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L. L. EAKIN
HOISTING APPARATUS

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3 Sheets-Sheet 1

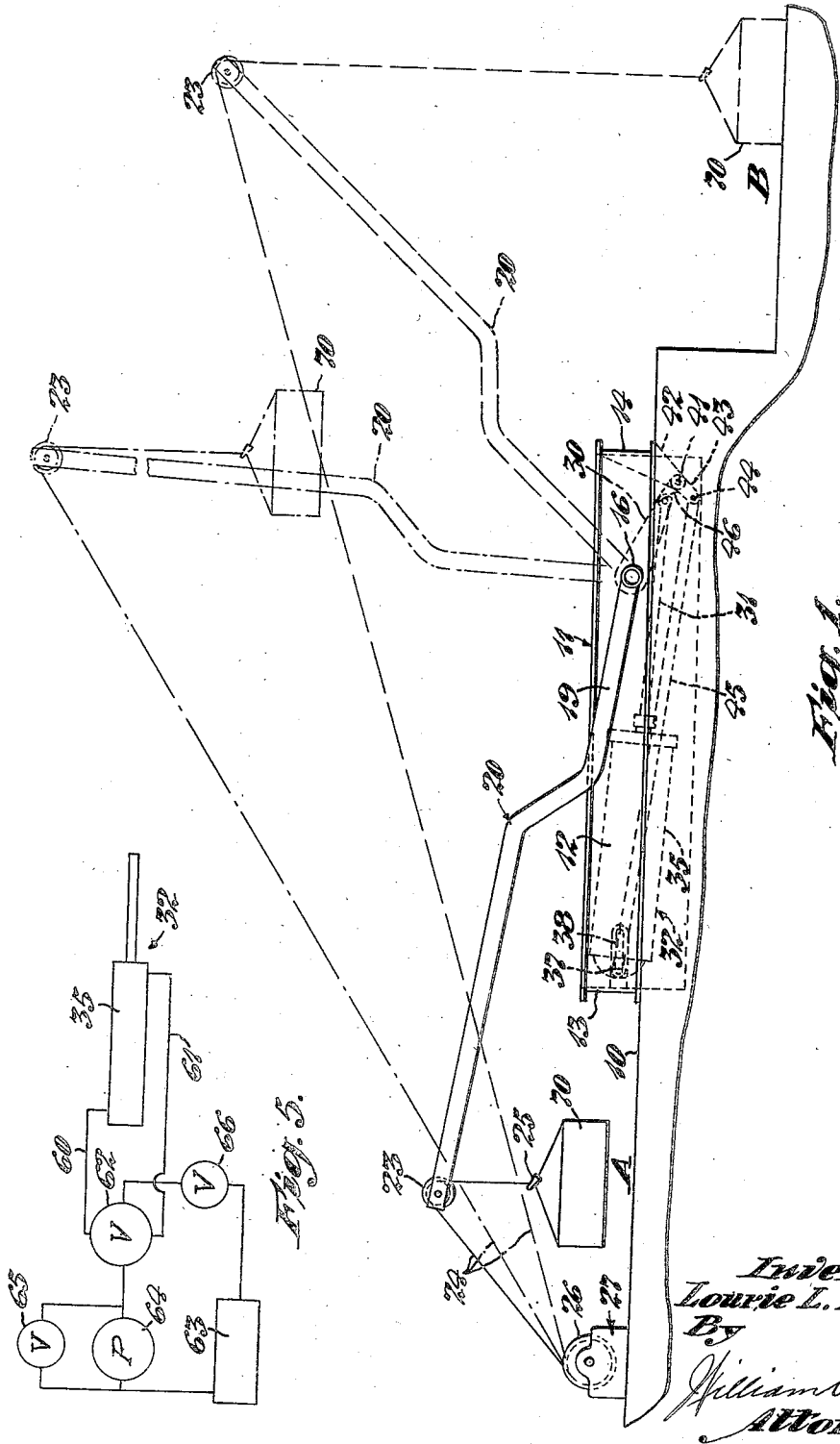


Fig. 1.

