June 9, 1959 A. CHATRENET 2,889,643

HYDRAULICALLY-OPERATED GRAB BUCKET

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Fig. 1

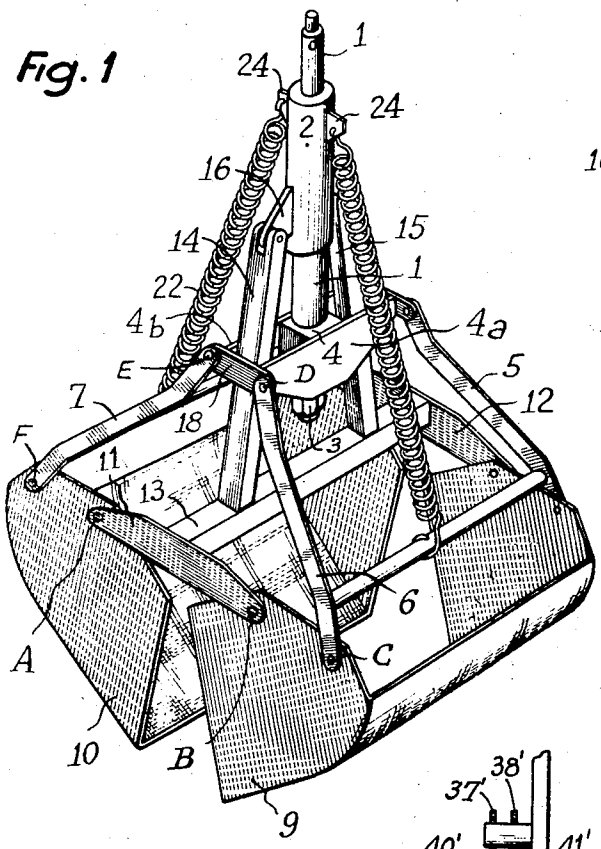


Fig. 2

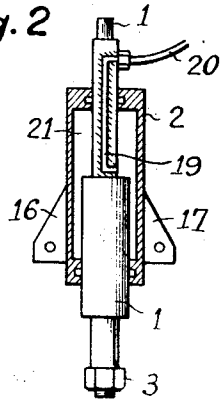
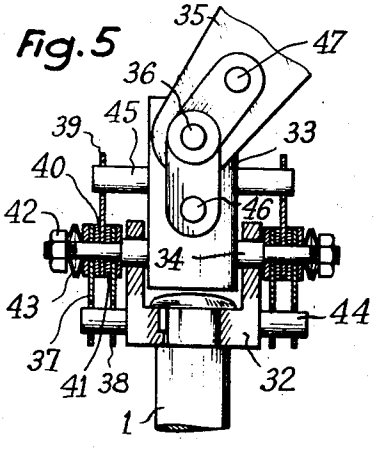


