July 24, 1956 H. M. RUSH 2,755,939

HYDRAULIC CRANE

Filed April 14, 1952 4 Sheets-Sheet 1

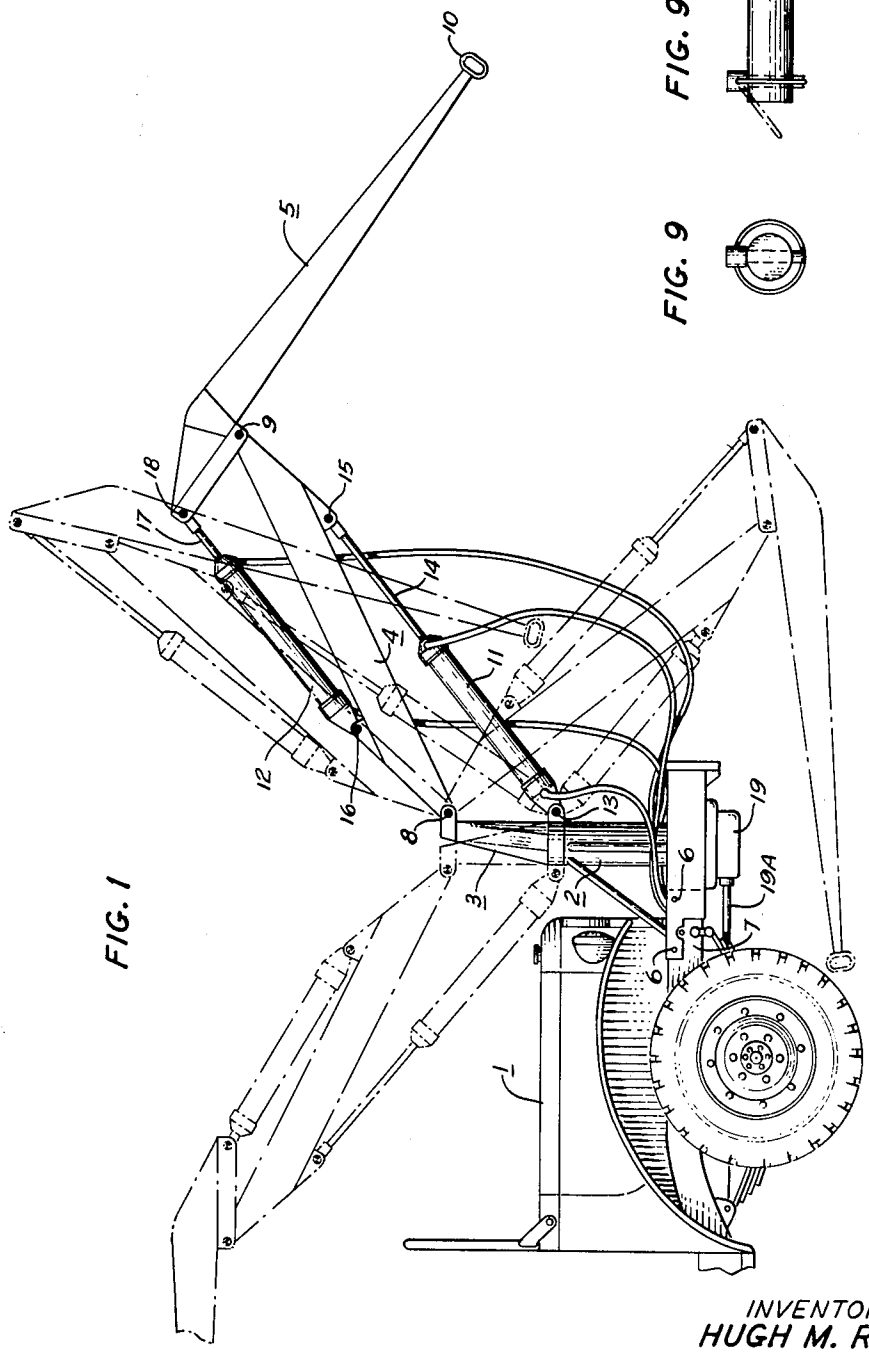



FIG. 1



FIG. 9A



FIG. 9

INVENTOR
HUGH M. RUSH
BY
Earl C. Loughlin
ATTORNEY

July 24, 1956 H. M. RUSH 2,755,939

HYDRAULIC CRANE

Filed April 14, 1952

4 Sheets-Sheet 2

FIG. 2

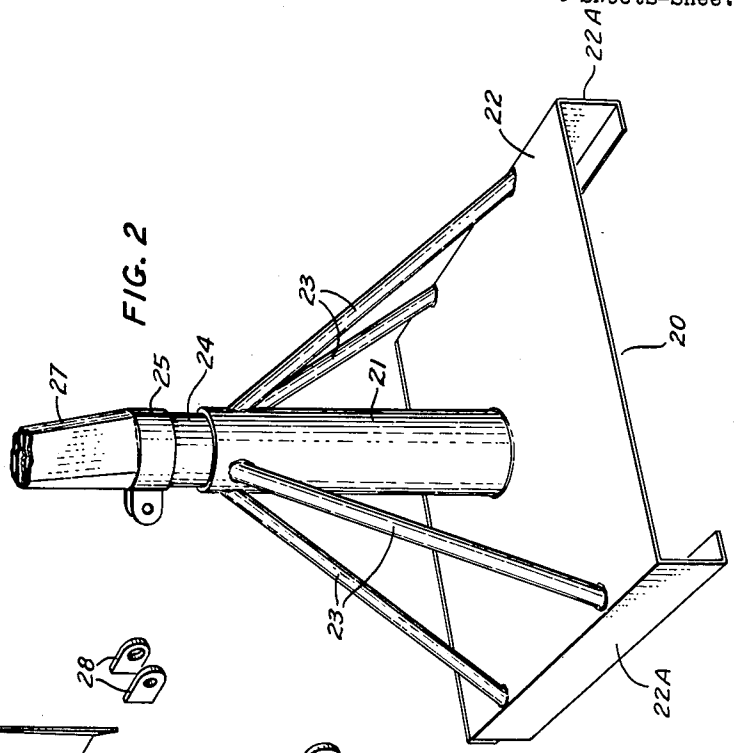



FIG. 6

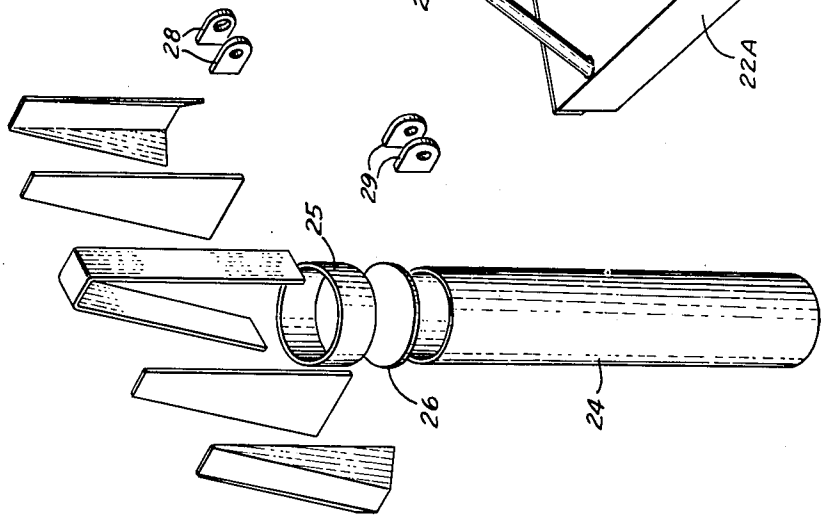
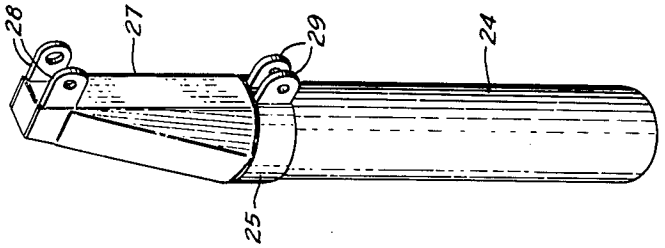



