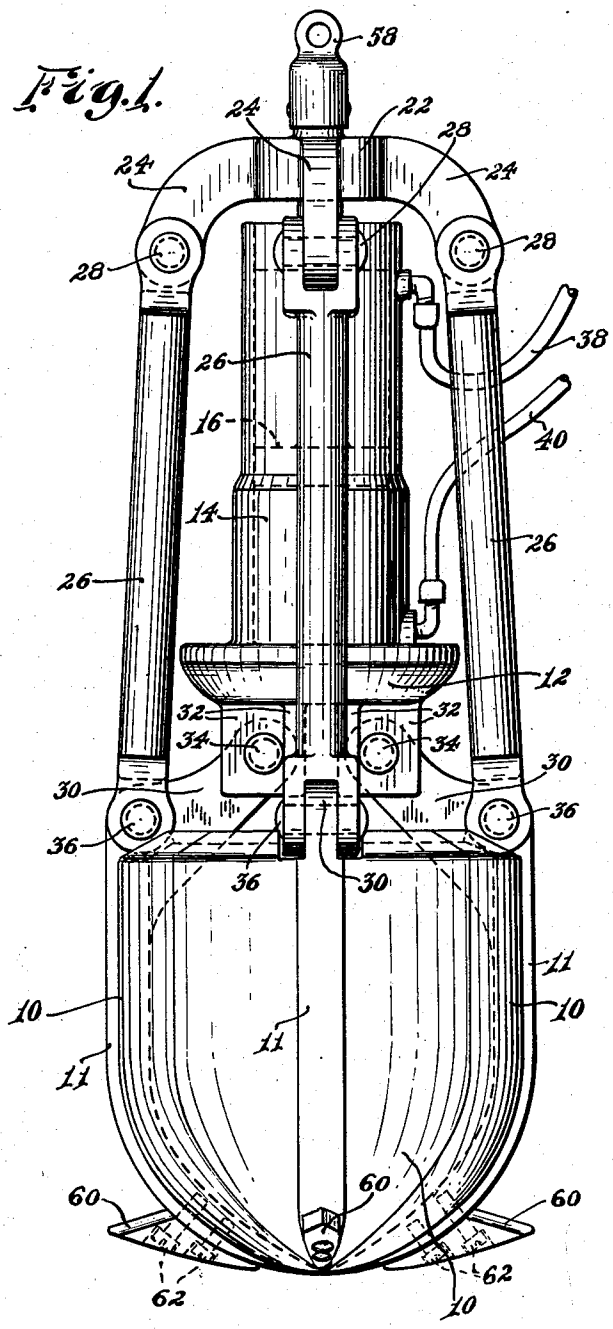
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BOOM-SUSPENSION BUCKETS AND THE LIKE

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Fig. 1.



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Fig. 2.

