No. 667,313. Patented Feb. 5, 1901.

O. HETLESAETER.

EXCAVATOR.

(Application filed May 7, 1900.)

(No Model.) 3 Sheets—Sheet 1.

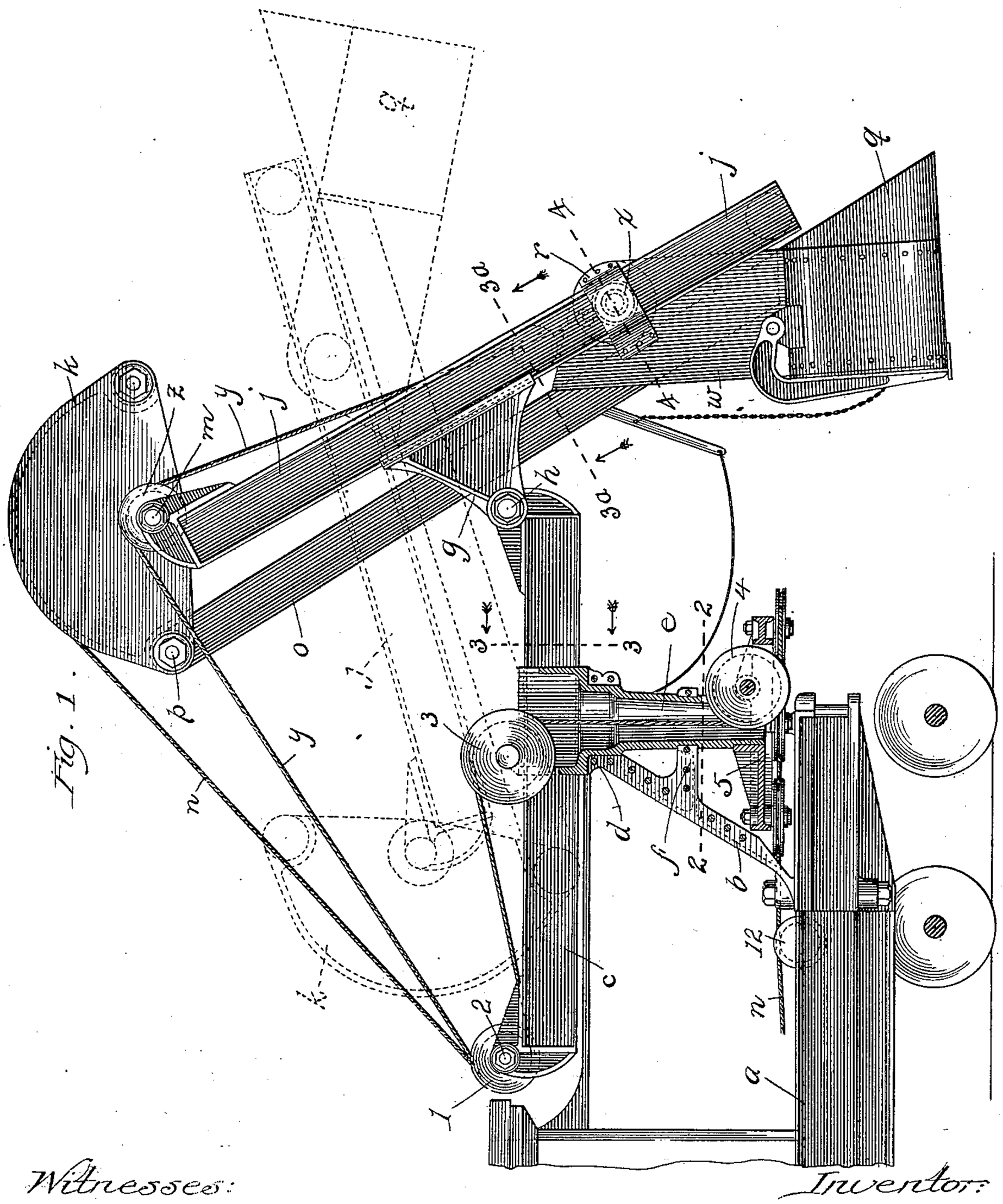

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Fig. 2.

