No. 665,684. Patented Jan. 8, 1901.

O. HETLESAETER.

SWINGING MECHANISM FOR CRANES.

(Application filed Mar. 2, 1900.)

(No Model.) 3 Sheets—Sheet 1.

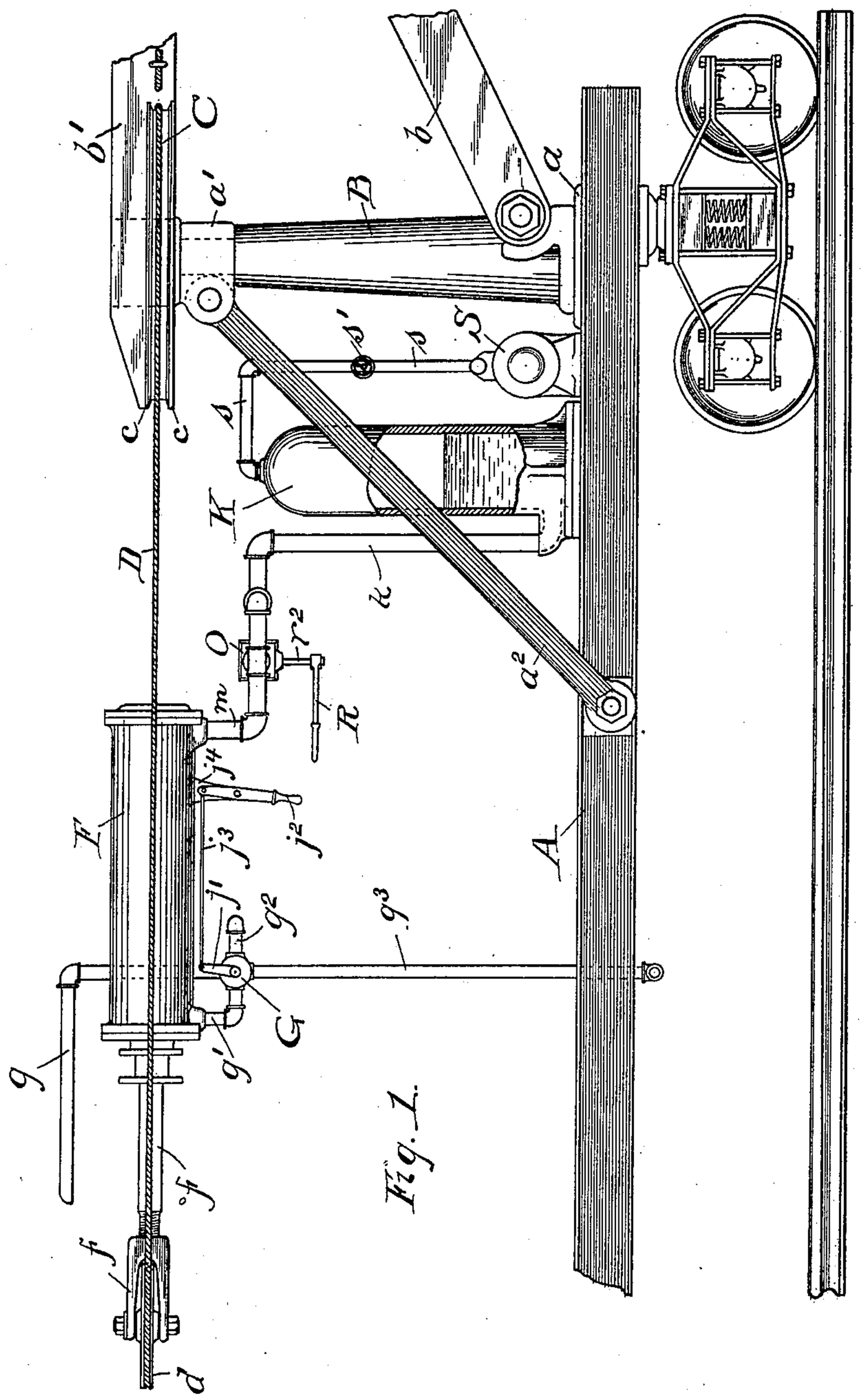

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