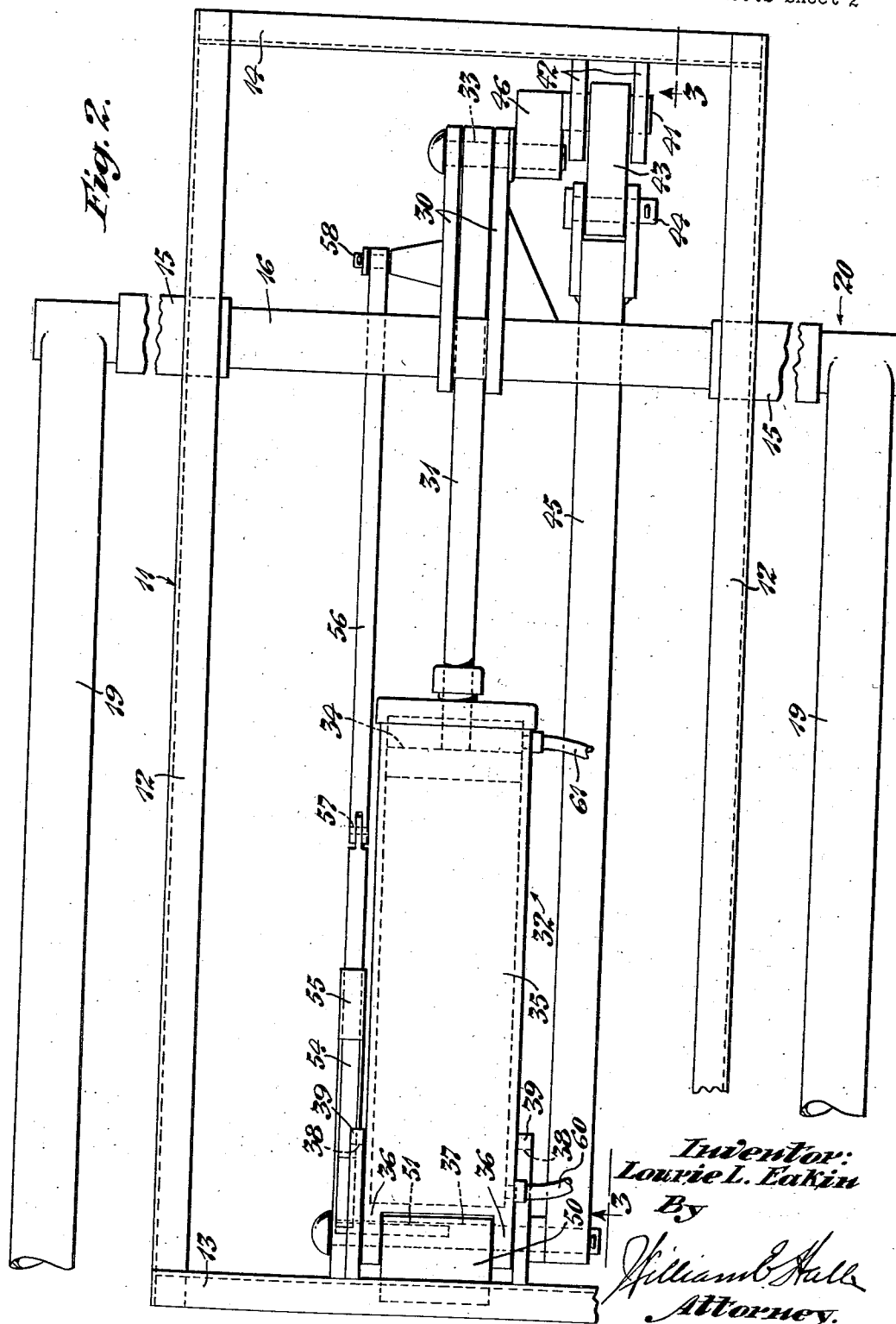
Fig. 5.

