United States Patent [19]

Anderson

[11] **3,750,311**

[45] **Aug. 7, 1973**

[54] **GRAVITY OPERATED MECHANICAL GRAB**

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[22] Filed: **Oct. 12, 1971**

[21] Appl. No.: **187,996**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 39,432, May 21, 1970, abandoned.

[52] **U.S. Cl.** **37/188,** 214/650, 294/110

[51] **Int. Cl.** **B66c 3/02**

[58] **Field of Search** 37/187, 188, 183; 294/86, 86.17, 86.19, 86.20, 86.21, 88, 70, 106, 109, 110, 116, 118; 214/650, 656, 657, 658

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Primary Examiner—Robert E. Pulfrey
Assistant Examiner—Eugene H. Eickholt
Attorney—Greek Wells, David P. Roberts et al.

[57] **ABSTRACT**

A mechanical grab is described that has two telescopic members, with one attached to a single hoist line and the other having jaw elements mounted thereon. Linkage interconnects the one member with the jaw elements to automatically open and close the jaw elements as the two telescopic members move in relation to each other when the mechanical grab is lowered and raised from the ground. The mechanical grab has a provision for preventing the jaw elements from closing every other time the mechanical grab is lowered to the ground to prevent the jaws from closing on a just released load and for maintaining the jaws open until the mechanical grab is again lowered to the ground.

