United States Patent

[11] **3,554,395**

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[45] Patented **Jan. 12, 1971**

[54] **CRANE**
8 Claims, 11 Drawing Figs.

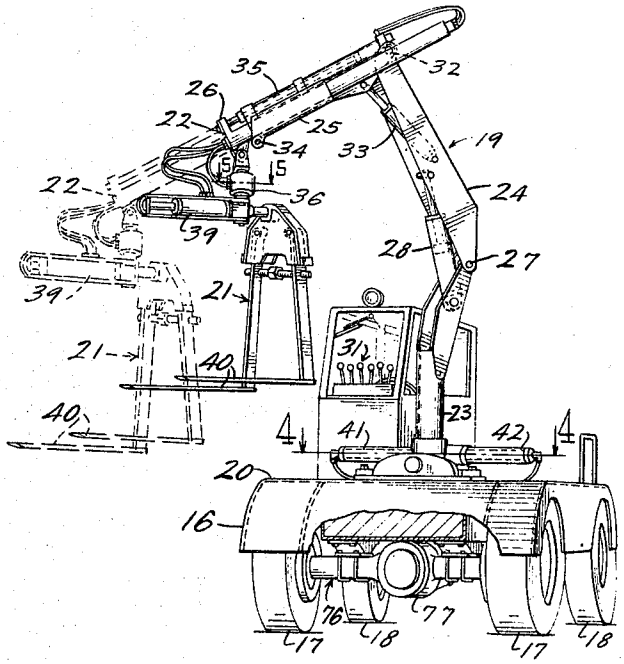
[52] **U.S. Cl.** **214/138,** 214/142, 212/49
[51] **Int. Cl.** **E02f 3/75**
[50] **Field of Search** 214/138, 131, 142, 141; 212/48, 49, 125, 55, 66; 280/150E

[56] **References Cited**
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Primary Examiner—Hugo O. Schulz
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ABSTRACT: An automatic yard crane for lifting and moving materials. A loading arm extends above a generally flat, hollow body. The body is divided into a number of enclosed chambers having removable access covers for adding and removing granular ballast. An internal combustion engine drives a first pump for supplying pressurized fluid to a hydraulic drive motor and a second pump for supplying pressurized fluid to hydraulic pistons for operating the loading arm.



