

(No Model.)

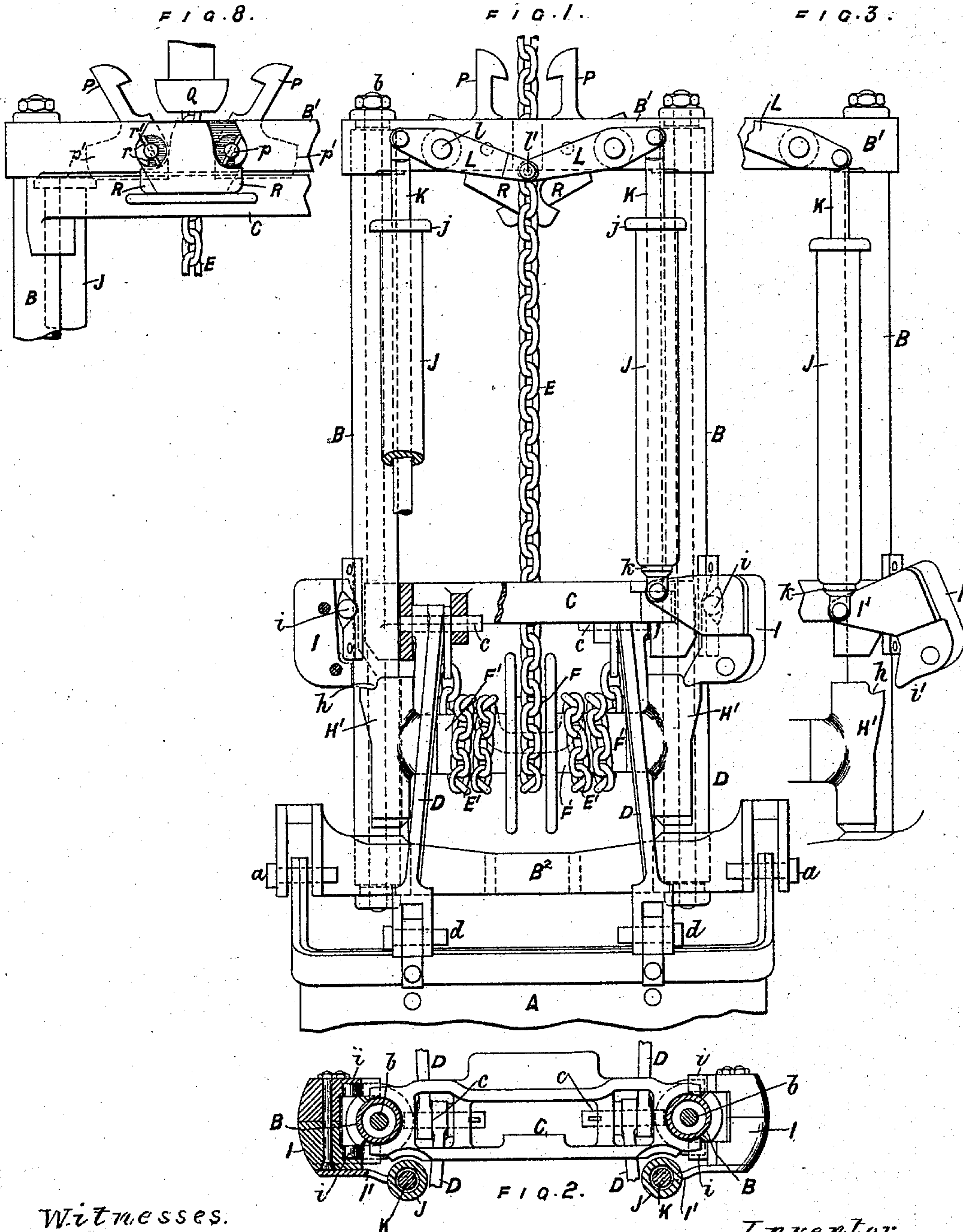
2 Sheets—Sheet 1.

H. GRAFTON.

GRAB BUCKET OR DIGGER FOR EXCAVATING.

No. 416,836.

Patented Dec. 10, 1889.



Witnesses.
C. W. Reiterich
J. F. Bourne

Inventor
Henry Grafton
By Briesen, Steele & Knapp

Attorneys.

(No Model.)

