No. 649,245.

Patented May 8, 1900.

O. HETLESAETER.

EXCAVATOR.

(Application filed Sept. 18, 1899.)

(No Model.)

2 Sheets—Sheet 1.

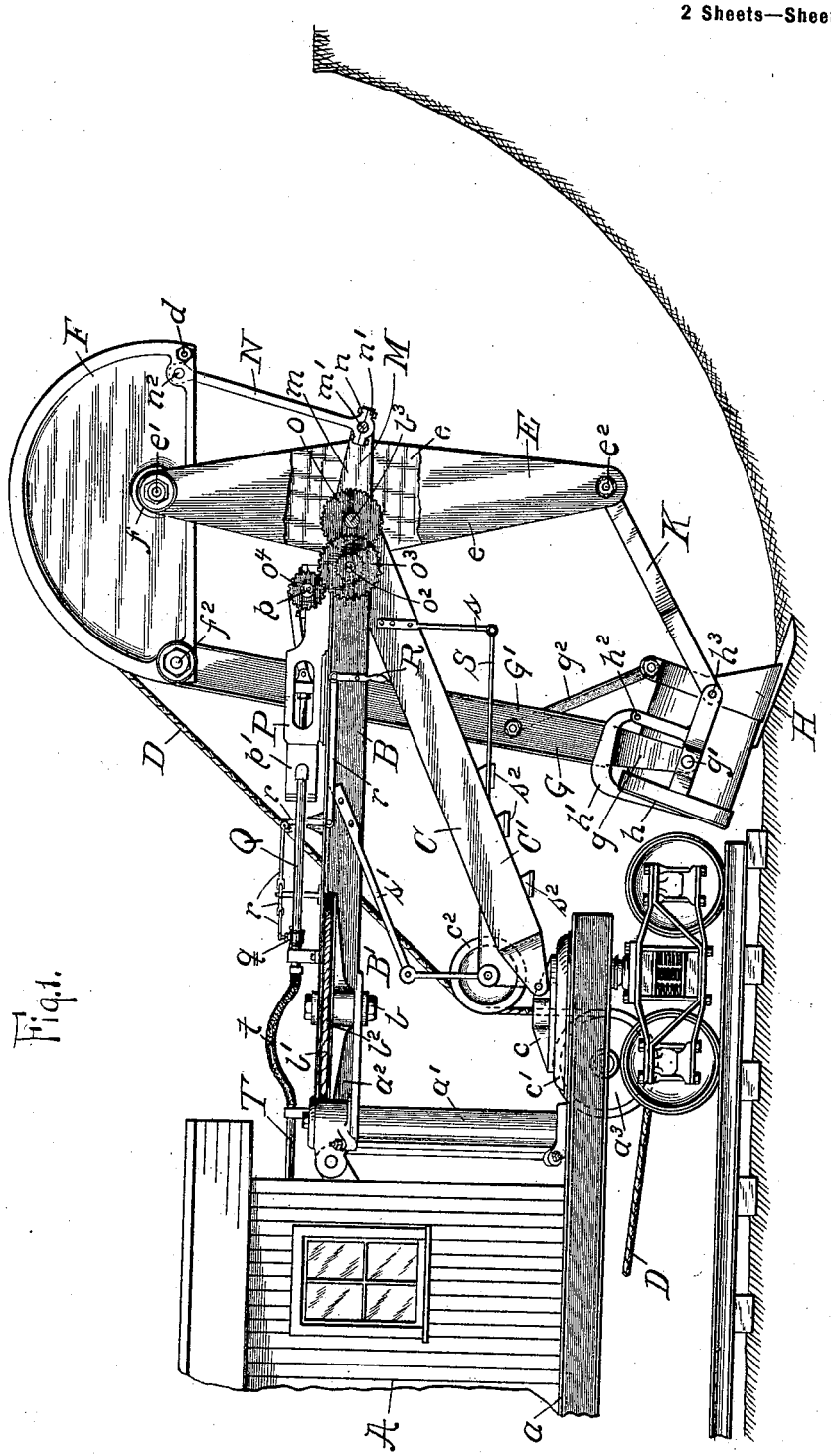

Fig. 1.