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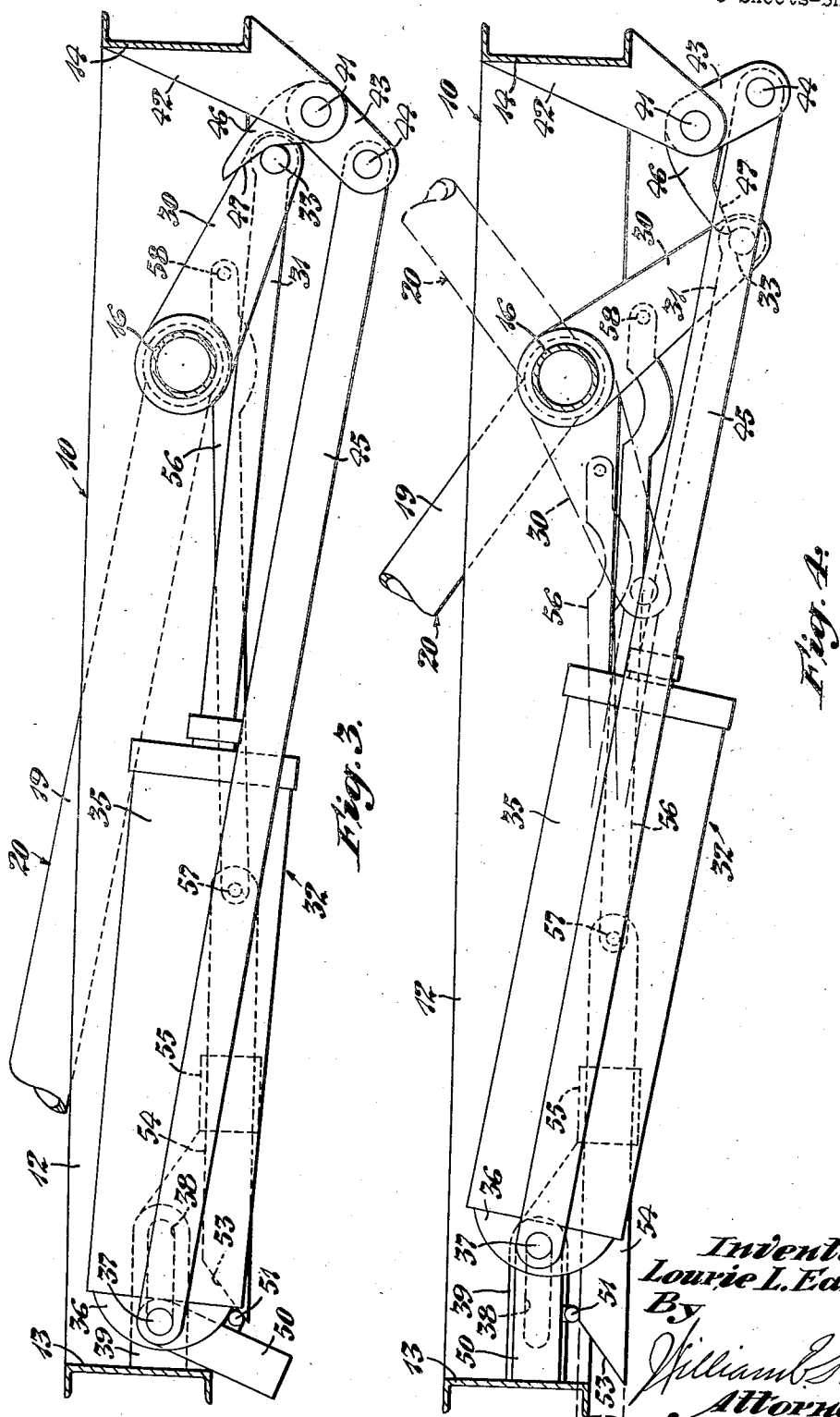
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UNITED STATES PATENT OFFICE

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HOISTING APPARATUS

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11 Claims. (Cl. 212—8)

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My invention relates to hoisting apparatus for use in hoisting and moving relatively heavy objects from one location to another. The present invention is concerned with a hoisting apparatus which is embodied in a self-contained unit adapted to be mounted on the platform of a truck, railroad flat-car, the deck of a boat, or any stationary platform upon which objects are to be placed, or from which the objects are to be removed. As a practical application of my invention, the hoisting apparatus may be employed on a transporting vehicle in a manner similar to that disclosed in my pending application for patent on Vehicle Hoisting Apparatus, Serial No. 746,248, filed May 6, 1947. Specifically, the present invention pertains to a novel and improved power-operated means for actuating the hoisting boom.