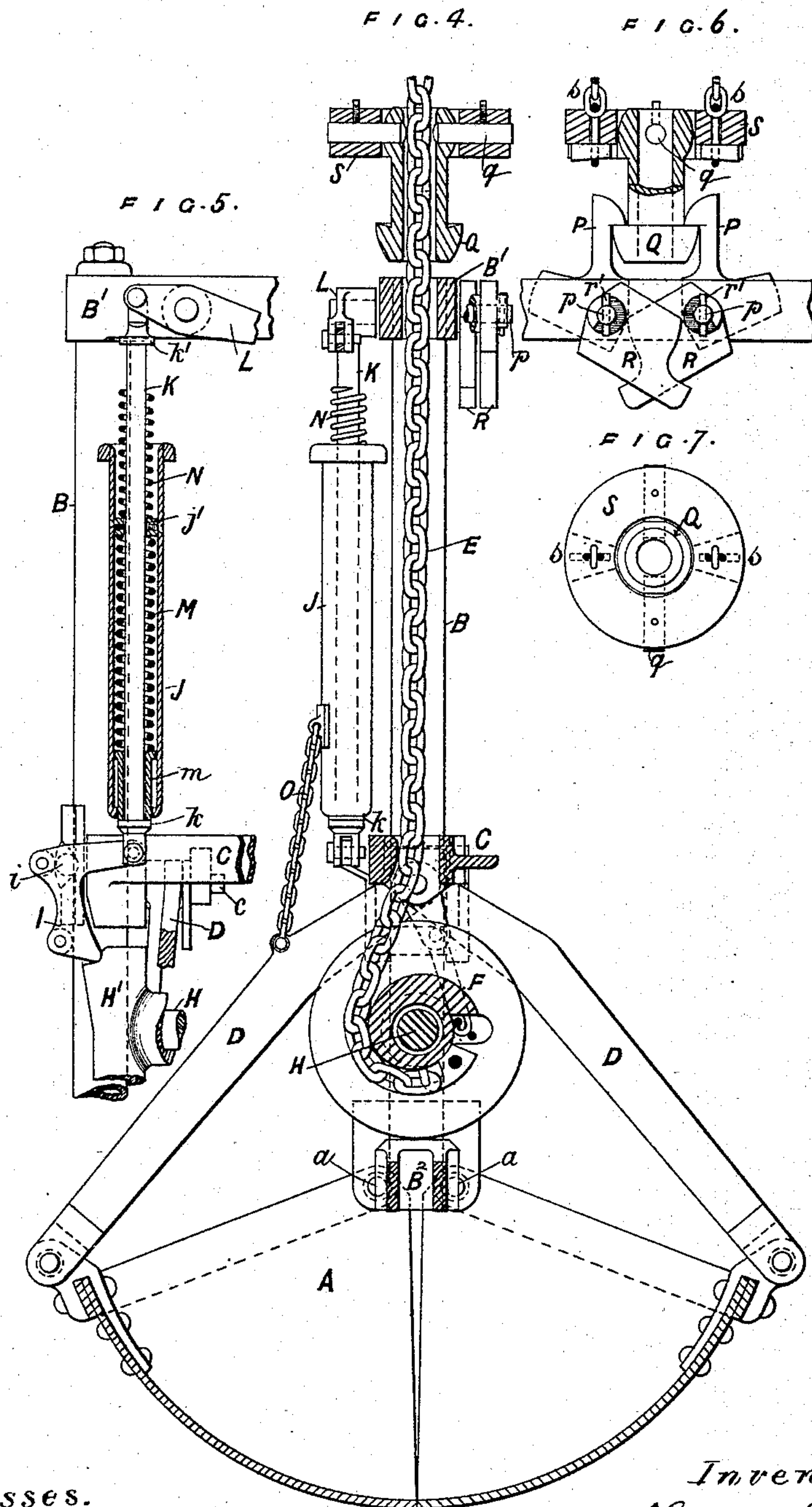
2 Sheets—Sheet 2.

H. GRAFTON.

GRAB BUCKET OR DIGGER FOR EXCAVATING.

No. 416,836.

Patented Dec. 10, 1889.



Witnesses.
Otto Dietrich
T. F. Bourne,

Inventor.
Henry Grafton
By Briesen, Steere & Knapp
Attorneys.

UNITED STATES PATENT OFFICE.

