No. 691,035. Patented Jan. 14, 1902.

J. D. WILKENS.

COUNTERBALANCE FOR LIFT BRIDGES, &c.

(Application filed Nov. 25, 1895.)

(No Model.) 2 Sheets—Sheet 1.

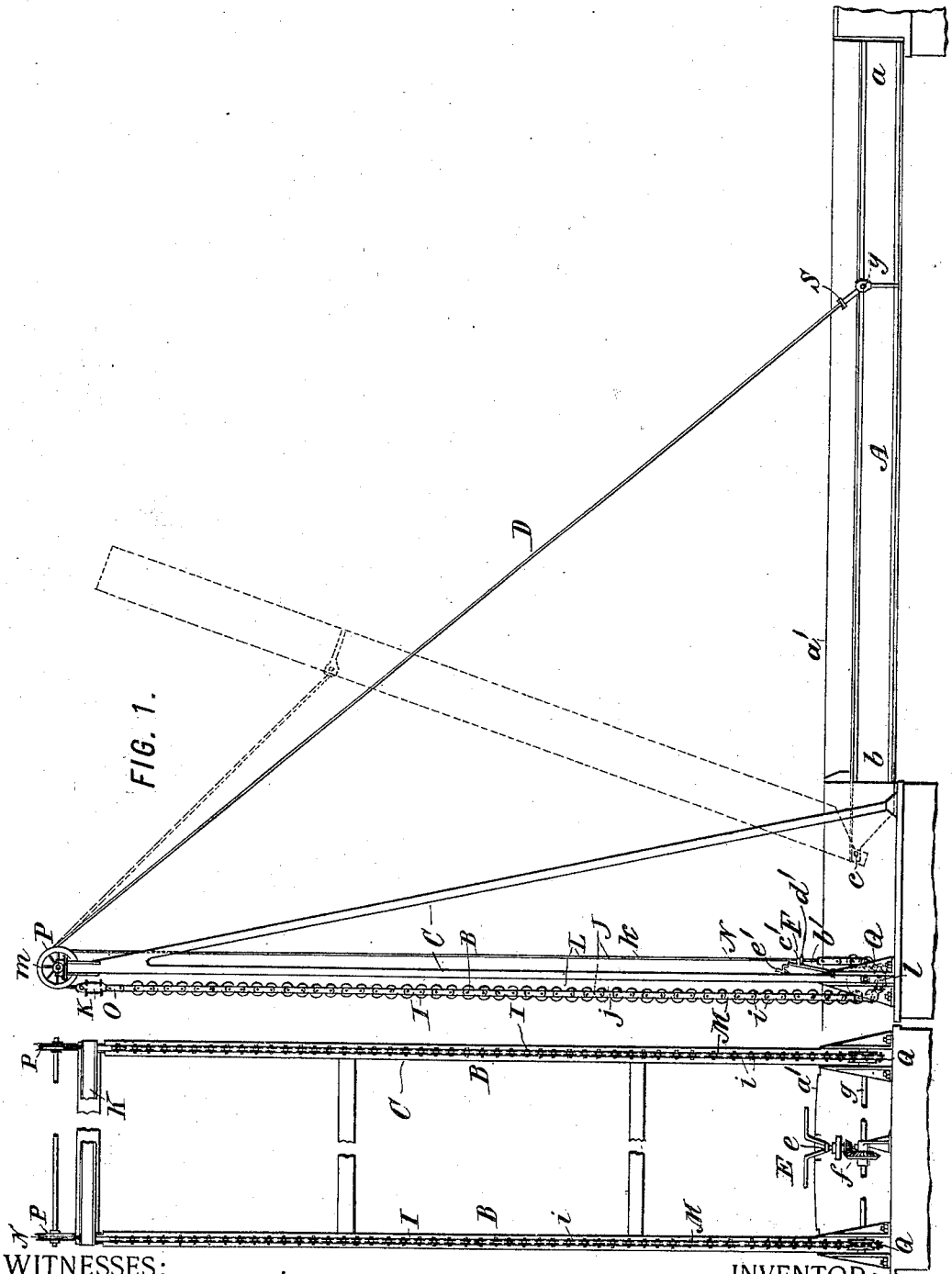


FIG. 1.

FIG. 2.

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(No Model.) 2 Sheets—Sheet 2.

