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3,096,831 7/1963 Adams 173/128
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[54] **HYDRAULIC PILE EXTRACTOR**
7 Claims, 3 Drawing Figs.

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173/91, 173/132
[51] Int. Cl. E02d 7/00
[50] Field of Search. 173/131,
132, 91

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ABSTRACT: A pile extractor of the type having a housing suspended from a crane, a ram reciprocable within the housing, and a pulling member having an impact head adapted to be secured to a pile and movable longitudinally in the housing. A cylinder supplied with hydraulic fluid is attached to the top of the housing, having a piston and piston rod movable within the hydraulic cylinder; the piston rod is connected to the ram, and the ram has a longitudinal through bore into which the pulling member extends; a step in the bore forms an impact face for the head of the pulling member accommodated within the bore. An hydraulic accumulator connected to the hydraulic fluid feed line is an integral part of the cylinder. In the preferred modification the pulling member is provided with a shaft and piston movable in a compensating cylinder attached to the bottom of the housing, the compensating cylinder being provided with hydraulic fluid from the hydraulic fluid feed line.

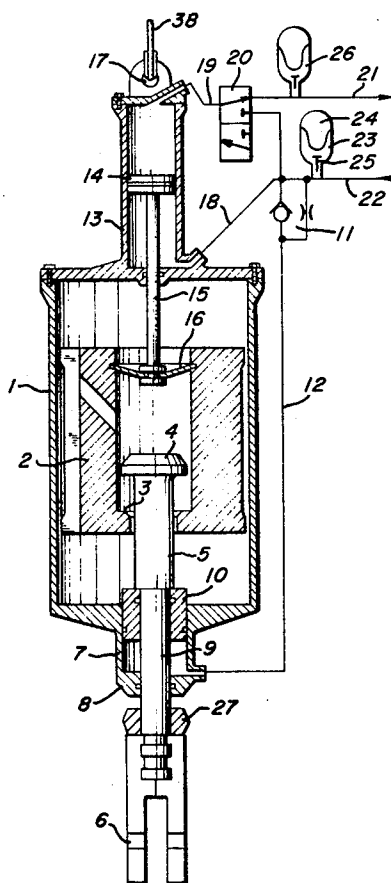


FIG-1

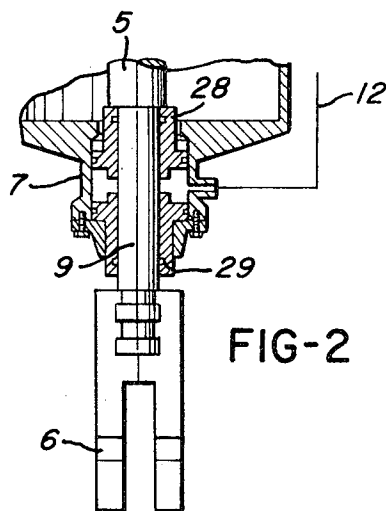
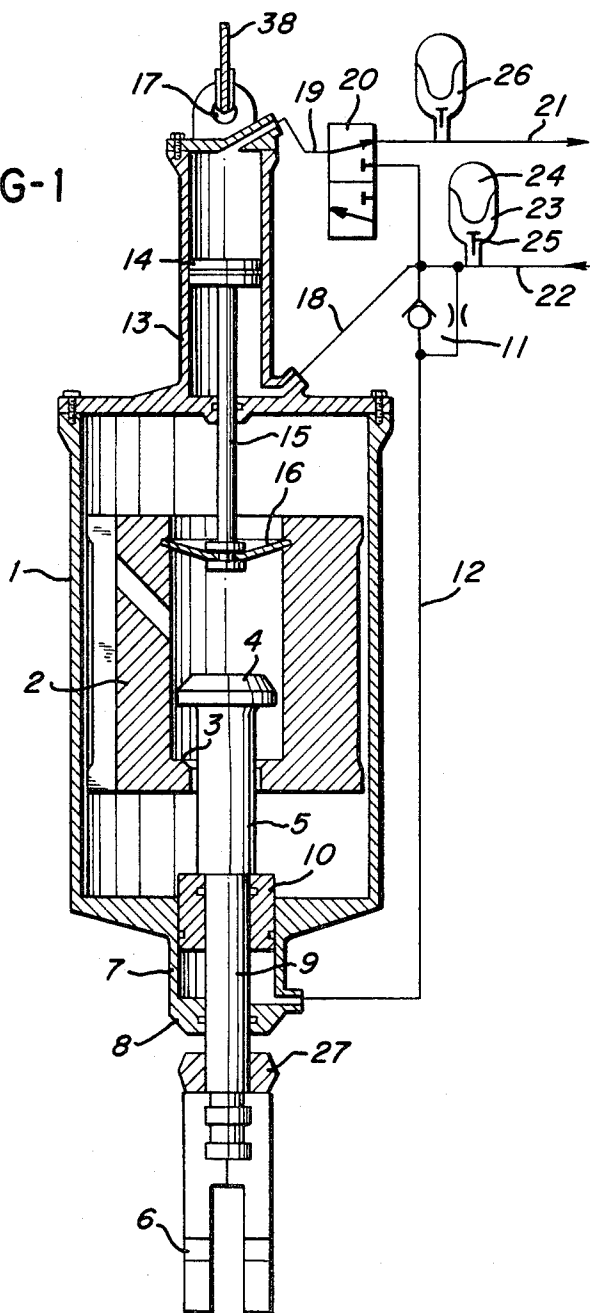
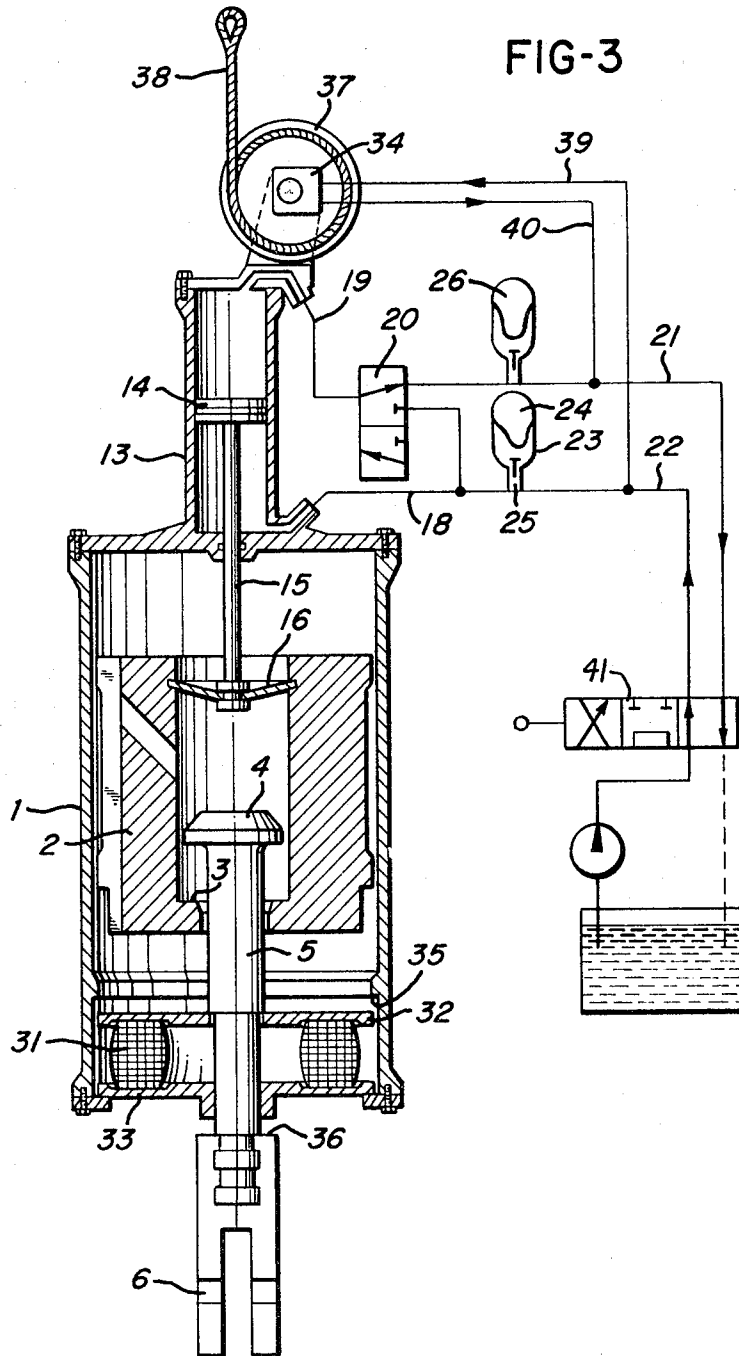


FIG-2

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HYDRAULIC PILE EXTRACTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an hydraulic pile extractor which is suspended from a crane above the pile to be extracted and has a pulling member which is secured to the pile and subjected to a succession of tractive upward impacts by means of a ram which may be connected to or integral with the driving element. The descending ram is cushioned in order to counter gravity and accelerated for the next upward movement by means of an hydraulic accumulator in the feed line whereby, when the fluid energy is switched to "lifting," the fluid displaced from the lower part of the cylinder is stored and recycled in order to boost the upward movement of the ram.