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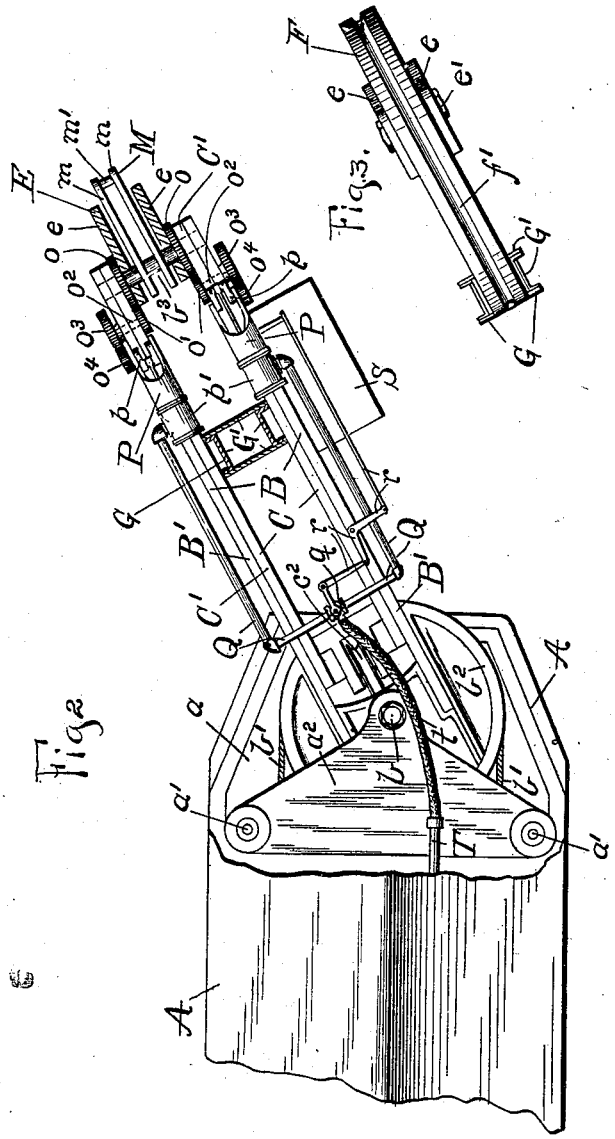

Fig. 2.

Fig. 3.

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UNITED STATES PATENT OFFICE.

OLAF HETLESAETER, OF CHICAGO, ILLINOIS.

EXCAVATOR.

SPECIFICATION forming part of Letters Patent No. 649,245, dated May 8, 1900.

Application filed September 18, 1899. Serial No. 730,829. (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 improvements in excavators wherein the bucket-arm is composed of links or members capable of motion relatively to each other; and the objects of my invention are, first, to provide means whereby positive and complete control of the bucket may be had in all positions thereof, and, second, to provide means whereby the bucket may be controllably thrust or crowded into the bank with a force additional to the force derived from the hoisting mechanism. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a side view of an excavator mounted upon a railway-car and shows the linked bucket-arm supported upon the boom and operated by the hoisting-cable. Said figure also shows the controlling-engines mounted on said boom and the controlling-link connecting the controlling-crank to the thrust-segment. A portion of the oscillating lever is broken away to expose the controlling gear-wheels and said controlling-crank. Fig. 2 is a plan view of the excavator and car, the portions of the bucket-arm above the central supporting-bearing of the oscillating lever being removed to show the arrangement of the controlling engines and gears. Fig. 3 is a plan view of the thrust-segment, showing the relative positions of the bucket-handle and oscillating lever.

Similar letters refer to similar parts throughout the several views.