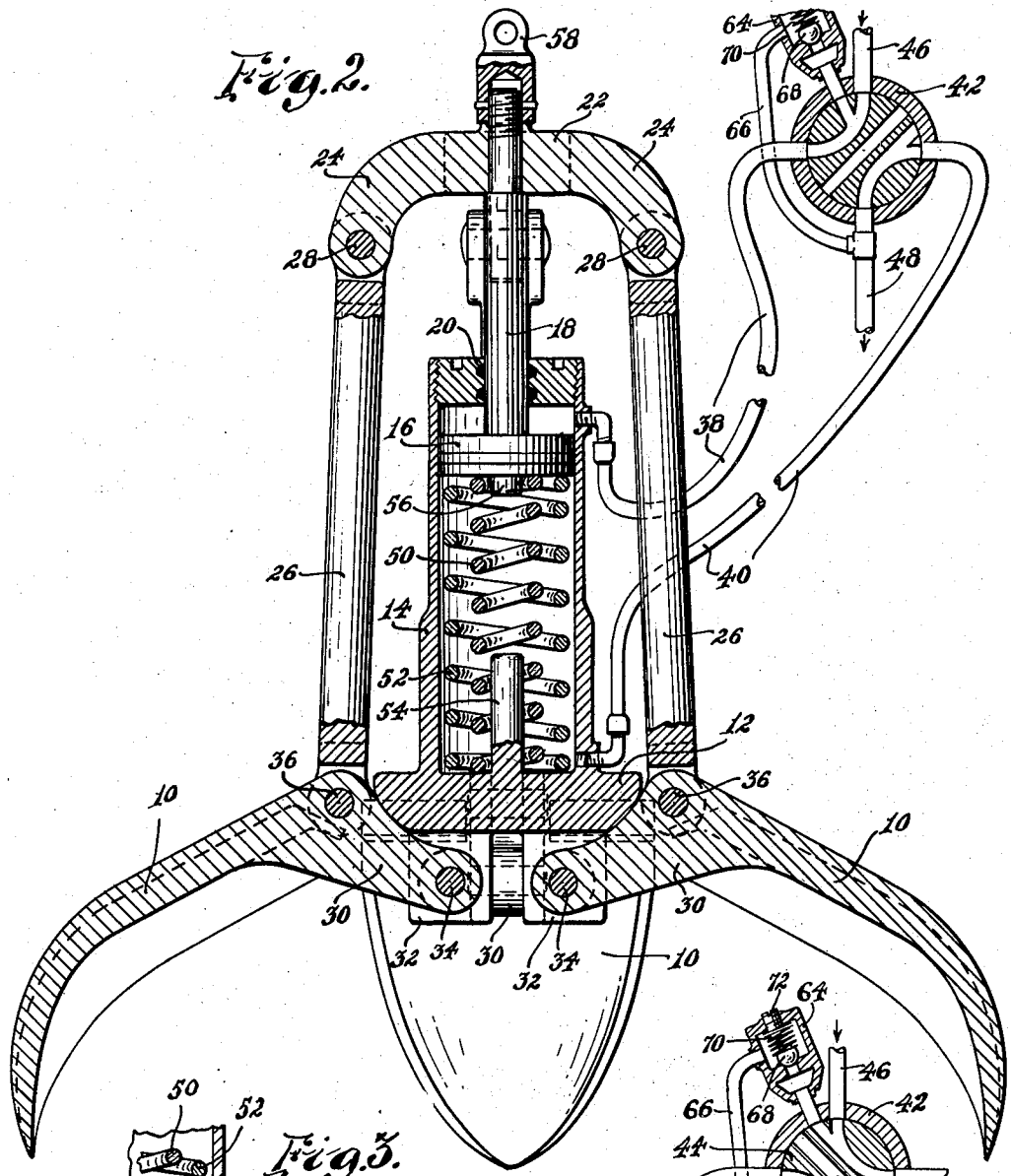


Fig. 3.

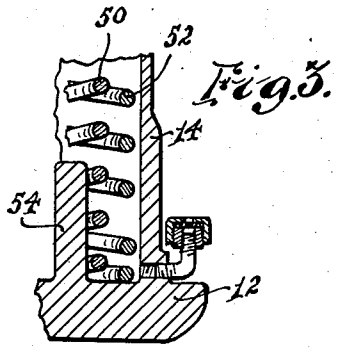


Fig. 2a.

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BOOM-SUSPENSION BUCKETS AND THE LIKE

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6 Claims. (Cl. 37—182)

This invention relates to improvements in boom-suspended buckets and the like. More particularly the invention provides an improved boom-suspended bucket which may be hydraulically operated and controlled more effectively and efficiently as compared with prior comparable buckets, and which may be operated in the nature of a rooter for breaking and loosening roots and other material which may be interfering with closing of the bucket jaws around a suitable load of material, such as when the bucket is in service for removing accumulated matter from catch-basins and the like.

