July 31, 1934. B. H. KERSTING 1,968,493

CLAMSHELL BUCKET

Filed March 29, 1933 6 Sheets-Sheet 1

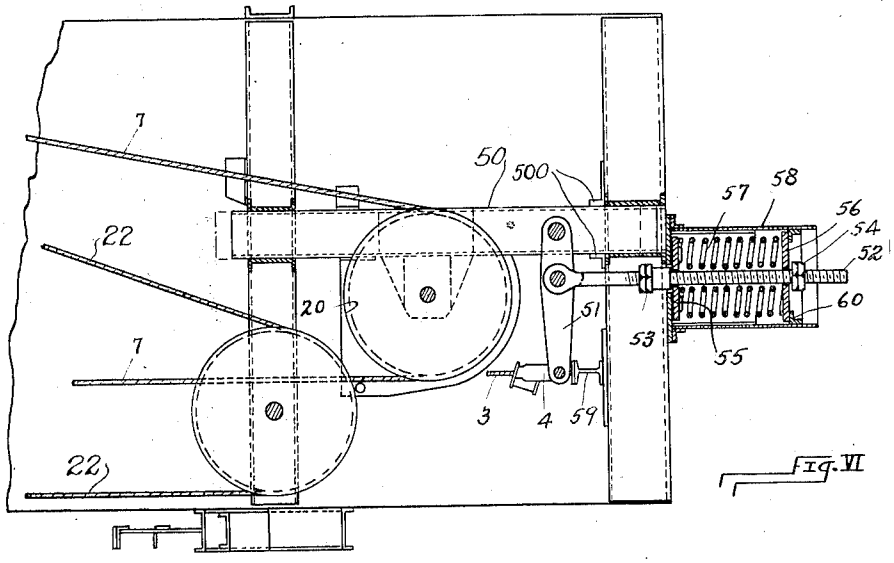
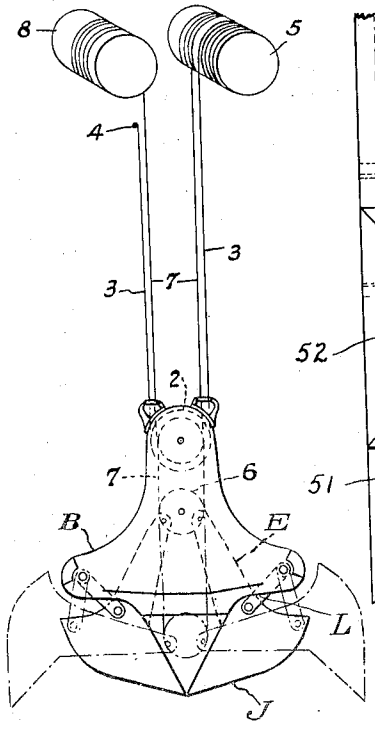


Fig. VI

Fig. I.