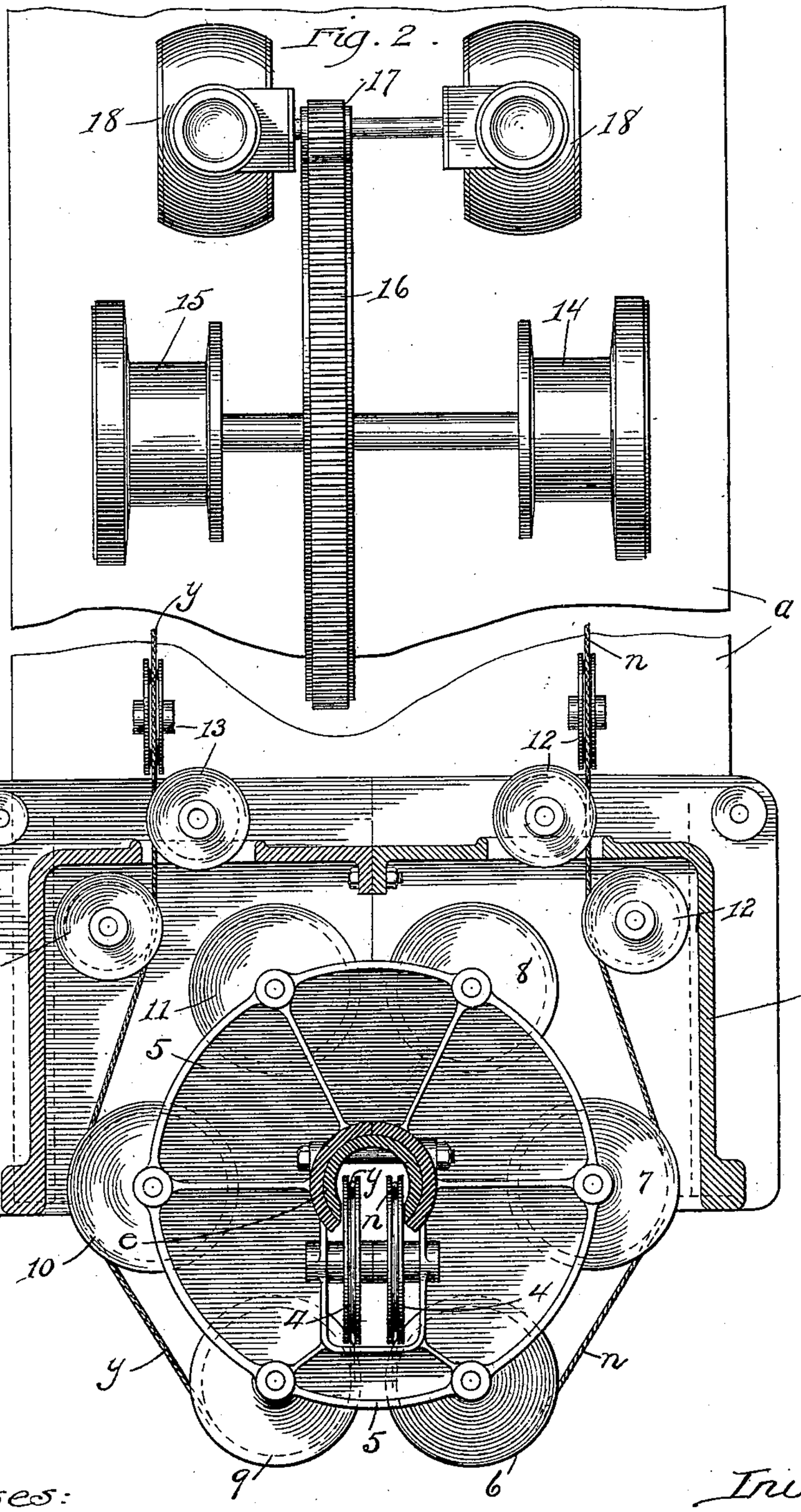

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Fig. 3.

