No. 667,315. Patented Feb. 5, 1901.

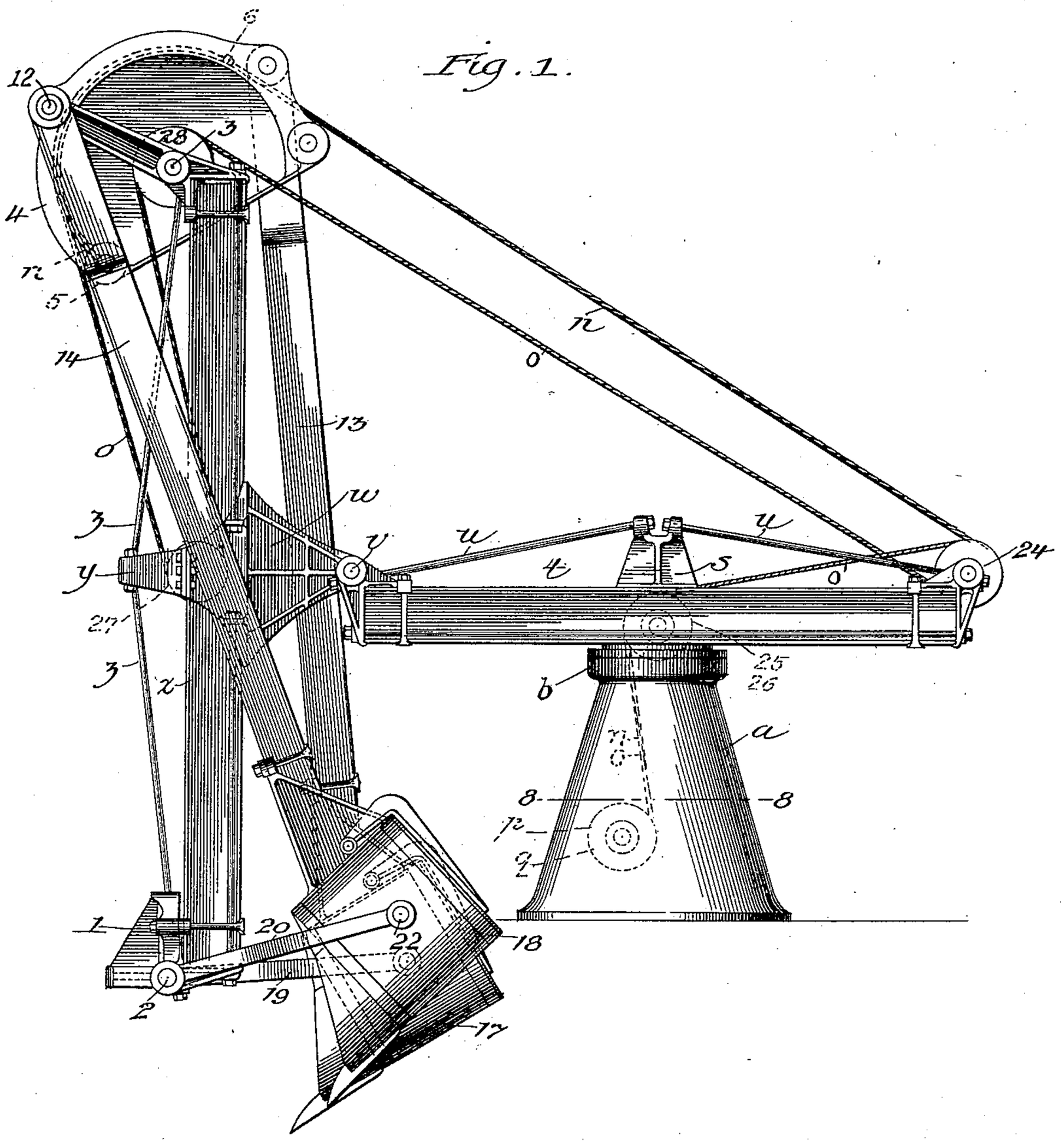
O. HETLESAETER.

EXCAVATOR.

(Application filed June 11, 1900.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 5 Sheets—Sheet 2.

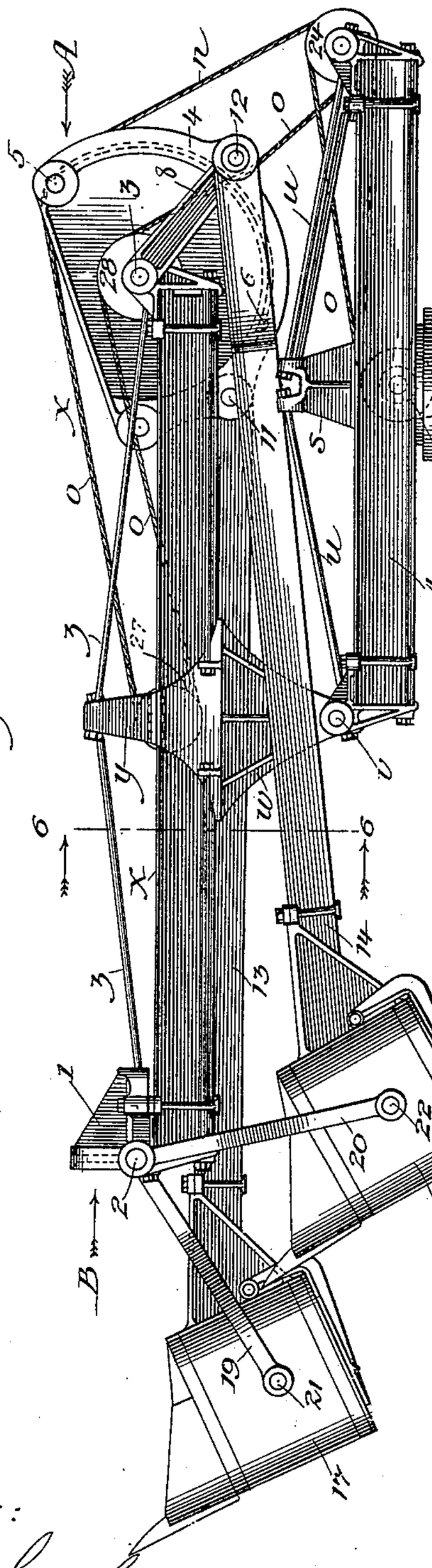

Fig. 2.