FIG. 4.

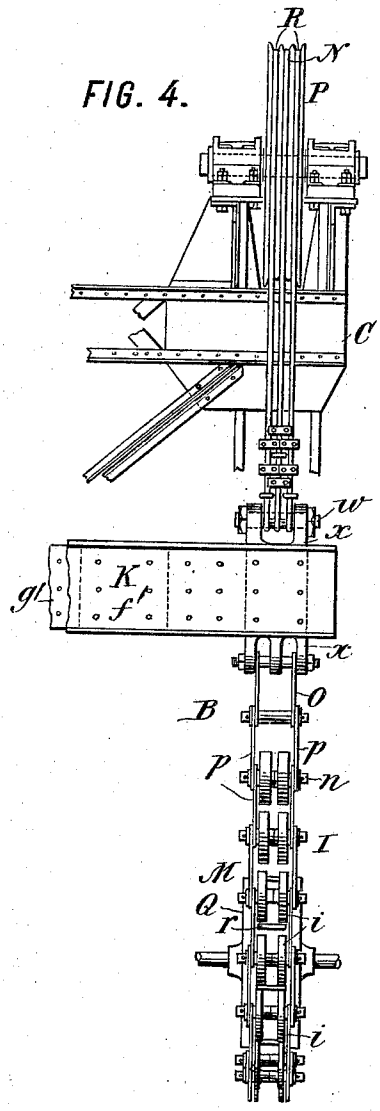


FIG. 3.

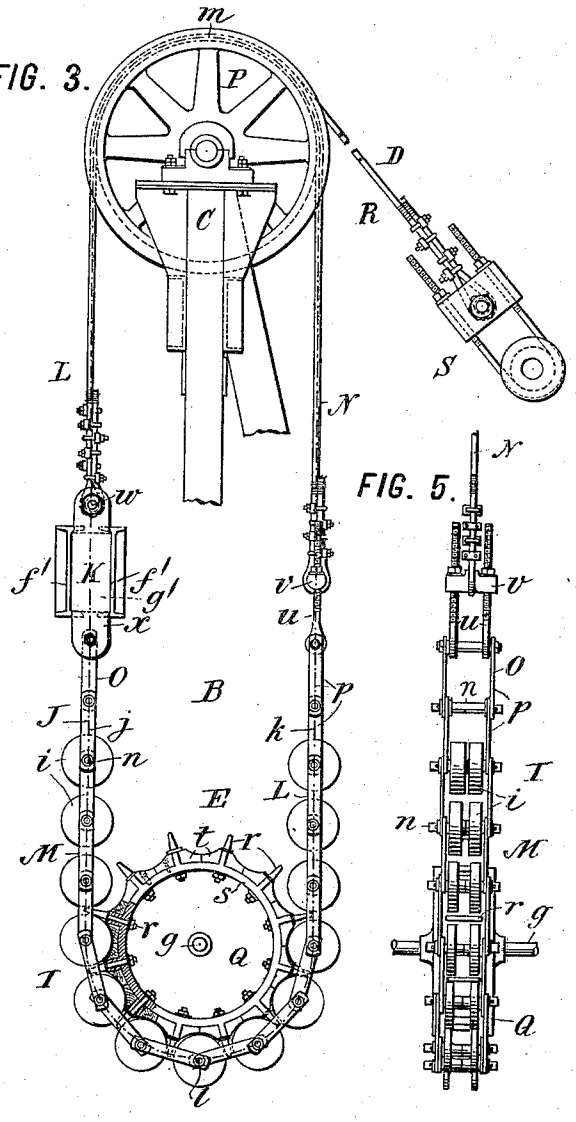


FIG. 5.

FIG. 6.

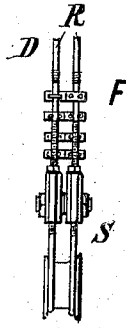
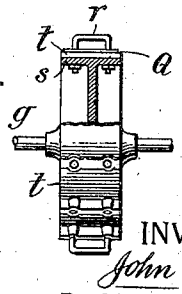


FIG. 7.



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UNITED STATES PATENT OFFICE.

JOHN D. WILKENS, OF NEW YORK, N. Y., ASSIGNOR OF ONE-HALF TO R. WALTER CREUZBAUR, OF NEW YORK, N. Y.