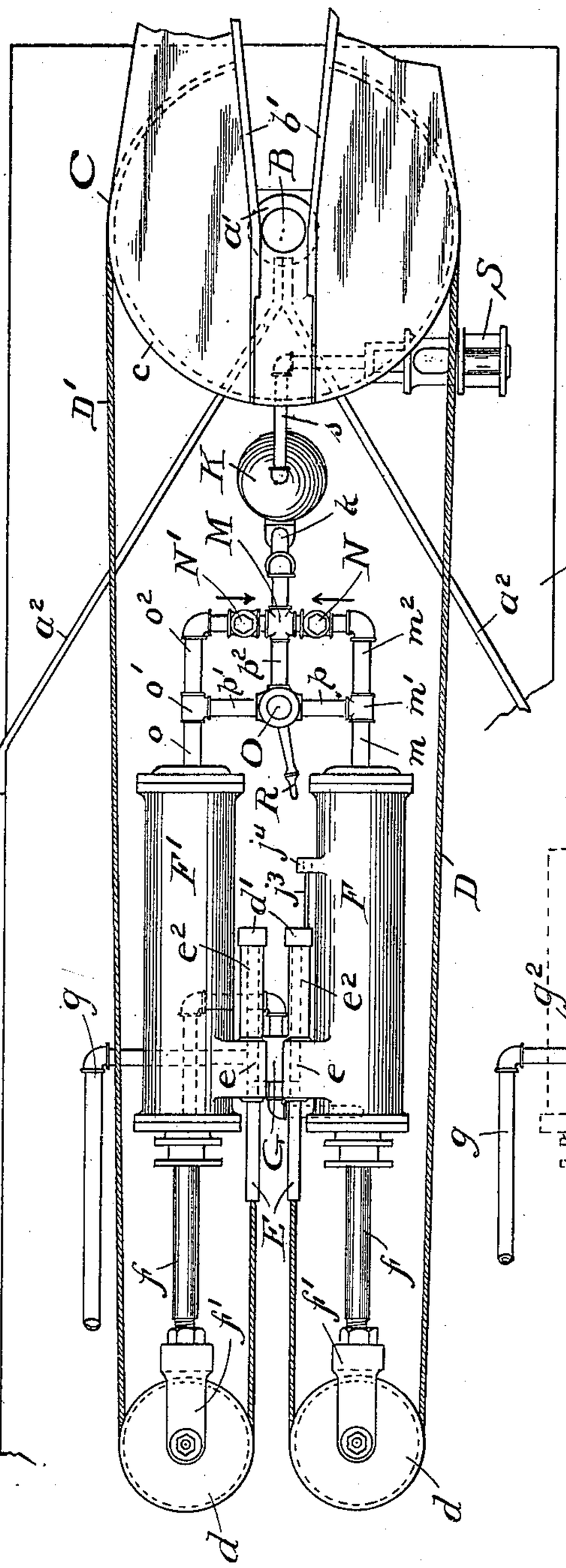

Fig. 2.

Fig. 3.

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(No Model.) 3 Sheets—Sheet 3.

Fig. 8

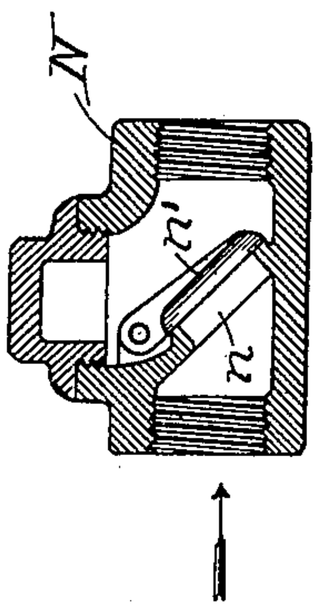


Fig. 6.

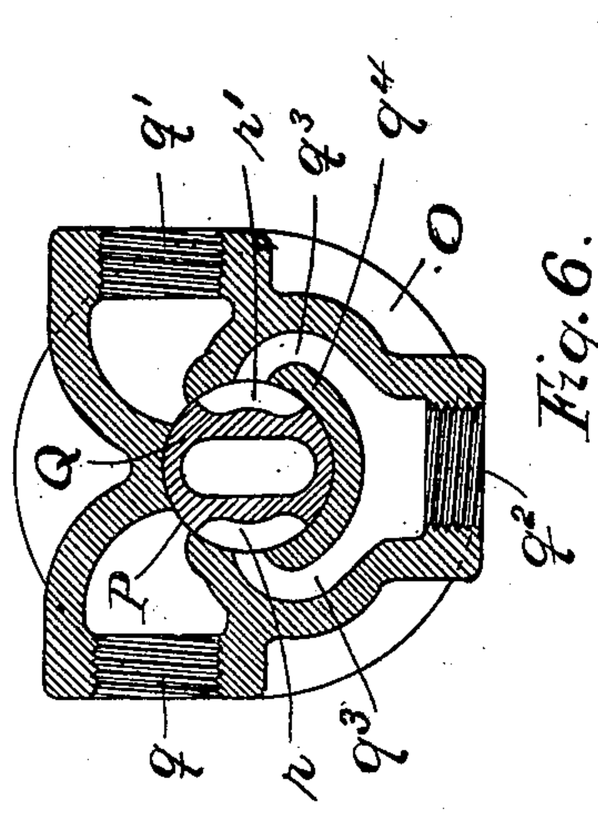


Fig. 4.