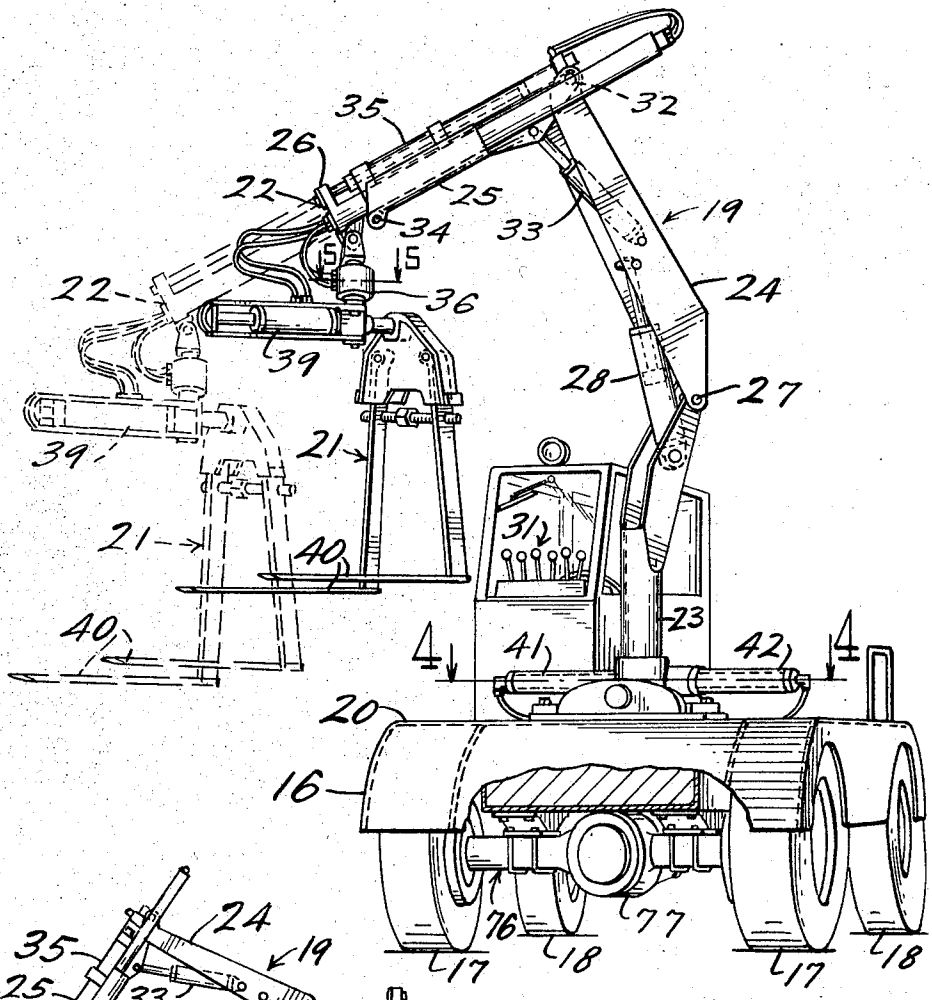


FIG-1-

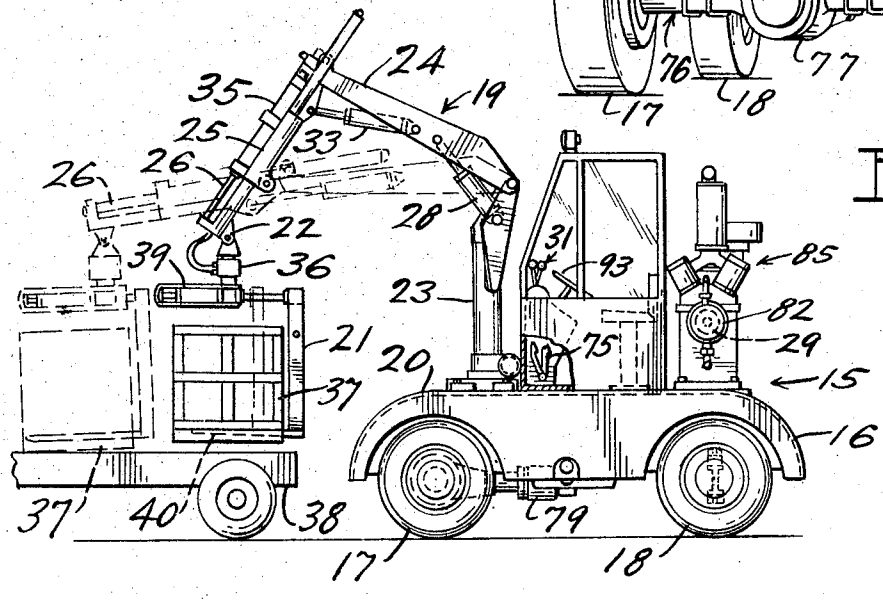


FIG-2-

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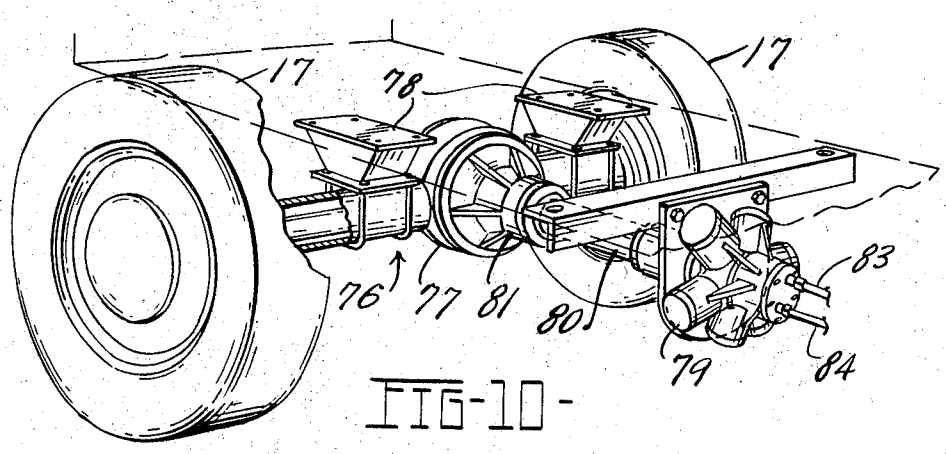