Fig. 5



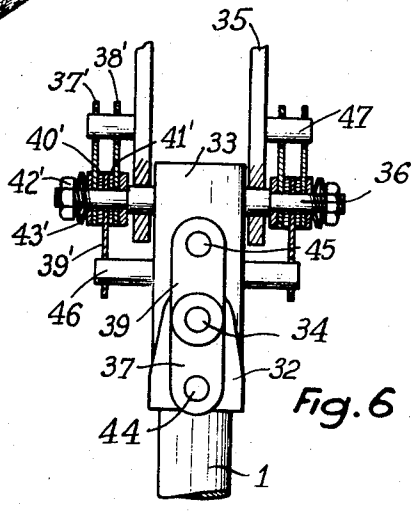


Fig. 6

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Fig. 4

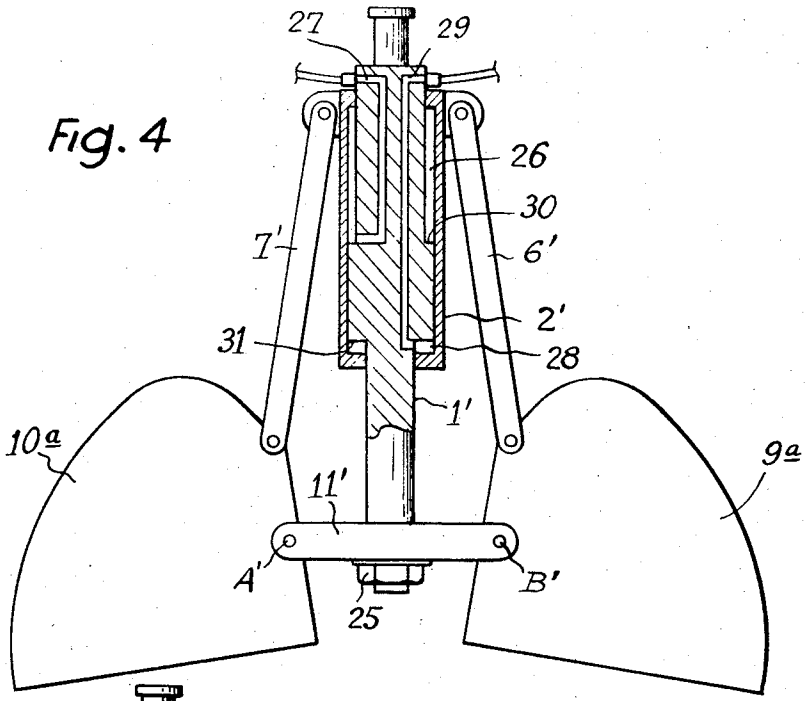
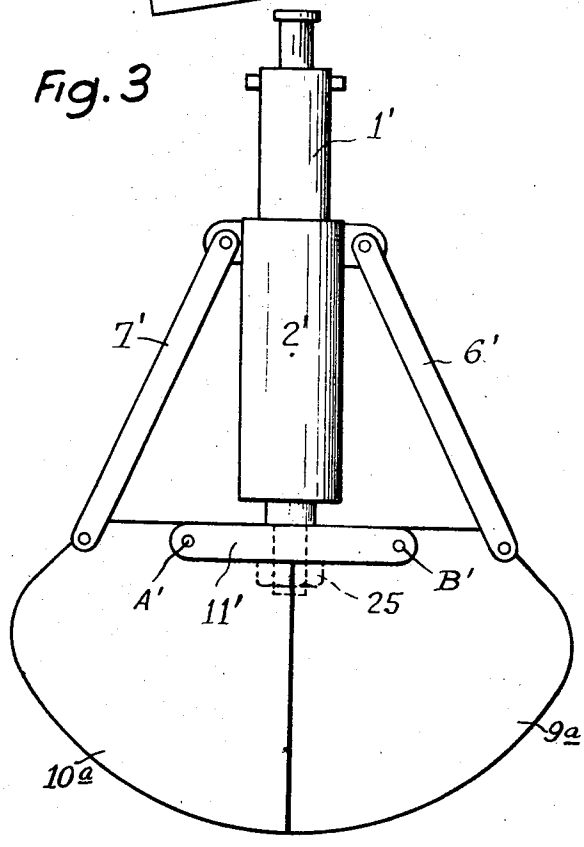


Fig. 3



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2,889,643

HYDRAULICALLY-OPERATED GRAB BUCKET

André Chatrenet, Plessis-Belleville, France, assignor to Societé à Responsabilité Limitée so-called: Ateliers de Poclain, Plessis-Belleville, France, a French company

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Claims priority, application France October 13, 1955

4 Claims. (Cl. 37—183)

The present invention relates to a grab bucket of a type which may equip hoisting cranes or excavators as well as handling equipment for public works and agricultural work.

The invention is particularly characterized in that the grab bucket is hydraulically operated by a ram or jack motor having a differential piston supporting the bucket assembly, while the ram cylinder is slidable with respect to the piston and has connecting rods or the like pivoted to it for controlling the opening-out movement of the bucket jaws or sections.

