

Nov. 27, 1951

D. A. WALLACE
HOISTING APPARATUS

2,576,908

Filed Sept. 20, 1947

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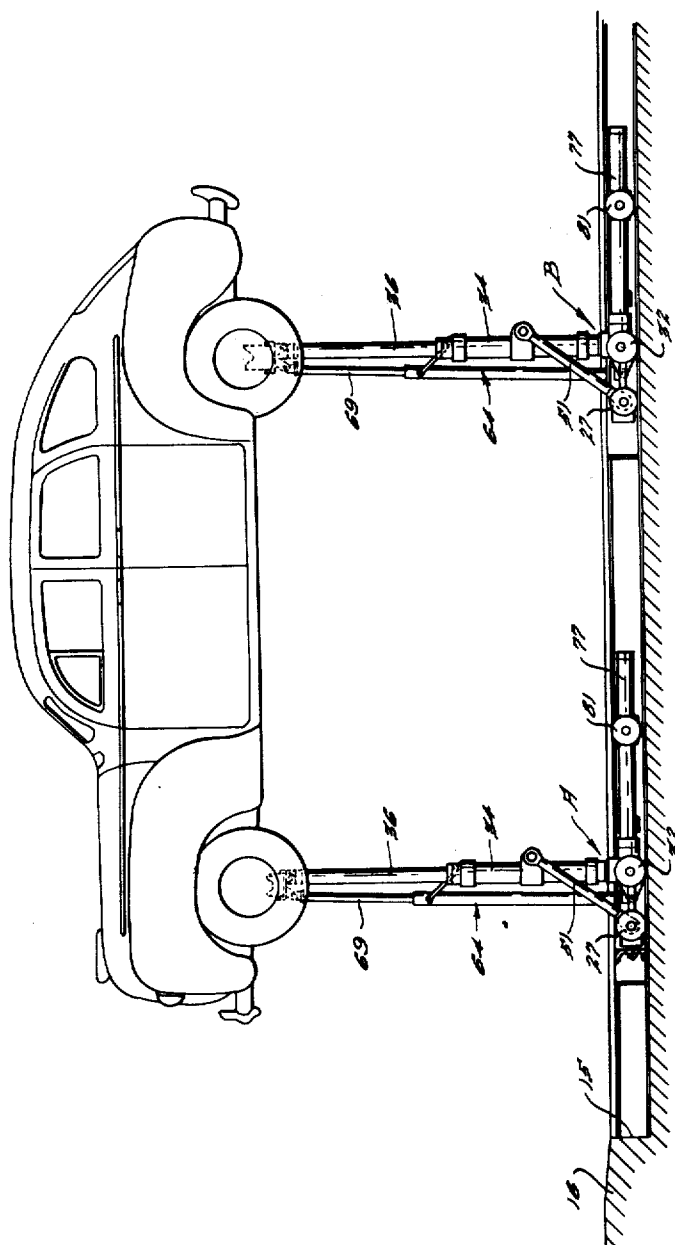


FIG. 1.

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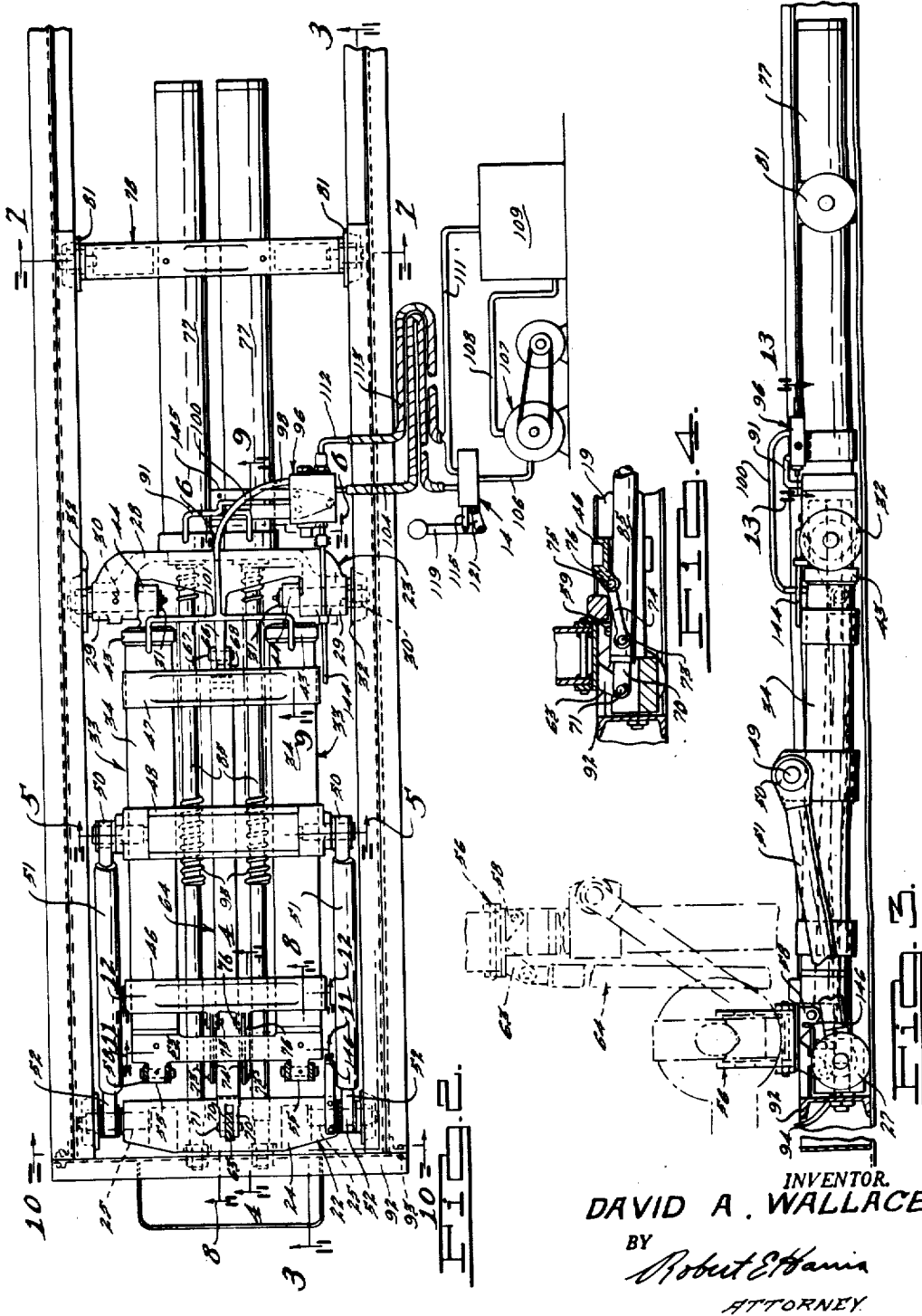
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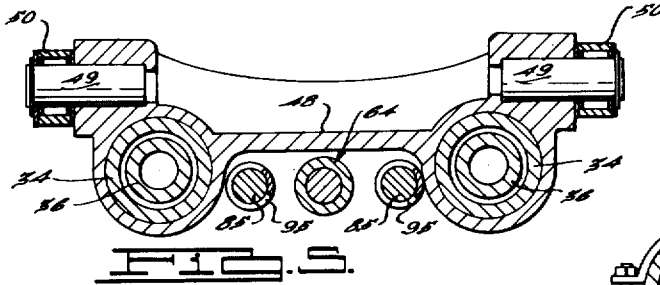
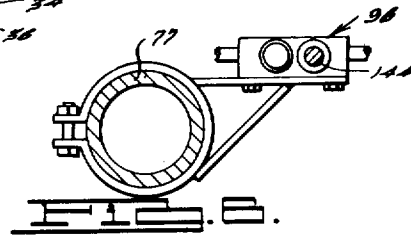
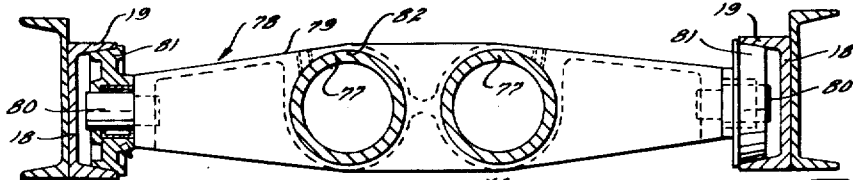
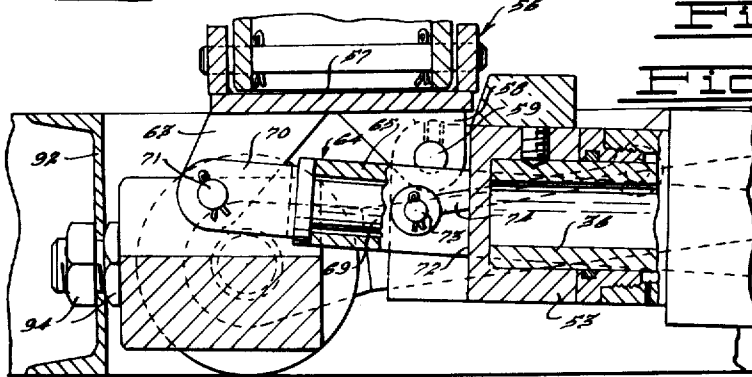
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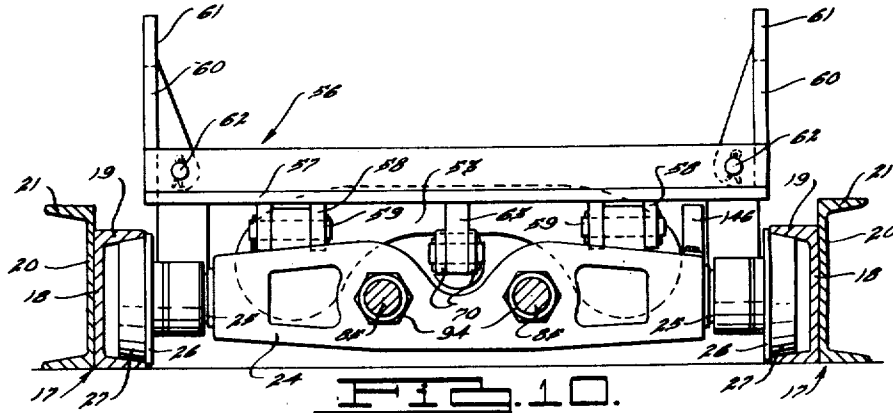
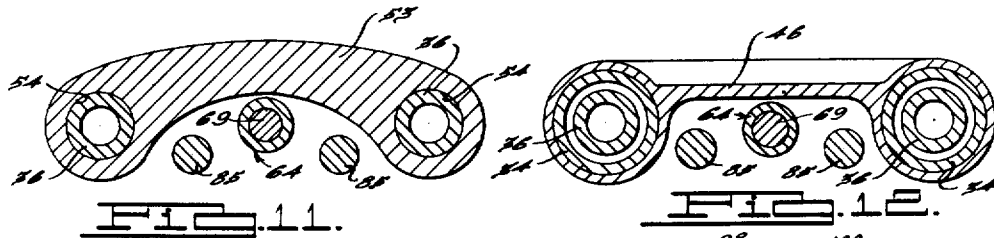
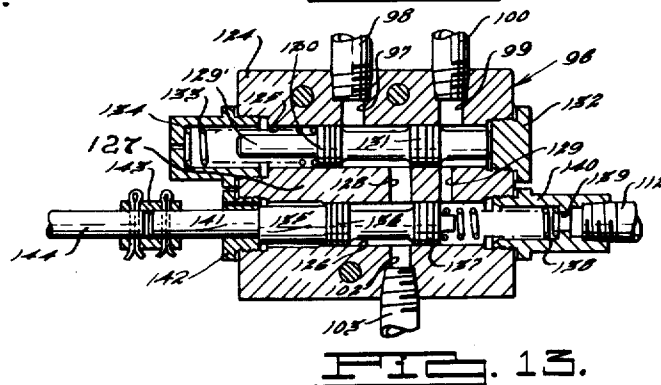
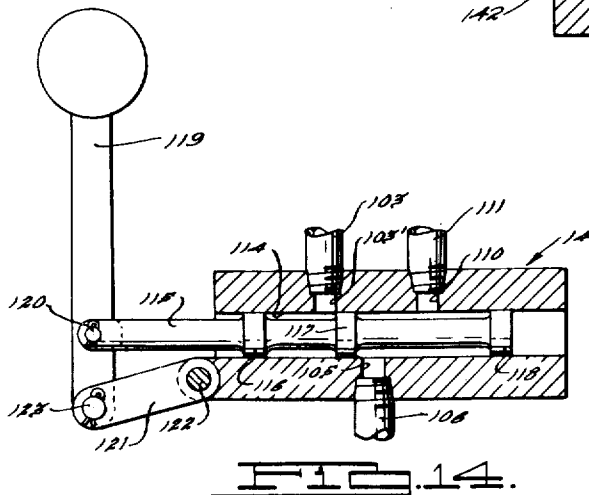
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4 Sheets-Sheet 4