FIG-10-

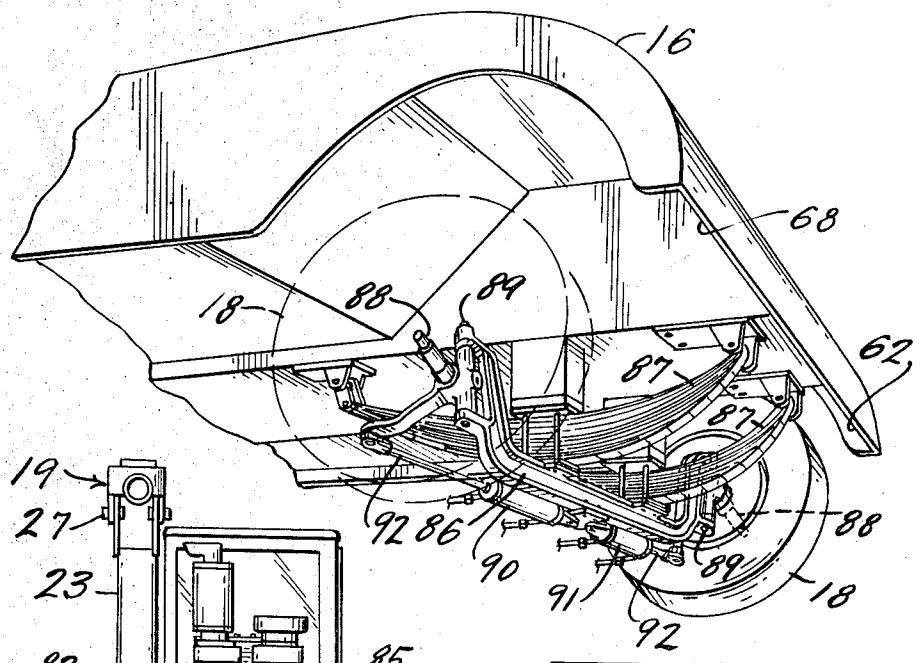


FIG-11-

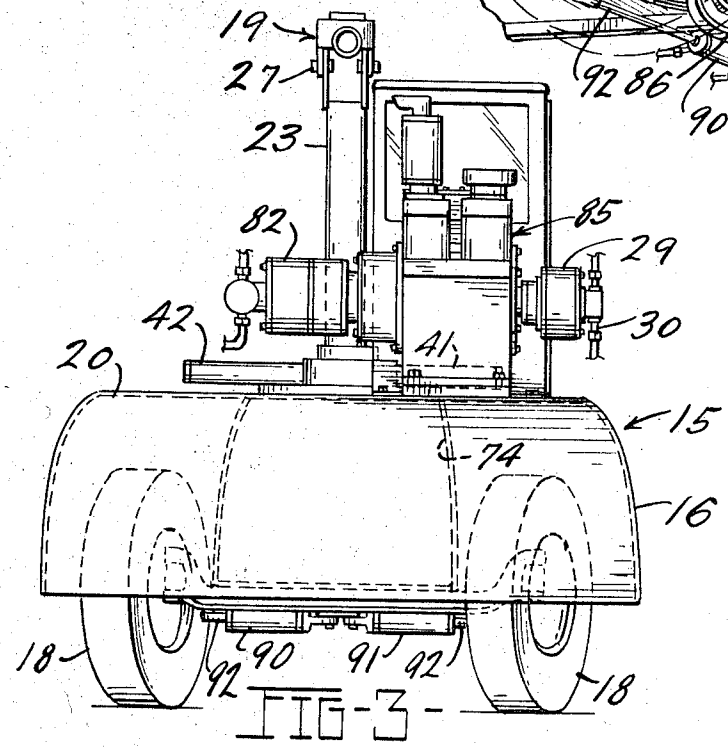


FIG-3-

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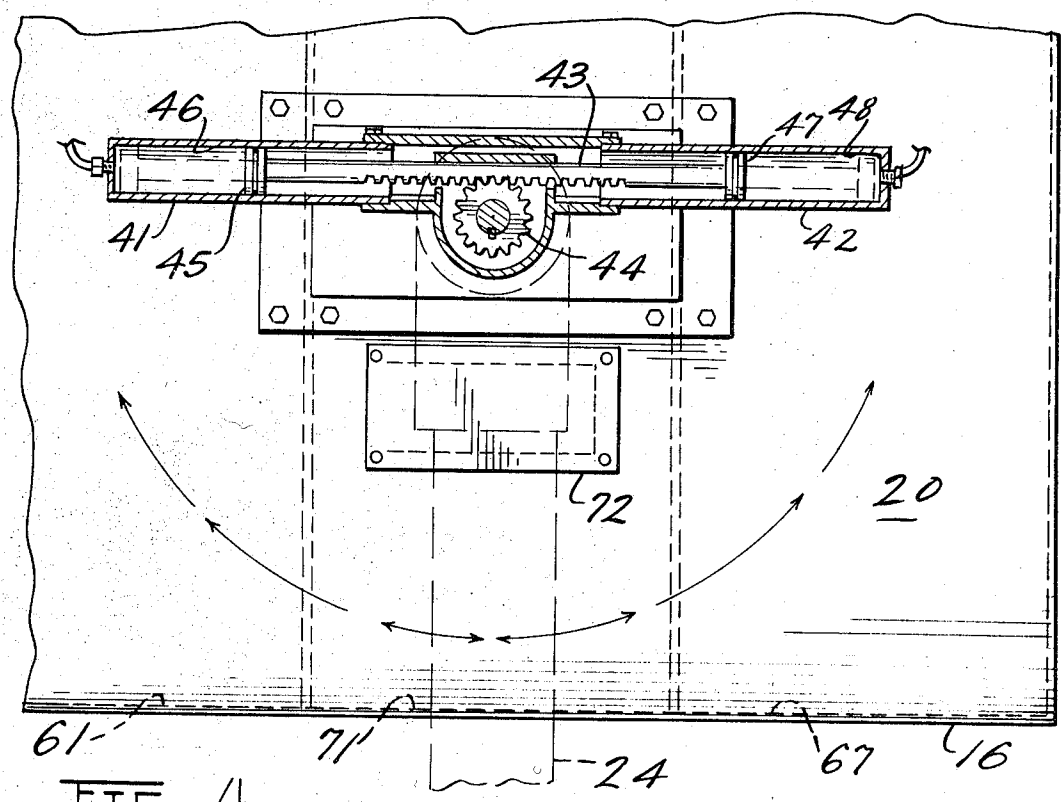