HENRY GRAFTON, OF WILLES ROAD, KENTISH TOWN, COUNTY OF MIDDLESEX, ENGLAND.

GRAB-BUCKET OR DIGGER FOR EXCAVATING.

SPECIFICATION forming part of Letters Patent No. 416,836, dated December 10, 1889.

Application filed May 22, 1889. Serial No. 311,652. (No model.) Patented in England February 8, 1888, No. 1,927; in France August 7, 1888, No. 192,292, and in Belgium August 7, 1888, No. 82,826.

To all whom it may concern:

Be it known that I, HENRY GRAFTON, engineer, of 26 Willes Road, Kentish Town, in the county of Middlesex, England, have invented
5 a new and useful Improved Grab-Bucket or Digger for Excavating and other Purposes, (for which I have obtained Letters Patent as follows: in Great Britain, dated February 8, 1888, No. 1,927; in France, dated August 7,
10 1888, No. 192,292, and in Belgium, dated August 7, 1888, No. 82,826,) of which the following is a full, clear, and exact description.

This invention relates to a grab-bucket or digger for dredging, excavating, unloading
15 bulk cargoes from vessels, depositing a load, and for other purposes for which grab-buckets are commonly employed.

This improved grab-bucket is worked by a single chain and upon any ordinary crane
20 provided at the jib-head with the suspension-tube hereinafter referred to, and it may be opened (whether it be loaded or not) when "hung up" at the jib-head, and also without aid when resting on the ground or other under-
25 neath support. It may therefore be caused to open, whether under water or not, either for the purpose of releasing its hold in case it should make a "false grab,"—that is to say, in case it should catch hold of an object
30 which it is unable to raise, or in case it should close without grabbing anything—or for the purpose of depositing a load of concrete or other material.

The opening of the grab-bucket when hung
35 up at the jib-head is effected within its own length—that is to say, without elongation of the apparatus by the dropping of the frame—as is usual in other grab-buckets, (whether worked by one or two chains,) and consequently, as the grab-bucket occupies a less
40 vertical distance (measured downward from the jib-head) when it is opened than when it is closed, it can deposit its load at a greater height for the same amount of lift than can
45 be done by other buckets in which the frame is lowered in the act of opening.

The opening of the grab-bucket when landed on the ground or other underneath support (whether under water or not) for the purpose

of depositing its load, and the opening of the
50 bucket, should it in the act of closing make a false grab, is effected by exactly the same motion of the parts as when the bucket is hung up at the jib-head. This improved grab-bucket therefore combines advantages not
55 heretofore possessed by any other worked by a single chain.

Further, this improved grab-bucket is distinguished from other single-chain grab-buckets by the fact that it may be opened
60 (when suspended by the hoisting-chain alone) at any intermediate point in mid-air without the use of any special suspension-gear, which could heretofore only be done by a grab-bucket worked by two separate chains. This
65 improved grab-bucket may therefore have all the advantages appertaining to a double-chain grab-bucket without the attendant disadvantage of requiring a special crane with double winding-gear to work the two chains.
70

The invention consists, essentially, in the means whereby the grab-bucket is enabled to be worked by a single chain in the manner and under the circumstances above described, and it is distinguished from most other grab-
75 buckets by the fact that the jaws are opened at the jib-head by a hoisting motion of the chain. This is accomplished mainly by the combination, with that part of the opening and closing gear which is intended to resist the
80 pull of the hoisting-chain and which is made vertically movable in or on the frame, of retaining-catches which are both self-engaging and self-releasing, whereby such vertically-movable part of the closing-gear is at required
85 times automatically retained at the lower part of the frame for the purpose of acting as an "abutment," "fulcrum," or "point of resistance," necessary for reversing the direction of pull of the chain and converting the up-
90 ward pull on the chain into a downward pull of the sliding cross-head, and is at required times released in order that the upward pull of the chain shall exert an upward pull on the sliding cross-head.
95

The opening of the grab-bucket in the manner above described when hung up at the jib-head is accomplished by the combination,

with the grab-bucket having the vertically-movable abutment or fulcrum for the chain and the self-engaging and self-releasing catches for said abutment, as above described, of "hanging-up" catches applied to the frame of the grab-bucket for engagement with the suspension-tube at the jib-head, so that the opening of the grab-bucket is effected by hanging it up by its frame to effect the release of the said retaining-catches and then hauling up the hoisting-chain while the frame remains stationary, instead of, as usual, hanging up the bucket by the sliding cross-head and lowering off the bucket-frame.