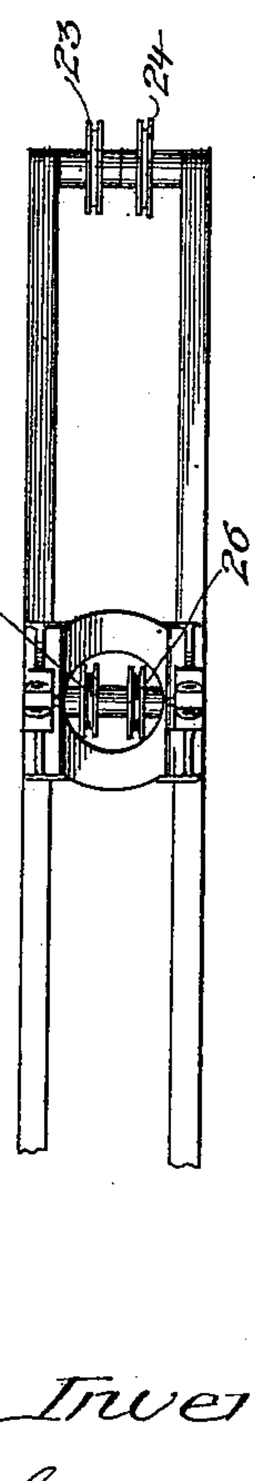

Fig. 3.

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Fig. 4.

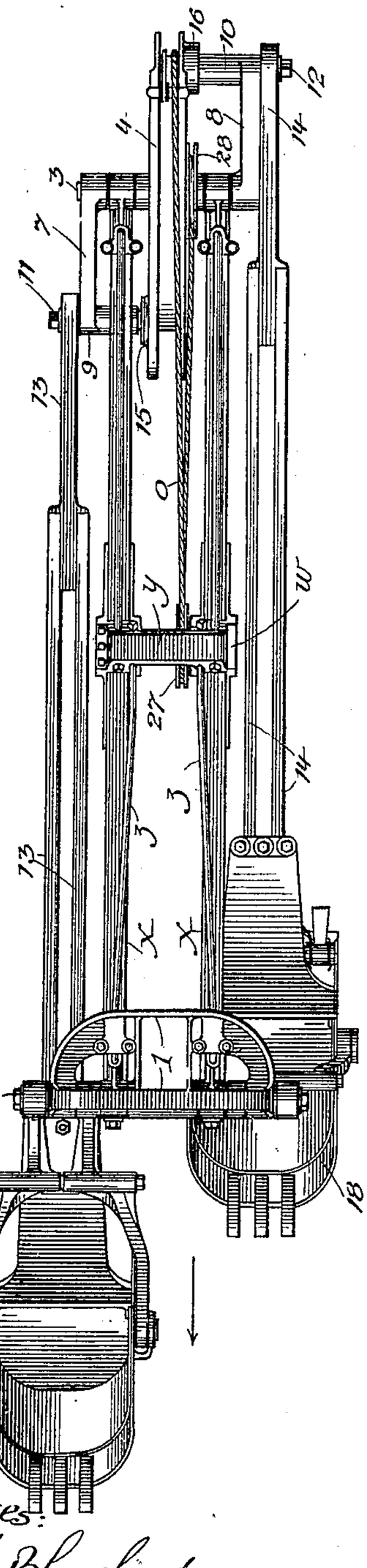


Fig. 5.

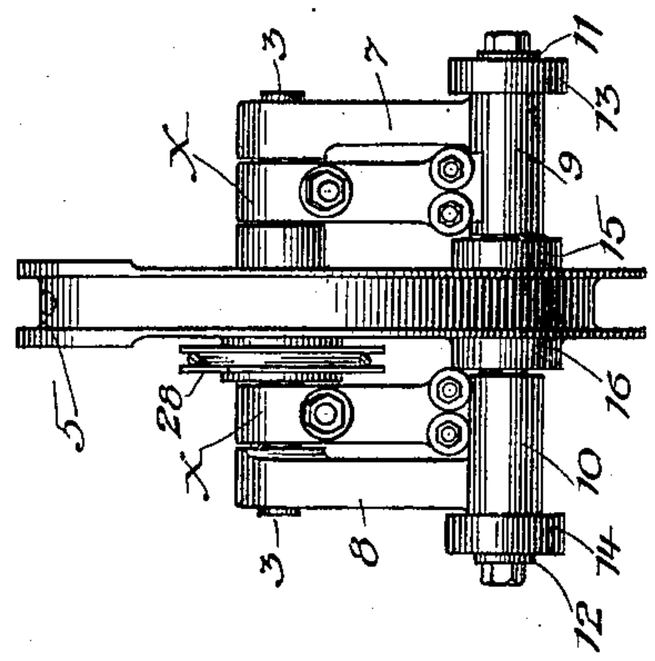


Fig. 7.