It is among the objects of the invention to provide a bucket of the mentioned general type wherein both closing and opening of the bucket jaws is in response to hydraulic pressure on a jaw-actuating ram or piston but wherein the resilient force of a compressed spring, or compressed springs, is utilized to overcome at least a substantial part of the frictional resistance to flow of the pressure fluid when the jaws are opening, whereby the fluid pressure, acting with the spring or springs to open the jaws, can effect opening of the jaws positively with a desired rapidity of their opening. According to the invention, a ram or piston has a ram rod or piston rod extending from one side only of the ram or piston and connected for actuation of the bucket jaws. One or more coil springs having relatively large bulk may be under compression at the other side of the ram or piston constantly biasing the ram or piston in jaw-opening direction. Fluid under pressure may be selectively admitted to either side of the ram or piston with the opposite side simultaneously being opened to exhaust. When pressure fluid is admitted to the rod side of the ram or piston, the ram or piston moves in direction to close the bucket jaws and simultaneously substantial energy is stored in the spring or springs which become compressed by the jaw-closing movement of the ram or piston. Reversal of the directions of flow of the pressure fluid admits fluid under pressure to the spring-engaged side of the ram or piston and the rod side thereof is opened to exhaust, whereby the energy stored in the spring or springs is released for driving the ram or piston in jaw-opening direction simultaneously with the conjoint driving effect of the pressure fluid entering the cylinder space which is occupied in large part by the spring or springs and which has substantially reduced volume for receiving pressure fluid. Hence, substantial energy is applied mechanically to the ram or piston in conjunction with an effective application of fluid pressure thereto, for attaining a rapid and positive opening of the bucket jaws.

Another object of the invention is to provide a boom-suspended bucket having hydraulic propulsion of pivoted bucket jaws in both closing and opening directions and having means for positively stopping opening travel of each jaw appreciably short of a ninety degree movement thereof. The invention shortens the opening time of the bucket by a shock-inducing stopping of the opening travel of the jaws short of a fully opened condition thereof, the shape of the jaws permitting complete emptying of the bucket, and the induced shock serving to loosen and kick out material adhering to the open jaws.

A further object of the invention is to provide a boom-suspended bucket having jaws which are positively forcibly propelled in both closing and opening directions, and having rooter means exteriorly of at least one of the jaws whereby the bucket may be utilized as a rooter when its jaws are propelled in opening direction.

It is, moreover, my purpose and object generally to improve the structure and operative efficiency and effectiveness of buckets of the boom-suspension variety, and especially buckets adapted for suspension on booms of truck cranes, and the like vehicle-carried cranes.

In the accompanying drawings:

Fig. 1 is a side elevation of a bucket embodying features of the invention, the jaws of the bucket being in closed condition;

Fig. 2 is a cross-sectional view of the bucket of Fig. 1 but showing the bucket jaws in their fully open positions;

Fig. 2*a* is a cross-sectional view of the bucket-control valve means of Fig. 2 with the rotary valve member shifted with respect to its position in Fig. 2; and

Fig. 3 is a cross-sectional view of a lower fragment of the control cylinder of the bucket but showing one of the fluid-pressure connections equipped with a venting cap.

Referring to the drawings, the illustrated bucket has four pivotally mounted jaws **10** adapted to close to their positions of Fig. 1 and to open to their positions as represented in Fig. 2. The jaws are mounted at the under side of a relatively heavy base flange **12** of a cylinder **14** within which a ram or piston **16** is operable. Ram or piston **16** is rigid on the lower end of a rod **18** which extends slidably through the upper end of the cylinder with suitable packing at **20**. A spider member **22** is suitably secured to the outer end of rod **18** and includes four right-angularly related arms **24** to each of which the upper end of a different actuating rod **26** is pivotally connected at **28**.

Each bucket jaw **10** is pivotally supported on the cylinder base flange **12** by means of a relatively long ear **30** rigid on the top of the bucket and extending inwardly between a pair of ears **32** depending from the said base flange **12**, and a pin **34** extends through ears **32** and through the inner end of the bucket jaw ear **30** to effect the pivotal support of the jaw. The lower end of each actuating rod **26** is pivotally connected at **36** to an outer portion of the ear **30** of a different jaw **10**.

It is a feature of the invention that the bucket jaws **10** are forcibly closed and also forcibly opened by fluid pressure acting on the ram or piston **16** in cylinder **14**, and that the opening of the jaws is a positively propelled rapid movement thereof in response to combined mechanical and fluid pressure.