Besides the above-mentioned features, the invention also comprises certain peculiarities of construction of the various parts, as hereinafter described.

Reference is to be had to the accompanying drawings, forming part of this specification, wherein—

Figure 1 is a front elevation of the grab-bucket closed, parts being broken away to show the details more clearly. Fig. 2 is a horizontal section taken just above the retaining-catches for holding down the cross-head. Fig. 3 is a view of one of the weight-actuated retaining-catches out of engagement with the abutment. Fig. 4 is a central cross-section of the bucket, the retaining-catches being spring-actuated. Fig. 5 is a sectional elevation of one of the spring-actuated retaining-catches separately. Fig. 6 is a part sectional elevation of the suspension-tube and hanging-up catches engaged thereon. Fig. 7 is a plan of the suspension-tube. Fig. 8 is a similar view to Fig. 6, showing the action of disengaging the hanging-up catches from the suspension-tube.

The same letters of reference indicate like parts in all the figures.

A A are the bucket-jaws, hinged at *a* to the main frame B and connected to a vertically-sliding cross-head C by links D, jointed to the jaws at *d* and to the cross-head at *c*, the opening and closing of the jaws being respectively produced by the sliding motion of this cross-head up and down the frame B. The vertical or side members B of the frame are steel tubes fitted into sockets in the top and bottom cross-heads B' B² and traversed by tie-bolts *b*, whereby the whole frame is rigidly secured.

The hoisting-chain E may work the jaws of the bucket without multiplication of power; but it is usually preferred to obtain "purchase" or multiplication of power for the purpose of more forcibly closing the jaws of the bucket, and for this purpose power-multiplying gear of any ordinary kind may be employed, that shown in the drawings being of the ordinary kind, based on the principle of the well-known Chinese windlass. It is this gear, whether of the kind shown or any other and whether purchase-gear or not, that acts as an abutment or fulcrum for reversing the direction of pull of the hoisting-chain E.

In the example illustrated the term "abutment" or "fulcrum" includes the barrel, its axle, and appurtenances, the hoisting-chain E being attached to and wound on the part F of the barrel and upon itself, and branch chains E' (formed of a single length of chain, the middle portion of which lies in a cross-passage through the middle part F of the barrel, so as to equalize the strain) being wound (in the reverse direction to chain E) on the parts F' of the same barrel, of less diameter than the part F, the chains E' being connected to the sliding cross-head C. The barrel turns loose on an axle H, which is fast to shoes H', fitted to slide up and down the side members of the frame B. In order, however, to afford the point of resistance necessary to enable the upward pull on the hoisting-chain E to be converted into a downward pull on the chains E' by the unwinding of the former and the winding up of the latter, and thereby to enable the cross-head C to be drawn down and the bucket-jaws A to be closed, the barrel-axle is at proper times retained at the lower part of the frame B by the self-acting retaining catches next described.

The retaining-catches by which the abutment is held down in the frame, as above mentioned, are both self-engaging and self-releasing—that is to say, when not engaged with the abutment they tend to assume the position of engagement, and when engaged tend to fall out of engagement with the abutment, but are prevented from so doing by the strain upon them due to the weight of the bucket. The disengagement of the retaining-catches and the consequent release of the abutment is permitted by the cessation of the strain upon the retaining-catches, which occurs whenever the hoisting-chain is temporarily relieved of the weight of the bucket. By the release of the abutment the upward pull of the chain is permitted to raise the said abutment, which carries up with it the sliding cross-head, and thereby opens the bucket-jaws. The retaining-catches, which hold the barrel-axle down in the frame, are acted on, each in two opposite directions, either by springs or by weights, according as the mid-air discharge of the bucket is or is not required.

In the example illustrated in Figs. 1 to 3 weights are used to actuate the catches in both directions, while in Figs. 4 and 5 springs are shown in lieu of weights, one, of course, being the equivalent of the other.

I are catches pivoted at *i* to the vertical members of the frame B in position to engage by their nibs *i'* with notches *h* in the shoes H' when the latter descend with the barrel-axle to their lowest position in the frame. When thus engaged, the barrel is retained at the lower part of the frame, as shown in Fig. 1. These catches are caused by their own weight or by springs to fall into position of engagement, except when the bucket is nearly closed, at which moment

other weights or springs, acting in the opposite direction to the first, are permitted to come into action.