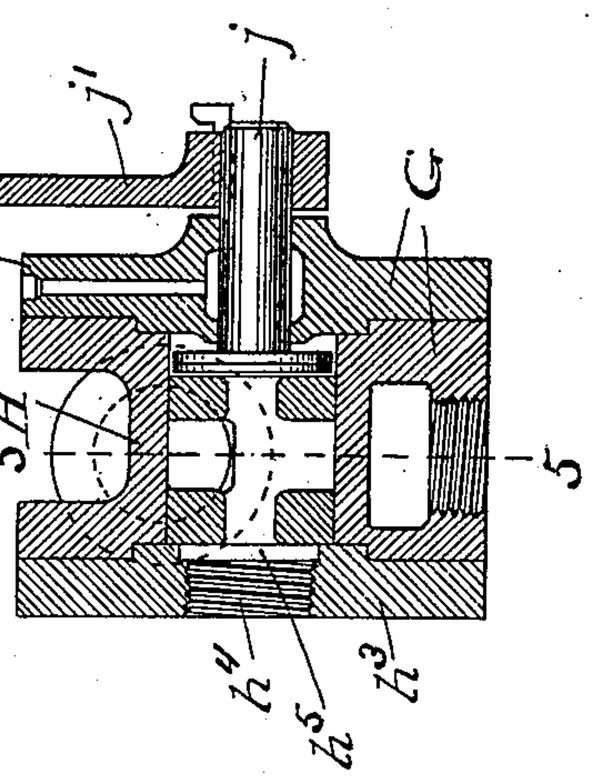


Fig. 5.

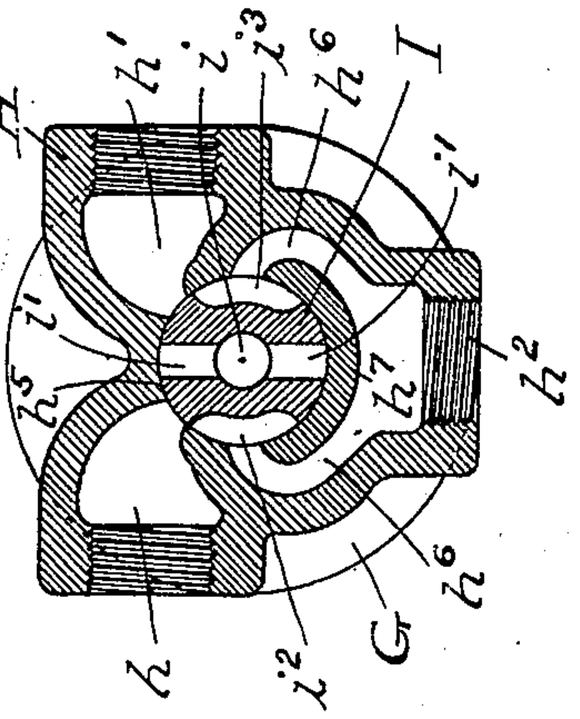


Fig. 7.