3 Claims, 16 Drawing Figures

United States Patent [19]
Anderson

[11] **3,750,311**
[45] **Aug. 7, 1973**

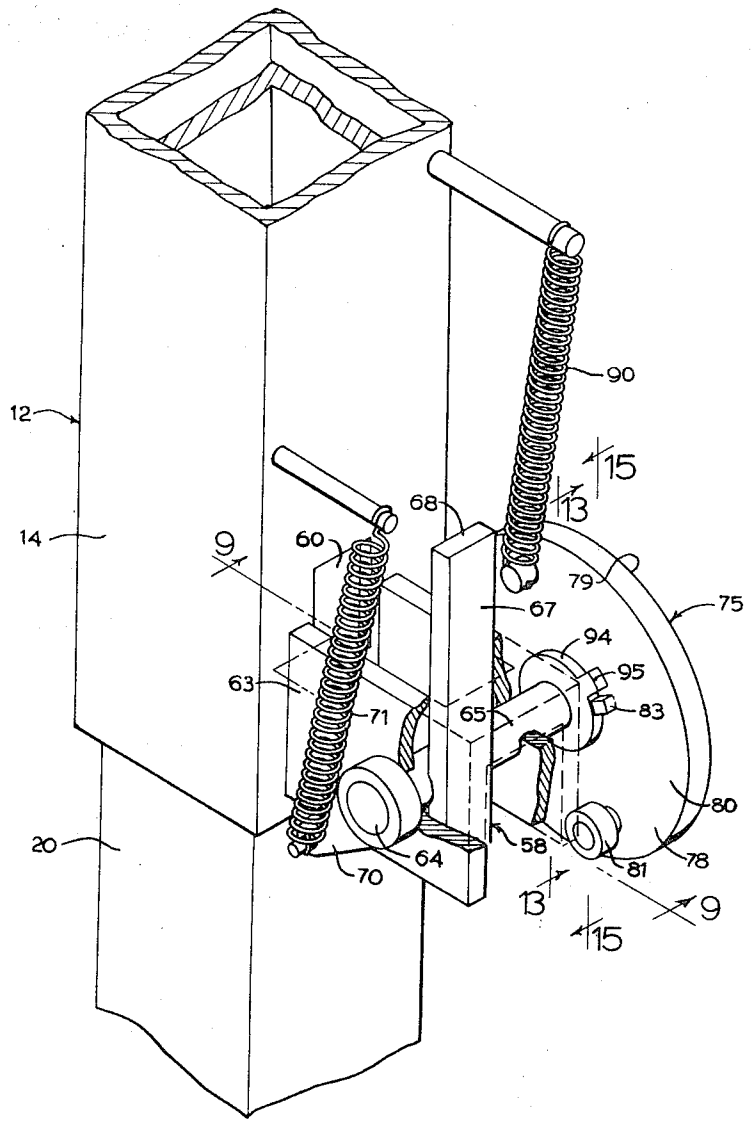


FIG 1

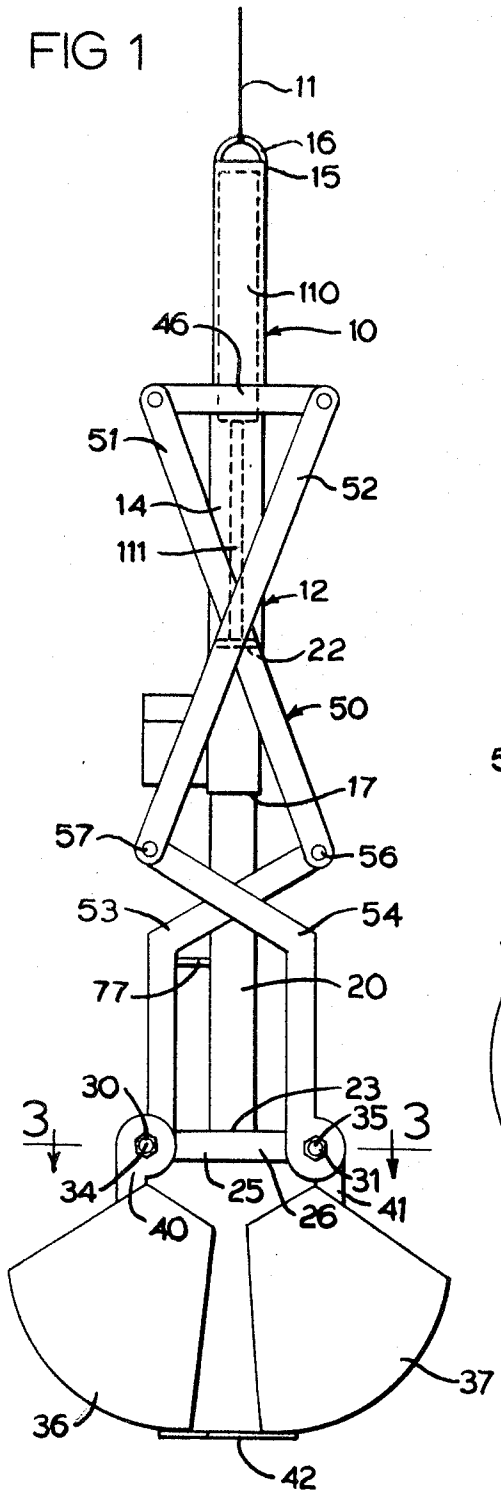
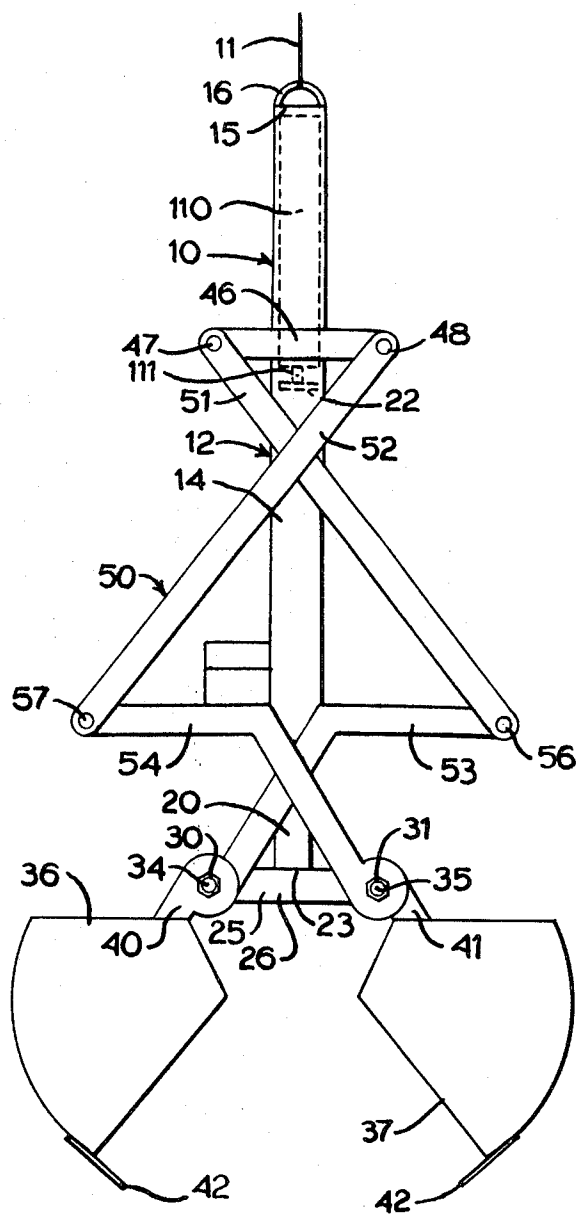

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FIG 2


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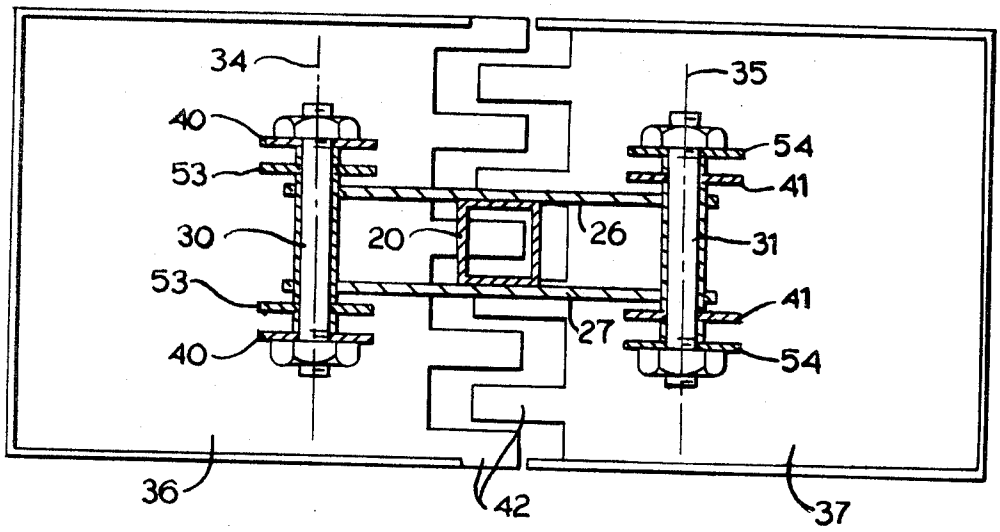