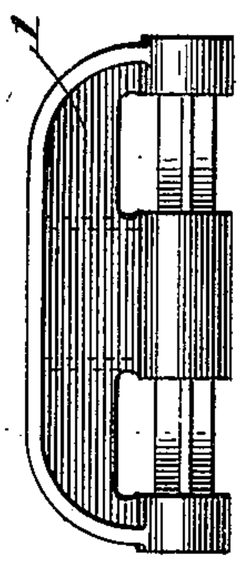
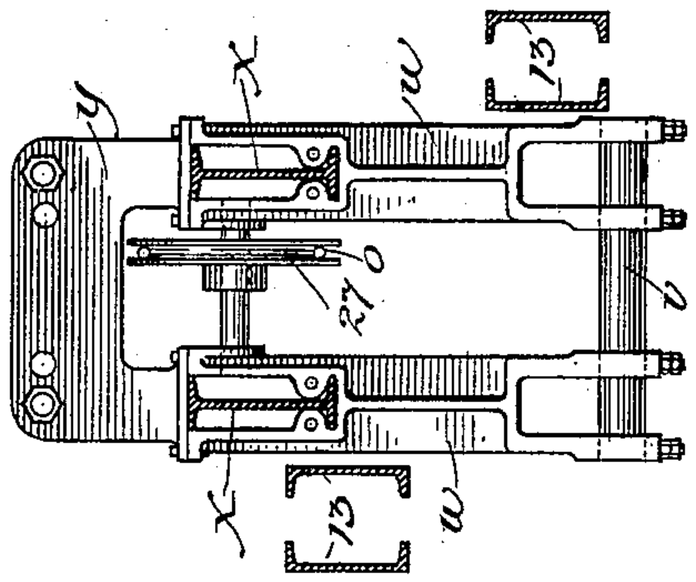


Fig. 6.



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(No Model.) 5 Sheets—Sheet 4.

Fig. 9.

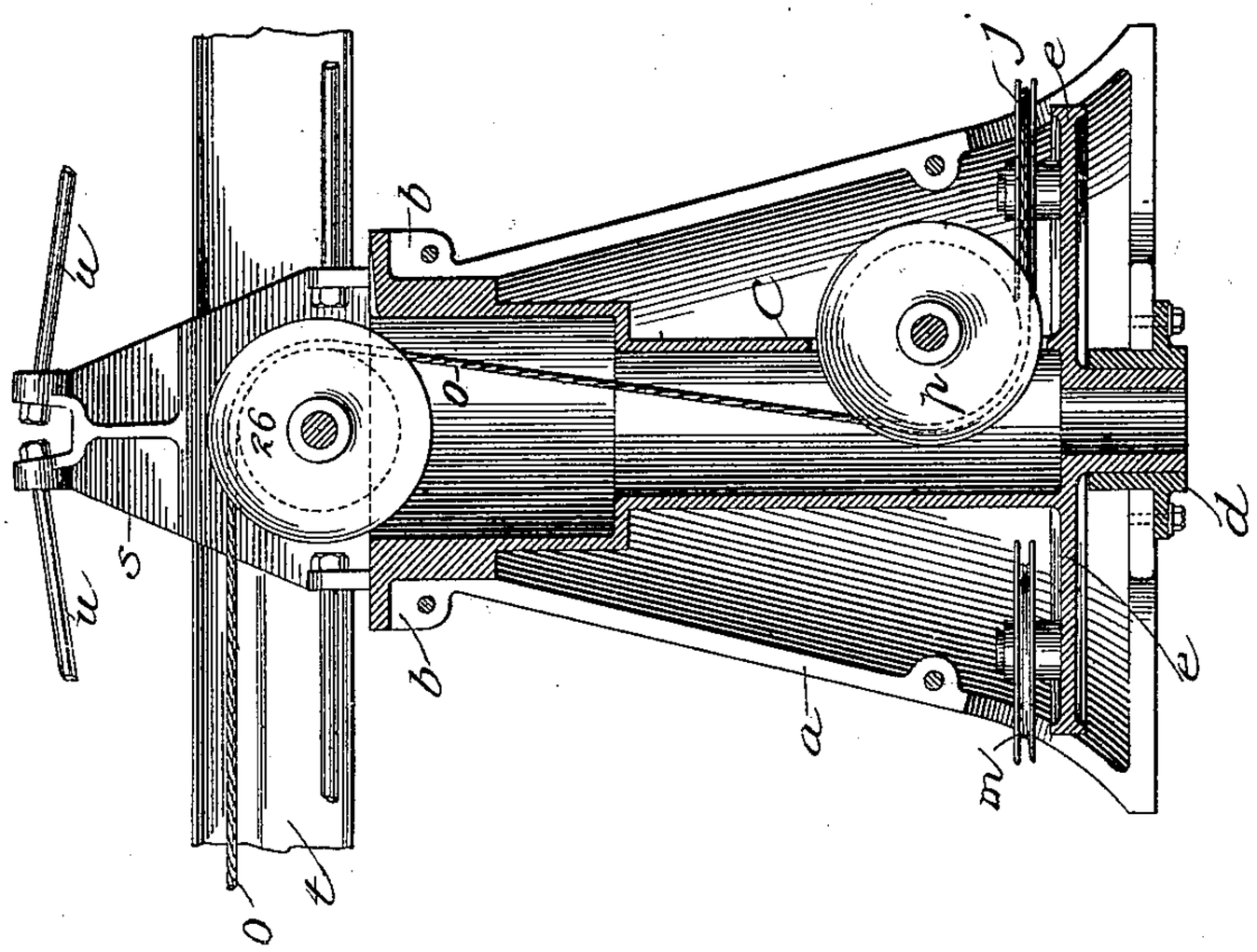
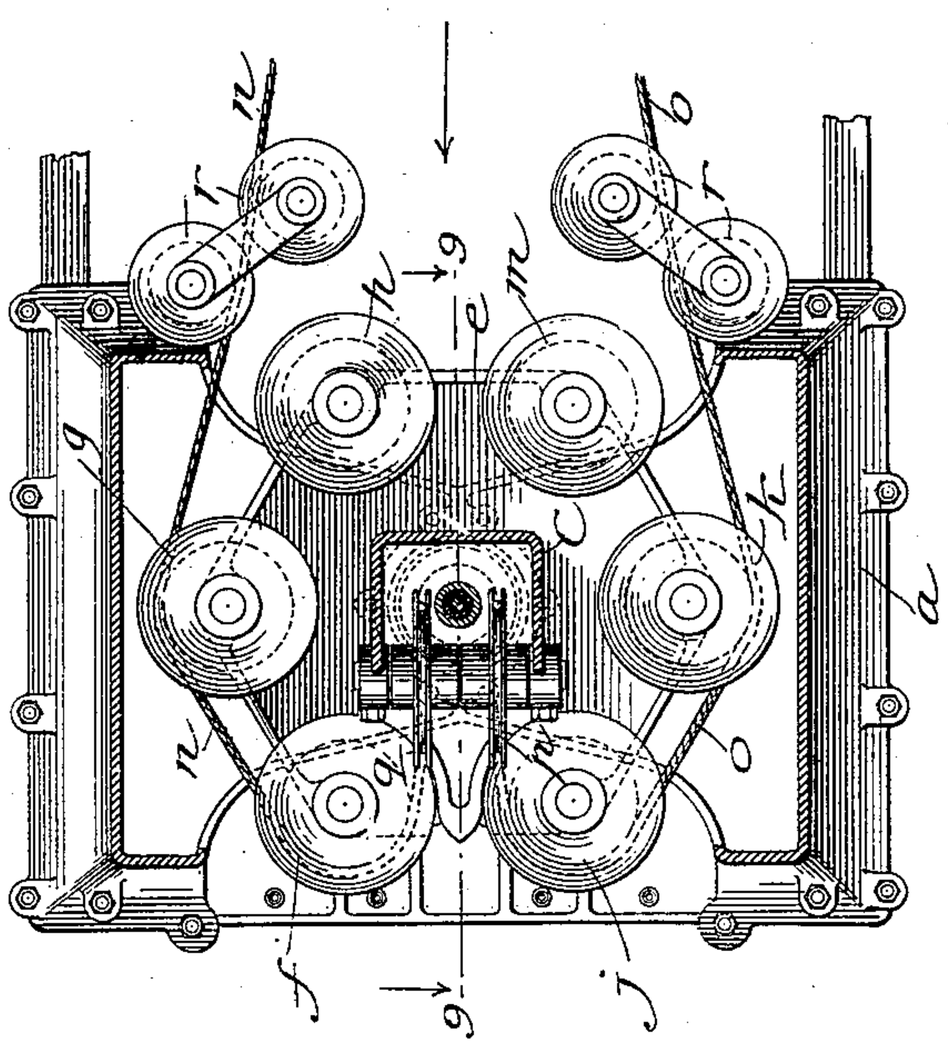