COUNTERBALANCE FOR LIFT-BRIDGES, &c.

SPECIFICATION forming part of Letters Patent No. 691,035, dated January 14, 1902.

Application filed November 25, 1895. Serial No. 569,995. (No model.)

To all whom it may concern:

Be it known that I, JOHN D. WILKENS, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Counterbalancing and other Devices for Lifting and other Purposes, of which the following is a specification.

My invention relates to means for producing or exerting a counterbalancing, lifting, or other tension or force, and aims to provide certain improvements therein. Such means are applicable to numerous uses—such, for example, as the lifting or moving of swinging, hinged, or draw-up bridges, water-tank spouts, coal-pocket aprons, folding beds, and water or canal gates. In use with such structures as those just mentioned as examples, and also in any other structure requiring a counterbalancing, resisting, or actuating force, the means employed for exerting this force are necessarily varied to adapt them to the peculiar requirements of use.

My invention, while capable of general employment, is especially adapted to devices requiring the application of a variable force—such, for example, as a bascule or hinged drawbridge—and therefore I will proceed to describe my improvements as adapted to and in conjunction with such a structure.

Heretofore in counterbalancing devices, particularly where a counterbalanced member has opposed a variable resistance, as is the case with an end-lift or hinged bridge, various attempts have been made with the object of modifying the force exerted by the counterbalancing member to accord with the variations of resistance opposed to it during the movements of the member lifted. In small structures the varying tension of springs has been employed with this end in view, and in larger structures—as, for example, in drawbridges—a plurality of weights have been employed in such manner, according to one expedient, that by the use of successively-operating catches certain of the weights are rendered neutral or inactive relatively to the counterbalancing device and, according to another expedient a plurality of weights connected to the counterbalancing device have been deflected in their movement toward or from a vertical path to the end of decreasing their effective action on the counterbalancing device in accordance with their departure from the vertical in direction of movement. Much difficulty and expense have been involved in the attempts made to use these prior devices, particularly for large structures, the provisions for catching and carrying the several weights being complicated, cumbersome, and expensive and the means for changing the direction of travel of the weights from a vertical toward a horizontal direction requiring guiding provisions of great accuracy and expensive construction and occupying an inconvenient amount of space.

My invention aims to provide counterbalancing provisions of simple construction and operation, capable of ready and exact adaptation to the requirements of use, compact, and self-contained, and which in operation effect their changes of tension or force gradually and with regularity. To this end in carrying out the preferred form of my invention, and in the example taken for illustrating it of its adaptation to a hinged drawbridge, I provide a weight or medium of predetermined specific gravity, a path of travel for this weight or medium having portions in which the effectiveness of that portion of the weight or medium therein is in opposition to that portion of the weight or medium in the other portion of the path, and intermediate of those portions of the path I provide a connecting and neutral portion through which the effect of the weight in each side portion is communicated and in which the weight of that part of the medium in the neutral portion is neutral or ineffective as against the other portions of the weight or medium, and I provide means for moving the weight or medium through such path to vary its disposition relatively to such neutral point until the excess of weight in one portion of the path over that in the other portion shall equal the amount desired, and means for availing of this excess as a counterbalancing or tension force, and means for controlling or varying the speed or extent of travel of the weight or medium from one side to the other of the neutral point. Preferably the path is an endless path, having substantially parallel and

substantially vertical upright active parts and substantially semicircular intervening neutral parts, and the weight consists of a plurality of movable weights connected together and disposed about to move in this path as desired. An endless connection passing over two pulleys and carrying throughout a part of its length a number of weights is a simple expedient for availing of this principle, the weights being disposed when in their most active position substantially all in one leg of the path and to traverse toward and into the other leg as their activity is to be decreased. In whatever position the weights are disposed at any part of their operation the excess of weight in one leg over that in the other leg constitutes the effective force of the counterbalancing provision. Any operating means for the counterbalancing provision and any locking means therefor may be employed. This plurality of weights connected so as to form a part of the movable loop described is herein named the "lifter."