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2,576,908

HOISTING APPARATUS

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Application September 20, 1947, Serial No. 775,191

28 Claims. (Cl. 254—89)

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This invention relates to an improved hoisting apparatus and is an improvement of the hoisting apparatus shown in my patent applications Serial Nos. 653,386 filed March 9, 1946, and 711,649 filed November 22, 1946.

More specifically the invention pertains to improvements in hoisting apparatus which is particularly adapted for hoisting vehicles.

The hoisting apparatus disclosed in my above prior applications includes a pair of hoisting units, one for application to each of the respectively opposite end portions of a vehicle and each hoisting unit comprises a fluid pressure operable extensible boom member which is adapted to be disposed in a substantially horizontal and contracted position for receiving a load. The load may thereafter be elevated by first rotating the contracted boom members to a substantially vertical position and then extending the boom member vertically to further elevate the load. Rotation of the contracted boom member occurs, in the structure of the above applications, about an axis at or adjacent one end of the boom member and accordingly considerable space is required in advance of the hoisting apparatus in order to accommodate the resulting swinging movement of the load.

It is one of the main objects of this invention to provide in hoisting apparatus of this kind, an extensible boom member and means for shifting it, which confines the initial movement of the load which occurs during translations of the boom members from their horizontal to their vertical positions, to a generally vertical path, thereby rendering it unnecessary to provide space in advance of the hoisting apparatus for accommodating swinging movement of the load.

Other objects of the invention are to provide improved toggle acting mechanism for shifting the boom members from horizontal to vertical positions which moves the load supporting ends of the boom members in a generally vertical path; to provide toggle acting mechanism of this kind which has a favorable initial mechanical advantage as it shifts the boom member from its most horizontal position and a rapidly increasing and more favorable mechanical advantage as the boom is shifted toward its vertical position, to provide energy accumulating means in hoisting apparatus of this kind which is energized during elevating the boom member through a portion of its increased mechanical advantage operating stage and which applies the accumulated energy to accelerate lowering of the boom member toward its horizontal position, and to

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provide energy accumulating means of this kind which does not oppose elevating of the boom member throughout the initial stages of its movement from a horizontal position when the mechanical advantage of the boom member and toggle acting means is at its lower value range.

A further object of the invention is to provide improved means for retaining a load receiving seat which is pivotally attached to each boom member in a predetermined position with respect to a horizontal plane during shifting of the boom member from its horizontal position to its vertical position and during reverse movement of the boom member.

Still further objects of the invention are to provide in a hoisting unit of this character, means for opposing unintended extension of the boom member during movement from its horizontal position to its vertical position, and to provide safeguarding means of this kind which is ineffective to oppose extension of the boom member when the latter is in its vertical position.