FIG. 3




INVENTOR
HUGH M. RUSH
BY
Earl C. Langlois
ATTORNEY

July 24, 1956 H. M. RUSH 2,755,939

HYDRAULIC CRANE

Filed April 14, 1952 4 Sheets-Sheet 3

FIG. 5

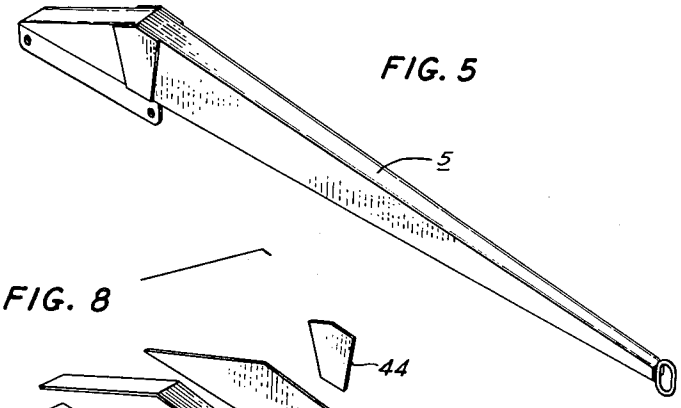



FIG. 8

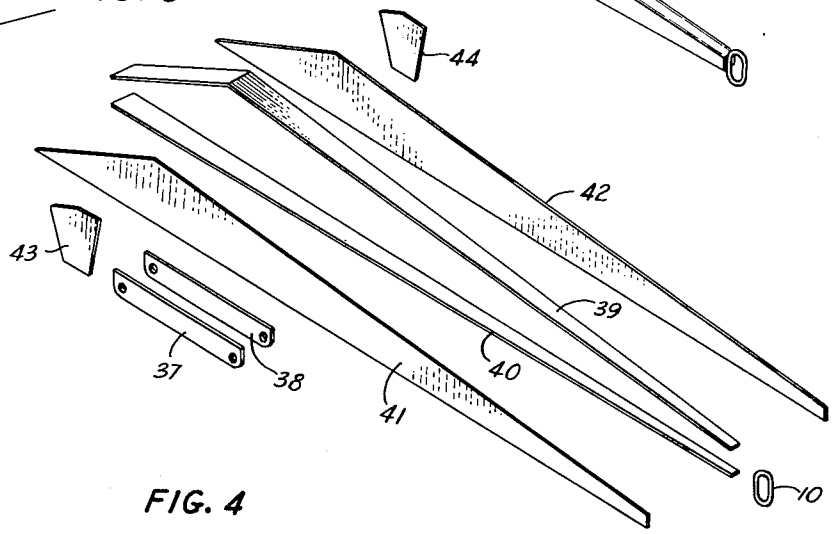



FIG. 4

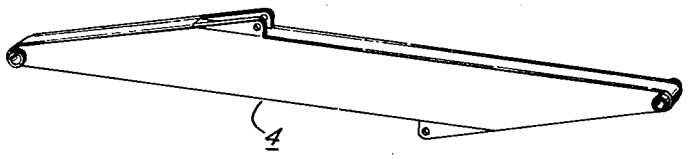
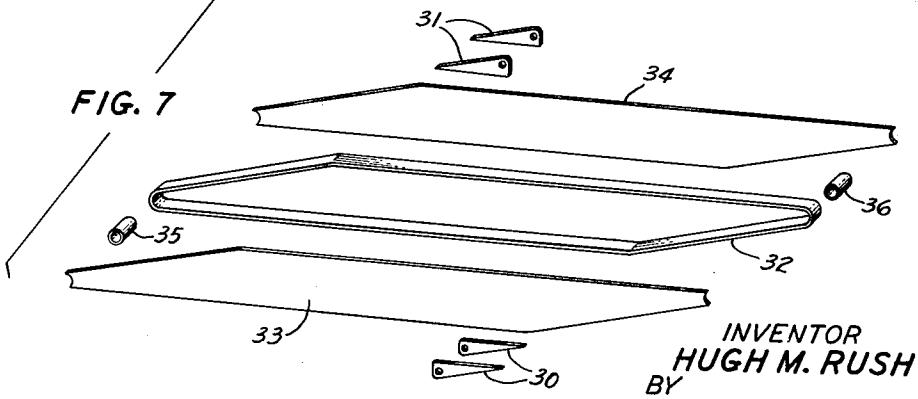