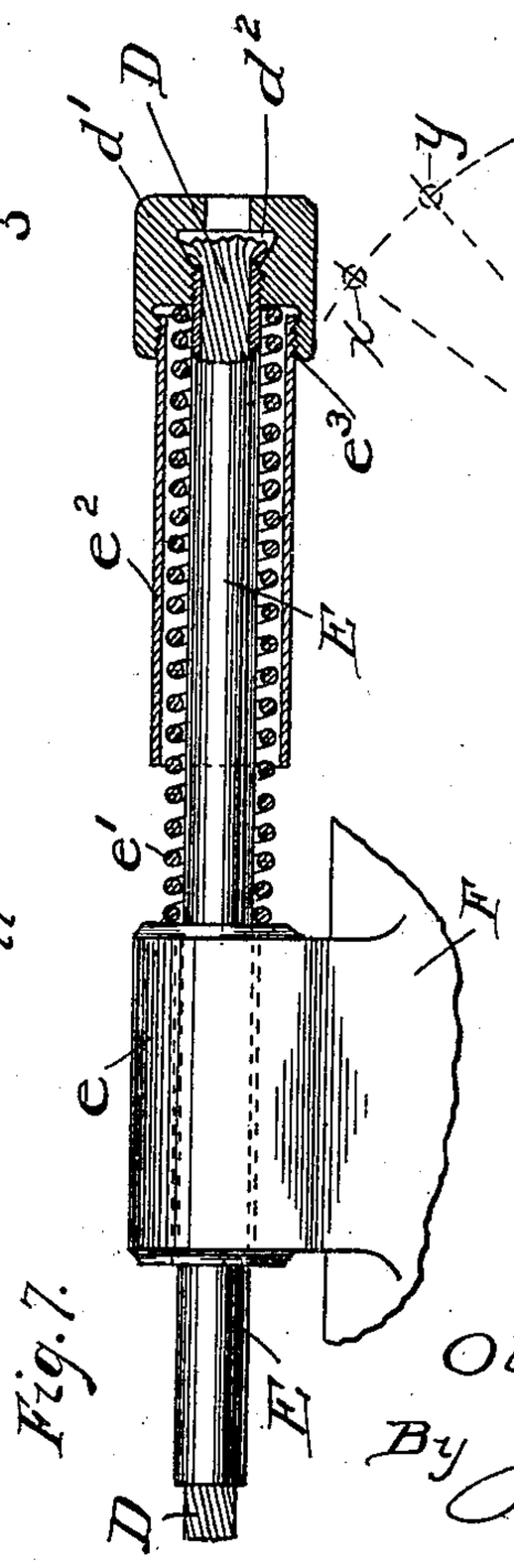
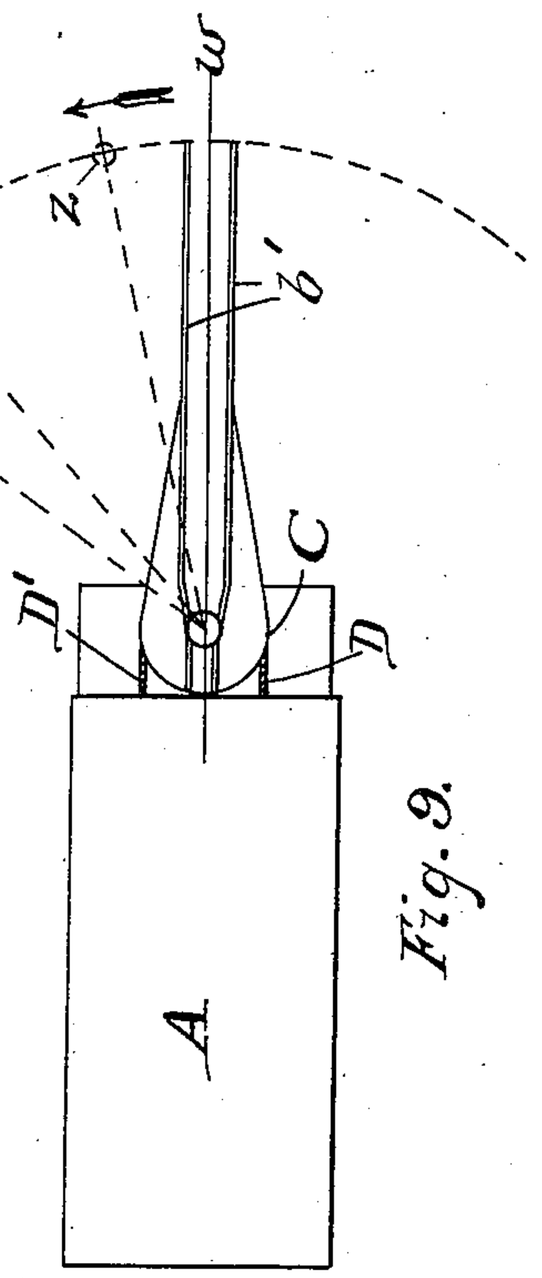


Fig. 9.



Witnesses:
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UNITED STATES PATENT OFFICE.

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SWINGING MECHANISM FOR CRANES.

SPECIFICATION forming part of Letters Patent No. 665,684, dated January 8, 1901.

Application filed March 2, 1900. Serial No. 7,049. (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 Swinging Mechanism for Cranes, of which the following is a specification.

My invention relates to swinging mechanisms for cranes and other objects swung in a similar manner; and my present invention is similar in certain respects to a swinging mechanism for which I have made application for Letters Patent, filed February 24, 1900, Serial No. 6,326.

The objects of my invention are, first, to provide means for rapidly imparting to the crane a lateral motion and means for terminating said motion without jar; second, to provide means whereby the kinetic energy due to the momentum of the swinging parts may be converted into potential energy at the termination of the lateral motion of said parts and said potential energy reconverted into kinetic energy available for imparting succeeding lateral motion to said parts; third, to provide a cable-tightener, whereby the swinging cable may be kept taut under all conditions arising during the operation of the machine, and, fourth, to provide the other details hereinafter set forth. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a general view, in side elevation, of a portion of a railway-car whereon is mounted a crane operated by my swinging mechanism. Said figure shows the swinging cylinders, the pressure-tank, and the rear portion of the crane. Fig. 2 is a plan view of the cylinders, pressure-tank, and crane as shown in Fig. 1. Fig. 3 is a plan view of the pipe connections between the cylinders and the cylinder-operating valve. The positions of said cylinders are indicated by dotted lines. Fig. 4 is a detail view, in longitudinal section, of the cylinder-operating valve. Fig. 5 is a detail view of the said operating-valve in cross-section, taken on the line 5 5, Fig. 4. Fig. 6 is a detail view, in cross-section, of the controlling-valve which is located in the piping connecting the cylinders with the pressure-tank. Fig. 7 is a plan view, in detail, of the spring and cap and other constituent parts of the cable-tightener, whereby the swinging cable is prevented from sagging at the termination of the lateral motion of the crane. Said figure also shows the cylinder-lug whereby said tightener is supported. Fig. 8 is a detail view, in longitudinal section, of the check-valve located in the piping of the pressure-tank. Fig. 9 is a diagram showing a plan of the crane and car and illustrating the operation of the swinging mechanism.

Similar letters refer to similar parts throughout the several views.