Additional objects of the invention are to provide an improved fluid pressure supply system for the boom shifting and boom extending mechanism of hoisting apparatus of this character, to provide an automatic valve mechanism which prevents the supply of fluid pressure to the boom extending mechanism prior to movement of the boom member to a predetermined upright position, to provide valve mechanism of this kind which automatically conditions the fluid pressure system to supply pressure to the boom extending apparatus immediately upon movement of the boom member to said predetermined upright position; to provide in valve mechanism of this kind means for assuring contraction of the boom member before it is shifted to its horizontal position, to provide valve mechanism of this kind which automatically conditions the fluid pressure system to release the fluid pressure retaining the boom member in a vertical position immediately upon contraction of the boom member from an extended position, to provide a fluid pressure system of this kind which assures contraction of the boom member before it shifts to a horizontal position in the event of a leak or break in the fluid pressure line which leads from a source of fluid pressure to the automatic valve mechanism and to provide automatic valve mechanism of this kind which will assure contraction of the boom member from an extended position at a faster rate than the boom member is shifted toward its horizontal position in the event of a relatively slow leak from the cylinders of the

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boom shifting mechanism or in any of the pressure lines leading thereto.

An illustrative embodiment of the invention is shown in the accompanying drawings in which:

Figure 1 is a side elevational view, partly in section showing hoisting apparatus embodying the invention as applied to the hoisting of a vehicle.

Figure 2 is a fragmentary plan view of the hoisting apparatus shown in Figure 1, illustrating one hoisting unit thereof, somewhat in detail.

Figure 3 is a longitudinal vertical sectional view taken on line 3—3 of Figure 2.

Figure 4 is a fragmentary vertical sectional view taken on the line 4—4 of Figure 2.

Figure 5 is a transverse vertical sectional view taken on the line 5—5 of Figure 2.

Figure 6 is a fragmentary transverse vertical sectional view taken on the line 6—6 of Figure 2.

Figure 7 is a transverse vertical sectional view taken on the line 7—7 of Figure 2.

Figure 8 is a fragmentary vertical sectional view taken on the line 8—8 of Figure 2.

Figure 9 is a vertical sectional view taken on the line 9—9 of Figure 2.

Figure 10 is a transverse vertical sectional view taken on the line 10—10 of Figure 2.

Figure 11 is a fragmentary transverse vertical sectional view taken on the line 11 of Figure 2.

Figure 12 is a fragmentary transverse vertical sectional view taken on the line 12—12 of Figure 2.

Figure 13 is a sectional view taken on the line 13—13 of Figure 3.

Figure 14 is a vertical sectional view of manual control valve mechanism indicated at 14 in Figure 2.

The improved hoisting apparatus shown in the drawings may be mounted on the floor of a building but it is preferably disposed in a recess 15 provided in a floor structure 16 or in a relatively thin platform mounted upon a floor structure. Disposed along the longitudinal sides of the recess 15 are spaced rails, generally designated by the numeral 17, each of which comprises a track member 18 of channel shaped cross-section having opposite horizontal flanges 19 facing inwardly of the recess. The internal surfaces of the flanges 19 of each track member 18 converge outwardly from the recess. Each rail 17 also includes a channel member 20 having its web portion fixed to the web of the adjacent track member 18 and having flanges 21 extending outwardly with respect to the recess.

The hoisting apparatus shown in Figure 1 includes a pair of substantially identical hoisting units A and B, the description of one of which will serve for both. While two hoisting units are preferably employed in hoisting a vehicle, only one may be employed for lifting the ends of a vehicle one at a time. Any desired number of hoisting units may be used as required by the nature of the object or load to be hoisted.

Each hoisting unit includes a pair of carriages generally designated by the numerals 22 and 23 in Figure 2. The front carriage 22, as viewed in Figure 2, comprises an intermediate frame member 24 having shafts or trunnions 25 extending outwardly from its opposite extremities. Journalled on each outer end portion of each trunnion 25 is a wheel 26 having a beveled periphery 27 which is received between the converging sides of the flanges 19 of the rail members 18. The rear carriage 23 comprises a yoke shaped body

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portion 28 having arms 29 at its opposite ends provided with passages 30 in which are mounted shafts 31. The shafts 31 have opposite end portions projecting beyond the inner and outer extremities of the arms 29 of the yoke shaped body portion 28. Journalled on the outer end portions of each of the shafts 31 is a wheel 32 similar to the wheels 26 of the front carriage 22. The wheels 32 fit between the flanges 19 of the rail members 18 in the same manner as do the wheels 26.

Pivotaly mounted on the inwardly extending end portion of the shafts 31 is a boom member generally designated by the numeral 33. The boom member 33 includes a pair of piston and cylinder assemblies each having a cylinder 34 and a piston 35, shown in section in Figure 9. Each piston member 35 includes a tubular piston rod portion 36 of substantially smaller outer diameter than the inner diameter of the cylinder 34. Each piston portion has a boss element 37 which is received in the passage of its tubular connecting rod 38 and secured thereto by a pin 39 extending through registering apertures in the tubular piston rod 36 and boss 37. Each piston 35 has a cap member 39 on the end thereof opposite from the boss 37 which bears against a packing ring 40 provided in a recess 41 formed in the body portion of the piston. The cap 39 may be clampingly engaged with the packing ring 40 by a bolt 42 extending through the cap and which is threaded in the body portion of the piston 35. The right hand end of each cylinder 34, as viewed in Figures 2 and 9, is closed by a cap structure 43 having a projecting web portion 44 provided with an aperture 45 in which one of the inwardly extending end portions of each shaft 31, respectively, is received. In this manner, the right ends of the cylinder and piston assemblies of the boom structure are pivoted to the rear carriage 23 for rotative movement about the axes of the shafts 31 which are aligned.

The cylinders 34 of the boom member are rigidly connected together and held in spaced relationship by transversely extending cleat members 46 and 47 which are located at the right and left end portions of the boom member, respectively, as shown in Figure 2. The cleats 46 and 47 are substantially identical and one thereof is shown in section in Figure 12. The boom member 33 is also transversely rigidified at its intermediate portion by a cleat member 48 shown in section in Figure 5. The cleat members 46, 47, and 48 have apertures which receive the cylinder members 34 and the cleat member 48 is additionally provided with trunnions 49 which extend outwardly in opposite directions from the end portions of the cleat 48. Journalled on each outwardly extending end portion of each trunnion 49 is a bearing 50 provided at one end of a link 51, respectively. Each link 51 has a bearing 52 at its opposite end which is journalled on an intermediate portion of one of the trunnions 25 of the front carriage 22, respectively, at a location between the frame member 24 of the carriage and a wheel 26 thereof. The cleats 46, 47 and 48 are all welded or otherwise rigidly secured to the cylinders 34 of the boom member.

The outer ends of the connecting rod portions 36 of the piston members are connected together by a transversely extending bar 53 shown in section in Figure 11, which is of generally crescent shape. This bar has recesses 54 in its opposite end portions in which the outer extremities of the piston rod portion 36 are received. The outer

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ends of the piston rod portions may be welded or otherwise suitably secured to the bar 53. Extending rightwardly as viewed in Figure 2, from the bar 53 are lugs 55 on which a load receiving seat, generally designated by the numeral 56, is pivoted. The load receiving seat is adapted to engage and support one end of a vehicle or other object to be lifted and it comprises a body portion 57 having two pairs of spaced flanges 58 each of which is adapted to embrace one of the lugs 55 of the bar 53. The lugs 55 and flanges 58 are provided with registering apertures in which pins 59 are received for providing a pivotal connection between the seat 56 and the bar 53. The seat 56, shown in Figure 10, is particularly designed to receive a rear axle portion of the vehicle. It is provided with pivotally mounted crotch members 60 having notches 61 in their upper extremities. These crotch members may be rotated between vertical operative and horizontal inoperative positions about their respective pivots 62. It should be understood that the load receiving seat portion of each of the hoisting units A and B are designed to receive the particular portion of the vehicle or other load to which they are intended to be applied.

It will be seen in Figures 3 and 8 that the flanges 58 of the load receiving seat 56 are provided at the right edge of the structure 56 and that they depend downwardly from its body portion 57. Provided substantially midway between the ends of the body portion 57 of the seat 56 is a downwardly and leftwardly extending flange 63 to which is pivoted one end of a telescoping control rod, generally designated by the numeral 64. The control rod 64 comprises a lower tubular section 65 which is pivotally mounted at its lower end, or right end as viewed in Figure 2, to an extension 66 of the yoke shaped body portion 23 of the right hand carriage 22. This pivotal connection is formed by a pin 67 which extends through registering apertures. In the extension 66 and in spaced flanges 68 extending rightwardly from the right end of the tube 65 the telescoping control rod 64 includes an inner bar member 69 which is of substantially smaller diameter than the inner diameter of the tube 65 and it is provided on its left extremity, as viewed in Figure 2, with spaced flanges 70 which embrace the flange 63 of the seat structure 56. The flanges 63 and 70 are provided with registering apertures in which are received a pin 71 for forming the pivotal connection between the bar 69 of the telescoping control rod 64 and the seat structure 56.

