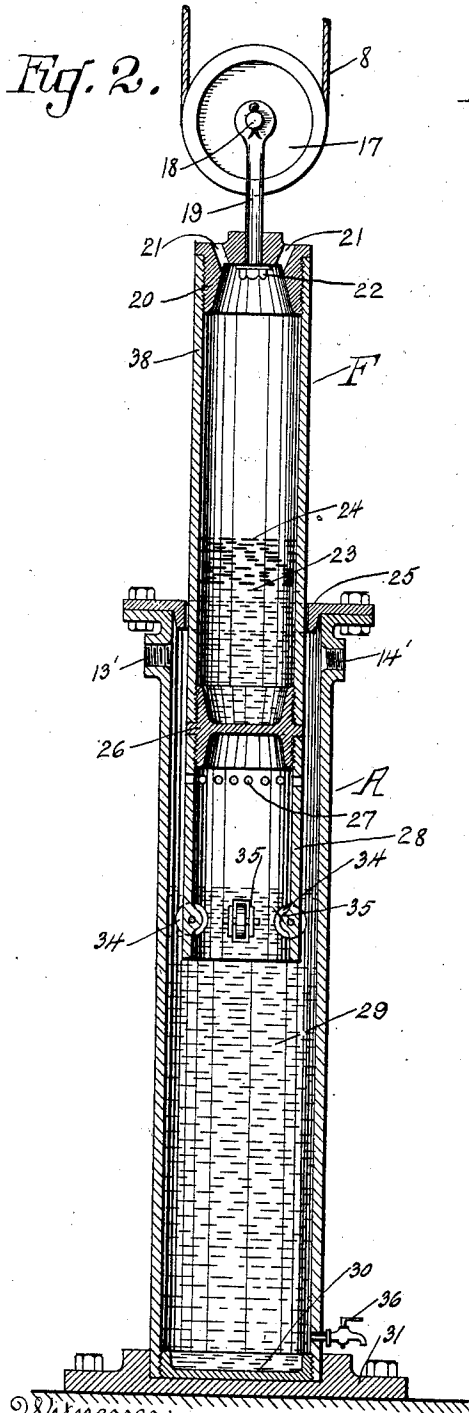
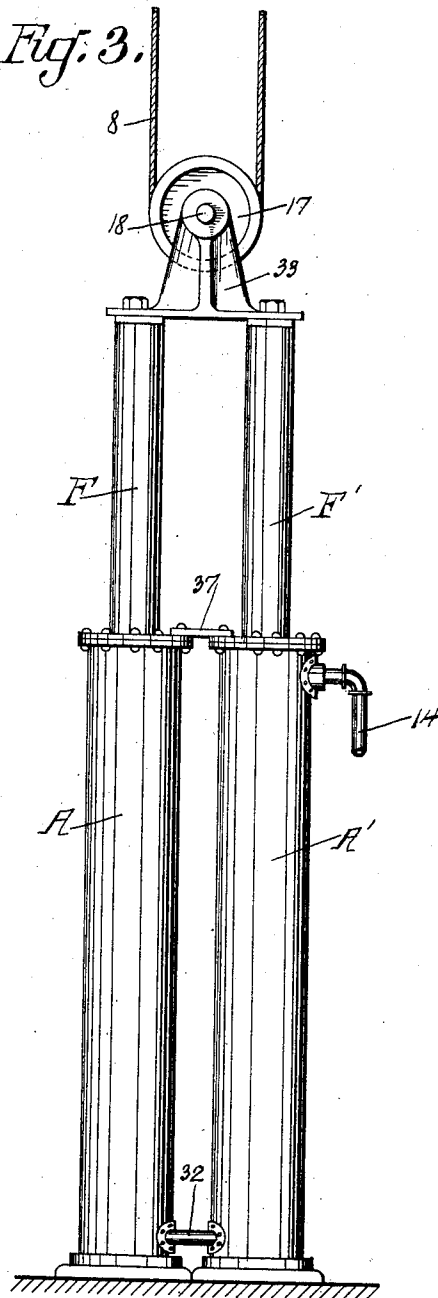


Fig. 3.



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UNITED STATES PATENT OFFICE.