Fig. 8.



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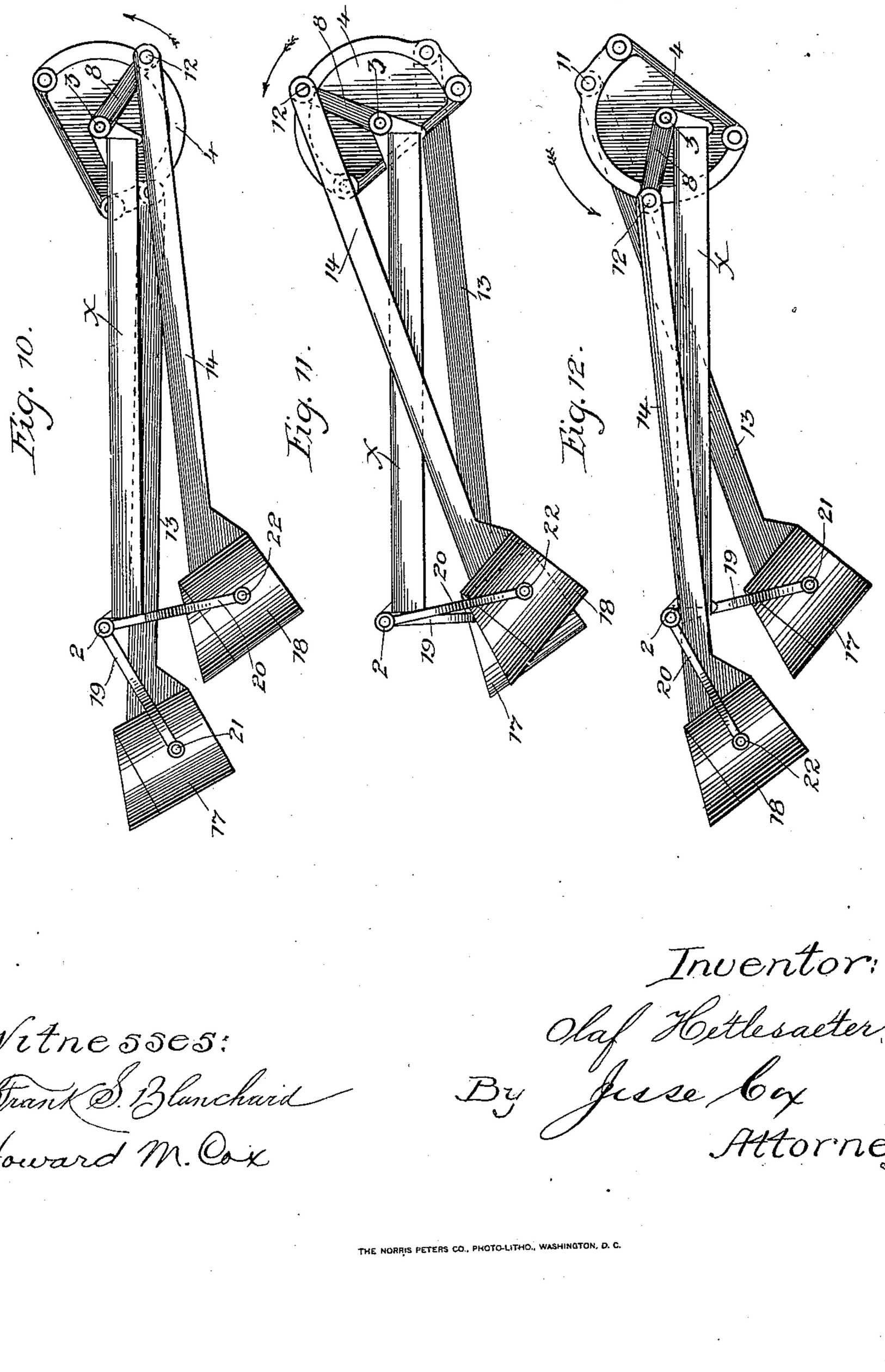
(No Model.) 5 Sheets—Sheet 5