In the accompanying drawings, which show certain adaptations of my invention, Figure 1 is a diagrammatic side elevation of a simple form of hinge-drawbridge, showing one form of my improved lifter therefor. Fig. 2 is a fragmentary end elevation thereof. Fig. 3 is a fragmentary side elevation, partly in vertical section, on a larger scale, showing part of the counterbalancing mechanism. Fig. 4 is a fragmentary rear elevation thereof. Fig. 5 is a fragmentary front elevation thereof. Fig. 6 is a fragmentary front elevation of the connection between the lifter and the bridge. Fig. 7 is an elevation, partly in section, of the sprocket-wheel.

Referring to the drawings, let A represent a bridge; *a*, the lift end thereof; *b*, the hinge end thereof; B, the lifter; C, the tower carrying the latter; D, the connection between the bridge and its lifter, and E the lifter-operating mechanism.

The bridge A may be any movable body or member against which a moving force is to be exerted. The bridge shown is of usual construction, swinging on a hinge or axis *c* at at one end from a horizontal to a substantially vertical position when lifted and resting on an abutment *d* at its other end when in its normal position.

The lifter or counterbalancing device B serves to raise and lower the movable member A and hold it in its several positions.

The tower C is any suitable or usual construction of tower or other provision adapted to hold or carry the lifter. The connection D is any suitable connection between the movable member A and the lifter, transmitting the motions of one to the other, that shown being a cable or strand connected at one end to the bridge A, near the lift end thereof, and at its other end connected to the lifter, by which it is moved.

The operating means E may be any suitable motor for driving or controlling the movement of the lifter or the bridge, that shown being composed of a hand-bar *e*, connected by gearing *f* to a driving-shaft *g*, driving the lifting mechanism at two points in the length of the shaft, which points are at the respective sides of the bridge. The operating means are best located below the floor or road line *a'* of the bridge, and the shaft *g* extends across the abutment from one side of the tower to the other.

The lock F may be any suitable device for engaging any portion of the apparatus either at some particular point in the operation or at any point therein and preventing movement in one or both directions, as desired. The lock shown consists of a hook or catch *b'*, pivoted to the tower C at its lower end and having a hook *c'* at its other end engaging a projection *d'* on a movable part of the apparatus when the lock is in the active position. A catch *e'*, pivoted to the tower, engages the hook *b'* and holds the latter in the inactive position.

In their general features the several parts of the apparatus may be of any usual or suitable construction and principle of operation. The parts shown are taken as convenient examples of one character of apparatus to which my improvements are applicable and in connection with which they will be hereinafter more fully set forth.

In the construction shown in the drawings the load is a variable load, decreasing as the bridge approaches the vertical and being at a maximum when the bridge is at or near the horizontal. It is desirable that the effective force of the lifting device should substantially equal the strain of the load throughout all or most of its variations, so that the driving power necessary to operate the parts may be reduced to a minimum and there will be no tendency of the parts to move unless driven. Preferably the driving power necessary will only be that requisite to overcome the inertia of the movable parts and the friction incident to their movement, and accidental displacement of the parts is prevented by the lock.

According to the preferred form of my invention the lifter comprises a flexible weight medium I, from which the effective force of the device is obtained, means for opposing a portion of the weight of this medium against another portion of its weight and for varying this opposition so that the difference in weight of one portion relatively to another can be utilized as the effective force of the device, and means for utilizing this effective force. This is best accomplished in the manner shown in the drawings, wherein the weight medium is caused to move along a path, track, or guideway J, having upwardly-extending active leg or part *j* and inactive leg or part *k*, an intervening neutral part *l*, and preferably a similar neutral part *m*. The parts *j k* are shown as parallel and vertical

and the parts *l m* as curved and semicircular. The weight medium moves in the vertical parts of the path and through the neutral part from one to the other, its portion in the neutral part being inactive and its portions in the other vertical parts being in opposition.

Any suitable provision for maintaining the weight medium in its path may be employed, but I prefer to use an endless flexible member extending and movable throughout the path and consisting of two portions. This member is lettered L, and its portions, one of which is relatively heavy and lettered M and the other of which is relatively light and lettered N, are connected together at their extremities and disposed in the path as circumstances render desirable. The portion M is composed of or carries in the construction shown the weight medium I, and the portion N is composed of a cable or other flexible strand, sufficing to connect the two extremities of the weight medium. This endless member or lifter L is best sustained from a pulley P at top and is best guided and driven by a sprocket-wheel Q at bottom, although any suitable substitutes for these provisions or any other arrangement thereof may be used.