A represents a car whereon is mounted machinery suitable for furnishing the necessary power to the moving parts of the excavator. Upon the platform a of said car rest the stanchions a' a', whereby the top frame a^2 is supported. The boom B consists of the parallel beams B′ B′, rigidly held in their proper relative positions and having a pivot-bearing b in the said top frame a^2. The boom-support C, consisting of the beams C′ C′, is secured at its lower extremity to the pintle-plate c, said plate c having a bearing in the base-plate c' on said car. Said bearings b and c' have vertical axes lying in the same line and permit the boom B and boom-support C to swing horizontally. Said pintle-plate c and base-plate c' are suitably apertured at their axes of revolution to afford a passage for the hoisting-cable D. The idler a^3, having a bearing in the body of the car A, and the idler c^2, having a bearing upon the lower extremity of the boom-support C, are so placed as to guide the said cable D vertically through the apertured pintle-plate c and base-plate c', and thereby convert the lateral motion of the forward extremity of said cable into torsion, confined within said cable between said idlers a^3 and c^2. The lateral position of said boom and support is governed by means of the cable b', working in the peripherally-grooved sheave or sluing-circle b^2, attached to said boom B, concentrically with the bearing b. Each of the said beams B′ B′ is securely attached at its forward extremity to the laterally-adjacent one of the said beams C′ C′, where said beams form journal-bearings for the shaft b^3. The oscillating lever E is pivoted upon said shaft b^3 and consists of the parallel plates e e, connected at their upper extremities by means of the pin e' and at their lower extremities by means of the pin e^2. The thrust-segment F has a bearing f, whereby it is pivotally supported upon said pin e' at the upper extremity of the oscillating lever E. Said segment consists of a plate resembling in outline a half-disk with the said bearing f approximately at the center of curvature. In the curved periphery of said segment is the groove f', which serves as a guide for the cable D. Near the forward extremity of said groove f is a pin d, whereby said cable is attached to said segment F. From said pin d the cable D takes rearward along said groove f, downward between the beams B′ B′, over the idler c^2, under the idler a^3, and rearward to the driving-engines. At the rear portion of said segment F, and preferably near the extremity of the curved portion thereof, is secured the pin f^2, whereby said segment is pivotally connected with the bucket-handle G. Said bucket-handle G consists, preferably, of plates G′, suitably fastened together, and is provided at its lower

extremity with a yoke g, spanning the excavator-bucket H. Said bucket is of the ordinary pattern and is attached to said handle G by means of studs g', secured to the sides of said bucket and extending through the arms of said yoke g at the lower extremity thereof. The bucket is further secured to said handle G by means of the brace g^2, one extremity whereof is fastened to said bucket and the other extremity whereof is fastened to said handle.

The bucket H is provided with the swinging bottom h, hung upon the hinges h', pivotally supported on said bucket by means of the pins h^2. At the forward portion of the bucket H and pivotally attached thereto by means of the trunnions h^3 are the two bucket-links K, one on each side of the bucket, extending to and connected with the lower extremity of the oscillating lever E. Said trunnions h^3 are located on opposite sides of the bucket, and said links K are preferably bowed so as to extend from said trunnions to the interior of the lever E, whereto they are pivotally connected by means of the said pin e^2.

As regard the parts hereinabove described, the structure is analogous to the structure described and claimed by me in a previous application, Serial No. 729,706, filed September 7, 1899, wherein the bucket is manipulated by taking advantage of certain novel counter and overbalancing tendencies of the bucket-arm. This method of manipulating the bucket is adequate and particularly adapted to the requirements of the lighter machines; but in the larger excavators, to which my present invention is especially applicable, it is desirable that the thrust of the bucket should be at all times and in all positions under the immediate and complete control of the operators. To this end a positive-acting controlling mechanism has been devised consisting of certain parts hereinafter described.

