No. 849,078. PATENTED APR. 2, 1907.

L. MOSS.

HOISTING APPARATUS.

APPLICATION FILED APR. 15, 1904.

2 SHEETS—SHEET 1.

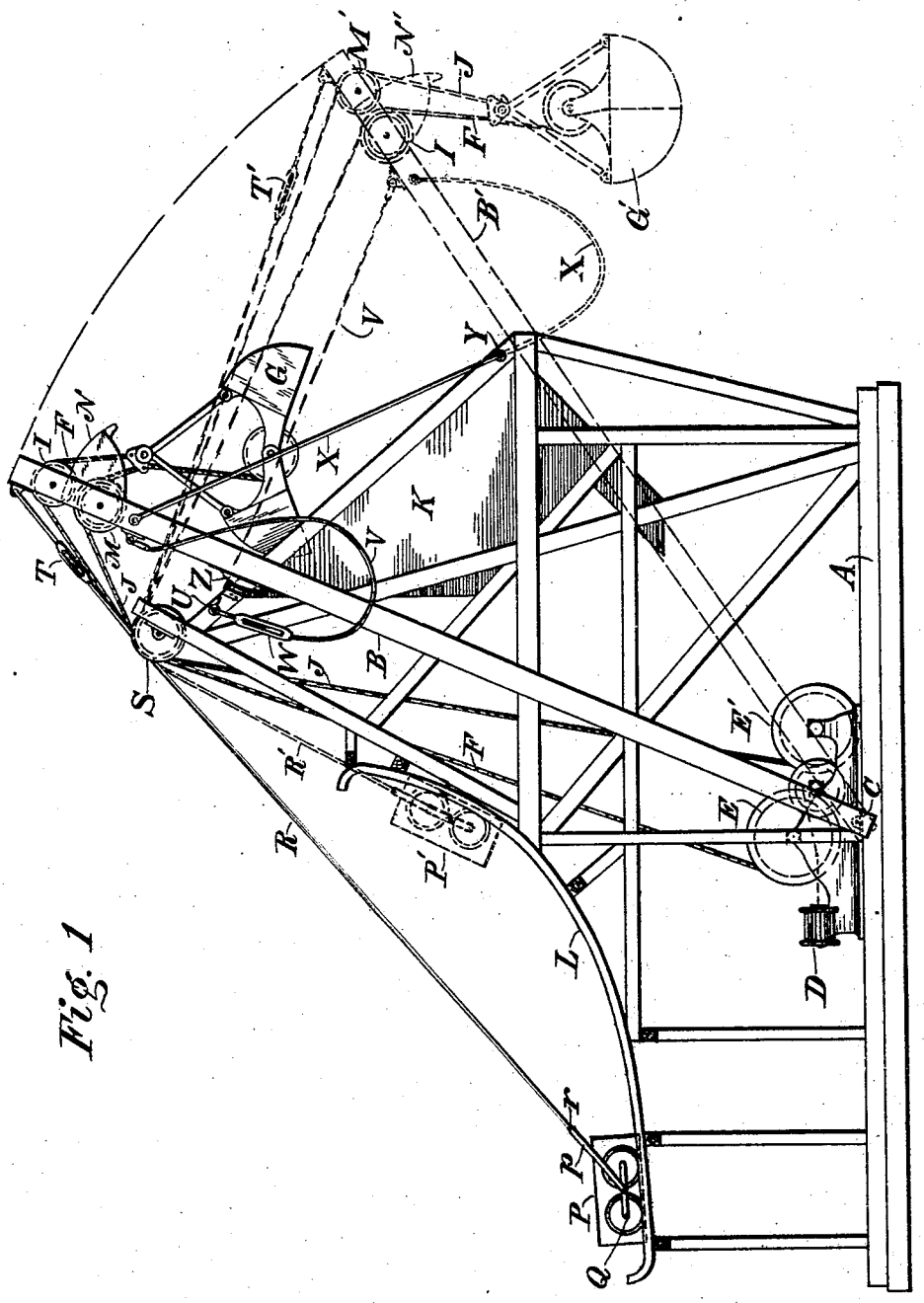

Fig. 1

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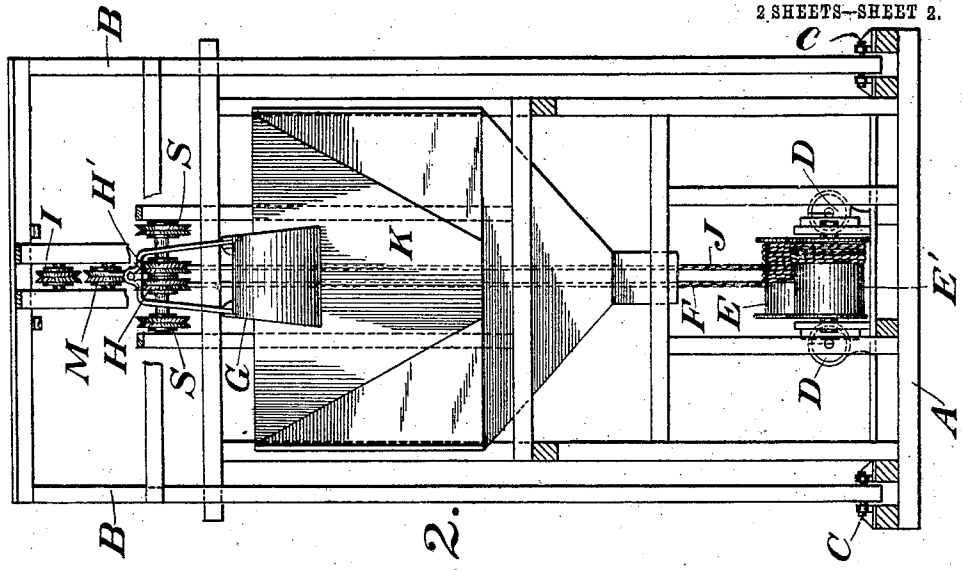

Fig. 2.

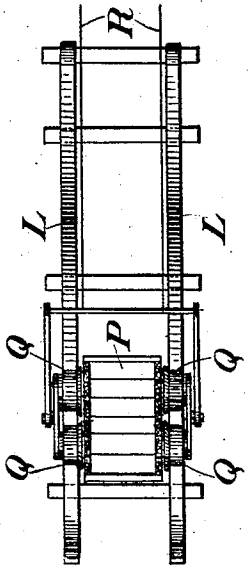

Fig. 3.

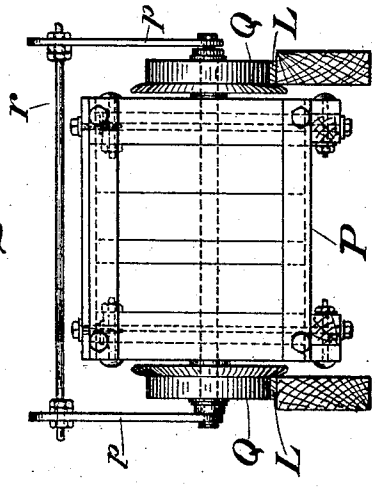

Fig. 4.

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HOISTING APPARATUS.

No. 849,078. Specification of Letters Patent. Patented April 2, 1907.

Application filed April 15, 1904. Serial No. 203,263.

To all whom it may concern:

Be it known that I, LINCOLN MOSS, of the city, county, and State of New York, have invented certain new and useful Improvements in Hoisting Apparatus, of which the following is a specification.

My invention relates to hoisting apparatus, and more particularly to that class of hoisting apparatus known as "balanced shear-leg elevators."

The object of the invention is to provide in hoisting apparatus of the type specified improved means for counterbalancing the pivoted boom of the apparatus in such a way as to obviate shocks to the apparatus when in operation and to relieve the operating machinery of all unnecessary strain.

Stated in detail, the object contemplated in the invention is to provide in hoisting apparatus of the type specified novel devices for opposing to the moment of the pivoted boom a resistance which is approximately equal to that moment when at its maximum, but which decreases more rapidly than the moment of the boom as it approaches its minimum.