In the use shown the cable N is a single cable riding in a central groove on the pulley P and the portion M is a link or sprocket chain throughout the greater part of its length, which rides around the sprocket-wheel Q, the two portions being of substantially equal length and moving from the position of maximum force in which the portion M is almost wholly in the leg *j* of the path J to a position of minimum force, in which the portion M is largely in the leg *k* of the path J.

The weight medium may be of any suitable character or construction. I prefer to use a heavy weight or beam K, consisting of eye-beams *f'* and weights *g'* between them, as a portion of the weight medium, so disposing it that its effective weight shall be constant, or substantially so, in all positions of the endless member, and to use beyond this weight a plurality of lesser weights *i*, connected movably and preferably rotatively together at predetermined and fixed distances apart and preferably of different and gradually-modified specific weight, those shown being heaviest near the extremities of the part M and lightest near the middle of this part. The weights *i* are best used in pairs mounted rotatively on axial pins *n*, connected together by the links *p* of the chain O, which constitutes a portion of the part M of the member L. The weights can rotate on these pins as the chain bends as they pass around the sprocket-wheel Q, the teeth *r* of which pass between the weights and act against them. These teeth *r* are U-shaped bars bolted to the rim *s* of the wheel and clamping between them wooden shoes *t*, having concave faces receiving and holding the weights as they pass. At the end of the chain O farthest from the girder K are screw-threaded eye bolts *u*, adjustably carrying a connecting-yoke *v*, about which the adjacent end of the cable N is looped. The other end of the cable is looped about a pin *w*, carried by the links *x*, to which the beam K is secured. The pulley P is suitably mounted in bearings on the top of the tower and is a passive pulley.

Any means for transmitting the effective force of the weight medium to any point of use can be availed of. I prefer the connection D, which is best constructed of two flexible strands or cables R, connected to the pin *w* of the weight medium at equal distances on each side of the cable N, running over the pulley P in grooves parallel with that of the cable N and thence extending to the point for applying the power—the pin *y* on the bridge A in the construction shown. These cables are united by a yoke S at their outer ends to adjustably engage this pin. Thus the tension may be equally divided between these cables and an equilibrium of strain is maintained on the pulley P and through the endless member L.

In operation the lifter will vary its effective force almost exactly in accordance with the variation of the load in the construction shown, and by proper adjustment any desired variation may be obtained. The frictional resistance to the movement of the weight member will be the same at all times and can be moved with equal facility in either direction. The movements of the weight medium and other parts will be confined within narrow limits and in the main will be in vertical direction.

In use the number of counterbalancing devices employed will be varied as circumstances require; but usually two will suffice for bridgework of the character shown in the drawings. In such work each will be an exact duplicate of the other, and to insure their uniform action the loaded beam K and the driving-shaft *g* are extended from one to the other, as shown. When the loaded beam K reaches the roadway, this in the construction shown serves as a lodgment for it, upon striking which it substantially ceases to counterbalance any part of the bridge. The latter must come to a stop, the moving power being insufficient to raise the bridge when thus unbalanced. The lodgment serves to arrest movement of the bridge by arresting the loaded beam K, or constant counterweight in this construction; but any suitable stop or arrester having this function can be applied at any suitable place for this purpose. The flexibly-connected counterweights embodied in the loop serve by their adaptation to be shifted from one side of the sheave to the other side thereof, the double purpose, first, of counterbalancing the bridge as it commences to rise, and then as the pull of the bridge upon its hoisting-cable diminishes these looped weights are gradually shifted

to the other side of the sheave, whereby their weight is added to the diminishing pull of the bridge upon its hoisting-cable, and a perfect balance is maintained. Owing to this shifting adaptation of the looped counterweights the cheaply-constructed loaded-beam counterweight can be made heavier accordingly. For instance, in a certain bridge raised to an angle of eighty degrees the final pull upon its hoisting-cable is forty per cent. of its pull when the bridge commences to rise. In that case the constant counterweight is made forty per cent. of the maximum pull plus half the difference between the minimum and the maximum pull upon the hoisting-cable, in all seventy per cent. of the maximum pull, the looped weights making up the other thirty per cent. to balance the bridge at the beginning of its rise. At the end of the hoist these thirty per cent. of weights will have passed from the descending leg of the loop into the rising leg thereof, thereby balancing an equivalent weight of the loaded beam, leaving the active weight of the beam equal to the final pull of the bridge upon its hoisting-cable.