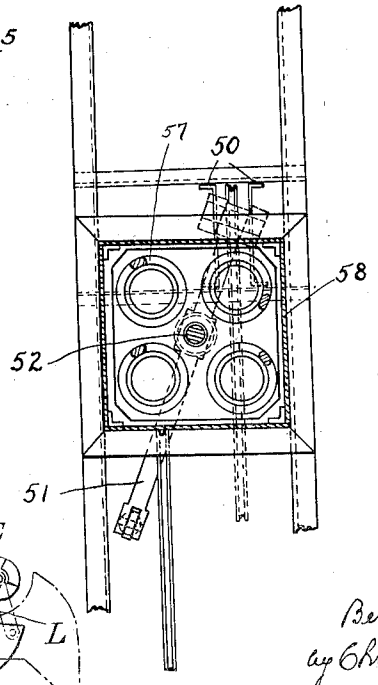


Fig. VII

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CLAMSHELL BUCKET

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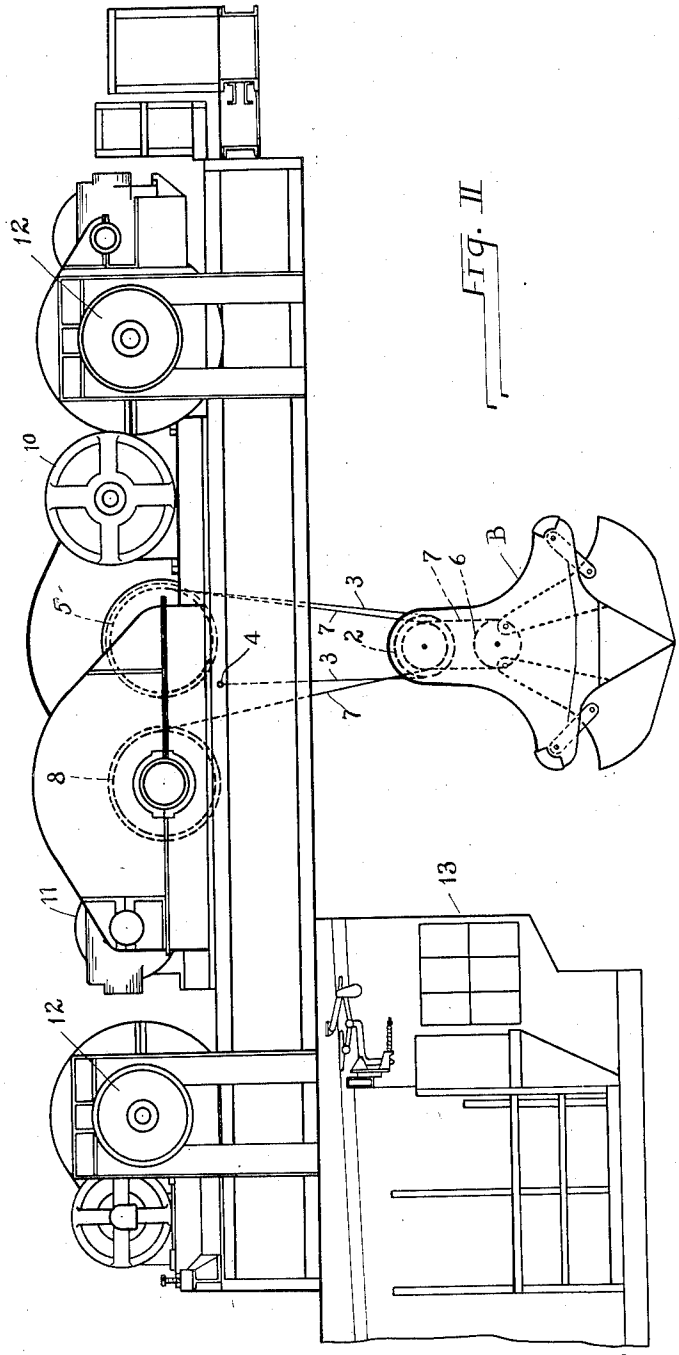


Fig. II

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CLAMSHELL BUCKET

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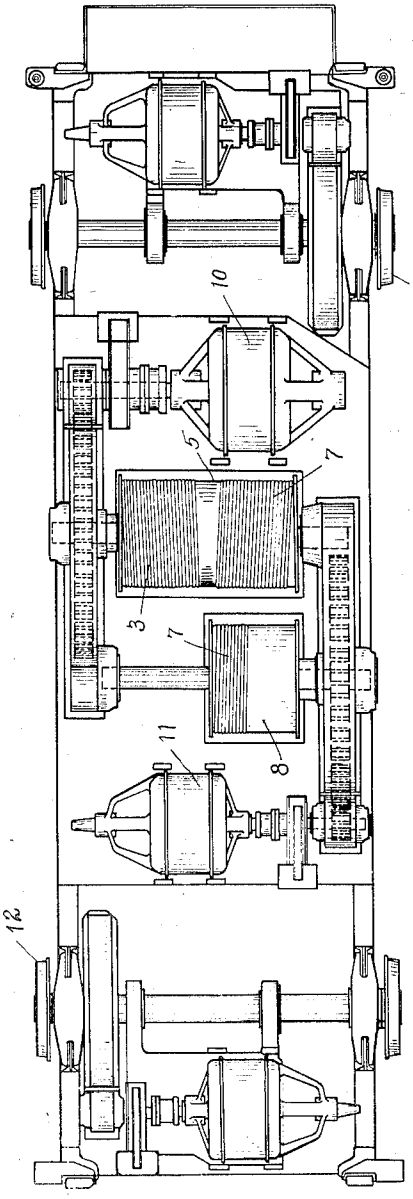