A represents a railway-car whereon the crane and the crane-swinging mechanism are mounted. Said crane consists of the post or mast B, the jib *b*, and the main backstay or tie *b'*, which latter forms the support for the forward extremity of said jib. Said mast B is pivotally supported upon the plate *a*, attached to and mounted upon the forward extremity of the car A, and is held in position by means of the mast-collar *a'*, having the braces a^2 a^2. Said mast has attached thereto at its lower portion the rear extremity of the said jib *b*, and at the upper extremity of said mast is attached the said backstay *b'*.

The swinging circle C is attached to the backstay *b'* concentrically with the vertical axis of rotation of the mast B. Said swinging circle consists, preferably, of a channel-beam bent into circular form, with the flanges *c c* thereof extending outwardly, thus forming a guide for the swinging cables D and D'. Said cable D lies upon the right and the cable D' upon the left of the center line of the mechanism, and although steel ropes are preferable for this purpose chains or any suitable substitute may be employed. The forward portions of said cables lie within the swinging circle C and are securely attached at their forward extremities to the backstay *b'*. From said swinging circle C each of said cables D and D' extends rearwardly, training around the adjacent one of the sheaves *d d* and thence extending in a forward direction to its respective cap *d'*, which forms a part of the cable-tightener. Said cap *d'* (shown in detail in Fig. 7) has a chambered recess d^2 for receiving the extremity of its respective cable. Said recess is also interiorly threaded to receive the threaded extremity of the guiding-

sleeve E. Said sleeve E, which is screwed into said threaded recess d^2 in the cap d', incloses the forward portion of the cable D and travels freely within the supporting cylinder-lug e, thereby serving as a protection to said cable end and also as a guide for the moving parts of the tightener. The cable is conveniently secured to said cap d' and sleeve E by spreading the strands thereof within said recess d^2 and pouring thereinto molten metal, which is afterward allowed to cool. The stationary lugs e e are preferably cast upon the crane-swinging cylinders F and F' and extend in the direction of the length thereof. Said lugs are centrally apertured, so as to receive the guiding-sleeves E E and permit said sleeves to travel longitudinally in either direction therein. A helical tightener-spring e' encircles each of said sleeves E E and bears at one extremity against the lug e and at the other extremity against the cap d'. Inclosing the spring e' is the spacing-sleeve e^2, which is threaded at one extremity for screwing into the suitably-threaded aperture e^3 in the cap d'. The length of the sleeve e^2 is such that said sleeve will come to a bearing against the lug e shortly before the spring e' reaches the condition of utmost compression. The force of the spring e' is less than the working tension of the cables D D', and therefore in general the sleeve e^2 will bear against the lug e, thus virtually effecting a rigid connection between the cables and the cylinder whereto said lug is attached. When, however, the tension in said cable decreases to such an extent as to create a tendency in said cable to become slack and to sag, said spring extends, thereby providing for the temporary excess of length and maintaining said cable in its proper position.

The cylinders F and F' are substantially alike in construction and purpose; but the cylinder F lying upon the right is distinguished for convenience of description from the cylinder F' lying upon the left looking toward the front of the machine. Said cylinders F and F' are preferably horizontal, parallel, and adjacent and so placed that their axes are at the same height as the swinging circle C, and their piston-rods f f extend in a direction away from said circle. At the outer or rear extremities of said piston-rods f f are attached the yokes f' f', which carry the said cable-sheaves d d.

Steam or other gas under pressure for operating the cylinders F F' is supplied thereto through the operating-valve G from the supply-pipe g. From said valve the pipe g' leads to the rear end of the cylinder F, and the pipe g^2 leads to the rear end of the cylinder F', while the pipe g^3 leads to exhaust. Said valve is placed for convenience between and a short distance beneath said cylinders. The body H of said valve G (shown in detail in Figs. 4 and 5) has a lateral opening h for receiving the said pipe g', a lateral opening h' for receiving the pipe g^2, and an opening h^2, extending downward for connecting with the exhaust-pipe g^3. The valve-cover h^3 forms one extremity of the valve G and has an opening h^4 for receiving the supply-pipe g. Said opening h^4 connects with the center bore h^5, which is located in said valve-body H and receives the valve-core I. The openings h and h' connect directly with said center bore h^5, and the opening h^2 has the passages h^6 h^6 branching around the wall h^7, and thence connecting with said bore h^5.

The rotary valve-core I has a cylindrical steam-passage i extending longitudinally through its central portion and communicating with the said opening h^4. The ports i' i' in said core extend in opposite directions from said passage i in such a manner that said ports may be brought into connection with either the opening h or opening h'. The ports i^2 and i^3 are symmetrically located upon opposite portions of the core I, in the periphery thereof, and are so formed that when said core is rotated sufficiently in one direction the port i^2 connects the openings h and h^2, and when said core is rotated in the opposite direction the port i^3 connects the openings h' and h^2. The passages in the valve-body H and valve-core I are so related that when the passage h is open to exhaust the passage h' receives live steam, and when the passage h' is open to exhaust the passage h receives live steam; but the steam lap is greater than the exhaust lap, and therefore one of the said passages may be open to exhaust without necessitating the opening of the opposite passage to steam.