2. Description of the Prior Art

Pile extractors which can be suspended from a crane or the like, and whose tractive effect is derived from a succession of impacts from a ram driven by a supply of steam or compressed air are known in the art. These require a steam boiler or air compressor unit as a power source, which units must be provided separately since modern cranes are usually motor driven. On the other hand, some cranes have an hydraulic system from which hydraulic fluid to operate a pile extractor could be drawn. However, so far as is known, pile extractors driven by hydraulic fluid have not heretofore been developed.

Of the pile extractors driven by steam or compressed air, those designs in which the driving element is integral with the ram have given best results. In these designs either the cylinder or the piston constitute the moving ram, and the upward impact is transferred directly to the pulling member. In one known embodiment of this type the ram, acting as a piston, has a longitudinal bore accommodating the pulling member.

Such prior art devices, operating on low-pressure gas on the order of 90 p.s.i. (6 kg./cm.²) are not readily adaptable to operation by hydraulic fluids which are typically supplied at 1500—3000 p.s.i. (100—200 kg./cm.²), wherein the hydraulic fluid must be returned to the supply reservoir, contrary to gaseous exhaust which is simply vented to the atmosphere. Because of this elevated pressure, the area of the driving piston need not be large, but on the other hand the piston needs a large diameter because of its function as a heavy ram. This is especially true if the ram has a bore sufficient to accommodate a powerful pulling member. This results in narrow ring areas of great diameter which must be sealed against high pressure. Under such conditions leakage becomes uncontrollable, and the fluid overheats readily.

Unlike conditions prevailing in pile drivers, in pile extractors the descending ram must be cushioned in order to offset gravity and accelerated for its upward movement. This requires considerable energy. The descending mass cannot be braked by an incompressible hydraulic medium, contrary to the situation existing when steam or compressed air is used for actuation.

SUMMARY

The present invention provides a novel hydraulic pile extractor with impact action in which the pulling member is a central rod provided with an impact head. An hydraulic cylinder, having a piston and piston rod reciprocable therein, is positioned at the top of a housing, and a ram reciprocable within the housing is attached to the piston rod, the ram being provided with a longitudinal through bore having an inwardly projecting step which forms the impact area for the head at the top of the pulling member which extends into the longitudinal bore. The piston rod is hinged or flexibly connected to the inside of the ram, which also guides the pulling member.

In order to cushion the descending ram and to accelerate it on its next upward movement, an hydraulic accumulator in the feed line is an integral part of the hydraulic cylinder. When the fluid energy flow is switched to "lifting," the fluid dis-

placed from the lower portion of the cylinder is stored and recycled in order to reinforce the upward motion of the ram.

The present invention effects a direct transfer of the impact from the ram to the pulling member, thus minimizing energy losses. Moreover, the diameters of the piston and piston rod are reduced in order to permit application of conventional hydraulic pressures. Only two high-pressure seals of small diameter are required, which results in reduced piston leakage.

The arrangement of the impact head inside the ram provides a compact, and hence lightweight, design of the pulling member, thereby improving performance. In addition, the hydraulic cylinder, the piston rod seal and the hydraulic supply tubes are not exposed to the impact blow, since the pulling member can move in a longitudinal direction within the housing.

A flexible connection of the piston rod to the ram may assure that the piston and its rod are protected from excessive vibrations. The longitudinal movement between the housing and the pulling member may be limited by a compensating cylinder attached to the housing and a piston attached to the pulling member. This compensating cylinder receives its fluid from the hydraulic supply line in accordance with the present invention. Such an arrangement insures a constant and powerful pull through an adequate length of stroke, without the necessity for an additional feed line and source of power.

However, for some purposes the stroke of this compensating cylinder may be insufficient. A preferred embodiment of the invention thus provides, where desired, an hydraulic winch having feed and exhaust lines connected to those of the hydraulic cylinder, and having pulling means attached to a crane or to some other fixed point. The hydraulic winch will automatically establish a pretensioned condition of the pile, as soon as hydraulic fluid is supplied, and may thus replace the winch of a crane. One hydraulic valve can thus function to raise, hold suspended or lower the pile extractor, and actuate the ram.

BRIEF DESCRIPTION OF THE DRAWING

Reference is made to the accompanying drawing wherein preferred embodiments of the invention are shown.

FIG. 1 is a vertical section of an extractor of the present invention wherein a pulling member has a piston within a compensating chamber;

FIG. 2 is a vertical section of a lower portion of the pile extractor, illustrating a modification wherein the pulling member has two longitudinally movable pistons; and

FIG. 3 is a vertical section of a further embodiment of an extractor provided with an hydraulic winch.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawings, a housing 1 and an hydraulic cylinder 13 attached thereabove are suspended from a crane by a cable 38. A ram 2 is provided inside housing 1 and is movable longitudinally therein. The ram is provided with a longitudinal bore which accommodates a pulling member 5. The bore terminates in an inwardly projecting step 3 forming an impact area for an expanded head 4 of pulling member 5. Above the head 4 the ram 2 is attached by means of a damper 16 or equivalent flexible coupling to a piston rod 15 and piston 14.