As during the operation of the bridge there is no sudden change of momentum and inertia, there is no danger of breakage, and the movements can be rapid accordingly.

It will be understood that my invention is not limited in its application to the particular details of construction, arrangement, and use hereinbefore set forth and that it can be availed of according to such modifications as circumstances or the judgment of those skilled in the art may dictate without departing from the spirit of the invention.

What I claim, and desire to secure by Letters Patent, is—

1. As a means for operating a bascule bridge and the like, a tower; a sheave mounted upon the tower, a series of weights flexibly connected and incorporated in a loop suspended from said sheave; a cable connecting said loop with the free end of the bridge; means for moving said loop around the axis of said sheave, whereby part of its weights are shifted from one side of the loop and sheave to the other side thereof; in combination with automatic means for stopping the rising bridge at a predetermined angle, consisting of a preponderating constant weight incorporated in said loop at or near the upper end of its counterweights when the bridge is closed, together with a lodgment located so as to uphold said constant weight when the bridge has reached its predetermined angle of rise; whereby said weight becomes inactive as a counterweight to the bridge, and the bridge is unbalanced and brought to a stop.

2. In end-lift bridges, the bridge; a tower upon each side of the fulcrum end of the bridge; a sheave mounted upon each tower; a series of independent weights flexibly connected and incorporated in a loop suspended from each respective sheave; in combination with a constant counterweight reaching across from one loop to the other loop, and attached to both loops; together with a flexible connection from the free end of the bridge to said loops, and means for moving said loops in unison around the axis of their respective sheaves.

3. In end-lift bridges, the bridge; a tower upon each side of the fulcrum end of the bridge; a sheave mounted upon each tower; a series of independent weights flexibly connected and incorporated in a loop suspended from each respective sheave, and adapted to be shifted from one side of said loop and sheave to the other side thereof; in combination with a constant counterweight reaching across from one loop to the other loop, attached to both loops, and adapted to move in substantially a vertical path only; whereby the weight common to both loops remains a constant counterweight, and the independent weights serve in turn as counterbalance to the bridge, and when shifted to the other side of the respective loop, as counterbalance to the constant weight common to both loops; together with a flexible connection from the free end of the bridge to said loops; and means for moving said loops in unison around the axis of their respective sheaves.

4. In an end-lift bridge, the bridge; two sheaves mounted each upon a tower a distance apart from each other along the fulcrum end of the bridge; a loop suspended from each sheave; a series of independent weights flexibly connected incorporated in each loop; a connection from each loop to the free end of the bridge adapted to move them in unison; and a means to move said loops in unison around the axis of their respective sheaves, whereby the said weights are shifted from one vertical member of the loop to the other vertical member thereof while the bridge is in motion; in combination with a constant counterweight reaching across and attached to both loops so as to move in a vertical path only or nearly so; together with a lodgment for said weight common to both loops, whereby the rising bridge is brought to a stop.

5. In end-lift bridges and the like, a tower; a sheave rotatively mounted upon the same; a preponderating counterweight suspended from said sheave adapted to be moved up and down only; auxiliary counterweights flexibly connected suspended from said sheave and adapted to be shifted from one side of said sheave to the other side thereof; a connection from all said weights to each other and to the free end of the bridge adapted to cause them to move in unison; and means for giving motion to said weights and the bridge.

6. In end-lift bridges, a tower; a sheave rotatively mounted upon the tower; a preponderating constant counterweight suspended from said sheave adapted to be moved up and down only; auxiliary counterweights, flexibly connected, suspended from said

sheave and adapted to be shifted from one side of said sheave to the other side thereof; a connection from all said weights to each other and to the free end of the bridge adapted to cause them to move in unison; means for giving motion to said weights and the bridge; and a lodgment for said constant preponderating counterweight, whereby the bridge is unbalanced and automatically brought to a stop.