The valve-cover J closes the extremity of the valve-body H opposite to the cover h^3 and is centrally bored to afford a passage for the valve-spindle j. Said spindle is suitably attached to said valve-core I and projects beyond said cover J sufficiently to afford means of attachment for the valve-operating lever j'. Said operating-lever j' is connected with the hand-lever j^2 by means of the rod j^3. The bracket j^4, attached to the cylinder F, serves as a means of support for said hand-lever j^2.

At the forward extremities of the cylinders F and F', toward the swinging circle C, is the piping whereby said cylinders are connected with the pressure-tank K. In said piping the length m extends from the cylinder F to the T m', and the length m^2 extends from said T m' to the check-valve N. (Shown in detail in Fig. 8.) Said valve N has therein a valve-seat n, which receives the hinged disk n' in such a manner as to allow the passage of a fluid through said valve in the direction of the arrows, Figs. 2 and 8, but so as to prevent the passage of a fluid in the opposite direction. Similarly the length of pipe o extends from the cylinder F' to the T o', and the length o^2 extends from said T o' to the check-valve N'. Said valve N' is of the same construction as the check-valve N, above described, and is so placed that the fluid is permitted to pass therethrough when coming

from the direction of the said length of pipe o^2, as indicated by the adjacent arrow, Fig. 2. The cross M has one branch connecting with the said check-valve N, another branch connecting with the said check-valve N′, a third branch connecting with the pressure-tank K by way of the pipe k, and a fourth branch connecting with the controlling-valve O. Said valve O is connected with the T m' by the pipe p, is connected with the T o' by the pipe p', and is connected with the said cross M by the pipe p^2. In said valve O (shown in detail in Fig. 6) the opening q receives the said pipe p, the opening q' receives the pipe p', and the opening q^2 receives the pipe p^2. Said valve O has a center bore P, which receives the cylindrical rotary valve-core Q. Said openings q and q' connect directly with the said center bore P; but the opening q^2 is connected with the said center bore by the passages q^3 q^3, which branch around the wall q^4 in the body of said valve O. The ports r r' are symmetrically located upon opposite portions of the said valve-core Q, in the periphery thereof, and are so formed that when said core is rotated sufficiently in one direction the port r connects the opening q with the opening q^2, and when said core is rotated in the opposite direction the port r' connects the opening q' with said opening q^2. When said opening q^2 is in connection with the opening q', the passage of a fluid from said opening q^2 to the opening q is prevented, and, conversely, when the opening q^2 is in connection with the opening q the passage of a fluid from said opening q^2 to the opening q' is prevented. Said valve-core Q is centrally chambered to secure lightness and is operated by means of the valve-spindle r^2 and hand-lever R. Said lever R is preferably in proximity to the operating-lever j^2 in order that both of said levers may be conveniently operated simultaneously by a single operator.

The pressure-tank K consists of a closed vessel, preferably upright and capable of containing both air and water under pressure. Near its lower extremity said tank is connected with the said pipe k and near its upper extremity with the piping s s, leading to the air-compressor S. Said piping s s is provided with the valve s', whereby communication between said tank and said air-compressor may be cut off. Said compressor S may be of any usual type and is employed to compress the air or other gas contained within the upper portion of the pressure-tank K.

In the operation of my device those portions of the cylinders F and F′ which lie between the cylinder-pistons and the extremities of said cylinders lying nearest the swinging circle are filled with water, and so, also, is the lower portion of the pressure-tank K and the piping whereby said cylinders and said tank are connected. When it is desired to swing the crane to the left, or in the direction of the arrow, Fig. 9, the valve G is so set that live steam from the supply-pipe g passes from said pipe into said valve and thence into the rear extremity of the cylinder F through the pipe g'. This setting of the valve opens the passages which connect the pipe g^2 with the exhaust g^3, and steam is thereby allowed to escape from the rear portion of said cylinder F′. Simultaneously the operator so sets the valve O that water may pass from the pipe p^2 into the pipe p', thus at the same time cutting off communication between the pipes p and p^2. As the pressure of the live steam causes the piston within the cylinder F to move toward the forward extremity of said cylinder, the water in said forward extremity is forced by said piston into the pipe m and T m', and as the pipe p, connecting with the T m', cannot discharge through the valve O the water from said cylinder F is forced to pass into the pipe m^2 and through the check-valve N into the cross M. The check-valve N′ prevents the passage of water into the pipe o^2, and there are therefore only two directions in which water may pass from said cross M—to wit, through said pipe p^2, valve O, pipe p', and pipe o into the forward portion of the cylinder F′, or into the pressure-tank K by way of the pipe k; but the valve s' is closed, and the air within the upper portion of the tank K being thus confined exerts a pressure which tends to prevent the passage of water from said cross M into said tank K. As the rear extremity of the cylinder F′ is open to exhaust, said cylinder presents the least resistance to the water from the said cross M, and therefore said water passes into said cylinder F′ and forces the piston therein in a rearward direction. The motion of the piston toward the rear of said cylinder F′ forces the respective piston-rod f and sheave d thereon in a rearward direction. As the extremity of said cable D′, which is secured to the tightener, is virtually fixed, the rearward motion of said sheave results in the rearward motion of the outside reach only of said cable, and consequently the corresponding left side of the swinging circle C is drawn rearwardly. Simultaneously the forward motion of the piston within the right cylinder F has in an analogous manner paid out the outer reach of the cable D in a forward direction and the crane is swung toward the left.