Fig. III

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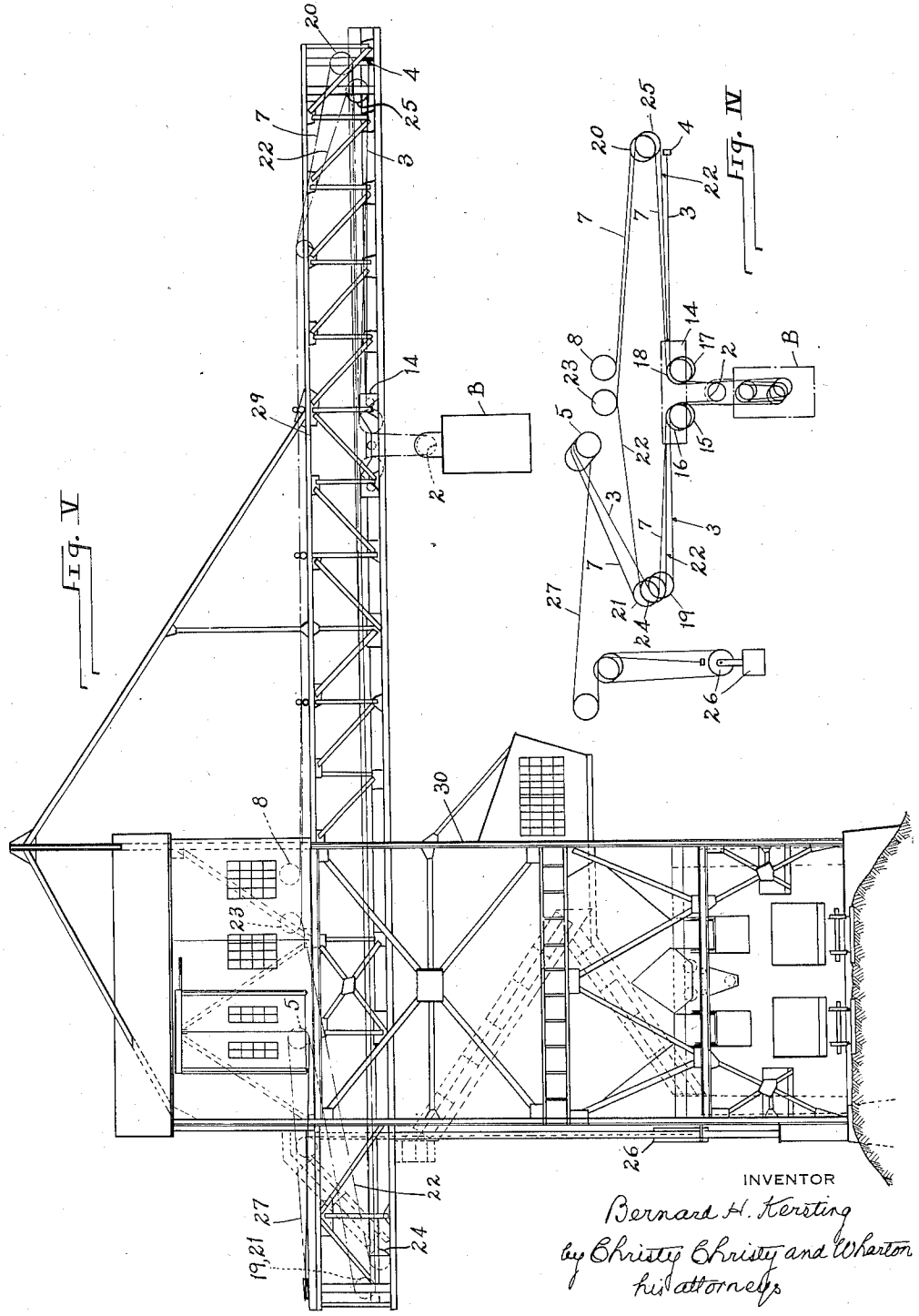
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July 31, 1934. B. H. KERSTING 1,968,493

CLAMSHELL BUCKET

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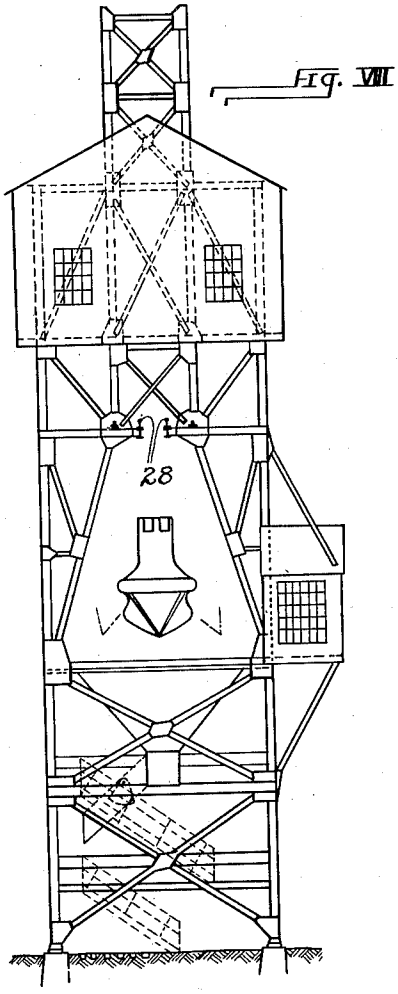