The controlling-crank M consists of the arms m m, keyed or securely attached in any other suitable manner to the shaft b^3. Said arms m m extend in the same direction and have rigidly fixed thereto near their outer extremities the pin m'. The controlling-link N has a box n and cap n', inclosing said pin m', and is thus pivotally connected with said crank M. By means of the pin n^2 the said lever N is pivotally connected with the segment F at a point on the forward portion thereof, preferably near the said pin d. By this construction the pivots f^2 and n^2 are on opposite sides of the segment F, approximately equidistant from the bearing f thereof. Rigidly attached to the said shaft b^3 by means of a key or in any other suitable manner are the spur-gears o o. Said gears o o are preferably located one at each side of the boom B, between the plates e e of the oscillating lever E and the beams B′ B′ of said boom. The gears o' o' intermesh with said gears o o and are keyed to the counter-shafts o^2 o^2. Said shafts o^2 o^2 have a bearing in the beams B′ and C′ and project beyond said beams sufficiently to support the said gears o' o' at the interior of said boom and to support the gears o^3 o^3 at the exterior thereof. Said gears o^3 o^3 are also keyed to said counter-shafts o^2 o^2 and intermesh with the gears o^4 o^4. In relative sizes the gears o^4 o^4 are smaller than the gears o^3 o^3 and the gears o' o' smaller than the gears o o. The purpose in employing double reduction-gears, as described, is to reduce the size of the engines necessary to furnish sufficient power to operate the controlling-crank M. Securely mounted upon each one of the beams B′ B′ of the boom B, longitudinally thereof, are the controlling-engines P P, whose crank-shafts p p are in line and carry the said gears o^4 o^4, rigidly attached thereto. Said engines are of the ordinary double-acting slide-valve type and for convenience are placed with the cylinders p' thereof toward the rear of the boom B. To avoid the possibility of dead-center, said engines are placed with their cranks at an angle of about ninety degrees apart.

Steam is supplied to the cylinders p' by means of the pipes Q Q, which connect with the throttle-valve q, located at a convenient point on the boom B, far enough to the rear thereon to clear the thrust-segment E and cable D when the bucket-arm is in any position. A series of rods and bell-crank levers marked r r connects the said throttle-valve q with the throttle-lever R, located at a forward portion of the boom B, within reach of a cranesman standing upon the platform S. Said platform is suspended from the supports C by means of the hangers s and is preferably located at a forward portion of the boom, in order that the cranesman standing thereon may more easily watch and control the bucket H. A hand-rail s' and steps s^2 s^2, leading to said platform S, are provided for safety and convenience. The steam-pipe T, leading from the source of steam-supply on the body of the excavator, is flexibly connected with the said throttle-valve q on the boom B by means of the steam-hose t.

In the operation of the machine when the driving mechanism induces tension in the cable D the force thereof is transmitted to the thrust-segment F; but said segment is capable of two separate motions, which may occur simultaneously—namely, a rotary or oscillatory motion about the pivot e' and a swinging motion, together with the oscillating lever E, about the shaft b^3. Therefore the force of said cable is resolved into two components, whereof one is effective in producing the rotation of said segment about the pivot e', resulting in a downward thrust of the bucket-handle G and bucket H directly toward the bank. The other component of the force of said cable is effective in producing the swinging of the segment F and lever E, together with the other members of the bucket-arm, about the shaft b^3, thus resulting in a forward motion of the bucket. As the grooved