In order to illustrate a peculiar and important feature of my invention, let it be desired to swing the crane from the central position (indicated by the letter w in the diagram Fig. 9) to a position at the left, (denoted by the letter x.) When the crane has reached the position denoted by the letter y prior to the position x, the valve g is closed by the operator, and the supply of steam to the cylinder F and the exhaust from the cylinder F′ are both thereby cut off. The valve O is also completely closed, so that no water may pass in any direction therethrough. At said point y, however, the crane has great momentum,

depending in magnitude upon the weight and velocity of the moving parts. The momentum acquired by the crane when it has reached the position *y* tends to draw the right cable D in a forward direction, thus forcing the piston in the right cylinder F in a forward direction and causing the water in the pipe *m* to pass into the T *m'*. As the valve O is now completely closed, water from the T *m'* is permitted egress in one direction only—to wit, into the pipe *k*, leading to the cylinder K—for the check-valve N' prevents passage into the pipe o^2 and the valve O prevents passage into the pipe *p'*. Therefore the water is forced into the pressure-tank K, and the air in the upper portion thereof is accordingly compressed. The pressure in the tank K increases until it is sufficient to prevent any further entrance of water thereinto, with the result that the water in the cylinder F has no available outlet and the motion of the piston in said cylinder is arrested. When the motion of said piston ceases, the motion of the connected piston-rod *f*, sheave *d*, and cable D also ceases, and the crane comes to rest at the said position *x*. It will be observed that when the condition of equilibrium of the forces—to wit, the force due to the momentum of the moving parts and to the pressure of the steam remaining in the cylinder F after the closure of valve G, acting in one direction, and the pressure in the tank K, acting in the opposite direction—has been reached the water in said tank is prevented by the check-valves N and N' and controlling-valve O from escaping from said tank, and the pressure therein is therefore maintained. While the crane is traveling from position *y* to position *x*, the outer reach of the cable D' has been running in a rearward direction; but the motion of the piston in the cylinder F' has been partially checked, for the reason that no water could enter into said cylinder F' after the valve O was closed, and the closure of the valve O occurred when the crane was in position *y*. As the rearward motion of the cable D' continues after the motion of the piston in the cylinder F' is partially checked, the said cable D' tends to become slack. The slackening of the cable D' permits the helical tightener-spring *e'* to extend and force the cap *d'* away from the lug *e*. The adjacent extremity of the cable D' is thus forced in a forward direction, and said cable is thereby prevented from sagging or becoming untrained, as the valve G is so constructed that one cylinder may be partially open to exhaust, while the other cylinder remains completely closed. If desired, the pressure due to the steam remaining in the cylinder F may be decreased by thus partially opening the cylinder F to exhaust while the crane is being arrested.

When it is desired to bring the crane to the initial position *w*, the valve G is set by the operator in such a position that the steam or rear end of the cylinder F is open to exhaust while the cylinder F' receives live steam. The valve O is then so set that water may pass from the cross M and pipe p^2 into the pipe *p* and thence into the cylinder F. The air and water having been confined within the tank K, said air and water are still under the high pressure acquired while the motion of the crane was being arrested. As the water in said tank may now enter into the cylinder F, the water in said tank is forced by said pressure through said pipes into said cylinder F, and moves the piston within said cylinder in a rearward direction, thus causing the adjacent piston-rod *f* and sheave *d* to move in a rearward direction. This draws the cable D toward the rear and causes said cable to move the crane toward the right. This return motion of the crane incidentally compresses the spring *e'*, adjacent to the cylinder F, and draws the cap *d* and sleeve e^2 to a firm bearing against the lug *e*. When the pressure in the tank K is reduced to a pressure equivalent to that of the steam which is now entering the cylinder F', the water from said cylinder is forced through the pipe o^2 and check-valve N' into the cross M and the pipe p^2, whence said water passes through the valve O and into the right cylinder F. This causes the continued motion of the crane toward the right. When the crane in its return reaches a position denoted by the letter *z* in the diagram Fig. 9, the valves O and G are again completely closed by the operator and the momentum of the crane forces the water from the cylinder F' into the tank K and raises the pressure in said tank in a manner similar to that above described. Therefore when said crane has come to rest at the position *w* the water and air are again confined in said tank K under great pressure.

It is obvious that as the arrangement of the piping is symmetrical with respect to each of the cylinders the energy due to the pressure in the tank K may be taken advantage of to swing the crane, either to the right or to the left with equal facility and from any position of the crane.