In order that the action of the two catches shall be simultaneous and equal at the two sides of the bucket, the catches have arms I' , projecting toward each other and connected to rock-levers L by vertical rods K , jointed to the said arms I' and to the outer ends of the rock-levers L , which are pivoted at l to the top transom B' of the frame, and are connected together at their inner ends l' by a pin and slot.

In Figs. 2 and 3 weights J are used to throw the catches out of engagement. They are tubular and slide on the rods K and have flanges j at their upper ends projecting into the path of the sliding cross-head C , so that when the latter is raised in the frame, as shown in Fig. 8, it catches under said flanges and carries up with it the tubular weights J . In this the open position of the grab-bucket the weights J are inoperative, and consequently the catches I are caused by their own weight to assume the position of engagement shown in Fig. 1. This they do immediately they are relieved of the weights J , and remain in that position so long as the bucket is open, except that when the barrel descends alone in the frame the catches I are momentarily pushed back by the shoes H' in slipping past them, the catches then falling into engagement with said shoes, as shown in Fig. 1. This descent of the barrel or abutment occurs when the grab-bucket has been lowered in the open position for the purpose of digging, the barrel then descending to the position shown in Fig. 1, while the sliding cross-head C is held up in the frame, as shown in Fig. 8, by the open jaws A , resting on the ground. As the cross-head is drawn down in the frame in the act of closing the bucket the weights J are allowed to rest upon shoulders k of rods K , and they then act in opposition to and are ready to overcome the self-engaging tendency of the catches I , the relative arrangement being such that they come into operative position only when the cross-head has been so far drawn down that the bucket-jaws have been nearly closed and to have obtained a good grip of the ground, so that the upward pull on the chain E will put considerable pressure on the contacting faces of h and i' . Owing to this strain on the retaining-catches, the weights J are unable to assert their power until the hoisting-chain E is relieved of strain by being slackened out while the bucket is hung up or landed, whereupon the weights J prevail and throw the catches I out of engagement with the shoes H' , as shown in Fig. 3, thus permitting the barrel or abutment to be drawn up in the frame by a hoisting motion of the chain E , for the purpose of opening the bucket. In Figs. 4 and 5 springs are used to throw the catches both into and out of engagement. In this case weights J are acted on by the cross-head

in the same way; but they are tubular and contain spiral springs M N , situated, respectively, below and above an internal shoulder j' of the tube, the spring M (which is the strongest) being confined between said shoulder j' and a sleeve m , bearing against the shoulder k of the rod, and upon which tube J is free to slide. The spring N is compressed (only when the cross-head C raises the tube J) between the collar j' and the upper shoulder k' of the rod K . When the springs N are thus compressed, the springs M are inoperative. The springs N then cause the catches I to assume the position of engagement with the abutment-shoes H' .

When the sliding cross-head C has so far descended in the act of closing the bucket that the latter is about three parts closed, the tubes J are drawn down by the action of the cross-head C upon it, (transmitted through chains O , connecting the tubes J to the links D), and thereby compress the springs M , which then tend to disengage the catches I from the abutment, but are prevented from doing so by the strain on the catches I due to the weight of the bucket and load.

The temporary relief of the hoisting-chain necessary to allow the self-disengagement of the retaining-catches (whether they be actuated by springs or weights) may be obtained either by supporting the grab by its frame at the jib-head or by landing it on the ground or elsewhere or by slacking the chain when the grab is already engaged in the ground. Temporary relief may also be obtained (when the catches I are actuated by springs and it is required to open the bucket in mid-air without hanging it up at the jib-head) by suddenly permitting the bucket to descend quickly for a short distance. During the short interval when by the more or less free falling of the bucket and load through space the strain on the retaining gear is relieved the self-releasing tendency of the retaining-catches is permitted to assert itself, which it does instantaneously, the retaining-catches being for the particular purpose of this mid-air opening of the bucket actuated by a power which acts independently of gravity, whereas in other cases the said catches may be actuated entirely by weights. It will, however, be obvious that springs are available in all cases where weights can be used.