FIG 3

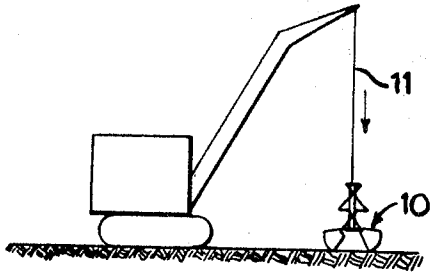


FIG 4

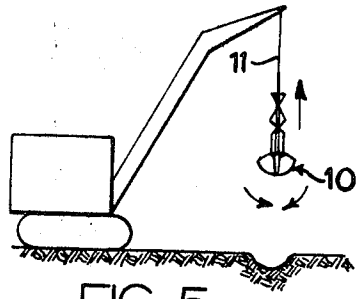


FIG 5

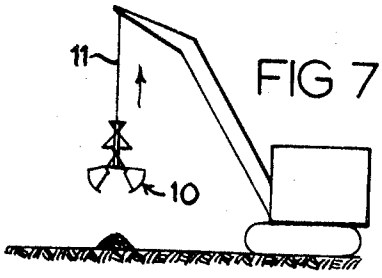


FIG 7

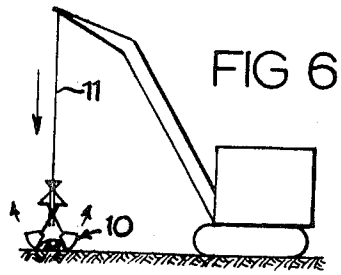
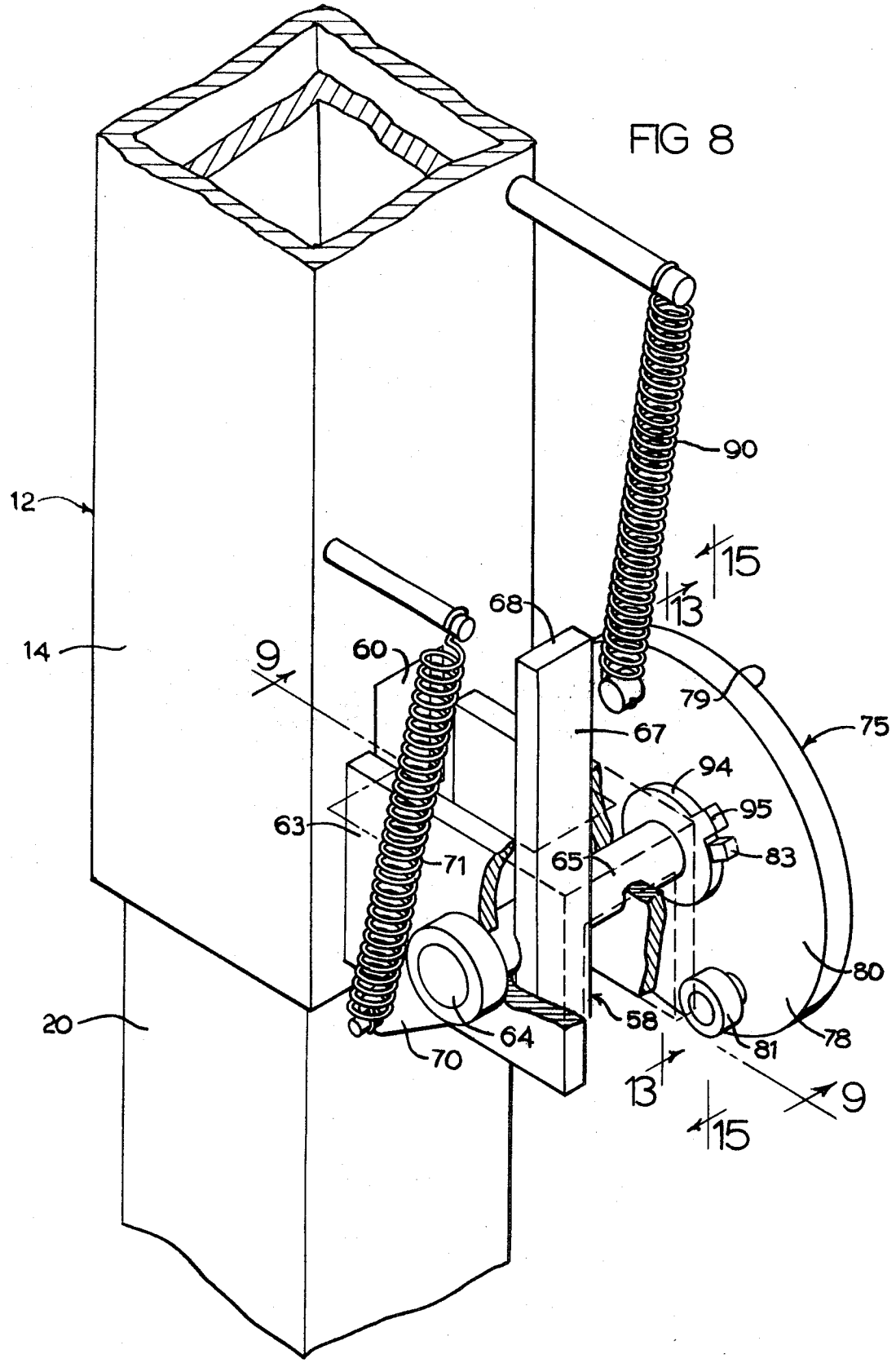


FIG 6

FIG 8


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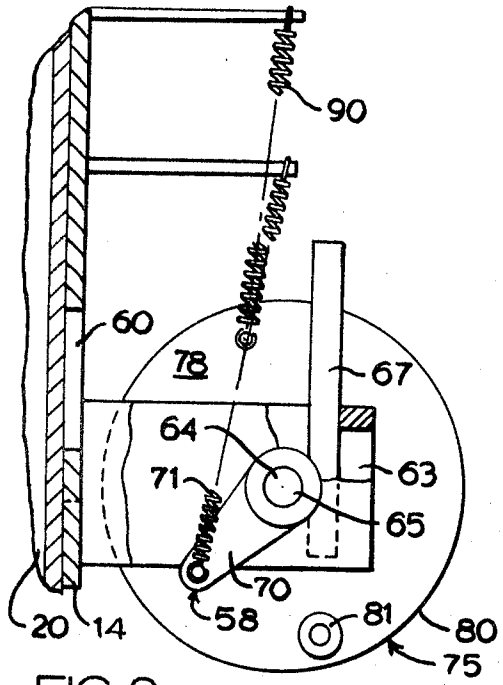