In a modification of the invention, the ram or jack motor is single-acting and controls the bucket closing movement while the opening of the bucket is produced by the action of the weight of the bucket jaws assisted by springs. This arrangement reduces the complexity of the jack controlling distributor valve and brings with it a reduction in the number of oil distributing lines required.

Since the force required for opening the bucket is relatively small, it is possible, according to a further modification of the invention, to use a double-acting ram or jack motor without unduly reducing the diameter of the extension of the piston supporting the bucket assembly, as the upper ram chamber provided in the sliding cylinder may be provided with a useful area much less than that of the lower chamber which effects the closing movement of the bucket and holds the bucket jaws in closed position.

This arrangement furthermore makes it possible to greatly simplify the kinematics of the system, since the opening, upward movement of the jaws corresponds to an upward displacement of the cylinder casing along the carrier piston.

A clear understanding of the invention will be gained from the ensuing description of illustrative embodiments which is to be read in connection with the attached drawings wherein:

Fig. 1 is a perspective view of a grab bucket operated by a single-acting ram in accordance with one embodiment of the invention;

Fig. 2 is an axial section through the ram for effecting closure of the bucket shown in Fig. 1;

Fig. 3 is a side elevational view of a bucket operated by a double-acting ram in accordance with another embodiment of the invention;

Fig. 4 is a side elevational view of the arrangement of Fig. 3, but showing the bucket in open condition, and with the operating ram being shown partly in section;

Fig. 5 is a front elevational view, partly broken away and in section, of a universal or cardan joint for supporting a bucket embodying this invention; and

Fig. 6 illustrates the same support in side elevational view and partly in section.

The bucket assembly of Figs. 1 and 2 is suspended from the piston 1 of a ram motor about which a cylinder casing 2 is slidable. Rotatably mounted and retained by means of a nut 3 on the lower end of the piston 1 is

a balance arm 4 having members 18 at the opposite end to which connecting rods or links 5, 6, 7 and 8 are pivotally connected to support the bucket jaws 9 and 10, which in turn, are interconnected by straps 11 and 12 pivoted at their opposite ends to each bucket section. The straps 11 and 12 are connected with cylinder 2 through a cross bar 13 interconnecting a pair of uprights 14 and 15 which, at their upper ends, are pivotally connected to lugs 16 and 17 projecting from the cylinder 2. Sliding displacement of cylinder 2 along piston 1 produces a parallel displacement of the straps 11 and 12 relative to balance arm 4, which results in opening or closing of the bucket sections or jaws 9 and 10.

The linkage system comprising the bucket sections 9 and 10, links 6 and 7, and strap member 11 may, when viewed from one side, be regarded as a hexagon having one side constituted by the member 18 which remains stationary, while the opposite side constituted by the strap 11 is displaced, and during such displacement remains parallel to a common direction.

The two uprights 14 and 15 rock and slide between the sides 4*a* and 4*b* of the balance arm, thereby ensuring symmetrical displacements of the bucket jaws.

The drive means comprises a single-acting, differential-piston, hydraulic ram or jack which, on application of pressure to it through a pipe 20, causes the cylinder casing 2 to move upwardly with respect to the piston 1. The opening-out of the bucket jaws results from lowering of their points of attachment A, B to the strap 11, while the pivotal axes D and E connecting links 6 and 7 to the balance arm 4, remain stationary. The casing 2 slides in sealing relation along the piston 1, which has two different cross-sectional areas the larger one of which is at the bottom. The drive force for closing the bucket jaws results from the hydraulic pressure applied in chamber 21 to the radial shoulder defined between the portions of the piston having different cross-sectional areas. Thus, as large a force as may be desired for closing the bucket jaws can be obtained by suitably selecting this difference in cross-sectional areas as well as the hydraulic pressure.