Fig. VIII

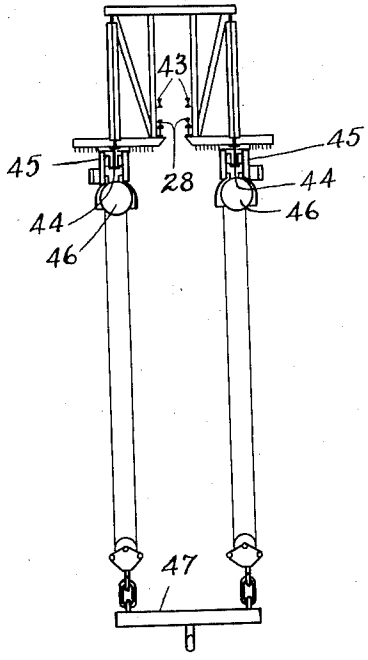


Fig. XII

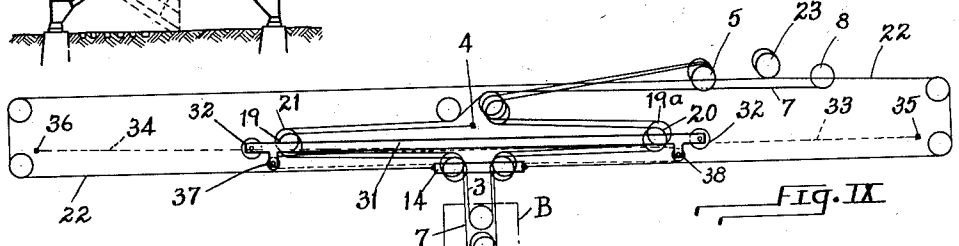


Fig. IX

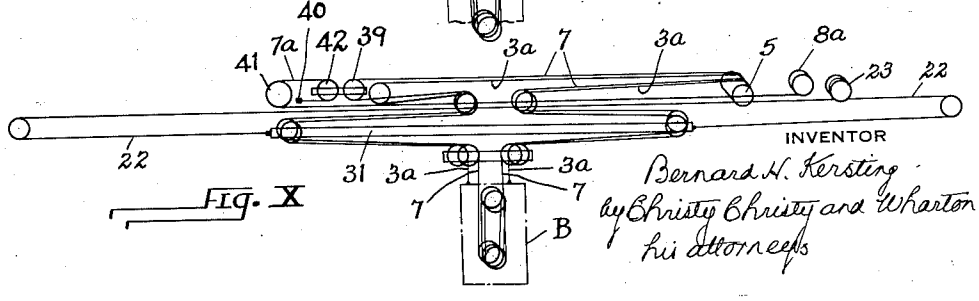


Fig. X

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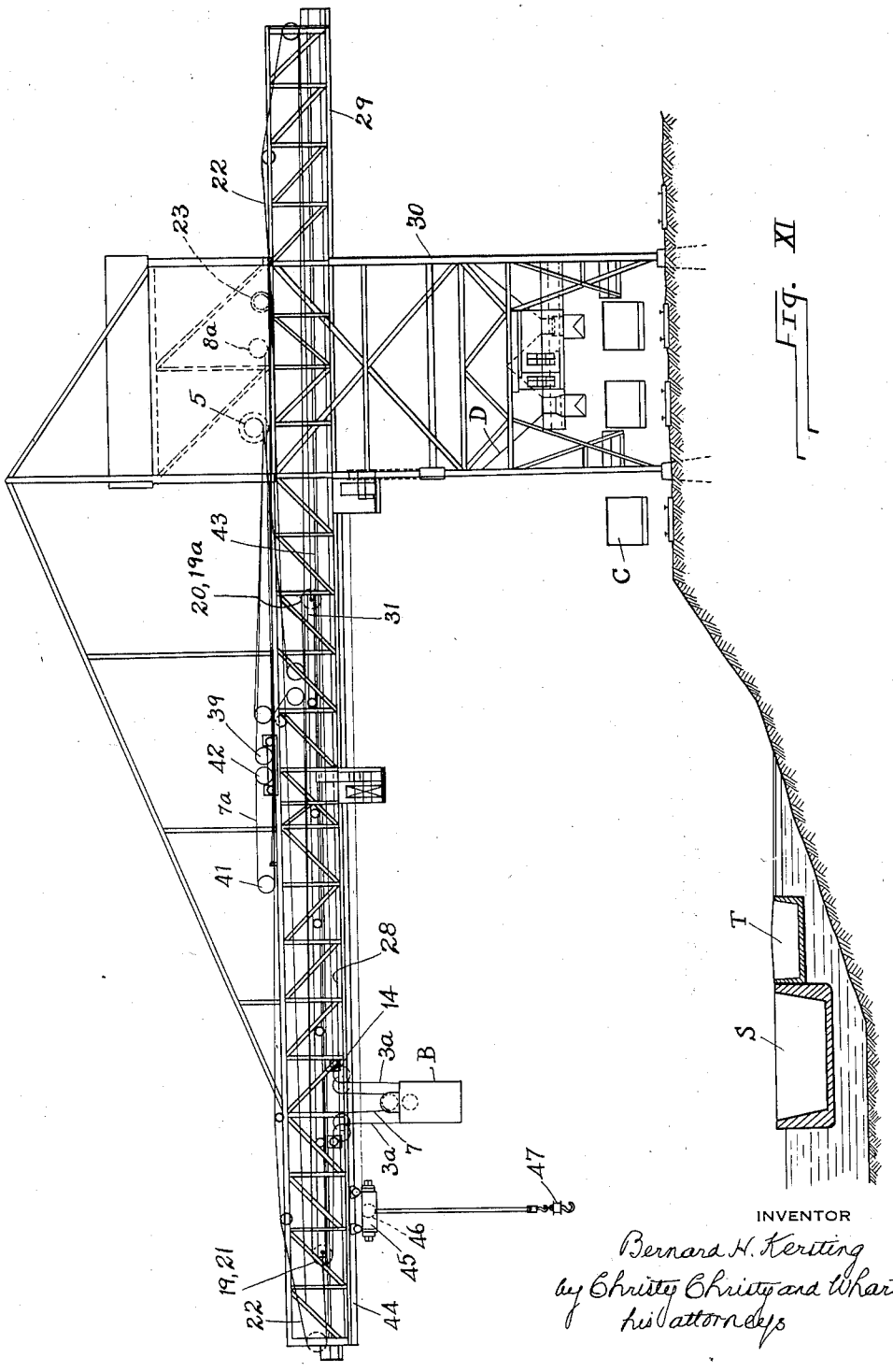