As the boom member is shifted, as hereinafter more fully described, from its lower generally horizontal position to its upper generally vertical position the control rod 64 maintains the load receiving seat in a substantially horizontal position throughout the entire path of movement of the boom member. This is accomplished by locating the pivotal axis of the pin 67 the same distance from the pivotal axis of the boom member in its movement about the aligned axis of the shafts 31 as the pivotal axis of the seat 56 and the control rod 64. This construction provides a parallelogram action which retains the seat 56 horizontal between movement of the boom member, hereinafter described. When the boom member is in its upper position, as shown in dotted lines in Figure 3, the body portion 57 is received on the side surface 72 of the cross bar 53 which connects the piston rod portion 36, as previously described.

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When the structure so far described is employed in lifting a vehicle, for example, the forward carriage 22 of one of the hoisting units is fixed in position in a manner hereinafter disclosed. It is unnecessary to fix either of the carriages of the other hoisting unit in this manner for the rigid connection provided by the vehicle between the two hoisting units serves this purpose. When the vehicle or other load to be hoisted is properly positioned with respect to the load receiving seats of the respective hoisting units, the boom member 33 is shifted from its lower position in which the piston and cylinder assemblies thereof are in contracted state, to its upper position, shown in dotted lines in Figure 3, by urging the rear carriage 23 of each unit toward the forward carriage 22 of each unit respectively. This action is performed by fluid pressure mechanism, hereinafter more fully described. During movement of the rear carriage 23 toward the front carriage 22 the rear carriage is held against upward movement by engagement of its wheels 32 with the flanges 19 of the rails 18. The end of the boom member by which the seat 56 is supported is urged upwardly by a somewhat toggle-like action provided by the links 51 which shifts the lower end of the boom member horizontally in a direction opposite to the horizontal component of the pivotal movement of the boom member about its pivotal axis provided by the shafts 31. This causes the load receiving seat 56 to ascend in a path which departs but slightly from a vertical course. While the path of movement of the seat 56 is not truly vertical it is much more so than would be obtained by merely rotating the boom member about a fixed axis and as a result less space is required in advance of the hoisting structure to accommodate upward shifting of the boom member. There is also a mechanical advantage gained in this hoisting action. The mechanical advantage of the system is at a lower value during initial shifting of the boom member from its lower position than during subsequent shifting of the boom member toward its upright position. The same action takes place during lowering of the boom member from its upper to its lower position. As will be hereinafter set forth in greater detail, the boom member may be extended after it is in its upright position to further elevate the load.

The upper end of the tubular part 65 of the extensible guide bar 64 is provided with oppositely extending trunnions 73 on which are pivotally mounted links 74, as shown in Figures 2 and 8. The other ends of the links 74, are secured by pins 75 to spaced pairs of flanges 76 extending leftwardly as viewed in Figure 2 from the cleat 46. The links 74 serve to hold the boom structure against unintended extension when the boom member is displaced from its substantially upright position. It will be seen in Figure 8 that the effective lengths of the links 74 are equal to the distance between the pivotal axis of the seat 56 established by the pins 59 and the pivotal connection of the flange 63 on the seat with the extensible rod 69 of the control bar. Any tendency of the piston and piston rod portions of the boom structure to extend outwardly while the boom member is in its horizontal and initially elevated positions tends also to disturb the parallelogram geometry which the links 74 form with the span between the pivots 59 and 71. Thus the outward urge of the piston and piston rod portion of the boom member tends to rotate the

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seat 56 in a counterclockwise direction, as viewed in Figure 8, about the pivot 59. Such turning of the seat 56 about the pivot 59 is opposed by the links 74 and guide bar which cannot be readily moved from its relation with respect to the longitudinal axis of the boom member while the boom member is substantially displaced from its vertical position.

It will be seen in Figures 1 and 3 that when the boom member is in its upright position it is slightly displaced to the left of a true vertical plane. This arrangement is provided to assure downward rotation of the boom member in a counterclockwise direction, as viewed in these figures. It will also be noted that the guide member 64 is not exactly parallel to the boom member in Figures 1 and 3. Such displacement from a truly parallel relationship is accommodated by the space shown in Figure 8 between the inner and outer telescoping parts 69 and 65, respectively, of the guide bar 64 which provides free action of the parts of the mechanism.

Each hoisting unit is provided with fluid pressure actuating mechanism by which the boom member is shifted bodily from its horizontal to its vertical position and which also extends the boom member axially to further elevate a load supported on the seat 56. The actuating mechanism which bodily shifts the boom members comprises a pair of cylinders 77 which, as shown in Figures 2 and 7 are shiftably carried by a carriage generally designated at 78. The carriage 78 has a main body portion 79 provided with trunnions 80 on which wheels 81 are journaled. The wheels 81 are received between the flanges 19 of the track member 18 in the same manner as the wheels 27 and 32 are engaged with the track member 19. The body portion 79 of the carriage 78 is provided with spaced openings 82 in which the cylinders 77 are received and these cylinders may be welded or otherwise suitably secured to the body member 79 of this carriage.

As shown in Figure 9 the left end of each cylinder 77 is provided with a cap member 83 in which is provided a gland generally designated by the numeral 84 in which a piston rod 85 is slidably received. Each piston rod 85 has a piston 86 on its right end disposed in one of the cylinders 77, respectively. Formed on the left extremity of each cap 83 is a collar 87 which surrounds the gland 84 and which is received in a circular opening 88 of the body portion 28 of the carriage 23. The collars 87 and cylinders to which they are attached are fixed to the body portion 28 of the carriage 23 by set screws, one of which is shown at 89 in Figure 9. The caps 83 are each provided with a fluid pressure passage 90 which communicates at one end with the interior of one of the cylinders 77. The other end of each passage is connected to one end of a U-shaped conduit 91 of a fluid pressure supply system hereinafter more fully described.

The piston rods 85 extend leftwardly from the carriage 23 thru registering apertures in the body portion 24 of the front carriage 22 and in a channel bar 92 which extends transversely between the ends of the parallel track members 17 to which they are attached by bolts 93. The left end portions of the piston rods are threaded and provided with nuts 94, one located on each opposite side of the web of the channel bar 92, as shown in Figure 8. The nuts 94 clampingly hold the carriage 22 in fixed position adjacent the channel bar 92 and also fix the left ends of the piston rods 85 against

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movement. When fluid pressure is admitted to left ends of the cylinders 77, the cylinders and the carriage 23 together with the right end of the boom member are forced leftwardly as viewed in Figure 2, the pistons and piston rods remaining stationary. This action, as previously described, shifts the boom member from its horizontal to its vertical position under the control of the links 51 which confine the movement of the left end of the boom member and seat 56 thereon to a path which does not depart greatly from a vertical course.

A helical spring 95 surrounds each of the piston rods and extends from the rear carriage 23, leftwardly as viewed in Figure 2, to a location spaced substantially from the front carriage 22. As the cylinders 77 initially move toward the front carriage 22 the springs are also shifted in the same direction until their left extremities engage the body portion of the carriage 22. During the initial shifting of the carriage which corresponds to this initial shifting of the cylinders, the load is elevated under a relatively unfavorable mechanical advantage. During further upward movement of the boom member, the mechanical advantage improves and it is during this stage of the operation that the springs 95 are compressed and loaded for the purpose of assisting in the initial stages of the boom lowering operation.