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UNITED STATES PATENT OFFICE.

OLAF HETLESAETER, OF CHICAGO, ILLINOIS.

EXCAVATOR.

SPECIFICATION forming part of Letters Patent No. 667,315, dated February 5, 1901.

Application filed June 11, 1900. Serial No. 19,794. (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, dredges, steam-shovels, and such machines, and is allied to the class of machines which form the subject of a series of applications for Letters Patent of the United States, more particularly Patent No. 649,244, issued May 8, 1900, and applications filed May 7, 1900, Serial Nos. 15,703 and 15,705.

The object of my present invention is to provide means whereby two buckets may be employed upon one bucket-arm and filled consecutively in such a manner that the requisite strength of the bucket-arm and the arm supporting and driving parts may be substantially no greater than the strength which would be requisite to operate a single bucket of the size of one of the buckets in the double machine. I attain this object by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a view of the machine in side elevation, showing the bucket-arm in an approximately upright position and also showing the buckets approximately side by side. Fig. 2 is also a side view of the machine, the bucket-arm being shown in an approximately horizontal position. One of the buckets is here shown projected, while the other bucket is consequently in a retracted position. Fig. 3 is a plan view of a portion of the crane. Fig. 4 is a top or plan view of the bucket-arm as the same appears when the parts are in the position shown in Fig. 2. Fig. 5 is a view of the thrust-segment and connected parts looking in the direction of the arrow at A, Fig. 2. Fig. 6 is a detail view of the bucket-arm in section on the line 6 6, Fig. 2, looking in the direction of the arrows adjacent to said line. Fig. 7 is a detail view of the yoke at the forward or lower extremity of the bucket-arm, the view being taken in the direction of the arrow at B, Fig. 2. Fig. 8 is a plan view of the turret and of the crane-swinging mechanism, taken on the line 8 8, Fig. 1. Fig. 9 is a sectional view in elevation of the parts shown in Fig. 8, the section being taken on the line 9 9 in said Fig. 8 looking in the direction of the arrows adjacent to said line. Figs. 10, 11, and 12 are diagrammatic views from the side of the bucket-arm, illustrating the principal positions of the buckets relatively to each other during the operation of the machine. Referring to the buckets as "right" and "left," according to their positions upon the bucket-arm when the view is taken looking in the direction of the arrow, Fig. 4, Fig. 10 shows the right bucket projected and the left bucket retracted, this position being also shown in Figs. 2 and 4. Fig. 11 shows the buckets substantially side by side, and Fig. 12 shows the right bucket retracted and the left bucket projected.

Similar characters refer to similar parts throughout the several views.

The turret *a* constitutes the crane-support and consists, preferably, of a metallic frame constructed in sections adapted to be bolted together, said turret being designed to be rigidly secured to a railway-car or other suitable supporting structure. (Not shown.) At the upper extremity of said turret is the bearing *b*, which supports the crane-pivot *c* in such a manner that the latter is revoluble about a vertical axis. Said crane-pivot consists of a hollow shaft of different diameters at different portions thereof, and in addition to the said bearing *b* is provided with a bearing *d* at the lower extremity of said pivot. Said bearing *d* consists of a collar secured to the lower extremity of the turret *b* and serves to laterally brace the lower extremity of said pivot, as shown in Fig. 9. Near its lower portion said pivot has a horizontally-extending plate or turn-table *e*, whereby the crane is rotated. Looking toward the front of the machine—that is, in the direction of the arrow, Fig. 8—said turn-table has the sheaves *f g h* mounted upon the right and the sheaves *j k m* upon the left of the pivot-axis at the periphery of said turn-table, said sheaves rotating in horizontal planes and serving to guide the cables *n* and *o*. Said sheaves *f* and *j* occupy positions at the front of said turn-table, and the substantially vertical sheaves *p* and *q* are so mounted near the lower portion of the pivot *e* that the cables *n* and *o* will be guided from a point within said pivot

and will lead fair onto said sheaves *f* and *j*, respectively. The sheaves *r r* have axes fixed relatively to the turret *a* and serve to guide said cables *n* and *o* from the turn-table *e* to suitable driving mechanism. (Not shown.)