FIG. 7




INVENTOR
HUGH M. RUSH
BY
Earl C. Kauffman
ATTORNEY

July 24, 1956 H. M. RUSH 2,755,939

HYDRAULIC CRANE

Filed April 14, 1952 4 Sheets-Sheet 4

FIG. 10

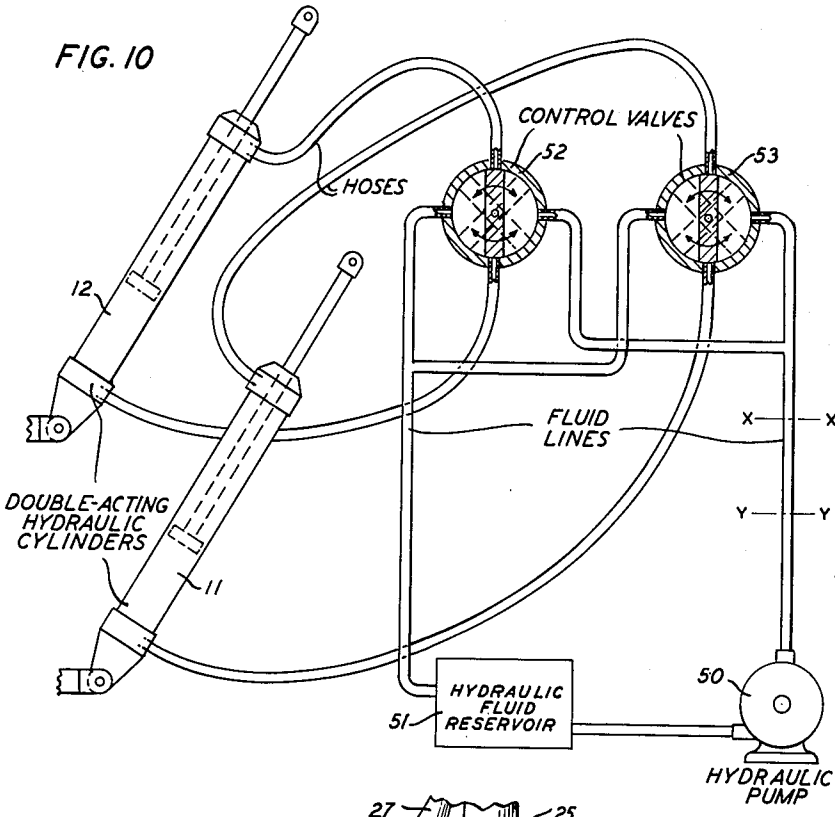



FIG. 11

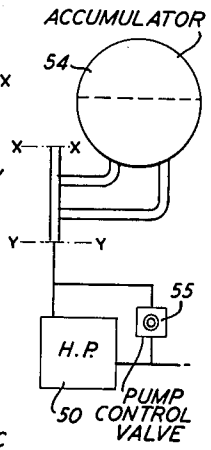



FIG. 12

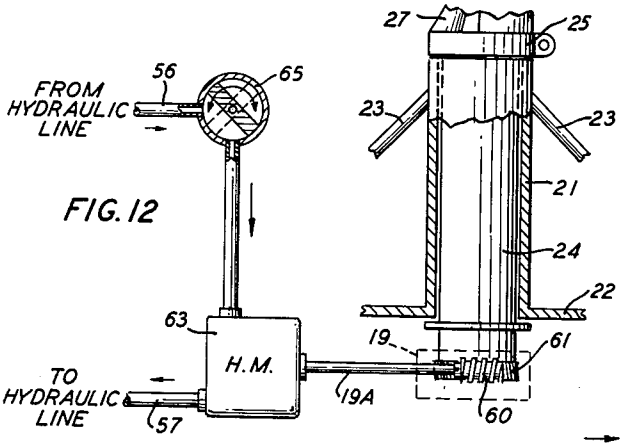



FIG. 13

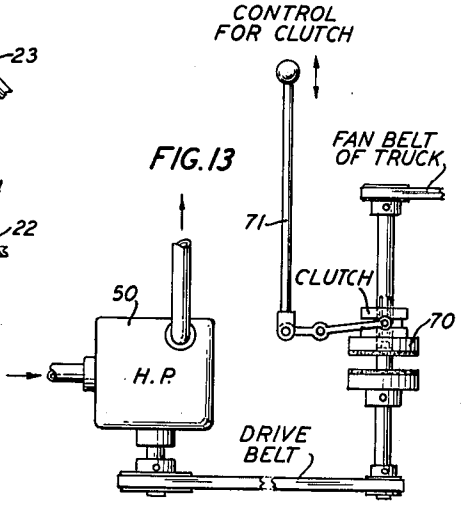
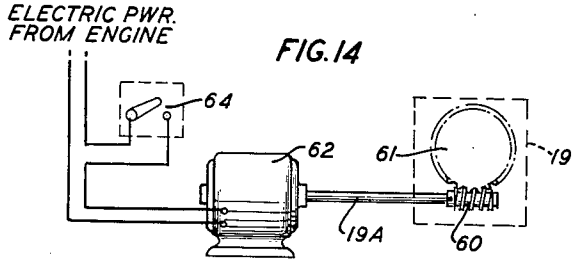



FIG. 14




INVENTOR
HUGH M. RUSH

BY
Earl C. Longfellow
ATTORNEY

United States Patent Office

2,755,939

Patented July 24, 1956



2,755,939

# HYDRAULIC CRANE

Hugh M. Rush, Elkhart, Ind.

Application April 14, 1952, Serial No. 282,228

4 Claims. (Cl. 212—35)

The invention relates to equipment for lifting and handling heavy objects and particularly to cranes of the hydraulic type used for this purpose.

It is specifically directed to, although not limited to, small hydraulic cranes for lifting and moving loads of weight in the range from just above the lifting capacity of one or two men to several thousand pounds.

An object of the invention is to improve such cranes from the standpoint of initial and maintenance costs; simplicity of construction; low weight for a given lifting capacity; ease and efficiency of operation; ease of fabrication, handling, storage and transportation when not in use; and versatility of use.

A related object is to provide a crane of simple construction, utilizing a small number of working parts and with simple controls, for lifting and moving heavy loads to any desired location within a defined space.

The hydraulic crane of the invention for attaining the above objects includes a rotatable, vertically-disposed mast member and a two-link mechanical linkage having one end connected to the top of the mast member, so as to be rotatable with that member horizontally about its vertical axis. Means are provided for attaching a load to be lifted and moved to the other end of the linkage. The mechanical linkage has two pivoting connections one of which is fixed with respect to the mast member and the other substantially free with respect thereto, which are respectively adapted to swing a different one of the two links of the linkage vertically about their respective pivoting points. The combination of horizontal and vertical rotary motions provided by these connections enables the load to be lifted and moved to any desired location within a defined space limited only by the working radii of the crane members and the necessary clearances. The vertical rotation of each of the two links of the mechanical linkage is controlled by a different one of two hydraulic power cylinders suitably located with respect to the linkage, forming a part of a hydraulically-actuated mechanism under control of the operator of the crane; and the horizontal rotation of the mast member, and thus of the mechanical linkage and the load attached thereto, is controlled by another suitable power-driven or hand-operated mechanism under control of the operator.

The simplicity of the crane of the invention and the small number of simple controls required for its operation necessitating a minimum of operator training are important features.