While the mechanical advantage of the system is lower when the boom member is in its lowermost position than in any of its other positions, it is improved considerably at the lowermost position of the boom member because of the location of axis of each trunnion 49, as shown in Figure 3. The location of the axes of the trunnions 49 of each unit above the plane defined by the pivotal axis of the lower ends of the links 51 and the pivotal axis of the boom member thereof as when the boom member is in its lower position as shown in Figure 3, prevents unintended locking of the boom member 34 and links 51 in an aligned relationship and also provides a greater mechanical advantage during initial lifting of the load. Since the minimum mechanical advantage in the leverage system embodied in the above described hoisting apparatus occurs when the boom members are in their lowermost positions, increasing of the mechanical advantage at this end of the range of movement significantly reduces the maximum power requirements and size of the driving mechanism.

The fluid pressure system by which the boom is both shifted and extended comprises an automatic valve mechanism, generally designated by the numeral 96 in Figure 2. This valve mechanism shown in detail in Figure 13, has an inlet port 97 which is connected by a conduit 98 with the U-shaped conduit 91 so as to simultaneously supply fluid medium to both cylinders 77. The automatic valve 96 has another port 99 which is connected by a conduit 100 with a U-shaped conduit 101 having opposite end portions communicating with the interior of the cylinders 34, respectively, of the boom member at a location on the right side of the pistons 35 which are disposed in the cylinders, as shown in Figure 9.

The automatic valve 96 has an inlet port 102 which is connected by a conduit 103 with an outlet port 103' of the manual control valve 14. This conduit includes a flexible hose section 104. The manual control valve 14 is provided with an inlet port 105 which is connected by a conduit 106 with the outlet of a compressor generally des-

ignated by the numeral 107. The compressor 107 has an inlet which is connected by a conduit 108 with a source or tank 109. The manual control valve 14 also has an outlet port 110 which is connected by a conduit 111 with the inlet of the tank 109. A branch conduit 112 including a section of hose 113 connects the conduit 111 with the automatic valve 96 for draining fluid medium from the latter in conveying it to the tank 109 for the purpose hereinafter set forth.

The manual control valve 14 has a bore 114 with which the ports 103', 110 and 105 communicate. Shiftably mounted in the bore 114 is a valve element 115 having spaced piston like portions 116, 117 and 118 which are so disposed as to establish communication between the inlet port 105 and the outlet port 110 when the valve element 115 is disposed in the position shown in Figure 14. The piston portions 116, 117 and 118 sealingly engage the wall of the bore 114 and when the valve element 115 is in the position shown the piston portion 117 blocks the flow of fluid medium from the inlet port 105 to the outlet port 103'. This setting of the valve element 115 by-passes fluid pressure from the inlet port 105 thru the outlet port 110 and conduit 111 and the piston portion 117 blocks the reverse flow of fluid pressure from the automatic valve mechanism and port 103'. The valve element 115 may be shifted in opposite directions from the position shown in Figure 14 by a handle 119 pivotally attached at 120 to the valve element 115. The lower end of the handle 119 is swingably supported by a link 121 which is pivotally attached at one end at 122 to the casing of the manual control valve 14 and at its other end to the handle 119 at 123.

When the valve element 115 is shifted leftwardly from the position shown in Figure 14 sufficiently to bring the piston port 117 to the left side of the outlet port 103', communication is established between the inlet port 105 and both outlet ports 103' and 110 and thus fluid pressure is exhausted from the conduit 103 and inlet port 102 of the automatic valve 96 and at the same time the fluid pressure supplied by the compressor 107 is by-passed thru the port 110 to the tank 109. The outlet port 110 is of ample capacity to relieve the pressure from the automatic valve 96 and at the same time accommodate the return to the tank of fluid medium supplied by the compressor.

The automatic valve mechanism 96 includes a valve casing 124 in which are formed upper and lower parallel bores 125 and 126. The upper bore 125 communicates with the outlet ports 97 and 99 and the lower bore 126 communicates with the inlet port 102. Provided in a partition element 127 which separates the bores 125 and 126 is a large passage 128 and a smaller passage 129 both of which connect the bores 125 and 126. A valve member 129' is shiftably mounted in the upper bore 125 and provided with piston-like valve elements 130 and 131 which closely fit the wall of the bore. The right end of the upper bore 125 is closed by a threaded plug 132 against which the valve member 129' is yieldably held by a spring 133 which bears between the piston-like valve element 130 and a hollow cap 134 which is threaded in the left end of the bore 125.

A valve member 135 is shiftably mounted in the lower bore 126 and provided with piston-like valve elements 136 and 137 which closely fit the wall of the bore. The valve member 135 is yieldably urged leftwardly, as viewed in Figure 13, by

a spring 138 which bears between the valve element 137 and a shoulder 139 formed within a nipple 140 which is threaded in the right end of the bore 126. The conduit 112 is threaded in the outer end of the nipple 140.

Provided on the left end of the valve member 135 is a stem 141 which is slidably received in sealing engagement in the passage of a gland element 142 threaded in the left end of the bore 126. The stem 141 of the valve member 135 is connected by a coupling 143 with a rod 144 which is axially shiftably mounted on the carriage 23, as shown in Figure 2. The automatic valve 96 is supported on a bracket 145, also shown in Figure 2, which is carried by one of the cylinders 77. The rod 144 and automatic valve mechanism 96 with which it is associated shifts in unison with the carriage 23 and the left end of the rod 144 is adapted to engage an abutment 146 mounted on the front carriage 22 when the rear carriage 23 has been shifted leftwardly, as viewed in Figure 2, sufficiently to bring the boom member to its upright position. Engagement of the rod 144 with the abutment 146 during the final stage of upward shifting movement of the boom member urges the valve member 135 rightwardly against the action of the spring 138.

Operation of the valve mechanism, shown in Figure 14, takes place in the following manner. The manual control valve handle 119 is turned in a clockwise direction to supply fluid medium to the outlet port 103' which passes thru the conduit 103 to the inlet 102 of the automatic valve. With the valve member 129' and 135 in the position shown in Figure 13, the fluid pressure medium flows directly thru the passage 128, bore 125, outlet port 97, conduit 98 and U-shaped conduit 91 to each of the cylinders 77. The fluid medium continues to flow into the cylinders 77 until the boom member has been shifted from its horizontal to its vertical position. As the boom member approaches its vertical position the valve element 135 is shifted rightwardly against the spring 138 by engagement of the rod 144 with the abutment 146. This action brings the piston-like valve element 137 to the right side of the small passage 129. The pressure of the fluid medium admitted thru the passage 129 to the bore 125 shifts the valve member 129' leftwardly, as viewed in Figure 13, against the action of the spring 133 until the valve-element 131 is entirely disposed on the left side of the passage 128. The fluid pressure previously applied to the cylinders 77 is maintained therein by the obstruction of the valve element 131 to the reverse flow of fluid medium from the outlet 97. When the valve member 133 is in its left position fluid medium flows from the inlet 102 thru the bore 126, passages 128 and 129, bore 125, outlet 99, conduit 100 and U-shaped conduit 101 into the cylinders 34 of the boom member thereby extending the boom member while it is in its upright position. The valve mechanism thus automatically supplies fluid medium to the cylinders 34 until the boom member is in this condition.

When it is desired to lower a vehicle or other load supported on the upright extended boom members of the pair of hoists, shown in Figure 1, the manual control valve handles are shifted in a counterclockwise direction to move the valve member 115 leftwardly, as viewed in Figure 14, until communication is established between the ports 103', 110 and 105. This exhausts fluid pressure from the bore 126 of the automatic valve 96. The upper valve member 129', however, is

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held in its left-hand position by the fluid pressure on the right side of the valve element 131 while fluid pressure is exhausted from the cylinders 34 thru the U-shaped conduit 101, conduit 100, port 99, bore 125, passages 128 and 139, bore 126, port 102 and conduit 103. This exhausting of fluid medium from the cylinders 34 accommodates contraction of the boom member which remains in its upright position until the piston and piston rod portions of the boom member are fully contracted. Pressure on the right side of the valve element 131 is reduced sufficiently to allow the spring 133 to shift the valve member 129 rightwardly to the position shown in Figure 13. Fluid pressure then flows from the cylinders 77 thru the port 97, bore 125, passage 128, bore 126, outlet 102 and conduit 103 to the tank 109, thereby permitting the boom member to be shifted downwardly, initially by the combined action of the load and springs 85 and subsequently only by the load, until the boom member reaches its horizontal position. As the boom member departs from its upright position, the rod 144 parts contact with the abutment 146 and the spring 138 returns the valve member 135 to the position shown in Figure 15. Thus the automatic valve mechanism 96 automatically causes shifting of the boom member from its upright to its horizontal position after the boom member has been fully contracted and prevents such shifting of the boom member until it is fully contracted.