It is desirable in hoisting apparatus that the hoisting boom be capable of pivoting through an angle of substantially 180 degrees, that is, from one horizontal position to the opposite horizontal position, so that the end of the boom can be lowered to a point close to the ground, or to the object which is to be raised. It is preferable that hydraulic power means be employed for pivoting the boom in order to obtain the power necessary to pivot the boom when relatively heavy objects are being lifted. In such apparatus, it is the usual practice to operatively connect the piston of a hydraulic actuating jack to a relatively short arm projecting from the pivot of the boom in a downward direction. Since the boom moves through substantially 180 degrees the arm likewise swings through the same angle, and at the extreme forward and rearward movement of the arm the arm and piston approach alignment, and this has the effect to cause a substantially "dead-center" condition. Due to this condition, a tremendous amount of power is required to obtain the mechanical advantage necessary to overcome the weight of the boom and its supported load.

It is an object of this invention to provide means, actuated by the hydraulic ram at the start of the lifting operation, for increasing the force applied against the boom so as to overcome such a substantially "dead-center" condition and initially pivot the boom to a position wherein the piston of the hydraulic ram can complete the pivoting of the boom. This object can best be attained by so mounting the actuating ram, or hydraulic cylinder, that it is movable, within prescribed limits, toward and away from the boom pivot, such movement of the cylinder being utilized to actuate a cam lever which, in

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turn, is operative to initially swing the boom through a predetermined angle, the piston rod of the hydraulic jack then becoming active to complete the pivotal movement of the boom to its maximum extent. By this construction, a single hydraulic jack can be employed for pivoting the boom from one substantially horizontal position to the opposite horizontal position without the aid of auxiliary jacks, or other power means.

Another object is to provide a power-actuated hoisting apparatus in which the boom is pivoted through substantially 90 degrees to an upright position by the hydraulic means, after which the weight of the boom and the object supported thereby pivot downwardly under the force of gravity, and it is a further object to provide means whereby the rate of descent is controlled in a manner such that the object can be lowered gradually. This object is best accomplished by providing valve means for regulating the bleeding of the hydraulic fluid from the hydraulic jack which, at this time, serves to control such action of the boom in a manner to positively control the final downward pivotal movement, to ease the boom slowly and safely downward even when large loads are sustained by the boom.

Another object is to provide a hoisting apparatus of sturdy construction which is embodied in a self-contained unit capable of being mounted on either a stationary support, such as a freight unloading platform, or adapted to be installed on a transporting truck, railroad car, or other vehicle. It is within the concept of my invention to mount the apparatus on a turntable so that it is capable of lifting objects at one location and depositing the objects at various other positions.

Further objects of the invention are set forth in the following description and will be apparent from the drawings, which are intended for the purpose of illustration only, and in which:

Fig. 1 is a side elevational view of my improved hoisting apparatus;

Fig. 2 is a plan view of the power-actuated means for operating the hoisting boom;

Fig. 3 is a longitudinal sectional view, taken on line 3—3 of Fig. 2, and showing the relationship of the parts of the actuating means when the boom is in inoperative position;

Fig. 4 is a view similar to Fig. 3, but showing the relationship of the parts during the initial pivotal movement of the boom; and,

Fig. 5 is a diagram of the hydraulic circuit for the power-operated means.

Referring to the drawings in detail, my im-

proved hoisting apparatus is shown as mounted on a stationary platform 16, by way of example, but it will be understood that the apparatus can be installed on a truck, or other vehicle. The apparatus includes a rectangular base 11 having side rails 12 joined at their ends by end members 13 and 14. Fixed to the side rails 12 of the base 11 are tubular bearings 15 in which a tubular axle or pivot member 16 is adapted to rotate. Welded or otherwise secured to the ends of the tubular axle 16 are the ends of the arms 19 of a hoisting boom 20, the arms extending parallel to the side rails 12, as shown in Fig. 2. The boom 20 may be of the same general form as disclosed in my pending application, referred to previously, and thus is not described in detail herein. Suffice it to say that the arms 19 converge at their distal ends, and rotatable at this end of the boom is a pulley or sheath 23 over which a cable 24 passes, the cable having a hook 25 at one end. The other end of the cable is wound around the drum 26 of a power winch, indicated at 27.

The hoisting boom is adapted to be pivoted to any of the positions indicated in Fig. 1 by means of a hydraulically-actuated mechanism to be next described. The pivot tube or axle 16 has a pair of spaced radial arms 30 (Fig. 2) welded thereto, between which is pivotally connected the end of a piston rod 31 of a hydraulic jack 32 by means of a pin 33. The rod 31 carries a piston 34 which is slidable in the cylinder 35 of the jack 32. The cylinder 35 has ears 36 at its end between which extends a pivot pin 37, the pin projecting through horizontal slots 38 in spaced brackets 39 carried by the end member 13. It is thus seen that the hydraulic cylinder 35 may move longitudinally to an extent limited by the slots 38, and the cylinder is also capable of pivoting on the pin 37.