The crane-pivot *c* is provided with the posts *s*, which project above the turret *a* and form rests for supporting the crane-beams *t t* and also form points of attachment for the tension-rods *u u*, whereby said beams are braced. At the forward extremity of said crane is mounted the shaft *v*, which forms the pivotal support for the blocks *w*, wherein the beams *x x* of the oscillating lever are secured. Said blocks *w* are recessed at their upper or outer extremities to receive said beams *x*, and the cross-brace *y* extends across and is attached to said blocks *w* in such a manner as to hold said beams in place and also act as a distance-piece between said blocks. Said cross-brace *y* serves another purpose also, in that it affords means of attachment for the rods *z z*. Said rods *z* extend in both directions from said cross-brace and are also attached to the extremities of the said beams *x*, thereby bracing the same.

The forward extremity of the oscillating lever is bound together by means of the yoke 1, which extends across from one to the other of the beams *x x* and carries the shaft 2. At the rear or upper extremity of the oscillating lever is secured the shaft 3, which extends transversely to the oscillating lever and forms a pivotal connection between said lever and the thrust-segment 4. Said segment is approximately disk-shaped, having a portion of its periphery curved and approximately concentric with the said shaft 3. The curved portion of the periphery of said segment is grooved to receive the cables *n* and *o* above mentioned, the cable *n* being connected to said segment at the point of attachment 5 thereon, which is so located at the forward portion thereof that said cable *n* may be tangential to the periphery of said segment in all positions of the latter within the working limits of the machine. The point of attachment 6 for the cable *o* is so located near the rear portion of said segment that said cable may be at all times tangential to the periphery of said segment.

The shaft 3 above mentioned projects beyond the beams *x x* and has the cranks 7 and 8 keyed or otherwise secured to its extended portions, the crank 7 lying upon the right and the crank 8 lying upon the left of the segment 4 looking toward the front of the machine, as indicated by the arrow, Fig. 4. At the outer extremities of the cranks 7 and 8 are formed the sleeves 9 and 10, respectively, which receive the wrist-pins 11 and 12, respectively. Said pins 11 and 12 project outwardly beyond the sleeves 9 and 10 and have a bearing at their outer extremities in the right bucket-handle 13 and left bucket-handle 14, respectively, thereby forming the pivotal connections between the cranks 7 and 8 and their respective bucket-handles.

On the opposite faces of the segment 4 and at points preferably near the periphery thereof are formed the bosses 15 and 16, which are screw-threaded or otherwise adapted to receive and retain the inner extremities of the wrist-pins 11 and 12, respectively. By this construction the said wrist-pins form studs extending from said bosses through the crank-sleeves 9 and 10 and bucket-handles 13 and 14, respectively, thereby effecting a more rigid connection between the segment 4 and cranks 7 and 8. Said bosses are so placed upon said segment that the cranks 7 and 8 lie at an angle of one hundred and five degees apart, more or less, measuring in the plane of rotation of said segment about the shaft 3. As the cranks 7 and 8 lie outside of the lever-beams *x x* and the sleeves 9 and 10 extend inwardly to the thrust-segment 4, the rotation of the segment will bring said sleeves into contact with said beams, said sleeves thereby acting as stops to limit the rotation of said segment. In order to combine stiffness and rigidity with lightness of weight, said bucket-handles 13 and 14 are preferably built-up members and at their forward or lower extremities carry the buckets 17 and 18, respectively. Said buckets 17 and 18 are of the ordinary pattern and are provided with the bails 19 and 20, the bail 19 being hinged to the bucket 17 by means of the trunnions 21 and the bail 20 being hinged to the bucket 18 by means of the trunnions 22. Said bails are also hinged upon the shaft 2 at the forward or lower extremity of the oscillating lever.

It is obvious that in the present machine, although the bucket-arm is practically single, for the reason that it rotates as a whole about a single axis *v*, there is nevertheless such a duplication of parts that said arm virtually comprises two linkworks, one of which may be defined by its pivoted joints as follows, to wit: 2 to 3, to 11, to 21, to 2, and the other of which may similarly be defined as follows, to wit: 2 to 3, to 12, to 22, to 2. The rotation of the segment 4 about the shaft 3 will change the configuration of said linkworks and thereby cause the projection and retraction of the buckets 17 and 18 relatively to the oscillating lever-beams *x*.

The parts of the bucket-arm are so related and proportioned that when the right sleeve 9 is in contact with the lower edge of the right beam *x* of the oscillating lever the right bucket 17 will be projected and the left bucket 18 retracted, as shown in Fig. 10. When the left sleeve 10 is in contact with the upper edge of the left beam *x* of the oscillating lever, the left bucket 18 will be projected and the right bucket 17 retracted, as shown in Fig. 12. When the segment is in a position midway between the extreme positions just mentioned, the buckets 17 and 18 will lie substantially side by side, as approximately shown in Fig. 11.

The center of gravity of the bucket-arm is so located that the buckets tend to drop downward and approach the turret *a*.

The rotation of the segment 4 about the shaft 3, the rotation of the bucket-arm about the shaft *v*, and the swinging of the crane are all accomplished by means of the cables *n* and *o*, the connections of which will now be described.