FIG 9

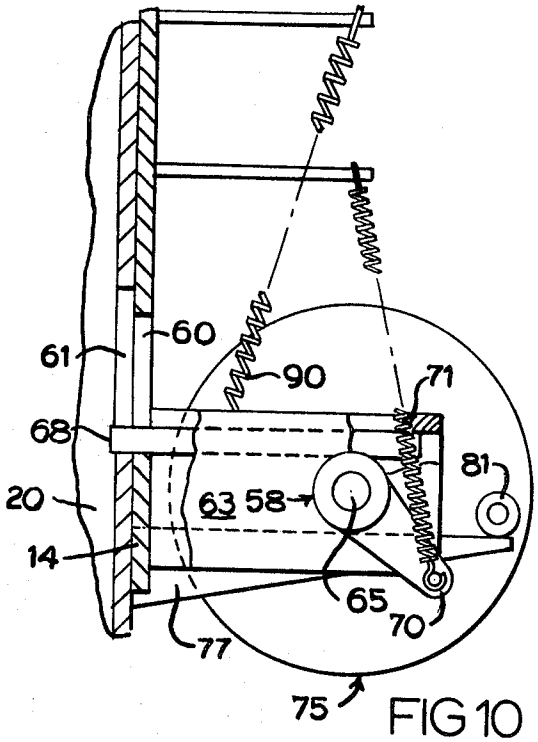


FIG 10

FIG 11

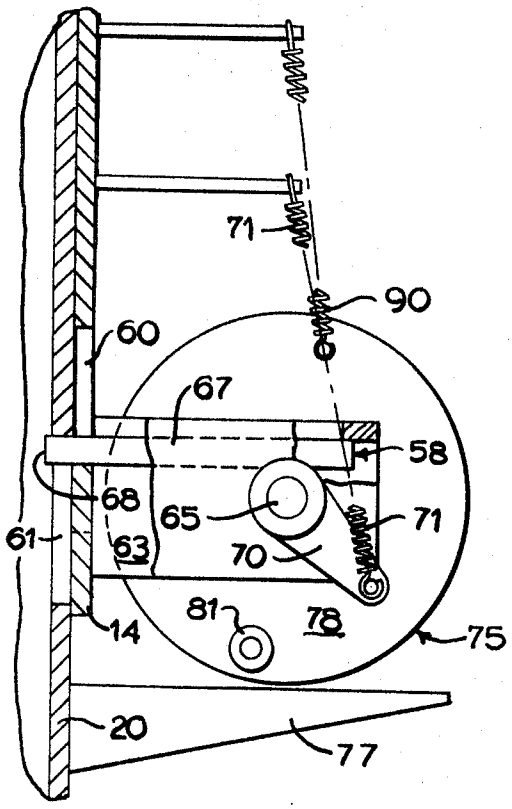
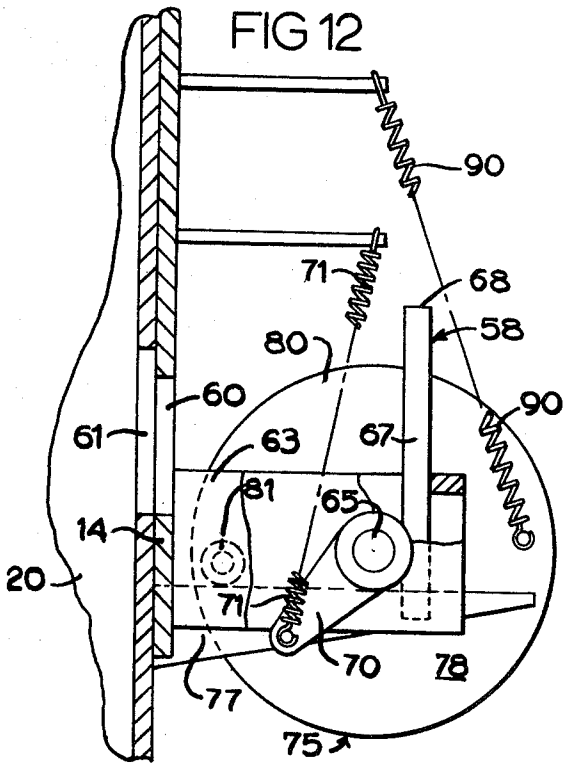