With the exception of the slidable pivot means, described above, the fluid-actuated boom operating means is similar to conventional hydraulic mechanisms for pivoting booms, and similar arms. As previously pointed out, it is desirable that the boom be capable of being pivoted through substantially 180 degrees, but such movement of the boom cannot be readily attained by the use of such conventional operating mechanism for the reason that the hydraulic piston rod and the arms 30 of the boom approach a straight line, or dead-center relationship, at the opposite extremes of pivotal movement of the boom. Consequently, unless some auxiliary means is provided for effecting the initial pivotal movement of the boom, it is impossible for the hydraulic jack to tilt the boom through such an arc. The present invention contemplates means for initially starting the pivotal movement of the boom, such means being constructed and arranged as next described.

Pivoted on a pin 41 extending between bracket arms 42 carried by the end member 14 of the base 11 is an arm 43. The end of the arm 43 carries a pin 44 on which is pivotally connected one end of a relatively long link 45, the other end of the link being pivotally joined to the pin 37 which, as previously explained, is slidable in the slots 38. Carried by the pin 41 is a cam arm 46 having a cam edge 47 which, when the boom is in the inoperative position, shown in Fig. 3, overlies the projecting end of the pin 33 on the arms 30.

Freely pivoted on the pin 37 is a stop element 59 which is provided with a cylindrical follower 51 at one side. The follower 51 is adapted to be engaged by the inclined edge 53 of a slide

member 54, which is slidable in a guide bracket 55 carried by the end member 13 of the base 11. The slide member 54 is adapted to be slid by means of a link or push-bar 56 to which it is connected by a pivot pin 57. The other end of the push-bar is pivotally connected to one of the arms 30 by means of a pin 58.

The hydraulic cylinder 35 is connected in a hydraulic system in the manner indicated in the diagram, lines 60 and 61, extending from the opposite ends of the cylinder to a selector valve 62. The system also includes a reservoir 63, a pump 64, a by-pass valve 65, and a pressure-responsive valve 66.

Assuming that the boom 20 is in the position shown by full lines in Figs. 1 and 3, with the parts of the actuating mechanism assuming the relationship shown in Fig. 3, the boom may be pivoted to the position indicated by dash lines in the manner next explained. By operating the selector valve 62, hydraulic fluid under pressure is caused to be introduced through the line 61 into the right-hand end of the cylinder 35. Since the boom 20 is in lowermost position and offers maximum resistance to sliding movement of the piston 34, the fluid, acting against the right-hand end of the cylinder 35, causes the latter to move toward the right with its pin 37 riding in the horizontal slots 38.

During movement of the cylinder 35 in this manner, the link 45 is also shifted toward the right, and, since it is connected to the cam arm 43, 46 by the pin 44, the cam arm is caused to pivot in counterclockwise direction, as viewed in Fig. 4. Consequently, the cam edge 47 acts against the pin 33 to pivot the arms 30 in clockwise direction and thus cause the boom 20 to pivot upwardly. The extent to which the cam edge 47 is capable of pivoting the arms 30 and boom 20 is illustrated in Fig. 4. It is thus seen that when fluid is first introduced into the right-hand end of the cylinder 35, the boom 20 is initially pivoted from the position shown in Fig. 3 to that illustrated in Fig. 4.

During pivotal movement of the arms 30 to the position shown in Fig. 4, the push-bar 56 acts to slide the slide member 54 toward the left. Simultaneous with the sliding movement of the slide member toward the left, the stop element 50 is carried toward the right by reason of its connection with the pin 37, so that its follower 51 engages the inclined edge 53 of the slide member 54. Movement of the stop member and slide member therefore results in pivotal movement of the stop member from the position shown in Fig. 3 to that illustrated in Fig. 4, so that the end of the stop member is disposed adjacent the end member 13 of the base 11.