The guide-sheaves 23 and 24 (best shown in Figs. 2 and 3) are mounted side by side at the rear extremity of the crane for guiding the cables *n* and *o*, respectively, the sheave 23 lying to the right of said sheave 24. The guide-sheaves 25 and 26 are similarly mounted for the same purpose near the upper extremity of the crane-pivot *c* in such a manner that the cable *n* may extend through said pivot and lead onto the sheave *q*, above mentioned, while the cable *o* may train over the sheave 26, extend through said pivot also, and lead onto the sheave *p*, above mentioned. The right cable *n* is attached to the segment 4 at the point 5, on the forward portion thereof, and extends from said point 5 rearwardly along the grooved periphery of said segment to the guide-sheave 23, above described. From said sheave 23 the cable *n* leads over the sheave 25, thence through the pivot *c* and under the sheave *q*, thence forward around the horizontal sheaves *f* and *g* upon the right in the order named, and finally by way of the guides *r* to suitable driving mechanism.

It will be obvious by referring to the drawings, especially Fig. 1, that if tension is exerted in the cable *n* the effect upon the segment 4 in so far as the rotation of the latter about the shaft 3 is concerned will be to rotate said segment in such a direction that the bucket 17 will be projected or thrust forward and the bucket 18 will be retracted. The effect of such tension in the cable *n* upon the bucket-arm as a whole will be to rotate said arm about the shaft *v*, so as to hoist both of said buckets.

The cable *o* is attached to the segment 4 at the point 6 thereon and leads from said point in a forward direction along the grooved periphery of said segment and thence to and around the sheave 27, which is mounted upon the pivot-blocks *w w* in the manner best shown in Figs. 4 and 6. From the sheave 27 said cable *o* trains onto the sheave 28, mounted upon the shaft 3 at the upper extremity of the oscillating lever, as best shown in Figs. 2, 4, and 5. Said cable then extends to the sheaves 24 and 26 in the order named, thence through the pivot *c* beneath the sheave *p*, and, turning to the left, extends along the sheaves *j* and *k* toward suitable driving mechanism. (Not shown.)

If tension is exerted in the cable *o*, the effect upon the segment 4 will be to rotate the same about the shaft 3 in such a direction as to retract the bucket 17 and project the bucket 18. The cables *n* and *o* therefore have opposite effects upon the segment 4 as far as the rotation of the latter about the shaft 3 is concerned. As the sheave 28, however, is upon the same side of the shaft *v* as is the segment 4 and as both the said cables *n* and *o* extend from their respective points on the bucket-arm directly to the sheaves 25 and 26 upon the crane, said cables will supplement each other in rotating said bucket-arm about the shaft *v*.

When the bucket-arm is fixed relatively to the crane—as, for example, when the arm is rotated to the limit of its motion, so that the further rotation thereof is prevented—the cables *n* and *o* will operate to swing said crane. This will be evident by referring to Fig. 8, for after leaving the driving mechanism said cables first make contact with the crane adjuncts on opposite sides of the axis of the crane. If now the rotation of the bucket-arm about the pivot *v* is prevented, said cables become virtually attached to said crane adjuncts at the sheaves *g* and *k*, and under these circumstances if the cable *n* is slackened off and tension is exerted in the cable *o* the forward extremity of the crane will tend to rotate toward the left. Reversedly, if the cable *o* is slackened off and tension is exerted in the cable *n* the forward extremity of said crane will tend to rotate toward the right.

My present machine operates in the following manner: If the buckets 17 and 18 are in the hoisted position shown in Fig. 2 and the cables *n* and *o* are allowed to run out, said buckets drop downward and backward into a position for taking a cut. Tension is now exerted in the right cable *n*, and the bucket-arm rotates, so as to force the bucket 17 in a forward direction to take a cut. If at this time tension is not exerted in the cable *o*, the cable *n* will also have a tendency to rotate the segment 4 in such a direction as to further project the bucket 17—that is, to thrust or crowd said bucket directly into the bank. If, however, tension is also exerted in the cable *o*, the effect of said cable *o* upon said segment will be to partially overcome the thrust or crowding effect of said cable *n*. These two opposite effects of the cables *n* and *o* may be so regulated as to obtain any desired degree of thrust or crowding action upon the bucket 17. When the bucket 17 is filled, the tensional strain in the cable *n* is terminated, and tension is exerted in the cable *o*. The effect of this tension in the cable *o* is to rotate the segment 4 about the shaft 3 in such a direction that the bucket 18 is projected or crowded directly into the bank, while at the same time the bucket 17 is retracted from the bank, the parts of the bucket-arm tending to assume the relative positions shown in Fig. 12. The tension in the cable *o* also forces the bucket 18 in a forward direction to take a cut. The thrust or crowding effect of the cable *o* may be modified by simultaneously exerting tension in the cable *n*. It is evident, therefore, that by suitably regulating the tension in the cables *n* and *o* the configuration of the

bucket-arm may be completely controlled by the said cables and that said arm may be so manipulated that one only of the buckets is filled at one time. For this reason the parts do not require greater strength, practically speaking, than if a single bucket of equal size were employed.

The rotation of the crane by reason of the unequal tensions in the cables *n* and *o* during the actual cutting of the bank is prevented by the bank itself, which prevents lateral motion of the buckets. When the buckets have been filled, however, and are hoisted clear of the bank, unequal tension in said cables will cause the immediate commencement of the swinging motion of the crane, the swinging being accomplished by said cables in the manner above described. The crane may therefore commence to swing as soon as the buckets are filled and while said buckets are being hoisted, for said hoisting may be accomplished by either one of the cables singly, and such cable may be employed for hoisting as will swing the crane in the desired direction.