Another feature is the use of like pivot pins and journals for all pivoting connections, and associated like snap-action locking arrangements for holding the pivot pins in place, which simplifies the parts supply problem and facilitates quick assembly and dismantling of the crane.

Those and other features and the advantages of the hydraulic crane of the invention are explained more fully in the following complete description to be read in conjunction with the accompanying drawings, in which:

Fig. 1 shows a side elevation view of one embodiment



of the hydraulic crane of the invention mounted on one end of an automotive truck;

Figs. 2 to 5 respectively show perspective assembly views of different essential members of the hydraulic crane of Fig. 1;

Figs. 6 to 8 respectively show perspective exploded views of the mast, boom and stick members of the hydraulic crane of Fig. 1, illustrating the component parts of these members and how they are fabricated more clearly;

Figs. 9 and 9A show different views of one type of snap-action locking arrangement which may be used at each pivoting point in the crane of Fig. 1 to hold the pivot pin in place when the crane is assembled and which will enable quick assembly and dismantling of the crane;

Figs. 10 and 11 show diagrammatically alternative types of hydraulic systems which may be employed for controlling the operation of the hydraulic crane of the invention shown in Fig. 1; and Figs. 12 to 14 illustrate diagrammatically alternative arrangements which may be used for controlling the operation of the crane.

One practical embodiment of the hydraulic crane of the invention, which was constructed and successfully operated, is shown in Fig. 1 mounted on the front end of an automotive truck 1 of standard design, only a portion of the truck being illustrated. Although this crane is adapted to be mounted on and operated from the rear end or the side of a vehicle, as well, front mounting is preferred because it leaves the vehicle free to transport other material and simplifies crane operation in that the driver of the vehicle may operate the crane from the driver's seat and it allows the bed of the truck or other vehicle to be loaded with ballast, if necessary, to prevent tipping of the vehicle when heavy loads are being handled by the crane. Also, such front mounting facilitates the use of the truck engine as the primary source of power for operating the crane.

As shown in Fig. 1, the crane includes as essential members, a support member 2, a mast member 3, a boom member 4 and a stick member 5. The support member 2, the detailed construction of which will be described later in connection with Fig. 2, is affixed by bolts 6 or other securing means to the frame 7 of the truck 1, from which the front bumper has been removed. The mast member 3 is mounted on the support member 2, with its longitudinal axis in a vertical position, and is adapted for rotation horizontally about its longitudinal axis. The boom member 4 extending longitudinally away from the mast member 3 has one end pivotally connected at a point 8 to the top of the mast member 3, so as to be rotatable vertically about its pivoting point. The pivoting of the boom member 4 about the high point on the mast member 3 gives the maximum amount of clearance over the crane and below it.