When the boom member is extended and in its upright position the valve element 131 blocks the return flow of fluid medium from the cylinders 77. Any small leak which might occur in the portion of the fluid system which supplies fluid medium from the source to the automatic valve would merely cause the boom member to be lowered in its usual way. Contraction of the boom member would take place before it shifted from its vertical to its horizontal position for the valve element 131 would remain in obstructing relation to back flow of fluid medium from the cylinders 77 until all pressure had been relieved on the right side of the valve element 131.

A slow leak at the cylinders 77 or in the conduits leading from the automatic valve 96 would result in a slight downward shifting of the boom member while in its extended condition. However this slight movement would disengage the end of the rod 144 from the abutment 146 and allow the spring 138 to shift the lower valve member 135 leftwardly, as viewed in Figure 15 and permit free flow of fluid medium from the cylinders 34 of the boom member, the fluid medium would then be returned from the right end of the bore 126 thru the passage of the nipple 140 and thru the conduit 112 to the tank 109. This free flow of fluid medium from the cylinders 34 would result in contraction of the boom member at a much faster rate than it was permitted to shift toward its horizontal position and accordingly, the boom member would be fully contracted long before it rotated in an extended condition to a dangerous position.

In the foregoing disclosure of the structure and operation of the improved hoisting apparatus it will be seen that provision is made for shifting the load upwardly in a path which does not depart far from the vertical course, thus eliminating the necessity of providing adequate room to accommodate swinging of the load about an axis. The apparatus is also provided with springs for urging the boom downwardly from its vertical position during initial stage of its downward

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movement when such movement tends to occur at a slow rate. These springs are energized during the stage of upward movement when a favorable mechanical advantage is present and therefore provision of additional power over that required during the initial shifting of the boom member from its horizontal position is not required. Dependable self acting safeguard mechanism is provided for preventing unintended extension of the boom member prior to movement thereof to its upright position. A fluid pressure system is provided for operating the hoist and has a fully automatic valve mechanism which assures contraction of the boom before it is rotated downwardly under all conditions. This valve mechanism also automatically causes the contraction and shifting and the extension and shifting of the boom member to automatically occur in proper sequence.

Although but one specific embodiment of the invention has been herein shown and described it will be understood that various changes in the details and construction thereof may be made without departing from the spirit and scope of my invention.

I claim:

1. Hoisting apparatus comprising a boom member, a load receiving seat on one end portion of said boom member, means shiftably and pivotally supporting the opposite end of said boom member, means for holding said first mentioned means against displacement from a horizontal plane, a link member terminating at and pivotally connected at one end only with said boom member at a location between said seat member and supporting means, a fixed pivot member pivotally supporting the other end of said link member, and mechanism for shifting said opposite end of said boom member to move it from a generally horizontal to a generally vertical position.

2. Hoisting apparatus comprising a boom member shiftable between generally horizontal and vertical positions, a load receiving seat on one end portion of said boom member, a support linearly shiftably and pivotally supporting the opposite end of said boom member, a link member pivotally attached to said boom member at a location between said seat member and support and extending away from said opposite end of said boom member when the latter is in its generally horizontal position, a fixed pivot member pivotally supporting the other end of said link member, and mechanism for shifting said boom member from its horizontal to its vertical position including an actuating element for urging said opposite end of said boom member toward said fixed pivot, said actuating element including power actuated means mounted on said support and extending away from said fixed pivot member so as to accommodate movement of said opposite end of said boom member into close proximity to said fixed pivot member.

3. Hoisting apparatus comprising a boom member shiftable between horizontal and vertical positions, a load receiving seat on one end portion of said boom member, a support linearly shiftably and pivotally supporting the opposite end of said boom member, a base structure shiftably receiving and cooperating with said support and including means for holding said support and said opposite end of said boom member against movement in opposite directions transverse with respect to the path of linear shifting movement of said support, a link member pivotally attached at one end to said boom member at a location inter-

mediate its end portions, a pivot fixed with respect to said base structure and pivotally supporting the other end of said link member, said pivot being spaced from said first mentioned end of said link member in a direction opposite from said support, and actuating mechanism for shifting said support toward said fixed pivot to elevate said boom member.

4. Hoisting apparatus comprising a boom member including first and second relatively axially extensible and contractable sections and means for axially shiftably guiding and supporting said first section on said second section, a load receiving seat on one end of said first section, means shiftably and pivotally supporting the opposite end of said second section, a link member pivotally connected at one end with said second section of said boom member at a location spaced from said supporting means, a pivot member pivotally supporting the other end of said link member, mechanism for shifting said opposite end of said last mentioned boom section to move said boom member from a generally horizontal to a generally vertical position, and mechanism for relatively axially extending said boom member sections.

5. Hoisting apparatus comprising a boom member including first and second relatively axially extensible and contractable sections and comprising means for axially shiftably guiding and supporting said first section on said second section, a load receiving seat on one end of said first section, a support linearly shiftably and pivotally supporting the opposite end of said second section of said boom member, a base structure shiftably receiving and cooperating with said support for holding it against movement in a direction transverse to its path of linear shifting movement, a link member attached at one end to said second boom section at a location intermediate its end portions, a pivot carried by said base structure and pivotally supporting the other end of said link member, said pivot being spaced from said first mentioned end of said link member in a direction opposite from said support, actuating mechanism for shifting said support toward said fixed pivot to elevate said boom member, and actuating means for relatively axially extending said boom sections.

6. Hoisting apparatus comprising a boom member, a load receiving seat on one end portion of said boom member, means shiftably supporting said boom member for combined pivotal and translatable movements between generally vertical and generally horizontal positions, actuating mechanism for shifting said boom member from said generally horizontal position to said generally vertical position, and energy accumulating mechanism energizable only by the shifting of said boom member from a position intermediate its generally horizontal and generally vertical positions to its generally vertical position for urging said boom member toward its generally horizontal position.

7. Hoisting apparatus comprising a boom member, mechanism for shiftably supporting and positively drivingly shifting said boom member from an approximately horizontal to an approximately vertical position, said mechanism comprising a system of levers having a lower mechanical advantage during initial portions of its stage of boom shifting movement from a horizontal position than during subsequent portions of such stage of movement and including power actuating mechanism, and energy accumulating

apparatus energizable by said mechanism only during said subsequent portion of its boom shifting movement for urging said boom member toward its generally vertical position.

8. Hoisting apparatus comprising a base structure, a boom member shiftable between generally horizontal and vertical positions, a load receiving seat on one end portion of said boom member, means shiftably supporting said boom member on said base structure for combined pivotal and longitudinally translatable movements relative to said base structure, coacting elements on said base structure and supporting means for holding said supporting means against vertical displacement from said base structure said means including a link member free from said load receiving seat and coacting only between said boom member and said base structure for shifting said end of said boom member and said load receiving seat horizontally in a direction opposite to the horizontal movement thereof resulting from pivotal movement of said boom member to confine the movement of said load receiving seat to an approximately vertical path.

9. Hoisting apparatus comprising a base structure, a boom member shiftable between generally horizontal and vertical positions, a load receiving seat on one end portion of said boom member and means shiftably supporting said boom member on said base structure for combined pivotal and translatable longitudinal movements relative to said base structure, coacting elements on said base structure and said supporting means for holding said supporting means against vertical displacement from said base structure, said means including a link member free from said load receiving seat coacting between only said boom member and said base structure for shifting said end of said boom member and said load receiving seat horizontally in a direction opposite to the horizontal movement thereof resulting from pivotal movement of said boom member to confine the movement of said load receiving seat to an approximately vertical path, and power actuating mechanism for shifting said boom member in a path defined by said supporting means from said generally horizontal to said generally vertical position, said power actuating mechanism including driving means spaced from between said boom member and said link member.