periphery of the segment F is approximately circular and concentric with the bearing f on the pin e', the cable D will be tangential to said periphery in all positions of said segment and of the bucket-arm, and the normal thrust of the bucket due to the force of said cable will be substantially constant. When the thrust of the bucket due to the force of the cable is insufficient, or when it is desired to feed the bucket directly into the bank independently of the hoisting-cable, the cranesman upon the platform S opens the throttle q by means of the lever R and causes the engines P P to drive the controlling-gear in such a direction as to raise the forward extremity of the crank M, and thereby raise the link N relatively to the oscillating lever E. As the segment F is revolubly supported on the lever E, the pin e' acts as a fulcrum, and the raising of the link N and forward portion of the said segment causes a corresponding lowering of the rear portion of said segment, and consequently a downward thrust on the bucket-handle G and bucket H. In its ability to feed the bucket normally into the bank with a force independent of and additional to the force derived from the thrusting component of the force of the hoisting-cable lies one of the important advantages of my machine, for the length of the cut necessary to fill the bucket, especially in soft material, is thereby materially shortened. When the downward thrust of the bucket due to the force of the cable is too great, said thrust is diminished by running said engines P P in the opposite direction, and thereby lowering the link N relatively to the oscillating lever E. When it is desired to raise the bucket vertically and directly out of the bank to avoid an obstruction or for any other purpose, the cable D is held fast and the engines P P run in a direction to lower the link N relatively to the lever E. It is also a great advantage to be able to thus lift the bucket directly from the bank, and in the large machines and in dredges this feature amounts almost to a necessity. When the bucket-arm is rotated by the cable D and the bucket moves in a forward direction, the path of said bucket may become a circular one about the shaft b^3 as a center by running the engines P P in such a direction and at such a speed that the crank M and oscillating lever E maintain a constant angular relation. It is thus evident that although the mechanism for controlling the bucket-arm is not a locking device, it may be operated so as to hold the parts of the bucket-arm constantly in the same position relatively to each other. By means of the cable D the bucket-arm may be rotated until the pin d on the segment F closely approaches the idler c^2, thus raising the bucket to a height somewhat above that of the boom B. When the bucket is to be discharged, it is hoisted to the necessary height by the cable D, and the boom B is swung laterally by means of the cable b' and sluing-circle b^2. In order to gain the exact position desired for discharging, the bucket is then thrust forward or retracted by means of the controlling mechanism in the same manner as the thrusting and raising is accomplished when the bucket is in a lower position. When the bucket has been discharged, the cable D is paid out, and the weight of the bucket and adjacent portions of its supporting-arm tend to bring said bucket downward and rearward to a position for taking another cut. The return of the bucket is facilitated by running the engines P P in such a direction as to lower the crank M, for this not only tends to impel the bucket-arm in the desired direction, but also tends to raise the bucket clear of the bank. If when the cable D is in tension the controlling mechanism be run in such a direction as to draw the bucket directly away from the bank, a portion of the force of said cable and said controlling mechanism will be exerted in opposing directions, entailing a loss of power; but in practice this condition seldom occurs. When the cable is in tension and the bucket is being hoisted, if any extraneous force is needed in a direction perpendicular to the direction of the cut such force is usually required for the purpose of increasing rather than decreasing the thrust into the bank, and when the controlling mechanism is increasing the thrust the force of said mechanism is an addition to the force of the cable. The major portion of the time when the force of the controlling mechanism is exerted to raise the bucket away from the bank is during the return stroke, when the cable D is lax.

It is evident that the principal members of the bucket-arm pivotally linked together virtually constitute a polylateral whose sides are determined by the pivotal points e' e^2 h^3 f^2, also that the sides of said polylateral are of constant length, but may assume various positions relatively to each other. The crank M and link N, taken in connection with the forward portion of the segment F and the upper portion of the oscillating lever E, are pivotally connected and form a linkwork constituting a second polylateral whose sides are determined by the pivots d, n, b^3, and e'. The sides of said second polylateral are also of constant length, and a change in the configuration of said second polylateral produces a corresponding change in said first polylateral, and consequently in the position of the bucket. I do not limit myself, however, to a controlling mechanism comprising a linkwork constituting a polylateral, as other means for transmitting the power of the controlling-engines to the bucket-arm will suggest themselves to those skilled in the art to which this machine pertains. Nor is the location of the engines on the laterally-swinging boom an essential feature, as it is evident that said engines may be located on or controlled from the main body of the excavator. Any mechanism whereby the power of the controlling-engines is made

use of to control the configuration of the linked bucket-arm would lie within the spirit of my invention.

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

1. In an excavator, the combination of a bucket-arm composed of an articulating linkwork, at least three of the links whereof are of fixed length, and all of the links whereof are movable about a common horizontal axis; and means for controllably varying the position of the links of said arm relatively to each other.