The stick member 5, which extends longitudinally to opposite sides of the other end of the boom member 4, is pivotally connected at a point intermediate its ends and nearer one end than the other, to the other end of the boom member 4 at the point 9 so as to be rotatable vertically about its pivoting point. A hoisting ring 10 is affixed to the end of the stick member 5 farthest from its pivoting point. The load to be lifted and moved may be attached to the hoisting ring 10 by a cable and hook or other suitable means (not shown).

The means for operating the crane includes hydraulically-actuated mechanism under control of the operator of the crane, including two double-acting hydraulic power cylinders 11 and 12, each having a piston and associated piston rod movable longitudinally therein under control of oil or other hydraulic fluid under pressure to provide a power stroke in each direction. The cylinder 11 is pivotally mounted at its rear end to the mast member 3 at a point 13 intermediate the ends of the latter, and the free end of its piston rod 14 is pivotally connected to

the underside of the boom member 4 at a point 15, so that a power stroke of the piston rod 14 in the direction towards or away from the mast member 3 will apply force to the boom member 4 to swing it vertically about its pivoting point 8 at the top of the mast member 3, clockwise or counter-clockwise, respectively, over a given angle. This will lower or raise, respectively, the pivoting point 9 of the stick member 5 by a distance proportional to the length of the controlling power stroke which is under control of the operator of the crane. The other power cylinder 12 is pivotally mounted at its rear end on the upperside of the boom member 4 at a point 16, and the free end of its piston rod 17 is pivotally connected to the stick member 5 at a point 18 near the end thereof nearest the pivoting point 9, so that a power stroke of the piston rod 17 in the direction towards or away from the mast member 3 will apply force to that end of the stick member 5 to swing that member vertically about its pivoting point 9, counter-clockwise or clockwise, respectively, over a given angle. This will raise or lower, respectively, the hoisting ring 10 at the other end of that member, and thus any load attached to that ring, by a distance proportional to the length of the controlling power stroke, which is under control of the operator of the crane.

Thus, the combined actions of the hydraulic power cylinders 11 and 12 and their associated piston rods, under control of the crane operator, may be employed to adjust the height to which the load is raised or lowered and the distance of the load from the mast member 3 to the desired values. The function of the substantially free pivoting point 9 in the mechanical linkage formed by the boom member 4 and the stick member 5, is to add a lost motion component to that linkage which will effectively increase the amount of angular swing of the load and thus increase the working range of the crane over that which would be attainable with a mechanical linkage having only one pivoting point.

The hydraulic system for controlling the operation of the two double-acting power cylinders 11 and 12 and their associated piston rods, which forms no part of the present invention, may be of any of the well-known types. Such a system as shown in Fig. 10 would include a hydraulic pump 50, an associated reservoir 51 for the hydraulic fluid used, suitable control valves 52 and 53 and interconnecting lines or hoses for feeding the hydraulic fluid under pressure from the pump through the valves into the cylinders and back from the cylinders to the reservoir. There are two principal types of control valve systems which may be used for operating more than one double-acting hydraulic power cylinder. These are the open center and closed center valve systems, both of which are illustrated, this classification having reference to the condition of the valves in the system when they are not being operated: thus, in an open center valve system, as shown in Fig. 10, the hydraulic fluid flows directly through the valves 52 and 53 from the pump 50 and back to the reservoir 51 when the cylinders 11 and 12 are not being operated; whereas in a closed center valve system, as shown in Fig. 10 modified in accordance with Fig. 11, the hydraulic fluid must build up pressure in an accumulator 54, if one is used, and the lines up to the valves, and when the pressure builds up high enough, the fluid is bypassed back to the reservoir 51 through a pump control or other relief valve 55. The open center valve system, which was the one employed with the hydraulic crane of the invention which was built and operated by applicant, has the advantage of greater simplicity and the absence of pressure in the system when the cylinders are not being used. The closed center system has the disadvantage of requiring the use of more equipment including a pump control valve, an accumulator and relief valve or, at the very least, a relief valve. A pump control valve is merely a manually-operated device which, when turned off, diverts the hydraulic fluid back to the reservoir without resistance and, when turned on, delivers the hydraulic fluid to the accumulator and/or the relief valve under pressure. The closed center system has the advantage of allowing operation of the cylinders independently or together in any combination without affecting the pressure on the pump in such a way as to cause it to rise due to interference between the cylinders. Both open center and closed center valve systems have been described here in some detail as either may be used satisfactorily with the crane of the invention.

As shown in Fig. 10, each of the cylinders 11 and 12 would have the usual ports, indicated by dotted lines, at the front and rear ends for respectively admitting the hydraulic fluid under pressure fed thereto from the hydraulic power pump 50 on one or the other side of the piston to provide the power strokes of the associated piston rod in opposite directions, and for returning it to the reservoir 51, through the associated control valve 52 or 53 and flexible conduits as shown, when the movable member of the valve is rotated by the crane operator counter-clockwise or clockwise, respectively. The pump, reservoir, and valves and other control equipment of the hydraulic system would preferably be mounted on the truck at some convenient location. The pump 50 may be driven from the fan belt or other pressure take-off of the truck engine, and may be controlled by a disc—or other type of clutch mechanism 70 operated through a shift lever 71 under control of the operator from the cab of the truck, as shown diagrammatically in Fig. 13. Alternatively, the pump could be driven from an auxiliary electric motor 62 mounted on the truck and controlled by a suitable electric switch 64 under control of the operator as shown in Fig. 14; or a hand-operated pump could be used. The opening and closing of the valves to control the length of the power strokes of the piston rods in the cylinders 11 and 12 could also be controlled by the operator by means of the same or other controls in the cab of the truck.