10. Hoisting apparatus comprising a base structure, a boom member shiftable between generally horizontal and vertical positions, a load receiving seat on one end portion of said boom member and means shiftably supporting said boom member on said base structure for combined pivotal and translatable movements relative to said base structure, said means including a link member coacting between said boom member and said base structure for shifting said end of said boom member and said load receiving seat horizontally in a direction opposite to the horizontal movement thereof resulting from pivotal movement of said boom member to confine the movement of said load receiving seat to an approximately vertical path, power actuating mechanism for shifting said boom member in a path defined by said supporting means from said generally horizontal to said generally vertical position and energy accumulating apparatus energizable by shifting of said boom member toward its generally vertical position for urging said boom member toward its generally horizontal position.

11. Hoisting apparatus comprising a base mem-

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ber, a boom member comprising spaced piston and cylinder assemblies, means including a shiftable pivot support shiftablely mounting said boom member on said base member for combined pivotal and translative movements relative to said base member between substantially horizontal and vertical positions, an article supporting member carried by said piston members and located at one end of said boom member, said means including a link coacting between said boom and base member for shifting said end of said boom member horizontally in a direction opposite to the horizontal component of the pivotal movement of said boom during raising and lowering operations of said boom member to retain the path of movement of said end of said boom member approximately vertical, mechanism for shifting said boom member from its horizontal to its vertical position to initially lift an article on said article support to one elevation, and means including conduits for supplying fluid pressure to said cylinders for extending said pistons to lift said article to a higher elevation.

12. Hoisting apparatus comprising a base structure, a boom member comprising a piston and cylinder member shiftable between generally horizontal and generally vertical positions, a load receiving seat on said piston member located at one end of said boom member, means for shiftablely supporting said cylinder member on said base structure for combined pivotal and translative movements relative to said base structure, said means including a link member coacting between said boom member and base structure for shifting said load receiving seat horizontally during pivotal movement of said boom member in a direction opposite to the horizontal movement thereof resulting from pivotal movement of said boom member to confine the movement of said load receiving seat to an approximately vertical path, fluid pressure mechanism for shifting said boom member from its horizontal to its vertical position, and fluid pressure supply apparatus for extending said piston relative to said cylinder after said boom member is in its vertical position.

13. Hoisting apparatus comprising a base structure, a boom member comprising a piston and cylinder member shiftable between generally horizontal and generally vertical positions, a load receiving seat on said piston member located at one end of said boom member, means for shiftablely supporting said cylinder member on said base structure for combined pivotal and translative movements relative to said base structure, said means including a link member coacting between said boom member and base structure for shifting said load receiving seat horizontally during pivotal movement of said boom member in a direction opposite to the horizontal movement thereof resulting from pivotal movement of said boom member to confine the movement of said load receiving seat to an approximately vertical path, fluid pressure mechanism for shifting said boom member from its horizontal to its vertical position, fluid pressure supply apparatus for extending said piston relative to said cylinder after said boom member is in its vertical position, and a spring energizable by upward shifting movement of said boom member for assisting in returning it from its vertical to its horizontal position.

14. Apparatus for hoisting a vehicle comprising a base structure, a pair of hoisting units on said base structure, each of said hoisting units including a boom member comprising a main

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section and a relatively extensible section, a seat on the extensible section of each of said boom members for receiving an end portion of a vehicle respectively, means shiftablely supporting the main section of each of said boom members including a pair of carriages mounted on said base structure, said means including members pivotally connecting an end of each main section of each boom member with one of said carriages and a link swingably connecting an intermediate portion of each of said main sections with one of said carriages, mechanism for shifting the carriage supported end of each of said main sections toward the other carriage of each unit respectively for moving said boom members from generally horizontal to generally vertical positions to initially elevate said vehicle approximately vertically, and apparatus for shifting said extensible sections of said boom member axially relative to the main sections thereof to further elevate said boom members.

15. Apparatus for hoisting a vehicle comprising a base structure, a pair of hoisting units on said base structure, each of said hoisting units including a boom member comprising a main section and a relatively extensible section, a seat on the extensible section of each of said boom members for receiving an end portion of a vehicle respectively, means shiftablely supporting the main section of each of said boom members including a pair of carriages mounted on said base structure, said means including members pivotally connecting an end of each main section of each boom member with one of said carriages and a link swingably connecting an intermediate portion of each of said main sections with one of said carriages, mechanism including a fluid pressure actuated device for shifting the carriage support end of each of said main sections toward the other carriage of each unit respectively for moving said boom members from generally horizontal to generally vertical positions to initially elevate said vehicle approximately vertically, said main and extensible sections of said boom members comprising telescoping cylinder and piston elements respectively, and fluid pressure supply apparatus for feeding fluid pressure to each of said cylinder elements to shift said extensible sections axially of said main sections in order to further elevate said boom member.

16. Apparatus for hoisting a vehicle comprising a base structure, a pair of hoisting units on said base structure, each of said hoisting units including a boom member comprising a main section and a relatively extensible section, a seat on the extensible section of each of said boom members for receiving an end portion of a vehicle respectively, means shiftablely supporting the main section of each of said boom members including a pair of carriages mounted on said base structure, said means including members pivotally connecting an end of each main section of each boom member with one of said carriages and a link swingably connecting an intermediate portion of each of said main sections with one of said carriages, mechanism for shifting the carriage supported end of each of said main sections toward the other carriage of each unit respectively for moving said boom members from generally horizontal to generally vertical positions to initially elevate said vehicle approximately vertically, said base structure including flanges for holding said carriages against vertical displacement, and means fixing the link supporting

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carriage of one hoisting unit against horizontal shifting movement relative to said base structure.

17. Hoisting apparatus comprising a shiftable carriage, a boom member shiftable between generally horizontal and generally vertical positions and comprising a main section pivotally mounted on said carriage and a relatively axially extensible section carried by said main section, a load receiving seat pivotally mounted on said extensible section and mechanism for holding said seat in a predetermined position with respect to a horizontal plane including a guide member extending along said main boom section having one end pivotally mounted on said carriage in spaced relation to the pivotal axis of said main boom section and including a link swingably connecting the opposite end of said guide member to said main boom section, said mechanism including a rod member axially slidably engaged with said guide member and pivotally attached to said seat at a location spaced from its pivotal axis.

18. Hoisting apparatus comprising a shiftable carriage, a boom member shiftable between generally horizontal and generally vertical positions and comprising a main section pivotally mounted on said carriage and a relatively axially extensible section carried by said main section, a load receiving seat pivotally mounted on said extensible section and mechanism for holding said seat in a predetermined position with respect to a horizontal plane including a tubular member extending along said main boom section having an end pivotally mounted on said carriage in a predetermined spaced relation to the pivotal axis of said main boom section and including a link swingably connecting the opposite end of said tubular member to said main boom section and having an effective length substantially equal to said predetermined distance, said mechanism including a rod slidably guided in said tubular member having an end pivotally attached to said seat at a location spaced substantially said predetermined distance from its pivotal axis.

19. Hoisting apparatus comprising a shiftable carriage, a boom member shiftable between generally horizontal and generally vertical positions and comprising a main section pivotally mounted on said carriage and a relatively axially extensible section carried by said main section, a load receiving seat pivotally mounted on said extensible section and mechanism for holding said seat in a predetermined position with respect to a horizontal plane including a tubular member extending along said main boom section having an end pivotally mounted on said carriage in a predetermined spaced relation to the pivotal axis of said main boom section and including a link swingably connecting the opposite end of said tubular member to said main boom section and having an effective length substantially equal to said predetermined distance, said mechanism including a rod slidably guided in said tubular member having an end pivotally attached to said seat at a location spaced substantially said predetermined distance from its pivotal axis, said seat positioning mechanism being adapted to hold said extensible boom section against unintended extension when said boom member is out of its generally vertical position.