As the pressure from the tank K is effective at the commencement of the lateral swing of the crane, said tank-pressure is of great value in overcoming the inertia of said crane.

From the above description it is apparent that the tank K and connecting-piping and fittings constitute a cushioned hydraulic stop or buffer for quickly arresting the lateral motion of the crane without shock or jar. The higher the pressure in the tank K the more quickly will the moving parts be brought to rest. By means of the compressor S any desired degree of pressure may be obtained in said tank; but said compressor is ordinarily in use only at infrequent intervals and may be entirely dispensed with without rendering my device inoperative.

When the crane is at rest, the pressure in

the tank K in excess of the amount necessary for equilibrium between the tank-pressure and cylinder steam-pressure represents the energy due to the momentum of the crane, and this energy, which in former constructions was lost, is in my device conserved and utilized.

My swinging mechanism is especially useful in connection with cranes employed in excavating, dredging, and grading, for in this class of machinery the crane is usually of great weight, and there is a considerable added weight due to the bucket or dipper, especially when the latter is filled. Moreover, the lateral strokes of the crane are frequent, and the aggregate loss of time due to slow starting and stopping has frequently heretofore been great. My device not only economizes time by employing increased pressure at the commencement and termination of lateral motion, but economizes energy as well, for the increased pressure is gained without incurring an increase in steam consumption.

Although the forward extremities of the swinging cables are attached to the crane at separate portions thereof, it is evident that a single cable continuing about the swinging circle may be employed.

In view of the fact that in many forms of of cranes economy of space is of great importance I do not confine myself to the arrangement of parts as shown in the accompanying drawings. One skilled in the art will readily understand that the described arrangement, especially of the pipes and fittings, is to a certain extent diagrammatical. Any suitable arrangement whereby liquid may pass from the cylinders to the tank and be controllably prevented from passing from said tank to said cylinders would lie within the spirit of my invention.

Although the operating fluids are preferably water, steam, and air, other suitable liquids may be substituted for water and other gases for steam and for air.

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

1. In a swinging mechanism for cranes, the combination of crane-swinging cylinders, steam connections for the operation of said cylinders, an auxiliary pressure-tank, and means whereby a compressed gas in said tank may be utilized in swinging the crane.

2. In a swinging mechanism for cranes, the combination of crane-swinging cylinders having suitable connections with the crane for governing the lateral position thereof; means for controllably supplying steam to one extremity of said cylinders; a closed vessel constituting a pressure-tank; and connections between said closed vessel and the other extremity of said cylinders whereby a liquid may controllably pass between said vessel and said cylinders.

3. In a swinging mechanism for cranes, the combination of crane-swinging cylinders adapted to receive steam at one end and water at the other end thereof, means for controllably supplying steam for operating said cylinders, means whereby the lateral position of the crane is governed by said cylinders, a pressure-tank, connections between said tank and the water end of said cylinders, and a valve in said connections whereby there may be communication between said tank, and one only of said cylinders.

4. In a swinging mechanism for cranes, the combination of crane-swinging cylinders adapted to receive steam at one end and water at the other end thereof, means for controllably supplying steam for operating said cylinders, means whereby the lateral position of the crane is governed by said cylinders, a pressure-tank, connections between said tank and the water end of said cylinders, a valve in said connections whereby there may be communication between said tank and one only of said cylinders; and by-passes in said connections whereby water may at all times have free passage from said cylinders to said tank, but not in the opposite direction.

5. In a swinging mechanism for cranes, the combination of crane-swinging cylinders having suitable connections with the crane for governing the lateral position thereof; means for controllably supplying steam to one extremity of said cylinders; a closed vessel constituting a pressure-tank; connections between said closed vessel and the other extremity of said cylinders whereby a liquid may controllably pass between said vessel and said cylinders; and a compressor for increasing the pressure of the gas confined within said vessel.

6. In a crane-swinging mechanism wherein a cable is employed to govern the lateral position of the crane, the combination, with said cable, of cable-tighteners composed of protecting-guides inclosing the cable ends, stationary objects suitably apertured to receive said protecting-guides and forming a bearing for the tightener-springs, tightener-springs bearing against said stationary objects and also against caps attached to said guiding-sleeves, and caps attached to said cable and to said guiding-sleeves.

7. In a crane-swinging mechanism wherein a cable is employed to govern the lateral position of the crane, the combination, with said cable, of cable-tighteners composed of protecting-guides inclosing the cable ends, stationary objects suitably apertured to receive said protecting-guides and forming a bearing for the tightener-springs, tightener-springs bearing against said stationary objects, and also against caps attached to said guiding-sleeves, and caps attached to said cable and to said guiding-sleeves, and spacing-sleeves, attached to said caps and adapt-

ed to bear against said stationary objects when said springs are compressed.

8. In a crane-swinging mechanism, the combination of crane-swinging cylinders, cables operated by said cylinders and swinging said crane, water connections between a pressure-tank and said cylinders, valves in said connections, a pressure-tank, means for controllably supplying steam to said cylinders, and cable-tighteners for preventing the sagging of said cables.

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