LEONARD ATWOOD, OF FARMINGTON FALLS, MAINE, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

COMPENSATING COUNTERWEIGHT.

1,047,143.

Specification of Letters Patent.

Patented Dec. 17, 1912.

Application filed August 10, 1908. Serial No. 447,843.

To all whom it may concern:

Be it known that I, LEONARD ATWOOD, a citizen of the United States, residing at Farmington Falls, in the county of Franklin and State of Maine, have invented a new and useful Improvement in Compensating Counterweights, of which the following is a specification.

My invention relates to counterbalances for elevators or other hoisting apparatus, although it may have a general application.

One object of my invention is the provision of a counterbalance of varying effective weight.

Another object is the provision of means for dispensing with the usual compensating balance chains.

A further object is the provision of a counterbalance which cannot fall.

Other objects will appear hereinafter, the novel combinations of elements being finally pointed out in the appended claims.

In the accompanying drawings, Figure 1 shows in elevation a typical elevator system embodying my invention; Fig. 2 is a detail sectional view of certain parts shown in Fig. 1; and Fig. 3 is a modification.

Similar characters of reference denote similar parts throughout all the figures.

Referring to Fig. 1, C designates an elevator car suspended from the cables 7 and 8 which pass over guide pulleys 11 and 10, respectively, supported upon the overhead beams 12. The cables 7 are wound about a hoisting drum D which is connected through the usual worm and worm wheel gearing contained in the gear case E to a prime mover M, herein shown as an electric motor, although the motive power may be of any desired character such as steam or water under pressure. R designates a motor-controlling device which may be mounted upon the top of the motor, as shown, and which is controlled or operated from the car C to start, stop or reverse the elevator machinery by means of a small switch S. B is a main line switch which serves to connect the motor-controlling device R to a suitable source of electrical supply by means of the conductors + and -. 5 and 6 designate the motor armature and field connections, respectively.

In lieu of the usual car counterbalance weight, I employ a tubular counterbalance comprising a tubular weight F arranged to travel freely in a cylinder A which is partially filled with water. 13 designates an overflow pipe which connects the upper part of the cylinder to a drain or sewer. A supply pipe 14 is arranged to supply water to the cylinder A and tubular counterbalance F when desired, the supply being controlled by the valves 16 and 15, respectively. 36 is a drain cock, by means of which the cylinder may be drained when so desired. The tubular counterbalance F is connected by a yoke 19 and pin 18 to a cable sheave 17. Cables 8 are connected at one end to a bracket 9 secured to the overhead beams 12, thence they lead down and around the sheave 17, then up and over the guide pulley 10 and are finally connected at their other end to the top of the elevator car C. This arrangement of counterbalance cables 8 gives a travel of counterbalance F equal to one-half of that of the elevator car. By a suitable arrangement of the cables 8 and multiplying sheaves, any desired ratio between the car and counterbalance travel may be obtained; or, if desired, the cables 8 may be connected directly to the tubular weight F, so that the latter will have the same travel as that of the car. The arrangement herein shown is preferable, however, under ordinary conditions.

Referring to Fig. 2, the cylinder A is provided with a head 25 through which the tubular weight F freely passes. At or near the top of the cylinder an opening 14' is provided, which is connected through the valve 16 to the supply pipe 14 shown in Fig. 1. The bottom of the cylinder rests on a base 31 and is closed by a suitable screw plug 30. The counterbalance F is preferably made of two sections of tubing 38 and 28 connected together by means of a screw-threaded plug or internal coupling 26 which not only serves to connect the sections together, but also acts as a water-tight partition between the sections. At the top of the counterbalance a screw-threaded cap or plug 20 is arranged, in which are one or more holes 21 which may be left open as shown, or closed by means of screw plugs which may

be removed when it is desired to empty or add water to the counterbalance F. The yoke 19 carrying the sheave 17 extends through the head 20 and is rigidly connected thereto by a nut 22 or other suitable fastening. The lower section 28 of the counterbalance is left open at the bottom and has a series of holes 27 drilled around the circumference close to the plug 26. At or near the lower end of this section 28 a number of anti-friction guide rollers 34 are arranged in brackets 35 which are fastened to the tubing 28. These anti-friction rollers extend out beyond the tubing 28 somewhat and their function is to guide the lower end of the counterbalance as it travels in the cylinder A. The upper section of tubing 38 is partially filled with water 23, or until it has the requisite weight. Where the holes 21 in the cap 20 are left open, a layer of heavy paraffin oil 24 is floated on top of the water so as to prevent loss of water by evaporation. This oil may be omitted where the holes 21 are plugged up, since in that case its use is unnecessary.