For the purpose of opening the jaws by hanging up the grab to the jib-head, the frame B is provided with catches P at top, which, when the grab is raised in the closed position, (see Fig. 1,) strike against a flanged tube Q , hung just below the jib-head, and through which tube the hoisting-chain E freely passes. The catches P , having struck and risen just above the flange of the tube Q , are caused to fall inward, so that they will hang thereon, as shown in Fig. 6, when the grab is slightly lowered for that purpose. When the grab is thus supported by the catches P , and the hoisting-chain E is suffi-

ciently slacked off to be relieved of the tension due to the weight of the grab, the weights J or springs M are at liberty to act and effect the release of the barrel from the retaining-catches I in the manner above described. When the barrel has been thus released, the grab-jaws are opened to discharge the load by again winding up the hoisting-chain at the crane, as in hoisting, thereby drawing the barrel up in the frame and carrying up along with it the cross-head C.

The catches P normally tend to fall into position for engagement with the tube Q, as above described, but are so acted on by the sliding cross-head C when the latter nears its highest position in the frame in the operation of opening the grab, as last described, that they tend to fall off the flanged tube Q, and do fall off immediately they are relieved of the weight of the grab. This occurs when the cross-head C quite reaches the uppermost limit of its motion, whereupon the chain E supports the weight of the grab and the catches P fall out of engagement, as shown in Fig. 8, leaving the grab-bucket free to be lowered in the open position ready for repeating the operation of digging. This self-engagement and self-disengagement of the catches P is effected by pivoting the catches on axes p in the top cross-transom B' of the main frame B and providing them with horizontal outwardly-projecting tail-pieces p' , which act as weights, tending to throw the catches outward. The catches are fast on their axes p , and upon the latter are loosely mounted tumbler-weights R, having shoulders r on their bosses, which engage with cross-pins r' in the axes p , so as to form a sort of clutch, which permits limited independent motion of the tumbler-weights and of the catches. The tumbler-weights R respectively act in opposition to the tail-weights p' of the catches to which they are applied, and the said tail-weights p' are thereby overcome so long as the tumbler-weights R are free to act. The catches P are thus normally held in position for engagement with the flanged tube Q; but when the cross-head nears its highest point in the frame the tumbler-weights R are lifted by it, as shown in Fig. 8, and rendered inoperative, whereupon the tail-weights p' are free to act, and they disengage the catches from the tube Q as soon as the said catches are relieved of the weight of the grab, which occurs when the cross-head meets the top cross-transom B' or other stop limiting its upward motion in the frame. It will be evident that springs might be substituted for the tail-weights p' and tumbler-weights R. The passage through the tube Q and the passage through the top transom B' fit the chain E closely enough to insure that the tube Q shall be always centered with regard to the catches P; and in order to insure the two catches P always bearing an equal amount of weight, notwithstanding lateral swinging of the bucket in the act

of slewing the crane, the tube Q is hung by a pair of gudgeons q in a ring S, which is hung by a pair of links or chains s from the jib-head, the gudgeons q being in a plane at right angles to the plane of the links or chains s . The gudgeons q therefore allow the tube Q to swing in a direction at right angles to the direction of swing permitted by the links or chains s , the two together forming a sort of universal connection, permitting swing in any direction, so that the plane of the flange of the tube Q, upon which the catches P engage, will always be perpendicular to the direction of the chain E.

It will be seen that as the opening of the grab-jaws, when the grab is hung up at the jib-head, is effected by a rising motion of the cross-head C, while the frame B remains stationary, the grab is opened within a less vertical distance, measured downward from the jib-head, than can at present be done with similar grab-buckets in which is the cross-head C, which is hung up to the jib-head while the frame B is allowed to descend. This is a great advantage, as it increases the altitude at which the grab can discharge its load from a crane-jib of a given height. The opening of the grab-jaws is similarly effected if the loaded grab, instead of being hung up at the jib-head, be landed on the ground or other underneath support. The chain E being thus relieved of the weight, the barrel is released and by a hoisting motion of the chain is drawn up in the frame, carrying up with it the cross-head C, whereupon the grab is opened and the load is gently deposited. Similarly, should the apparatus make a false grab—i. e., close on a rock or other object which it cannot raise—all that is necessary is to slacken out the hoisting-chain a little, whereupon the jaws are caused to release their hold.