FIG-4-

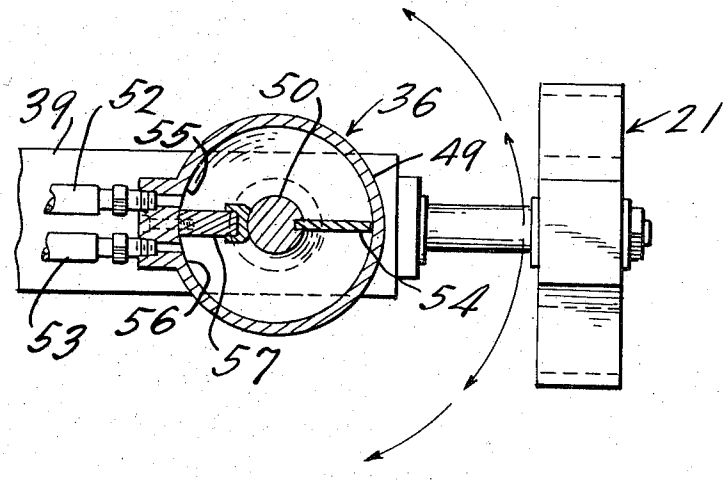


FIG-5-

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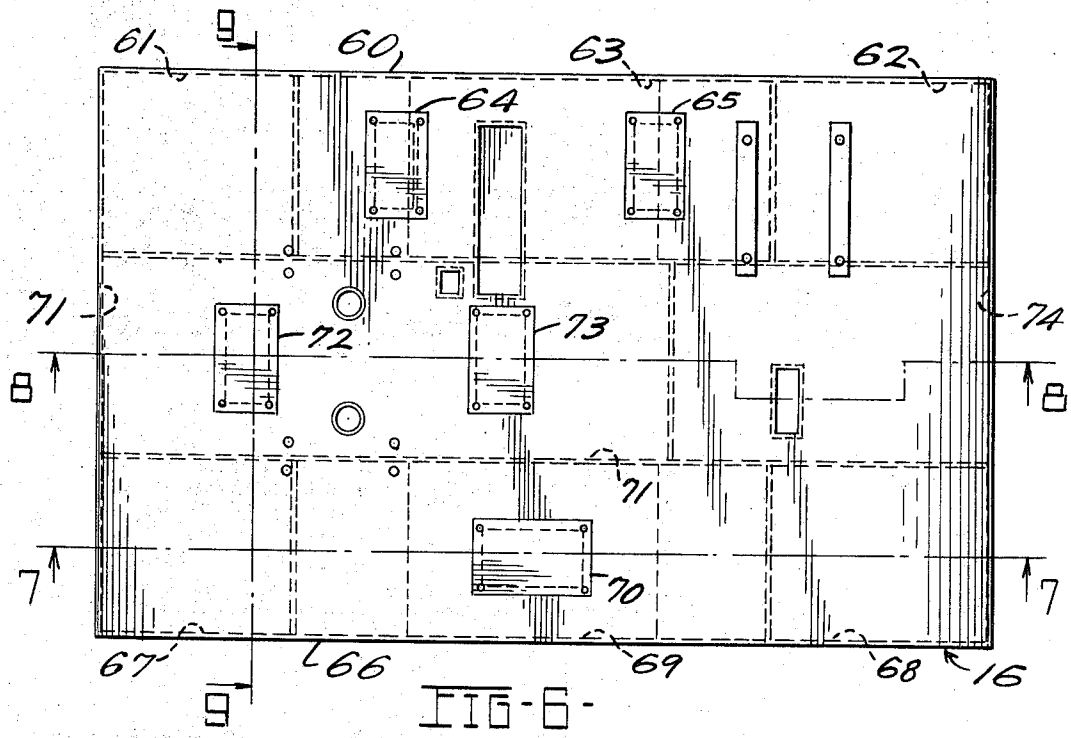