Fig. XI

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UNITED STATES PATENT OFFICE

1,968,493

CLAMSHELL BUCKET

Bernard H. Kersting, Ben Avon, Pa., assignor to The Dravo Contracting Company, a corporation of Pennsylvania

Application March 29, 1933, Serial No. 663,331

7 Claims. (Cl. 212—81)

In the organization and operation of clamshell buckets it is usual to suspend the bucket on a sheave running in a bight in a hoisting line. The sheave by which the bucket is so hung is included in the structure of one of a pair of blocks about which a tension line is trained. As this tension line is drawn and slackened the blocks are drawn together and allowed to separate. The drawing of the blocks together closes the bucket. The weight of the movable parts and of the load opens the bucket when the line is slackened. In the usual arrangement the hoisting or "holding" line and the tension or "closing" line are attached each at one end to suitable anchorages, and the two lines at their other ends are carried around two drums, which two drums are mounted in association with a suitable motor; driving connections are provided, such that either drum may be rotated alone in either direction, or the two may be rotated simultaneously. As the two drums are rotated simultaneously in one direction and the other, the bucket is raised and lowered. As the drum which carries the closing line is rotated in one direction or the other, while the other drum remains at rest, the two blocks are either drawn together or allowed to move apart, and the bucket is closed or opened. Additionally, it is to be remarked that, even while the drum which carries the holding line is being turned, the bucket may be opened and closed by a rotation of the closing drum in opposite direction or at a different speed from the speed of the holding drum. The operation of these drums is usually accomplished by means of a single motor and gearing, using manually operated friction clutches for connecting the drums to the motor; or by means of two separate motors, one motor being gear-connected to each drum, without the use of frictions.

In such arrangements, if a single motor be used, the drive connections between the motor and the drums include, as a practical necessity, manually operated friction clutches; and it is practically impossible, under varying conditions of load, to maintain through friction clutches perfectly synchronous rotation of the two drums. Particularly, is this true when the motor is driven by alternating current. If, alternatively, two motors be used, a like difficulty is found in maintaining synchronism of the two motors under varying conditions of load. The effects in either case are a more or less pronounced opening movement of the bucket at undesired times and an imposition of load upon one set of cables.

The invention is found in the provision of additional means for drawing upon and easing off the closing line. In one embodiment of the invention two drums are provided for the closing line; stationary anchorage for the closing line is eliminated; the closing line at its two ends is secured to the two said drums; one of the two drums is identified with the drum upon which the holding line is wound—that is to say, upon one of the two drums both lines are at one end wound. The last-named drum is preferably driven through unyielding power-transmission means from a motor. The motor may be driven by direct or alternating current, as is convenient, and without such disadvantage in the operation of the apparatus as that alluded to as characteristic of the heretofore usual arrangement. Rotation of the last-named drum effects raising and lowering; rotation of the other drum alone, upon which at its opposite end the closing line alone is wound, effects the opening and closing of the bucket.

In the accompanying drawings, Fig. I is a diagrammatic view of a clamshell bucket suspended and connected in the manner contemplated in the practice of my invention in one of several specific forms. Fig. II is a view in side elevation of an actual installation, and Fig. III is a plan view of this installation, from above. In Figs. II and III the invention as illustrated in Fig. I is embodied. Figs. IV and V are views corresponding to Figs. I and II, and illustrating the invention adapted to different conditions of service. Figs. VI and VII are fragmentary views to larger scale, showing in longitudinal and transverse sections a detail of the structure of Fig. V. Fig. VIII is a view in end elevation of the structure of Fig. V. Figs. IX and X are diagrammatic views, such as Fig. I, illustrating the invention under still other conditions of service,—Fig. X illustrating a modification in an essential feature. Figs. XI and XII are views corresponding to Figs. V and VIII, and illustrating another particular embodiment of the invention. Fig. X is a diagram of bucket operation in the embodiment of Figs. XI and XII.

Referring first to Fig. I, the clamshell bucket B is indicated in full lines in closed position, and in broken lines in open position. The bucket includes a body, to which the letter B is immediately applied, and the jaws J, movably mounted to swing between the full-line and the broken-line positions. A bucket-supporting sheave 2 rests in the bight of a holding line 3. This holding line at one end is anchored at 4, and at the other end is wrapped upon a drum 5. As the drum rotates, the bight in which the sheave 2 rests is lengthened and shortened, and the bucket is lowered and

raised. The sheave 2 is included in one of a pair of blocks. One of the blocks of the pair, mounted in the bucket body, constitutes a standing block, while the second (indicated by the numeral 6) constitutes a running block. The jaws J of the bucket are pivotally mounted through links L upon bucket body B; and they are provided with integral extensions E, by which they are pivotally connected to the running block 6. A closing line 7 is trained upon the sheaves of the two said blocks. It will be understood that as (by the taking in of the closing line) the two blocks approach one another the bucket closes; and as (by the paying out of the closing line) they recede, it opens. This closing line 7 is at one end wrapped upon drum 5. At its opposite end this closing line 7 is wrapped upon a drum 8. It will be perceived that as the drum 5 is rotated (drum 8 being at rest) the bucket will be raised and lowered, without change in its position of opening and closure; it will be perceived that (drum 5 remaining at rest) rotation of drum 8 in one direction or the other will effect the paying out or taking in of the closing line and the consequent opening or closing of the bucket; and it will further be perceived that, if there be simultaneous rotation of the two drums, differences in speed and in direction of rotation may be made effective to cause, simultaneously with vertical movement, either opening or closing.