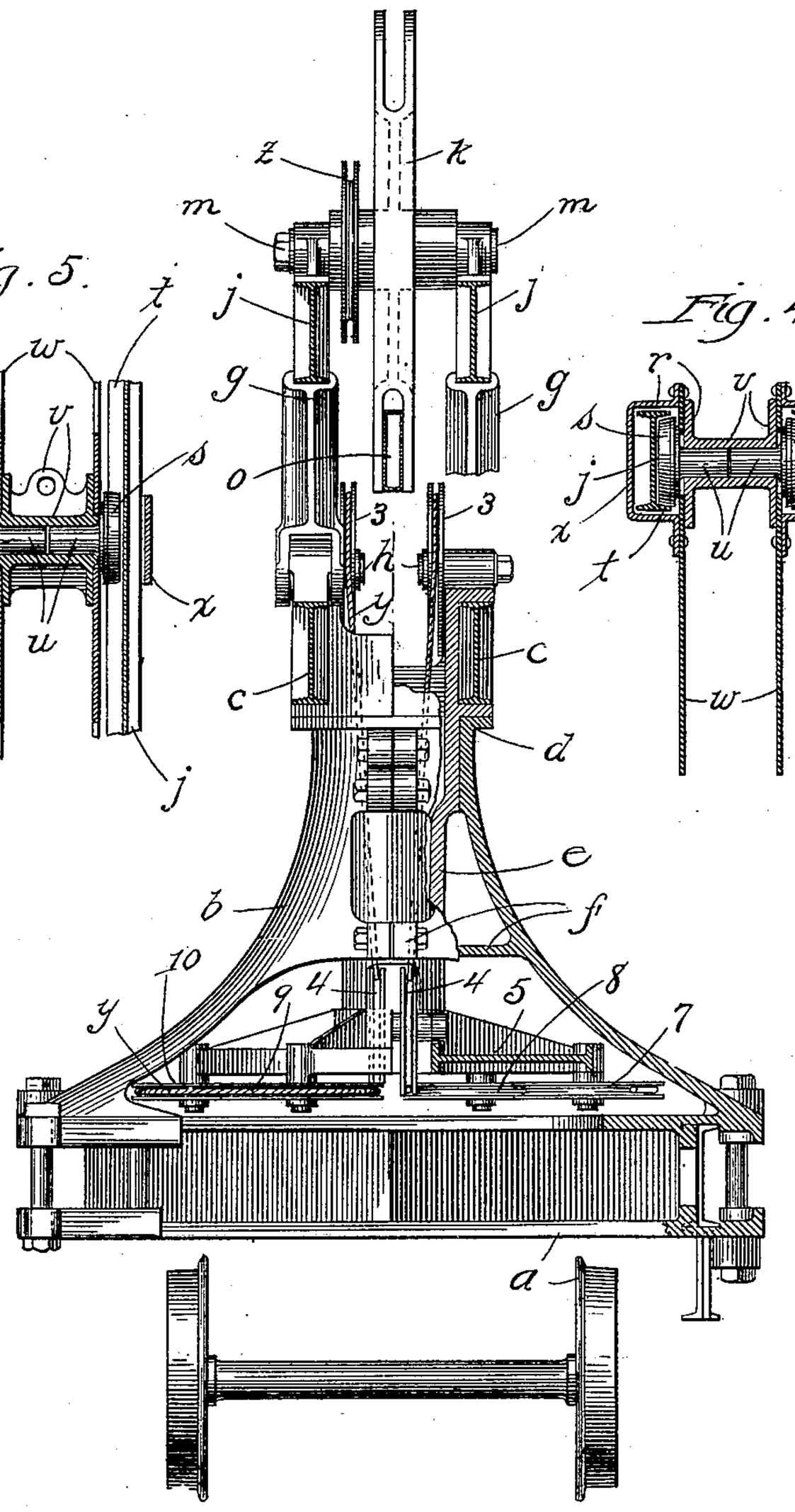

Fig. 5.

