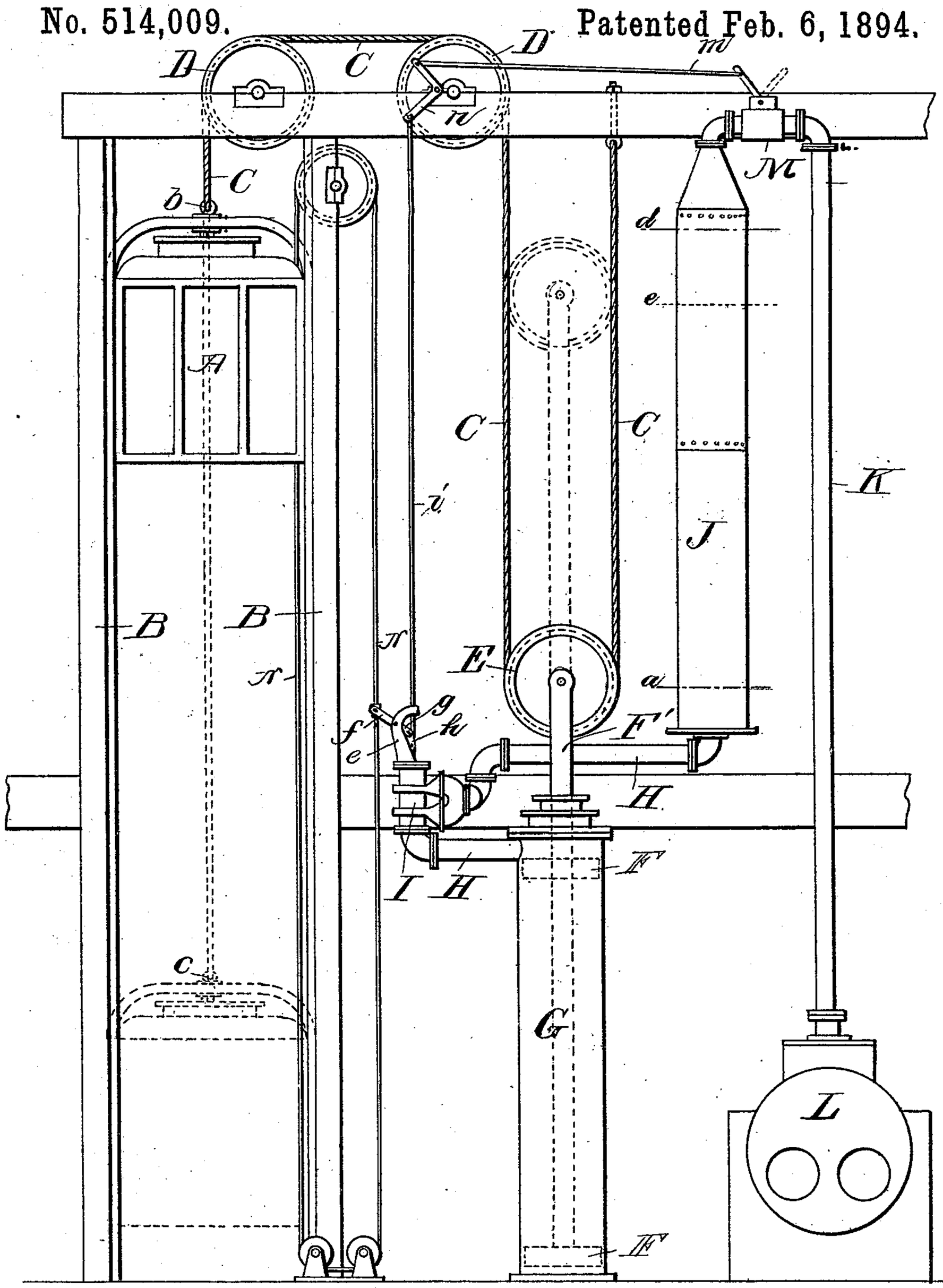
(No Model.)

# B. C. KEELER.

## MEANS FOR COUNTERBALANCING ELEVATORS.

No. 514,009. Patented Feb. 6, 1894.

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## MEANS FOR COUNTERBALANCING ELEVATORS.

SPECIFICATION forming part of Letters Patent No. 514,009, dated February 6, 1894.

Application filed April 22, 1893. Serial No. 471,465. (No model.)

*To all whom it may concern:*

Be it known that I, BRONSON C. KEELER, a citizen of the United States, residing at the city of St. Louis, State of Missouri, have invented a certain new and useful Improvement in Means for Counterbalancing Elevators, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My improvement is intended to be applied to that class of hydraulic elevators in which the motive power is obtained by the application of steam under pressure, directly to the surface of the water which is used to operate the elevator, the water not being allowed to waste at each trip of the elevator, but being used over and over repeatedly.