As shown in Figs. 1, 12 and 14, the mast member 3 may be rotated to swing the boom and stick members, and thus the load attached to the latter, horizonally about the longitudinal axis of the mast member over the necessary angle to bring the load to the desired directional position with respect to the mast member 3, by a gearing arrangement contained within the box 19, connected to the bottom of the portion 24 of mast member 3 through an opening in the bottom of the portion 22 of support member 2. This gearing arrangement, for example, might comprise a gear 60 and worm wheel 61 driven through the drive shaft 19A by an electric motor 62 or hydraulic motor 63 driven by power supplied from a power take-off point of the truck engine and also through a disc—or other type clutch mechanism similar to that shown in Fig. 13, if desired. This mechanism could be controlled by an electric switch 64 or hydraulic valve 65 in the cab of the truck, operated by the truck driver or other crane operator. Thus, with a small number of controls the crane can be operated to give the three different motions which will produce a free movement of the load anywhere within the working range of the crane limited only by the working radii of the several crane members and the necessary clearances.

In Fig. 1, the solid black lines show the position of the various parts of the crane for one position of rotation of the mast member 3 with the boom member 4 raised and the stick member 5 extended to intermediate positions. The dotted lines indicate the positions which the parts would have for the same condition of rotation of the mast member with the boom member fully raised and the stick member closed and with the boom member lowered and the stick member folded back under the truck; and with a 180-degree angle rotation of the mast member with the boom member raised and the stick member extended horizontally; showing the versatility of the crane movement.

The construction details of the essential members of the hydraulic crane of the invention will now be described with reference to the other figures of the drawings.

The support member 2, as shown in Fig. 2 includes a

steel table-like base portion **20** and a steel tubular member **21** mounted vertically thereon, the tubular member serving as a means for supporting the mast member **3** coaxially therein so as to enable free rotation of that member about its longitudinal axis. The mast member **3** is shown in Fig. 2 partially inserted in the tubular member **21**. When the mast member **3** is inserted coaxially within the tubular member **21** to the operating position, the bottom of a steel collar **25**, to be referred to later in connection with a detailed description of the mast member, would rest on the top of the tubular member, the two contacting surfaces serving as bearings when the mast member is rotated horizontally about its longitudinal axis. In the embodiment of the crane of the invention which was built, the base portion **20** was pressed from 3/16-inch steel plate to form a flat rectangular-shaped surface **22** serving as the table top and two oppositely situated end portions **22A** serving as the table legs. Properly positioned holes are drilled in the end portions **22A** of the base **20** for the bolts **6** for attaching the supporting member **2** to the frame **7** of the truck, as shown in Fig. 1, such that when the crane is mounted on and affixed to the truck the flat portion **22** is disposed in a horizontal plane. The tubular member **21** in the crane which was constructed was of circular cross-section having an inside diameter of 6 inches. The lower end of the member **21** is inserted through a hole cut in the flat portion **22** of the base **20** at a central location and is welded to that portion. Four rods **23**, which may be made from 1-inch steel pipe, are welded at their upper ends to spaced points around the periphery of the tubular member **21** near the top thereof and are welded at their lower ends to the flat portion **22** of the base **20** at spaced points near its opposite ends. These rods are used to brace the mast support tube **21**.

The mast member **3**, as shown in Figs. 3 to 6, includes a cylindrical lower portion **24** of circular cross-section, which may comprise a piece of steel pipe having an outside diameter of 5½ inches. A circular steel collar **25**, about 2½ inches high and having an inside diameter of 5½ inches, which is closed at its lower end with a circular steel plate **26** of 3/16-inch thickness, which is welded thereto, is mounted on and welded to the top of the cylindrical lower portion **24** of the mast member. An upper mast portion **27** of fabricated steel box construction tapering towards the top of the mast member, the several component parts of which, made from 10-gauge steel plate and 2½" x ¼" flat bar steel stock, before being welded together are shown in the exploded view of the mast member in Fig. 6, is mounted on and welded to the top of the collar **25**. Two sets of oppositely disposed steel lugs or ears **28** and **29** are respectively welded to the side of the upper mast portion **27** near its top and to the side of the collar **25**. The two lugs of each set of lugs **28** and **29** have oppositely disposed horizontal holes therein which are used as journals for horizontal pivot pins pivotally connecting the mast member **3** at the point **8** near its top to the end of the boom member **4** and at the intermediate point **13** to the rear end of hydraulic cylinder **11**, respectively, as shown in Fig. 1. The several component parts of the mast member **3**, as described above, are shown more clearly in the perspective exploded view thereof in Fig. 6 of the drawings.