FIG 12



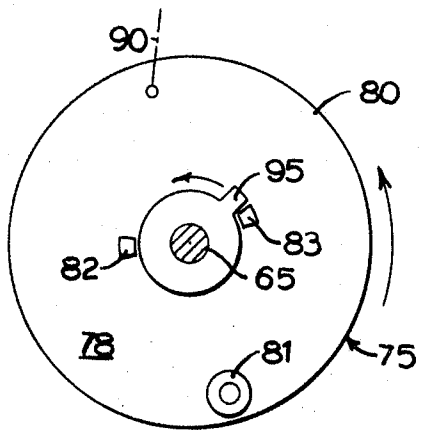


FIG 13

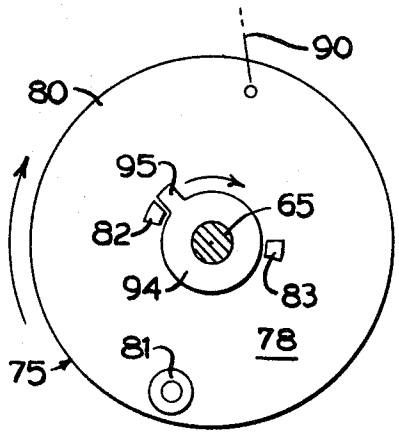


FIG 14

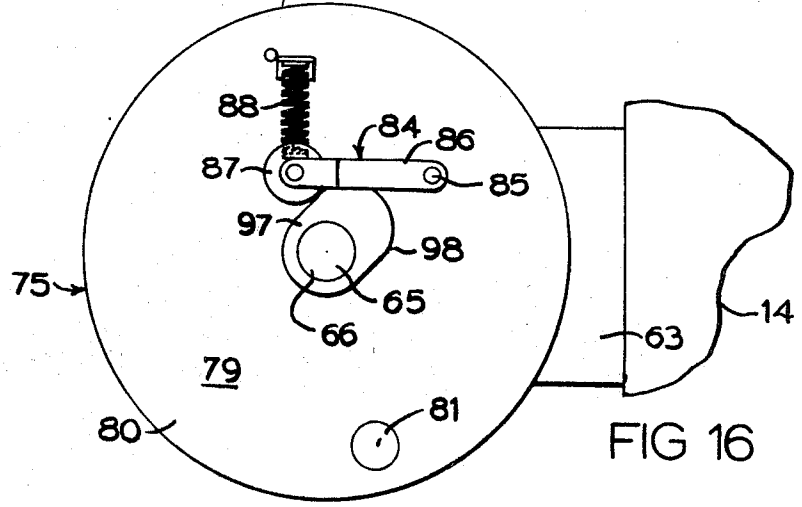


FIG 16

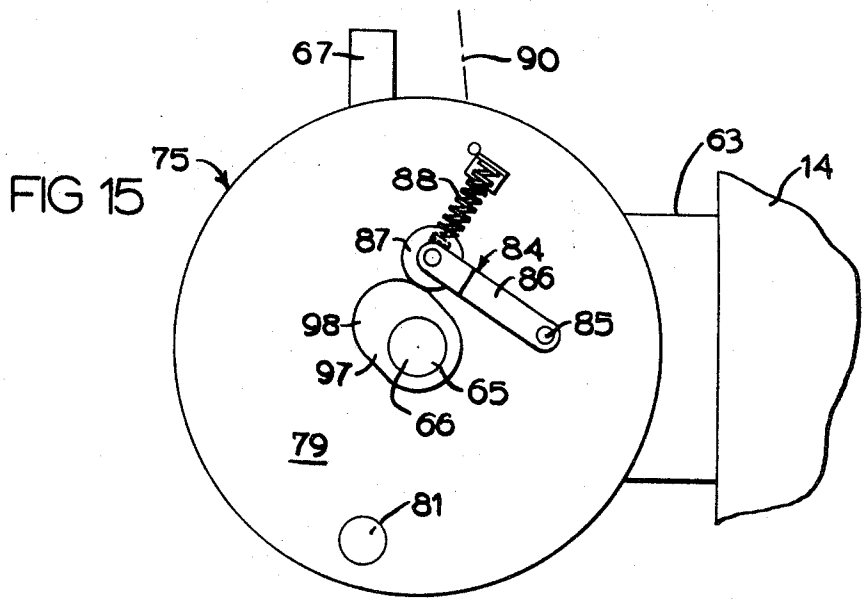


FIG 15

GRAVITY OPERATED MECHANICAL GRAB

RELATED APPLICATIONS

This application is a continuation-in-part of parent application Ser. No. 39,432, filed May 21, 1970, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to mechanical grabs and more particularly to mechanical grabs that may be operated by single hoist line.

The simplicity and desirability of constructing and utilizing a mechanical grab or clambucket that may be operated from a single hoist line has long been recognized. Most single line mechanical grabs have hydraulic or pneumatic cylinders mounted thereon for selectively opening and closing the clam or jaw elements to pick up and release loads. Devices along this line are illustrated in U. S. Pat. Nos. 2,715,787; 2,837,846; 3,187,916; 3,314,709 and 3,451,150. Although such devices are quite effective, they are also quite expensive requiring a source of pressurized fluid and fluid lines that run out the boom and down the single hoist line. Sometimes the fluid lines become entangled and are subjected to breakage which seriously hampers the operation of the device.

Other devices use a secondary line connected to a latching mechanism for releasing the jaw or clam elements to dump or release a load. An example of such a device is illustrated in U. S. Pat. No. 2,644,263.

One of the principal objects of this invention is to provide a mechanical grab that does not utilize a hydraulic cylinder or a secondary pull line to operate the jaw elements. One of the main problems encountered in the design of such a device is the necessity of keeping the jaw elements open after the load has been released so that the jaw elements will not pick up the released load when the hoist line lifts the grab. It is also necessary to keep the jaw elements open until the grab is again lowered to pick up another load.

A device that is directed along this line is disclosed in U. S. Pat. No. 2,758,398. It shows a digging bucket that is suspended by a single line hoist frame with a linkage interconnecting the hoist frame and the bucket. The linkage automatically opens the bucket when the device is dropped to the ground and automatically closes the bucket when the device is lifted from the ground. To keep the bucket open after a load has been released, a latching means is mounted on the frame for locking the linkage in a fixed position to prevent the bucket from opening. The latching means is operated by tipping the bucket over on one of its sides to activate and lock the latching means. One can readily appreciate the difficulty of consistently, with a minimum of effort, being able to tip the bucket over to actuate the latching means. Such a procedure is frequently quite tedious and greatly limits the efficiency of the mechanical grab.