Fig. 4.

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OLAF HETLESAETER, OF CHICAGO, ILLINOIS.

EXCAVATOR.

SPECIFICATION forming part of Letters Patent No. 667,313, dated February 5, 1901.

Application filed May 7, 1900. Serial No. 15,704. (No model.)

To all whom it may concern:

Be it known that I, OLAF HETLESAETER, a citizen of the United States, residing in the city of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Excavators, of which the following is a specification.

My invention relates to excavators wherein the bucket-arm is composed of a plurality of parts movable relatively to each other; and the objects of my invention are, first, to provide a linkwork bucket-arm comprising a pair of longitudinal members having a sliding connection at one end and at the other joined by a transverse link; second, to provide such sliding connection between the longitudinal members of the bucket-arm as will minimize the sidelash of the bucket and the warping or torsion of the bucket-arm, and, third, to provide a turret of sectional construction for facilitating the manufacture of the machine. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a side view of the crane and excavating mechanism, together with a portion of the car which forms the supporting structure. The dotted lines indicate the position of the bucket-arm when the bucket is raised or hoisted to its extreme position. Fig. 2 is a plan view, partly in section, on the line 2 2, Fig. 1, showing the crane-supporting turret, the crane-swinging plate and its adjuncts, and also indicating portions of the driving mechanism. Fig. 3 is a front elevation, partly in section, of the turret, the supporting-car, and portions of the bucket-arm. The crane is shown in section taken on the line 3 3, Fig. 1, and the bucket-arm is shown in section taken on the line 3^a 3^a, Fig. 1, looking in the direction of the respective arrows. In said Fig. 3 the turret is also partially shown in transverse vertical section through the center thereof. Fig. 4 is a sectional detail view of the sliding bearing or bucket-handle trolley, taken on the line 4 4, Fig. 1. Fig. 5 is a sectional view in detail of the sliding bearing or trolley, as in Fig. 4, and is taken on a line passing through the axis of the rollers of said bearing at right angles to the line 4 4, Fig. 1.

Similar characters refer to similar parts throughout the several views.

a represents a railway-car which forms the supporting structure of the excavator. At the front of said car is the turret *b*, which forms the support whereon the crane *c* is revolubly mounted. Said turret is secured to the forward extremity of said car *a* and consists of cast metal, which for convenience of manufacture is formed in two parts. Said parts are joined at a vertical plane which extends from front to rear of the excavator and passes through the axis of rotation of the crane *c* upon said turret, said parts of the turret being bolted or otherwise fastened together. By this construction the rotating parts supported by and inclosed within said turret may have configurations which if the turret were made of a single piece would render the assembling of the parts impracticable or even impossible. The said turret is hollow and incloses the crane-pivot, sheaves, and other parts hereinafter described, thereby affording protection to the inclosed parts. At its upper extremity said turret has an annular bearing *d*, on which the crane-pivot *e* is supported. Said turret has also a lug or web *f* at a point below said bearing *d*, said lug or web forming an auxiliary bearing for bracing the lower extremity of said pivot *e*. Said pivot *e* is preferably grooved or peripherally channeled at its bearing in the lug *f*, and said web enters and encircles said groove or channel in said pivot in such a manner that said pivot is prevented from rising from its position upon the turret *b*. Said crane-pivot consists of a hollow shaft extending above said bearing *d* and below said lug *f* and has a vertical axis of rotation.

The crane *c* consists of substantially parallel beams attached to the upper extremity of the crane-pivot *e*. Said crane extends in two opposite directions from the pivot *e* and being mounted above the turret *b* can be swung through a complete revolution. In respect to the general construction of the crane and crane-support my present machine resembles the machines described and claimed by me in separate applications numbered as 1 and 4 in a series of four applications for Letters Patent filed this day, Serial Nos. 15,702 and 15,705, respectively.

At the forward extremity of each of the beams of the crane *c* is mounted one of the

pivot-blocks *g g*, which rotate about the pins *h* and carry the parallel beams *j j*, constituting the oscillating lever. Said lever forms one of the members of the bucket-arm and is supported between its extremities by said pivot-blocks *g*.