With the object above stated and further objects in view, as will hereinafter appear, my invention consists in a novel construction, combination, and arrangement of parts of a balanced shear-leg elevator, as hereinafter described and claimed, and illustrated in the accompanying drawings, in which corresponding parts are designated by similar characters of reference throughout the several views, it being understood that changes in the form, proportions, and mode of assemblage of the elements exhibited may be made within the scope of the appended claims without departing from the spirit of the invention or sacrificing its advantages.

In the drawings, Figure 1 is a view in side elevation of a preferred form of apparatus embodying the invention. Fig. 2 is a view in front elevation of the apparatus illustrated in Fig. 1. Fig. 3 is a detail view in plan, showing the arrangement of the counterweight and the track upon which it travels. Fig. 4 is a detail view of the counterweight mounted on the track, the view being taken upon a vertical plane intersecting the track at right angles.

Referring to the drawings, the reference character A designates the base upon which the framework of the hoisting apparatus is erected. The framework employed for supporting the hoisting apparatus may be of any preferred design and construction, the exact arrangement of the elements of the supporting structure forming no part of the present invention. It is, however, essential that the framework be sufficiently rigid to withstand the strains to which the apparatus is subjected in operation, and the framework illustrated in the drawings is especially designed for the purpose, being adapted for the support of large weights by the provision of a considerable number of substantially upright members and being braced against lateral strains by a sufficient number of horizontal members and diagonal struts.