Referring to Figs. II and III, it will be seen that the drum 5 is driven through an unyielding line of power transmission by a motor 10; and that drum 8 is driven through a similar line of transmission by the motor 11. As the motor 10 rotates in one direction or the other, bucket is raised or lowered; as the motor 11 rotates in one direction or the other, the bucket is opened or closed; as both motors rotate simultaneously, the bucket will be raised or lowered and, simultaneously, either opened or closed, according to the directions and relative speeds of rotation.

The apparatus of Figs. II—III includes a carriage, and the carriage is equipped with wheels 12 upon which it may travel along rails—the rails of an overhead crane, for example. Upon the carriage is mounted an operator's cab 13 also. Such a unit is termed a "man trolley hoist", and this unit and the operator in cab 13 travel along the rails upon which the carriage rests.

In Fig. IV an arrangement is diagrammatically shown which, in contrast with the arrangement of Fig. I, adapts the invention to a situation in which the operating drums are journaled in a stationary support and the bucket-equipped carriage moves relatively to that support. The drums 5 and 8, whose offices are the same as the correspondingly indicated parts of Fig. I, may be understood to be stationary in their mountings. The carriage is indicated at 14, and this carriage may be understood to be movable in right and left direction upon suitable rails. The holding line 3 and the closing line 7, passing over carriage-borne sheaves 15, 16, 17, 18, engage the bucket identically as in Fig. I. The holding line 3, secured at one end to a stationary anchorage 4 beyond the range of carriage travel, is, beyond the opposite end of the range of carriage, trained over a sheave 19, and it extends thence to drum 5. The sheave 19 is idly rotatable in a support which is stationary. The closing line 7, extending from drum 8 to drum 5, is carried around sheaves 20 and 21; and these sheaves too are idly rotatable in stationary supports and are situated beyond the ends of the range of carriage travel. In such an arrangement it is manifest that the drums 5 and 8 (stationary as they are) are capable of controlling the rise and descent and the opening and closing of the bucket, precisely as in the case of Fig. I.

Additionally, in Fig. IV a rack line 22 is shown, wrapped upon a drum 23, carried around sheaves 24 and 25 and at its opposite ends secured to carriage 14. The sheaves 24 and 25 are idly rotatable in stationary bearings arranged beyond the ends of the range of carriage travel. Rotation of drum 23 will effect the shifting of carriage 14, and (drums 5 and 8 being at rest) this shifting of the carriage will be accomplished without change either in the height at which the bucket is at the time sustained or in its condition of opening or closure. The lines 3 and 7 will, during carriage shifting, merely run through the sheave 2 and the sheaves of the blocks which the bucket carries.

Fig. IV shows also a counterweight 26, sustained in a bight in a line 27, which line (anchored at one end) is at its opposite end wrapped upon drum 5, and wrapped in opposite direction relatively to lines 3 and 7. The counterweight so arranged tends to relieve the hoisting engine which drives drum 5 of the torque due to the weight of the bucket.

Figs. V–VIII show an actual installation in which the arrangement diagrammatically shown in Fig. IV is carried out. The carriage 14 travels upon rails 28 in the boom 29 of tower 30,—apparatus such as is employed, for example, in unloading coal from barges. The parts already described are in Fig. V indicated by reference numerals corresponding to those of Fig. IV. The drums 5, 8, and 23 are, it will be observed, mounted in the tower 30, from which the boom 29 extends. It will be understood that three motors are advantageously provided for driving severally the three drums.

The operator in the tower, having under his control the several (or simultaneous) rotations of drums 23, 5, and 8, may shift the bucket B along the boom 29, may raise or lower it, open or close it, as he will.

Provision is made that inequalities due to unequal stretching of holding line 3 and closing line 7 shall find compensation, without disturbing the described operation which they severally and conjointly perform. The sheave 20 at the outer end of the boom, around which the closing line is trained is journalled to rotate idly in bearings upon a member in the form of a beam 50 mounted in the boom structure and movable in its mounting in the direction of carriage travel. A lever 51 is fulcrumed to an anchorage in the boom and the fulcrum point is movable against spring tension in a direction inward from the end of the boom toward the tower. The lever extends in a direction transverse to the direction of carriage travel, and swings in a plane which for structural reasons is slightly inclined to the vertical. To one arm of this lever the beam 50 is pivoted, and in the other arm the anchorage 4 of the holding line is secured. The range of movement of member 50 to the right, as seen in Fig. VI, is limited by stops 500, mounted on the member itself, and adapted to abut upon the boom structure.