Referring to Fig. 2, a fluid pressure line **38** is open into cylinder **14** at the upper side of ram or piston **16** and a fluid pressure line **40** is open into cylinder **14** at the lower side of ram or piston **16**. Lines **38**, **40** are connected to a valve casing **42** within which any suitable reversing valve **44** is operable to connect either line **38** or line **40** to the main pressure line **46** from any suitable source of pressure fluid, and to simultaneously connect the other line **38** or **40** to the main return line **48**. A neutral position of valve **44** closes both lines **38**, **40** and connects main pressure line **46** directly to main return line **48**.

According to the invention, spring pressure acts with the pressure fluid to effect opening of the bucket jaws **10**. As represented, two coil springs **50**, **52** of relatively large diameter stock constantly are under compression within cylinder **14** at the under side of ram or piston **16**. A single spring, or more than two springs

might be employed, if desired. However, the spring or springs should have relatively large bulk for substantially reducing the volume of pressure fluid entering the cylinder 14 on the up-stroke of ram or piston 16. Actually substantial energy is stored in springs 50, 52 when they are compressed on the jaw-closing down-stroke of the ram or piston 16 and, when the directions of flow of fluid in lines 38, 40 are reversed, this stored energy in the springs is released and acts with the entering pressure fluid in propelling the ram or piston 16 rapidly upward for effecting quick-opening of the bucket jaws 10. But it is important to note that the bulk of the springs greatly reduces the volume of pressure fluid needed in cylinder 14 at the under side of ram or piston 16 in order to effectively act on the ram or piston. This is particularly true when the springs are in maximum compressed condition at the start of the jaw-opening up-stroke of the ram or piston at which time the springs occupy a large part of the available cylinder space below the ram or piston. This available space may be further reduced by a post 54 rising from the bottom of the cylinder and/or a projection 56 on the under side of the ram or piston which conveniently serve also to center the inner spring 50, in the illustrated embodiment.

The bucket may be suspended from a boom in a conventional manner by means of the eye-member 58, or the like, fixed on the outer extreme end of rod 18 so that, in operation of the bucket, cylinder 14 moves relative to the piston 16 and spider member 22.

Buckets of the general type to which the invention relates, heretofore have lacked the ability to open with desired rapidity. Perhaps of equal or greater importance, the opening movements of the bucket jaws have been objectionably non-positive in that the jaws have been opened either by pull-cables or by the mere resilience of a spring. In using such a bucket suspended from the boom of a crane, maneuverability and speed of control of the bucket are important factors. For example, when the bucket is being used to clean out a catch basin, or the like, it must be lowered in closed condition through the circular opening into the catch basin and be then opened preparatory to enclosing a load of sludge, or other material, when the jaws are again closed. The loaded bucket is raised out of the catch basin and swung to a dumping location, such as over a truck body. When being swung toward and from the dumping location, the resulting pendulum-like swinging of the bucket involves considerable loss of time unless the opening and complete unloading may be accomplished in timed relation to the swing so that swing of the boom away from the dumping location can catch and be synchronized with the pendulum back-swing of the bucket following opening of the bucket jaws. The invention provides such rapidity of opening and complete dumping of a bucket that the mentioned synchronization of swings of bucket and boom may be readily accomplished as distinguished from prior comparable buckets whose opening has been sluggish.

Also, it is a further feature of the invention that the bucket jaws 10 are shaped so that it is not necessary to swing the jaws through 90° of opening travel, which contributes to the speed of opening and unloading of the bucket.

As is readily apparent in Fig. 2, the jaws 10 are positively stopped, with the jaws appreciably inclined, when the jaw ears 30 strike the curved peripheral surface of the cylinder base-flange 12, and the shock serves to loosen any material which may be adhering to the jaws.

Frequently buckets of the general type to which the invention relates may encounter tree roots or other elements or conditions which interfere with effective loading of a bucket, and the prior buckets have been unable adequately to cope with these situations. The bucket of the invention, however, has such a forceful and positive jaw-opening action, and the movements of the jaws may be reversed so rapidly, that it becomes feasible and particularly advantageous to utilize the jaws as rooters for removing and loosening elements and material which may be interfering with proper loading of the bucket. Fig. 1 shows detachable rooter members 60 on the jaws 10, exteriorly thereof. The rooter members 60 may be variously shaped as desired, and may be mounted on the jaw ribs 11 by means of screws 62 or any other suitable means. If desired, the members 60 may be integral with or permanently fixed on the bucket jaws 10.