The operation of opening the grab at any intermediate point in mid-air without the aid of the suspension-tube Q depends on the springs M effecting the release of the abutment or barrel from its retaining-catches I at the moment when, by a sudden lowering off of the hoisting-chain, the catches are momentarily relieved of strain. This action is based on the theory that if the loaded grab were to fall freely (as it would do were the chain to break) the gravity of the bucket and load would exert no pressure on the retaining-catches, and the springs (which are equally operative whether the grab be falling or at rest) would consequently assert their power and disengage the barrel. For this particular purpose weights are not available, as they would be without action on the retaining-catches when both are falling freely. The action agrees in practice with the above-described theory, except in so far as the free falling of the grab is checked by the friction and inertia of the chain E and its winding-gear on the crane. This more or less free falling of the grab through a very small space is performed under the control of the

brake on the crane, which is suddenly released and reapplied after a momentary interval. The opening of the grab under these circumstances is accomplished by the same relative motion of the parts, the frame and jaws having, however, in this particular case, a descending motion, while the barrel and cross-head remain at about the same actual position in space.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a single-chain grab-bucket whereof the jaws are both opened and closed by an upward motion of the hoisting-chain, and whereof that part which acts as an abutment or fulcrum (to resist and reverse the effect of the pull of the chain) is movable up and down the frame, the combination, with such vertically-movable part or abutment and with the frame, of catches adapted to connect the abutment with the frame and prevent it rising therein, the said catches being so weighted that when disengaged they assume the position for engagement, and of weights acting on the catches in opposition to and overcoming the self-engaging tendency of the catches whenever said catches are relieved of the strain due to the weight of the grab, substantially as specified.

2. In a single-chain grab-bucket whereof the jaws are both opened and closed by an upward motion of the hoisting-chain, and whereof that part which acts as an abutment or fulcrum (to resist and reverse the effect of the pull of the chain) is movable up and down the frame, but is retained at the lower part of the frame in order that it may act as an abutment by catches, each acted on in opposite directions by weights, as described, the combination, with the catches and the weights which tend to disengage the catches, of the sliding cross-head or other part movable up and down therewith, such cross-head or equivalent part acting on the said weights in such manner as to render them inoperative when the cross-head is nearly raised and permit them to act on the catches in opposition to the self-engaging tendency only when the cross-head has been partly drawn down in the frame, as specified.

3. In a single-chain grab-bucket wherein the upward pull of the chain is converted into a downward pull of the sliding cross-head by an abutment or fulcrum which is vertically movable in the frame, but is held down therein by automatic retaining-catches operating as described, the combination of the frame, a

sliding cross-head, an abutment and catches for holding said abutment, and of an overhead support with hanging-up catches adapted to connect the frame of the grab with said overhead support for the purpose of relieving the hoisting-chain of the weight of the grab and so permitting the disengagement of the abutment from the retaining-catches, as and for the purpose specified.

4. In a single-chain grab-bucket, the combination, with the frame, an overhead support, and the sliding cross-head, of hanging-up catches acted on by opposing weights, the one set of weights normally prevailing, so as to cause the catches to automatically connect the frame with an overhead support, the said weights being so acted on by the sliding cross-head when the latter is drawn up in the frame that the other set of weights are permitted to automatically effect the disengagement of the grab-frame from the overhead support when said catches are relieved of the weight of the grab, as specified.

5. The combination, with a pair of hanging-up catches mounted on the top cross-transom of a grab-bucket at opposite sides of an aperture therein and with the hoisting-chain passing through said aperture, of an abutment and catches and a suspension-tube adapted for engagement by the catches and fitting closely around the hoisting-chain while permitting its free passage, so that the hoisting-chain acts as a guide, whereby the tube and hanging-up catches are accurately centered with regard to each other and their proper engagement is insured, as specified.

6. The combination of the frame, hanging-up catches carried thereby, and an actuating-chain with a suspension-tube adapted for engagement with the hanging-up catches of a grab and giving passage to but fitting closely around the hoisting-chain, as described, the tube being so hung as to be free to participate in the swinging of the grab in any direction in order to insure both of the hanging-up catches, when engaged therewith, supporting the weight of the grab, as specified.

The foregoing specification of my improved grab-bucket or digger for excavating and other purposes signed by me this 11th day of April, 1889.

London, April 11, 1889.

HENRY GRAFTON.

Witnesses:

WALTER J. SKERTEN,
17 Gracechurch Street, London, E. C.

WILMER M. HARRIS,
Notary Public, 17 Gracechurch Street, London.