It will be perceived that any increased tension upon either line relatively to the other will express itself in a swinging of lever 51 and a consequent correction of the inequality.

The spring-backed anchorage for the compensating lever 51 is adapted additionally to con-

stitute a cushioned stop when the lines are relieved of load. The anchorage consists of a bolt 52 upon whose shank are adjustably set nuts 53, 54, and against these nuts follower plates 55 and 56 abut. Between the follower plates springs 57 are set, grouped within a suitable housing 58. Outward movement of follower plate 56 is limited by stops 60 which form part of the housing 58; inward movement of follower plate 55 is limited by abutment upon the inner end wall of the housing. The springs under compression manifestly sustain the equalizing lever 51 in its position in the boom.

On the outward side of lever 51, behind the arm that carries anchorage 4, a block 59 is set, borne rigidly in the frame of the boom. When stress upon closing line 7 exceeds greatly that upon the holding line the beam 51, coming to abutment upon block 59, finds there a new fulcrum; the beam becomes a lever of the second class, and the tension of springs 57 becomes increasingly effective to resist the excess of stress. The parts are so proportioned that, when stress upon the holding line 3 is relieved—as happens when the bucket is placed upon the ground (or, perhaps, on the bottom of a barge)—the violent recoil of springs 57 will reach its permissible limit and bring nut 53 to abutment upon follower plate 55 before the end of beam 51 strikes block 59.

In Fig. IX the arrangement of Fig. IV is modified in this respect: The sheaves 19 (and 19*a*), 20 and 21, over which the holding line and the closing line are trained, are mounted, not on the stationary structure, but on a second carriage 31, which may be termed an "auxiliary carriage" and which, borne on wheels 32, travels along the same boom or other structure upon which carriage 14 travels. Two lines 33 and 34, anchored at 35 and 36 beyond the ends of the range of bucket travel, pass around sheaves 37, 38 (which sheaves are mounted in the auxiliary carriage 31) and at their opposite ends are secured to carriage 14. The rack line 22, as in Fig. IV, is secured to carriage 14. The distance at which the sheaves, 19, 21 at one end and 20, 19*a* at the other, are spaced apart upon auxiliary carriage 31 is at least half as great as the interval through which carriage 14, and with it bucket B, is intended to be shifted. In all other respects the arrangement is that already described in Fig. IV. It will be perceived of the arrangement of Fig. IX that, with the provision of the auxiliary carriage, when by the rotation of drum 23 the rack line 22 is drawn upon and carriage 14 is shifted, the auxiliary carriage 31 also is shifted. It is shifted by tension upon one or the other of lines 33 and 34 (the other at the same time easing off); it is shifted in the same direction with carriage 14; and, by virtue of the bends over sheaves 37, 38, it is shifted through half the interval through which carriage 14 is shifted. Such relative shifting of carriage 31 with respect to carriage 14 effects relative shifting of the sheaves 19, 21—20, 19*a* with respect to the engagements of the lines 3, 7 with the bucket B; and the relative shifting is precisely such that the lines 3 and 7 are taken up on one side of bucket B at precisely the same rate at which they are eased off on the other side. In consequence, in the operation of the apparatus of Fig. IX, shifting of the bucket along the boom or other support will not cause the lines 3 and 7 to run in the bucket-borne sheaves with which they are engaged. The bucket member continues inactive: its sheaves at rest in bights which advance coincidently with carriage advance.

In Fig. X there are two hoist lines 3*a*, 3*a*, secured each at one end to the bucket B and at the opposite end wrapped upon drum 5. Manifestly, as before, rotation of drum 5 will effect raising and lowering of the bucket. In this figure another variant upon the reeving of the lines is shown. The closing line 7, instead of being wrapped at its two ends upon two drums, is wrapped at both ends upon drum 5. Instead of varying the effective length of the closing line 7 in the manner shown in the earlier figures, a bight of variable length is formed in the closing line around a sheave 39. The sheave 39 may be shifted, to increase the length of the bight or to allow it to diminish. A line 7*a* wrapped upon a drum 8*a* and anchored at 40 encircles a sheave 41 (mounted in stationary bearings) and a sheave 42 (linked to sheave 39). Drum 8*a* (cf. drum 8, Fig. III) may be understood to be driven, advantageously, by a motor of its own. As, by the rotation of drum 8*a*, line 7*a* is drawn up or eased off, the bight in line 7 is lengthened or allowed to diminish, and accordingly the bucket B is closed or allowed to open. In other respects, the arrangement of Fig. X is that of Fig. IX.

The counterweight assembled with the drum 5 of Fig. IV may, manifestly, be assembled with the drum 5 of Fig. IX, or with the drum 5 of Fig. X, and so assembled may serve the purpose described in connection with Fig. IV.

The elaborations illustrated in Figs. IX and X involve, additionally, guide sheaves for the several lines, rendering them effective in the manner and to the ends described. These guide sheaves are details of engineering and will be recognized on examination of the drawings; they need not be more minutely identified.

In Fig. XI a tower 30 is shown, provided with a boom 29; and in the boom a bucket B is carried, in the manner indicated in the diagram, Fig. X. The same reference numerals are employed, and by them the structure will be found to correspond to the foregoing description.