The thrust-segment *k* is pivotally mounted upon the shaft *m*, located at an extremity of the oscillating lever, which will be referred to as the "upper" extremity thereof. Said segment forms one of the members of the bucket-arm and is similar in construction and operation to the thrust-segment shown and described in an application for patent filed by me September 7, 1899, Serial No. 729,706. Said segment *k* is approximately semicircular in outline, and said shaft *m* is located at or near the center of curvature thereof. The periphery of said segment is grooved to receive the hoisting-cable *n*, which is attached to the forward extremity of said segment. The bucket-handle *o* constitutes another member of the bucket-arm and is pivotally attached at its upper extremity to the rear extremity of the segment *k* by means of the pin *p*. Said handle extends in the general direction of the oscillating lever *j* and is located, preferably, between the pivot-blocks *g g*. The excavator-bucket *q* is secured to the lower extremity of said handle *j* and may be of any suitable pattern. At a point preferably near the bucket *q* the bucket-handle *o* is slidingly connected with the oscillating lever *j* by means of a trolley *r*. (Shown in detail in Figs. 4 and 5.) Said trolley consists of two rollers *s s*, which travel upon the flanges *t t* of the beams *j j* of the oscillating lever. The axles *u* of said rollers rotate within and form a support for the trolley-hub *v*, to which the bucket-handle *o* is attached by means of the plates *w*. It is preferable that said rollers have separate axles in order that said rollers may rotate independently of each other. To prevent the beams *j j* from being spread apart by the trolley during the operation of the machine, the straps *x x* are provided, which extend around the outside of said beams and are fastened to said trolley-hub upon the inside of said beams, but do not interfere with the motion of said trolley. The weight of the bucket *q* and handle *o* is such that when the bucket-arm is in an approximately vertical position the bucket will drop downward and said trolley will approach the lower extremity of the lever *j*. By this construction of the bucket-arm the rotation of the thrust-segment *k* about the shaft *m* causes the motion of the bucket-handle lengthwise of the oscillating lever. The controlling-cable *y* is attached to said trolley-hub *v* and trains over the guide-sheave *z*, mounted upon the shaft *m* at the upper extremity of the oscillating lever. From the sheave *z* said controlling-cable trains over one of the guide-sheaves 1, mounted upon the shaft 2 at the rear extremity of the crane *c*. The other one of said sheaves 1 receives the hoisting-cable *n*. The guide-sheaves 3 3 are mounted at the upper extremity of the crane-pivot *e* and the guide-sheaves 4 4 at the lower extremity thereof in such a manner that the portions of the cables *n* and *y* extending between said sheaves lie within said hollow pivot *e*. The distance between said sheaves 3 3 is sufficient to permit the passage of the bucket-arm between them. The crane-swinging disk or plate 5 extends horizontally and is bolted or otherwise securely attached to the lower extremity of the pivot *e*, concentrically with the axis thereof. Sheaves for guiding the cables *n* and *y* are mounted so as to lie horizontally and preferably equidistantly in said disk 5 at the periphery thereof. When looking toward the front of the excavator, or in the direction of the arrow, Fig. 2, the sheaves 6, 7, and 8 lie upon the left and the sheaves 9, 10, and 11 upon the right of the center line of the crane *c*. The number of said sheaves is immaterial; but the sheaves 6 and 9, which lie to the front of said disk and receive said cables from the sheaves 4 4, are so arranged as to lie in a plane containing the lowest point of the grooved peripheries of said sheaves 4 4, thereby avoiding any tendency of said cables to become untrained in thus passing from substantially vertical to substantially horizontal sheaves.

The auxiliary guide-sheaves 12 12 are mounted near the rear of the base of the turret *b* upon the left and receive the cable *n*, while the sheaves 13 13 are similarly mounted upon the right and receive the cable *y*.