In all elevators, and particularly those which have a long travel, it is desirable to counterbalance the car, such counterbalance usually being as heavy as the combined weights of the car and its average load. This counterweight is made up of cast iron blocks bolted together and arranged to travel on suitable guide rails located at one side of the elevator shaft or hatchway and is usually connected by one or more cables to the top of the elevator car. As the car travels upwardly, the counterweight descends, and vice versa, thus when the car is at or near its upper limit of travel the counterweight is at its lower limit of travel. With the car at or near its upper limit of travel, it is readily seen that the weight of the counterweight cables, together with the weight of the hoisting cables, is tending to keep the car at the top of the hatchway, and it sometimes happens when the rise of the elevator is considerable, as in tall buildings, that the combined weights of these cables is sufficient to overbalance the car and prevent its descent. In order to overcome this overbalancing of the car, it is customary to attach heavy iron chains to the bottom of the car in order to lend their weight to the car when the same is at the top of the building, and thus cause the car to descend when the hoisting machinery pays out the hoisting cables. These chains are so attached to the car and walls of the hatchway that when the car is at the bottom of the building the weight of the chains is entirely sustained at the hatchway connection, but as soon as the car travels upwardly the weight of the chains is gradually transferred to the car, until finally when the car reaches the upper limit of its travel substantially the entire

weight of the chains is transferred to the car. Thus, while it is possible by properly proportioning the chains to counterbalance the counterweight cables for all positions of the car, the use of chains for this purpose is undesirable, since they form an item of expense, are unsightly, and very often make considerable noise.

As before stated, the counterbalance F contains just enough water to give it the required weight, and the outside cylinder A in which it travels may contain as much water as is necessary to change the relation between the car and the unbalanced cables. When the car is at the bottom of its travel, the counterbalance F may be raised entirely out of the water contained in the cylinder A, and it is then at its maximum weight. As the car ascends, the lower tubular section 28 enters the water which rises in the tube 28 and forces the air out through the holes 27 and through both the space between the counterbalance and the loose fitting head 25 and the overflow pipe 13. The displacement of the water contained in the cylinder by the descent of the lower open ended section 28 therein may be neglected for all practical purposes, since the thickness of the tubing composing the lower section may be made very small and the displacement caused by its immersion into the water contained in the cylinder is correspondingly small. As soon, however, as the upper section 38 of the counterbalance enters the water, the counterbalance F rapidly loses its effective weight, the water contained in the cylinder rising in the latter as the counterbalance descends until the elevator car reaches its upper limit of travel, at which time the weight of the counterbalance is almost entirely sustained by the hydrostatic column of water in the cylinder A. I prefer to so arrange the parts that the counterbalance F is never entirely sustained or floated by the hydrostatic column in the cylinder, since in such case the counterbalance cables would tend to become slack and disarranged.

By altering the diameter of the tubular counterbalance F and changing the location of the plug or partition 26, the counterbalancing effect may be varied as much as desired. The counterbalance may make one-half or any fraction of its travel before entering or leaving the water contained in the cylinder A and the height of water in the latter may be changed at will.

An important difference in the operation of the present construction over the usual arrangement of counterweights and chains is thus obtained, owing to the fact that the effective weight of the counterweight F is changed only during a portion of the travel of the car. To make this operation clear, we may assume an example in which the

travel of the car is 200 feet and the travel of the counterweight 100 feet. Assume also, for simplicity, that the section 28 is omitted, the cross-sectional area of the counterweight F is 20 square inches and the cross-sectional area of the interior of the cylinder A is 25 square inches. Then the difference in cross-section between the weight F and cylinder A is 5 square inches, or one-fourth the area of the weight F, and the latter in moving downward through the water one foot will cause a rise of four feet in the head of water in the cylinder A. Then by having 20 feet of water in the cylinder A the weight F will cause the head of water to rise to 100 feet during the last 20 feet in the downward travel of the weight F. In other words, the effective weight of the counterweight is gradually reduced to compensate for the weight of the cables only during the last 40 feet in the upward travel of the car.