The boom B is pivoted upon the base A at C and is adapted to be raised and lowered by any suitable mechanism, as the hoisting-engine D, which is operatively connected with the winding-drums E and E′, over which the hoisting-cable F and the dumping-cable J, respectively, are wound. The hoisting-cable F passes upward from the drum E over a sheave H, mounted at the top of the framework of the apparatus, thence over a sheave M at the free end of the boom B, and is finally attached to the grab-bucket G or other load-container employed in connection with the apparatus. The dumping-cable J passes over a sheave H′, then over a sheave I, carried by the boom B, and finally downward to the grab-bucket, which is supported by the cable J and hangs below check-blocks or buffers N.

The counterbalancing devices employed in connection with the grab-bucket G and the boom B include a counterweight P, provided in the present instance with rollers Q, a two-rail track L, upon which the rollers Q of the counterweight travel, and cables R, which pass upward from the counterweight over the sheaves S and are adjustably connected with the boom B by means of turnbuckles T. The track L, upon which the counterweight P is arranged to travel, is formed upon a curve which departs but little from a portion of an ellipse having a horizontal major axis and a vertical minor axis. The ends of the rails of the track are bent sharply at angles to the rest of the track, as shown, in order to prevent possible travel of the car beyond the ends of the track in case of the breakage of the cables R or the rapid descent of the boom B. The cables R are preferably connected with the counterweight by means of a pivoted frame or bail *r*, the

ends of which are pivoted to side bars *p*, extending between the axles upon which the rollers Q are mounted. The pull of the cables R is thus transmitted to the counterweight substantially midway between its end, and the pull upon the cable has therefore a minimum tendency to lift either end of the counterweight off the track.

In order to provide a positive limit of downward movement for the boom B, I provide on either side of the apparatus a check rope or cable V, which is attached at one end to the boom immediately below the guide-sheave I and is attached at its other end to the supporting-framework, as at U, each of the check-ropes being provided intermediate of its ends with a turnbuckle W, by which the length of the check-rope may be accurately adjusted. To afford a similar limit to the upward movement of the boom, I provide at each side thereof a check-rope X, secured at one end to the boom adjacent to the attachment of the check-rope V and having its other end attached to the framework of the apparatus at Y, and buffer-springs Z, which are secured on the framework of the apparatus in such position that the frame of the boom B contacts with these buffer-springs when the boom is in its extreme upper position. (Shown in full lines in Fig. 1.)

The hoisting apparatus described in the foregoing paragraphs is shown in connection with a hopper K, into which the material hoisted is discharged when the grab-bucket is at the upper limit of its swing, as shown in Fig. 1.

In the operation of the apparatus the boom swings between the limits indicated by the two positions of the boom shown in solid and dotted lines, respectively, in Fig. 1. At the upper limit of the boom's movement, as shown in solid lines, the moment of the boom is at a minimum, and consequently the counterweight connected with the boom must be arranged to oppose a minimum of resistance to the moment of the boom when in this position, the moment of the boom in this position being partially counterbalanced by the upward impulse imparted to the boom by pull of the grab-buckets on the hoisting-cable. This relation between the moment of the boom and the resistance offered thereto by the counterweight P is secured in the apparatus illustrated in Fig. 3. The counterweight is at the lowermost portion of its path when the boom is raised to the position shown in solid lines in Fig. 1, and the track L, upon which the counterweight travels, is almost horizontal at its lower end. The effect of the counterweight in opposing resistance to the moment of the boom is therefore very small when the counterweight is at the lower end of the track, and the effect of the counterweight when in this position is still further reduced by the direction in which its pull is exerted upon the boom. As clearly seen in Fig. 1, when the boom is at the upper limit of its swing the pull of the counterweight upon the cables R is almost parallel in direction to the boom B, and consequently the pull of the counterweight upon the boom acts at great disadvantage in opposing the moment of the boom. This arrangement of the parts of the apparatus is provided in order that the moment of the boom may not be so nearly counterbalanced when the boom is raised as when it is lowered. The moment of the boom when raised is comparatively small, and it is desirable to offer but little resistance thereto in order that the small moment of the boom when raised may cause the boom and grab-bucket to begin to descend with a tolerably rapid initial movement as soon as a load in the grab-bucket is discharged and the drum E is released to pay out the hoisting-cable F. As the boom B and the grab-bucket G descend from the raised position to the lowered position the moment of the boom increases rapidly, owing to the increased effect of the force of gravity upon the boom and the diminution of the upward impulse imparted to the boom from the pull of the grab-bucket on the hoisting-cable; but the resistance opposed to this increased moment of the boom and grab-bucket by the counterweight P increases at a rate that is more rapid than the rate of increase of the moment. Consequently as the boom approaches the lower limit of its movement the resistance opposed by the counterweight P to the moment of the boom becomes almost equal to that moment. Thus it will be seen that while the boom and grab-bucket begin to descend with a comparatively rapid movement the rapidly-increasing resistance opposed to that descent by the counterweight P not only prevents the rapid increase of the rate of descent, but gradually checks the descent of the boom, so that when it reaches the lower limit of its movement and is stopped by the check-ropes V the shock received by the check-ropes is so small as to be unnoticeable.