FIG-6-

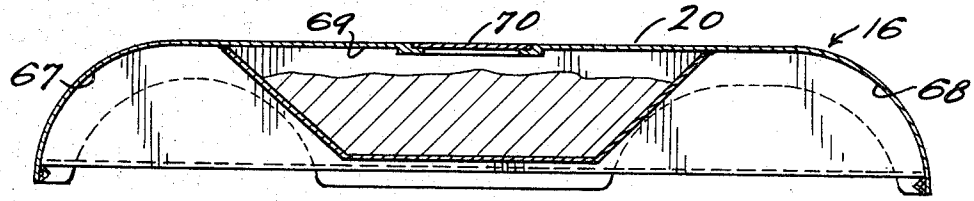


FIG-7-

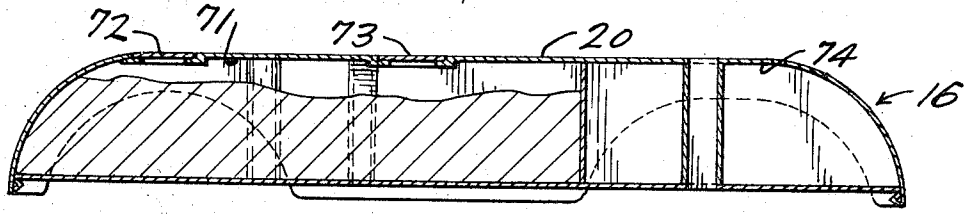


FIG-8-

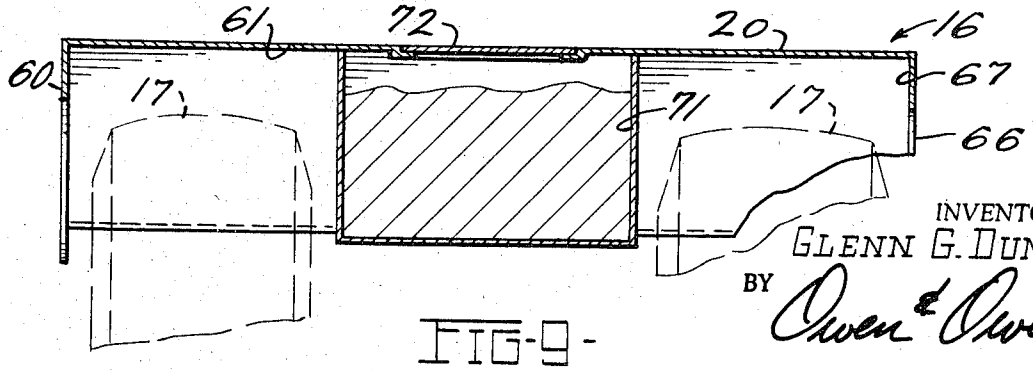


FIG-9-

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CRANE

BACKGROUND OF THE INVENTION

This invention relates generally to material-handling vehicles and, more particularly, to a hydraulically-operated yard crane for lifting and moving materials.

In the past, material-handling in yards and at shipping and receiving docks has typically been accomplished by the use of forklike trucks and prior art cranes. When material is on a pallet or in a suitable container, a forklift truck is often used for loading and unloading the material from trucks and trains and for moving the material about a storage yard. However, several problems exist with conventional forklift trucks. The forklift truck, which usually includes a pair of parallel horizontal arms attached to a carriage, is restricted to a vertical lifting movement. The entire forklift truck must be aligned with the material prior to lifting and must similarly be aligned with the unloading area prior to lowering. Considerable time is wasted in maneuvering the truck. Furthermore, the forklift truck operator's view is often obstructed by the load, making the truck difficult and sometimes hazardous to maneuver. The forklift truck is also restricted to operation in obstacle-free areas where the forklift can be readily positioned under the material. It is often difficult or impossible to position the fork arms under a load which is positioned on an elevated support or in a depressed storage area.

A prior art crane is sometimes used where it is inconvenient to use a forklift truck. Often the crane has a lengthy boom, which supports a vertically movable cable. A bucket, a hook, or other type of supporting device depends from the end of the cable. Often the crane is self-propelled and is driven by an internal combustion engine. This type of crane requires a skilled operator and often requires an assistant crane operator or oiler.

If the materials are to be loaded and unloaded at a fixed location, such as railroad siding, a crane is sometimes permanently installed at the location. The permanently installed crane, however, lacks the mobility of the forklift truck and is restricted in its operation.