By placing a valve in the plug 26 and arranging means for opening the same at some convenient point, the water in the counterbalance F may be run out into the cylinder, and by means of the drain cock 36 all of the water contained in the entire apparatus may be readily emptied out, thereby making it very convenient for cleaning and repairing the parts which are comparatively light in weight and easily handled when emptied of water.

Furthermore, the tubular counterbalance occupies a minimum of space, requires no guides, and dispenses with the noisy chains frequently used, besides requiring no lubrication, and is moreover absolutely noiseless in operation. Another important feature of my invention is that all danger of falling counterbalance weights is entirely overcome, for, even though the counterweight cables should part or the counterbalance tend to fall from any cause whatsoever, the latter will speedily come to rest in the containing cylinder, being buoyed up by the water therein.

I sometimes construct the tubular counterbalance of a single length of tubing with a water-tight partition on the inside corresponding to the plug 26, with means extending below said partition for supporting one or more guide rollers. In some cases I find it desirable to make the lower end of the counterbalance tapering in form, so that when the same enters the water contained in the outside cylinder such entrance will be accomplished gradually, thereby overcoming any tendency to violently agitate or displace the water therein.

Whenever the counterbalance requires a greater weight than could be obtained from one tubular counterbalance of moderate size, I use two or more counterbalances, as shown in Fig. 3, in which the counterbalance

weights F and F' are connected together by the bracket 33 while the cylinders A and A' are connected near the bottom by a pipe 32 which makes the water level in both cylinders the same. 37 is a brace or tie rod for maintaining the cylinders in alinement.

While I have illustrated and described a preferred construction of my invention as embodied in a typical elevator system, I desire not to be confined to this use alone, since my invention may be employed to various uses not mentioned herein.

Furthermore, I desire not to be limited to the precise constructions and arrangement of parts herein set forth, since various changes could readily be made by those skilled in the art without departing from the spirit and scope of my invention.

Therefore, what I claim as new and desire to have protected by Letters Patent of the United States is:—

1. In an elevator, the combination with a car, of means for lifting and lowering the car, a counterweight in the form of a receptacle, liquid therein forming a substantial addition to the weight of the counterweight and variable to regulate the weight, and a second receptacle also adapted to hold liquid and positioned to receive and partially immerse the counterweight in the liquid during a portion of its travel.

2. In an elevator, the combination with a car, of a hoisting motor, operating connections between the car and motor, a counterweight in the form of a receptacle, a receptacle in position to receive the counterweight, and means for supplying liquid to said receptacles.

3. In an elevator, the combination with a car, of hoisting mechanism, a counterweight in the form of a receptacle, liquid in said receptacle and forming a governing portion of the counterweight, a receptacle in position to receive the counterweight, liquid in said last named receptacle in which the counterweight is partially immersed during a portion of its travel and means for supplying water to said receptacles.

4. In counterbalancing mechanism, the combination of a receptacle, and a counterweight comprising an upper section, a lower open section, and a liquid tight partition between said sections.

5. In counterbalancing mechanism, the combination with a receptacle, of a hollow cylindrical counterweight formed of upper and lower sections, and a watertight partition between the sections, the lower section being open at the bottom and also provided with an opening or openings adjacent to the partition.

6. In counterbalancing mechanism, the combination with vertically disposed parallel cylindrical receptacles adapted to contain liquid, of a pipe connecting the recep-

tacles to maintain the liquid at the same level in the receptacles, cylindrical counterweights telescoping with the receptacles, a bracket connecting the counterweights, and
5 means for lifting and lowering the counterweights.

In testimony whereof, I have signed my

name to this specification in the presence of two subscribing witnesses.

LEONARD ATWOOD.

Witnesses:

CHAS. M. NISSEN,
JAS. G. BETHELL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."