With the applicant's invention, this procedure is unnecessary. The applicant's invention provides a mechanical grab that has a latching means that automatically prevents the jaw elements from closing every other time the mechanical grab is lowered to the ground. No external means is needed nor are unusual maneuvers required to operate the latching means.

In this invention, the latching means is operated by means that is responsive to the relative movement between two telescopic members that are positioned vertically when suspended by the single hoist line.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of this invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a frontal view of a mechanical grab incorporating the principal features of this invention in which the mechanical grab is shown in an extended closed position;

FIG. 2 is a frontal view similar to FIG. 1 except showing the grab in a contracted, open position;

FIG. 3 is a sectioned plan view taken along line 3—3 in FIG. 1;

FIGS. 4–7 are a series of diagrammatic views showing one operating cycle of the mechanical grab;

FIG. 8 is a fragmentary isometric view of a latching means for the mechanical grab;

FIGS. 9–12 are a sequence of sectioned views illustrating the operation of the latching means;

FIG. 13 is a sectioned side view of a portion of the latching means taken along line 13—13 in FIG. 8;

FIG. 14 is a view similar to FIG. 13 illustrating a different operative relationship of elements seen in FIG. 13;

FIG. 15 is a side view taken along line 15—15 in FIG. 8; and

FIG. 16 is a side view similar to FIG. 15 except showing a different operative relationship of the elements seen in FIG. 15.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now in detail to the drawings, a mechanical grab is shown at 10 (FIGS. 1 and 2) attached to one end of single hoist line 11. Such a mechanical grab 10 is utilized for picking up a load, moving it to another location, and releasing it. Such devices are frequently used in the excavation and construction industries for moving dirt and similar earth materials.

Grab 10 has a frame 12 that includes a first tubular member 14 slidably mounting on a second tubular member 20. Members 14 and 20 are substantially square in cross-section with member 14 being slightly larger in cross-section to slidably accommodate member 20 longitudinally within. A hook 16 is rigidly affixed to one end 15 of member 14 to provide attachment to line 11. The other end 17 of member 14 is open to accommodate member 20.

Second tubular member 20 includes one end 22 which extends through open end 17 and is slidably engaged within member 14. The other end 23 of member 20 projects outwardly from member 14. Members 14 and 20 are capable of longitudinal movement relative to one another in a telescopic fashion.

This longitudinal, telescopic movement of members 14 and 20 is utilized to open and close an opposed pair of jaws or bucket elements 36, 37 by operating an interconnecting toggle linkage 50.

End 23 of member 20 carries a transversely mounted cross frame head 25. The frame head 25 includes plates 26 and 27 that extend outwardly from two opposing sides of member 20. Parallel pins 30 and 31 are mounted between the plates 26 and 27. Pins 30 and 31 define pivot axes 34 and 35 respectively.

Jaw elements 36 and 37 are mounted on frame head 25 for opposed pivotal movement about axes 34 and 35, by respective arms 40 and 41. Each jaw element 36, 37 has a lower edge with teeth 42 extending therefrom for breaking up and scooping a load of dirt into the jaw elements.

A second cross frame head 46 is affixed to tubular member 14 between ends 15 and 17. Head 46 has parallel pins 47 and 48 mounted thereon on opposite sides of member 14 with axes parallel to the axes 34 and 35 of pins 30 and 31.

Linkage 50 interconnects pins 30 and 31 with pins 47 and 48 in a toggle joint relationship to automatically pivot jaws 36 and 37 to open and close in response to relative telescopic movement between tubular members 14 and 20.

Pins 47 and 48 pivotally support respective elongated arms 51 and 52. Arms 51 and 52 cross each other as shown in FIGS. 1 and 2. The linkage 50 further includes arms 53 and 54 having ends pivotally connected to arms 51 and 52 and rigidly connected to arms 40 and 41 along pins 30 and 31 for pivoting jaws 36 and 37 about pin axes 34 and 35 respectively. Arms 51 and 53 are interconnected by a pivot pin 56. Arms 52 and 54 are similarly connected by a pivot pin 57.

In operation, the mechanical grab 10 is lowered to the ground by single hoist line 11. Upon contacting the ground, member 14 will move downwardly over member 20 to the contracted position as shown in FIGS. 2 and 4. As tubular member 14 moves downwardly the arms comprising linkage 50 pivot to force jaws 36 and 37 to pivot to the open position shown in FIGS. 2 and 4.

As the grab 10 is lifted, tubular member 14 moves upwardly with respect to member 20. This upward relative movement causes linkage 50 to pivot the jaw elements 36 and 37 to the closed position as shown in FIG. 5.

It may thus be understood that the mechanical grab is normally gravity operated to open and close the jaw elements.

Mechanical grab 10 further includes a locking or latching means 58 and a means 75 for operating the locking means to cause the jaws 36 and 37 to automatically remain open every other time that the mechanical grab is lifted from the ground. The resulting jaw opening and closing operation cycle may best be seen in FIGS. 4–7. Jaws 36 and 37 which have been previously locked open are lowered to the ground (FIG. 4). Upon contact with the ground, locking mechanism 58 releases allowing jaws 36 and 37 to close as the grab is raised to scoop up a load of dirt (FIG. 5). The grab is then moved to a desired location where it is lowered (FIG. 6). As the grab contacts the ground, the jaws 36 and 37 are opened by toggle linkage 50 to deposit the load. When the jaws become fully opened, the locking mechanism automatically operates, locking the jaws open. The grab is raised (FIG. 7) and carried back to the position shown in FIG. 4 and the above described sequence is repeated until the excavation is complete.