SUMMARY OF THE INVENTION

According to the instant invention, a versatile, hydraulically-operated yard crane is provided for lifting and moving materials. The yard crane has a generally flat, hollow body mounted to move on front and rear pairs of wheels. The hollow body is divided into a number of enclosed ballast chambers. Removable covers permit access to the chambers for adding and removing ballast. At least one wheel of the front pair of wheels is driven by a hydraulic motor and the rear pair of wheels is hydraulically turned for steering the crane.

A loading arm, including a mast, an inner boom, an outer boom, and an extension boom, extends above the crane body from a position centered between and to the rear of the front pair of wheels. The mast is rotatably mounted and extends vertically upwardly from the top surface of the body. The inner boom is pivotally attached at one end to the upper end of the mast and the outer boom is pivotally attached at one end to the other end of the inner boom. The extension boom is telescopically attached to the outer boom. The loading arm is operated by controlling fluid flow to a number of hydraulic cylinders. An implement, such as a hoisting fork, a clam shell bucket, a grapple, or a hook, is removably attached to the projecting end of the extension boom by means of a hydraulic "wrist," which permits the crane operator to rotate the implement for accurately positioning the load. When the implement is a hoisting fork, it may conveniently be of the type disclosed in my patent 3,239,072, which includes a hydraulic cylinder for adjusting the pitch of the fork arms. Adjusting the pitch of the arms facilitates the sliding of the arms under a pallet or other load and allows the operator to level the load.

An internal combustion engine operates two high pressure hydraulic pumps. One pump is connected to a hydraulic motor and is in communication with a pair of foot operated valves, permitting the crane operator to instantly move the crane forward or backward, while leaving his hands free for steering the crane and for operating the loading arm. The second pump is connected through a plurality of hand operated valves to the hydraulic cylinders which control the loading arm. By controlling the flow of hydraulic fluid to the loading arm, the arm can be made to duplicate virtually every movement of the human arm and hand.

Accordingly, it is the object of the invention to provide an improved crane for lifting and moving materials.

Other objects and advantages of the invention will become apparent from the following detailed description, reference being made to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an automatic yard crane constructed in accordance with the instant invention and showing by dashed lines the extension boom in its extended position;

FIG. 2 is a side elevational view of a yard crane according to the instant invention and showing by dashed lines the loading arm with the inner and outer booms in an aligned position;

FIG. 3 is a rear end view of a yard crane according to the instant invention, showing the internal combustion engine and two hydraulic pumps for operating the yard crane, with the rear wheels shown in a turned position;

FIG. 4 is a cross-sectional view taken along line 4–4 of FIG. 1 and showing in detail the hydraulic means for rotating the loading arm;

FIG. 5 is a cross-sectional view taken along line 5–5 of FIG. 1 and showing the hydraulic "wrist" for rotating the forklift;

FIG. 6 is a top view of the yard crane body;

FIG. 7 is a cross-sectional view of the yard crane body taken along line 7–7 of FIG. 6 and showing one of the enclosed ballast chambers;

FIG. 8 is a cross-sectional view of the yard crane body taken along line 8–8 of FIG. 6 and showing a second enclosed ballast chamber and the hydraulic fluid reservoir;

FIG. 9 is a cross-sectional view of the yard crane body taken along line 9–9 of FIG. 6;

FIG. 10 is a fragmentary perspective view of the yard crane, showing the front axle and the hydraulic drive system; and

FIG. 11 is a fragmentary perspective view of the yard crane, showing the hydraulic steering system and the suspension for the rear wheels.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1–3, a crane **15**, constructed according to the instant invention, is shown in detail. The yard crane **15** includes a generally flat, horizontally extending body **16** mounted by axle assemblies on a pair of front wheels **17** and a pair of rear wheels **18**. The crane **15** has a hydraulically operated loading arm **19** mounted on its upper surface **20**. A variable pitch hoisting fork **21** is shown attached to a free end **22** of the loader arm **19** for picking up materials which are to be lifted or moved.

The loading arm **19** includes a mast **23**, an inner boom **24**, an outer boom **25**, and an extension boom **26**. The mast **23** is vertically mounted on the upper surface **20** of the crane body **16** at a point centered between and to the rear of the front pair of wheels **17**. The inner boom **24** is pivotally attached to the upper end of the mast **23** by means of a pivot pin **27**. A hydraulic cylinder **28** is connected between the inner boom **24** and the mast **23** for pivoting the inner boom **24** about the pivot pin **27**. Hydraulic fluid is supplied to the cylinder **28** by a fluid supply system, including a high pressure pump **29** (FIG. **3**), a conduit **30**, and one of a series of manually operated valves **31**. The outer boom **25** is pivotally attached to the inner boom **24** by means of a pivot pin **32**. A hydraulic cylinder **33** is attached between the outer boom **25** and the inner boom **24** for pivoting the outer boom **25** about the pivot pin **32**. The cylinder **33** is supplied by the fluid supply system, including one of the series of manually operated valves **31** in a manner similar to the cylinder **28**.