Toward the rear of the car *a* is mounted driving mechanism, which may be of any suitable construction. In the present instance, referring to Fig. 2 of the drawings, 14 represents a drum for operating the cable *n*, and 15 a drum for operating the cable *y*. Said drums are operated by the gear 16, driven by the pinion 17 upon the shaft of the engines 18 18.

The course of the hoisting-cable *y* is as follows: from its point of attachment on the trolley-hub *v*, over the sheave *z* on the upper extremity of the oscillating lever *j*, around one of the sheaves 1 lying toward the right side at the rear extremity of the crane *c*, over the sheave 3 lying toward the right side of said crane above the pivot *e*, through said pivot, beneath the sheave 4 lying toward the right near the lower extremity of said pivot, around the sheave 9, and thence along the sheaves 10 and 13 to the drum 15.

The course of the controlling-cable *n* is from the point of attachment at the forward extremity of the thrust-segment *k*, along the grooved periphery of the latter, around its respective one of the sheaves 1, over its respective one of the sheaves 3, through the pivot *e*, beneath its respective one of the sheaves 4, around the sheave 6, and thence along the sheaves 7 and 12 to the drum 14.

In the operation of the excavator when tension is exerted in the cable *n* the force

thereof is resolved by the thrust-segment *k* into two components, one of which tends to rotate the bucket-arm about the shaft *h* and the other of which tends to rotate the segment *k* about the shaft *m*. Said rotation of the bucket-arm raises or hoists the bucket as in the manner shown in dotted lines in Fig. 1. Said rotation of the segment *k* about the shaft *m* causes the bucket-handle *o* and bucket *q* to be thrust forward along the lever *j*, said bucket and handle being guided by the trolley *r*, traveling upon said lever. On account of the location of the guide-sheave *z* when tension is exerted in the cable *y* the force thereof tends to retract said bucket—that is, to move the trolley-hub *v*, and consequently the bucket-handle *j* and bucket *q*, toward the segment *k*. Therefore said cables have opposite effects on said bucket in so far as change in the configuration of the bucket-arm is concerned. As the segment *k* and sheave *z* are each located upon the bucket-arm upon the same side of the arm-supporting pivot *h*, each of said cables *n* and *y* when under tension will tend to rotate the bucket-arm, so as to hoist the bucket. If, however, both of said cables are under tension simultaneously, they will tend to hoist the bucket without materially affecting the configuration of the bucket-arm. Therefore said cables supplement each other in hoisting, but have opposite effects as far as the thrusting and retraction of the bucket are concerned. By varying the relative amounts of tension in the two cables *n* and *y* any desired position of the members of the bucket-arm relatively to each other may be attained. By thus regulating the tension in said cables the thrusting effect of the cable *n* is controlled and the depth of cut governed.

The center of gravity of the bucket-arm is so located relatively to the supporting-shaft *h* that gravity acting upon said arm tends to cause the bucket *q* to approach the car *a* and assume a position for taking a cut.

When the bucket has been hoisted to its highest point permitted by the construction of the parts, as shown by the dotted lines, Fig. 1, continued tension in the cables *n* and *y* cannot produce any further effect upon the bucket-arm as far as rotation about the shaft *h* is concerned, and the result is virtually the same as if the bucket-arm became a part of the crane *c* and the cables were fastened to said crane. Under this condition the bucket-arm, the crane *c*, crane-pivot *e*, and disk 5 rotate together as a single part. It is evident that the bucket-arm may be maintained in this extreme position by either one of the cables *n* or *y*. If now the cable *y* is put under tension and the cable *n* is slackened off, cable *y* will tend to rotate the crane *c* toward the right with a leverage substantially equal to the distance between the axis of the pivot *e* and the point of tangency of said cable *y* to the sheave 10 upon the disk 5. Reversedly, if the cable *n* is put under tension and the cable *y* is slackened the crane will be rotated toward the left with a leverage substantially equal to the distance between the axis of the pivot *e* and the point of tangency of the cable *n* to the sheave 7 on the disk 5.

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

1. In an excavator, a bucket-arm composed of members movable relatively to each other, two of said members having a sliding connection, and one of the members of said arm constituting a power-receiving member located at or near the extremity of said arm opposite to the excavator-bucket.