2. In an excavator, the combination of a bucket-arm comprising links articulately connected together, one of said links being pivotally supported and forming the support for said arm, two links of said arm being of fixed lengths and articulately connected to said supporting-link, means for connecting said last-mentioned links, and means for controllably varying the configuration of said bucket-arm.

3. In an excavator, a linked bucket-arm pivoted to a suitable support, and provided with a joint between its supporting-pivot and a point of power application, whereby a single power-applying device may effect both a downward and a forward movement of the bucket; in combination with a power-applying device for operating said arm, a support for said arm, a bucket, a controlling member attached to one of the links of said arm, and mechanism for operating said controlling member, one of the parts of said operating mechanism having a pivot-bearing, fixed relatively to another of the links of said arm.

4. In an excavator, the combination with an articulating linkwork forming a bucket-arm, a bucket attached to said arm, a support for said arm, and a power device for operating said arm, of a controlling-link attached to one of the links of said bucket-arm, a crank connected with said controlling-link, and means for operating said crank.

5. In an excavator, a linked bucket-arm pivoted to a suitable support upon a swinging boom and having two longitudinal links, an upper transverse link, and linked connections to a bucket; a power device applied to said upper transverse link for operating said bucket-arm; a laterally-swinging boom supporting said bucket-arm; and a controlling mechanism, one of the pivots whereof is supported on said boom concentrically with the pivot supporting said bucket-arm, said controlling mechanism being connected to said transverse link through a crank and auxiliary link whereby said transverse link may be oscillated by means of said controlling mechanism.

6. In an excavator, the combination of a linked bucket-arm pivotally supported, a power device for operating said arm, a controlling-link attached to one of the links of said arm, a crank attached to and operating said controlling-link, a shaft supporting and operating said crank, and a controlling-engine and gear operating said shaft and located upon a part of said excavator other than said bucket-arm.

7. In an excavator, the combination of a shaft, a laterally-swinging boom supporting said shaft, a linked bucket-arm pivotally supported on said shaft, a crank secured to said shaft, gear-wheels secured to said shaft, a link connecting said controlling-lever and said bucket-arm, a controlling-engine for operating said gears, and a power device for operating said bucket-arm.

8. In an excavator, the combination of an oscillating lever pivotally supported, a thrust-link pivotally supported on said lever, two pivots located in said thrust-link on opposite sides of the pivot whereby said thrust-link is supported, a bucket-handle attached to one of the two oppositely-placed pivots on said thrust-link, a controlling mechanism attached to the other of the two oppositely-placed pivots on said thrust-link, a bucket, connections between said bucket and said oscillating lever, connections between said bucket and said bucket-handle, and means for applying power to said thrust-link.

9. In an excavator, the combination of a boom, an oscillating lever pivotally supported upon said boom, a thrust-segment pivotally supported upon said lever, a cable for transmitting power from the excavator-driving engines to said segment, a bucket, connections between said bucket and the rear portion of said thrust-segment, connections between said bucket and said oscillating lever, a link pivotally connected with the forward portion of said thrust-segment, a crank for operating said link, a shaft for operating said controlling-lever, gears for operating said shaft, engines located on said boom for driving said gears and means for operating said engines.

10. In an excavator, linked members suitably supported and constituting two polylaterals, wherein two of the sides of the first polylateral are formed by members forming two of the sides of the second polylateral, a bucket attached to members forming parts of said second polylateral, a power device for operating the members of said second polylateral, and means for controlling the relative positions of the members forming said first polylateral.

11. In an excavator, linked members constituting two quadrilaterals, wherein two of the sides of the first quadrilateral are formed by members forming two of the sides of the second quadrilateral, and wherein but a single point is common to the extremities of four of the sides of said quadrilaterals; a boom pivotally supporting one of said members common to both of said quadrilaterals; a bucket attached to members forming parts of said second quadrilateral, a power device for op-

erating the members of said second quadrilateral, and means for controlling the relative positions of the members forming said first quadrilateral.

12. In an excavator, the combination of a crane, a linkwork bucket-arm pivotally supported upon said crane, and a power device located on said crane for controlling the configuration of said bucket-arm.

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