The extension boom 26 is telescopically mounted on the outer boom 25 to slide on a bearing surface 34. A hydraulic cylinder 35 is used for axially positioning the extension boom 26 with respect to the outer boom 25. Again, the cylinder 35 is a part of the fluid supply system, including another one of the valves 31 (FIG. 1). An implement, such as the variable pitch hoisting fork 21, is attached to the free end 22 of the extension boom 26 by means of a hydraulic wrist 36 which allows the crane operator to rotate the implement. FIGS. 1 and 2 each shows the loading arm 19 in two positions. In FIG. 1, the loading arm 19 is shown with the extension boom 26 in a retracted position in solid lines and in an extended position in dashed lines. In FIG. 2, the loading arm 19 is shown in solid lines holding material 37 over the end of a trailer 38 and in dashed lines holding the material 37 over the middle of the trailer 38. The material 37 has been moved by pivoting the inner boom 24 with respect to the mast 23, by pivoting the outer boom 25 with respect to the inner boom 24, and by extending the extension boom 26. A hydraulic cylinder 39 on the hoisting fork 21 is retracted to tilt the arms 40 of the hoisting fork 21. The variable pitch hoisting fork 21 is described in greater detail in my U.S. Pat. No. 3,239,072. Each of the hydraulic cylinders 28, 33, 35 and 39 and the hydraulic wrist 36 receives pressurized hydraulic fluid from the pump 29 (FIG. 3) and is controlled by one of the manually operated valves 31.

Referring to FIGS. 1 and 4, one of the manually operated valves 31 also supplies hydraulic fluid to a pair of opposed hydraulic cylinders 41 and 42 for rotating the mast 23. The mast 23 is rotated by means of a rack 43 and a pinion 44. The pinion 44 is attached directly to the mast 23, while the rack 43 is mounted to move coaxially within the opposed hydraulic cylinders 41 and 42. A piston 45 is attached to one end of the rack 43 for sealably engaging an interior wall 46 of the cylinder 41, and a piston 47 is attached to the other end of the rack 43 for sealably engaging the interior wall 48 of the cylinder 42. The rack 43 is moved axially to rotate the pinion 44 by forcing hydraulic fluid into either the hydraulic cylinder 41 or the hydraulic cylinder 42.

The hydraulic "wrist" 36 which is used for rotating the hoisting fork 21 is shown in detail in FIG. 5. The "wrist" 36 includes a cylindrical body 49 which is suspended from the free end 22 of the extension boom 26 and a downwardly extending axle 50. A vane 57 extends radially inward from the body 49 to sealingly engage the axle 50, while permitting the axle 50 to rotate with respect to the body 49. Hydraulic inlets 52 and 53 are connected through one of the manually operated valves 31 to either side of the vane 51. A vane 54 is attached to and extends from the axle 50 to sealably engage the body 49, thereby forming two enclosed chambers 55 and 56. The shaft 50 and the hoisting fork 21 are rotated in one direction by forcing hydraulic fluid through the inlet 52 into the chamber 55, and are rotated in the other direction by forcing hydraulic fluid through the inlet 53 into the chamber 56. Movement of the vane 54 rotates the axle 50 with respect to the cylindrical body 49.

Referring now to FIGS. 6–9, the yard crane body 16 is shown in detail. The body 16 is generally flat shaped and defines compartments for receiving ballast. A right side 60 of the body 16 is divided into front and rear wheel wells 61 and 62, respectively, separated by an enclosed chamber 63. The chamber 63 has two access covers 64 and 65 which are removable for adding and removing ballast. The left side 66 of the body 16 similarly is divided into front and rear wheel wells 67 and 68 which are separated by an enclosed ballast chamber 69 having a removable access cover 70. A third ballast chamber 71 extends between the front wheel wells 61 and 67 and the chambers 63 and 69, and has a pair of removable access covers 72 and 73. Ballast, for example granular ballast comprising 6,000 pounds of scrap steel slugs is placed in the chambers 63, 69 and 71. It has been found that the body design, and particularly the ballast chambers give the crane, constructed according to the present invention, great stability. Such body construction is an important feature of the present invention. A fourth enclosed chamber 74 behind the ballast chamber 71 is used as a hydraulic fluid reservoir.