The locking means 58 includes a side aperture 60 (FIG. 8) formed in the outer tubular member 14 adjacent the end 17. A corresponding side aperture 61 is formed in tubular member 20 adjacent the lower end 23. The side apertures 60 and 61 are aligned with each other when the jaws 36 and 37 are in the open position.

As seen in FIG. 8, locking means 58 includes a side frame 63 affixed to a side of tubular member 14 adjacent the side aperture 60. A shaft 65 is rotatably positioned on frame 63, having an axis substantially transverse to the longitudinal axis of members 14 and 20. Stop 67 is affixed to shaft 65 to be pivoted about the shaft axis between an inoperative position (FIG. 8) and an operative position where stop 67 projects through apertures 60 and 61 (FIG. 10 and 11). Stop 67 is in the form of an elongated bar that is affixed to the side of shaft 65 transverse to the shaft axis and adjacent aperture 60. Stop 67 is pivoted in an approximate 90° arc from the inoperative position shown in FIGS. 8, 9 and 12 with the stop substantially parallel with the axis of members 14 and 20, to the operative position with end 68 extending through side apertures 60 and 61 (FIGS. 10 and 11). It should be noted that apertures 60 and 61 are of sufficient size to allow a small amount of relative movement between the tubular members 14 and 20 when the stop is in the operative position, the importance of which is described later.

Locking means 58 is provided with an over-center arrangement (FIG. 8) to cause shaft 65 and thereby stop 67 to snap to either an operative or inoperative position once the shaft is rotated past a dead-center position. The over-center arrangement includes a crank 70 affixed to one end 64 of shaft 65. A tension spring 71 is connected between the extended end of crank 70 and a rod protruding from tubular member 14. Spring 71 becomes fully extended, intersecting the axis of shaft 65 when crank 70 is pivoted approximately 45° to a dead-center position. Further pivotal movement of shaft 65 in either direction will cause spring 71 to bias the crank 70 in that direction, pivoting shaft 65 and stop 67 inwardly to the position shown in FIG. 10 or outwardly to the position shown in FIGS. 9 and 12.

Operating means 75 is operatively connected to locking means 58 to rotate shaft 65 past the dead-center position enabling spring 71 to snap stop 67 into apertures 60, 61 when jaws 36 and 37 reach the open position or to snap stop 67 to the inoperative position as the previously opened jaws again engage the ground and attain a fully open position. Operating means 75 includes a cam finger 77 (FIGS. 10–12) affixed to the side of tubular member 20 and projecting outward therefrom. Cam finger 77 is positioned on member 20 to engage a follower 81 rotatably mounted to a wheel 80. Shaft 65 rotatably supports wheel 80 for free rotation about its axis adjacent shaft end 66. Follower 81 is comprised of a freely rotatable roller located near the edge of inner side 78 of wheel 80 projecting into the path of finger 77. A tension spring 90 is affixed at one end to a rod extending from member 14 and at the other to a point on wheel 80 diametrically opposing follower 81. Follower 81 is biased, by spring 90, toward a "zero" or "center" position where the centers of shaft 65 and follower 81 would align with the longitudinal axis of spring 90.

The inner side 75 of wheel 80 has two radially spaced lugs 82 and 83 (FIGS. 13 and 14) extending therefrom for alternately engaging a corresponding shoulder 95 of collar 94 affixed to shaft 65 adjacent wheel side 78. Either lugs 82 and 83 in response to the rotation of the wheel 80 engages and moves shoulder 95 to rotate shaft 65.

A disc cam 97 is affixed on shaft end 66 adjacent wheel side 79. The cam 97 has a lobe 98 that projects

radially outward from the axis of shaft 65. A cam follower assembly 84 is mounted to the side 79 of the wheel 80. The cam follower assembly 84 includes a stud shaft 85 on which an arm 86 is pivotally mounted. A cam follower roller 87 is mounted on the end of the arm 86 for riding on the cam 97. The roller 87 is biased against the cam 97 by a compression spring 88. The cam lobe 98 engages the roller 87 creating a moment on the wheel 80 to bias the wheel 80 counter to the tension of the spring 90 when the roller 81 is not engaged by the cam 77. This arrangement causes the cam follower 81 to assume offset positions on either side of the "zero" position depending on the location of the cam lobe 98. When the locking means 58 is in the operating position, the cam lobe is in the position shown in FIG. 16 creating a counter-clockwise moment on the wheel 80 as viewed in FIGS. 15 and 16 to offset the roller 81 from the center line of the shaft 64 and spring 90 toward the tubular members 14 and 20. When the locking means is in the inoperative position, the cam lobe 98 is in the position shown in FIG. 15 creating a clockwise moment on the wheel 80 as viewed in FIGS. 15 and 16 to offset the roller 81 to the outside of the center line.

In describing the operation of latching means 58 and operating means 75, attention is directed to FIGS. 9–16. It should be noted that initially roller 87 is biased against the right side of cam lobe 98 (FIG. 15), lug 83 is adjacent shoulder 95 (FIG. 13), and the cam follower 81 is offset to the outside (FIG. 15), and the remaining elements of latching means 58 are positioned as shown in FIG. 9, thereby permitting relative movement between members 14, 20. As the closed jaws are lowered to the ground by line 11, outer tubular member 14 slides down member 20 causing the jaw elements to progressively open, releasing the load (FIG. 6). When the jaws approach the full open position, cam follower 81 engages finger 77 to pivot wheel 80 counterclockwise as viewed in FIGS. 10 and 13 and clockwise as viewed in FIG. 15. As wheel 80 pivots, lug 83 engages shoulder 95 and progressively rotates shaft 65 past the dead-center position, allowing spring 71 to drive or snap stop 67 into the operative position with end 68 projecting through the aligned apertures 60 and 61 (FIG. 10). This movement involves approximately 90° rotation of shaft 65 and elements attached thereto including the cam 97 from the inoperative position (FIG. 9) to the operative position (FIG. 10).