In Figs. XI and XII a further capability of the boom is illustrated. The carriage 14, from which bucket B is immediately hung, travels on tracks 28, and the auxiliary carriage 31 travels upon tracks 43. Externally of these the boom is provided with beams 44 upon which run carriages 45. The carriages 45 bear electric hoists 46. These hoists, provided in pairs, may be operated severally, or, united in engagement with an equalizer beam 47, may be operated in unison. The carriages 45 may be caused to travel along beams 44 in any desired manner, as by means of motor and gearing.

By such provision this boom is adapted to handle material, whether in piece or in bulk. When the bucket B is withdrawn to the right (Fig. XI) and within tower 30, the hoists 46 may range along the boom and transfer material in piece between a boat S, for example, and a freight car C; when the hoists 46 are shifted to the outer left-hand end of the boom, or if the equalizer beam 47 has been removed from the hoists, the bucket B may range along the boom and transfer material in bulk from a boat T to the bins D in the tower.

I claim as my invention:

1. In apparatus for operating a clamshell bucket, the combination, with a support, a carriage movable upon such support, a second carriage movable upon such support in parallelism

with the first, the second carriage being of greater longitudinal extent than the first, and a bucket, of a drum mounted for rotation in such support, two groups of sheaves spaced apart upon the first carriage, two groups of sheaves spaced apart upon the second carriage at an interval exceeding the range of movement of the first carriage relatively to the second, a holding line and a closing line each wrapped at one end upon said drum and severally passing over sheaves borne by the said carriages and engaging the bucket, means for shifting the first carriage, means for causing the second carriage to move at relatively slow speed in response to movement of the first carriage, and means for drawing upon and easing off the said closing line independently of the holding line.

2. In apparatus for operating a clamshell bucket, the combination, with a support, a carriage movable upon the support, and a bucket borne by the carriage, with means for raising and lowering and opening and closing the said bucket, such means including a holding line and a closing line, of a member mounted in the support and movable in its mounting in the direction of carriage travel, a sheave rotatably borne by said member, the closing line being trained upon such sheave, and a lever mounted in the support beyond the range of carriage travel, the said member being pivotally connected to the said lever in one arm thereof, and the holding line being anchored in the opposite arm of said lever.

3. In apparatus for operating a clamshell bucket, the combination, with a support, a carriage movable upon the support, and a bucket borne by the carriage, with means for raising and lowering and opening and closing the said bucket, such means including a holding line and a closing line, of a member mounted in the support and adapted to be shifted against spring tension and in the direction of carriage travel, a lever fulcrumed to said member, a sheave borne by one arm of said lever, the closing line being trained upon said sheave and the holding line being anchored in the opposite arm of the lever.

4. In apparatus for operating a clamshell bucket, the combination, with a support, a carriage movable upon the support, and a bucket hung from said carriage by a holding line and equipped with a closing line, of a beam mounted in the support and reciprocable in its mounting in the direction of carriage travel, a sheave rotatably borne by said beam, the closing line being trained upon such sheave, a spring-backed member mounted in the support and adapted to be shifted in its mounting in the line of carriage travel, a lever fulcrumed to said member, the said beam being pivotally connected to one arm of said lever the holding line being anchored to the opposite arm of said lever, the parts being so proportioned that a swinging of the lever upon the fulcrum defined brings it at one end to a new fulcrum point in the support.

5. In apparatus for operating a clamshell bucket, the combination, with a support, a carriage movable upon the support, and a bucket borne by the carriage, with means for raising and lowering and for opening and closing the said bucket, such means including a holding line and a closing line, of a bolt mounted in and longitudinally movable in the support and in the direction of carriage movement, means for yieldingly holding the bolt against movement in either direction, a lever pivoted in the said bolt, a sheave borne by one arm of the lever, the closing line being trained upon said sheave, and the holding line being anchored in the arm of the lever opposite that which bears the said sheave, the parts being so arranged that in the range of swing the lever comes to bearing at one end upon a new fulcrum point in the support.

6. In apparatus for operating a clamshell bucket, the combination, with a support and a bucket, of a drum-operated holding line engaging the bucket, a drum-operated closing line engaging the bucket, a member movable in the said support in a direction toward and from the bucket, a sheave borne by said member, over which sheave one of said lines is carried, a lever mounted in the said support, the said member being pivotally connected to the lever in one arm thereof, and the other of the said lines being anchored in the other arm of the said lever, whereby in the automatic movement of said member inequalities in the stretching of the said lines finds compensation.

7. In apparatus for operating a clamshell bucket, the combination of a support, a carriage movable upon said support, a second carriage movable upon said support, the length of such second carriage being as great as half the intended range of bucket travel, a bucket, a drum mounted for rotation in said support, two groups of sheaves spaced apart upon the first carriage, two groups of sheaves borne by the second carriage at the ends thereof, a holding line and a closing line each wrapped at one end upon said drum and severally passing over sheaves borne by the said carriages and engaging the bucket, means for shifting the first carriage upon the said support, and means for shifting the second carriage in response to movement of the first and at a speed one half as great as that of the first.

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