Since the delivery of oil into the chamber 21 effects closure of the bucket, it will be noted that the opening of the bucket is effected under the effect of gravity and the obliquely directed reaction force components of the materials contained in the bucket. These forces are generally amply sufficient to overcome the weight of the sliding assembly. It will be noted moreover that the hexagon described above, in the closed position, reduces substantially to a trapezoid C—D—E—F since the pivot axes C and F connecting links 6 and 7 to bucket jaws 9 and 10 assume positions substantially on the same level with the strap 11. In order to produce a more square and wider expansion of the bucket jaws particularly towards the end of the opening movement, springs 22 and 23 are connected between the jaws 9 and 10 respectively, and arms 24 projecting from cylinder 2.

The oil distribution system as herein disclosed is advantageous in that it allows the bucket to be pivoted on piston 1 without regard to the hydraulic connecting lines. The importance of this feature lies in the fact that it may be necessary to adjust the angular position of the bucket manually or mechanically, as when unloading materials from the corners of a railway car or other vehicle. Thus, as shown in Fig. 2, the hydraulic fluid supply pipe 20 connects to a bore 19 in the piston 1 which opens into the chamber 21 within cylinder 2.

Turning now to Fig. 3, it will be seen that the bucket as there shown is operated by a double-acting hydraulic ram, with the closing of the bucket sections 9*a* and 10*a* being effected by the downstroke of a cylinder casing 2' relative to the piston 1'.

The bucket assembly is suspended from the piston 1' of the ram along which the casing 2' forming a movable cylinder is slidable.

Mounted at the lower end of piston 1' and retained by means of a nut 25 is a rotatable balance arm having rigidly connected to its opposite ends a pair of straps, of which only the strap 11' is visible, and about which the bucket sections 9a and 10a are pivoted, as at A' and B'. The bucket sections are pivotally suspended from the lower ends of links 6', 7' at both sides of the bucket sections, and the upper ends of such links are pivotally connected to the cylinder casing 2'.

Sliding movement of cylinder 2' along piston 1' displaces the arms 6', 7', which in turn produce a rotation of the bucket sections about the axes A' and B' carried by the straps 11' and 12' which are stationary with respect to the piston.

Intake of pressure oil into the upper chamber 26 of the ram through passage 27 in piston 1' causes the cylinder 2' to move upwardly relative to the piston 1' and opens the bucket. If on the other hand pressure oil is admitted into the lower chamber 28 through passage 29 in piston 1', the cylinder moves downwardly relative to the piston and causes the bucket sections to close or move together.

Since the areas of the radial shoulders 30 and 31 of the piston against which the pressure acts are different, two unequal forces are obtained, the greater force being used for closing the bucket, while the smaller force, in the opposite direction, is used to open or spread apart the bucket sections.

It will be readily realized from a consideration of the modifications of Figs. 1 and 3 that the use of the double-acting ram motor provides a way of preventing tangling of the arms and of accelerating handling operations due to the hydraulic control of the opening movement.

It will be seen moreover that the presence of the smaller-area chamber 26 about the upper part of the piston (corresponding to a larger diameter of the latter and hence resulting in increased strength of the cantilever support) reduces the complexity of the interpivoted elements since the cylinder casing 2' and the bucket sections 9' and 10' need to be actuated in the same directions during opening and closing of the bucket.

Since the bucket of the invention is designed for suspension from the jib or arm of a crane or excavator, it has to be suspended through a cardan-type or universal support about two orthogonal axes. It is generally recognized that it is necessary to damp or brake the swinging motions of the bucket occurring during rotation or displacement of the crane or excavator, since such swinging interferes with the accuracy of the work and can endanger the equipment. According to the invention therefore the pivot axes of the cardan support are provided with frictional damping means an example of which will now be described with reference to Figs. 5 and 6.