7. In an end-lift bridge and the like, a frame; a sheave mounted upon the frame; a constant counterweight, exceeding in weight the pull of the bridge upon its hoisting-cable when raised to its maximum angle, suspended from said sheave and adapted to be moved up and down only; auxiliary counterweights flexibly connected and incorporated in a loop suspended from said sheave; a connection between the constant counterweight and the auxiliary counterweights adapted to cause them to move in unison; a connection from said weights and loop to the free end of the bridge; and a means for moving said loop around the axis of said sheave; whereby the bridge is moved, and the auxiliary weights gradually shifted from one side of the sheave to the other side thereof, and thereby the constant counterweight reinforced by the auxiliary weights when upon the same side of the sheave; and the excess of the constant weight over the pull of the bridge upon its hoisting-cable neutralized by the auxiliary weights when upon the opposite side of the sheave.

8. In devices of the character described, a frame; a sheave mounted upon the frame; an endless member or loop supported by said sheave and connected with the object to be lifted and balanced; a constant weight incorporated in said loop having its path of travel confined to a vertical movement in the main; a lodgment for said constant weight adapted to limit the travel of said loop; a series of weights suspended from said constant weight and forming a part of said loop, and substantially the side thereof below the constant weight when the latter is in its highest position, and substantially located in the other side of the loop when the constant weight is lodged; together with a connection from said loop to an actuating power; whereby the object to be lifted under a varying strain upon its lifting-cable is under perfect control, balanced in all its positions, and automatically brought to a stop.

9. In end-lift bridges and the like, a tower; a bridge pivoted at one end, with its free end adapted to swing toward and from the tower; counterweights mounted in the tower and connected to the free end of the bridge, consisting of a constant counterweight adapted to move up and down only; a lodgment for said weight adapted to limit the descent and the rise of the bridge; auxiliary counterweights adapted to be shifted, from a path in which they add their gravity to that of the constant counterweight in counterbalancing the bridge, to a path in which these auxiliary weights act in opposition to the constant counterweight, and as a reinforcement to the pull of the bridge upon its hoisting-cable; and actuating means adapted to give motion to the said counterweights and the bridge.

10. As a means for quickly operating and fully balancing end-lift bridges and the like, without jars and sudden checks of momentum and change of inertia, a tower; a sheave mounted upon the tower; a mass serving as constant counterweight, constituting the larger part of the counterweight used; together with a series of auxiliary weights, flexibly connected, suspended from the said mass, forming the lesser part of the counterweight used; a flexible connection joining the end of said flexibly-connected weights farthest from the mass, to the upper part of said mass, so as to form a continuous loop adapted to ride upon said sheave and suspended from the same; a flexible connection from said loop to the free end of the bridge, whereby the bridge is balanced by said counterweights; and actuating means adapted to move the free end of the bridge and the said loop in unison; whereby the said auxiliary weights are gradually shifted from the leg of the loop wherein the said mass has its path of travel, to the other leg of the loop, thereby adding the gravity of the auxiliary weights to the diminishing pull of the rising bridge upon its counterweight; whereby a complete balance of the bridge is maintained, and shocks in its operation are eliminated.

11. In end-lift bridges and the like, a tower; a sheave mounted upon said tower; counterweights flexibly incorporated in a loop suspended from said sheave; a flexible connection from said loop to the free end of the bridge; a means for giving motion to said loop and for shifting part of its weight from one side of the sheave to the other side thereof; in combination with a locking device adapted to prevent the movement of said loop while the bridge is to remain at rest.

12. In devices of the class described, a weight member consisting of a plurality of weights movably connected together at predetermined points, each independently rotative, and the whole movable through a curved path.

13. In bridges, a lifter, comprising a tower, a cross-weight extending across the latter, two series of weights suspended from said cross-weight, means connecting the top of said cross-weight with the last of each of said series of weights, means sustaining said weights movably, means transmitting the effective gravity of said weights to a bridge, sprocket-wheels moving said weights, a driving-shaft moving said wheels together, and means operating said shaft.

14. In end-lift bridges and the like, a flexible counterbalance consisting of an endless loop, pulleys forming a pathway for said

looped counterbalance, means for rotating one of said pulleys, such driven pulley moving said counterbalance in unison with it, the distribution of said counterbalance and its movement relative to the free end of the bridge as described, and an oblique hoisting-cable connecting said counterbalance with the free end of a bridge, whereby such free end of the bridge is approximately counterbalanced in any and all its respective positions, and the effect of the varying obliquity of the hoisting-cable is compensated for.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JOHN D. WILKENS.

Witnesses:
GEORGE H. FRASER,
THOMAS F. WALLACE.