After the load has been released, grab 10 may be raised by line 11 with the jaws 36 and 37 locked in the open position. As the grab is elevated, member 14 moves slightly in relation to member 20 from the position shown in FIG. 10 to the position shown in FIG. 11. This movement allows finger 77 to become dis-engaged with follower 81 thereby allowing wheel 80 to rotate under the influence of tension spring 90 in a clockwise direction as viewed in FIGS. 10 and 11 and counterclockwise as viewed in FIG. 16. Because of the bias influence of cam 97 against follower 87, the roller 81 is moved past the "zero" position to the inside offset position shown in FIGS. 11 and 16 to ready the operating means for the second half of a cycle. In this position the follower 87 is on the left side of the lobe 98 as shown in FIG. 16.

The grab is then returned to the pickup location where it is again lowered to the ground for picking up a second load (FIG. 4). As the jaws 36, 37 engage the ground, member 14 moves downwardly slightly with respect to member 20, moving follower 81 into engagement with finger 77. Finger 77 rotates the wheel 80 clockwise as viewed in FIGS. 12 and 14 and counterclockwise as viewed in FIG. 16, to move lug 82 into engagement with shoulder 95. Lug 82 progressively rotates shaft 65, stop 67 and cam 97 past the dead-center position, enabling spring 71 to snap stop 67 back into the inoperative position shown in FIG. 12. Cam 97 is rotated to the position shown in FIG. 15. As the grab is lifted progressively jaws 36 and 37 progressively close to scoop up a second load. As the members 14 and 20 move relative to each other, follower 81 disengages from finger 77 rendering spring 90 effective to rotate the wheel 80 and follower 81 counter-clockwise from the position shown in FIG. 12 to the outside offset position shown in FIG. 9. As the wheel 80 rotates the follower 87 moves to the right side of lobe 98 as shown in FIG. 15 causing the follower 81 to be biased to the outside offset position to complete the cycle.

As can be readily appreciated from the above description, the locking means and the operating means automatically cause the jaw elements to remain open every other time the mechanical grab is lowered and supported on the ground. It can be stated that the operating means is responsive to the relative movement between the tubular members 14 and 20 for operating the locking means every other time the tubular members move into the contracted position by the effect of gravity on the mechanical grab.

Although this mechanical grab is particularly designed for releasing the load at ground level an alternative feature is provided for enabling the mechanical grab to be opened above the ground. This is provided by a cylinder or actuator 110 mounted in the tubular member 14 with a piston rod 111 attached to the tubular member 20. In this configuration, the mechanical grab may be utilized either for dropping the earth material above the ground or it may be utilized for discharging the material at the ground level. The piston is normally allowed to freely move in the cylinder 110. However, when an elevated drop is required fluid pressure is applied to the piston to retract the rod 111 to cause the linkage means to open the jaw elements 36 and 37.

It should be understood that the above described embodiment is simply illustrative of the principals of this invention, and that numerous other embodiments may be devised by those skilled in the art utilizing the principals thereof. Therefore, only the following claims are intended to define this invention.

What is claimed is:

1. A gravity-operated mechanical grab attachable to a single hoist line for automatically picking up and releasing loads, comprising:

two telescopic members with one telescopic member attachable to the single hoist line and the other telescopic member slidable in relation to the one telescopic member;

opposing jaw elements pivotally mounted on the other telescopic member for selectively closing to receive a load therebetween and opening to release the load;

linkage means extending between the one telescopic member and the opposing jaw elements for pivoting the jaws in response to the relative movements of the telescopic members to automatically close the jaw elements as the mechanical grab is lifted

and automatically open the jaw elements as the mechanical grab is lowered onto the ground;

said telescopic members having corresponding side apertures formed therein which are aligned with each other when the jaw elements are open;

a stop means mounted on the outside of the telescopic member having an end for pivotal movement into and out of the aligned apertures when the jaw elements are open to prevent and permit respectively relative movement between the telescopic members;

a cam means mounted on the outside of the other telescopic member for movement therewith;

an over-center spring means operatively connected to the stop means for biasing the stop means end into and out of the aligned aperture from a neutral position;

a cam follower means mounted on the outside of the one telescopic member in the path of the cam means and operatively connected to the stop means for pivoting the stop means alternatively past the neutral position in opposite directions when engaged by the cam means to render the spring means effective to move the stop means into and out of the aligned apertures.

2. The mechanical grab as defined in claim **1** wherein the linkage means includes:

a first set of crisscrossing link arms having one end thereof pivotally connected to a fixed pivot supported by the one telescopic member and the other end thereof pivotally connected to a free pivot;

a second set of crisscrossing link arms having one end thereof pivotally connected to a fixed pivot supported by the other telescopic member and operatively connected to the jaw elements and the other end thereof pivotally connected to the free pivot to pivot the jaw elements in response to the relative movement of the telescopic members.

3. The mechanical grab as defined in claim **1** wherein the stop means includes:

a stop bar mounted transversely to a rotatable shaft; said shaft has a radial shoulder formed therein;

said over-center spring means being operatively connected to the shaft to bias the shaft in opposite directions from a neutral shaft position;

said cam means being supported on a wheel that is freely rotatable on said shaft; and

said wheel having angularly spaced lugs projecting therefrom for engaging the shaft radial shoulder on opposite sides to rotate the shaft in opposite directions from the neutral shaft position in response to the rotation of the wheel.

* * * * *