After the boom comes to rest in the position shown in dotted lines in Fig. 1 the grab-bucket is lowered by the continued unwinding of the cable F from the drum E until the bucket reaches the material to be hoisted, when it is operated to take up its load, and the cable F is again wound on the drum E to hoist the bucket. The bucket rises without imparting movement to the boom until the upper portion of the bucket comes into contact with the buffer-blocks N, at which instant, under the influence of the counterweight P, which is then in the position indicated in dotted lines in Fig. 1, the boom rises with the grab-bucket until the upward movement of the boom is stopped by the buffer-springs Z and the check-ropes X. As

the boom and grab-bucket rise together from the lowered position of the boom to the raised position, the resistance to the moment of the boom opposed by the counterweight gradually decreases, so that the upward momentum of the boom, grab-bucket, and load, due to their rapid movement, may not cause a shock when the upward movement is checked by the buffer-springs and check-ropes.

I am aware that various devices have been employed prior to my invention for counterbalancing in part the weight of the pivoted boom of a hoisting apparatus and the load-container supported thereby; but so far as I am aware the counterbalancing devices heretofore used in such apparatus have never been arranged so as to oppose to the moment of the boom a resistance which almost equals the moment of the boom when lowered, but which decreases so rapidly as the boom and load-container are raised that when the boom and load-container are at the upper limit of their movement the resistance opposed to the moment of the boom by the counterweight is very small, leaving that moment practically unbalanced to impart an initial descending movement to the boom as soon as the hoisting-cable is released. I do not, therefore, claim broadly as my invention the combination of a boom and means for counterbalancing it in any position; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. The combination with a boom arranged for pivotal movement in vertical plane, of means for opposing resistance to the moment of the boom which increases throughout the descent of the boom at a rate considerably more rapid than the rate of increase of said moment, whereby the movement of the boom and its load is gradually arrested as the boom approaches its lowermost position.

2. The combination with a boom of a track, a counterweight arranged for travel on said track, and connections between said boom and said counterweight, the track and connections between the boom and the counterweight being so arranged that the counterweight opposes to the moment of the boom a resistance which varies disproportionately to the variation of the moment of the boom.

3. The combination with a boom of a track, a counterweight arranged to travel upon said track, and an adjustable connection between said counterweight and boom, said track and said connection being so arranged that the counterweight is caused to oppose a resistance to the moment of the boom which varies disproportionately to the variation of the moment of the boom.

4. The combination with a pivoted boom of counterbalancing devices including a counterweight operatively connected with said boom and a track along which said counterweight travels, said track being nearly horizontal at its lower end and curving upward in a curve of gradually-increasing curvature which is substantially vertical at its upper end.

5. The combination with a pivoted boom and a load-holder suspended therefrom, of means for opposing to the moment of the boom a resistance which is always less than said moment, but which nearly equals said moment when at its maximum and is considerably less than said moment when at its minimum.

6. The combination with a pivoted boom of means for positively limiting the movement of said boom, a hoisting-cable guided over said boom, a load-holder suspended at the end of said hoisting-cable and susceptible of movement independent of said boom after the boom has reached the lower limit of its movement, and means for opposing a variable resistance to the moment of the boom.

7. The combination with a pivoted boom having a guide-sheave near its free end, of a hoisting-cable passing over said guide-sheave, a load-holder suspended by said cable below said boom, and means for opposing to the moment of said boom a resistance which varies disproportionately to the variation of said moment.

8. The combination with a pivoted boom having a guide-sheave near its free end, of means for limiting the movement of said boom, a hoisting-cable passing over said guide-sheave, a load-holder suspended at the end of said hoisting-cable, a buffer carried by said boom and adapted to be engaged by said load-holder when hoisted, and means for opposing to the moment of the boom a resistance which varies disproportionately to the variation of said moment.

9. The combination with a boom, of counterbalancing devices including a track formed upon a curve in a vertical plane, a counterweight having two pairs of rollers resting on said track and a connection between said boom and said counterweight, said connection being secured to the counterweight substantially midway between its ends.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

LINCOLN MOSS.

Witnesses:
EMIL CHAS. EGEK,
JAMES E. GOODEVE.