Referring now to FIG. 10, the drive train for the yard crane 15 is shown in detail. A rear axle 76, including a differential 77, mounts a pair of blocks 78 which in turn are attached to and support the body 16. The axle 76 is positioned such that the front wheels 17 are positioned within the wheel wells 61 and 67. A hydraulic motor 79 is connected through a drive shaft 80 and a universal 81 to the differential 77 for driving the front wheels 17. Hydraulic fluid is supplied by a fluid supply system including a pump 82 (see FIG. 3), a pair of foot operated valves 75 (see FIG. 2), the conduits 83 and 84, and the pump 79. The hydraulic pump 82 for driving the hydraulic motor 79 and the hydraulic pump 29 for operating the loader arm 19 and the steering mechanism are driven by a conventional internal combustion engine 85. Hydraulic fluid flows from the reservoir 74 through the pump 82, the forward and reverse pedal operated control valves 75, and conduits 83 and 84, to the hydraulic motor 79, and back to the reservoir 74. Hydraulic fluid also flows from the reservoir 74 through the pump 29, the manually operated control valves 31, one of the hydraulic cylinders 28, 33, 35 and 39, or the hydraulic wrist 36, and back to the reservoir 74.

Referring now to FIG. 11, the hydraulic steering mechanism is shown in detail. A rigid beam 86 mounts the crane body 16 by means of a pair of leaf spring assemblies 87. The rear wheels 18 are mounted to rotate on axles 88 which are pivotally attached to the beam 86 by means of king bolts 89. Left and right hydraulic cylinders 90 and 91 are connected through tie rods 92 to pivot the axles 88 about the king pins 89. The flow of hydraulic fluid to the hydraulic cylinders 90 and 91 is controlled by means of valves operated by rotating a steering wheel 93 (see FIG. 2). Referring to FIG. 3, the rear wheels 18 are shown in position for making a left turn.

I claim:

1. A crane comprising, in combination, a horizontally extending body having a generally flat upper surface, said body defining a plurality of enclosed chambers for receiving ballast, removable means for access to said enclosed chamber for adding and removing such ballast, front and rear pairs of wheels, means attaching said wheels below said body, hydraulic means for turning said rear pair of wheels for steering said yard crane, means for driving at least one wheel of the front pair of wheels, a loading arm including an elongated mast and inner and outer elongated booms, means rotatably mounting said mast on said body, said mast extending vertically above said body from a location adjacent the front end of said body, hydraulic means for rotating said mast, means pivotally attaching one end of said inner boom to the upper end of said mast, hydraulic means for pivoting said inner boom with respect to said mast, means pivotally attaching one end of said outer boom to the other end of said inner boom, hydraulic means for pivoting said outer boom with respect to said inner boom, an implement, and means for attaching said implement to the other end of said outer boom.

2. A crane, as defined in claim 1, wherein said means for driving at least one wheel is a hydraulic motor, and including a first pump for supplying pressurized hydraulic fluid to said hydraulic motor, means for controlling the flow of hydraulic fluid from said first pump to said hydraulic motor, a second pump for supplying pressurized hydraulic fluid to said loading arm, means for controlling the flow of hydraulic fluid from said second pump to said hydraulic means for rotating said mast, means for controlling the flow of hydraulic fluid from said second pump to said hydraulic means for pivoting said inner boom, means for controlling the flow of hydraulic fluid from said second pump to said hydraulic means for pivoting said outer boom, and an internal combustion engine for driving said first and second pumps.

3. A crane, as defined in claim 2, wherein said means for controlling the flow of hydraulic fluid from said first pump to said hydraulic motor includes a pair of foot operated valves, one of said valves controlling the flow of hydraulic fluid to said motor for controlling forward movement of the crane and the other of said valves controlling the flow of hydraulic fluid to said motor for controlling reverse movement of the crane.

4. An automatic yard crane, as defined in claim 3, wherein said means for attaching said implement to the other end of said outer boom includes hydraulic means for rotating said implement, and further including means for controlling flow of hydraulic fluid from said second pump to said hydraulic means for rotating said implement.

5. A crane, as defined in claim 4, wherein said implement is a hoisting fork means including support arms for lifting a pallet, said hoisting fork means having means for varying the pitch of said support arms.

6. A crane, as defined in claim 5, wherein said means for attaching said hoisting fork means to said outer boom further includes an extension boom telescopically attached to said outer boom, and hydraulic means for axially positioning said extension boom with respect to said outer boom.

7. A crane, as defined in claim 2, wherein said means for attaching said implement to the other end of said outer boom further includes an extension boom telescopically attached to said outer boom, and hydraulic means for axially positioning said extension boom with respect to said outer boom.

8. An automatic yard crane comprising, in combination, a body having a generally flat upper surface, said body defining a plurality of chambers for receiving ballast, a front axle positioned beneath the front end of said body, a pair of front wheels mounted on opposed ends of said front axle, drive means for driving at least one of said front wheels, said drive means including a hydraulic motor operatively connected to at least one of said front wheels, a pair of rear wheels mounted for turning movement beneath the rear end of said body, steering means including hydraulic cylinders operatively connected to said rear wheels for turning said rear wheels, and a loading arm extending vertically above said body from a location adjacent the front of said body.