When the cylinder 35 reaches the position shown in Fig. 4, its movement toward the right is arrested by reason of the engagement of the pin 37 with the right-hand end of the slots 38. It is apparent, therefore, that further introduction of hydraulic fluid into the right-hand end of the cylinder 35 causes the piston 34 to move toward the left, so that the arms 30 are pivoted from the full line to the dash line position, shown in Fig. 4, it being understood that movement of the cylinder 35 toward the left is prevented through the engagement of the stop member 50 with the end member 13. In this manner, the boom 20 is pivoted through the remainder of its movement toward the right so that an object 70 supported by the cable 24 is lifted at A and deposited at B. As the boom 20 arrives at

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the central position, indicated by the dot-and-dash lines in Fig. 1, it is subjected to the force of gravity and tends to fall. However, the pressure-responsive valve 66 becomes active, due to increased pressure developed in the line 60, and the valve controls the return of the fluid to the reservoir 63 and thus regulates the descent of the boom, so as to ease the load 70 gradually onto a supporting structure, as indicated at B.

While I have herein shown and described the hoisting apparatus as embodied in a preferred construction, by way of example, it will be understood that various modifications may be made in the structure without departing from the spirit or scope of the invention. Therefore, without limiting myself in this respect, I claim:

1. In a hoisting apparatus: a support; a boom pivoted transversely of said support and adapted to move through an arc to opposite, substantially horizontal positions and to positions intermediate said opposite positions, said boom having an arm projecting from its pivotal end; cam means pivoted on said support and adapted when pivoted in one direction to engage the free end of said arm so as to pivot the same and said boom through a portion only of said arc; and power means operatively connected to said cam means for pivoting the same, said power means being also connected to said arm and operative in response to the completion of the pivotal movement of said cam means in said one direction to pivot said arm and said boom through the remainder of the said arc.

2. In a hoisting apparatus: a support; a boom pivoted transversely of said support and adapted to move through an arc to opposite, substantially horizontal positions and to positions intermediate said opposite positions, said boom having an arm projecting from its pivotal end; cam means carried by and movable on said support and adapted, when moved in one direction, to engage the free end of said arm so as to pivot the same and said boom through a portion only of said arc; and hydraulic means carried by and movable on said support and operatively connected to said cam means for moving the same, said hydraulic means being directly connected to said arm and operative in response to completion of movement of said cam means in said one direction to pivot said arm and said boom through the remainder of said arc.

3. In a hoisting apparatus: a support; a boom pivoted transversely of said support and adapted to move through an arc to opposite, substantially horizontal positions and to positions intermediate said opposite positions, said boom having an arm projecting from its pivotal end; cam means pivoted on said support and adapted to engage the free end of said arm so as to pivot the same and said boom through a portion only of said arc; a hydraulic jack including a cylinder, a piston and a piston rod, said rod being pivotally connected to said arm; means for mounting said jack cylinder for movement toward and away from the pivotal axis of said arm, said cylinder being adapted to be moved in one direction in response to fluid pressure applied between one end of said cylinder and said piston; link means operatively connected between said cylinder and said cam means and adapted to move said cam means in response to movement of said cylinder in said one direction to an operative position; and stop means on said support engageable with said cylinder to retain the same in its operative position so that fluid under

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pressure thereafter introduced between said end of the cylinder and the piston causes said piston and rod to move in a direction opposite to said one direction so as to pivot said boom through the remainder of said arc.

4. In a hoisting apparatus: a support; a boom pivoted transversely of said support and adapted to move through an arc to opposite, substantially horizontal positions and to positions intermediate said opposite positions, said boom having an arm projecting from its pivotal end; cam means pivoted on said support and adapted to engage the free end of said arm to pivot the same and said boom through a portion only of said arc; a hydraulic jack including a cylinder, a piston and a piston rod, said rod being pivotally connected to said arm; means for mounting said jack cylinder for axial movement toward and away from said arm, said cylinder being adapted to be moved in one direction in response to fluid pressure applied between one end of said cylinder and said piston; link means operatively connected between said cylinder and said cam means and adapted to pivot said cam means in response to movement of said cylinder in said one direction to an operative position; and stop means carried by and movable with said cylinder and engageable with said support for retaining said cylinder in its said operative position so that fluid under pressure thereafter introduced between said end of the cylinder and the piston causes said piston and rod to move in a direction opposite to said one direction so as to pivot said boom through the remainder of said arc.