The boom member **4**, as shown in Figs. 4 and 7, is of fabricated box channel construction, this type of construction having been employed to reduce weight and permit the use of a beam of constant strength. It is fabricated from nine pieces of rolled and cut steel including, as shown in Fig. 7, two sets of lugs or ears **30** and **31** respectively attached (welded) to the underside and upperside of the boom proper at the points **15** and **16**, respectively. Oppositely disposed horizontal holes in the two lugs of each set serve as journals for the horizontal pivot pins at these points for pivotally connecting the boom member **4** to the piston rod **14** of the cylinder **11** and to the rear end of the cylinder **12**, respectively, as shown in Fig. 1. The boom member **4** also includes a center flange (strap) **32**, made from 2½" x ¼" flat bar steel stock; two side plates **33** and **34**; and two bushings **35** and **36**, made from short pieces of 1-inch steel pipe, for use as journals for the horizontal pivot pins at the two ends of the member, pivotally connecting the member to the top of the mast member **3** at the point **8** and to the stick member **5** at the point **9**, respectively. All of these parts are welded together to produce the assembled boom as shown in Fig. 4. As a result of an analysis of bending and shearing moments, the advantageous shape shown in Fig. 4 was arrived at, the boom member being made uniform in width throughout its length but tapered in depth in the same direction from each set of cylinder lugs to the near end of the boom and made uniform in depth between the two sets of cylinder lugs. The boom is made alike at the two ends so that it cannot be assembled incorrectly.



The stick member **5** is also of fabricated box channel construction to reduce its weight. It is fabricated from nine pieces of sheet steel including, as shown in Fig. 8: two oppositely situated hinge plates **37** and **38** at one end of the stick member having oppositely disposed horizontal holes therein at the proper positions to serve as journals for the horizontal pivot pins at the pivoting points **9** and **18** (see Fig. 1) for pivotally connecting the member to the boom member **4** and to the piston rod **17** of hydraulic cylinder **12**, respectively; two center flanges **39** and **40**; two side plates **41** and **42**; and two oppositely disposed gusset plates **43** and **44** for reinforcing the stick member near the intermediate hinge point **9** for preventing buckling of the web thereat; and the hoisting ring **10** at the other end of the stick member. These nine pieces are welded together to form the assembled stick member as shown in Fig. 5. The advantageous shape of the member as shown in that figure was based on a force analysis. As shown, the stick member is made uniform in width from the cylinder pivot pin at point **18** to the boom pivot pin at point **9** and is tapered in depth from each end to a common point opposite the boom pin at pivoting point **9** to produce the greatest depth at that point where it is needed.

The six pivoting or hinging joints in the crane of the invention were found from the force analysis to be enough alike to allow the use of the same diameter pivot pin and the same width journal at each joint. Also, all of the pins and the journals are made alike so as to simplify the parts supply problem. The pivot pins used were 1¼ inches in diameter. Like pins with associated snap-action locking pins of the type illustrated in Figs. 9 and 9A were used at all pivoting points to hold the pivot pins in place when the crane is assembled and to enable quick assembly and dismantling of the crane.

All parts of the crane in accordance with the invention, which was built and tested, were made from commercial quality low carbon steel, but the weight could be much reduced, possibly by forty percent, by using alloy steels or aluminum, if the cost and difficulty of fabricating would not make the use of such materials prohibitive. The versatility of use of this crane is indicated by the fact that it is capable of loading or unloading the vehicle on which it is mounted, raising the front of the vehicle on which is it mounted; and even for changing its own engine if an outside source of hydraulic power is used. Although the total weight of the crane built was only 315 pounds, divided as follows: mounting—77.5 pounds; two power cylinders—68 pounds; boom—85 pounds; and stick—60.5 pounds; it was capable of lifting the front of the truck on which it was used which weighed over 3150 pounds at the axle. Other advantages are: its simplicity of design and small number of controls requiring a minimum of operator training; fool-proof design in that the boom is made symmetrical and the ends of the cylinders and the piston rods are made alike, so that it cannot be assembled incor-

rectly; large lifting capacity compared to its own weight; and a large working radius (which was 10 feet for the embodiment built) although occupying a minimum of storage space when folded or dismantled. The crane which was built had the following pertinent dimensions: distance between end pivots of boom—63 inches; distance from end of boom attached to mast to pivot point **16**—15 inches; distance between pivot points **9** and **18**—15 inches; and distance between pivot point **9** and hoisting ring **10**—63 inches.

It is to be understood that the particular materials, weights and dimensions of the crane parts and weights of the loads handled given above are only for illustrative purposes, and other suitable materials, weights and dimensions can be used in accordance with the invention. The design features in accordance with the invention described above are adapted for use with a crane of any size and for handling loads much larger than those specified above. Although, as pointed out, the crane of the invention is particularly adapted for mounting on one end of an automotive truck; it may be mounted on any other type of movable conveyance, such as a boat, railroad car, used in bridge buildings, track laying or other building, digging, or loading operations; or it may be used with a permanent stationary mounting for lifting and loading operations at one point, for example, lifting and moving heavy machinery and building materials in a factory, steel mill or the like. Various other modifications of the crane as illustrated and described which are within the spirit and scope of the invention will occur to persons skilled in the art.

What is claimed is:

1. A hydraulic crane comprising a supporting member, a mast member mounted on said supporting member with its longitudinal axis in the vertical position and adapted for substantially unrestricted rotation horizontally about said longitudinal axis, a boom member extending longitudinally away from said mast member with one end pivotally connected to the top thereof so that said boom member is rotatable vertically about its pivoting axis, a stick member extending longitudinally to each side of the other end of said boom member, said stick member being pivotally connected at a point intermediate its ends and nearer to one end than the other, to said other end of said boom member so as to be rotatable vertically about its pivoting axis, means for attaching a load to be lifted and moved, to one end of said stick member farthest from its pivoting axis and means for operating said crane to lift and move said load to any desired location within the working range of the crane determined by the angular range of horizontal rotation of said mast member and of vertical rotation of said boom member, the working radii of said boom and stick members and the working clearances between the several crane members and between these members and the load, comprising two double-acting hydraulic power cylinders each with a piston and associated piston rod operable longitudinally therein under hydraulic control to provide a power stroke in each direction, one of said cylinders being pivotally mounted on said mast member at a point below the point of connection of said boom member thereto and its piston rod being pivotally connected to the underside of said boom member near said ther end thereof, the other of said cylinders being pivotally mounted on the upperside of said boom member near said one end thereof and its piston rod being pivotally connected to the other end of said stick member, the power strokes in opposite direction of the piston rods of said power cylinders operating respectively to swing said boom member and said stick member vertically about their respective pivoting axis over given angles in a clockwise or counterclock-wise direction depending respectively on the length and direction of said power strokes, one control means under the control of the operator of the crane for causing operation of said power cylinders to provide the desired length and direction of the power strokes of their piston rods and thus the desired amount and direction of angular swing of said boom and stick members, a second control means under control of said operator for causing the desired amount of horizontal rotation of said mast member, and thus of said boom and stick members and said load, about said longitudinal axis, separate pivot pins and separate journals for providing the pivotal connections between the mast and the boom member, between the boom and stick member and between the piston rods of said cylinders and said boom and stick member, respectively, and the pivotal mounting of said one cylinder on said mast member and of said other cylinder on said boom member; and to simplify parts supply and enable quick assembly and dismantling of the crane parts, all of said pivot pins are identical and all of said journals therefor are identical, respectively, and identical snap-action locking arrangements are used for holding the pivot pins in place in their journals when the crane is assembled in operating condition.

2. A hydraulic crane comprising a supporting member, a mast member rotatably mounted on said supporting member, a boom member pivotally connected at one end to the top of said mast member, a stick member pivotally connected at a point intermediate its ends to the other end of said boom member, means for attaching a load to one end of said stick member and means for operating the crane including two hydraulic power cylinders each with a piston and associated piston rod operable longitudinally therein, one of said cylinders being pivotally connected to said mast member and its piston rod being pivotally connected to said boom member, the other of said cylinders being pivotally connected to said boom member and its piston rod being pivotally connected to the other end of said stick member, said mast member including a lower cylindrical portion of circular cross-section, an upper portion of fabricated box construction tapering towards the top of the mast member, a collar closed at its lower end, mounted on and affixed to said lower cylindrical portion and two sets of lugs, one set of which is affixed to said upper portion of said mast member near its top and the other set of which is affixed to said collar to which set of lugs said one end of said boom member and said one hydraulic power cylinder are respectively pivotally connected, said supporting member including a vertical tube portion of circular cross-sectcion, said lower cylindrical portion of said mast member being coaxially supported in said tubular portion of said supporting member with the lower surface of said collar abutting against the top of said tubular member, and being adapted for horizontal rotation in said tubular portion of said supporting member.

3. A hydraulic crane comprising a supporting member, a mast member rotatably mounted on said supporting member, a boom member pivotally connected at one end to the top of said mast member, a stick member pivotally connected at a point intermediate its ends to the other end of said boom member, means for attaching a load to one end of said stick member and means for operating the crane including two hydraulic power cylinders each with a piston and associated piston rod operable longitudinally therein, one of said cylinders being pivotally connected to said mast member and its piston rod being pivotally connected to said boom member, the other of said cylinders being pivotally connected to said boom member and its piston rod being pivotally connected to the other end of said stick member, said boom member being of fabricated box construction and including two sets of lugs one set of which is affixed to the underside and the other set of which is affixed to the upperside, respectively, of said boom member, at respective points equidistant from said other end and said one end of that member, respectively, to which sets of lugs the piston rod of said one hydraulic power cylinder and the rear end of said other hydraulic power cylinder are respectively pivotally connected, said boom member being uniform in width throughout its length, uniform in depth between said two sets of lugs and

tapered in depth in the same direction from each set of lugs to the near end of the boom member.

4. A hydraulic crane comprising a supporting member, a mast member rotatably mounted on said supporting member, a boom member pivotally connected at one end to the top of said mast member, a stick member pivotally connected at a point intermediate its ends to the other end of said boom member, means for attaching a load to one end of said stick member and means for operating the crane including two hydraulic power cylinders each with a piston and associated piston rod operable longitudinally therein, one of said cylinders being pivotally connected to said mast member and its piston rod being pivotally connected to said boom member, the other of said cylinders being pivotally connected to said boom member and its piston rod being pivotally connected to the other end of said stick member, said stick member being of fabricated box construction, a set of hinge plates being attached to the underside of that member and extend from said other end thereof to a point slightly beyond its pivoting point on said boom member, to which hinge plates the piston rod of said other cylinder and said other end of said boom member are pivotally connected at the appropriate points and said load attaching means including a hoisting ring attached to said stick member at said



one end thereof; said stick member being uniform in width from its pivoting point on said boom member to its said other end and tapered in width from that pivoting point to said hoisting ring, and being tapered oppositely in depth from each end of the stick member to a common point directly above said boom pivoting point to provide the greatest depth opposite that point.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| D. 162,873 | Pilch | Apr. 10, 1951 |
| 1,371,344 | Brackett | Mar. 15, 1921 |
| 1,385,322 | Hoffmeyer | July 19, 1921 |
| 1,688,664 | Sheehan | Oct. 23, 1928 |
| 2,082,017 | McClain | May 18, 1935 |
| 2,109,388 | Heller | Feb. 22, 1938 |
| 2,389,872 | Ruger et al. | Nov. 27, 1945 |
| 2,588,928 | Humpal et al. | Mar. 11, 1952 |
| 2,599,991 | Hegre | June 10, 1952 |
| 2,621,803 | Taylor | Dec. 16, 1952 |

OTHER REFERENCES

Advertising Circular of Sherman Products, Inc. Form SP547. Copy received Div. 4, June 12, 1950, published early summer 1949.