Another advantage which results from the herein disclosed positive fluid-pressure opening of the bucket jaws is that substantially the full weight of the suspended bucket apparatus may be utilized to effect sinking of the jaws into the material which is being excavated. As compared with prior bucket apparatus weighing several times more than the herein described bucket apparatus but whose jaws are cable actuated for opening, considerable weight advantage is attained with my lighter apparatus because only a relatively small part of the total weight of the heavier apparatus can be utilized for sinking the jaws into the material to be excavated. A large part of that total weight is required for overcoming the jaw-opening upward pull of the jaw-actuating cables.

In Fig. 2, the illustrated fluid control valve includes pressure-relief means 64 for protecting the pump, or other comparable device, which supplies fluid under pressure to the main pressure line 46. As shown pressure-relief valve 64 is mounted on valve casing 42 adjacent to the main pressure line 46 and has conduit-connection at 66 to the return line 48. Relief valve 64 may include a valve member 68 strongly biased to its seat by a compression spring 70 one end of which may be engaged by a screw 72 by means of which the spring force seating the valve member 68 may be adjusted. When the main pressure line 46 is connected to line 38, as in Fig. 2, the rotary valve 44 also connects this high pressure line with the relief valve 64. If, for example, the bucket jaws, when closing, engage material which prevents their complete closing, the resulting build-up of pressure on the high pressure side of the apparatus might do damage to the pump is not relieved before it reaches a dangerous magnitude. The relief valve 64 will be set for relieving the pressure at a predetermined safe value, and fluid escaping through the relief valve is delivered through conduit 66 into the return line 48. Similarly, when the main high pressure line 46 is connected to line 40, as in Fig. 2*a*, the rotary valve 44 also connects this high pressure line with the relief valve 64. If opening of the jaws is obstructed, for any reason, the relief valve 64 will open before the pressure build-up reaches a dangerous level, and fluid passing through relief valve 64 delivers into return line 48.

Also, this provision for relieving fluid pressure at the fluid control valve has an important advantage in the control and operation of the bucket in that, assuming the jaws have closed upon material which prevents their complete closing, the bucket may be raised with fluid pressure still tending strongly to close the jaws during the upward travel of the bucket and this raising of the bucket, in conjunction with falling away of excess material, ordinarily will result in complete closing of the jaws. This is in contrast to prior procedures which, so far as I am aware, have required, under similar conditions, lifting and opening of the jaws to release the inadequately enclosed material, followed by a fresh lowering of the open bucket.

Although I have shown springs 50, 52 for acting with fluid pressure for quick-opening of the bucket jaws it will be obvious that my improved bucket may be used without the springs, if desired. Also, if desired, my bucket may be employed with fluid pressure acting only for closing the bucket in which case one or more of the springs 50, 52 may be employed as the only means for opening the bucket, as in Fig. 3, wherein the lower fluid line connec-

tion is equipped with a venting cap. When fluid pressure acts on the piston only in one direction, as would be the case in Fig. 3, fluid pressure continues available in the circuit for raising the bucket while fluid pressure is active for closing the bucket, such as if and when material initially may prevent complete closing of the bucket jaws, as explained in connection with the Figs. 1 and 2 embodiment.

It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty exist in the invention disclosed.

I claim as my invention:

1. An excavating bucket comprising a plurality of jaws, a cylinder having a base portion on which said jaws are pivotally mounted for movements between open and closed positions, a piston movable in said cylinder and having a piston rod connected thereto and extending out of said cylinder, a member secured to said piston rod exteriorly of the cylinder, a plurality of actuating rods each having one end pivotally connected to said member and its other end pivotally connected to one of said jaws whereby said actuating rods open and close the said jaws in response to relative movements of said cylinder and piston, means whereby said bucket may be suspended from a single support, a relatively powerful coil spring within said cylinder acting on said piston in the direction to effect opening of said jaws, and flexible conduit means for directing pressure fluid into one end portion of said cylinder for driving the piston relative to the cylinder in the direction to compress and store substantial energy in said spring while said jaws are being closed by said pressure fluid.