Hydraulic fluid is fed by lines 22 and 18 to the cylinder space below the piston 14. A valve 20 and line 19 supply fluid to the cylinder space above piston 14, and in its second position (as shown in FIG. 1) valve 20 connects this cylinder space to exhaust line 21. Feed line 22 is connected with a fluid accumulator 23, which may be provided with a diaphragm 24 and spring-controlled drain valve 25 which is closed by the pressure of the diaphragm. Return line 21 is equipped with a low-pressure accumulator 26 of a suitable type which may be similar to accumulator 23.

The valve 20 is preferably rendered automatic in operation by a conventional device (not shown), and a further actuating valve (not shown in FIG. 1) is preferably provided in line 21 to initiate operation of the piston 14.

The housing 1 is connected to a compensating cylinder 7 which is beneath ram 2. Pulling member 5 is provided with a piston 10 on its shaft which moves longitudinally within compensating cylinder 7. Cylinder 7 is supplied with pressure fluid from line 22 by way of line 12. For more effective damping of shocks, supply line 12 may be fitted with a one-way check valve 11. This permits the pressure in compensating cylinder 7 to increase temporarily above that in feed line 22.

Piston 10 may be rigidly connected to pulling member 5, or may move longitudinally within predetermined limits. A rubber cushion 27 acts as a stop for piston 10.

Alternatively, as shown in FIG. 2, two pistons 28, 29 may be provided in compensating cylinder 7, instead of one piston and a rubber cushion. In this embodiment, pressurized fluid is supplied by line 12 to the space between both pistons. This arrangement will cushion the downwardly directed impact of ram 2, as well as the upwardly directed impact of pulling member 5 and will transfer these forces smoothly to housing 1.

In the embodiment of FIG. 3, instead of a compensating cylinder 7, a damping means, e.g., a rubber block 31, is installed between the housing 1 and pulling member 5. The damping means are rendered double-acting by plates 32 and 33. The housing 1 supports an hydraulic winch 37, the supply and return lines 39 and 40 of which are connected to feed and return lines 22, 21 of the hydraulic pressure system of cylinder 13. Cable 38 may be suspended from a fixed point such as a tripod. A control valve 41, shown on the right side of FIG. 3, can reverse the hydraulic flow, allowing the pile extractor to be lowered, or to be held suspended. This makes the use of an extraneous winch unnecessary.

Although the automatic valve 20 and fluid accumulators 23 and 26 are illustrated diagrammatically in FIGS. 1 and 3 as separate elements connected to the lines 21 and 22, it should be understood that in the preferred construction the valve 20 and accumulators 23 and 26 are integral with, or attached to, the hydraulic cylinder 13 and/or housing 1.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

I claim:

1. In apparatus for extracting piles and the like, wherein a

housing is suspended from a crane, a ram movable in said housing is provided with a longitudinal through bore, and a pulling member adapted to be attached to a pile is movable longitudinally within said housing, said pulling member being accommodated within said longitudinal bore of the ram, the improvement which comprises:

a cylinder supplied with hydraulic fluid under pressure attached to said housing above said ram;

a piston and a downwardly depending piston rod in said cylinder, said piston rod being connected to said ram;

said pulling member terminating at its upper end in an enlarged head accommodated within said longitudinal bore in said ram;

said longitudinal bore having an inwardly projecting step, said step forming an impact face for said head of said pulling member; and

an hydraulic accumulator connected to an hydraulic fluid feed line to said cylinder.

2. Apparatus according to claim 1, including a flexible coupling connecting said ram to said piston rod.

3. Apparatus according to claim 1, wherein said pulling member incorporates a shaft and a piston, a compensating cylinder is connected to said housing beneath said ram, said shaft and piston being movable longitudinally in said compensating cylinder, and including a connecting line for supplying hydraulic fluid to the space within said compensating cylinder, said connecting line communicating with said feed line.

4. Apparatus according to claim 3, including a one-way check valve in said connecting line.

5. Apparatus according to claim 3, wherein said piston is movable longitudinally on said shaft.

6. Apparatus according to claim 1, wherein said pulling member incorporates a shaft and two pistons, a compensating cylinder is connected to said housing beneath said ram, said pistons being mounted on said shaft for limited longitudinal movement in said compensating cylinder, and including a connecting line for supplying hydraulic fluid to the space in said compensating cylinder between said pistons, said connecting line communicating with said feed line.

7. Apparatus according to claim 1, including an hydraulic winch secured to said housing, hydraulic feed and return lines connected to said winch supplied by feed and return lines of said cylinder, and a cable on said winch attached to a point of suspension.

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