It is evident that many of the details of construction herein described may be altered without departing from my invention. For example, the cranks 7 and 8 may be dispensed with, and the direct attachment of the wrist-pins 11 and 12 may alone be relied upon to hold said pins rigidly in position upon the segment or wrist-plate 4.

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

1. An excavator bucket-arm, having an articulately-supported member which forms the support for said arm, and a plurality of buckets having connections with said supporting member whereby said buckets may be reciprocated in the general direction of the length of said arm-supporting member.

2. An excavator bucket-arm composed of a plurality of members articulately connected together, two of said members bearing excavator-buckets, in combination with means for reciprocating said bucket-supporting members simultaneously in opposite directions.

3. An excavator bucket-arm comprising two linkworks each of which carries a bucket, at least two of the members of said linkworks being common to both of said linkworks.

4. An excavator bucket-arm comprising a revolubly-supported member, a second member pivotally supported on said first member, a plurality of bucket-supporting members, each having at one extremity a bucket, and at the other extremity pivoted connections to said second member, and means whereby said first member is articulately connected to said bucket-supporting members at or near the buckets thereon, thereby permitting the motion of said bucket-supporting members relatively to said first member.

5. In an excavator bucket-arm, the combination of a revolubly-supported member forming the support for said arm; a plurality of bucket-handles; and connections between said handles and said arm-supporting member, said connections comprising a member pivotally mounted on said arm-supporting member, and connected to said handles in such a manner that the rotation of said pivotally-mounted member upon its supporting-pivot causes the motion of said handles relatively to each other, said connections also comprising other mechanism for articulately joining said arm-supporting member and said handles.

6. In an excavator bucket-arm, a plurality of members articulately connected together, two of said members carrying excavator-buckets and having pivotal connections to a segment or wrist-plate, a segment or wrist-plate as aforesaid, pivotally supported by one of the members of said arm other than said bucket-supporting members, said segment or wrist-plate affording means for varying the positions of the bucket-supporting members relatively to each other.

7. In an excavator bucket-arm, the combination of an oscillating lever, a pair of bucket-handles, connections between the lower extremity of said lever and each of the lower extremities of said handles, and connections between the upper extremities of said bucket-handles and said lever, said last-mentioned connections affording means whereby the positions of said lever and handles may be varied relatively to each other.

8. In an excavator bucket-arm, the combination of an oscillating lever, a pair of bucket handles, connections between the lower extremity of said lever, and each of the lower extremities of said handles, and a member pivotally supported at or near the upper extremity of said oscillating lever, and having articulate connections with each of the said bucket-handles, thereby affording means for varying the positions of the said handles relatively to each other.

9. In an excavator, a linkwork bucket-arm comprising a pair of bucket-handles, a pivotally-supported oscillating lever, connections between the lower extremity of said lever and each of said handles, a thrust-segment pivoted to said lever, and pivots in the upper extremities of said handles for transmitting motion thereto, said pivots being fixed relatively to said thrust-segment at different points thereon, the rotation of said segment upon its supporting-pivot thereby effecting the motion of said handles relatively to each other; in combination with means for rotating said thrust-segment about its supporting-pivot.

10. In an excavator, a bucket-arm comprising a revolubly-supported member which forms the support for said arm, a pair of bucket-handles, means for connecting the bucket extremities of said handles to said arm-supporting member, and a power-receiving member connected to said arm-supporting member and to said handles whereby power is resolved into two components, one of which rotates said arm about its support, and

the other of which changes the positions of the members of said arm relatively to each other; in combination with means for applying power to said power-receiving member.

11. In an excavator, the combination of a crane, a bucket-arm pivotally supported on said crane, and comprising members articulately connected together, two of said members constituting bucket-handles, and a third of said members constituting a thrust-segment whereby power is resolved into two components, one of which rotates said arm upon said crane, and the other of which changes the positions of the members of said bucket-arm relatively to each other; and cables connected to said segment for supplying power thereto.

12. In an excavator, the combination of a crane, a bucket-arm supported thereon, said arm having a pair of bucket-handles connected to a pivotally-supported thrust-segment at points located outside of the axis of the supporting-pivot thereof, and said arm having other members for supporting said segment and handles; in combination with cables for operating said arm, said cables being connected to said segment and having opposite effects thereon in so far as the rotation of said segment about its supporting-pivot is concerned.

13. In an excavator, a pivotally-supported bucket-arm composed of articulately-connected members, two of which constitute bucket-handles, a third of which constitutes an oscillating lever, and a fourth of which constitutes a thrust-segment pivotally supported on said lever; in combination with a crane for supporting said arm, two cables for operating said arm, said cables being connected to said segment so as to rotate the same in opposite directions about the pivot of said segment; and means for guiding both of said cables from points on said arm on the same side of the point of support thereof to points on said crane, said cables thereby tending to rotate said segment about the segment-supporting pivot, and also to rotate said arm about the arm-supporting pivot.

14. In an excavator, the combination of a pivoted crane; a bucket-arm pivoted to said crane, said arm comprising two linkworks each supporting a bucket, at least two of the members of said linkwork being common to both of said linkworks, one of said common members being pivotally supported on the crane and forming the support for said arm, and a second of said members being pivoted to said arm-supporting member and affording means for varying the configuration of said linkworks; two cables connected to said second member for operating the same, means for guiding said cables to points on said crane from points on said arm located on the same side of the supporting-pivot thereof; and guides located on said crane or its adjuncts whereby the forces of said cables tend to rotate said crane in opposite directions.

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