2. An excavating bucket comprising a plurality of jaws, a cylinder having a base portion on which said jaws are pivotally mounted for movements between open and closed positions, a piston movable in said cylinder and having a piston rod connected thereto and extending out of said cylinder, a member fixed on said piston rod exteriorly of the cylinder, a plurality of actuating rods each having one end pivotally connected to said actuator and its other end pivotally connected to one of said jaws whereby said actuating rods open and close the said jaws in response to relative movements of said cylinder and piston, means whereby said bucket may be suspended from a support, flexible conduit means for directing pressure fluid into one end portion of said cylinder for driving the piston relative to the cylinder in the direction to effect closing of said jaws, relatively massive spring means in said cylinder in position to be compressed by a said relative movement of the piston in jaw-closing direction, whereby substantial energy is stored in said spring for driving the piston relative to the cylinder in jaw-opening direction when the supply of said pressure fluid is cut off and said one end portion of the cylinder is opened to exhaust, and means for connection of a pressure fluid conduit to said cylinder at the spring-containing end thereof, whereby pressure fluid may be directed into said cylinder to act with said spring means in driving the piston relative to the cylinder in said jaw-opening direction.

3. An excavating bucket as defined in claim 2, wherein said relatively massive spring means is of a nature to occupy the major portion of the cylinder space at one side of the piston when the piston approaches the limit of its said relative movement in said direction to effect closing of the jaws, whereby a relatively small volume of pressure fluid acts with said spring means to positively and rapidly drive said piston relative to the cylinder in the direction to effect opening of said jaws.

4. A suspension type excavating bucket comprising a cylinder member having a base flange thereon, a plurality of bucket jaws pivotally mounted on said base flange and movable between closed and open positions, a piston operable within the cylinder of said cylinder member, a piston rod connected to said piston and extending out of said cylinder member at one end thereof, actuating connections extending between said bucket jaws and said extending portion of the piston rod for actuating the bucket jaws between open and closed positions in response to relative movements of the cylinder member and piston, conduit means for selectively directing pressure fluid into the cylinder at either side of the piston therein and for simultaneously connecting the cylinder at the other side of the piston to exhaust, and relatively massive spring means in the cylinder at one side of the piston substantially reducing the volume of the cylinder space at that side of the piston, and valve means for controlling the flow of fluid in said conduit means.

5. A suspension type excavating bucket comprising a cylinder having a substantial base flange thereon, a plurality of bucket jaws pivotally mounted at the under side of said base flange and movable about their pivots between closed and open positions, a piston operable within said cylinder and having a piston rod connected thereto and extending out of the cylinder at one end thereof, actuating connections extending between said jaws and said extending portion of the piston rod for actuating the jaws between open and closed positions in response to relative movements of the cylinder and piston, conduit means for selectively directing pressure fluid into the cylinder at either side of the piston and for simultaneously connecting the cylinder at the other side of the piston to exhaust, a rooter member on at least one of said jaws, exteriorly thereof, for constituting a rooter when said jaws are fluid-actuated in opening directions, and a mechanism associated with said conduit means for relatively quickly shifting the flow of pressure fluid first into one end and then into the other end of said cylinder for forcibly propelling said rootor intermittently in opposite directions when said rooter encounters an obstinate obstruction to opening movement of the rooter-carrying jaw of the bucket.

6. An excavating bucket as defined in claim 1, having valve means relatively remote from said cylinder and selectively operable in a fluid circuit for directing pressure fluid into said flexible conduit means and for connecting said flexible conduit means to a return portion of said circuit, said valve means having associated therewith pressure-relief means which operates only when a predetermined relatively high fluid pressure prevails in said circuit, said relief means having conduit connection to said return portion of said circuit whereby fluid escaping through said relief means by-passes said cylinder.

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