Heretofore, the general practice in operating hydraulic elevators which do not waste the water at each trip, has been to place a tank in the upper part of the building, and to raise the water into the tank by means of a pump in the basement, or lower part of the building, and to use the head of the water thus obtained, to operate the elevator; or, instead of having the tank in the upper part of the building, a closed tank is placed in the lower part, and the pump forces the water into this tank until the pressure is secured by the resistance of the confined atmosphere sufficient to operate the machine. This latter method is usually called the "compression tank system," while the other is usually known as the "gravity tank system." It is evident, that in neither of these systems, can the column of water be used to counterbalance the elevator, since in the case of the "gravity tank system," for example, the column of water from the upper tank to the elevator cylinder is balanced by the column of water from the pump in the basement to the upper tank. The method of counterbalancing, which I contemplate, is not therefore applicable to any system in which power from the initial source, *i. e.*, from a boiler or a pump operated by any other means, is required to operate the elevator; but it is applicable to a system which takes advantage of the fact that an elastic fluid, such as steam, may be conducted from an initial source, such as a main in the street, or a boiler, sufficiently large, in the basement to the upper part of the building, without serious loss of power. Furthermore, the general practice in counterbalancing elevators has been through the medium of weights, suspended by cables passing over a sheave or sheaves at the top of the shaft, and little account has been taken of the constantly changing weight caused by the cables, both of the car and of its counterbalance, passing from one side of their sheaves to the other, yet practically it is an important matter, for, as the car ascends, the cables in passing from the car-side of the shaft to the machine-side, not only reduce the load to be lifted, but assist in performing the work, so that when the car has reached the top of its rise, it has a greater lifting capacity than when it was at the bottom of the shaft. This irregularity in the performance of the machine is supplemented by the further disadvantage that, under this method of counterbalancing, the car in its ascent, is liable to "jump" when the power is suddenly cut off, and the consequent leap into the air and dropping back of the car, brings a heavy strain on the cables, which not infrequently snaps them and causes an accident.

The object of the present invention is to obviate these detrimental conditions, by so constructing and arranging the power, that the counterbalancing weight and its consequent objections, are entirely dispensed with, being replaced by a vapor chamber and hydraulic cylinder, so constructed and arranged relative to each other, that the column of water forms a counterbalance for the car, and at the same time it compensates for the varying weight of the cables while the car is in motion, by decreasing the head of the column of water as the car ascends, so as to decrease the effective power of the machinery proportionately to the less amount of work to be done; and by increasing the head of the column of water as the car descends so as to increase the effective power of the machinery proportionately to the increased amount of work to be done, thereby equalizing the counterbalance relative to the car and its cables, so that varying conditions exist in the power to compensate for the varying weight caused by the

cables passing in and out of the shaft. This I accomplish by the construction illustrated in the accompanying drawing, wherein—

A represents a cage or car, moving between the usual guide posts B, being suspended by a rope or cable C, which rope or cable passes over the sheaves or pulleys D, at the top of the shaft, thence down and under a pulley or sheave E mounted in the end of a piston rod F′ of the hydraulic cylinder G, whence it passes upwardly and is secured in any suitable manner above the limit of the stroke of the piston F. Of course it will be understood, that although I have illustrated in this form, a proportion of two to one—*i. e.*, the car moving twice the length of the stroke of the piston, I may interpose and arrange any suitable number of pulleys or sheaves, thereby changing the proportion of the movement of the car relatively to the stroke of the piston, as occasion demands.

The hydraulic cylinder G is of any ordinary or approved construction, having a piston F and its rod F′, which rod carries the sheave or pulley E as shown, said cylinder having led into its upper end, a pipe H, which admits an inelastic fluid, which I shall term water, on the top of the head of the piston F.

To control the admission and exit of the water to and from the cylinder G, I arrange in the pipe H, a valve I, which may be of any suitable construction.

Located on a plane above the hydraulic cylinder G, is a vapor chamber J, of less diameter, but of greater cubical capacity than the cylinder G. Into the lower end of this cylinder J leads the pipe H, and into its upper end, the pipe K, which is connected to any suitable source of supply of an elastic fluid, such as air in a street main, or, as shown in the drawing, steam, generated by a boiler L.

Arranged in the pipe K is a valve M for controlling the admission and exit of the elastic fluid, which I shall term steam, to and from the chamber J, which valve, in this instance, is operated by a connecting rod *m* whose other end is connected to one member of a bell crank lever *n*, the other member of the bell crank lever being connected to the piston stem *i* of the valve I. This piston stem is operated by a cord or rope N which is arranged in juxtaposition to the car A, and has connected thereto an arm *f* pivoted to a standard *e* on the valve I, which arm has its other member *g* connected by links *h* to the piston stem *i*, thereby enabling an operator in the car to control the valves I and M by simply raising or lowering the rope or cord N.