2. In an excavator, a pivotally-supported bucket-arm consisting of relatively movable members two of which have a sliding connection at a point other than the point of support of said arm, one of the members of said arm being located at or near the extremity of said arm opposite to the excavator-bucket and constituting a thrust member whereby an operating force may be resolved into two components, one of which effects a downward and the other of which effects a forward movement of the excavator-bucket.

3. In an excavator, the combination of a pivotally-supported oscillating lever, a bucket-handle connected to and sliding longitudinally on said lever, and cables for sliding said handle upon said lever, said cables also affording means for rotating said arm about its supporting-pivot.

4. In an excavator, the combination of a pair of longitudinal members, one of which is pivotally supported; said members being joined at one extremity by a transverse link; a power device connected to said transverse link and applying power in a direction other than the line through the pivots of said transverse link, and means for slidingly connecting said longitudinal members at or near the extremities thereof opposite to said transverse link; said longitudinal members and said transverse link forming the bucket-arm of the excavator.

5. In an excavator, the combination of an oscillating lever suitably supported; a bucket-handle; a thrust-segment connecting said lever and said handle; a trolley attached to said bucket-handle at or near the bucket and traveling upon said oscillating lever lengthwise thereof, and means for operating said lever, thrust-segment and bucket-handle.

6. In an excavator, a linkwork bucket-arm pivotally supported between its extremities; said bucket-arm comprising an oscillating lever and bucket-handle extending in the general direction of said oscillating lever; a transverse link connecting said lever and said handle at the upper extremities thereof; a sliding connection between said lever and said handle at or near the lower extremities thereof; a cable connected to said transverse link and exerting its power in a line other than the line through the pivots of said transverse link, and a second cable attached to one of

the members of said bucket-arm, and having a point of deflection upon another of the members of said bucket-arm, and means for operating said cables.

7. In an excavator, the combination of an oscillating lever pivotally supported; a bucket-handle; a thrust-segment connecting said lever and handle at the upper extremities thereof; a trolley whereby said lever and said handle are slidingly connected at or near the bucket; a cable connected to said thrust-segment; and a second cable connected to said bucket-handle, and passing over a guide-sheave mounted upon said oscillating lever, and means for operating said cables.

8. In an excavator, the combination of a linkwork bucket-arm comprising a pair of longitudinal members connected at one end by a transverse link, means for operating said arm; rollers traveling upon one of said longitudinal members; connections between said rollers and the other of said longitudinal members whereby said second longitudinal member may be supported upon and travel in the direction of the length of said first-mentioned longitudinal member.

9. In an excavator, the combination of a linkwork bucket-arm having an oscillating lever, a bucket-handle, a transverse link connecting said lever and said handle, means for operating said bucket-arm, rollers traveling longitudinally upon said oscillating lever; axles connected to said rollers; a trolley-hub supported upon said rollers, and means for connecting said trolley-hub with said bucket-handle.

10. In an excavator, a linkwork constituting the bucket-arm, said linkwork being pivotally supported between its extremities and having a sliding connection between two of its members, in combination with a crane for supporting said arm, and power devices for changing the configuration of said arm.

11. In an excavator, the combination of a linkwork bucket-arm having a sliding connection between two members thereof at or near the bucket; a power device for operating said arm; a crane for supporting said arm; a crane-pivot attached to said crane; and a turret for supporting said pivot and crane, said turret consisting of a metal frame constructed in sections, which, when assembled, encircle said crane-pivot.

12. In an excavator, the combination of a linkwork bucket-arm comprising a pair of longitudinal members, one of which is pivotally supported, said members being slidingly connected at or near one end, and at the other joined by a transverse link; a cable connected to said transverse link; and a second cable attached to one of said longitudinal members and passing over a guide-sheave mounted upon the other of said longitudinal members; a pivotally-supported crane for supporting said bucket-arm, and means for guiding said cables respectively to points on said crane lying on opposite sides of the axis of rotation thereof.

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