The piston 1 is directly mounted on one of the yokes 32 of the cardan joint, while the central block 33 of the latter is in turn pivotally connected to the yoke 32 by means of the trunnions 34. Similarly the jib 35 of the crane is pivotally connected to the center block 33 by means of trunnions 36. The damping means are arranged at each end of each of the pairs of trunnions 34 and 36 and comprise, in each instance, three steel plates or strips two of which, 37 and 38, are clamped about the third strip 39 with friction discs 40 and 41 interposed therebetween, the entire assembly being pressed together by means of a nut 42 acting upon resilient means such as a pair of confronting concave washers 43. The steel strips 37 and 38 are rotatable about the axis of trunnion 34 and are secured to the yoke 32 through a drive pin 44, while the strip 39 is also rotatable about the axis of the trunnion 34 and is rigidly connected to the center block 33 by another pin 45. Such frictional dampers are mounted on each end of each trunnion 34 and 36. In the

case of the trunnions 36, the plates, friction discs, nut and concave washers of each damping means are referred to by the same reference numerals used in connection with the described damping means of the trunnions 34, but with a prime appended thereto.

Further, the plates or strips 39' are connected to yoke 33 through a drive pin 46, while the plates 37' and 38' are connected to the jib 35 by a drive pin 47.

What I claim is:

1. A grab bucket comprising a substantially vertically directed cylindrical casing member, a substantially vertically directed standard member extending axially through said casing member and projecting from the opposite ends of the latter, with said casing member being axially slidable and rotatable relative to said standard member, said standard member having at least one vertically facing shoulder within said casing member to define a piston so that said casing and standard members cooperate to form an hydraulically operated jack, means at the upper end of said standard member for suspending the latter, pivot means carried by said casing member and pivot means rotatably carried by the lower end of said standard member and defining parallel pairs of pivoting axes perpendicular to the axis of said casing member, a pair of bucket sections swingably mounted on one of said pivot means for swinging movement about the related pair of pivoting axes toward and away from each other, connecting rods extending from the other of said pivot means to swing about the pair of pivoting axes defined by the latter and pivotally connected to said bucket sections at pivoting axes spaced from, and parallel to the pivoting axes defined by said one pivot means so that said swinging movement of the bucket sections is controllable by relative axial movement of said casing and standard members, said standard member having at least one longitudinal passage therein opening, at its opposite ends, outside of said casing member and into the interior of said casing member adjacent said piston defining shoulder, respectively, and means for supplying hydraulic fluid under pressure to the end of said passage opening outside of said casing member so that the hydraulic fluid is transmitted through said passage to the interior of the casing member to there act against said shoulder for causing relative axial movement of said casing and standard members.

2. A grab bucket as in claim 1; wherein said standard member has two oppositely directed, vertically facing shoulders within said casing member to define the upper and lower surfaces of a piston, and said standard member has two longitudinal passages therein which, at one end, open outside of said casing member, the other end of one of said passages opening into the interior of said casing member below said lower surface of the piston and the other end of the other of said passages opening into the interior of said casing member above said upper surface of the piston; and wherein means for supplying fluid under pressure are connected to the ends of both of said passages opening outside of said casing member so that the latter can be selectively moved upwardly and downwardly relative to said standard member.

3. A grab bucket as in claim 2; wherein said bucket sections are swingably mounted on the pivot means rotatably carried by said lower end of the standard member and said connecting rods extend from the pivot means carried by said casing member so that said bucket sections are moved toward and away from each other in response to downward movement and upward movement, respectively, of said casing member relative to said standard member, and wherein said lower surface of the piston has a larger area than said upper surface of the latter to provide a larger force for moving said bucket sections toward each other than for moving the bucket sections away from each other.

4. A grab bucket as in claim 1; wherein said means

at the upper end of the standard member for suspending the latter includes first and second yokes, said first yoke being fixed to said upper end of the standard member, a first axle pivotally interconnecting said first and second yokes, a second axle carried by said second yoke at right angles to said first axle and adapted for pivotally connecting said second yoke to a support so that said yokes and axles define a universal joint between said standard member and the support, frictional damping means at said first and second axles operative to resist swinging of said first yoke relative to said second yoke about said first axle and operative to resist swinging of said second yoke about said second axle relative to a support pivotally connected thereto.

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