5. In a hoisting apparatus: a support; a boom pivoted transversely of said support and adapted to move through an arc to opposite, substantially horizontal positions and to positions intermediate said opposite positions, said boom having an arm projecting from its pivotal end; cam means pivoted on said support and adapted to engage the free end of said arm so as to pivot the same and said boom through a portion only of said arc; a hydraulic jack including a cylinder, a piston and a piston rod, said rod being pivotally connected to said arm; means for mounting said jack cylinder for axial movement toward and away from said arm, said cylinder being adapted to be moved in one direction in response to fluid pressure applied between one end of said cylinder and said piston; link means operatively connected between said cylinder and said cam means and adapted to pivot said cam means in response to movement of said cylinder in said one direction to an operative position; stop means pivotally mounted on said movable cylinder and adapted to be pivoted into engagement with said support to retain said cylinder in its said operative position so that fluid pressure thereafter introduced between said end of the cylinder and the piston causes said piston and rod to move in a direction opposite to said one direction so as to pivot said boom through the remainder of said arc; and means for pivoting said stop means.

6. In a hoisting apparatus: a support; a boom pivoted transversely of said support and adapted to move through an arc to opposite, substantially horizontal positions and to positions intermediate said opposite positions, said boom having an arm projecting from its pivotal end; cam means pivoted on said support and adapted to engage the free end of said arm so as to pivot the same and said boom through a portion only of said arc; a hydraulic jack including a cylinder, a piston and a piston rod, said rod being pivotally connected

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to said arm; means for mounting said jack cylinder for axial movement toward and away from said arm, said cylinder being adapted to be moved in one direction in response to fluid pressure applied between one end of said cylinder and said piston; link means operatively connected between said cylinder and said cam means and adapted to pivot, said cam means in response to movement of said cylinder in said one direction to an operative position; stop means pivotally mounted on said movable cylinder and adapted to be pivoted into engagement with said support to retain said cylinder in its operative position so that fluid pressure thereafter introduced between said end of the cylinder and the piston causes said piston and rod to move in a direction opposite to said one direction so as to pivot said boom through the remainder of said arc; and means operatively connected to and operated by said arm during the pivotal movement of said arm through said portion of said arc for pivoting said stop means.

7. In a hoisting apparatus: a support; a boom pivoted transversely of said support and adapted to move through an arc to opposite, substantially horizontal positions and to positions intermediate said opposite positions, said boom having an arm projecting from its pivotal end; cam means pivoted on said support and adapted to engage the free end of said arm so as to pivot the same and said boom through a portion only of said arc; a hydraulic jack including a cylinder, a piston slidable in the cylinder, and a piston rod pivotally connected to said arm; means for slidably mounting said cylinder on said support to adapt it to slide axially in a direction toward the pivotal axis of said arm to an operative position; a first stop means fast on said cylinder and engageable with said support to limit sliding movement of said cylinder in said direction; a link connected between said cylinder and said cam means and adapted to move said cam means in response to movement of said cylinder to said operative position, said cylinder being movable in response to fluid pressure applied between an end thereof and said piston; a second stop means pivoted on said cylinder and adapted, when pivoted to one position, to engage said support to retain said cylinder in its operative position; a

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slide member adapted, when slid in one direction, to pivot said second stop means to said position; and a push-bar operatively connected between said slide member and said arm and operative in response to pivotal movement of said arm through said portion of said arc to actuate said slide member, fluid pressure introduced between said end of the cylinder and said piston subsequent to movement of the cylinder to said operative position causing said piston and rod to move in a direction away from the pivotal axis of said arm so that said boom is pivoted through the remainder of said arc.

8. An apparatus as defined in claim 7, including bracket arms on said support, said cylinder being pivotally and slidably connected between said bracket arms.

9. An apparatus as defined in claim 7, including bracket arms on said support, said arms having slots, and a pin on said cylinder pivotally and slidably arranged in said slots, one end of said slots constituting said first stop means.

10. An apparatus as defined in claim 7, in which said second stop means consists of an arm pivoted to said cylinder and having a follower, and in which said slide member has an inclined end engageable with said follower to pivot said arm.

11. An apparatus as defined in claim 7, in which said hydraulic jack is adapted to pivot said boom to a substantially vertical position, pivotal movement beyond said vertical position being augmented by the force of gravity, and including a hydraulic system in which said hydraulic cylinder is disposed, and a pressure-responsive valve in said system for controlling the exhaust of fluid from said cylinder so as to control the rate of descent of said boom.

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