20. Hoisting apparatus including a base structure, a boom member shiftable supported on said base structure for movement from a generally horizontal to a generally vertical position, mechanism for shifting said boom member from said

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horizontal to said vertical position, said boom member comprising a tubular main section and an extensible section axially slidably mounted in said main section and projecting from it, mechanism for shifting said boom member from said horizontal to said vertical position, a seat pivotally mounted on the outer end of said extensible section, means for shifting said seat relative to said extensible section of said boom member during shifting of the latter between said positions including a guide member having a tubular part extending substantially parallel to said boom member and a substantially equal length link member connecting the end portion of said guide member to said main boom section, said guide member also including an extensible part slidably mounted in said tubular part of said guide member and pivotally attached to said seat, the pivotal axis of said seat and the pivotal connection between said seat and said extensible part of said guide member being so positioned relative to each other when said boom member is displaced from its generally vertical position as to oppose unintended extension of said boom member when it is displaced from its generally vertical position, and means for extending said extensible section of said boom member when the latter is in its generally vertical position.

21. Hoisting apparatus comprising a base structure, a boom member having a load receiving seat on one end, a carriage pivotally supporting the other end of said boom member and shiftable mounted on said base structure, link means pivotally connected with an intermediate portion of said boom member and pivotally connected with said base structure, and mechanism for shifting said boom member from a generally horizontal to a generally vertical position comprising a shiftable cylinder member carried by said carriage and a piston member fixed with respect to said base structure and slidably engaged in said cylinder and comprising means for supplying fluid pressure to said cylinder for shifting said carriage.

22. In hoisting apparatus comprising a boom member having relatively extensible piston and cylinder sections and shiftable mounted for movement between generally horizontal and generally vertical positions and comprising a piston and cylinder actuating unit for shifting said boom member from its generally horizontal to its generally vertical position; a fluid pressure supply system comprising an automatic valve having a valve housing provided with a fluid pressure inlet and first and second fluid pressure outlets, said first outlet being connected to said actuating unit and said second outlet being connected to said cylinder section of said boom member, a first valve element chamber in said housing, a first valve element shiftable mounted in said first chamber for selectively controlling the flow of fluid pressure to said first and second outlets, means yieldably holding said first valve element in position to accommodate the flow of fluid pressure to said actuating unit, a second valve chamber in said housing communicating with said fluid pressure inlet port and having large and small ports communicating with said first valve element chamber, a second shiftable valve element, in said second valve element chamber, means yieldably holding said second valve element in position to accommodate the flow of fluid pressure through said large port to said first valve element chamber and first outlet and to obstruct the flow of fluid pressure to said small

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port, and means engageable by an element of said hoisting apparatus when said boom member reaches its vertical position for shifting said second valve element to accommodate flow of fluid pressure through said small port and into said first valve element chamber for shifting said second valve element to a position in which it obstructs reverse flow of fluid pressure from said first outlet and from said actuating unit and in which it accommodates flow of fluid pressure through said second outlet for extending said boom section.

23. In hoisting apparatus comprising a boom member having relatively extensible piston and cylinder sections and shiftably mounted for movement between generally horizontal and generally vertical positions and comprising a piston and cylinder actuating unit for shifting said boom member from its generally horizontal to its generally vertical position; a fluid pressure supply system comprising an automatic valve having a valve housing provided with a fluid pressure inlet and first and second fluid pressure outlets, said first outlet being connected to said actuating unit and said second outlet being connected to said cylinder section of said boom member, valve elements shiftably mounted in said housing for controlling the supply of fluid pressure medium from said inlet to said outlets and adapted to obstruct the reverse flow of fluid medium from said outlets, and valve actuating mechanism including members on one of said valve elements and boom member respectively engageable only when said hoisting apparatus is in its vertical position for shifting the latter valve element to effect the supply of fluid medium to said second outlet and cylinder section only when said boom member is in its vertical position.

24. In hoisting apparatus comprising a boom member having relatively extensible piston and cylinder sections and shiftably mounted for movement between generally horizontal and generally vertical positions and comprising a piston and cylinder actuating unit and means connecting it with said boom member for shifting said boom member from its generally horizontal to its generally vertical position; a fluid pressure supply system comprising an automatic valve having a valve housing provided with a fluid pressure inlet and first and second fluid pressure outlets, said first outlet being connected to said actuating unit and said second outlet being connected to said cylinder section of said boom member, valve elements shiftably mounted in said housing for controlling the supply of fluid pressure medium from said inlet to said outlets and adapted to obstruct the reverse flow of fluid medium from said outlets, and valve actuating mechanism including members on one of said valve elements and hoisting apparatus respectively in engagement when said boom member is in vertical position for conditioning said automatic valve to obstruct reverse flow of fluid pressure medium from said actuating unit while said boom member is in extended condition.

25. In hoisting apparatus comprising a boom member having relatively extensible piston and cylinder sections and shiftably mounted for movement between generally horizontal and generally vertical positions and comprising a piston and cylinder actuating unit for shifting said boom member from its generally horizontal to its generally vertical position; a fluid pressure supply system comprising an automatic valve

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having a valve housing provided with a fluid pressure inlet and first and second fluid pressure outlets, said first outlet being connected to said actuating unit and said second outlet being connected to said cylinder section of said boom member, and valve mechanism shiftably mounted in said housing including valve actuating means responsive to movement of said boom member to and away from its vertical position for respectively automatically admitting fluid pressure to said second outlet and cylinder section and accommodating the reverse flow of fluid pressure medium therefrom.

26. In hoisting apparatus comprising a boom member having relatively extensible piston and cylinder sections and shiftably mounted for movement between generally horizontal and generally vertical positions and comprising a piston and cylinder actuating unit for shifting said boom member from its generally horizontal to its generally vertical position; a fluid pressure supply system comprising an automatic valve having a valve housing provided with a fluid pressure inlet and first and second fluid pressure outlets, said first outlet being connected to said actuating unit and said second outlet being connected to said cylinder section of said boom member, and valve mechanism shiftably mounted in said housing including valve actuating means responsive to movement of said boom member to and away from its vertical position for respectively automatically admitting fluid pressure to said second outlet and cylinder section and accommodating the reverse flow of fluid pressure medium therefrom, said valve mechanism being so constructed and arranged as to cause contraction of said sections of said boom member at a faster rate than the rate of shifting of said boom member from its vertical position toward its horizontal position in the event of leakage of said fluid pressure medium from said cylinder section or from its supply from said second outlet.

27. In hoisting apparatus comprising a boom member having relatively extensible piston and cylinder sections and shiftably mounted for movement between generally horizontal and generally vertical positions and comprising a piston and cylinder actuating unit for shifting said boom member from its generally horizontal to its generally vertical position; a fluid pressure supply system comprising an automatic valve having a valve housing provided with a fluid pressure inlet and first and second fluid pressure outlets, said first outlet being connected to said actuating unit and said second outlet being connected to said cylinder section of said boom member, and valve mechanism shiftably mounted in said housing including valve actuating means responsive to movement of said boom member to and away from its vertical position for respectively automatically admitting fluid pressure to said second outlet and cylinder section and accommodating the reverse flow of fluid pressure medium therefrom, said valve mechanism being so constructed and arranged as to assure contraction of said boom member before shifting thereof from its vertical position in the event of leakage of fluid pressure medium between said automatic valve and the source of fluid pressure supply thereto.

28. Hoisting apparatus including a support, a boom member mounted on said support for shifting movement between generally horizontal and generally vertical positions, means pivotally connecting the lower end of said boom member

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with said support, a lever pivotally connected at its lower end with said support, the lower ends of said boom member and lever being relatively shiftable for accommodating raising and lowering of said boom member, means spaced from an intermediate portion of said boom member in the direction of its upward movement for pivotally connecting the upper end of said lever with said boom member about an axis spaced in all positions of said boom member a substantial distance from the plane of the pivotal axes of the lower ends of said boom member and lever for providing a favorable mechanical advantage during initial shifting movement of said boom member from its generally horizontal position, and means for relatively shifting said lower ends of

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said boom member and lever to raise said boom member.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,085,720	Nilson	June 29, 1937
2,402,572	Page	June 25, 1946
2,433,900	Grime	Jan. 6, 1948

FOREIGN PATENTS

Number	Country	Date
204,328	Switzerland	Aug. 1, 1939

Certificate of Correction

Patent No. 2,576,908

November 27, 1951

DAVID A. WALLACE

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 19, line 33, strike out "boom member" and insert instead *hoisting apparatus*; lines 34 and 35, strike out "hoisting apparatus" and insert instead *boom member*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of March, A. D. 1952.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.