It is evident that when the valve M is opened to admit steam from its source of supply, to the surface of the water in the chamber J, and that when the valve I is coincidently opened to permit the water to flow from the chamber J to the cylinder G on the top of the piston F, the steam pressure, assuming it to be great enough, will cause the piston F to descend and the car A to rise, and that when the valves are reversed, so as to shut off the flow of the steam from the boiler into the chamber J, and to permit the steam confined in the chamber to escape, and permit the water in the cylinder to flow back into the chamber J, the car will descend, assuming that the counterbalance is not too great.

As steam, by reason of its expansibility, can be conducted a considerable distance without deterioration of its power, it is evident that the vapor chamber J can be placed in the upper part of the building, in order to give a greater head to the column of water, which head of course depends largely upon the weight of the car, and the extent to which it is to be utilized as a counterbalancing medium, the heavier the car, the greater being the altitude required, it being assumed that the diameter of the cylinder G and the gear of the machine are determined. This column of water will act as a counterbalance to the car when the latter is either ascending or descending, the direction of its movement being the same as the direction of movement of a metallic counterbalance moving in guides in the shaft, viz., opposite to the direction of the movement of the car.

The vapor chamber J, having as it always must, a cubical capacity greater than the cubical capacity of the hydraulic cylinder G, may at the same time have a diameter greater, or equal to, or less than the diameter of the cylinder G, under each of which conditions, the column of water will act as a counterbalance; but if the diameter be greater, as has been the custom heretofore, the head of the water will be relatively increased as the piston F descends, and relatively decreased as the piston F ascends, thereby producing a variability of the machine in operation, which is aggravated by the weight of the cables passing into and out of the shaft. If the diameter of the vapor chamber J be equal to that of the cylinder G, the head of the column of water will remain relatively the same at all positions of the piston, and the power of the machine will be constant, except for the variability caused by the cables passing into and out of the shaft; but if the diameter of the vapor chamber be less, properly proportioned, than the diameter of the cylinder G, which construction forms the basis of my present application, the power of the machine will be constant, and the car and cables be perfectly counterbalanced for all positions of the piston, for, as the head of the water in the vapor chamber descends faster than the piston descends, and the column of water ceases to that degree, to perfectly counterbalance the car, the weight of cable which has passed from the car side to the machine side of the shaft, compensates for this decrease in head of water, by assisting the machine in its work to that degree, therefore coincidently restoring the equilibrium, and as the car descends, the reverse is true.

As the car starts downward, it is obvious,

that as the distance increases from the pulley D over the shaft to the car A, the weight of the cable is proportionately increased, making a greater load for the hydraulic cylinder, which load is constantly increasing as the car descends. We will now assume that the car has reached the position shown by the dotted lines at the bottom of the shaft. The added weight of the cable will be from the points *b* to *c*, and as the height of the column of water in the vapor chamber has been proportionately increased by reason of its smaller diameter compared with that of the hydraulic cylinder, such height will compensate for such increased load caused by the increased length of the cable. This height of the column of water, I have indicated by the dot and dash line *d*, the dot and dash line *a* indicating the height of the column when the car is at the top of the shaft, and the dotted line *e* the height which the column would have reached had the cylinder G and the vapor chamber J been of the same diameter, but which, as it will be obvious, would give no increased power to compensate for the greater weight caused by the increased length of cable in the shaft. It is obvious, that the height of the column of water in the chamber J is proportionately increased as the cable is lengthened above the car, thereby compensating proportionately therefor.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination with a cage or platform and its cable, of a hydraulic cylinder and its piston for raising the cage or platform through the medium of its cable, and a vapor chamber properly proportioned to said cylinder to accommodate different conditions, said chamber located above, and being of less diameter, but greater in cubical capacity than said hydraulic cylinder, whereby, as the cage or platform ascends or descends in the shaft, the column of water in the vapor chamber is shortened or lengthened to a greater extent relatively, than the stroke of the piston in the hydraulic cylinder, thereby proportionately decreasing or increasing the head of the column of water in the vapor chamber relative to the piston in the hydraulic cylinder, to counterbalance the car, and compensate for the varying lengths of the cable in the elevator shaft, substantially as described.

2. The combination with a cage or platform and its cable, of a hydraulic cylinder and its piston for raising the cage or platform through the medium of its cable, a vapor chamber, properly proportioned, relative to the size of the hydraulic cylinder, said chamber being located above, and being of less diameter, but greater in cubical capacity than the hydraulic cylinder, suitable valves for said cylinder and chamber, and means for operating said valves from the cage or platform, whereby, when the valves are operated to cause the piston to descend in the cylinder, the water will fall a greater distance in the vapor chamber, and when the valves are operated to cause the piston to rise, the water will rise to greater height in the vapor chamber, than the distance of the stroke of the piston in the cylinder, which difference of height of the column of water in the vapor chamber relative to the position of the piston in the cylinder, will compensate for the varying lengths of cable in the elevator shaft, substantially as described.

In testimony whereof I hereunto affix my signature, in presence of two witnesses, this 18th day of April, 1893.

BRONSON C. KEELER.

Witnesses:
F. R. CORNWALL,
HUGH K. WAGNER.